

Assessment of Food and Nutritional Security and Impact of Technologies

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1. Introduction

To secure adequate food is a primary concern of any country. The cutting edge technological breakthrough has converted the Indian agriculture from dependency into self sufficiency in food production, however, poverty, undernourishment and malnourishment still persists specially in rural areas. The study of dietary pattern and nutritional status of the mass population is one of the indicators to assess the economic development of a country. To bridge the gaps between demand and supply of food for the growing population, efforts are being made to develop new technologies. Further, the benefits of new technologies in agriculture are not realized in all the regions especially in underprivileged areas. It is, therefore, important to undertake studies to assess the food and nutritional status of the rural population and to assess the impact of new technologies/research/ technological interventions in the different areas of the country. The salient findings of important studies are presented under assessment of food and nutritional security and impact assessment of technologies.

2. Aims and Objectives

The change in dietary pattern and nutritional status of different socio-economic groups of rural households due to change in economic environment were studied under dietary pattern and nutritional status of rural households. Further, the socio-economic factors influencing the dietary pattern and nutritional status of rural households and the target groups for prioritization for improving the nutritional status were identified. Fruits and vegetables are important for balanced diet and food security and therefore, there should be a balance between demand and supply of fruits and vegetables in the future. Most of the studies pertaining to the demand estimation of food commodities were confined to estimation of demand for aggregate commodities like cereals, pulses, fats and oils, fruits and vegetables. The few studies were also estimated the demand of individual cereals. Therefore, in this direction a study on estimation of elasticities of demand and supply of major fruits and vegetables was undertaken to study the production and consumption pattern of major fruits and vegetables, to estimate the elasticities of fruits and vegetables at disaggregate level using Almost Ideal Demand System (AIDS) with Linear Approximation (LA) and to project short and long term demand and supply of major fruits and vegetables using the household level consumer expenditure survey data from three quinquennial rounds of National Sample Survey pertaining to the period 1987-88, 1992-93 and 1999-2000.

Earlier study on dietary pattern and nutritional status of rural households suggests that the landless, sub-marginal and marginal category of households in most of the states should be treated as target groups to raise their income to maintain their nutritional status. On this backdrop, the performance of microfinance was studied to examine the effectiveness of Self Help Groups (SHGs) in reaching vulnerable sections in different agro-climatic zones of selected states and the factors for non-participation of households were also identified under the study on determinants of performance of Self-help Groups (SHGs) in rural

micro-finance (mF). The study was conducted in Uttar Pradesh and Andhra Pradesh in two districts of each state using primary as well as secondary data. The irrigation water plays an important role in achieving food security of a country. Therefore a study was undertaken on water food security scenario analysis for 2025 with an overall goal to strengthen the knowledge base and develop exploratory models as a tool for policy makers, scientists and others to interact and address sustainable water food security related issues in an integrated framework.

Regarding the impact assessment of technologies, a study was undertaken to develop an appropriate model for estimating the economic gains from technological advance in rice production and to estimate the economic gains across different rice growing states due to new technology in rice production. In this study consumers' surplus approach was used to estimate the economic gain. The consumer surplus is the "excess of the price which the consumer would be willing to pay rather than go without the thing, over that what he actually does pay or the difference between what the consumer is willing to pay and what does he actually pays" and the producer surplus is analogous to that of consumer surplus and refers to "a difference between that is actually received from sale of a commodity and the minimum amount to induce a producer to part with it". A model was developed which can estimate year-wise gains from yield enhancing technology in rice cultivation. The historical change in the yield of rice in different states was studied by fitting spline function. Micro irrigation technology was emerged as water and other resource saving technology. In India, however, most of the studies on impact of micro irrigation are conducted on research stations. Therefore, to assess the impact of micro irrigation systems on yield and saving of resources, a study was undertaken on the farmers' fields in Gurgaon and Mahendergarh districts of Haryana.

The fisheries sector generates income and employment and provides livelihood to a large section of economically backward population and stimulates growth for a number of subsidiary industries in the country. Besides, the sector is a source of valuable foreign exchange earnings. Therefore, a study on impact Assessment of fisheries research in India was undertaken in collaboration with other ICAR institutes in order to justify allocation of public funding to fisheries research, to evaluate return to investment of fisheries research in capture and culture fisheries and to assess the socio-economic and environmental impacts of fisheries technologies in different systems. For the measurement of farm specific technical efficiency, one of the most popular methods, the Stochastic Frontier Production method has been used. In the stochastic frontier production function which is popularly known as 'composed error model', the error term ϵ is composed of two independent error components as: $\epsilon = V-U$. The error term $V \sim N(0, \sigma_v^2)$ is a two-sided error term symmetrically distributed ($-\infty < V_i < \infty$) and it captures the effects of random shocks outside the firm (farm) control, observation and measurement error on independent variables, and usual statistical 'noise' generally found in an empirical relationship. The other independent error component (U) is assumed to be non-negative and represents technical efficiency. This error term is one-sided and is a truncation of the $N(0, \sigma_u^2)$ distribution (i.e; half normal distribution). The economic interpretation of this error term U is that each farm production must be either on or below the production frontier.

The migratory sheep production system plays an important in the rural economy of the country especially in the economically weaker sections of society in tribal, backward and hilly areas. However, the productivity of this system is very poor. Therefore, improved technologies were intervened in this production system to enhance the productivity under NATP Project on Jai Vigyan National Science and Technology Mission on Household Food and Nutritional Security in Tribal, Backward and Hilly areas

and the impact of technological interventions were assessed. A benchmark survey was conducted during the year 2001, in order to get a comprehensive view of the socio-economic aspects of migratory sheep rearing and food and nutritional security status of the migratory sheep farmers. Three consecutive repeat surveys were conducted for the same migratory sheep households during the years 2002, 2003 and 2004 to assess the impact of technological interventions.

3. Assessment of Food and Nutritional Security

3.1 Dietary pattern and nutritional status of rural households

The dietary pattern of rural households in almost all states showed a general trend of reduction in consumption of cereal in favour of non-cereal foods during 1999-2000 over 1987-88. The consumption of other non-cereal foods like milk and milk products, egg, meat and fish, fruits and vegetables groups tend to increase in most of the states. However, the shift from cereal based to non-cereal based diet was not visible in all categories of socio-economic groups uniformly. It was also observed that in most of the states, the proportion of deficient rural households was higher in landless, sub-marginal and marginal class and it decreased with the size of holdings. It was observed that Assam and Orissa were the most deficient state in most of the nutrients. Punjab and Haryana were at a better situation in terms of nutrients intake in the diet. In most of the states and land holding categories of rural households, the key factor influencing nutritional status was found to be per capita expenditure on food. In all the states, the coefficients of unit calorie cost and non-food expenditure were found negative and significant, indicating that higher prices of food items and excess expenditure on non-food items affected the nutritional status of rural households adversely. In most of the cases, the coefficient of household size was found to be negative and significant which indicates that bigger the family size and lower the nutritional status of the household. The analysis suggests that the landless, sub-marginal and marginal category of households in most of the states should be treated as target groups to raise their income to maintain their nutritional status.

3.2 Demand and supply of fruits and vegetables

The demand for total vegetables was projected to be in the range of 93-106 million tonnes and 105-129 million tonnes for the year 2010 and 2015, respectively under different growth scenarios of the economy. Similarly, the projected demand for total fresh fruits was in the range of 19-22 million tonnes and 22-28 million tonnes for the year 2010 and 2015, respectively. The Box-Jenkins model was used for forecasting supply of individual fruits and vegetables and projections were made for the year 2010 and 2015 after validating the models. The study projected huge demand-supply gap (excess demand scenario) of fruits and vegetables if the same trend in consumption and production continues.

3.3 Assessment of performance of self help groups

SHG progress was very diverse in Andhra Pradesh and Uttar Pradesh States. In spite of higher growth rate of population, higher share of cultivators, lower female literacy and higher female population in the selected districts of Uttar Pradesh, the SHGs progress was slow in comparison to A.P. This scenario rejects the hypothesis that “there should be a higher positive correlation between female population and number of SHGs and SHGs are gender and poverty focused but not sector focused”. The probable reason may be that the policies adopted in Andhra Pradesh are seemed to be more effective as location and socioeconomic specific policies and programmes were implemented in the state. Regarding determinants of repayment of loans, the analysis showed that higher amount of loan and socially more heterogeneous

groups are the main factors responsible for default in repayment of loan. The over all position of SHG programme in Andhra Pradesh was better as compared to Uttar Pradesh. It seems that the policies introduced in Andhra Pradesh are area specific and suited to the socio-economic conditions of Andhra Pradesh. Farm based activities like animal husbandry are receiving attention in economic empowerment of women. A member of the SHG also has good access to the banks. It was observed that people intended to take consumption loan from the group. This showed that they felt economically strong, as they are more confident that they can get financial support as and when they require for the upliftment of livelihood. It was also observed that family relations have improved after becoming members of the group and thus status of women in the family have also improved. Domestic violence is reduced to some extent as financial dependence of women on male members is reduced. In case of women control over loan, it was found that it depends on the requirement and purpose of loan.

4. Water-Food Security Scenarios

The analysis showed that the cropping pattern in agro-ecological subregions, namely; Ganga Yamuna Doab, Rohilkhand and Avadh Plains, hot, moist semi-arid eco-subregion (AESR 4.3) and Madhya Bharat Plateau and Bundelkhand upland, hot, moist semi-arid eco-subregion (AESR 4.4) was dominated by foodgrain crops. In AESR 4.3, the cereals occupied nearly three-fourth of the gross cropped area and in AESR 4.4, the cereals (43 per cent) and pulses (37 per cent) occupied four-fifth of the gross cropped area. The AESR 4.3 had considerably good proportion of irrigated area (68 per cent) along with low degree of variability among the districts in comparison to AESR 4.4 (20 per cent). On the other hand, development of groundwater was low in both the sub-regions implying the scope for further expansion of irrigated agriculture. However, such scope are quite location specific based on the status of groundwater development. In both the sub-regions, the daily average calorie intake was lower than Recommended Daily Allowances (RDA) in rural as well as urban areas. However, it is to be noted that in terms of nutrition and calorie intake both sub-regions were relatively better than many other parts of the country. WATER-FOOD 2025 model was developed in collaboration with NCAP for simulating alternative scenarios of water-food security for 2025 in an integrated framework. Two alternative scenarios; namely, the Business As Usual Scenario (which assumes a continuation of current trends in water and food demand-supply drivers) and the Food Secure Sustainable Groundwater Use Scenario (which postulates no ground water mining and sustaining food security in future) were analyzed for these subregions for 2025 with specific set of interventions. ‘Business as usual scenario’ analysis showed that the sub-region 4.3 has food deficit and declining groundwater balance, whereas sub-region 4.4 has a very large food deficit but stable groundwater balance. On the other hand, ‘Food Secure Sustainable Groundwater Use Scenario’ analysis emphasized on yield growth in subregion 4.3 to eliminate the food deficit but groundwater depletion would continue unabated. In subregion 4.4, area expansion, intensity enhancement and yield growth while maintaining stable groundwater balance were explored and quantified to convert from a food-deficit to a food-surplus sub-region.

5. Impact Assessment of Technologies

5.1 Economic gains from advances in rice cultivation

The effects of technological advance in rice cultivation across states vary from high quality of land-dependent case to low quality to land-invariant case. The results showed that the technological advances

had added another factor responsible for variation in the yields of rice among the states. This indicated that the effect of technological advances in rice production depends on both input use as well as on land quality. The inherent advantages of land quality and higher input use in Punjab, Haryana, Tamil Nadu, Uttar Pradesh, Andhra Pradesh, West Bengal and Maharashtra showed better response to technological advances in rice production as compared to other rice growing states. In general, producers were the major beneficiaries of technological advance in rice production in all the states while the consumers' gains were found to be low as compared to producers gain in all the states. Grain yields from technological advances are mainly dependent on shift in supply curve and the movement of price. Consumers' gain mainly depends on price movement while producers' gains depend on the extent of shift in supply curve. Therefore price policy plays an important role in creating the economic surplus.

5.2 Impact of micro-irrigation on productivity and resource saving

With the advent of micro-irrigation in Gurgaon and Mahendergarh districts of Haryana, the benefits of drip irrigation in orchards are taken by only large farmers while sprinkler irrigation is being used by farmers irrespective of size of holdings. The benefit/cost ratios were computed for Guava, Ber, Aonla, Kinnow, Mausami and Anar orchards which are popular in the area. The maximum increase in productivity i.e. 173 percent was observed in Ber while the minimum i.e. 34 percent was observed in Aonla. An increase of 27 percent in productivity was observed in wheat and mustard, 20 percent in cotton and 14 percent in bajra. In Gurgaon some of the farms have introduced strawberry and Gladiolus and it was found that both new crops are more profitable under drip irrigation. The benefit/cost ratios were higher in case of subsidy on irrigation systems. The resource saving under drip irrigation varies from crop to crop; however, 40 to 60 percent of water, 17 to 55 percent of fertilizers, 34 to 50 percent of electricity and 7 to 20 percent of labour can be saved. Under sprinkler irrigation, wheat and mustard in *rabi* and cotton and bajra in *kharif* seasons are grown. About 20 to 30 percent of electricity and labour and 30 percent of water and fertilizers can be saved in wheat and mustard crops while 35 percent of water, 20 percent of fertilizers, 50 percent of labour and 36 percent of electricity can be saved in cotton and about 30, 20 and 20 percent of water, labour and electricity, respectively, can be saved in bajra cultivation under sprinkles. The share of credit and subsidy was 9 and 50 percent of the total investment, respectively.

5.3 Return to investment in fisheries research and technical efficiency of fishery farmers

The analysis of scheme-wise outlay for fishery development under different plans revealed that the central government has played an important role in the outlay for fisheries development as there is a direct relationship between central sector schemes outlay and share of fisheries in agricultural outlay. The analysis of expenditure on Fisheries Research showed that the proportionate share of outlay for fisheries research in total fisheries outlay had more than doubled from fourth plan to ninth plan. The incremental GDP in fisheries was impressive in early nineties resulting thereby decrease of incremental capital output ratio from 2.34 in late eighties to 2.02 in early nineties. The socio-economic analysis of the fish farmers from Punjab revealed that the majority of the farmers were having the pond size of less than 2.5 hectares with an average size being 1.4 ha. The net benefit-cost ratio was 0.62 on large farms indicating that the return per rupee of investment was impressive on large farms whereas it was 0.31 for small category of farms. It was found that among all the variables included in Frontier Production Function viz, stocking density, labour, fertilizers and feed, only stocking density and feed were significant, indicating

that one percent increase in stocking density would result in a change in output by 0.24 percent. The average technical efficiency of the fishery farmers in Punjab was 78 percent compared to the best frontier. About 39 % (47 farms) had shown less than 70 per cent efficiency and about 20% (24 farms) had shown efficiency between 70- 80 percent. On the other hand, 41 percent of the farms had shown more than 80 percent efficiency when compared with the best frontier. It is also observed that the small fish farmers are managing their resources better than the other category of farmers. Further, about 96 percent of the difference between the observed and the frontier output was mainly due to the inefficient use of resources which are under the control of fish farmers. Although, the farms are technically sound to some extent, the economic efficiency is low. There is a tremendous chance to increase technical, allocative and economic efficiencies of Punjab fish farmers. The aquaculture in Punjab is profitable, but it is wrought with certain constraints. Hence there is still some scope to increase the profitability in general and of small and medium category of farmers in particular by improving the technical efficiency and mitigating the constraints to the extent possible.

5.4 Impact of technological interventions in migratory sheep production system

The results of the study revealed that there was an impressive increase in productivity and income realization due to technological interventions (breeding, health aspects and nutritional supplementation) in migratory sheep production system. There was an increase in the consumption of deficit food items in both the districts, which indicates an improvement in food and nutritional security of the participating households. Further, spillover impacts of technological interventions especially in breeding component were impressive especially in Ajmer District. The findings of the study gave some important policy options to enhance the profitability and sustainability of the migratory sheep production system. Firstly, the efforts should be made to replicate the technological intervention programmes in other areas and secondly, the migratory sheep owners may be educated to adopt better package of practices to realize sustainable returns from this production system.