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CHIEF EDITOR
RAJESH KUMAR JHA

EDITOR
KAPIL KUMAR

PRODUCTION OFFICER
VINOD KUMAR MEENA

COVER DESIGN
RAJAT NAIK

EDITORIAL OFFICE
ROOM NO. 661, NIRMAN BHAVAN
A-WING (GATE NO.5),
MINISTRY OF RURAL DEVELOPMENT,
NEW DELHI-110011
TEL. : 23061014, 23061952
FAX : 011-23061014
E-MAIL : kurupage@yahoo.co.in
FOR SUBSCRIPTION ENQUIRIES,
RENEWALS AND AGENCY INFORMATION
PLEASE CONTACT:

Business Manager
EAST BLOCK-IV, LEVEL-VII, R.K. PURAM,
NEW DELHI-110066
TEL. : 26105590, 26100207
FAX : 26175516
E-MAIL : pdjucir_jcm@yahoo.co.in
WEBSITE : publicationsdivision.nic.in

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INSIDE

The Indian Agriculture is at the cross roads. While demand for commodities is increasing, the input prices have increased steeply and there is need to increase productivity. The GDP in agriculture has fallen over the decades even as agriculture supports nearly 70 per cent of the population.

The challenge before Indian agriculture is to feed the second most populous nation in the world accounting for about 17 per cent of world's population supported by only 2. 4 per cent of the land area. The demand for food grains in the year 2020 is projected at 255 million tones comprising 112 million tones of rice, 82 million tones of wheat, 39 million tones of coarse cereals and 28 million tones of pulses.

Despite the Green revolution, Blue revolution, the White revolution and the Yellow revolution the compound growth rate in agricultural production has stuck at around 2.7 per cent per annum since independence.

While agriculture scientists call for the need for a Second Green Revolution, there are novel ways to increase productivity. One such technique is better management of weeds which cut into the yield of crops, substantially. We discuss this in this issue as part of several other techniques of how to better agricultural practices.

Agriculture not only faces the challenge of how to increase productivity but also how to sustain. Some agriculture scientists say the main problem in agriculture pertains to sustainability of resources, use and indiscriminate use of chemical fertilizers and pesticides

These problems have led to increasing awareness and a felt-need for moving away from the input intensive agriculture pursued during the Green revolution phase, to sustainable farming in different parts of the world. Better agriculture practices are needed to bring sustainability in Indian Agriculture.

Others argue that agriculture is suffering because of lack of good extension services to the farmers. In addition to the poor infrastructure in many rural areas, the inability of farmers to directly access markets has sustained the presence of a chain of middlemen through whom most agricultural commodities must circulate before finally reaching consumers.

We discuss several of these issues which are currently facing the India agriculture, focusing on better agricultural practices in the face of all the constraints.

Better Practices for Sustainable Agricultural Production and Better Environment

Dr. Harender Raj Gautam & Dr. M.L.Bhardwaj

Better agriculture practices are needed to bring sustainability in Indian Agriculture. Excessive use of chemical fertilizers, chemical pesticides and chemical herbicides has long lasting and deleterious effects on the soil health; on the quality of agricultural produce; health of farm workers, consumers of the agriculture produce and other terrestrial and aquatic life and environment.

India's, Green Revolution in agriculture has made a significant contribution on aggregate supply of food grains, ensuring food security to the growing population. However, the momentum gained during the period of Green Revolution has slowly declined. Now, the agricultural growth faces a serious challenge in terms of sustainability. Today, the main problem in agriculture pertains to sustainability of resources, use and indiscriminate use of chemical fertilizers and pesticides. These problems have led to increasing awareness and a felt need for moving away from the input intensive agriculture pursued during the Green revolution phase, to sustainable farming in different parts of the world. Better agriculture practices are needed to bring sustainability in Indian Agriculture. Excessive use of chemical fertilizers, chemical pesticides and chemical herbicides has long lasting and deleterious effects on the soil health; on the quality of agricultural produce; health of farm workers, consumers of the agriculture produce and other terrestrial and aquatic life and

environment. Nature has provided us bountiful of resources which can meet the requirement of various inputs required for sustainable farming. There is need to judiciously harness and use these bio-resources to make agriculture profitable, safe to the agricultural workers and to the consumers.

Better agricultural practices are those which are safe to the environment, human beings and all other living beings on the earth and simultaneously also help in enhancing the agricultural production. Thus, such practices will certainly advocate the use of bio-resources. In India, better agricultural practices were part of our farming in traditional agriculture. Now, these practices are being adopted in different farming systems. These farming systems are sustainable agriculture, alternative agriculture, conservation agriculture and organic farming which all advocates the use of better agricultural practices.

Sustainable agricultural systems can be economically, environmentally and socially viable, and contribute positively to local livelihoods. The resource conservation practices conceived for this include minimum or zero tillage, letting crop residues get back into the soil instead of burning them, immaculate land leveling to ensure the even spread of water, and applying only need-based fertilizer and water to crops. The benefits of such practices are many, and somewhat obvious. They protect soil health to enhance its fertility, prevent the environmental pollution caused by burning of crop residues, save on the labour and energy required for repeated land tilling, and reduce the use of water in agriculture, sparing it for other purposes. The biggest advantage is that by letting biological residues get back into the soil, it transforms agriculture from a carbon emitter to a virtual carbon sequester by converting crop land into a carbon sink. Conservation agriculture is estimated to have spread globally to over 100 million hectares. In India, it is now practiced on about 2 million hectares and is proposed to be extended further to around 3.5 million hectares in the next two years.

Organic Farming

Organic farming is the other method which advocates the use of better agricultural practices. It recommends the use of such agricultural practices which are biological in nature and eco-friendly. These agricultural practices preserve environment and biodiversity. Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. Organic farming has emerged as the only answer to bring sustainability in agriculture which is good for the environment and also good for the human beings.

Organic farming advocates stopping the use of chemical fertilizers, chemical pesticides and all other inorganic puts in farming. Organic farming helps in creating an ecological balance and a micro-environment suitable for health and growth of soil micro-flora, plants, animals, farm workers and finally the vast population of consumers. Organic farming is practiced in more than 150 countries and 35 million hectares of agricultural land are managed organically. In India, about 528,171 hectare area is under organic farming (this includes certified and area under organic conversion) with 44,926 number of certified organic farms. This accounts for about 0.3 per cent of total agricultural land. Indian organic farming industry is estimated at US$ 78 million and is almost entirely export oriented. According to Agricultural and Processed Food Products Export Development Authority (APEDA), a nodal agency involved in promoting Indian organic agriculture, about 585,970 tonnes of organic products worth of Rs 301 million are being exported from India. Growing awareness, increasing market demand, increasing inclination of farmers to go organic and growing institutional support have resulted in more than 200 per cent growth in certified area during the last two years. Central Government has set up

a National Institute of Organic Farming in October 2003 in Ghaziabad, Utter Pradesh. The purpose of this institute is to formulate rules, regulations and certification of organic farm products in conformity with international standards. The major organic products sold in the global markets include dried fruits and nuts, cocoa, spices, herbs, oil crops, and derived products. Non-food items include cotton, cut flowers, livestock and potted plants.

Need for Better Agricultural Practices

Adverse effects of chemical pesticides have been reported on both the abiotic and biotic components of the environment. The former are exemplified by residues in soil, air, water, food etc. and the latter by phyto-toxicity, residues, vegetation changes etc. in plants and physiological deformities, diseases, mortality, population changes, genetic disorders etc. in mammals, avian, insects and other organisms. Entry of pesticides into the food chain coupled with their bioaccumulation and biomagnifications trigger effects of unforeseen consequences. Chemicals like methyl bromide, chlorofluorocarbons etc. are established culprits for depletion of the ozone layer.

There are several reports of adverse effects of chemical pesticides on human beings from Punjab, Andhra Pradesh, Kerala and other parts of the country where excessive use in certain pockets of these states has led to higher incidence of cancer and other diseases. Recent example of pesticide toxicity is of Endosulphon in Kerala and Karnataka, where the Hon'ble Supreme Court has to intervene to stop its sale.

Simultaneously, indiscriminate use of fertilizers, particularly the nitrogenous, has led to substantial pollution of soil, air and water. Fertilizer contamination of ground waters has led to eutrophication of lake and river waters causing depletion of oxygen and even death of aquatic life, nitrate pollution, increased emissions of gaseous N and metal toxicities. The presence of nitrates in potable water has been blamed for health hazards such as birth defects, impaired nervous system, cancer and methaemoglobinemia (the blue baby syndrome).

Options in Farming for Better Agricultural Practices

Sustainable agriculture or organic agriculture is the only answer for sustainable agricultural growth. There is need to promote organic farming practices in agriculture. Sustainable agriculture may be defined as any set of agronomic practices that are economically viable, environmentally safe, and socially acceptable. If a cropping system requires large inputs of fertilizer that leak from the system to pollute ground water, drinking supplies and distant coastal fisheries, the system may be sustainable economically as the long-term supply of fertilizer is stable and the economic cost of fertilizer is easily borne by larger grain production. But, this system is not sustainable environmentally or socially, since it does not cover the cost of environmental damage or social costs. In contrast, the organic agriculture focuses on "living soil", on optimizing the use of biological processes and on avoiding the use of synthetic chemicals and fertilizers. Adoption of better agricultural practices and organic inputs will certainly reduce the use of chemical inputs. Thus better agricultural practices should focus on the following areas to achieve the goal of sustainability in agriculture.

- Agricultural practices should focus on reduced use of off-farm inputs with less harm to environment and consumers. Bio-fertilizers and bio-pesticides are the potential alternatives in the area.
- There should be more productive use of biological and genetic potential of plants and animals. Biotechnological tools can help us to create novel technologies which have higher potential.
- Efforts should be made to have a better match between cropping patterns and the

physical capacity of lands. In India, there is vast scope away from the bowl of green revolution concentrated in Punjab, Haryana and Western Utter Pradesh to harness the potential of land and the crops with better agricultural practices and harnessing the natural resources.

- There should be an improved emphasis on conservation of soil, water, energy and biological resources as excessive use of chemical inputs has resulted in degradation of our soil eco-system.
- Water is a critical input of our agriculture which is crucial for agriculture growth in the future. Better water management is one of the important components of better agricultural practices. Emphasis should be given to adopt such irrigation practices like drip and sprinkler irrigation which reduces the wastage of water. Rainwater harvesting should an important component of better agricultural practices to increase water availability and recharge our groundwater sources.
- There should be efforts at every level of farming for more thorough incorporation of natural processes. Because, natural processes always enrich our environment and biodiversity.

Scope for Farming Based on Better Agricultural Practices

There is vast scope for adoption and promotion of better agricultural practices. If we take into consideration organic farming into consideration, the scope is tremendous. Organic farming relies heavily on biopesticides and biofertilizers. The current global market for organically raised agricultural products is valued at around US$ 30 billion with a growth rate of around 8 percent. Nearly 22 million hectares of land is now cultivated organically. The organic cultivation represents less than 1 percent of the world's conventional agricultural production and about 9 percent of the total agricultural area. This only highlights the tremendous potential in the growth of biopesticides and biofertilizers.In view of their several advantages, the demand for natural pesticides and fertilizers has been rising steadily. It is estimated that the total global market for synthetic pesticides which was valued at US$ 26.7 billion in 2005 would have decline to decline to US$ 25.3 billion in 2010. On the other hand, the global market for biopesticides will increase from US$ 672 million in 2005 to over US$ 1 billion in 2010. While Europe, at an average annual growth rate (AAGR) of 15 percent, is projected to lead the growth in biopesticide use, Asia will be no far behind with an average AAGR of 12 percent. Worldwide data for biofertilizer market are not available though the sale volume is estimated to be US$ 3 billion. While the overall market for pesticides is showing a decline, the biopesticides market is growing rapidly, increasing from $672 million in 2005 to over $1 billion in 2010, at an AAGR of 9.9 per cent. These pesticides are seeing increased usage because they are environmentally friendly. Biopesticides include microbial pesticides, plant-incorporated protectants, and others, which include natural predators, entomopathogenic nematodes, and parasitoids.

Biopesticides represent only 2.89 per cent (as on 2005) of the overall pesticide market in India and is expected to exhibit an annual growth rate of about 2.3 per cent in the coming years. In India, so far only 12 types of biopesticides have been registered under the Insecticide Act, 1968. Neem based pesticides, *Bacillus thuringensis*, NPV (viral insecticide) and *Trichoderma* (fungus) are the major biopesticides produced and used in India. Whereas, more than 190 synthetics are registered for use as chemical pesticides. Consumption of biopesticides has increased multifold.

India has 18 million of neem trees and if full potential of the neem trees is harnessed, it can meet the total requirement of pesticides in Indian

agriculture. Consumption of chemical pesticides has significantly fallen from 56,114 MT to 43,584 MT during the same period. The Indian Council of Agricultural Research (ICAR) has 31 bio-control production facilities while DBT supports another 22. The National Agriculture Technology Project (NATP) led IPM project during 1998 to 2005 also enhanced the use of biopesticides. States like Tamil Nadu and Andhra Pradesh already have 200 laboratories producing biopesticides. The National Centre for Integrated Pest Management (NCIPM) looks after plant protection needs in various agro-climatic zones of the country. Besides, it oversees the setting up and running of State Bio-control Labs (SBCLs). There are around 38 such SBCLs across the country, which are engaged in production and distribution of natural predators and parasites to farmers. The Insecticide Act of 1968 has been amended accordingly to simplify the process of registration to allow speedier development and production of biopesticides. The National Farmer Policy 2007 has strongly recommended the promotion of biopesticides for increasing agricultural production, sustaining the health of farmers and environment. To provide a boost to the organic products' exports, the government has decided to launch an awareness program amongst farmers and offer subsidies. APEDA (Agricultural and Processed Food Products Export Development Authority) will be launching a drive of 100 percent organic products exports from the current level of ₹530 crore per annum to ₹1,000 crore by 2012. APEDA is offering subsidies to encourage the marginal and poor farmers' community to undergo an extensive change from existing chemical farming to organic farming. Some of the other efforts towards promotion of organic exports include, attempts to collaborate with all the major organic products importing countries.

Although almost every country would now say that it supports sustainable agriculture but the evidence points towards only patchy reforms. There are some good examples where countries have given explicit national support for sustainable agriculture. These countries are putting it at the centre of agricultural development policy and integrating policies accordingly. These are Cuba and Switzerland. Cuba has a national policy for alternative agriculture; and Switzerland has three tiers of support for both types of sustainable agriculture and rural development. Austria, Denmark, Sweden and Finland have given explicit national support for organic agriculture, but this has not necessarily impacted upon conventional farmers. The impact of the new policy has already been remarkable. In Tamil Nadu, for example, farmers are experimenting with row planting, planting distance, biofertilizers (*Azospirillum, Azolla*), organic manures and basal fertilizer applications. With the increase in farmers' adoption of biocontrol agents (e.g. *Trichogramma*, neem), conventional pesticide use has fallen by 50 percent on average. Incomes of the farmers have increased by Rs 1 000-1 250/ha, and rice yields have increased by 250 kg/ha.

Better agricultural practices will promote conservation agriculture, organic farming which will help in sustainable production in agriculture. As the input required in such farming practices will have to be produced locally, such agricultural practices will create more rural employment in agriculture. Such practices will also help in reducing the cost of production in agriculture. In the long run, such practices will give a sustainable growth to our agricultural production.

[Dr. Harender Gautam is Senior Scientist, Department of Mycology and Plant Pathology and Dr. M. L. Bhardwaj is Professor and Head, Department of Vegetable Science, Dr.Y.S.Parmar University of Horticulture and Forestry, Nauni, Solan-173230, Himachal Pradesh. Dr. Harender Raj Gautam is the recipient of Himachal Gaurav award from the Government of Himachal Pradesh for promoting eco-friendly agricultural practices. e-mail:hrg_mpp@yahoo.com]

Land Use And Agrarian Relations- *Issues And Prospects In The Indian Context*

Francis Kuriakose and Deepa Kylasam Iyer

'The test of our progress is not whether we add more to the abundance of those who have much; it is whether we provide enough for those who have too little.'

Franklin Delano Roosevelt

Land is a finite resource and there are conflicting and competing demands on it. For 80% of the world population agriculture and land is the primary source of life and livelihood. India holds 2.4% of the world's geographical area (328.73 mha[1]) but supports 17.5% of the world's population (Provisional data of the 2011 Census). India is home to 18% of the cattle population of the world while owning a mere 0.5% of the total grazing area. Of the total 328 mha (total geographical area), land use statistics is available for approximately 305 mha (93%) of the total land. 228 million ha (69%) of its geographical area falls within dry land that encompasses arid, semi-arid, dry and sub-humid land as per Thornthewaite classification.

India is blessed with a wide range of soil pattern each particular to the locale. The alluvial soil (78 mha) that covers the great Indo-Gangetic Plains, the valleys of the rivers Narmada and Tapti (Madhya Pradesh), the Cauvery Basin (Tamil Nadu) supports cereals, oil, pulses, potato and sugar cane. The Black Cotton soil (51.8 mha) found in Maharashtra, Gujarat, Madhya Pradesh, Uttar Pradesh, Karnataka, Rajasthan and Andhra Pradesh supports cereals, cotton, citrus fruits, pulses, oil seeds and vegetables. The red soil of South India and Madhya Pradesh, West-Bengal and Bihar supports rice, millets, tobacco and vegetables. The laterite soil (12.6 mha) and desert soil (37 mha) are not found suitable for agriculture.

Water is a resource precious and scarce in India. The variability of precipitation spatially and in quantity can be inferred by the fact that rainfall has been recorded as low as 1oo mm in West Rajasthan and 9000mm in Meghalaya in North Eastern India. India receives 4000 cubic kilometre of precipitation in the country in its 35 meteorological sub-divisions. Of this amount, only 50% is put to benefit due to topographical and other constraints.

The fact that water is crucial to agriculture in a country that has 68% of its net cultivated area as rain-fed, can hardly be exaggerated. Of the total cultivated area of 142 mha, 97 mha is rainfed. The full irrigation potential of the country has been revised to 139.5 mha out of which 58.5 mha is watered by major and minor irrigation schemes, 15 mha by minor irrigation schemes and 40 mha by groundwater exploitation. India's irrigation potential increased from 22.6 mha (1951) to 90 mha (1995-96) but water usage efficiency is a meagre 30-40%. That is why more than 50% of the total cultivated area is still rainfed. The state of soil and water that mainly determine land and its utility in agriculture is of prime importance to maintain sustainable development. We need to define and examine land use pattern with an emphasis on a viable land use policy taking the above factors into consideration.

Land Use Pattern- The Indian Scenario

Land Use Pattern is determined by physical, economical and institutional framework, ie, the action and interaction of the physical characteristics of land, the economic factors like capital and labour, location of land with respect to factors of infrastructure like transport and institutional framework that determines the inter-relation between all the factors involved. In other words, land use pattern is a complex phenomenon determined by the dynamic equilibrium of factors of agrarian relations, economic development, infrastructure and policy making. It is the synthesis of physical, chemical and biological process on one hand and human process on the other.

The pattern of land use in India can be determined by looking at the post independence scenario. Till 1949-50, land area was divided into a five-fold classification. This was inadequate to meet the agricultural demands as there was lack of uniformity in definition and scope of classification. Hence it was difficult to compare and utilise the classification to improve the existing land pattern. To break up the existing tracts of land into smaller constituencies for better utility and monitoring, The Technical Committee on Co-ordination of Agricultural Statistics (Ministry of Food and Agriculture) recommended a nine-fold use of land in the country. There was the area under agriculture that was the mainstay of farmland. Three-fourth of this area was shared by the states Bihar, Gujarat, Madhya Pradesh, Karnataka and Maharashtra with Maharashtra topping the chart with the highest percent of the net sown area. The area under non-agricultural use comprised the land under water, land used for the construction of buildings, roads, railways and barren agricultural land. The area under forest was 76.52 mha (State Forest Department, 1999). It was classified as Reserve, Protected and Unclassed. Using Remote Sensing Technology, it was ascertained that the actual forest cover was only 63.73 mha. The ownership of forest land was left to the Government of India and community clans wherever applicable. The per capita availability of forest land was 0.08 hectares whereas the optimum area of land required for meeting the basic needs was 0.47 hectares. This immense pressure on forest cover led to the search of potential areas for expansion of forest cover in culturable land tracts. 13.94 mha of the total land form wetland, fallow land and land put to other uses. Forests form an important part of land use. Land allocation for forestry include forest land and land allotted for agro forestry, farm woodlots, wind belts, shelter belts, avenue trees, urban forests, homestead forests and sacred groves. The state of Natural forest in India can be deciphered from table 1.

Table 1

State of Natural Forests in India

Area of Natural Forest	51.73 mha
Total growing stock in Natural Forest	2431.30 million cu.m
Total biomass in Natural Forests	4805.7 million tonnes

Source: NFAP, MOEF, Government of India, 1999

Forests in India show the greatest variation and range depending rainfall topography and climactic factors. Forests are both a resource and a habitat and of the 16 detailed forest types given, 38.2% is topical deciduous forests and 30.2% is moist deciduous. The benefits of natural forests include soil protection, fertility, water flora and fauna conservation, microclimate, genetic resource conservation, use of genetic breeding and bio-technology, integrated watershed management and regeneration of eco-systems.

11 mha of the total land comes under permanent pastures and grazing lands. Rajasthan, Uttar Pradesh, Madhya Pradesh, Andhra Pradesh and Orissa cover 75% of the grazing land in India. The forests of India support 40% energy needs of the country out of which 80% needs are in the rural region and 30% fodder needs of cattle remain significant. The live stock statistics of India given in the table is relevant in this context. It is evident that as land remains constant, the increasing livestock population and their needs could be met only with judicious planning and sustainable use of land.

Table 2
Livestock population in India

Year	Total livestock population in (000)	Cattle (in ooo)
1977	369,645	180,140
1982	419,742	192,453
1987	445,286	199,645
1992	470,860	204,584

Source: Agricultural Statistics at a glance, 2001, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India. Note that livestock includes cattle, buffalo, sheep, goat, horse, pig, donkey, mule, camel, yak and 'mithun'.

Area under Common Property Resource (CPR) includes the land that caters to the basic needs and services of the vulnerable sections of the rural poor. This includes village forestry, grazing and watershed drainage to help the farmers in crisis. CPRs should not be confused with wasteland. Whereas CPRs have property rights in the land allocated, wasteland is the ecological characteristics coined to initiate developmental programmes for the recovery of degraded lands irrespective of property rights. Velayutham (2000) has shown that the area under CPR has diminished during the period 1950-1997. Grazing pressure, land degradation resulting from a burgeoning cattle population that increased from a livestock population of 292 million to 462 million during the period resulted in the gross erosion of CPR changing them into wastelands.

Case for Land Use Policy

The way land is used as a means for life and livelihood is not just dependent on the direct users; it is exposed to a wider realm and is decided by all the factors directly and indirectly involved. One of the main problems that is faced today is the depletion of the quality of land and land degradation. Approximately 5-7 million hectares of usable land is lost every year through land degradation. The relative influence of land degradation is 39% in Asia. This translates to half a billion people in the developing world with no irrigation facilities, 400 million living on soil unsuitable for agriculture, 200 million on slope dominated regions and 130 million in fragile forest eco-system. 73 % of the earth faces severe and significant problems in agricultural investment while trying to sustain a rising population. A recent pioneering study by three UN agencies including FAO, UNDP and UNEP estimate the severity and cost of land degradation in South Asia to be 2% of the Gross Domestic Product of the region and 7% of the agricultural output. The statistics given below reaffirm the finding.

Table 3
Extent of Land degradation in India (area)

Source of Erosion	Area in mha
Water	103.90
Wind	13.10
Physical Agents	12.23
Chemical Agents	10.30
Other Agents	7.20

Source : National Bureau of Soil Survey and Land Use Planning

The rising trend in land use degradation can be attributed to the following reasons

1. Deforestation
2. Inadequate land use

3. Unsustainable farming and grazing practices
4. Demographic pressure
5. Lack of adequate technology implementation
6. Markets and legal instruments
7. Climate fluctuation

Demographic Pressure

Demographic pressure is one of the foremost reasons of land degradation as increasing population puts more pressure on arable land, grazing, forestry, wild life, tourism and development. Not surprisingly, population pressure affects 35% of the productive land. The population demands for food, fuel and employment is going to double in the next five decades. This will involve expansion of fragile marginal lands for utility in developing countries as poverty is endemic and institutional capacity for land management is weak. Urbanisation and industrialisation outstrips land capacity. There are serious concerns about land, environmental degradation, decreased productivity and growth rate in the developing world. The population of 1.3 billion living on fragile land is set to double. The vulnerable segment of the population notably the rural poor with moderate assets, land, tradition social capital, human capital and indigenous knowledge are not developed by the institutions. These invisible millions living in disperse settlements in an informal economy are not picked up by the development juggernaut. They lay neglected along with the environmental distress signals.

Land degradation as a result of External features

The net value of land is the sum of two factors- the present value of the revenue stream and the present value of the terminal value of land. There are a number of factors that diminishes the value of land. Intensive farming practices are the foremost among these. Green revolution in India brought in petrochemical technology, pest intensive agricultural method, cross breeding and single species forest plantations which were mindlessly adopted from other parts of the world. Over application of nitrates has led to groundwater contamination, soil degradation and an imbalance in micro nutrients. The extension of area under irrigation has jumped from 19% to 38% in terms of net sown area in four decades. This has led to water logging and salinity. National Remote Sensing Agency and Forest Survey of India has brought out the fact that 60% of the total area under cultivation is degraded. More than one source of irrigation has increased the salinity and alkalinity of soil. Low precipitation coupled with unscientific use of water and drainage facilities take a toll on water resources. Improper cropping patterns and intensive farming practices degrade the quality and value of land.

The consequences of large scale land degradation are two-folded

i) The on-site costs-The technological breakthrough that the Green Revolution offered led us to produce short duration high yielding crops. Intensive land use, increased area under irrigation, prolific use of chemicals to raise the efficiency of production also brought in on-site costs like soil erosion, alkalinity, salinity, micro nutrient deficiency, water logging, depletion and contamination of ground water.

ii) The off-site costs- The off-site costs include river and dam siltation, damage to roadways and sewers, siltation of harbours and channels, loss of reservoir storage, disruption of stream ecology, damage to public health and increased frequency of flooding.

Policy Intervention

The rationale for policy intervention should be based on two factors

i) The significance of off-site costs as a result of land degradation

ii) The costs of on-site degradation even when it is not apparent in the immediate context.

This requires a foresight and vision for long term sustainable development through policies, action and awareness brought out through education, training and extension programmes. The objective of the policy intervention should be the following

i) Restore efficiency to meet the growing consumption needs

ii) Suitable mechanism for scientific management, conservation and development of land resource

iii) Expansion of forest cover to restore ecological balance

iv) Conjunctive use of surface and ground water

v) Preservation of agricultural land

The Integrated Approach

For effective and efficient use of land we need eminently practical plans for land use management. This is included in the integrated approach. To reduce the conflicts and to make trade-offs link social and economic development with environmental protection, sustainable development is the key. The essence of integrated approach is the sectoral planning management. There are a number of issues to consider while adopting approaches and policies. For land use pattern through sectoral approach, we need to plan linkages, formulate economically viable project for each sector and use technology. This would include making Land Use Atlases, system database on land utilisation and management, computerised and updated land records at district, state and national levels. Better legal, political and administrational will is also the key. We need strict laws for land use conversion, survey of land based on climate, water and soil particulars to improve investment and training orientation, publicity and awareness based on local needs. Effective reclamation is needed to check degeneration. This can be done through effective watershed management, reduction of regional imbalances and diversification of land use. Preventive measures on adverse effects from industrial wastes and effluent and development of agro-based industries are also keys to developing an integrated approach.

To monitor the better use of land, Remote sensing satellite technology like Geographical Information System and Global Positioning System can be used. One of the problems frequently encountered while measuring the loss of land value is the difficulty in measurement itself as there are so many variables involved. Empirical or process based models have to be so complex to take into consideration the effects of all the variables. One of the methods is to estimate long term average annual soil loss from arable land using Universal Soil Loss Equation (USLE) or its revised form (RUSLE). There are various mathematical simulation models based on physical process involved in soil detachment, transportation and deposition. Use of Iso-erosion rate map (Singh et.al, 1992) is an example. Soil erodability factor can also be measured. Loss of soil value due to land degradation is needed to understand the environmental costs of agriculture. Production approach that assesses the impact, preventive cost approach that focuses on conservation and defensive expenditure and replacement cost approach that relies on the cost of restoration are the different ways to measure this. There are various econometrics models that can include and evaluate the inputs for alteration and cropping pattern. In India, soil and land survey conducted by Department of Agriculture and co-operation developed land degeneration mapping in the eighth five-year plan through District Information System where soil information system of 30 districts in diverse agro-climactic zones were formulated. Similarly, the Department of Land Resources, Ministry of Rural Development has brought out the Wasteland Atlas of India 200o after studying different types of degraded wastelands in the country.

Reclamation of waste land is one of the most important aspects of sustainable land use. Agrarian practices can be modified for reclaiming wasteland. For example, application of gypsum consecutively for three years with reduced application in the second and third year will reduce salinity. Integrated watershed management is a preventive method in which soil and water is conserved and cropping pattern is altered to improve land use. Percolation of

water into subsoil, reduction of surface water run-off, elimination of soil erosion and increase water availability are the chief aims of such sustainable management practices. For attaining these objectives, check dams along gullies are constructed, bench terracing, contour bunding, land levelling, planting grass along the contours, good vegetal cover on the watershed are deployed. Difference can be brought through Governmental Intervention and policy making. The Soil and Water Conservation Division, Ministry of Agriculture plans to manage 86mha under 30 projects through Integrated Water Management. 30,000 hectares of shifting and semi-stable land dunes have been treated with shelter belts and strip cropping as a conservation measure (TERI Report, 1997). The National Land Use and Wasteland Development Council (1985) was set up with the objective of formulating a National Policy and Perspective Plan for Conservation and Management of Land Strategy. It is time to set right some policies unsuitable for sustainable development. For example, the governmental policy of heavily subsidising electricity for tube well irrigation and chemicals led to poor land quality and eventual abandoning of land. Similarly, the New Economic Policy that encouraged relaxation on land acquired by Non Resident Indians, conversion of agricultural land into non-agricultural land, ceiling of agricultural land holdings eventually led to distorted market value due to speculation. The encouragement given to export oriented agriculture and concessions given to agro-processing industry adversely affected Indian agriculture by increasing the investment costs. Rational Policies to face regional imbalances should be brought in. The commitments of Tropical Forestry Action Plan, World Food Programme, UNCED led Forest Principles and the Government of India's National Conservation Plan should be adhered to. Rational Pricing Policy combined with resource efficiency in agro-processing industry is the need of the hour.

Economic incentives for soil conservation practices, conjunctive use of chemicals with biological inputs, classification of Land use statistics and studying the land use impact on agriculture will help at the macro level. Use of remote sensing technology to study different dimensions of the problem is mandatory. Legislation is in place for conservation of bio-diversity and forests but not to protect soil relations. Such gaps in law should be filled in with appropriate legal protection. New technology and crop management practices should emphasise the integrated systems approach. Meaningful farm research practices will address the concept of linking agriculture with environment. The aim of agriculture should be sustainable crop production with enhanced production envisioned for the long term. Diversification of agriculture should be encouraged. Farming oilseeds and pulses in place of cereals and horticulture wherever applicable demand less water and encourage crop rotation. This permits an understanding of agro climatic conditions, favourable topographic conditions, efficient land use, conservation of soil and maximum use of land resources. Integration of farm forestry with agro forestry will reduce the tremendous pressure on land. Growing a combination of species like agri- silviculture, farm and grove system will make management approach complementary, improve biomass production, regeneration of land resources and increased generation of employment and income.

Thus integrated and sustainable land use comprises prioritisation of critical land sensitivity, understanding land use and forest response, integrated strategy for forest and pest management, diversification of agriculture, crop combination, use of people's indigenous knowledge to attain food and nutritional security, increased productivity and address the environmental concerns. This is the way forward towards an evergreen revolution.

Notes

mha is Million Hectares

(Francis Kuriakose is Assistant Professor of Commerce & Management, Achariya Arts and Science College Puducherry. e-mail : francyge83@yahoo.co.uk, and Deepa Kylasam Iyer is a contributing Editor with http://pio-indians.com/, a web portal based in Paris for the people of Indian origin, e-mail : deepa_7ki@yahoo.co.in)

WEED MANAGEMENT FOR INCREASED AGRICULTURAL PRODUCTIVITY

Yashbir Singh Shivay And Anshu Rahal

Weeds are the major constraints in realizing optimum yield potential which cause a drastic reduction in yield to a level of one-third to almost total failure of crop. Weeds not only deplete nutrients and moisture from soil but are also an alternate host of insects and diseases.

The challenge before Indian agriculture is to feed the second most populous nation in the world accounting for about 17% of world's population supported by only on 2.4% land area. The demand for food grains in the year 2020 is projected at 255 million tonnes comprising 112 million tonnes of rice, 82 million tonnes of wheat, 39 million tonnes of coarse cereals and 28 million tonnes of pulses. The gap in demand at production levels of 2007-08 would be 15 million tonnes in rice, 3 million tonnes in wheat, 2 million tonnes in coarse cereals, 13 million tonnes in pulses and 5 million tonnes in oilseeds (Table 1). On one side of the food requirement is increasing and on other net sown area in India has plateau around 141-143 million ha since 1970s till date. Any horizontal increase in food grain production by expanding the cultivable area is not possible.

Table 1. Gap in demand of food grains

Category	Demand by 2020 (million tonnes)	Production during 2007-08 (million tonnes)	Gap in demand (million tonnes)
Rice	112	97	15
Wheat	82	79	3
Pulses	28	15	13
Oilseeds	35	30	5
Coarse cereals	39	37	2

Though, the average annual growth rate of food grains production since 1950-51 to 2006-07 was 2.5% compared to the growth of population which averaged at 2.1%, it however, decelerated to 1.2% during 1990-2007 which was lower than the annual rate of growth of population, averaging 1.9%. To meet the growing needs of the food security, 2.0% growth in food grain production is considered essential.

Table 2. Crop losses due to agricultural pests in Indian agricultural scenario

S. No.	Agricultural pests	Losses (%)
1.	Weeds	37
2.	Insects	29
3.	Diseases	22
4.	Others	12
	Total	**100**

Table 3. Global and Indian pesticide use scenario (% of total)

S. No.	Agricultural pesticides	Global	India
1.	Insecticide	52	20
2.	Herbicide	7	61
3.	Fungicide	32	17
4.	others	4	2

The vertical increase by way of increasing crop productivity has got tremendous scope which can be achieved with better genotypes and providing farmer-friendly input technology. One such technology which has a potential to yield substantial increase in the production of food grains is proper weed management as weeds alone are known to account for to nearly one third of the losses caused by various biotic stresses (Table 2). In some situations to uncontrolled weeds can even lead to complete crop failure. Global and Indian pesticide use scenario is depicted in Table 3. The efforts to control weeds, many a times also contribute towards the increased cost of cultivation of crops. Studies suggest that proper weed management technologies if adapted can result in an additional production of 103 million tonnes of food grains, 15 m million tonnes of pulses, 10 million tonnes of oilseeds and 52 million tonnes of commercial crops, per annum, which in few cases are even equivalent to the existing annual production. This amounts to an additional income of Rs. 1,05,036 crores per annum. The losses due to weeds in food grains and oilseeds are almost half of the current production level while equal amounts are lost in pulses. Therefore, greater awareness about the losses caused by the weeds and the needs for improved weed management technologies are very vital to meet the growing demand for food grains, pulses, oilseeds and other crops by the ever increasing population. There is tremendous scope to increase the agricultural productivity by adapting the improved weed management technologies that have been developed in the country.

Weed and their harmful effects

Weeds are the plants growing in places where they are not desired. The definition given by Weed Science Society of America (WSSA) is *"any plant that is objectionable or interferes with activities and welfare of man".* This is given with the perspective that any plant or vegetation could be included as a weed in the future so long as the plant fits into the above definition. Unlike other pests, weeds are ubiquitous and affect almost all the crops.

In agriculture, weeds cause huge reductions in crop yields (Table 4), increase cost of cultivation, reduce input use-efficiency, interfere with agricultural operations, impair quality, act as alternate hosts for several insect pests, diseases and nematodes (Table 5). Weeds compete with crop plants for various inputs/resources like water, nutrients, sunlight etc. In addition to agriculture, weeds also affect and interfere in the management of all the terrestrial and aquatic resources. Besides, weeds it is also a nuisance in forestry reducing their productivity. Out of the total 826 weed species reported in the country, 80 are considered as very serious and 198 as serious weeds. The importance of their management seldom required any mention especially under the present day high input farming systems. At a conservative estimate, an amount of Rs. 100

billion is spent on weed management annually in India, in arable agriculture alone. The potential losses due to weeds can be as high as about 65-70% depending on the crop, degree of weed infestation, weed species and management practices. Weeds appear along with the crop and also in several flushes during the crop growth. For instance, purple nutsedge (*Cyperus rotundus* L.) in nutrient stressed environment, becomes very competitive as long as the canopy remained sufficiently open. The growth of this weed was lower at recommended doses of fertilizer application. Maintaining weed free crop would not be possible due to economic reasons hence they have to be managed within the critical period of crop-weed competition (Table 6) to obtain economically higher yields.

Efficient weed management in major crops like cereals (especially in rice-wheat system), pulses and oilseeds and vegetables is the key to improve their productivity. It is worth mentioning that all efforts to enhance productivity by any input resource or technology in any crop will be useless if weeds are not appropriately managed.

Cultural Methods

Despite the great progress made in agriculture, manual and mechanical methods continue to be important weed management practices in many regions of the world. Cultural methods are used to complement manual and mechanical methods. Cultural practices such as method and time of sowing, crop density and geometry, crop species and varieties, method and time of fertilizer application, mulching, crop rotation and intercropping, time of irrigation, soil-solarisation etc., have pronounced effect on crop-weed interference. Shade crops like cowpea and *Sesbania* strongly hamper the growth of nutsedge shoots and formation of tubers. Cultural practices are manipulated in such a way that they become more favorable for crop growth and less to weeds. They are not only eco-friendly but also reduce the use of costly herbicides.

Planting Geometry

Planting density and pattern modify the crop canopy structure and in turn influence weed smothering ability. Narrow row spacing will bring variation in microclimate viz., light intensity, evaporation and temperature at soil surface. The establishment of a crop with a more uniform and dense plant distribution may result in better use of light, water and nutrients and lead to greater crop competitive ability. Crops grown in narrow

Table 4. Nutrient depletion and yield losses due to weeds in different crops

Crops	Nutrient removal (kg/ha)			Reduction in yield (%)
	N	P_2O_5	K_2O	
Paddy (direct seeded)	20-37	5-14	17-48	47-86
Maize	23-59	6.10	16-62	40-60
Sorghum	36-46	11-18	31-47	6-40
Wheat	20-90	2-13	28-54	26-38
Pigeonpea	28.0	24.0	14.0	20-40
Mungbean	80-132	17-20	80-130	30-50
Chickpea	29-55	3-8	15-72	15-25
Peas	61-72	7-14	21-105	20-30
Lentil	39.0	5.0	21.0	20-30
Soybean	26-65	3-11	43-102	40-60
Groundnut	15-39	5-9	21-24	20-50
Rapeseed & mustard	22.0	3.0	12.0	15-30
Linseed	32.0	3.0	13.0	30-40
Sugarcane	35-162	22-44	135-242	20-30

rows start competing with weeds at an earlier stage than those in wide rows because of more rapid canopy closure and probably better root distribution. Increased shading at soil surface will smother weed growth.

Cropping systems/intercropping

Ideal crop system is one of the techniques employed to manage weed population. In mono-cropping system numerous weed species persist and expand rapidly but crop rotation helps in interrupting life cycle of weeds and prevents any weed species to become dominant. Out of seven crops viz. urdbean, *Sesbania*, pigeonpea, cowpea, sesame, rice and groundnut followed by wheat in winter and fallow and mungbean in summer season, lowest aerial nutsedge biomass was recorded in sesame-wheat (53 g/m^2) and sesame-wheat-mungbean (83 g/m^2) as against 498 g/m^2 in pigeonpea-wheat-mungbean after 3 years on fixed site. Studies on purple nutsedge infestation in different cropping systems viz., maize-wheat-mungbean, maize-potato-urdbean, maize + urdbean-berseem, pigeonpea-mungbean-wheat, rice-chickpea-mungbean, sesame-chickpea, cowpea-wheat, *Sesbania*-wheat-mungbean revealed that sesame-chickpea cropping system recorded minimum density an biomass of nutsedge (42 and 2.2 g/m^2) in comparison to other cropping sequences on fixed sites after 3 years duration. The author further recorded that sesame-chickpea crop system suppressed by 50 and 43 per cent after *Kharif* and *Rabi* seasons in comparison of maize-potato-urdbean.

Intercropping suppresses weeds better than sole cropping following the formation of the canopies due to the competitive planting pattern and thus provides an opportunity to utilize crops themselves as a tool of weed management. When two or more crops are grown together as intercrops, the total weed suppressing ability of a system will be higher than the sole cropping. Finding an intercrop which will suppress the growth of the weeds but not the crop has been difficult. Many short duration pulses like, cowpea, mungbean and soybean effectively smoother weeds without causing reduction in the yield of main oilseed crops. Sometimes a crop is grown as a living mulch to suppress weeds during initial stages of crop growth which are mechanically buried to terminate chemically to reduce competition to the main crop. In wide spaced pulses such as pigeonpea, intercropping is a common practice, which besides covering risk will reduce weed infestation.

Soil solarisation

Soils acts as a reservoir of weed seeds and therefore, the importance of soil solarization in destroying this seed reserve are increasingly being recognized. By covering of soil with transparent polythene sheet, the soil temperature is increased to the lethal level for weeds. Soil temperature increases to the tune of 8-12^{0}C by soil solarization over corresponding non-mulched soil. The response of soil solarization varies with weed species. Most of the annual weeds were effectively suppressed by solarization, however, the perennials such as *Cynodon dactylon, Cyperus rotundus* and *Convolvulus arvensis,* gradually recovered probably due to their deep rooted vegetative prop gules in the soil. Variability in weed control due to soil solarization is influenced by soil type, temperature, moisture content, size and location of seeds or vegetative prop gules in soil, besides the quality of polyethylene films. It was also observed that black polythene or farm litters comprising of farm waste resulted in low weed population and dry matter in rain-fed chickpea. This method could be effect of covering material on weed smothering efficiency (WSE) and enhancement in yield of chickpea adopted against a wide variety of weeds in several crops particularly under moisture stress conditions.

A modified version is of groundnut cultivation in China where the PE films are laid on soil and groundnut seeds are dibbled in the holes made in the PE films. This method enables good initial crop growth in an otherwise old environment and later helps in checking weed growth and evaporation of water. Following this technique a farmer in Andhra Pradesh recorded an yield of 5-6 t/ha of groundnut. This technique may find favor with farmers of northern eastern region, where

groundnut grown in rice fallow often suffer from low temperature.

Cultivar competitiveness

Cultivars vary in their growth habit which could influence weed growth substantially. Crops differ in relative growth rate, spreading habit, height, canopy structure and inherent competitive character and accordingly differ in their weed suppressing ability. A quick growing and early canopy-producing crop would be expected to be better competitor against weeds than crops lacking in these characters. Seed size within a species also influences the competition through vigorous plants from larger seeds. Increased competitive ability of cultivars has been attributed to early emergence, seedling vigour, and increased rate of leaf expansion, rapid creation of dense canopy, increased plant height, early root growth and increased root size. Future breeding and variety testing programmes should take factors of crop competitive ability into consideration. Pea cultivar JP 885 was quite effective in suppressing weed and recorded better seed yield over cultivar JM-1.

Mechanical method

Mechanical weed control involves removal of weeds with various tools and implements including manual removal by hand weeding. Inter-cultural operations are performed primarily to destroy the weeds present in the field and create favorable soil conditions for growth of pulses and oilseeds. Hand hoeing and manual weeding are most common practices performed for weed control in almost all pulses and oilseed crops. One or two hand weddings at critical crop-weeds stage provide satisfactory control of weeds in most of the pulses. Extra weeding may be required if crops are infested with perennial weeds. In pigeonpea, two mechanical weeding, one at 25-30 DAS and another at 45-50 DAS have been found to be as effective as complete weed free conditions. In mungbean and urdbean, two hand weeding in controlling weeds. In winter season pulses viz., chickpea, peas, lentil, frenchbean and fababean, two weeding one at 30 days and another at 60 days after sowing provided an effective control of all the weeds.

Two hand weeding at 20 & 40 DAS provided satisfactory control of weeds in groundnut. Harrowing twice before sowing and one hand weeding at 20 DAS controlled 96.5% weeds of soybean. In sesamum and sunflower, two weeding at 30 and 45 DAS gave satisfactory control of weeds. In mustard, hand weeding only once at 25-30 DAS gave effective control of weeds and higher seed yield. However, hand weeding twice did not control the perennial weeds viz., *Cyperus rotundus* and *Cynodon dactylon* due to their re-emergence.

Chemical weed management

A number of herbicides have been evaluated for their rates, time and mode of application in different pulses and oilseeds. The most promising herbicides are listed in Table 10 and 11.

Based on the research work carried out in India on different oilseeds-based cropping system viz., sunflower, finger millet / soybean, sorghum-safflower, maize-sunflower/mustard, cotton-groundnut / sunflower rice-sunflower, soybean-wheat / mustard / chickpea, soybean-mustard-mungbean etc., it is clear that the herbicides applied in preceding crops has no toxic effect on the succeeding crops in the rotation. This may be attributed to the faster degradation of the applied herbicides in the soil. Allelopathic effect of sunflower on succeeding crops of finger millet and soybean was observed.

Vegetables

More than 40 types of vegetables are grown in different parts of India. India is next only to China in world vegetable production. During the year 2007-08, India produced about 122 million tonnes of vegetables from an area of 7.73 million ha with an average productivity of 15.8 tonnes per hectare. However, according to one estimate the production needs to be increased to 250 million tonnes by the year 2025 to meet the country's demand. Looking into various constraints in bridging the gaps to achieve the production targets, weed infestation emerges as an important one. The problems of weed management in vegetable crops are different from other field crops. They are usually grown in input intensive

systems characterized by heavy doses of manures and fertilizers and more number of irrigations. These conditions also favour luxuriant growth of weeds in associated crops. Losses in the yield of vegetable crops can be as high as 80%.

Herbicides are an effective tool for weed management in commercial vegetable production. Control of weeds through herbicides is easier, less time consuming and less costly in comparison to mechanical methods. Approximately 7% of total herbicides are used in vegetable crops in India..

Conclusion

Agriculture depends heavily on energy to sustain surge in needed productivity growth to feed the burgeoning population. Like water and nutrients, low weed control efficiency in major cereals, pulses and oilseeds is a matter of serious concern from food security point of view. There are several new developments in weed control (e.g. use of green manure and intercropping) which require implementation as a part of an integrated approach. Breeders and weed scientists should work closely together to develop new cultivars and look for the possibilities of producing either allelopathic or highly competitive varieties that are able to compete with the associated weeds. This should be another important element in the development of integrated weed management. Policy-makers need to pay more attention to the problems posed by weeds as an important issue. Support to weed research programmes and farmers' training in improved weed management in this system is required for further improvement of food production.

(The first author is a Principal Scientist, Division of Agronomy, Indian Agricultural Research Institute, New Delhi 110 012, e-mail: ysshivay@hotmail.com; ysshivay@iari.res.in; Second author is an assistant Professor, Department of Animal Nutrition, College of Veterinary and Animal Sciences, G. B. Pant University of Agriculture & Technology, Pantnagar 263 145, Uttarakhand, e-mail : anshurahal@rediffmail.com)

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Potential and constraints of organic agriculture in India

Pravash Chandra Moharana

Possibly, the greatest impact of organic agriculture is on the mindset of the people. It uses traditional and indigenous farming knowledge. By adopting organic agriculture, farmers are challenged to take on new knowledge and perspectives, and to innovate.

Organic agriculture is a form of agriculture that relies on ecosystem management and attempts to reduce or eliminate external agricultural inputs, especially synthetic ones. It is a holistic production management system that promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. Organic farming is not a new concept to India. Indian farmers have the distinction of using organics in agriculture from time immemorial. Ancient Indian scriptures, the *Ramayana*, *Mahabharata*, *Vedas* and the *Upanishads* have documented the use of animal excreta, fish, bones and various kinds of plant residues as manure. Use of organic manures and green manure are mentioned in *Rig Veda* (2500-1500 BC) and *Atharva Veda* (1000 BC). At present in India about 3,39,1113 hectares area is under certified organic farming (this includes wild herb collection area of MP and UP) with about 1,41,904 numbers of farmers engaged in organic farming. The Indian organic farming industry is estimated at US $ 78 million and is almost entirely export oriented.

Organic agriculture has huge potential in India. But it also faces many constraints. This section lists these potentials and constraints, and suggests changes needed if the potentials are to be achieved.

Potentials

The following points are ranked in order of importance

1. **Potential organic producers:** All farmers in India have the potential to go organic. With full government support to promoting organic farming and assistance to help farmers bridge the 2–3 year transition period, it is estimated that about 25% of Indian farmers would change to organic agriculture within 5 years.

2. **Organic by default:** Many areas in India are farmed in a traditional way, untouched by chemical farming, so are organic by default. Most are subsistence farms in remote and marginal areas. They should be covered by a specific programme concentrating on organic agriculture to help farmers make themselves self-sufficient on a sustainable basis. By improving their livelihoods in this way, such a support programme would alleviate the need for social welfare programmes serving the same groups.

3. **Research on traditional varieties:** As most agricultural research has concentrated on high-yielding varieties of wheat, rice and other staples, traditional food crops have been neglected. Almost no attention has been given to local varieties of rice, wheat, millets, pulses and other cereals, while only 8-10 varieties are cultivated in 80% of all rice fields. Traditional varieties should be identified, improved and promoted.

4. **Links to markets:** Many smallholder farmers still have very weak links with markets for their produce. Specific emphasis on strengthening and improving such links would make it attractive for farmers and rural enterprises to improve the quality of their products. This would create new employment opportunities for local people. Many local products are produced with little capital investment but high inputs of labour, which is plentiful in India.

5. **Certified organic agriculture:** This is a niche market which offers premium prices to producers. For small-scale farmers to tap this potential, they must be connected to the potential markets. This will require improved organization (e.g., organizing as cooperatives or farmer associations), training, quality control, market information and facilitation (e.g., certification), and specific requirements for each commodity (e.g., storage).

6. **National organic certification:** At the moment it is still very difficult and costly for Indian farmer groups to organize certification for the national Indian market. Farmers wanting to sell their produce on the national market have to undergo a complicated, expensive process to comply with international standards. Creating a national certification standard, specifically designed and adapted to local conditions, would reduce the cost of this process and increase the number of smallholders who could take advantage of it.

7. **Protecting farmers from foreign competition:** Liberalizing trade rules creates new opportunities for Indian farmers to export. But it also creates the risk that cheap foreign food will sweep into the Indian market, cutting food prices drastically and pushing smallholder farmers out of business. While complying with the international agreements it has signed, India must also find ways to protect its many smallholder farmers from losing their only source of income.

8. **Rising input prices:** If the prices for energy and agricultural inputs for conventional farming continue to rise, labour-intensive agriculture will become more attractive even for larger-scale farmers.

9. **Reducing risks through diversification:** Organic agriculture has great potential to reduce farmers' risks. A single organically grown crop might yield less than if it were grown conventionally, but the total value of all the organic crops, in combination with drastically reduced input costs, gives farmers

a similar (or even somewhat higher) profits. The organic farmer also is cushioned from price fluctuations of individual crops, bad weather and environmental degradation.

10. **Traditional foods:** Organic agriculture emphasizes traditional foods which have declined in popularity due to the shift to wheat and rice. Many of these traditional foods are highly nutritious, as well as being adapted to the local ecology and contributing to a diverse farm system. New markets could be created by developing delicious recipes based on traditional ingredients.

11. **Rehabilitating watersheds:** Both conventional high-input agriculture and unsustainable traditional types of farming seriously damage the environment, lowering soil fertility and causing erosion. This damage, and the high costs of rehabilitation, are not reflected in the costs of production. Sustainable organic agriculture would avoid these costs. It would be well worth supporting farmers to produce in a sustainable manner.

Successful experiences suggest that a framework for sustainable agriculture should be based on the following.

1. **Integration of natural and regenerative principles** (nutrient cycling, nitrogen fixation, soil regeneration and natural enemies) into crop production. This can produce stable yields around the same level as from conventional farming. Because input costs are much lower, farmers make more money and are less likely to go into debt. With further measures, such as the use of beneficial insects that prey on or parasitize pests, the selection of seeds and the improved recycling of biomass, yields from organic agriculture even can exceed those from conventional farming.

2. **Using local inputs, management skills and labour** instead of external inputs. Making productive use of the people's capacities to work together helps solve common management problems related to pests, watershed management, irrigation and forest management. This can be further enhanced by training and on-farm research to improve the already available knowledge and techniques.

3. **Adopting multifunctional technologies** that conserve and regenerate resources, such as composting and water conservation. This will improve several components of the farming system at the same time.

4. **Providing credit on the basis of land**, rather than for particular crops. Farmers can now get credit for single crops such as cotton or sugarcane. They should also be able to get credit for a farm under biodiverse cropping systems. The system should allow for rolling loans with long gestation periods.

Constraints

There are many constraints to the spread of organic agriculture in India. Here are the main ones.

1. **Bias towards chemical farming:** Existing policies, research and extension activities all support high-external-input farming. Little attention is given to organic agriculture, and no resource materials are available.

2. **Misappropriation of local varieties:** There is a danger that local seed varieties will be patented by multinational companies. The Indian government should recognize the rich heritage which is the property if India and its local people. This property should be protected by law.

3. **Hazardous chemicals** The government should ensure that hazardous substances which are banned internationally do not reach Indian farmers. Such chemicals are dangerous to people and the environment. Laws already regulate them, but they are not properly enforced.

4. **Certification of organic farming** Policy support for organic agriculture is arriving, but it caters to big organic enterprises. The procedures and requirements are not suited to small-scale farmers.

5. **Bias in incentives** The government provides many different incentives for high input agriculture. Equal attention should be given to sustainable agricultural practices.

6. **Lack of research and extension support** to organic farming and on various aspects like traditional varieties.

7. **Poor marketing** There is a lack of organized, appropriate marketing structures for small-scale organic farming.

8. **Misinformation and market power** The pesticide industry provides misleading or false information to farmers. Its well-established marketing structures feed India's farmers with persuasive messages promoting high-input farming.

9. **Lack of awareness** Farmers and consumers are still not awakened to the dangers of chemical farming and the continuing depletion of natural resources.

Many areas in India are farmed in a traditional way, untouched by chemical farming, so are organic by default. Most are subsistence farms in remote and marginal areas.

Changes needed to achieve the potentials of organic agriculture

Many changes are needed if India is to overcome these constraints and achieve its rich potential in organic agriculture.

1. **Research and extension:** Research is needed to improve the yield of local crop varieties. Research and extension systems should place more emphasis on developing indigenous crops and livestock.

2. **Supporting small-scale organic farming:** Specific attention should be given to improving local agricultural production by marginal farmers and smallholders who are still "organic by default" and frequently depend on public welfare programmes.

3. **Protect livelihoods of rural poor:** The deregulation of national food markets has been agreed on an international level. Within this framework, agricultural policy should develop new strategies to prevent small-scale farmers from being pushed out of the market and off their land into poverty.

4. **Local control of land:** Large areas of wasteland and forest land located close to villages should be supervised by village committees. This would increase their ability to rehabilitate and use these lands in a sustainable way.

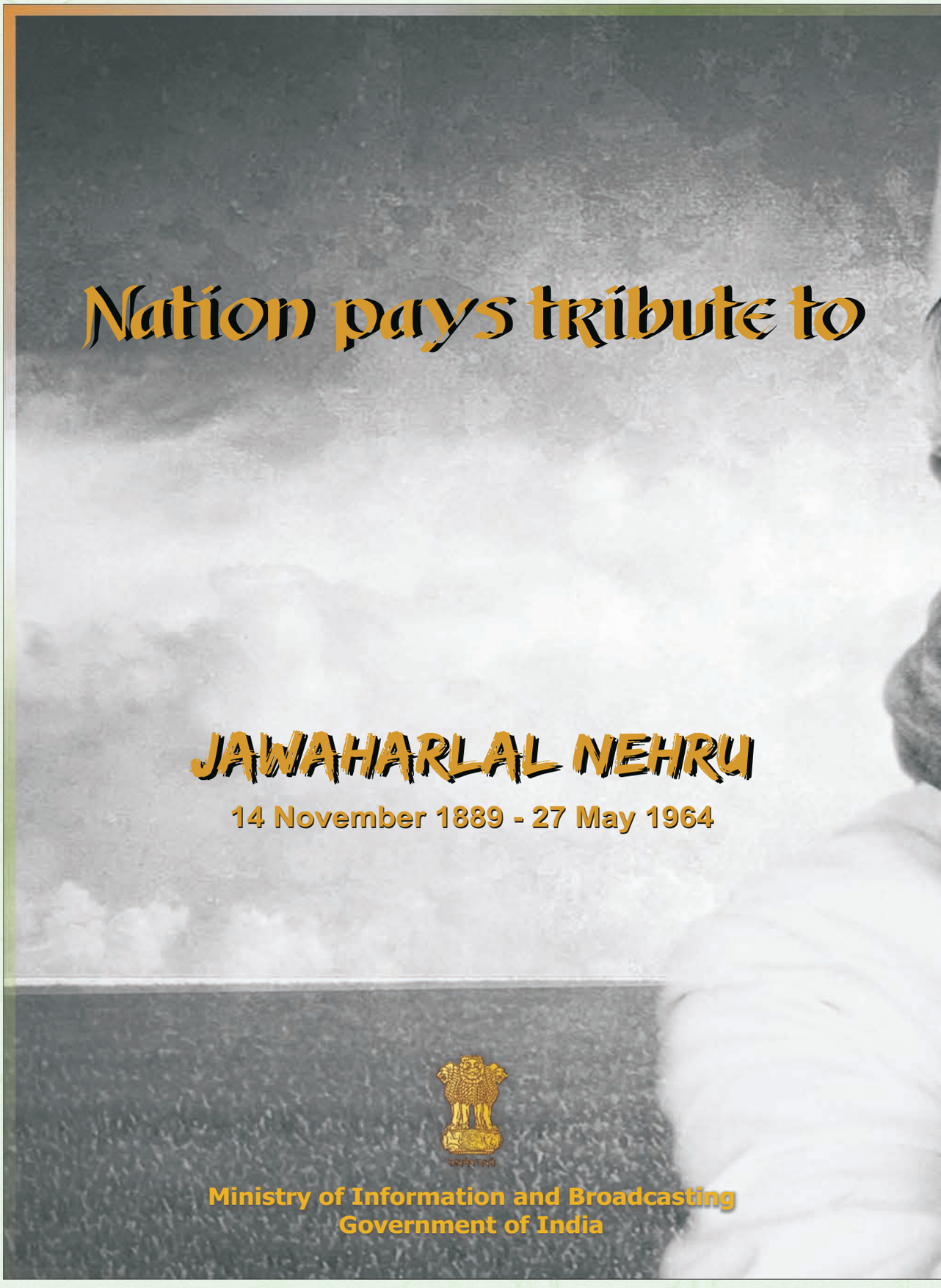
5. **Local enterprises:** Village-level, farm-based enterprises need to be promoted, strengthened and linked to potential markets. This requires support structures that are rarely in place. The government should provide guidelines and support to improve transport facilities, access to information, training, local marketing systems, etc.

6. **Education** Organic agriculture should become part of the agricultural curriculum. Professional degrees in organic agriculture should be offered at universities to meet the demand for qualified specialists.

Conclusion

Possibly, the greatest impact of organic agriculture is on the mindset of people. It uses traditional and indigenous farming knowledge. By adopting organic agriculture, farmers are challenged to take on new knowledge and perspectives, and to innovate. This leads to an increased engagement in farming which can trigger greater opportunities for rural employment and economic upliftment. Thus through greater emphasis on use of local resources and self-reliance, conversion to organic agriculture definitely contributes to the empowerment of farmers and local communities.

[The author is a Ph.D. Scholar, Division of Soil Science and Agricultural Chemistry, Indian Agricultural Research Institute, New Delhi-110012. e-mail: pravashiari@gmail.com]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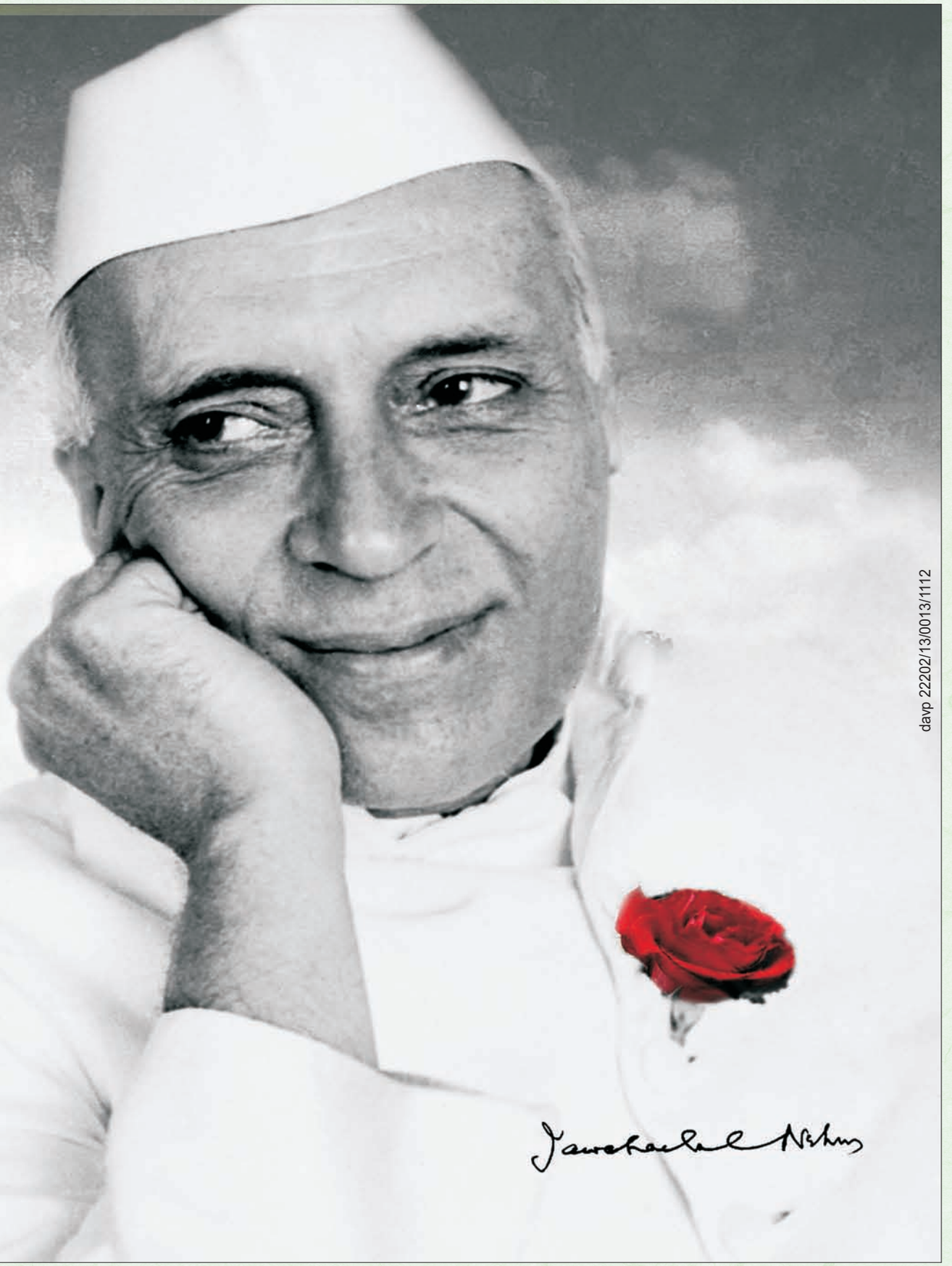
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Sustainable Agriculture in India-An Overview

S.Jeyakumar

Agriculture sector, world over, has experienced a phenomenal growth since the mid-twentieth century. The growth, driven by Green Revolution technology, has made a significant dent on aggregate supply of food grains, ensuring food security to the growing population. The next stage of agricultural growth however, faces a serious challenge in terms of sustainability. Whereas the main problem faced by the developing countries in the south pertains to sustainability of resource use, the main challenge facing the developed economies in the north is overuse of chemical inputs. These problems have led to increasing awareness and a felt need for moving away from the input intensive agriculture perused during the Green revolution phase, to sustainable farming in different parts of the world. While the need for a paradigmatic shift in the growth strategy is well recognized, the transition from input intensive to sustainable farming however, has certain inherent difficulties. Notwithstanding these limitations, policies in both the north as well as the south have led increased emphasis on promoting sustainable agriculture.

Sustainability in agriculture can be achieved broadly through:

- Efficient management of natural resource base
- Integrated approaches to crop management.

Concept of Sustainable Agriculture

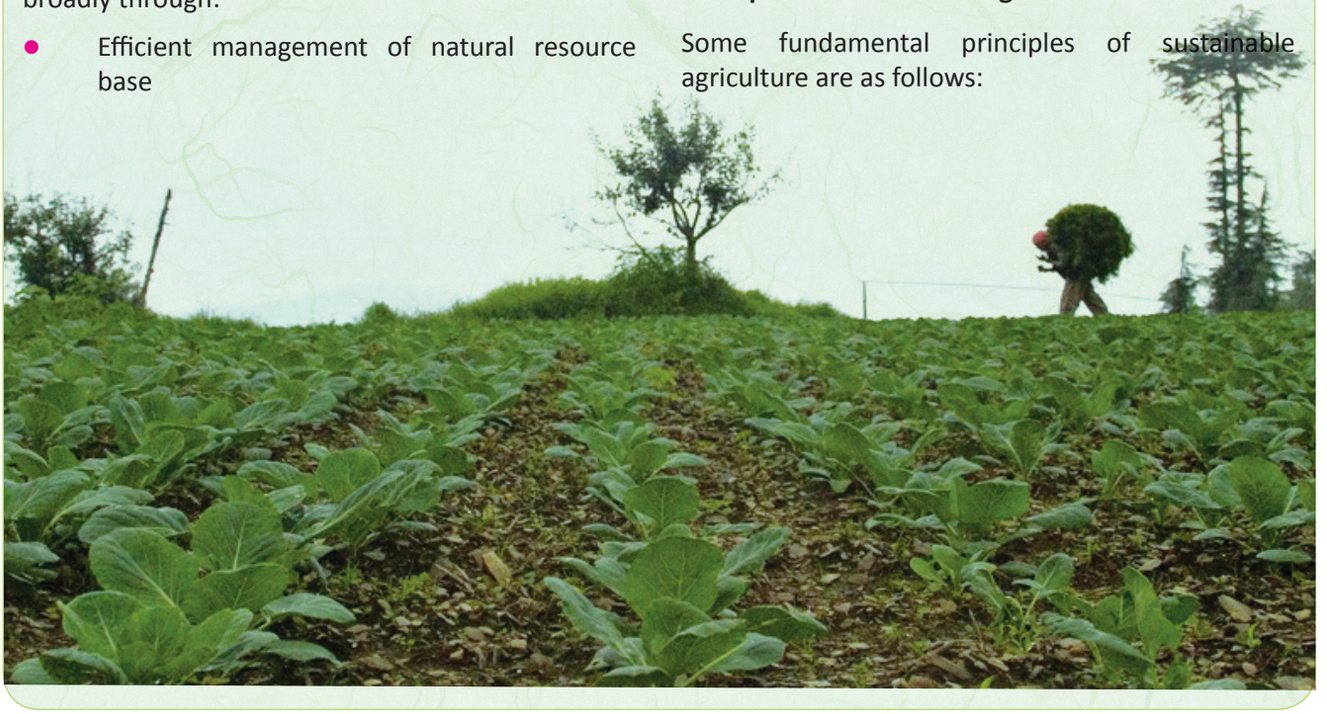
'Sustainability' is one of the buzz-words of our times. It has been attached to any number of social and economic pursuits: we want sustainable economic growth, sustainable development, sustainable forestry, a sustainable population, sustainable cities, and so on. Increasingly, we also talk about the need for "sustainable agriculture." Sustainable agriculture uses ecological principles to farm, hence the prefex agro- to farm and ecology- the science of the relationship between organisms and their environment.

Sustainable agriculture is the use of farming systems and practices, which maintain or enhance:

- The economic viability of agricultural production;
- The natural resource base; and
- Other ecosystems, which are influenced by agricultural activities.

Principles of Sustainable Agriculture

Some fundamental principles of sustainable agriculture are as follows:



- That farm productivity is enhanced over the long term;
- That adverse impacts on the natural resource base and associated ecosystems are ameliorated, minimised or avoided;
- That residues resulting from the use of chemicals in agriculture are minimised;
- That net social benefit (in both monetary and non-monetary terms) from agriculture is maximised; and
- That farming systems are sufficiently flexible to manage risks associated with the vagaries of climate and markets.

Goal of Sustainable Agriculture

The goal of sustainable agriculture is to feed the expanding population while fanning profitably in an ecologically sound, regenerative way. In order to be sustainable, agriculture needs to be

- Technologically feasible
- Economically viable
- Socially acceptable and
- Environmentally sound.

Sustainable Agriculture in India

Sustainable agriculture may be defined as any set of agronomic practices that are economically viable, environmentally safe, and socially acceptable. If a cropping system requires large inputs of fertilizer that leak from the system to pollute ground water, drinking supplies and distant coastal fisheries, the system may be sustainable economically as the long-term supply of fertilizer is stable and the economic cost of fertilizer is easily borne by larger grain production but it is not sustainable environmentally or socially, since it does not cover the cost of environmental damage or social costs. The organic agriculture focuses on "living soil", on optimizing the use of biological processes and on avoiding the use of synthetic chemicals and fertilizers.

Advocates of sustainable agriculture agree with biological focus and hope to reduce but not necessarily eliminate chemical use. In the context of sustainable agriculture another term "alternative agriculture" has been prominently used. Definition of alternative agriculture sheds much light on operational aspects of sustainable agriculture. Any food or fiber production that has.

- a more thorough incorporation of natural processes,
- reduced use of off-farm inputs with less harm to environment and consumers,
- a more productive use of biological and genetic potential of plants and animals,
- a better match between cropping patterns and the physical capacity of lands and,
- An improved emphasis on conservation of soil, water, energy and biological resources, is defined as alternative agriculture.

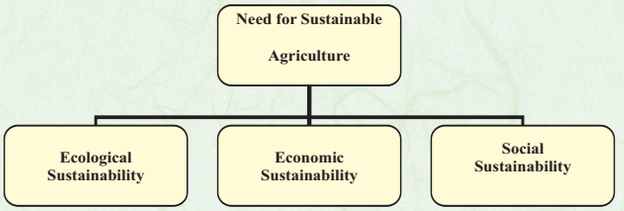
The normal agricultural practices using irrigation, chemical fertilizer, pesticides and high-yielding variety of seeds is called conventional agriculture. With increasing use of chemical fertilizers and pesticides, the conventional agriculture is major source of pollution of inland water bodies and coastal seas. There has been growing criticism of conventional agriculture for its side effects, the "external costs" which impact communities, the environment, and human health.

Naturally much work is needed to lift the agriculture to a level where it is least affected by vagaries of monsoon and needs little from outside the farm, i.e., lesser dependence on chemical fertilizers and water. The limited success of green revolution has been a mixed bag in that it has given rise to new set of problems: overuse of water and fertilizers. Excessive use of water results in water logging and salinization whereas excess of fertilizers and pesticide cause pollution of water bodies contamination of ground water. India has the largest area of irrigated land (55 million hectares) of which about one-third land is already degraded and 7 million hectare have been abandoned. In such a situation a renewable and lasting alternative, sustainable agriculture, has to emerge for successful agricultural revolution.

As for indicators of sustainability, there is no single prescription. Sustainable practices will vary by cropping system, local environment and socio-economic system. Still, experience tells us that locally sustainable systems tend to be more resource conservative than less sustainable system and tend to rely less on external inputs and more on internal ecosystem services.

Need for Sustainable Agriculture

Sustainable agriculture is compare three broad types of farming: traditional production systems, conventional modern agriculture (such as Green Revolution technologies), and sustainable agriculture. It can compare them across three dimensions: ecological, economical and social.



Ecological Sustainability

Many traditional and most conventional farm practices are not ecologically sustainable: they overuse natural resources, reducing soil fertility, causing soil erosion, and contributing to global climatic change. Sustainable agriculture has several major advantages over both traditional and conventional practices:

***Soil fertility*: A** continuous fall in soil fertility is a major problem in many parts of India. Sustainable agriculture improves fertility and soil structure and prevents erosion, so would be an answer to this problem.

Water: Irrigation is the biggest consumer of fresh water, and fertilizer and pesticides contaminate both surface- and groundwater. Sustainable agriculture increases the organic matter content of the topsoil, so raising its ability to retain and store water that falls as rain.

Biodiversity: Sustainable agricultural practices frequently involve mixed cropping, so increasing the diversity of crops produced and raising the diversity of insects and other animals and plants in and around fields.

Pollution: Pesticides are hazardous to human health as well as to the local ecology. Incorrect handling, storage and use of pesticides lead to health and pollution problems. Sustainable agriculture reduces or eliminates the use of hazardous chemicals; instead it controls pests with a variety of biological and agronomic measures and the use of natural substances.

***Landscape*:** Agriculture and forestry clothe the rural landscape. Inappropriate use causes erosion, landslides and flooding, clogs irrigation channels, and reduces the ability of the land to support the local population. Impoverished rural people flock into the cities in search of jobs, forming unsightly, insanitary slums that further destroy the landscape. Rehabilitating ecologically damaged areas needs huge investments that few countries can afford. Sustainable agriculture avoids these problems by improving productivity, conserving the soil, avoiding the expansion of farming into unsuitable areas, and preserving rural jobs.

***Climate*:** The way agriculture is practiced contributes significantly to global climatic changes. Conventional agriculture contributes to the production of greenhouse gases in various ways: by reducing the amount of carbon stored in the soil and in vegetation, through the production of methane in irrigated fields, and through energy-intensive activities such as the production of artificial fertilizers. Adopting sustainable agriculture would reduce these impacts significantly.

Economic Sustainability

Agriculture cannot be sustainable unless it is economically viable over the long term. Conventional agriculture poses greater long-term economic risks than "sustainable" alternatives.

Export vs. local orientation: Governments tend to view export-oriented production systems as more important than those that supply domestic demands. This is misguided. Focusing on exports alone involves hidden costs: in transport, in assuring local food security, etc. Policies should treat domestic demand and in particular food security (either by farmers producing food for themselves, or by selling produce for cash they can use to buy food) as equally important to the visible trade balance.

***Debt*:** The Green Revolution raised India's grain output significantly, but a vast number of small-scale farmers ran into a debt trap: they took out loans to raise their production, and then found they could not pay the money back. About 40,000 were so desperate that they committed suicide.

***Risk*:** Concentrating on specific commodities seems to promise high economic returns. But market production implies certain risks: markets change quickly, and international agricultural prices are dropping. Cheap foreign food may sweep into the

national market, leaving Indian farmers without a market. As a World Trade Organization signatory, the Indian government is under pressure to deregulate and open its economy to the world market so cannot protect its farmers behind tariff walls.

***Niche markets*:** Organic agriculture is one of the strongest ways to farm in an environmentally sustainable way. The demand for certified organic products is increasing quickly, opening opportunities to expand sales of such products and to explore niche markets.

***Employment*:** Farming is the main source of employment for rural people. Trends towards specialization and mechanization may increase narrowly measured "efficiency", but they reduce employment on the land. The welfare costs of unemployment must be taken into account when designing national agricultural support programmes. Sustainable agriculture, with its emphasis on small-scale, labour-intensive activities, helps overcome these problems.

Social Sustainability

The social sustainability of farming techniques is related to the ideas of social acceptability and justice.

***Inclusiveness*:** Development cannot be sustainable unless it reduces poverty for the broad masses of people in India. The government must find ways to enable the rural poor to benefit from agricultural development.

Political unrest: Gaps between the "haves" and "have-nots" feed a feeling of social injustice among those who feel neglected and excluded from development opportunities, as well as from better-off sympathizers. The result is a climate favorable to political opposition and even violence.

***Local acceptance*:** Many new technologies fail because they are based on practices or assumptions from outside. Sustainable agricultural practices usually are based on local social customs, traditions, norms and taboos, so local people are more likely to accept them and adapt them to their own needs.

***Indigenous knowledge*:** Sustainable agricultural practices often rely on traditional knowhow and local innovation. Local people have a wealth of knowledge about their environment, crops and livestock. They keep locally adapted breeds and crop varieties. They have social structures that manage and conserve common resources, help people in need, and maintain the social fabric. Rather than ignoring or replacing this knowledge, sustainable agricultural development seeks to build on it and enrich it with appropriate information from outside.

***Gender*:** In traditional agriculture, women traditionally bear the heaviest burdens in terms of labour. In modern conventional farming, too, men often benefit the most: they control what is grown and how the resulting income is spent. Sustainable agriculture attempts to ensure that the burdens and benefits are shared more equitably between men and women.

***Food security*:** Traditional farming techniques often fail to produce enough food, or enough variety of food for a balanced diet. Conventional modern farming focuses on a few commodities, so people still do not have a balanced diet. Sustainable agriculture improves food security by improving the quality and nutritional value of the food, and by producing a bigger range of produce throughout the year.

Participation: Traditional society in India is raven by wealth and caste distinctions. Introducing conventional farming innovations tends to exacerbate these: the rich and higher-caste tend to benefit, while the poor and lower-caste are left out. Sustainable agricultural interventions consciously target the less well-off, and empower them so they can organize and speak with their own "voice", so promoting dialogue and democracy.

Conclusion

The conditions for development of sustainable agriculture are becoming more and more favorable. New opportunities are opening the eyes of farmers, development workers, researchers and policy makers. Conditions for farming will continue to change, the key to sustainable agriculture is the capacity of farmers and all other actors in agricultural development, as well as the wider society, to learn, experiment, adapt and cooperate in an effective way. To conclude, a small farm management to improve productivity, profitability and sustainability of the farming system will go a long way to ensure the all round sustainability.

(The author is Assistant Professor, Department of Commerce, Sri S.R.N.M. College, Sattur – 626 203, Tamilnadu., e-mail: jeyakumaruma@yahoo.com)

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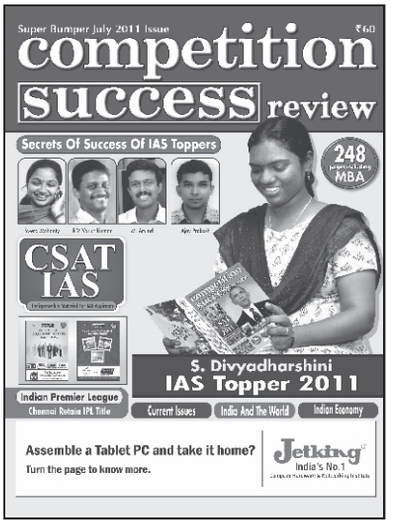

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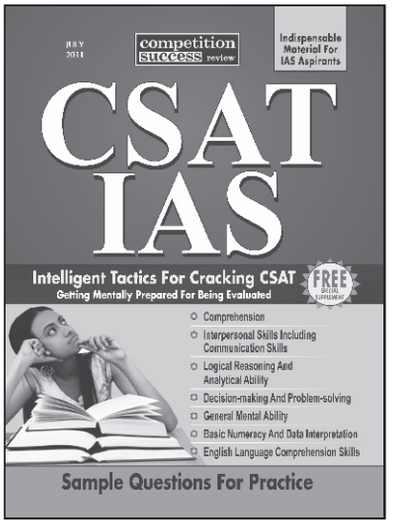

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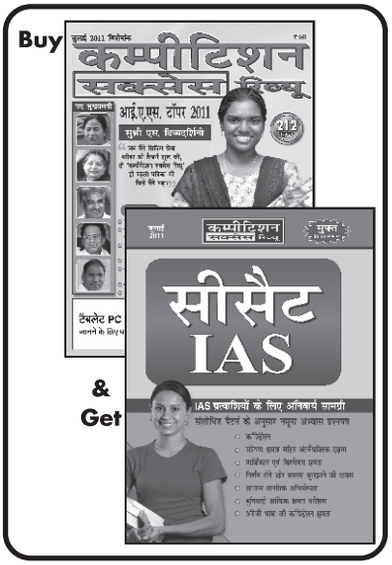

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Lab to Land Initiative – Reaching Out to Rural Populace

Atul K. Tiwary

Programs have a direct bearing on the well being of the rural community. A host of programs sponsored by Central Government and State Governments are being implemented in the field or rural development, agriculture, animal husbandry, fisheries, watershed, forests and environment, health, education, nutrition, public distribution system, industries, development of women, children, ST/ST and physically challenged persons, rural electrification, management of land records and so on. Most of these programs are being implemented under the supervision of District Collector and BDOs. In the implementation of these programs large number of stakeholders comprising Line Departments, NGOs and PRIs are involved. The achievement of the objectives of the program depends on the commitment and cooperation among the stakeholders and proper knowledge and understanding of the programs

There is considerable scope to enhance effectiveness of the program by building leadership, disseminating knowledge and encouraging innovations. Taking a cue the Ministry Of Rural Development has embarked upon an ambitious Lab-to-Land initiative which aims to enhance the

effectiveness of program implementation in rural areas through field level trainings of functionaries in collaboration with stakeholders.

Vision Of Lab to Land Initiative

- To build a knowledge and innovation community of all stakeholders in development including policy makers, implementers, financial institutions, academia, NGOs, experts and international organizations.
- To achieve a complete understanding among stakeholders for full achievement of all program objectives under implementation in rural areas – (employment, income, health, education, women, children, food security, agriculture, watershed, water, forests, electricity, roads, land records, etc.).
- To trigger a development process which ensures broad based improvement in the quality of life of people especially the poor, SCs/STs, OBCs, minorities and women.
- Focus on faster and more inclusive growth.

Thrust areas

- Governance : Transparency & Accountability
- Infrastructure: Power, Roads, Housing, ICT
- People's Institutions: Gram Sabha, NGOs, JMFCs, Youth Clubs, CRPs
- Health : Access to Food, Immunization, Drinking Water ; IMR, MMR
- Education : Literacy & School Enrolment
- Safe Childhood
- Gender Empowerment
- Environment: Forest, Clean Air & Water, Sanitation
- Natural Resources : Land & Water Management
- Skill Development, Employment & Income
- Financial Inclusion & Bank Credit
- Marketing

Ministry Of Rural Development has embarked upon an ambitious Lab-to-Land initiative which aims to enhance the effectiveness of program implementation in rural areas through field level trainings of functionaries in collaboration with stakeholders.

Objective : Enhancing the effectiveness of Government Programmes

The Lab-to-Land initiative aims at organization of the stakeholders into a Knowledge and Innovation Community (KIC) that will work together for full achievement of the objectives of various Government programs being implemented in rural areas for sustainable and inclusive development. For this purpose in the initial phase of this initiative, one Block has been identified in each State. Stakeholders involved in the implementation of the programs in the Block will be identified and their interests and abilities will be mapped. A program will be drawn up to engage and involve all the stakeholders under the leadership of the District Collector at the district level and the BDO at the execution of the initiative will be constituted at State, District, Block levels including areas/objectives under various programs, actions required to achieve the desired results and indicators to measure performance. This will constitute the action plan under the initiative which will be taken up for implementation. The action plan will ultimately lead to building people's institutions, improved management of natural resources, development of infrastructure and better marketing of rural products to ensure steady flow of rural income.

Pilot Project

Under the initiative, 43 districts have been identified

List districts/blocks identified for the pilot project is as follows:

S.No.	State	District	Block
1.	Andhra Pradesh	Rangareddy	Manchal
		Warangal	Parvathagiri
2.	Arunachal Pradesh	Papumpare	Doimukh
3.	Assam	Kamrup	Dimuria
		Marigaon	Marigaon
4.	Bihar	Patna	Maner
		Vaishali	Hajipur
		Nalanda	Biharsharief
		Bhojpur	Koilwar
		Begusarai	Barauni
		Jehanabad	Jehanabad Sadr
5.	Chattisgarh	Dhamtari	Dhamtari
6.	Goa	North Goa	Pernam
7.	Gujarat	Sabarkantha	Prantij
		Banaskantha	
8.	Haryana	Karnal	Karnal
		Mahendergarh	Mahendergarh
9.	Himachal Pradesh	Solan	Kandaghat
10.	Jammu & Kashmir	Jammu	Akhnoor
		Laddakh	
11.	Jharkhand	Dhanbad	BaliapurW
12.	Karnataka	Davangere	Harihar
13.	Kerala	Kollam	Sasthamcotta
14.	Madhya Pradesh	Jabalpur	Patan
		Satna	Majhgavan
15.	Maharashtra	Wardha&Sangli	Deoli
16.	Manipur	Thoubal	Kakachin
17.	Meghalaya	Ribhoi	Umsning
18.	Mizoram	Kolasib	Thingdawl
19.	Nagaland	Kohima	JakhamaRD Block
20.	Orissa	Cuttack	Kantapada
		Kandhmal	
		Keonjhar	
		Mayurbhanj	
		Gajapati	
21.	Punjab	Fathehgarh Sahib	Kheri
22.	Rajasthan	Bhilwara	Sawana
23.	Sikkim	South District	Jorethang
24.	Tamil Nadu	Villupuram	Olakkur
25.	Tripura	West Tripura	Kathalia
26.	Uttar Pradesh	Chitrakoot	Mau
27.	Uttarakhand	Udhamsingh Nagar	Rudrapur
28.	West Bengal	Nadia	Shantipur

from 28 states across the country wherein on a pilot basis the effectiveness of program implementation would be enhanced through field level training. The initiative aims to build a collaborative knowledge and innovation community and demonstrate full achievement of the objective of all schemes of the rural sector (Rural Development, Agriculture, Watershed, Environment, Income generation, Employment, Roads, Health, Education, Sanitation, Drinking water, Electrification, Food Security, Land records, Industries, Irrigation, Citizen's charter, Grievance redressal mechanism etc.)

Training

In order to bring together different stakeholders to a common understanding and constitute the Knowledge and Innovation Community (KIC), training programs will be conducted in the Block and the District by SIRDs. Stakeholders will be made aware of the availability of resources under various programs and the manner in which the resources can be optimally utilized in a collaborative fashion. Stress will be laid on enhancing the knowledge and program management skills of the elected Panchayati Raj representatives, Community Resource Persons, Self Help Groups and other peoples' institutions like youth clubs, mahila mandals, user groups, watershed committees, JFMC, youth volunteers, etc., knowledge of latest innovations and best practices in program management will be shared with all the stakeholders. In particular, use of community radio will be promoted along with other media of communication such as wall newspapers, leaflets, pamphlets, magazines, radio, TV, folk songs, dance, drama, puppet, shows etc. to enhance program literacy among the people. Quizzes may be organized to enhance the knowledge and understanding of the community of the programs of the Government. Support from the various Media Units of the Ministry Of Information & Broadcasting including Regional Kendras of Doordarshan and AIR, Directorate of Field Publicity and Song and Drama Division would be solicited to extend the outreach

Under the initiative, 43 districts have been identified from 28 states across the country wherein on a pilot basis the effectiveness of program implementation would be enhanced through field level training.

Implementation

The action plan prepared under the Initiative will be implemented with available resources under various programs. Training programs will be completed in one block within a period of three to four months. On successful completion of the training program in three to four months, similar activities will be taken up in other blocks of the district by the District Administration. State may take another block in another district for undertaking this initiative. The achievements in the block may be showcased at different venues and it can be used as best practice model which can be customized in local context to take up Initiative in other blocks. In this manner, coverage of the implementation of the Initiative will progressively expand. It is expected that the outcome of the initiative will go a long way towards fulfilling the dreams of Gram Swaraj, as envisioned by the Father of the Nation, Mahatma Gandhi. (PIB Features)

(The author is **Director (M & C), Press Information Bureau, New Delhi)**

BALANCED FERTILIZATION
- REAL BENEFITS FOR AGRICULTURE SUSTAINABILITY

K.N.Tiwari and Rakesh Tiwari

Fertilizers feed the world by feeding the soils and in turn plants, and, if the world is not to go hungry, fertilizers will continue to play the key role in food production. No country in the world has been able to increase agricultural productivity without expanding the use of mineral fertilizers. In India, contribution of fertilizers towards increase in food grain production is estimated to be 50%. Farmers, their agricultural advisors, economists and policy makers all know this very well. What many seem less clear about is that simply adding some nutrients in excessive amount and ignoring the others altogether continuously is not only constraining crop production but the excessive use of any nutrient what the crop has already absorbed to capacity, is proving to be unproductive, expensive, wasteful and damaging to the environment. Simultaneously, utilization of those nutrients which were not replenished through external sources, in particular fertilizers, was mined causing severe nutrient deficiencies and thus constraining the crop productivity. So it is not so much "fertilizer" that feeds people but the "balanced use of plant nutrients through external sources mainly fertilizers" that will raise agricultural production and make more food available to a hungry world.

It has been estimated that fertilization accounts for nearly 50 per cent of all crop yield in India. In other parts of the world, where farm land has been abused for centuries or where new land is brought into production and quickly mined of its nutrients, fertilization might contribute as much as 75 per cent of total food production. Proper crop fertilization is essential to prevent massive global starvation. Herein, we should consider all the roles that soil plays in the production of food and fiber for the world's people. It is the medium in which plants grow and the source of most plant nutrients. Soil, water and air bathe plant roots and help keep them and above-ground plant parts healthy and

growing. The quality of soil in which plants grow is extremely important in determining yield as well as the sustainability of crop production. The key role of balanced use of fertilizers in maintaining soil fertility is well established. The present article deals with the real benefits of balanced fertilization for agriculture sustainability in India.

Balanced Fertilization Improves Soil Health: As science progressed, it was discovered that long-term sustainability of crop production was dependent on building and maintaining soil fertility, an important soil quality measurement. Later, it was demonstrated that organic matter levels could be maintained and even increased through balanced fertilization. One of the greatest benefits of crop fertilization, aside from increasing crop yields and improving farmer profit, is its effect on soil organic matter. Harvested crop yields increase as a result of crop fertilization, as does unharvested plant biomass left on the soil surface and crop residues (roots) remaining in the soil. Most of the unharvested surface biomass and underground residues become soil organic matter. It has long been known that organic matter positively influences structure, tilth, bulk density, water infiltration rates, water holding capacity, and water and air movement within the soil, thus improving soil quality. Organic matter helps to bind soil particles together, reduces soil crusting, increases the stability of soil aggregates, acts as a reservoir for plant nutrients, and reduces soil runoff and erosion losses.

Data from 12 long-term experiments (LTE) conducted in India under the Indian Council of Agricultural Research (ICAR) Coordinated Project on Cropping Systems were analyzed to evaluate the effect of different sources of organic matter (farmyard manure [FYM] and green manure [GM]) in combination with inorganic fertilizer, on the productivity of rice-wheat systems. The fertiliser treatments showed no significant effect on final yield, although the initial yield was significantly higher with 100% NPK than with FYM. The average rice yield with 100% NPK was still significantly higher than with FYM. In wheat, average yields and yield trends were not significantly different among the fertiliser treatments.

Other long-term rotation studies in India have also demonstrated that moderate amounts of fertilizers increase soil organic matter quantity and quality. The positive benefits of fertilization have been directly attributed to the amount of crop residues returned to the soil. In addition to higher grain yields, fertilizer increased straw and root production, the precursors of soil organic matter. However, the realities surrounding short supplies of FYM because of burning of cow dung for fuel and the high labour and transportation costs continue to restrict its extensive and widespread application in agriculture. It is most likely that the most immediate solution to sustaining crop yields in the absence of adequate FYM supply will come from the regular use of site specific application of inorganic fertilizers.

Balance Beyond NPK

Balanced fertilizer use today implies much more than NPK application. In India, almost 50 percent of over 200,000 soil samples analyzed have tested low (deficient) in zinc. Soil S deficiencies once considered to be confined to coarse-textured soils under oilseeds are now estimated to occur in a wide variety of soils in close to 130 districts and S induced yield increases under field conditions have been recorded in over 40 crops. Likewise, in specific areas, the application of magnesium (Mg) and boron (B) has become necessary for high yields, greater nutrient use efficiency and enhanced profits. These nutrient combinations represent the many facets of balanced fertiliser use **(Table 2)**.

Therefore, feeding crops for high yields in India is no longer a simple NPK story. This in no way minimizes the importance of NPK (fertiliser pillars) but emphasizes that the efficiency of NPK and returns from their application can be maximized only when due attention is also paid to other nutrient deficiencies.

Table 2. Balanced nutrient application for a number of soil/crop combinations in India

No.	Situation	Component of Balance
1.	Alluvial soils, rice-wheat belt	N, P, K, S, Zn and B
2.	Red and lateritic soils	N, P, K, S, B with lime
3.	Areas under oilseeds	N, P, K, S, Zn and B
4.	Malnad area of Karnataka	N, P, K, S and Mg
5.	High yielding tea in South	N, P, K, Mg, S and Zn

Source: Tiwari (2000)

***Balanced Fertilization Improves Nutrient Use Efficiency (NUE)*:** Research has shown that when N is balanced with P, K and other essential plant nutrients, N use efficiency increases. That means more N is used by the crop and less is left in the soil as a potential pollutant. Thus, efficiency of applied N depends not only on the N applied, but also on the availability of other nutrients. When balanced fertilization is practiced, one nutrient often increases the efficiency of the other through synergistic interaction. Data from a large number of multi-location experiments conducted under the ICAR's LTE Project, and on farmer's fields under the AICARP, clearly bring out the importance of balanced fertilization in increasing NUE **(Table 3)**.

Balanced Fertilization Improves Water Quality and Water Use Efficiency: A common perception among non-agriculturists is that fertiliser use damages the environment, specifically water quality. The truth is that balanced fertilization goes hand in hand with high, efficiently produced crop yields, and environmental protection-including soil conservation and water quality.

Proper nutrition helps to produce a healthy, fast growing crop having a vigorous root system and establishes a dense canopy to protect the soil surface, resulting in:

- less runoff and erosion;
- increased water infiltration to supply crop needs while boosting yields and slowing water decent to rivers, thus reducing flooding;
- more biomass left after crop harvest to help keep the soil stable and to contribute to organic matter levels.

Table 3. Effect of balanced (NPK) fertilization on agronomic efficiency of nitrogen (AE_N)

Crop	Control yield (kg ha^{-1})	N applied (kg ha^{-1})	AE_N		Increase in AE_N (%)
			N alone	+ PK	
Rice (wet season)	2,740	40	13.5	27.0	100
Rice (summer)	3,030	40	10.5	81.0	671
Wheat	1,450	40	10.8	20.0	85
Pearl millet	1,050	40	4.7	15.0	219
Maize	1,670	40	19.5	39.0	100
Sorghum	1,270	40	5.3	12.0	126
Sugarcane	47,200	150	78.7	227.7	189

Source: Prasad (1996)

By developing nutrient management plans and fertilizing according to complete soil tests, farmers help to assure that most of the fertiliser nutrients they apply are taken up by the crop being grown, not left in the soil for possible entry into nature's water system. Nitrogen and P are the only nutrients of concern with regards to potential water problems from fertilization. But, when used in balance with other essential nutrients when needed, such as K, secondary and micronutrients, within systems utilizing best management practices, there is little danger to either surface water or groundwater.

In order to protect water quality, care should be taken to avoid over fertilization. However, significant danger to water quality is also associated with too little fertilization. When crops are produced without proper nutrition, their growth is less robust, and they offer little protection from the potential impacts of wind and water erosion. If the crop can't take up the nutrients it needs because of low soil fertility or improper fertilization, erosion - with the potential loss of soil P to surface water - is more common, as is N leaching into groundwater. Needless to say, farmers then produce lower yields per acre, they can feed fewer people, their incomes suffer and their soil resource degrades, slipping them deep into a poverty cycle.

By developing nutrient management plans and fertilizing according to complete soil tests, farmers help to assure that most of the fertiliser nutrients they apply are taken up by the crop being grown, not left in the soil for possible entry into nature's water system.

Water use efficiency can be increased by as much as 200% and more, simply by supplying essential nutrients in the proper balance. There is increasing competition between urban areas and agriculture for limited surface and ground water supplies. Thus, anything agriculture can do to increase water use efficiency is obviously a good thing for both sectors. People must have clean water to drink, but they must also have food to eat.

Balanced Fertilization: Important for Desired Food Quality and Premium Price: Balanced fertilization improve the quality of the produce and attracts a premium price. Balanced fertilization can bring prosperity to farmers and to rural communities. On a national scale, higher agricultural production can reduce the need for imports, may increase export earnings and, by encouraging a thriving rural economy, help to stem the flow of young people seeking their fortune in major towns and cities. When farmers' incomes rise, they spend their extra money on non-agricultural items, bringing, on average, more than double the value to the national economy. So balanced use of fertilizers brings benefits to the nation as a whole.

In India, people often say that the food quality has deteriorated due to increasing use of fertilizers. The old taste of the local varieties is being compared with changed taste of the high yielding/hybrids of cereals, pulses, vegetable and fruits and innocently and ignorantly, fertiliser is being considered as the main culprit for this change, People saying this fail to understand that they can't have the same taste of wheat and rice in high yielding varieties as to local varieties, similarly of local varieties of tomato and other vegetable crops in hybrids of these crops. If one plants *Dashehari* mango, can he get the taste of *Deshi* mango. So where is the fault of fertilizers, is it not the effect of high yielding varieties and hybrids which they are growing in their own interest and also in the interest of the nation to have higher yield and profits and also to meet increasing demand of food and other commodities?. Balanced

fertilization, undoubtedly, makes nutrient use more efficient leading to increased proteins, vitamins and mineral contents and also the taste. But this should always be compared with the produce of the same variety grown under two different nutrient management practices ie. With imbalanced and balanced fertilization.

Balanced Fertilization Reduces the Risks of Bad Weather: Certainly yields are reduced in "Bad Years". That fact has to be recognized. As important as yields are to profitable production, the opportunity for reducing risk in those unpredictable years is even more important to the farm's financial health. Good fertilizer management strategies minimize the drastic consequences of 'bad' year effects. Adequate potassium helps in two ways: it offsets severe yield reduction caused by high stress conditions; and, it minimizes the cash flow and income problems which result with lower than anticipated yields. Better yet, adequate plant nutrients put everything in place for top yields in the years with excellent growing conditions. The important role of potassium in mitigating abiotic and biotic stresses is well established. Unfortunately, in the entire history of Indian agriculture, use of potash never exceeded 10% of the total nutrient supply through fertilizers with the result mining of soils' potassium reserves is continuing at an alarming rate. The estimated share of potassium in total nutrient mining in Indian agriculture is about 55%.

(Dr K.N.Tiwari is Former Director, International Plant Nutrition Institute - India Programme, 5/1074, Viram Khand, Gomti Nagar, Lucknow 226010 and Dr Rakesh Tiwari is Subject Matter Specialist (Soil Science), Sardar Vallabh Bhai Patel University of Agriculture and Technology, Krish Vigyan Kendra, Hastinapur, Meerut. e-mail: tiwarikn@hotmail.com)

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BgM: A Boon to Sustainable Agricultural Production

Dr. Sunil Kumar Khandelwal And Dr. Ganesh Rajamani

Biogas manure or BgM, an effluent of biogas plants has good nutritive value to both plant and soil and should be utilized for increasing crop production as well as soil fertility. Presently, various methods of handling and utilization of BgM are available. It is essential to maximize the use of nutrients available in the BgM for crop production at appropriate time periods as an effective substitute to inorganic fertilizers.

Much In modern agriculture, the requirement of major plant nutrients is primarily met through application of inorganic fertilizers. World agriculture has now reached a stage that chemical fertilizers can not be replaced by achieving higher and continued productivity of the crops to meet the growing food requirement. Average fertilizer consumption in India increased from 0.5 kg/ha during 1951-52 to 117.07 kg/ha during 2007-08 (**Economic Survey, 2008-09**). Intensive agriculture with the use of agrochemicals in large quantities has increased the land productivity of various farm commodities manifold. Nevertheless, adverse effects of these chemicals are clearly visible on soil micro flora, quality of water, food, fodder etc. Pesticides and nitrates from fertilizers have been detected in ground water of many agricultural regions. High concentration of nitrates in drinking water affects human health.

With an exponential increase in population year by year, countries are compelled to increase agricultural food production in a sustainable

manner. Addition of organic manures like farm yard manure, compost, crop residues, biogas plant spent slurry (biogas manure; BgM), vermicompost, etc. help in improving soil fertility. Applications of these soil amendments also change rhizosphere environment by affecting soil porosity, aeration, temperature, water holding capacity and soil micro flora.

What is Biogas Manure (BgM)?

BgM is a natural substance used for enriching the soil. It is a by- product obtained from the biogas plant as a result of fermentation of cattle dung or other biomass yielding generation of methane rich gas. BgM contains a full range of plant nutrients. The use of BgM as organically enriched fertilizer gives the farmers a double advantage of biogas plant installation. The fibrous material, inorganic solids which don't digest or convert into methane either settle down in the plant or come out with slurry liquid through outlet. This contains many rich and nutritive elements including nitrogen, phosphorus, potassium and trace elements i.e. Zn (144 ppm), Mn (188 ppm), Fe (3550 ppm) and Cu (28 ppm). BgM improves physical, chemical and biological properties of the soil that in turn enhances crop yields.

The nitrogen present in cattle dung is conserved totally when processed through a biogas plant whereas in open pit composting most of the nitrogen (over 50%) is lost due to leaching or evaporation. About 20% of the total nitrogen present in the BgM is in ammonical form which is readily available for crops. However, this form of nitrogen is rapidly lost if the digested slurry is sun-dried.

BgM nourishes the soil with supply of essential nutrients to accelerate the growth of plants, especially for root growth due to humus and aeration which enhances crop yield in a sustainable manner. Moreover, during anaerobic digestion weed seeds gets destroyed. As a result, BgM is free from weed seeds and there is no foul smell from the fields. The application of BgM enhances the fertility of the soil to optimize quality production. Due to its dark colour, it absorbs sunlight thereby resulting in warming up of the soil.

Benefits of BgM:

- It has no bad smell.
- Insects do not grow in it.
- Micronutrients in soil increases, thus improving soil structure.
- Water holding capacity of the soil is enhanced that ensures plant growth.
- Retains and enhances nutrient uptake for better nourishment of plants.
- Enhances the aeration of soil for root penetration resulting in better growth.
- The viability of weed seeds is lost.
- Less methane exposure.
- Qualitative improvement in taste, smell, size and colour of the food product etc.
- Readily available, can be used whenever needed.

Comparison of BgM with other organic manures:

Organic manures are valuable by-products of farming and allied industries derived from both plant and animal sources. The organic manures can be broadly grouped into two main categories:

Bulky organic manures: Examples- Farm yard manure, biogas plant spent slurry, vermicompost, night soil, compost, sludge, etc.

Green manure crops: These crops add organic matter and plant nutrients to soil. Examples- Sesbenia, Sunhemp, Dhaincha.

The influence of organic manures on soil quality is as follows-

- Organic manures contain both major and minor nutrients in small quantities. These manures are applied in large quantities per unit area and have a direct effect on plant growth.
- Organic manures increase organic matter content of the soil and therefore, improve its physical properties and water holding capacity.
- Organic manures also stimulate microbial population which in turn helps make nutrients available to the plants.

Farm yard manure: The term farm yard manure (FYM) refers to the decomposed mixture of dung and urine of farm animals along with

litter (bedding material) and left over material from roughage, fodder, etc. fed to the cattle. FYM consists mainly of dung and part of urine soaked in the refuse. The average composition of fresh excreta and urine of various animals is given in Table 1. In general, urine of all animals contains higher nitrogen and potash as compared to dung.

Green Manure: Green manuring can be defined as a practice of ploughing or turning into the soil undecomposed green plants for improving physical structure and fertility of the soil. It is an age-old practice followed by the farmers to improve soil fertility.

The main advantages of the green manuring are-

- It stimulates the activities of beneficial soil microorganisms by addition of organic matter
- It improves the soil structure and reduces runoff and soil erosion.
- Green manuring with leguminous crops (Sunhemp, Dhaiancha and Sesbania etc.) also adds nitrogen to the soil through biological nitrogen fixation.
- They also help in conserving soil nutrients by avoiding leaching loss.

The success of green manuring depends upon proper availability of moisture at decomposition sites. Besides, farmers practising green manuring should be aware of possible pests and diseases of such green manure crops and their impact on successive plantations.

Vermicompost: Earthworms are regarded as farmers' natural friends in the soil. They burrow the soil continuously and turn it alongwith the organic material. They feed on this organic material, degrades it and the excreta are referred to as *vermicompost*. The degradation of organic matter in the body of the earthworm is carried out continuously by the microflora present in their intestine. The microflora contains several bacteria and actinomycetes that produce enzymes required for the said decomposition. They also produce several vitamins and growth promoting substances that accelerate plant growth.

The main advantages of vermicompost are-

- Fresh vermicompost contains major nutrients (nitrogen, phosphorus and potash) and micronutrients (0.16% zinc, 0.03% copper and 1.38% iron). Its pH normally varies between 6.8-7.2. Every quintal of fresh vermicompost can supply approximately 800g, 1100g and 500g of N, P and K besides several trace elements which are easily made available to the plants.
- Vermicompost improves aeration and water holding capacity of the soil. It also reduces soil erosion.

Biogas plant spent slurry (BSS or Biogas manure; BgM): The slurry coming out of biogas plant is referred to as biogas plant spent slurry. The digested slurry discharged from the common biogas plants normally contains 92-94% moisture. It is rich in N, P, K and several micronutrients. BgM improves physical, chemical and biological properties of the soil that in turn enhances crop yields. BgM can be used as a rooting medium for horticultural crops and it also supports the growth of aquatic fern plants (Azolla) and algae.

Table 1: Average nitrogen, phosphorus and potash contents of fresh excreta of common farm animals

Animal (s)	Excreta	Nitrogen (N_2O)	Phosphorus (P_2O_5)	Potassium (K_2O)
Cow and Bullock	Dung	0.40	0.20	0.10
	Urine	0.75	Trace	1.35
Sheep and Goat	Dung	0.75	0.50	0.45
	Urine	1.35	0.05	2.10
Horses	Dung	0.55	0.30	0.40
	Urine	1.35	Trace	1.25
Pigs	Dung	0.55	0.50	0.40
	Urine	0.40	0.10	0.45

Anaerobic fermentation of dung or other biomass in biogas plant reduces the C/N ratio by removing some of the carbon, which has the advantage of increasing the fertilizing effect. Another favorable effect is that nitrogen and other plant nutrients become mineralized and hence are more readily available to plants. More over, well digested slurry is practically odorless, easier to spread and does not attract weeds and insect flies. Table 2 indicates how BgM is more effective than other organic manures in relation to NPK content.

Chemical fertilizer and BgM: The inorganic chemical fertilizers are harmful in the long run as they do not provide balanced diet to plants, severely affecting the physical, chemical and microbial properties of the soil. The extensive use of inorganic fertilizers result in following impacts-

- Destroys soil microflora, especially the nitrogen fixing bacteria.
- Causes pollution of fresh water reserves.
- Reduces soil porosity, aggregation and ultimately to infertility.
- Erodes topsoil due to wind because of missing organic matter in the soil.
- Is not cost effective on long term basis.

Therefore installation of biogas plants to treat animal dung (from any source) for dual advantages, described above.

Utility of BgM: BgM has wide applications besides enriching the soil as crop manure. It can be used for fish culture as well as mushroom cultivation to increase production of fish and mushrooms. BgM can also be used to enrich inorganic fertilizers, vermicompost, NADEP compost, farmyard manure etc. Cattle urine can also be used with BgM as a diluent.

Manuring crops: BgM can be used effectively in any type of soil and for any crop. The recommended application of manure is 10 tonnes per hectare in irrigated areas and 5 tonnes per hectare in dry land areas. However, the response of crops would vary. The increase in crop yield is about 10 to 40 %. Most responsive amongst crops are vegetables and fruit trees, particularly root crops such as carrot, radish, sweet potato, tea, coffee, sugarcane, rice and jute. BgM can be used as fertilizer for crops in any one of the following forms:

1. **Liquid BgM:** Maximum benefit is obtained when the slurry is used in liquid form as it comes out of the biogas plant. It can be easily distributed in the fields if the slurry outlet of the plant is linked with the main irrigation channel. This would be possible only if the biogas plant is installed on the farm. Otherwise, BgM can be transported in discarded oil drums or buckets, by wheel barrow or bullock cart, which is more cumbersome. BgM has a solid content of about 6 per cent, a pH value of about 8 to 9 and nitrogen 1.8 % along with other nutrients. This is the best form of BgM for application because-
   - Better nitrogen component compared to dry and semi-dried slurry.
   - As a soil conditioner. Aggregated soil communicates absorption of the slurry. Moreover, the bacterial and fungi growth is enhanced on application of BgM, which is crucial for plant and crop yield.

Table 2: Comparison of BgM with other organic manures (Average Percentage)

Manure	Nitrogen (N_2O)	Phosphorus (P_2O_5)	Potassium (K_2O)
Fresh cattle dung	0.3-0.4	0.1-0.2	0.1-0.3
Farmyard manure	0.4-1.5	0.3-0.9	0.3-0.9
Compost	0.5-1.5	0.3-0.9	0.8-1.2
BgM	1.5-2.5	1.0-1.5	0.8-1.2
Poultry manure	1.0-1.8	1.4-1.8	0.8-0.9
Cattle urine	0.9-1.2	Trace	0.5-1.0
Paddy straw	0.3-0.4	0.8-1.0	0.7-0.9
Wheat straw	0.5-0.6	0.1-0.2	1.1-1.3

- Good for acidic soils.
- Reduces harmful elements like aluminium thereby minimizing toxicity.
- Supplies nutrients to beneficial soil microbes.
- Changes membrane permeability of root hairs and enhances nutrient uptake.
- The water holding capacity of the soil increases.

2. **Semi-dried BgM:** This is the next best form for use. The BgM may be spread in shallow pits and allowed to dry partially. It is then scraped and stored in piles which should be covered with plastic sheets or mats until applied to the fields. It has a solid content varying from 15 to 20% and pH 7 to 9.

3. **Dry BgM:** It is the slurry coming out of the plant and stored in open for some time period before application. The content of solids varies from 20 to 30 per cent and the pH value from 7 to 8. Dry slurry has micronutrients but almost 20% less nitrogen as it gets lost due to sun drying. Complete drying under the sun should be avoided.

Other uses of BgM:

Pisciculture: BgM has been used in fish ponds resulting in healthy growth of fish, control of common diseases and improved fish quality. It is concluded that addition of BgM increases the level of dissolved oxygen in pond water thus helping in more activities and increase in weight of the fishes. Morever, BgM does not contain harmful bacteria, pathogens and media for growth of disease causing bacteria and thus the incidence of diseases in fishes reduced from 60-70 % to 5 %. Also, BgM helps in quick growth of algae, a food of liking of fishes that makes available additional nitrogen. This enhances free amino acids content of proteins, particularly lysine. In experiments conducted in India and China, it has been reported that the use of BgM increased the quantity of produce and reduced the harvest period. Application of BgM in a 0.1 ha of pond area resulted in 762 kg of fish production in a time period of 11 months. This is a commendable performance without making use of artificial feed. Similarly, two types of fish (Catla and Silver) were raised in six months showing record weights of 530g and 900g, respectively. The quantity of application of slurry depends on the oxygen budget of ponds, fish density and the population of aquatic plants. Utilization of digested slurry in pisciculture helps in the reduction of cost that would otherwise be invested in supplementary fish feed. This practice has been adopted by some farmers in West Bengal.

Mushroom production: Use of BgM has been found profitable in development of excellent media for the culture of edible fungi. This improves the quality and yield of mushrooms. The growth time was 3-4 days faster and pick up time reduced by 3-7 days with increase in yields from 19-26 %. On an average, 100 kg rice stalk can harvest 50-100 kg mushroom. The residues of mushroom and stalk can be used as feed for pig, cattle and other animals as it contains more protein.

Mode of application of BgM: BgM can be applied as needed depending on the species grown/ compost preparation and its availability.

Daily: BgM can be applied daily in kitchen gardens, for vegetable and horticultural plants. This functions as a soil conditioner. The BgM can be directly applied into an irrigational channel or applied while watering the plants. However, an exhaustive study to evolve a proper system to meet the requirement of different crops based on the output and fertility of soil is necessary.

Fortnightly/Weekly: Storage capacity, availability of biomass for compost making and alternative methods for use of BgM through pelletization are to be considered for fortnightly/ weekly applications. For dry land and cash crops, the slurry can be applied weekly/fortnightly.

Monthly: For paddy and horticultural plants BgM can be used periodically where the application of inorganic fertilizer is less as it works as a better substitute without any detrimental effect on the crop yield.

(The authors are Senior Technical Assistants (Biochemistry), Department of Molecular Biology and Biotechnology, Rajasthan College of Agriculture, Udaipur (Rajasthan) 313 001, e-mail: khandelwalsk19@yahoo.com)

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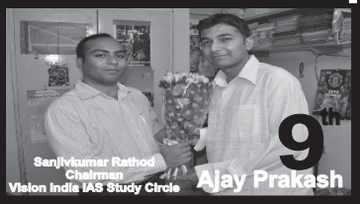

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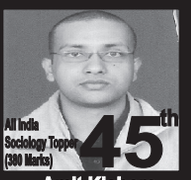

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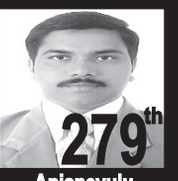
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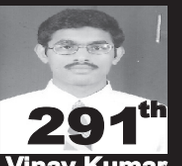
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Conflict of Interests in Agriculture

Yogesh Dewan, Bhopal

There seems to be a battle of wits and a battle of nerves between the lobbies pitching for organic agriculture and those who stick to the current formulae of chemical fertilizerpesticides usage. On the face of it, this conflict seems to reflect two diametrically opposing approaches to getting the maximum out of agriculture, no doubt an overriding concern for the country, still very much an agrarian economy.

But we need to delve a little deeper to find out just what the dynamics are in this face-off.

We could focus on one of our larger states where this has been played out in the public domain, Madhya Pradesh . Interestingly, this is the state which was declared and organic state' by the Chief Minister. As if to demonstrate his comittment, a slew of Agro Business Meets were organised which drew in the 'biggies' in agricultural sector or rather corporates and houses, which saw the potential of agriculture in a purely commercial way. These Meets under the aegis of the government were opportunities for these interests to get a preview of their market and strike deals or MoU's with the government. Over the past few months, these 'Business Bazaars' held at Bhopal, Indore, Jabalpur and Khajuraho have converged on the coveted document,MoU, which would open up the fields literally and figuratively speaking to their business plans. The latest meet was organized in Khajuraho in October 2010 where MoUs worth Rs. 2000 crores were signed. No surprises then that the CM has turned into a blue eyed boy of the corporate houses.

What one needs to understand at the outset clearly that the corporates have a game plan that it is predicated on, clearly the profit motive. It would thus produce flow-charts of inputs into agriculture leading to growth of the sector. But we would be living in a fool's paradise if we mistake this growth for social commitment or the responsibility for ensuring

that this will secure the lives of the thousands of farmers and agricultural labourers. What is crucial is to view the outcome of these 'Business Meets' from the prism of social justice and equity.

So now let us see. What has been decided at these Meets is to open new factories in power sector, fertilizer chemicals and cements sector. Again, this looks exciting, a sure way forward for progress to set in. But this entire edifice is being erected on the bulk sale of agricultural lands, which as experiences with Singur and more recently with the agitation around POSCO have shown needs extreme caution and sagacity. What is interesting is that as a pre-cursor to the Meet, a special session in the MP Assembly was called to discuss the ''development model of agriculture'. The emerging statements indicated a tendency to merely skim the surface than go to the root of the problem, which the agriculture sector is facing. For example the move to recognise the 13 climatic zones in the state as distinct needing differentiated approach to boost production.

A statement by the Agricultural Minister showed the government's intent to provide subsidies to farmers who were not getting a good price for their produce. In a sense, these sops were to get the farmers on their side, which was to pitch for corporatisation of agriculture. The government had thrown the dice in favour of widespread development of AEZ (Agriculture Economic Zone and the SEZ (Special Economic Zone). For this an unbridled use of agricultural lands for industry, which in turn needed, the farmers acquiescence. This is already afoot with more than 18,000 hectare of fertile land having already exchanged hands. The era of contractual farming has arrived in Madhya Pradesh with over 10 lakh hectare in the state being ploughed not by farmers but by companies.

What is of critical importance is to know how many ceiling rules and regulations were violated and lands of small and marginalized farmers taken over?

Over the years there has been a systematic decimation of the systems of agriculture and sale of produce, in the way the farmer engages with the process of cultivation and with the markets that provide the remuneration for his labour. What is sad is that the new systems being put in place, with the corporate sector being given the priority at the policy level, the interests of these farmers is being compromised. If we look at the beginning of this process with the BJP government in 2003-04, there has been a barrage of such moves. Change in Mandi laws, encouragement to contractual farming, beginning Bt cotton cultivation in western MP, all indicate the trend. What has been particularly disturbing is the move to reserve food grain for purchase by big companies like Indian Tobacco Company (ITC), Australian Wheat Board (AWB), Reliance, Kargil, Unilever, Mahindra, Dhanuka, Mahika and Monsento. This is the new 'retail market' opening up in the state and indeed in the country but the question is at what and whose cost? The dazzling outlets of Reliance Fresh, Mahindra Shubh Labh, Harit Bazaar are all coming up on the collapsed systems of the farmers engagement with the market. This leads to the moot question, the only one worth being asked today—on whose side is the government on, its people or the corporates?

Can we change the rules of the game, the terms of reference between those who produce and those who sell? Perhaps it is indeed time for a maverick to come up with a creative, out-of-the-box model, which would make the cultivators equal partners in rewards being reaped in markets based on their produce. Perhaps if this utopian theory gradually takes root and replaces the present one, so obviously loaded against the cultivators, fewer children would die of malnutrition (MP is on top of the chart) and fewer farmers will commit suicide (MP ranked third amongst other states).

Sacrificing the interests of the cultivators for a misplaced idea of growth does not behoove an elected government meant to look after the interests of all sections. It needs to stop singing the tune of those who have no other interests except to make profit. They need to uphold the interests of those who have elected them and ensure that their policies mitigate the suffering of those at the bottom end of the ladder.

(Courtesy Charkha)

Orange Rejuvenation Under Horticulture Mission

Khagendramani Pradhan

Mandarin orange has been one of the important commercial fruit of Sikkim being cultivated since time immemorial. According to a rough estimate

Nearly sixty lakh pieces of hill mandarin/ oranges were procured and exported from Sikkim this season to different parts of the country with Kolkata, Bihar and Bangladeshproviding a greater share of market. This was apart from the local consumption and those procured by the Government Fruit Preservative Factory and other small scale industry engaged in processing of oranges for different bye-products. Attempts were also made to reach the mandarin orange from Sikkim to global markets through its outlet established in the national capital region of New Delhi.

With SIMFED (Sikkim State Cooperative and Marketing Federation), a State Government subsidiary and NERAMAC (North Eastern Regional Agricultural Marketing Corporation Limited), a Government of India enterprise partnering in procuring and marketing of oranges from Sikkim, the value return that the producers could get has been very much encouraging.

Mandarin orange has been one of the important commercial fruit of Sikkim being cultivated since time immemorial. According to a rough estimate, Sikkim has nearly 6 thousand hectares of area under orange plantation which produces on an average of 1667 kg/hectare.The advent of Horticulture Mission for North East and Himalayan State, a centrally sponsored scheme, rapid area expansion has been initiated with a set target to double the area under orange cultivation. Orange farmers/producers are being provided with financial assistance for maintenance and area expansion of orange orchards.

Apart from the financial assistance, the Department of Horticulture and cash crop, Government of Sikkim, has also been providing the enterprising farmers and producers with planting materials, bio-pesticides and fungicides, tools and equipment, intensive training and exposure visit to National Research Centre for citrus at Nagpur and other progressive farmers' field. With a remarkable progress made in terms of area expansion and ray of hope coming in the direction of high returns, a number of nurseries have been established for producing healthy and quality planting materials, while tissue culture laboratories in the private sectors has also been supplementing the requirement of quality planting materials.

The Department of Horticulture and cash crops has also identified areas best suited for area expansion under the mission for rejuvenation of orange cultivation and production. Concentrated focus to provide missing link taking into account the entire gamut for its enhancement has been put to practice. And with the Government declaration of making Sikkim a fully organic state by the year 2015, emphasis is being laid on providing bio-organic input for cultivation and production of this fruit.

[Courtesy PIB]