

Sustainable Agriculture and Rural Livelihoods: A Synthesis

Praduman Kumar, N.P. Singh and V.C. Mathur

In developing countries, where a majority of families derive their livelihoods from agriculture, sustainable agriculture cannot be discussed in isolation of sustainable rural livelihoods. Sustainable rural livelihood is a multi-faceted concept and refers to maintenance or enhancement of access of rural families to food and income-generating activities on a long-term basis. It encompasses secured ownership of, or access to, resources, assets and income-earning activities to offset risks, ease shocks and meet contingencies. In the Indian context, where average farm-size is very small, and poverty and food-security continue to be preponderant among small landholders, the notion of sustainable agriculture ought to be viewed in the context of need for enhancement of productivity, production and profitability of agriculture and above all, for improvement in the economic conditions of farmers. All these need a careful and in-depth analysis.

In this regard, the Situation Analysis Study of Indian farmers conducted by NSSO as a part of Millennium Study of Union Ministry of Agriculture, has brought out some highly relevant and interesting results, some of which are: (i) An estimated 27 per cent of the farmers do not like farming because it is not considered profitable, (ii) Nearly 40 per cent of the farmers, if given a choice, would prefer to take up some other career, (iii) There is very low level of awareness among farmers about the modern eco-friendly technologies like use of bio-fertilizers, IPM and IPNM as well as of government programmes like MSP, crop insurance and agri-export promotion, (iv) Many farmers have reported non-availability of modern inputs within the villages, (v) Smallholders' dependence for livelihoods on dairying and other animal husbandry activities is higher than that of not-so-small farmers, (vi) Nearly 50 per cent of farm households are indebted and the ratio as well as average of outstanding loan per farm household are higher in relatively more developed states like Punjab, Tamil Nadu and Andhra Pradesh,

Division of Agricultural Economics, IARI, New Delhi 110012

The help from Dr. Mruthyunjaya, National Director, NAIP, Indian Council of Agricultural Research, New Delhi 110 012 is gratefully acknowledged.

(vii) There is a considerable variation in per capita expenditure of farm households across the states, (viii) The MPCE of farm households was high in Kerala (Rs 901), Nagaland (Rs 883) and Punjab (828); and low in Orissa (Rs 342), Jharkhand (Rs 353), Chattisgarh (Rs 379) and Bihar (Rs 404). The situation is being ascribed to economic growth without appreciable distributional benefits. In this context, it is being argued by some that though India has eradicated famines and reduced starvation after Independence, it has not provided the minimum level of food security to the poorest of the population, which is quite large in terms of its size. The recent phenomenon of increasing suicides by farmers in some states of the country reflects institutional and policy failures. It appears that human and material resources, and technology are not the main constraints in establishing agriculture on the path of sustainable development. However, these do become constraints when the policy regimes are inappropriate and ineffective. Perhaps, appropriate policy regime, farmer-friendly governance and institutional framework are equally, if not more, important.

Thus, there are several questions and issues that need to be discussed and analyzed carefully and answers sought appropriately. Some of them include: What are the major initiatives in the realm of sustainable agriculture, and what is the experience so far in different parts of the country? What potential do the frontier sciences, particularly biotechnologies, nanotechnologies, processing technologies and ICT provide in this area and what has been the experience so far in different parts of the country? There is also a need to look at the recent trends in profitability of farm enterprises (crops, horticulture, livestock, agro-forestry, etc.), particularly after the opening up of trade in farm products since the early-1990s. Analysis of trends in profitability of agriculture *inter alia* requires looking at the trends in yields, prices and costs of different farm enterprises at regional levels to assess the competitiveness of Indian agriculture. Another related development is that the consumers are becoming more quality conscious and as a result the demand for organic foods is increasing at a fast rate, both in the domestic and overseas markets. Some areas in the country do have definitive comparative advantage in organic farming. Further, it is also known that organic farming helps in reducing the dependence of farmers on purchased inputs. However, there are several preconditions for organic farming to succeed on a large scale.

Keeping these issues and questions in view, the AERA chose the theme “Sustainable Agriculture and Rural Livelihoods” for its XIV Annual Conference, for which 88 papers were received for discussion in the suggested sub-themes (i) Diversification of Rural Economy and Livelihoods, (ii) Trends in Profitability of Indian Agriculture, and (iii) Organic Farming

for deliberations during the Conference. A summary of the articles and the issues identified for discussion have been presented sub-theme-wise in the following sections.

I. Diversification of Rural Economy and Livelihoods

The strategy of agricultural development launched during mid-1960s helped the country in increasing the production of foodgrains and thereby achieved self-sufficiency in most of the food commodities. Since then, the production of cereals, oilseeds, sugarcane, cotton, fruits, vegetables, spices and livestock products has increased considerably which has helped in improving livelihoods, food and nutritional security. Growth of agriculture and its diversification are crucial for the growth of non-agricultural sector as well as overall economy and also for reducing inter-regional economic disparities. A large number of papers have been received where the authors have measured the diversification of rural economy and its implication on rural livelihoods based on time series published data and interestingly, a number of researchers have undertaken studies based on micro-data considering agriculture as the largest sector. Promotion of the livestock-based integrated farming system and the efficient and effective self-help groups are the key initiatives to make farming a profitable and less risky venture, thus sustaining rural livelihoods and reducing regional inequalities. Under this sub-theme, 35 papers were received for discussion which are summarized and issues listed for discussion.

Stressing on agricultural diversification in favour of livestock economy, L.D. Hatai, C. Sen and H.P. Singh have evaluated the sustainable agricultural development for rural livelihood perspective in different districts of Orissa. Sustainable Agricultural Development Index (SADI) was constructed to establish inter-district priority for the allocation of resources and upliftment of the rural poor.

Scarcity of water and declining groundwater level are the causes of diversification, whereas harvesting and conservation of rainfall are the major facilitators of diversification. A. Suresh, D.C. Gupta, J.S. Mann and V.K. Singh have reported diversification of crop and livestock sector for rural livelihood in the drought-prone areas of Rajasthan. The diversification in the state could not reduce the dependence on agriculture. R.P. Singh has studied sustainable livestock-crop production system for livelihood in different agro-climatic sub-zones of Bihar and Jharkhand states. Livestock-crop production system (buffalo + crop production system) is most sustainable production system in Bihar. In the Jharkhand state, livestock (more than one) + crop production system has the potential of generating income and employment.

Goat + Crop Production System (GCPS) has been found popular, adopted by 48-52 per cent farm households and has high potential for raising income and employment on landless, marginal and small farm households. B. Ganesh Kumar, S. Jeyakumar, R.B. Rai and Raj Vir Singh have analyzed the economics of buffalo farming in the Andaman and Nicobar islands by farm-size groups. Buffalo farming in these islands is a highly profitable enterprise under the prevailing conditions. The major constraints identified by the authors include non-availability of fodder.

M.N. Waghmare, D.B. Yadav and S.N. Tilekar have examined the mixed farming (crops and livestock) in the irrigated and rainfed regions using the survey data pertaining to the year 1999-00. Livestock has been found as an important activity in influencing the family's income of small and medium farms in the rainfed region of Western Maharashtra. The study by Shalander Kumar, A.D. Upadhyay and Surendra Singh has examined the goat-based farming systems for the livelihood security of farmers in arid-Rajasthan, based on survey data of a sample of 45 goat-keeping households from Kachaulia and Devari villages of Safer block of Nagaur district of Rajasthan. The crop-livestock production system evolved by the goat farmers is not only economically viable but also sustainable and may be a useful model for the development of goat enterprise in water and feed scarce rural areas. The production system evolved by the farmers was sustainable, where the goats played a major role in livelihood security of the family, contributing about 42 per cent to the farm family's total income and 142 to 168 days of employment.

P. Indira Devi has examined the performance of nine enterprises, viz. fruit and vegetable cultivation, vegetable seed production, commercial floriculture, mushroom production, vermicomposting, commercial nursery, commercial poultry farming, ornamental fisheries, and agro-processing in Kerala. Agricultural production activities with forward and backward linkages will provide an array of possible agribusiness activities for sustainable livelihood and rural prosperity. Management tools for these enterprises need to be developed and standardized to suit the requirement of the small size rural units. R.D. Khodaskar has examined the role of agro-processing co-operative societies in the rural economy in the Konkan region of Maharashtra from where mangoes are marketed to not only Indian market but in European countries also. More than half of the product is sold through co-operative societies in this area.

N.P. Singh, Ranjit Kumar and R.P. Singh have measured the agricultural diversification across states of India and have identified the factors influencing the diversification. Road and electrification have the negative correlation with the level of diversification. The successes of diversification

has been reported to depend on crop- or enterprise-specific technologies, creation or identification of markets, and provision of economic incentives. D. P. Malik and K.K. Kundu have constructed Simpson Index to measure the extent of diversification in crops by using time series data for three decades. Divergent trend in diversification indices has been observed in Haryana state and attributed to unbalanced development of agricultural production technologies over the years. The cropping pattern has shifted towards rice and wheat because of less risk involved and remunerative prices. Another study undertaken by Puran Chand, Shiv Kumar, Amit Kar and Geeta Bisaria for Haryana state has revealed that the economy has diversified from agricultural-dominated economy to non-agricultural economy.

Storage infrastructure is crucial for diversification of agriculture. M.S. Jairath has reported that more than 22 per cent of total investment has been made on storage in Andhra Pradesh, followed by Punjab (20%). Net-work of rural godowns is poor in many states of India. The share of investment by states in total investments for creating storage structure varied between 2.1 per cent and 9.9 per cent for West Bengal, Orissa, Gujarat, Chhatisgarh, Karnataka, Uttar Pradesh, Maharashtra and Madhya Pradesh.

Sanjay Kumar and G.S. Gill have examined the economic viability of agriculture-based enterprises for women in the state of Punjab. The study is based on a survey data of 100 women entrepreneurs, engaged in dairy, bee-keeping, *papar*, *badi* and pickles making in the year 2004-05. Marketing, lack of capital, problems of being women and technical deficiency have been reported as the major problems for women entrepreneurs.

The issue of agriculture and rural diversification has been probed by Brajesh Jha based on the NSS data of selected states of India for the years 1983, 1993-94 and 1999-00. The results suggest that effect of agricultural income on rural non-farm employment has decreased during the reference period. Infrastructure and land-labour ratio have been found as the important determinants of rural diversification. Archana Sinha has studied the employment on farm and non-farm sectors. Rural livelihood condition and low income are the pull factors responsible for the shift of the households from farm to non-farm sector. The agriculture-led growth is necessary towards sustained rise in farm output and incomes and acts as the prime mover in initiating the development of non-farm activities in the rural areas.

S.K. Chauhan has carried out a comparative study of exotic and indigenous honeybees based on data of 200 beekeepers, both stationary (69) and migratory (131), rearing exotic honeybees (*Apis mellifera*) and located in six districts of Himachal Pradesh. Honeybees enterprise has

increased income of the households by 120-132 per cent and employment from 70 per cent to 118 per cent. The increasing competition from migratory bees (*Apis mellifera*) has posed an imminent threat to the survivability and sustainability of indigenous honeybees (*Apis cerana*) in the higher hills of Kullu district that are more suited to local conditions, particularly to women beekeepers, since they do not require constant migration and can survive under harsh climate.

Sustainability of farming in the long-run depends upon soil care and reducing the levels of land degradation. S.C. Ramesh Kumar and M.P. Padmavati have characterized sustainable land management indicators and have mapped them at farm level. Ecological safety, economic security and social stability explained 68 per cent contribution in the sustainability of farm. Marginal and small farmers are adopting sustainable land management practices more than the large farmers.

Joginder Singh and R.S. Sidhu have examined the impact of environmental degradation in Punjab agriculture, which has reached a plateau. To sustain even the existing level of productivity, the costs are increasing and natural resources are being depleted due to overuse. The cost on account of these factors together went up by Rs 63/t in case of wheat and Rs189 /t in the case of rice. The policy measures to minimize excess use of natural resources require suitable input pricing, particularly for water resource, improving input-use efficiency and revamping market forces to encourage diversification of state agriculture from rice to alternative crops.

M. Thilagavathi and M. Chandrasekaran have assessed the value loss in agriculture due to sodicity in soils and its influence on rural migration. The analysis on value loss from agriculture due to land degradation (sodicity impact) has been found very high in paddy and millet crops, followed by pulse crops. But the value difference due to yield damage has been comparatively low in chillies and cotton. The average number of migrants per farm family ranged between 1.3 and 1.5 in the affected category and between 1.1 and 1.4 in the non-affected category. Another study has pointed out that the labour migration from rural areas of Tamil Nadu is accelerating on account of falling productivity and profitability of agriculture (P. Sivakumar and K.R. Sundaravardarajan). Family-size has positively influenced the migration, whereas dependency ratio and asset position have negatively influenced migration. The migrants earned more than non-migrants but socially they feel isolated and suffer from tension of parting. However, their livelihoods, communication skills and response to problem situation have improved. Livelihood of migrant vegetable sellers in Ludhiana city of Punjab has improved (Vipal Bhagat and M.S. Sidhu). Their average monthly earning was better than that of their fellow unskilled industrial workers, shop attendants, etc.

The dependence on the natural resources-based economic activity has been reduced. It has resulted in lower employment and reduction of jobs the people had, inducing forced migration. Most of the migrations are seasonal in nature. Degradation of natural resources, food insecurity, unemployment and starvation have induced distress migration in the Kalahandi district of Orissa, as reported by K. N. S. Banafar, A. K. Gauraha and D.K. Sahu. Another study by Kumar Anish Singh, R.K.P. Singh and D.K. Sinha has examined the role of migration in improving the sustainability of livelihood of migrant households of Bihar. Non-farm income has emerged as an important source of livelihood and contributes 49 per cent to the income generated by the migrant households. Livestock enterprise is the second important activity, where women empowerment has been pronounced, because livestock are cared by women, particularly on poor/socially-backward households.

K. Kareemulla, R.H. Rizvi, R.P. Dwivedi, Ramesh Singh and Kuldeep Kumar have studied commercial and traditional agro-forestry in western U.P. The benefit cost ratio of agro-forestry ranged between 2.8 and 3.0. Commercial agro-forestry is more profitable than the traditional agro-forestry. B.B. Beohar has examined the role of minor forest products on the livelihood of tribals in Madhya Pradesh. These products contribute about 46 per cent of the total income of tribals in Dhar district. Khem Chand, B. L. Jangid, S. S. Rao and Y.V. Singh have examined the strengths, weaknesses, opportunities and threats (SWOT) of henna production in arid fringes of Rajasthan. Henna is a plantation crop and gives economic returns for more than 25 years and provides sustainable livelihood to farmers. Drought has accounted for multi-dimensional impact on the socio-economic life of the people in Rajasthan. Sudhakar Dwivedi and Arun Bhadauria in their paper have reviewed the ground realities behind the scene and efficacy of drought relief operations.

About 76 per cent of the population depends on agriculture and allied services for their livelihood in Chhatisgarh, as has been reported by A.K.Gauraha and K.N. Banafar. Investment on rural infrastructure is essential to improve the living condition of the people and will induce overall agricultural development. Kehar Singh has studied the rural economy of Mizoram and the NEH region of India. Knowledge and skill development are the important attributes of successful entrepreneurship for small farm holders. Anshu Vishwakarma and R.K. Singh have examined the poverty levels of rural households in the central, south-west semi-arid, and Bundelkhand regions of Uttar Pradesh. The households spend 50 per cent of their total expenditure on food. Vertical diversification will reduce the poverty of the farmers. The diversification of milk into its products has been

suggested by Amalendu Kumar, based on the sample data of Bhagalpur district in Bihar. The diversification towards milk products has helped in generating income, employment and livelihood of the households. S.B. Singh and S.V. Ngachan have studied the scope and constraints of farm diversification in north-eastern states of India. They have pointed out that despite big scope for diversification in these states, it is still at a low level. Lack of marketing facilities combined with poor transport and communication infrastructures and existing land institutions are the important factors that restrain crop diversification. The study by B.K. Mali, P.P. Pawar, D.B. Yadav and P.V. Kale has shown that the grape wine industry in India has provided considerable opportunities for income and employment generation to rural households and contract farming.

P. Nasurudeen and N. Mahesh have examined the potential in promoting watershed system of farming for which, it is necessary to devise policies that will provide incentives to watershed farmers, both directly and indirectly. Suggested policy measures include effective extension services and credit facilities for promoting watershed farming, provided they are effectively implemented. Until effective biological measures of soil fertilization are introduced and policies adopted to promote the application of biological and chemical fertilizers in a balanced way, maintaining soil structure and sustaining or increasing crop yield will be difficult.

The papers by Manik Lal Bose and Madan Mohan Dey have dealt with how food-security status of a country should be evaluated through assessing per capita income-expenditure and food consumption. The cost of basic need (CBN) approach, FGT index and Gini-coefficient approaches have been suggested to measure poverty and inequalities. The study has wide implications towards methodology and nutritional-security policy.

Issues for Discussion

In terms of number of papers submitted on this sub-theme, it is well realized that diversification should matter for sustainable agriculture and rural livelihoods. This realization is in consonance with the priority given to it in the draft XI Five-Year Plan base paper. But, the level of debate, data and discussion in the papers do not address critical issues holding accelerated progress under diversification. Some of the issues that require analysis, debate and discussion include:

- (i) Where to diversify and what to diversify keeping in view food security, natural resource sustainability, profitability, exports, etc.?
- (ii) How is diversification dependent on the need of domestic consumption, agro-processing, exports, etc.?

- (iii) What structural changes are involved in agriculture and non-agriculture sectors and how to manage them?
- (iv) What is the role of effective marketing linkages (inputs and outputs) supported by modern marketing practices, including introduction of grading, post-harvest management, cold chains, certification, etc. ?
- (v) What is the role of policy initiatives and regulatory framework required for successful diversification?
- (vi) What is the role of private sector, self-help groups, etc. in promoting agricultural diversification?
- (vii) How can production and price risks be managed effectively?

II. Trends in Profitability of Indian Agriculture

Policy support, production strategies, public investment in infrastructure, research and extensions for field crops, horticulture, livestock, and fisheries have significantly helped in increasing food production since the inception of Green Revolution. The first post-Green Revolution phase witnessed the continued growth in returns from land through intensification of chemical inputs and machine use. The second post-Green Revolution phase begins when the use of inputs was high and natural resources base, water and bio-diversity were under severe pressure to attain national food-security and development needs. Fast declining agricultural productivity growth, especially in crops has resulted in increasing of the production cost per unit of output and declining of the profitability of Indian agriculture. Under this sub-theme, thirty-six papers were received for discussion, which have been summarized in this section and issues have been listed for discussion.

The paper on sustainability and trends in profitability of Indian agriculture by M.S. Bhatia has shown that during the four decades of development (1951-990) rates of growth of agricultural production was high enough to meet the increasing demand and thus the agricultural growth and development during this period was socially sustainable. However, after 1990-91, there was deceleration in rates of growth of production and yield of major cereals, sugarcane, jute, cotton, and potato. The declining trend in profitability at constant prices of most of the principal crops has adversely affected the economy and livelihood of farmers. Sushila Kaul has examined the yield performance of rice in different states of India by using time series published data. Significant improvement in rice yield has been observed for all the states, but few of them are leading to higher productivity, while many states, viz. Madhya Pradesh, Rajasthan, Bihar and Orissa are lagging behind. Rice milling is an important agro-processing industry in Bhandara district of

Maharashtra being a profitable non-farm enterprise and opportunity of employment for rural livelihood.

M.S. Aitawade, B. A. Bongane, D. B. Yadav and V. G. Pokharkar have estimated that value-addition per quintal in paddy processing for rice flakes was Rs 176 and it was 26 per cent over the cost of raw material. D.B. Yadav, H.R. Shinde, G.G. Joshi and B.V. Pagire have examined the status of pulse production in Maharashtra. Area, production and yield of pigeonpea, moong, black gram and chickpea have increased over time. R.K. Khatkar, J.C. Karwasra, R.S. Pannu and Arun Dahiya have examined the profitability of major crops in Haryana state. The returns to cost were higher for rice and wheat as compared to those for pulses and other crops. Cropping pattern has shifted from coarse cereals and pulses to rice and wheat, which are more remunerative and less risky, as shown by Kebebe Ergano, V.P.Mehta, D.P.Malik and Arun Kumar. Returns to sorghum in Maharashtra have been examined by M.N. Waghmare, P.N. Shendage and D. B. Yadav. The parity indices between farm harvest price and input prices were not favourable and resulted to higher production cost and lower income. For sustainable growth of sorghum, policy directions are needed to maintain parity between input-output prices.

P. Arumugam, D. Venkatesan, A.P. Gore and S.A. Paranjpe have estimated that weather contributes to the tune of one-third in the variability of sorghum yield. The suggested regression model can be used in predicting the yield by accounting the weather conditions. A surplus of seed production has been noticed for most of the crops in Andhra Pradesh (Y. Radha). Still, the farmers face the problem of availability of quality seeds, causing the problem of declining profitability. Various policy measures are needed to control the production and distribution of quality seeds in the state. R. Bhakar, S. Jain and S. Garg have reported the inefficient allocation of fertilizer to paddy crop in Chhattisgarh. Mukesh K. Wadhvani and Amit Kumar have analyzed the level of technology adoption and their impact on crop productivity/profitability for sustaining crop production in Diara eco-system whose potentials are yet to be exploited in Bihar. The level of technology adoption was much below the recommended level, which has resulted in lower yield and inefficiency in resource allocation. The areas are predominated with small and marginal farmers with, low marketable surplus and inadequate capital has resulted in sub-optimal use of critical inputs like seeds, fertilizers, plant protection chemicals, irrigation, etc. Therefore, sufficient and timely availability of credit with provision of crop insurance may help farmers to increase the use of various resources in crop production. Economics of ginger cultivation in middle Gujarat have been examined for different farm-size groups by S.P. Shah and Y.C. Zala. The study has used

survey data collected from 128 ginger-growers spread over 16 villages of four talukas, covering two ginger growing districts of the middle Gujarat region during 2004-05. Ginger cultivation has been found capital and labour-intensive. The average yield of ginger has been estimated about 133q/ha and net profit over cost C_2 was Rs1,80,338/ha with high benefit cost ratio of 1.97. Sanjeev Panwar, Anil Kumar, Sushila Kaul and Namita Jaggi have used the cost of cultivation data of sugarcane by states of India and have attempted Holt's two-parameter model (Exponential smoothing adjusted for trend) for forecasting the profitability of sugarcane farming.

Adoption of zero tillage technology is probably one of the best ways to increase profitability in wheat production and sustaining productivity of natural resources like soil and water. Results of the study by R.S. Tripathi, Ram Singh and Ram Suresh are quite convincing as far as economic superiority of the zero tillage is concerned over the traditional method of wheat production. Benefit-cost ratio has depicted that the zero tillage is economically the most feasible and attractive option (2.4) than the conventional method (2.0). The zero tillage has shown tremendous potential in the Indo-Gangetic Plains of India for improving soil quality and sustaining its fertility by increasing carbon sequestration and decreasing net emissions of carbon dioxide.

P.P. Pawar, S.S. Kaware and V.S. Chavan have examined the changing profitability of India's fruits export. Export trading requires commodity-wise attention, both in respect of pre-harvest and post-harvest operations. In order to meet the export demand of fruits, the strategies need to be developed at least in three major activities, viz. market-oriented (export-oriented) production techniques, integration of post-harvest management and institutional support to promote exports. R.S. Singh and V.V. Singh have examined the economics of banana cultivation and status of mechanization in Burhanpur district of Madhya Pradesh based on the survey data pertaining to the year 2004-05. Benefit-cost ratio was estimated as 2.1 for banana cultivation. Most of the important operations are performed manually. The co-operative fruit marketing societies, locally called *Kela Groups*, have to improve their work performance by adopting grading and correct weighing. Also, the study has suggested that market intelligence needs be provided to the growers to increase their marketing efficiency. B.V. Pagire, S.M. Desai, G.G. Joshi and H.R. Shinde have examined the economics of high-tech banana cultivation by conducting the survey of 60 farmers in the year 2003-04 and have found the hi-tech banana cultivation to be profitable and a high-value enterprise. B.S. Kakad, S.S. Kaware, S.M. Shete and P.P. Pawar have examined the quinquennial changes in the economics of production of banana in Jalgaon district over a time span of 20 years by using data collected by the cost accounting methods at five point of times, from 1980 to 2000.

The benefit-cost ratio which was 1.3 has increased to 1.8, indicating profitability of banana cultivation. The resource-use efficiency in Alphonso mango production has been studied by S.S. Wadkar, S.R. Bagade and P.D. Veerkar in the Sindhudurg district. The investment in mango plantation is more remunerative near the seashore than away from the seashore. High transportation cost, heavy incidence of pests and diseases, lack of technical guidance, high market charges and lack of market information are the constraints faced by the mango growers.

S.S. Wadkar, S.R. Bagade and P.D. Veerkar have studied the profitability of cutflower production under polyhouse conditions and have identified the constraints faced by the polyhouse owners in south Konkan region of Maharashtra. The profit at different cost levels was maximum in case of orchid and minimum in rose. The input-output ratio worked out to be 1 : 1.46 in anthurium, 1 : 1.30 in orchid, 1 : 1.20 in gerbera and only 1 : 1.05 in rose. This indicated that production of anthurium under polyhouse condition was the most profitable business, followed by orchid and gerbera. D.S. Navadkar, D.B. Yadav and B.K. Mali have studied the profitability of selected cut flowers and vegetables grown under hi-tech cultivation in Maharashtra. The study has identified constraints in production and marketing. The grading is more important for high-tech produce because it directly reflects on the price. More than 60 per cent growers sell their produce in the Mumbai market. The higher cost of planting material and its timely unavailability from production front and financial constraints in relation to marketing have been reported the major obstacles.

K.D. Sharma, M.S. Pathania and Harbans Lal have examined the sustainable issues of balanced development of agriculture in mountain areas by undertaking a study in the low and mid-hill regions of Himachal Pradesh, representing five major mountain farming systems, viz. maize-based, paddy-based, vegetable-based, fruit-based and livestock-based. The sustainable plans were developed for different systems by suggesting the optimal-mix of cereals, pulses, vegetable crops, fruits, fodder resources and livestock. Vegetable- and fruit-based farming systems were more diversified in the irrigated conditions while livestock-based system was sustainable under rainfed conditions. The increasing externalities in the study area require greater policy support for market infrastructure.

Chitra Parayil has presented the case study of a tea factory fully run by the tribals in the Wayanad district of Kerala, constituting 6 per cent farmers, 11 per cent agricultural labourers and 17 per cent scheduled tribes. Unemployment is a major problem for this category. The correlation between income and employment is low which shows that there is a high degree of inefficiency of labour in the factory.

Sukhpal Singh, Satwinder Singh and H.S. Kingra have compared the economics of Bt cotton and non-Bt cotton cultivation based on a sample of 40 experimental plots (20 Bt cotton and 20 non-Bt cotton) in the village Ramgarh Bunder of district Bathinda in Punjab. Bt cotton was cost-effective due to higher production and lowered the per quintal production cost by Rs 64, generating higher income (Rs 4301) and employment (17 mandays). Higher yield, income, and employment and lower use of insecticides on Bt cotton will sustain the cotton crop in the state, simultaneously protecting environmental health and improving the economic condition of cotton growers. Based on a field survey in the year 2005-06, D.B. Pawar and B.R. Pawar have examined the economics of Bt cotton under rainfed and irrigated conditions in Maharashtra. The results have revealed that yield of Bt cotton was 14.9 q/ha under rainfed and just double (27.3 q/ha) in irrigated condition, resulting into a lower cost per quintal of cotton and higher profitability under irrigated condition. The plant protection adoption behaviour of farmers in the Guntur district of Andhra Pradesh has been examined by C.A. Rama Rao, M. Srinivasa Rao, P. Naraiah, B. Malathi and Y.V.R. Reddy for cotton crop. The use of chemical insecticides accounted for 37 per cent of total variable costs. No significant reduction in plant protection expenditure was observed when Bt varieties were adopted without IPM practices. However, the adoption of IPM practices reduced the use and cost of insecticides and increased the profitability.

Govind Pal, A.K. Jaiswal and A. Bhattacharya have examined the trends and variation in price of lac prevailing in important primary, secondary and terminal markets of West Bengal. Growth rates of *rangeeni* lac prices at growers, assembling centres, manufacturing centres and Kolkata market were 6.18, 6.50, 6.78 and 6.69 per cent per annum, respectively. In order to encourage lac growers, the sustained production is to be ensured and minimum support price is necessary from policy angle.

The technical efficiency of Haryana farms has been found to vary across sample farms, ranging from 0.23 to 0.98 by Surender Singh. Wheat yield could be increased by 15 per cent by reducing inefficiency in production, without additional use of inputs. There is a need to promote young farmers as decision-makers along with raising the education level of farming community and also efforts should be made to further strengthen the extension contacts for farmers. S. Garg and R. Bhakar have examined the marketing efficiency and economic profitability for wheat crop in regulated market at Bikaner district of Rajasthan. The operational efficiency of the *mandi* will increase and price spread will decrease if quantity of arrivals increases, which will result in the low marketing cost.

The agricultural development in Bihar has been examined by Shiva Pujan Singh and Janmejay Kumar in the contest of performance, potential and constraints. Irrigation project plays an important role in increasing agricultural production. Upper Wardha Irrigation Project started functioning in the year 1995, covering Amravati and Wardha district. A.K. Vitonde and Simanchala Sahu have reported the impact of irrigation project on income, consumption and savings. With the presence of Upper Wardha Irrigation Project, watertable level has increased, and the livelihood of farmers has improved due to increase in cropping intensity, yield, income, production level and saving rate.

The sustainability issue of the crop productivity is fast emerging. The post-Green Revolution phase is characterized by high input-use and decelerating total factor productivity growth (TFPG). Praduman Kumar and Surabhi Mittal have computed the TFP indices for a number of crops grown in different states of India, covering the period 1971-2000. The TFP trends confirm that the productivity attained in 1980s was not sustained in 1990s and has posed a threat to sustainability of crops. Another TFP study by V. K. Khobarkar, J. M. Talathi, S. S. Wadkar and J. S. Dhekale has revealed the stagnation of productivity in the crop sector in the Konkan region. Concentrated efforts are needed to accelerate growth in TFP to increase the profitability of Indian agriculture. V.A. Thorat, S.N. Tilekar, J.S. Dhekale and H.K. Patil have analyzed the trend in total factor productivity growth (TFPG) of horticultural crops, viz. cashew, mango and coconut in the Konkan region of Maharashtra. The study has assessed the returns to investment on horticultural research and development. TFP growth for horticultural sector has been estimated 6.2 per cent in 1980s which was quite high. However, like crop sector, sharp deceleration in TFPG has been observed for the horticulture sector to 1.3 per cent during 1990s. Investment on research has been identified as the major source in TFP growth. Plantation crops are characterized by long gestation period, hence, investment made on research and development requires time to yield returns. The results have shown that there is a lag of six years time between investment on horticultural research and yields. The returns to horticulture research are high pay-off and internal rate of returns to horticultural research has been estimated 119 per cent. Ferdinand J. Paraguas and Madan Dey have tested the convergence hypothesis of aquaculture productivity across states in India. The results have confirmed the productivity convergence and TFP growth results have provided a strong evidence of the spatial heterogeneity of productivity convergence and spatial clustering of states.

B.S. Kalra and A.K. Singh have studied the utilization and efficiency of irrigation water-use in the rice-wheat system in the Indo-Gangetic Plains in

western Uttar Pradesh. The authors have reported large inter-farm variations in water-use. The study has revealed that lower irrigation charges have neither helped water utilization nor maximized the productivity of land. A hike in canal irrigation charges or electricity rates will generate funds for proper maintenance of water distribution system with simultaneous raise in the productivity levels of land and water.

Issues for Discussion

Agriculture in recent years has become less profitable and in some areas, unsustainable. It is a case of falling productivity for increasing costs. Natural resources are degrading and there is a technology fatigue. Agro-processing is suggested to increase profitability but constraints of power, roads, storage, cold chain, ports, etc. are serious concerns. Under these circumstances, the issues that need to be discussed include:

- (i) What is the nature and scope to shift the production function upward in field crops, horticulture, livestock and fishery by improving the technology index?
- (ii) What should be the priorities in rice and wheat vis-à-vis other crops in the coming years?
- (iii) What should be the strategy for oilseeds and pulses?
- (iv) What should be the strategy for water (surface and groundwater) management and irrigation covering expansion, distribution and efficient use?
- (v) What is the role of seed, credit, and extension system and how to strengthen them?
- (vi) What is the role of agro-processing and how to promote it?
- (vii) What is the scope for land reforms, keeping in view declining farm size?
- (viii) How to enhance the total factor productivity and reduce the cost per unit of output?

III. Organic Farming

Conservation of production resources, elimination of the use of synthetic inputs and reliance on management of ecosystems have implications for agricultural sustainability, safeguarding of human health and conservation of the environment, which justify the allocation of public funds for promoting and popularizing, adoption and spread of organic farming. Organic agriculture is a holistic production management system which promotes and enhances

health of agro-ecosystem, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, emphasizing the adaptation of local systems to regional conditions. As a system of production, organic farming uses agronomic, biological, and mechanical methods, as opposed to synthetic materials, to fulfill any specific function within the system.

For a product to qualify as “organic”, certification in accordance with precise technical specifications (standards) prescribed for production, storage, processing, handling and marketing by a certification body is essential. Standards have been developed to provide guidelines to producers and protect consumers against deception and fraud. These standards are usually more detailed, specific to special needs and legally binding.

Training to farmers on organic production, post-harvest management and marketing will help in rapid adoption of organic farming. With the spread of organic farming, the requirement of organic inputs increases. Thus, input availability can be a major obstacle in the progress of organic farming. Assured markets for organic products through contract farming, risk coverage through insurance of organic farming, promotion of consumers’ awareness on organic products, identification of markets for organic products, development of infrastructure facilities for post-harvest management, processing and marketing, financial support for organic agriculture, and strict monitoring for purposes of product certification for domestic and export markets are critical factors that need to be examined and analysed before suitable policies for promotion of organic agriculture can be formulated. The seventeen papers received for discussion under this theme have accorded due emphasis on many of the above factors.

A comparative analysis of the economics of crop production under organic and inorganic farming systems in Kangra district of Himachal Pradesh has been attempted by Sushil Kumar, D.S. Thakur, S.K. Chauhan and K.D. Sharma. Using survey data from 50 organic and 50 inorganic farms for various crops, the authors have concluded that income from crops under organic farming system is significantly higher as compared to that from inorganic farming system. Organic farming has improved the soil health and led to long-term production and livelihood sustainability.

Prospects and constraints in adoption of organic farming in Tamil Nadu have been examined by R. Venkatram and K. Mani, based on data collected from farmers under the scheme on Cost of Cultivation of Principal Crops (CCPC) for the period, 1980-1981 to 1999-2000. Organic farming has been found to be economically viable. However, its adoption is constrained by (i) limited technological options, (ii) large managerial costs and risk in shifting

to a new way of farming from the conventional inorganic farming, (iii) low awareness about the organic farming systems, (iv) lack of marketing and technical infrastructure, and (iv) added cost by way of inspection, certification and residue testing for produce to be marketed under organic label.

Comparative economics of organic and inorganic farming have been studied by E.R. Patil for cotton, tur, mung and wheat crops in the Akola district of Maharashtra. Organic cotton and wheat farming has been found comparatively more profitable than inorganic farming.

S.S. Kalamkar has comprehensively reviewed the status and development of organic farming in India. While a complete transition from conventional to organic agriculture in India is not a feasible option in view of the need to produce more food to meet the consumption needs of the growing population, there is a need to encourage organic farming because of the several benefits that it provides. Reduced yields, especially in the initial years of production, necessitating the need to charge higher prices and inadequate certification facilities pose major challenges to the growth of organic agriculture in India.

S. Ravichandran, K.R. Sundaravardarajan and R.Venkataraman have analyzed the economics of bio-inputs usage in the rice cultivation in northeastern agro-climatic zone of Tamil Nadu. Lower costs of production resulted in net returns of nearly Rs 17000 to the adopters and Rs 14000 to non-adopters of bio-inputs. The BCR was relatively higher for adopters (2.02) than non-adopters (1.89). Jitendra Singh, G.P. Singh and Rajkishor have examined the status and economics of organic farming in Udham Singh Nagar district of Uttaranchal. Most of the farmers of this state are resource-poor and apply very low levels of fertilizers and pesticides. Hill soils are almost free of residues of pesticides and chemical fertilizers. The yields from organic and non-organic paddy were estimated at 26.86 q/ha and 32.74 q/ha, respectively. Similarly, yield was found to be lower for organic wheat (19.85 q/ha) as compared to non-organic wheat (28.12 q/ha). However, farmers realised relatively higher prices for organic paddy and wheat and hence net income from organically-produced crops was much higher than that from the non-organic crops.

R.V. Sujatha, Y. Eswara Prasad and K. Suhasini have reported in their study conducted in Andhra Pradesh that more number of organic farmers in both rice and cotton are operating at high level of technical efficiency compared to inorganic farmers. This is indicative of the ample scope for increasing the efficiency of production through better utilization of the available resources from the existing level of technology. Lack of knowledge

about organic farming among the farming communities, lack of market information about the domestic and international market opportunities for organically-produced commodities, expensive certification procedures, poor marketing infrastructure for organic products, time taken for conversion of farms from conventional to organic, and lack of subsidies on bio-fertilizers and bio-pesticides have been identified as the major constraints to the growth of organic agriculture.

M. Anjugam, K.R. Jeganmohan, S. Padmarani and R. Sundaresan have analyzed the economics of usage of bio-inputs in sugarcane production, have identified the determinants of adoption of bio-inputs and have suggested alternate measures for increased use of bio-inputs in sugarcane cultivation in the western zone of Tamil Nadu. Farming experience and education have been found to influence the level of adoption of bio-inputs positively. Target-based policy support, improving the shelf-life of bio-inputs through agricultural research, encouraging private sector participation in production, easing the stringent registration norms and provision of institutional credit, regulation of prices of bio-inputs and organization of farmers' co-operatives have been suggested as the measures for increasing the adoption of organic production.

The sugar industry occupies a pivotal place on the economic map of Maharashtra because the state alone produces more than 40 per cent of the country's total sugar. M.S. Jadhav, B. H. Kamble and D. B. Yadav have examined the profitability of organic and inorganic sugarcane farming in Maharashtra. Though organic sugarcane farming gave lower yield (82 t/ha) than the inorganic farming (94 t/ha), per quintal cost of sugarcane production was lower on organic than inorganic farms. Consequently, per hectare net profit from organically-produced suru sugarcane was higher than the conventionally-produced suru sugarcane, implying higher profitability of organic farming. K. G. Kshirsagar has also compared the economics of organic and inorganic sugarcane production and has assessed the organic sugarcane farming with respect to important sustainability indicators such as conservation of soil, water, power and farmers' economic well-being and livelihood security based on data for the year 2004-05 collected from 30 certified organic and 30 inorganic sample households from the Jalgaon district of Maharashtra. Cost of cultivation of sugarcane was found lower on organic farms. Yields were also lower but were adequately compensated by the price premium received. In addition, organic farming was found to be superior in terms of the economic well-being and livelihood security of the farmers, indicating its enormous potential for improving sustainability of agriculture and farmers' economic well-being and livelihood security.

Anita Arya's case study of Agrocel Industries, established in 1988 at Mandvi in Kutch district of Gujarat to promote integrated crop management and efficient use of water, has identified growing health concerns and the increasing non-tariff barriers (sanitary and phyto-sanitary regulations) in the international market, coupled with impracticability of modern farming techniques on a small scale, as the causative factors for the shift from chemical-based to organic production and consumption systems. In Gujarat, organic production of cotton, chickoo, banana and coconut had higher productivity. The constraints to organic farming, in general, include high cost of certification, especially for relatively small farmers, complicated production technology, relatively smaller market opportunities, and the long time involved in converting from conventional to organic farming. A case study of organic fruit cultivation by Manesh Choubey in Arunachal Pradesh has identified the potential of organic fruit production in the state. The study has emphasized the need for dissemination of information on organic farming technology to the tribal farmers.

The weed infestation is a serious problem in old mango orchards. The chemical methods of weed control are costly and do not generate any additional income. A. A. Rane, S. R. Bagade, L. G. Pawar and S. S. Wadkar have conducted trails on farmer's fields to examine the efficacy of non-chemical weed control methods in mango orchards. It was found that in old mango orchards (age over 10 years) in Sindhudurg district of Maharashtra, grazing cattles was a more economical method of weed control than cutting grass as dry fodder or green fodder. In young mango orchards (age under 5 years), intercropping with ridge gourd has been found more profitable than cutting grass as dry fodder or green fodder.

Subhasis Mandal, S. Mohanty, K. K. Datta, A. K. Tripathi, D. K. Hore and M. R. Verma have examined the potential of organic farming in Meghalaya. Keeping in view the fact that the realization of the full potential of organic farming is demand-driven, the study has identified ginger, pineapple and turmeric as commodities having the immediate potential to be grown as 'organic' in the state. To reduce the risk, public-private partnership should be encouraged and state government should help to create investment-friendly environment.

J. Rai, M.P. Yadav, U.S. Tiwari, Anjani Kumar Singh and B.P. Singh have compared the economics of eight organic packages with pure inorganic, pure organic, organic + inorganic, and organic + biofertilizer combinations for high-value crops (maize-potato-onion) on the basis of productive efficiency, economic return, B:C ratio and profitability. The study has indicated that in the long-run, the organic and organic + biofertilizer treatments

perform well in terms of productivity, returns and profitability with sustainability of natural resources and safety of environment.

K.R. Waykar, D.B. Yadav, P.N. Shendage and Y.C. Sale have examined the nature and extent of use of organic inputs, based on the data collected from 60 grape farms (30 each of organic and inorganic). During the initial stages of organic farming, yield declined to about 93 q/ha. However, the yield is likely to be sustained after passing-off of the transition period of organic farming. The B:C ratio was observed to be 1.37 among organic farms relative to 1.51 among inorganic farms. Availability of organic inputs and high cost of vermicompost, biopesticides and vermiculture have been found the major constrains to organic grape production.

Issues for Discussion

Most of the papers received for discussion have evaluated the profitability of organic farming in respect of specific crops (sugarcane, paddy, cotton, ginger, orange, mango). Some authors have analysed the cost impact of bio-inputs on profitability in organic production while others have highlighted the importance of suitable government interventions in promoting organic farming. However, before a case can be made out for large-scale adoption of organic cultivation and suitable policies are formulated for its promotion, several issues need to be critically analysed, discussed and debated. Some of these include:

- (1) During the period of transition from conventional to organic farming and during the initial stages of organic farming, a decline in yields of different crops is evident. Since yield declines have important implications for national and household food-security, an important question is the extent or magnitude of the decline in yield in different crops. Is this decline transitory or permanent? How long does it take for yields to stabilize after shifting to organic production? Is the initial decline in yields reversible?
- (2) What are the critical factors that would determine the shift to organic production? Are demand-driven factors (demand for organically-produced foods) more important than supply-driven factors (supply of bio-inputs)? How to build consumer awareness for advantages of organic products?
- (3) What is the existing and potential demand for organically-produced foods? This needs to be discussed in relation to both domestic and international markets. The analysis of consumer demand for organic products must necessarily take into account the paying capacity of

consumers as willingness and ability of consumers to pay price premiums for organic products will depend upon the differences in prices of organic and conventional food commodities.

- (4) The cost and authenticity of organic certification are both critical to the success of organic agriculture. What are the mechanisms by which the cost of certification can be reduced, as this may be a major constraint, especially for the small producers. Also, how can the consumer be assured of the authenticity of the certification label? In other words, what kind of mechanisms can we build into the entire certification process to provide checks against unscrupulous packagers, processors and traders?
- (5) Besides human health, organic farming positively impacts the quality of the environment. How can the impact on environmental quality be quantified?
- (6) How to develop an information and extension system for promoting organic agriculture and products? How to build research, education and training system to promote organic agriculture and products? How can we ensure the contribution of research to the growth of organic farming? Crop production and breeding research will have to be reoriented to the development of packages of practices and varieties that respond better to organic production conditions rather than chemicals. Also, what kind of mechanisms should be evolved to integrate various production, weed and nutrient management and disease control measures in a holistic manner to ensure viability of organic agriculture?
- (7) Since organic agriculture prescribes norms or standards for post-harvest management, what are the implications for marketing organisations/agencies and processing firms? Will their existing facilities need major modifications? If so, what are the economic implications in terms of cost of equipment, methods of processing and handling, packaging, etc. To what extent will new investments in equipments, machineries and plants be required? How to build a certification system for inputs and outputs for organic agriculture?
- (8) What kind of changes will be required in the management of supply chains for organic products? How can agribusiness firms adapt to the changed system of procurement, handling and marketing?
- (9) Currently, a major chunk of the demand for organic products arises in the exports markets. How can the small producers be guaranteed a share in this export demand for organic products? Are SHGs the answer to this?

- (10) What kind of infrastructure and strategies are required to be evolved for organic agriculture in terms of its impact on environment? Organic agriculture is prophesized to be resource-conserving. However, large-scale organic production may still involve the use of heavy equipment and machinery for production and processing, thus consuming considerable energy and simultaneously contributing towards environmental pollution. How can the policies promoting organic agriculture ensure that the benefits of reduced environmental degradation are not offset by the energy consuming and polluting processing systems.

Sustainable Agriculture and Rural Development. Sustainable Development Gateway: Agriculture. United Nations Food and Agricultural Organization. Not have access to the use and benefits of the new technology, the increasing specialisation of livelihoods, the growing gap between the well-off and the poor, and the cooption of village institutions by the state. Source: Pretty, J. (1998) *Regenerating Agriculture*, Earthscan, London, p. 4. Impact of agriculture modernization on sustainable livelihood among the tribal and non-tribal farmers. *Journal of Agriculture Extension and Rural Development*, 6(4), 138–142. Google Scholar. Prajapati, M. M., Prajapati, M. R., Patel, R. N., & Joshi, H. N. (2015). *Sub-Saharan Africa betwixt and between: Rural livelihood practices and policies*. ASC Working Paper 43, De-Agrarianisation and Rural Employment Network, Afrika Studiecentrum, Leiden. Datta, S. K., & Sing, K. (2011). *Co-majors: Rural Sociology; Sustainable Agriculture Program of Study Committee: Robert E. Mazur, Co-major Professor Mike Duffy, Co-major Professor Jan Flora Gail Nonnecke Teresa Downing-Matibag*. Iowa State University Ames, Iowa 2010. The major thrust of the sustainable livelihoods perspective lies in investigating how powerful modernization forces under neoliberalism entrap resource-poor farmers in particular vulnerability contexts, and what strategies they adopt in order to sustain and improve their livelihoods.