New Strategies for Sustainable Agriculture Development

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ABSTRACT
The value-driven pillars of an economy are the tri-sectors viz.: the primary (agriculture), the secondary (industry), and the tertiary (service). Of these, the agricultural sector has been overlooked due to the charisma of the industrial sector in the eighteenth and nineteenth centuries, while it was once again ignored owing to the intellectual chutzpah of the service sector. All the same, the power of the agriculture sector could not be overlooked for long, as it is the sector which feeds all the other sectors. This paper studies the existing problems of agriculture in the Indian context and comes out with ideas to overcome the same in terms of not just for the present, but also to carry forward the ideas progressively in a sustainable fashion.

Keywords--- Agriculture, Sustainability/Sustainable Development, Technology, Biodiversity, Government Policies, Conservation

I. INTRODUCTION
For decades, global agriculture was characterised by policy-induced production surpluses in industrialised countries and stagnating growth in developing countries. Policy reforms and economic growth across the globe have been changing demand and supply fundamentals sufficiently to turn agriculture into a more market-driven sector which provides investment opportunities, particularly in developing countries. Agricultural trade is projected to increase with developing countries capturing most of the export growth. Expansion of agricultural production is likely to slow at least in the medium-term with slower area and productivity growth. Supply should keep pace with demand at prices that are expected to remain relatively high. In this context, measures to reduce food loss and waste will be important in meeting rising demand and for increasing productivity. Developments in global agriculture may have a major influence on world markets. With increasing production constraints and strong demand growth, additional agricultural imports may be anticipated.

At the very outset, several sustainable agricultural issues were identified. The issues included the measurement of sustainability, land use, degradation of resources, preservation of biodiversity, water use and quality, use of common property, the economic situation, social problems, trade, federal and provincial policies, and global change. Discussion of these issues provided a background for developing a conceptual framework for analysing the impact of government policies upon sustainable agriculture.

Vasavada (1991) adopted the definition of sustainable agriculture as “one that, over the long term, enhances environmental quality and the resource base on which agriculture depends, provides for basic human food and fibre needs, is economically viable and enhances the quality of life for farmers and society as a whole.” Though both parties are interested in achieving sustainability, measurement of sustainability is rendered complex by the differences between the views of economists and ecologists.

II. REVIEW OF LITERATURE
Rao (2002), in his paper, proposes a framework based on an identification of agricultural production systems at different levels and their linkages, assessments of production requirements and supplies over time, tradeoffs between production increases and the quality of the natural resource base, and the capabilities of knowledge and technologies to alter the balance of tradeoffs. The paper also identifies the challenges posed to the existing agricultural research and education systems in India in the transition towards sustainable agriculture.

Kushwaha (2008) reviews land use pattern and observes that large forest areas have been converted to cropland creating unprecedented ecological imbalance with no scope of expansion of agricultural land without further damage to natural environment. In the face of increasing demand for food grains intensive agriculture based on irrigation-fertilizer-high-yielding seed technology is the common practice. However, the
Intensive agriculture gives rise to serious environmental problems like pollution of water bodies with fertilizer and pesticides, contamination of ground water, and land degradation apart from the loss of indigenous crop species and genetic diversity. Sustainable agriculture with its emphasis on preservation of ecology, optimisation of economic and social benefits and conservation of energy is seen to provide stable and lasting solution. Ways and means have been discussed to operationalise the sustainable agriculture. Some of the aspects of sustainable agriculture have been illustrated through an example comparing farming practices of two farmers in two different regions of Bareilly district of the state of Uttar Pradesh in Northern India.

Green technology is used for conserving natural environment and resources and to reduce human involvement. It is an alternative to improve the national economy without harming the environment. Ghadiyali and Kayasth (2012) explain the contribution of green technology in the sustainable development of agriculture sector by trying to elaborate green technology and related terms along with how it would be helpful in the sustainable development in terms of contribution and impact of green technologies under various parameters such as poverty reduction through ecological agriculture and rural renewable energy by considering the regional eco-socio aspect including various practical and technical aspects of green technologies such as organic farming, integrated pest management, biomass, biogas, biofuel, wind energy, and use of ICT for facilitating green technology.

Bargout (2014) advises using a precautionary principle to identify sustainable adaptation solutions, ecological farming offers the most practical and holistic traits of resilience, particularly in the areas of soil, water, and biodiversity. When acknowledging ecological agriculture as an empowering adaptation strategy for smallholders, the evident sustainability of this approach is also apparent alongside key structural dynamics limiting its adoption.

Sengupta and Sonwani (2012) attempt to tackle and explore the issue of sustainable development of agriculture in India. Further, they aim to compare the sustainable agriculture system with the traditional system and the current system in practice, across the dimensions of ecological, economic, and social sustainability. It also tries to give long-term solutions to solve the problems plaguing the system so that sustainable practices could be promoted and practiced.

Nerker et al. (2013) study the growth and sustainability in agriculture sector which entails attaining equilibrium between the demand and supply of agriculture produce. The green revolution may bring the efficiency in agriculture produce and thus, the productivity increases. The ultimate performance of agriculture depends on the performance of various resources, the strategies and methods adopted. To face dryness due to the decrease in the rainfall, the agriculturist has to use the innovative strategies. The findings of the study reveal the innovative strategies and achieving the growth.

III. STATEMENT OF THE PROBLEM

India started her quest for industrial development after independence in 1947. The Industrial Policy Resolution of 1948 marked the beginning of evolution of the Indian Industrial Policy. The Resolution not only defined the broad contours of the policy, it delineated the role of the State in industrial development both as an entrepreneur and as an authority. Successive policy resolutions also reiterated this basic tilt in favour of the public sector. The Industrial Policy Resolution of 1956 gave the public sector strategic role in the economy. It categorised industries which would be the exclusive responsibility of the State or would progressively come under State control and others. Earmarking the pre- eminent position of the public sector, it envisaged private sector co-existing with the State and thus attempted to give the policy framework flexibility.

The Industrial Policy initiatives undertaken by the Government of India since July 1991 have been designed to build on the past industrial achievements and to accelerate the process of making Indian industry internationally competitive. It recognises the strength and maturity of the industry and attempts to provide the competitive stimulus for higher growth. The thrust of these initiatives has been to increase the domestic and external competition through extensive application of market mechanisms and facilitating forging of dynamic relationships with foreign investors and suppliers of technology. The process of reform has been continuous.

IV. DEGRADATION OF AGRICULTURAL SOIL RESOURCES

“Despite its widespread severity and global impact, soil degradation remains an emotional rhetoric rather than a precise and quantifiable scientific entity,” (Lal and Stewart, 1990). Soil is degraded as a result of processes that reduce its productivity (Campbell et al., 1986). Such processes usually arise from poor management of the resource. Soils are degraded primarily by the following reasons:

1. Soil Erosion: It reduces soil productivity through losses of nutrients, water storage capacity, and organic matter. The losses in terms of productive capacity are significant though presently obscured by the application of fertilizer.

2. Decline in Organic Matter: The main chemical constituents of soil organic matter are carbon and nitrogen. The former is the energy source for most soil microbes while the latter is one of the most important nutrients for plants. Other necessary components of organic matter are phosphorous and sulphur. Under the ecosystem prevailing previous to cultivation, mineralisation and immobilisation processes were
closely integrated. Plant growth (immobilisation) and mineralisation of soil organic matter occurred simultaneously. Therefore, losses of nutrients were minimised allowing for the accretion of organic matter over time, but the same has not been over the decades that rolled by.

3. Soil Salinity: Even before cultivation, large areas of the prairies contained saline soils. However, an expansion of these areas has occurred under cultivation. The rate of increase in the salinised area is related in part to the increase in ground water over time. Salinisation occurs as water containing soluble salts moves upward through the soil horizon. Evapotranspiration concentrates the salts in the soil solution to reach levels in the root zone that are detrimental to crop growth.

4. Soil Acidification: Though not a major problem in other than a limited part of the prairies. Acidification can be overcome by application of lime. However, heavy applications of nitrogen fertilizers over time have been found to result in soil acidification. Consequently, acidification may become a significant problem in parts of the prairie region under intensive cropping practices which require major inputs of nitrogen fertilizer.

While degradation of the soil resource can be reduced or halted by changes in cultural practices, unless these are demonstrated to be economic they are unlikely to be adopted even though desirable from the standpoint of society. Producers are more likely to be interested in maximising profits in the short-run rather than be concerned with conservation of natural resources and protection of the environment. Any sizeable shift in cropping practices by producers will depend on their ability to survive difficult economic times.

V. PRINCIPLES FOR SUSTAINABLE AGRICULTURE

Biodiversity is defined as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic systems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems.” (Sopuck, 1993). Biodiversity is considered essential for the resilience of ecosystems. Many ecosystem processes regulate conditions for life.

The following set of principles is put forward as including those which are essential to the sustainability of agriculture. They have been classified into categories of stewardship, economic viability, and social concerns.

5.1 STewardship:

1. Management:

Our sojourn here is limited. During this period, there exists both an individual and a collective responsibility to sustain the environment for both our own and future generations. Economic and social activities should be undertaken in such a fashion as to maintain and preferably enhance the capacity of the resources used for the benefit of future generations as well as our own.

2. Conservation:

The need to maintain biological diversity should be further explored while strengthening essential ecological processes. Non-renewable resources must be used wisely. A balance must be maintained between the use of resources and the economic and social effects on society. The major renewable resource in agriculture, the soil, must be protected so that its inherent productivity is maintained.

3. Rehabilitation:

Where renewable resources such as the soil have been damaged, a feasible effort must be expended for their rehabilitation. The original productivity is thereby restored or preferably increased, noting that improvement may be possible only over a long term. It is recognised that the lack of adequate care has contributed to soil degradation on the globe. The destruction of habitat which has occurred must be mitigated. Where the quality of water has been impaired by inappropriate practices, the causes should be removed so that the original quality may be restored.

5.2 Economic Viability:

Market Viability Production cannot be sustained unless it is economically viable. Such viability requires that the net returns from marketing are positive. Unless such returns are adequate within a region, the prairies for example, producers cannot be expected to continue to utilise their available resources for this purpose. The net returns from production should enable an adequate standard of living to be maintained, while at the same time being sufficient to continue to attract replacement operators.

1. Internalisation of Costs:

In our society, certain production inputs and outputs are not priced in terms of their real value. Examples include the air we breathe and the carbon dioxide absorbed by plants. Furthermore, the by-products of production in terms of their environmental damage or enhancement are not necessarily subject to a monetary penalty or premium. What is required is that the real costs of both, presently considered, free goods or undervalued goods be incorporated into the total costs when determining the net returns of production. Such costing, for example, will include the value of any net loss or gain in soil nutrients as a result of crop production.

2. Scientific and Technological Innovation:

Research to enhance the development of technologies which contribute to the maintenance of environmental quality and economic growth must be supported. Such support should extend to provision of educational services which will further the research programme while at the same time maintains social and cultural values. Maintenance of human health should coincide with this provision. Improving the efficiency of production is now an objective of research, but the development of research institutions and markets in order to capture the externalities associated with production is required. Means to ensure that the results of the research are effectively communicated to farmers are necessary.
3. **Trade Policy:**

Barriers to trade can create impediments to the achievement of sustainability. Consequently, trade liberalisation is an important component of progress towards sustainable development. In addition, such liberalisation leads to greater international efficiency in production. As a result, true comparative advantage should be an objective of trade policy. This objective implies recognising the real costs of production and, therefore, the maintenance of environmental integrity. E.g., exports of wheat should be made only where the real costs of production are less than the prices available in the world market. On the other hand, unsubsidised imports of sugar from developing countries should not be reduced as a result of internal price support schemes. An open approach to trade is necessary. Such a stance requires a degree of international cooperation not yet experienced. Nonetheless, trade policy should support and augment the degree of cooperation achievable through international trade agreements.

5.2 **Social Concerns:**

1. **Societal Consideration:**

Economic activity should minimise social costs while maximising social benefits. At the same time, it should not detract from human health and cultural resources or the quality of land and water. Cultural and social diversity should be respected. In agriculture, a balance must be struck between the size of production units consistent with technology and a social structure acceptable to all stakeholders, including those providing the infrastructure.

2. **Global Responsibility:**

Ecological interdependence exists among nations as there is no boundary to our environment. Stakeholders in the maintenance of the environment are, therefore, not necessarily local. How the local environment is treated ultimately impacts on other parts of the world and could be expected to haunt those guilty of its mistreatment. For example, excess use of fossil fuels with the attendant production of carbon dioxide and other contaminants, unless accompanied by appropriate means for their absorption, will impact unfavourably on the environments of other nations. There is a responsibility on the part of all nations to “think globally while acting locally.” In agriculture, for example, cropping practices should be adopted which minimise the contaminants produced while providing sinks for those which are produced. There is a continuing need to merge environmental considerations with those of economics in decision-making at the local and international levels in order to provide equitable solutions to problems. For agriculture, this need implies provision of technology, where appropriate, to assist other nations in overcoming their problems. At the same time, social and cultural differences must be respected while attempting to improve the human condition. There remains a moral responsibility to ensure that developing nations have an adequate supply of food. That doesn’t necessarily mean they should be given food, but rather that, if possible, they be enabled to produce their own supply.

3. **Food and Nutritional Security:**

Special efforts should be made to raise the productivity and production of crops to meet the increasing demand for food generated by unabated demographic pressures and raw materials for expanding agro-based industries. A regionally differentiated strategy should be pursued, taking into account the agronomic, climatic, and environmental conditions to realise the full growth potential of every region. Special attention would be given to development of new crop varieties, particularly of food crops, with higher nutritional value through adoption of biotechnology particularly, *genetic modification*, while addressing bio-safety concerns.

A major thrust should be given to the development of irrigated and irrigated horticulture, floriculture, roots and tubers, plantation crops, aromatic and medicinal plants, bee-keeping and sericulture, for augmenting food supply, exports and generating employment in rural areas. Availability of hybrid seeds and disease-free planting materials of improved varieties, supported by a network of regional nurseries, tissue culture laboratories, seed farms should be promoted to support systematic development of horticulture having emphasis on increased production, postharvest management, precision farming, bio-control of pests and quality regulation mechanism and markets.

Animal husbandry and fisheries also generate wealth and employment in agriculture sector. Development of animal husbandry, poultry, dairying, and aquaculture would receive a high priority in the efforts for diversifying agriculture, increasing animal protein availability in the food basket and for generating exportable surpluses. A national livestock breeding strategy should be evolved to meet the requirements of milk, meat, egg, and livestock products, and to enhance the role of draught animals as a source of energy for farming operations and transport. Major thrust should be on genetic upgradation of indigenous/native cattle and buffaloes using proven semen and high quality pedigreed bulls and by expanding artificial insemination network to provide services at the farmer’s doorstep.

Generation and dissemination of appropriate technologies in the field of animal production as also healthcare to enhance production and productivity levels should be given greater attention. Cultivation of fodder crops and fodder trees should be encouraged to meet the feed and fodder requirements and to improve animal nutrition and welfare. Priority should also be given to improve the processing, marketing and transport facilities, with emphasis on modernisation of abattoirs, carcass utilisation, and value addition thereon. Since animal disease eradication and quarantine is critical to exports, animal health system will be strengthened and disease-free zones created. The involvement of cooperatives and private sector should be encouraged for development of animal husbandry, poultry, and dairy. Incentives for livestock and fisheries production...
activities should be brought at par with incentives for crop production. An integrated approach to marine and inland fisheries, designed to promote sustainable aquaculture practices, should be adopted. Biotechnological application in the field of genetics and breeding, harmonal applications, immunology and disease control should receive particular attention for increased aquaculture production. Development of sustainable technologies for fin and shell fish culture as also pearl culture, their yield optimisation, harvest and postharvest operations, mechanisation of fishing boats, strengthening of infrastructure for production of fish seed, berthing, and landing facilities for fishing vessels and development of marketing infrastructure should be accorded high priority. Deep sea fishing industry should be developed to take advantage of the vast potential of country’s exclusive economic zone.

4. Generation and Transfer of Technology:
A very high priority should be accorded to evolving new location-specific and economically viable improved varieties of agricultural and horticultural crops, livestock species and aquaculture as also conservation and judicious use of germplasm and other biodiversity resources. The regionalisation of agricultural research, based on identified agro-climatic zones, should be accorded high priority. Application of frontier sciences like biotechnology, remote sensing technologies, pre- and postharvest technologies, energy-saving technologies, technology for environmental protection through national research system as well as proprietary research should be encouraged. The endeavour would be to build a well-organised, efficient, and result-oriented agriculture research and education system to introduce technological change in Indian agriculture. Upgradation of agricultural education and its orientation towards uniformity in education standards, women empowerment, user-orientation, vocationalisation and promotion of excellence would be the hallmark of the new policy.

The research and extension linkages should be strengthened to improve quality and effectiveness of research and extension system. The extension system should be broad-based and revitalised. Innovative and decentralised institutional changes should be introduced to make the extension system farmer-responsible and farmer-accountable. The role of krishi vigyan kendras (KVKs), non-governmental organisations (NGOs), farmers organisations, cooperatives, corporate sector and para-technicians in agricultural extension should be encouraged for organising demand-driven production systems. Development of human resource (HR) through capacity building and skill upgradation of public extension functionaries and other extension functionaries should be accorded a high priority. The Government should endeavour to move towards a regime of financial sustainability of extension services through effecting in a phased manner, a more realistic cost recovery of extension services and inputs, while simultaneously safeguarding the interests of the poor and the vulnerable groups.

Mainstreaming gender concerns in agriculture should receive particular attention. Appropriate structural, functional, and institutional measures should be initiated to empower women and build their capabilities and improve their access to inputs, technology, and other farming resources.

5. Investments in Agriculture:
The agriculture sector has been starved of capital. There has been a decline in the public sector investment in the agriculture sector. Public investment for narrowing regional imbalances, accelerating development of supportive infrastructure for agriculture and rural development particularly rural connectivity should be stepped up. A time-bound strategy for rationalisation and transparent pricing of inputs should be formulated to encourage judicious input use and to generate resources for agriculture. Input subsidy reforms should be pursued as a combination of price and institutional reforms to cut down costs of these inputs for agriculture. Resource allocation regime should be reviewed with a view to rechannelising the available resources from support measures towards assets formation in rural sector.

A conducive climate should be created through a favourable price and trade regime to promote farmers’ own investments as also investments by industries producing inputs for agriculture and agro-based industries. Private sector investments in agriculture should also be encouraged more particularly in areas like agricultural research, human resource development, postharvest management and marketing.

Rural electrification should be given a high priority as the prime mover for agricultural development. The quality and availability of electricity supply should be improved and the demand of the agriculture sector should be met adequately in a reliable and cost effective manner. The use of new and renewable sources of energy for irrigation and other agricultural purposes should also be encouraged.

Bridging the gap between irrigation potential created and utilised, completion of all ongoing projects, restoration and modernisation of irrigation infrastructure including drainage, evolving and implementing an integrated plan of augmentation and management of national water resources should receive special attention for augmenting the availability and use of irrigation water.

Emphasis should be laid on development of marketing infrastructure and techniques of preservation, storage and transportation with a view to reducing postharvest losses and ensuring a better return to the grower. The weekly periodic markets under the direct control of Panchayat Raj institutions should be upgraded and strengthened. Direct marketing and pledge financing should be promoted. Producers’ markets on the lines of Ryatu Bazars should be encouraged throughout the width and breadth of the country. Storage facilities for different kinds of agricultural products should be created
in the production areas or nearby places particularly in the rural areas so that the farmers can transport their produce to these places immediately after harvest in the shortest possible time. The establishment of cold chains, provision of pre-cooling facilities to farmers as a service and cold storage in the terminal markets and improving the retail marketing arrangements in urban areas, should be given priority. Upgradation and dissemination of market intelligence should receive particular attention.

Setting up of agro-processing units in the producing areas to reduce wastage, especially of horticultural produce, increased value addition, and creation of off-farm employment in rural areas should be encouraged. Collaboration between the producer cooperatives and the corporate sector should be encouraged to promote agro-processing industry. An interactive coupling between technology, economy, environment, and society should be promoted for speedy development of food and agro-processing industries and building up a substantial base for production of value added agro-products for domestic and export markets with a strong emphasis on food safety and quality. The Small Farmers Agro-Business Consortium (SFAC) should be energised to cater to the needs of farmer entrepreneurs and promote public and private investments in agri-business.

VI. CONCLUSION

The present pattern of agriculture has been moulded by the government policies adopted over time. These were designed to further national objectives. The course of development was also influenced by the environment, the effects of which required major initiatives to overcome, and by the distance to the export markets within which much of the agriculture product of the region found an outlet. The region is well-acquainted with adversity, due to both the natural environment and world economic conditions.

Agriculture has progressed through a series of stages, beginning with the initial breaking of the land and followed by a conservation stage made necessary by the type of cultivation being practiced and existing climatic conditions. During the 1940s, industrial development largely outside the region and the armed forces drained the surplus labour from the farms necessitating replacement by mechanisation. Following this stage of development, there was a period during which information on the products of research was obtained and mixed commodities desired.

Community development programmes must, therefore, address both rural and urban concerns if they are to be successful. These concern the quality of education, health services, housing, and other social services. A major challenge arising for rural communities becomes how to meet the opportunities and challenges for growth without losing the attractions which have led farm people and other local residents to prefer rural life.

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