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Social Costs and Economic Benefits of Micro Irrigation Systems for Dry Land Crops

D. Tata Rao*

The objectives of the paper are to analyse the changes in the farming systems associated with micro irrigation (MI) adoption in dryland crops, to evaluate the economic and social benefits of micro irrigation adoption in different crops and the methods of MI systems in dryland farming in Andhra Pradesh. Generally, the variables affecting the economic dynamics of micro irrigation adoption in dry land farming are: changes in crops, growth, production, productivity, sources, factors and methods. But, how these variables get altered depends on the socio-economic conditions of the farmers and the region under consideration. The social benefit depends on the extent of real water saving, rather than saving in applied water. Real water saving comes from reduction in non-beneficial evaporation from soil, and non-recoverable deep percolation. Real water saving due to micro irrigation depends on several physical factors. The adoption of micro irrigation system leads to increase in yield, real water saving, and expansion in area under irrigation, all resulting in social benefits. But, most of these perceptions are based on research on irrigated farms of dry land crops. Again, they looked at saving in applied water rather than actual water consumption by the crop. Thus, the social benefits tend to get over-emphasised. Since the studies were done in agriculturally prosperous regions where labour is in short supply, the social costs associated with removal of labour from farms get ignored. Thus, governments and donors are motivated to subsidise MI systems. But, many research studies in the past on irrigation seem to suggest that these systems are viable even when the full costs of the system are compared against the private benefit. Hence, subsidies may not be desirable from an equity perspective as it is mostly the large farmers having capital who go for micro irrigation systems. Instead, the criterion would be water productivity enhancement, which also ensures that the income returns are higher than what they would probably secure with food-irrigated crops under conditions of reduced water availability.

*Teaching Associate, Department of Rural Development, Dr. B. R. Ambedkar University, Srikakulam, Etcherla-532 410 (Andhra Pradesh).

A Study on Agrosilvipastoral Farming Systems for Optimising Forage and Energy Resources in Rainfed Areas of Bundelkhand Region of Uttar Pradesh

M.M. Rajpoot, Archana Shukla, S.B. Saxena, Anshu Gupta and Vivek Kumar Chaurasia[†]

An attempt has been made to study the agrosilvipastoral farming systems for optimising forage and energy resources in rainfed areas of Bundelkhand region of Uttar Pradesh. The agrosilvipastoral systems involve croplands, forests and animal husbandry with interdependence on each other involving flow of products for sustaining productivity and human welfare. The components of crops, trees, grasses, and animals operate either simultaneously or sequentially in order to grow, produce benefit each other in an integrated manner. Silvipastoral system is commonly defined as growing ideal combination of grasses, legumes and trees for optimising land productivity, conserving plants, soils and nutrients and producing forage, timber and firewood on a sustainable basis. This involves replantation, substitution or intervention in the existing vegetation by desirable species. The silvipastoral systems tried in various research institutes across in the country have been habitat-specific organisation of species mosaics in two or three tier systems involving trees, shrubs, grasses and legumes. The trees selected for this system were multipurpose, nitrogen fixing, fast growing, adaptable, palatable and drought hardy. Most of the species tried were indigenous. The results of the study indicate that the silvipastoral system promises employment to rural youth in the activities of animal production, collection, processing, manufacturing value added products from the trees and grasses, collection and trading of quality seed and other materials. The establishment and management of silvipastures can employ on an average of 10 year cycle and employ 120 man-days/ha/yr. The increased number of activity days assure higher returns from the land based activities. Besides employment, it can add to the recreational and aesthetic value.

Dynamics of Decadal Diversification and Transformation of Dry Land Hill Agriculture – A Case Study of Village Kot, Hamirpur District, Himachal Pradesh

S.P. Saraswat, Prem Dahiya and Hemant Sharma*

Hill agriculture in Himachal Pradesh is characterised by mounting natural resource depletion, low crop productivity, unsuitability of traditional technologies

[†]Reader and Head, Department of Agricultural Economics, B.N.V.P.G. College, Rath Hamirpur (Uttar Pradesh), Assistant Professor, D.B.S. P.G. College, Govind Nagar Kanpur (Uttar Pradesh), Ph.D. Scholar, Department of Economics, National P.G. College, Bhogaon Mainpuri (Uttar Pradesh), Lecturer, Economics, Chitra Degree College Naubasta Kanpur (Uttar Pradesh), M.Sc. (Arg.) Student, Department of Agricultural Extension Bundelkhand University, Jhansi (Uttar Pradesh), respectively.

*Agro-Economic Research Centre, Himachal Pradesh University, Shimla-171 005, Former Principal Scientist (Econ.), Central Potato Research Institute, Shimla, and School of Management Studies, H.P. University, Shimla- 171 005, respectively.

etc. where hardly 20 per cent of the cropped area has irrigation facilities. The long-term demographic, social, economic and agrarian changes have markedly impacted the diversification and transformation of agriculture in the State. In order to investigate the decadal socio-economic changes and transformation in rainfed (dry land) hill agriculture, a village study of Kot village, Hamirpur district of the State was conducted with 2004-05 as the current study year, taking 1959-60 study undertaken by Agricultural Economics Research Centre, Delhi and 1989-90 study undertaken as the bench mark base years. Census method was followed and data were collected through structured schedules from 338 village households against the total number of 221 households (1989-90) and 124 households (1959-60). Tabular analysis was carried out for socio-economic evaluation, while Herfindhal index, Ogive index, entropy index, Modified Entropy index and Composite Entropy Index were used to estimate diversification of agriculture. The net sown area of the village is found to have declined from 41 per cent of total geographical area in 1959-60 to 33.4 per cent in 2004-05. The average operational holding size decreased significantly from 1.58 ha to 0.40 ha over the study period. The livestock sector also received a setback resulting in decrease in standard animal units being 3.29 in 1959-60 to 1.21 in 2004-05. The share of farm income in total household income decreased from 52 per cent in bench mark base year to 27 per cent in 2004-05. The analysis of diversification revealed a dominant shift in cropping pattern towards specialised farming of maize and wheat crops. The various measures suggested include improvement of infrastructure, fillip to non-farm sector and positive price policy for pulses, fodder crops and other millets for improvement of the village economy.

Role of Electricity Prices and Water Rights in Making Groundwater Use in Agriculture Sustainable: A Review

Nitin Bassi[†]

Groundwater emerged as a major source of irrigation in India during mid-1970s. However, larger expansion in well irrigation due to massive rural electrification programme, government policies for promoting private tubewell construction and large subsidies on electricity for agricultural use resulted in groundwater over-extraction in many semi-arid and arid regions of India. Further, most of the direct and indirect measures to regulate groundwater use have met with little success and have been largely ineffective in arresting groundwater over-exploitation. This paper reviews the institutional and market based instruments that are now being advocated by scholars and practitioners as potential instruments for sustainable groundwater use focusing mainly on research which examined the viability and impacts of establishing private and tradeable water rights in groundwater and pro-rata pricing of electricity for irrigation use as instruments to arrest the problems of groundwater over-

[†]Senior Researcher, Institute for Resource Analysis and Policy (IRAP), Delhi - 110 085.

exploitation in India. The findings of the study suggest that enforcement of private and tradable water rights in groundwater can together bring about a significant increase in farm outputs, with a reduction in aggregate demand for water agriculture. Further, it was found that flat tariff regimes, whether rationed or managed, has a limited potential to control groundwater and energy use in agriculture. Therefore, metering and pro-rata pricing of electricity have to receive priority, especially in naturally water-scarce regions which also experience groundwater overdraft. However, in the groundwater-abundant eastern regions, the pricing structure should be designed in such a way that it encourages greater use of groundwater for agricultural production.

Technological Diversification of Dryland Agriculture in Bundelkhand Region of Uttar Pradesh

R.R. Kushawaha*, **R.R. Verma***, **Heera Lal****,
Shanti Sachan[†] and **Anita Katiyar[‡]**

Dryland area contributes above one half the production of coarse cereals, pulses, oilseeds and cotton in the country. Because of the diverse agro-climatic conditions under which these crops are grown and the rainfed nature of their cultivation, dryland agriculture is characterised by wide spatio-temporal variations in productivity. Over the years, location-specific technological practices have been identified and suggested to the farmers to improve the productivity of crops, but their success has not yet been adequately assessed. In the paper an attempt is made to examine the extent to which these technological practices have expanded the production possibilities in agriculture. Besides it also attempts to develop a technology index of technology adoption which captures the multi-faceted nature of a technology package, and use it to categorise farmers as 'low' or 'high' adopters, for each of the three crops. The analysis suggests that production response surfaces are indeed different for the two groups, although in some crops, important variables have insignificant coefficients. A decomposition analysis suggests that in the case of cotton, half of the difference in productivity levels between low and high technology adopters may be attributed to technical change; the other half arising out of higher input use. A comparison of marginal products with the input- output price ratio suggests that many inputs are used sub-optimally. However, the application of less than recommended doses of inputs is the characteristic of dryland farming, and occurs largely due to the presence of risky returns. The production function analysis undertaken here does not incorporate risk considerations. Technology adoption is positively correlated with the

*Assistant Professor, Department. of Agricultural Economics, N.D. University of Agriculture and Technology, Kumarganj, Faizabad (Uttar Pradesh), **Lecturer, Department of Commerce Government, Degree College, Charkhari, Mahoba (Uttar Pradesh), †Lecturer, Department of Commerce Khalasha Degree College, Harijendar Nagar, Kanpur (Uttar Pradesh) and ‡Ph..D. Scholar, Department of Extension National P.G. College Bhogaon.

use of female labour particularly hired labour in all three crops. This is also accompanied by a decline in the relative share of family labour, presumably because family labour is not sufficient to meet the higher labour demand associated with technology adoption. Wages increase, as expected, during times of peak agricultural activity-with peak wages being one-and-a-half times that during the lean season. However, there are considerable wage differences among men and women, with men being paid nearly twice as much as women. Interestingly, the differential does not decline appreciably in the peak season. Unfortunately, in this study area, women's work is considered as merely secondary to that of men, even though families frequently subsist on women's earnings. The new technology appears not to have touched this fundamental inequity.

Growth, Variability and Potential of Dry land Crops in India

Rakesh Singh[†], H.P. Singh[†] and Vijaya Laxmi Pandey[‡]

The study attempts (1) to examine the pattern of crop production of semi-arid tropics (SAT) and non-SAT states; and (2) to examine the growth trend and variability in area, production, productivity and minimum support price of major crops in SAT and non-SAT states. The study is based on the secondary data for the period of 1986-87 to 2010-11. Compound growth rate and coefficient of variation were used to analyse the objectives of the study. During 2010-11, the share of SAT states in total cropped area was 90-99 per cent for cotton, gram, sunflower, groundnut, jowar, castor, safflower and soyabean; 80 to 87 per cent for pulses, ragi, bajra, tur; 60 to 70 per cent for linseed, niger seed, maize, small millets, rapeseed-mustard and sesamum and 33 to 58 per cent for wheat, rice, sugarcane, millets and barley. The share of SAT states to India's production was 92 to 99 per cent for groundnut, jowar, castor, safflower and soyabean production; 84 to 90 per cent for sunflower, cotton, total oilseed, ragi and gram; 49 to 79 per cent for niger seed, sugarcane, barley, rapeseed-mustard, sesamum, bajra, maize, total pulses and tur and 25 to 47 per cent for wheat, small millets, rice and linseed. The variability was very high in case of area, production and yield of different crops grown in the SAT states. The farmers reduced area under the one crop and increased in other crop due to improvement in yield of that crop. Due to enhancement in availability of water for irrigation purposes farmers are reducing area under millets, oilseed and pulses and allocating for soyabean, paddy, wheat and sugarcane cultivation in SAT states. The gross value of agricultural output in the country was Rs 7604.02 billion during 2008-09. Out of this, the share of SAT states was Rs. 3339.51 billion. The country's gross value of output from livestock sector was Rs 2794.53 billion. Out of this, the share of

[†]Professor and Head, and Professor, respectively, Department of Agricultural Economics, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi and [‡]Associate Professor, Indira Gandhi Institute of Development Research, Goregaon (East), Mumbai-400 063.

SAT states was 45.48 per cent. Crop produce of SAT states having very low fertiliser application should be treated as safe/organic produce and provision of premium price will improve the income of the farmers. The safety-net programme should be provided to SAT farmers due to high risk of crop failure. It is required to develop and promote agri-business activities in dry land regions. Higher minimum support price (MSP) and enhanced procurement with assured market must be provided for improving the income of SAT states farmers.

Analysing the Instability in Agricultural Performance: A Region-wise Analysis of Gujarat

Jharna Pathak and Itishree Pattnaik*

An attempt is made in this study to examine the growth and instability of agricultural production in seven agro-climate regions of Gujarat in three different periods, i.e., 1980-89, 1990-99 and 2000-2009. Adoption of new technology was believed to reduce instability in the early phase of adoption of green revolution in India. These observations were limited to irrigated belts of the country. The study indicates that when a dryland region like Gujarat is considered, the inference on increase in instability due to adoption of new technology gets vague. The analysis indicate that the development of irrigation and associated new technology during the last decade or so has not been effective in curbing the instability of crop production in the state as well as in different regions. The state level estimates of instability in agricultural production mask the considerable inter-regional differences in these estimates. Ridge regression is used to understand the factors leading to instability in the gross value of output. It is evident that the state which is highly dominated with semi-arid climate has shifted its focus from high growth-heavy rainfall zone to other regions by extending the irrigation coverage, mainly through groundwater irrigation. The cultivation of water intensive crops through extensive use of groundwater in the semi-arid and arid region poses serious question towards the stability and sustainability issue for the near future. The study suggests the need to develop nationally relevant technical, institutional and financial policies to promote sustainable agriculture, ensure that risk to small farmers is minimised, and raise crop productivity and incomes. With appropriate investments through participatory and community-based institutions to ensure persistence of new practices, combined with appropriate policy support at all levels, it is clear that the sustainability agricultural practices is large. Implementation of sustainable agriculture by community and the Government jointly could increase the flow of new technology and investment leading to additional environmental and social benefits.

*Assistant Professor, Gujarat Institute of Development Research, Ahmedabad - 380 060 (Gujarat).

Assessment of Economic and Ecological Returns from Millet-Based Bio-Diverse Organic Farms vis-à-vis Conventional Farms

B. Suresh Reddy[†]

The study has focused in the socio-economic, ecological and livelihood dimensions of organic farming practices in dryland regions of Andhra Pradesh. The ill effect of green revolution has encouraged the farmers to take up organic farming. Based on the empirical evidence, this study analyses the economic and ecological returns of organic farming vis-à-vis conventional farming. The study was carried out in 8 villages of Anantpur district of Andhra Pradesh and a total sample of 75 organic farmers were selected from the study villages using proportionate random sampling technique. The study reveals that crop diversity has enhanced in organic farms with a prominent place for millets. Adoption of organic farming practices has positive implications for soil fertility management, pest management and for withstanding risk of climate changes in dryland regions. Organic farming is doing better compared to chemical farming on several fronts. However, a very strong support for livestock development is essential for better results in organic farming. There is a need for strong support to it in the form of subsidies, agricultural extension services and research.

Role of Institutional Support System in Drought Management: Evidence from Western Odisha

Mrutyunjay Swain*

The paper analyses the major role played by government safety nets, community level insurance mechanism and institutional support system in mitigating the drought risk and vulnerability in Bolangir district of western Odisha. The role played by the centre-state relationship and power equations in flow of funds for drought management has been critically examined in the context of the study region. The evolution and efficacy of drought management policies and development schemes have also been analysed. In addition to analysis of secondary data and literature, the primary survey data on 139 households have been analysed to assess the effects of institutional support system on households' resilience. The institutional support system was found to be weak in the study region to withstand drought in an effective manner. Though a gradual improvement to the drought management policies was observed and every major drought induced some qualitative improvement to the relief

[†]Associate Professor, Research Unit for Livelihoods and Natural Resources, Centre for Economic and Social Studies, Hyderabad – 500 016 (Andhra Pradesh).

*Research Officer (Economics), Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar-388 120 (Gujarat).

approach, the nature of centre-state relationship and influence of pressure groups were found to play a key role in the sanction of funds and implementation of the schemes.

Economic Viability of Sprinkler Irrigation in Vegetable Production in Temperate High Hills of Himachal Pradesh

Virender Kumar, Harbans Lal, K.D. Sharma and Suneel Thakur[†]

Agriculture in Himachal Pradesh is mostly rainfed. However, the inherent variations in agro-climatic conditions duly supported by appropriate policy regimes have resulted in quadrupling of vegetable production in the past two decades. Notwithstanding all these achievements, acute water scarcity and receding snowline have started impacting commercial vegetable growing. Under these circumstances, huge state support in terms of subsidies for using water-saving methods of irrigation, have encouraged farmers towards sprinkler irrigation in the state. Among the twelve districts of Himachal Pradesh, Shimla district was chosen for present study since it is the leading vegetable producing district and also there is general water scarcity for irrigation in the district. As high as 96 per cent of the total cropped area is rainfed in the district. Using an appropriate methodology, a random sample of 50 farmers was selected to examine the economics of sprinkler irrigation in vegetable cultivation in this district. The results indicated that cauliflower, cabbage, tomato, beans, pea, potato and capsicum were the main crops grown with sprinkler irrigation. Cropping intensity on sample farms was found to be 204 per cent. The average yields of most of the crops except cauliflower and cabbage were found to be higher as against the potential average yields of these crops. Among different crops, cabbage (*kharif*), tomato (*rabi zaid*) and green pea (*rabi*) were more remunerative. The expenditure on fertilisers, irrigation (number) and human labour were found to be affecting production of these crops significantly. The investment on sprinklers was highly beneficial as indicated by the project worth measures of benefit-cost ratio (BCR) and internal rate of return (IRR) both with 50 per cent subsidy and without subsidy. Based on the above findings, it would be worthwhile to encourage and keep incentivising the use of sprinkler irrigation in vegetable cultivation in Himachal Pradesh.

Technological, Institutional, Infrastructural and Policy Imperatives for Chickpea Production under Dryland Agriculture

Brahm Prakash and A.K. Sharma*

The paper attempts to analyse the dynamics of resource allocation to chickpea production in the national and dryland region and describes the technological

[†]Department of Agricultural Economics, Extension Education and Rural Sociology, College of Agriculture, CSK, Himachal Pradesh Krishi Vishwavidyalaya, Palampur-176 062 (Himachal Pradesh).

*Indian Institute of Sugarcane Research, Lucknow - 226 002 (Uttar Pradesh).

imperatives for improving its production in the dryland areas and to suggest suitable institutional, infrastructural and policy measures for increasing chickpea production. The study is based on the data available from secondary sources. It is revealed that the area under chickpea cultivation in dryland region increased from 3.594 million ha to 7.643 million ha. Chickpea production in Andhra Pradesh presents a model case where area and production of chickpea have experienced an upward trend during the last decade with 3.8, 9.3 and 2.4 fold increase in area, production and yield, respectively during last decade (1999-2000 to 2008-09) which can be attributed to the development of short duration and wilt resistant varieties like ICCV 2 and JG 11.

Research efforts made in the past through National Agricultural Research Systems (NARS) have led to release of more than 125 varieties, which are adapted to different agro-ecological zones and have the in-built capacity to tolerate some of the prevalent key biotic and abiotic stresses. The most productive, remunerative and sustainable cropping systems involving chickpea have been identified. Development of bio-intensive integrated pest management (IPM) technologies has helped in reducing the intensity and frequency of key biotic stresses and reduction in the cost of production. A fresh fillip is required to increase yield of the varieties grown organically by way of augmenting the production technology without using any chemical. Balanced and efficient fertilisers application combining organic fertilisers, organic manures and bio-fertiliser is essential for realising higher yield and reducing cost of cultivation. Field level demonstrations have shown that there was a yield advantage of 25 per cent over the local varieties during the period 1993-98 with the average yield range of 13.57 to 16.17 qtls/ha, while 21.8 per cent gain was recorded during the period 2005-10 with mean yield of 13.67 to 17.07 qtls/ha. The study suggests the need for accruing the benefits from the free trade, major structural reforms such as rationalisation of subsidies on inputs, institutional reforms related to rural credit at low rate of interest, opening of lease market, popularisation of integrated management approaches, strengthening of post-harvest infrastructure for handling processing, storage and marketing of chickpea is required along with lifting of all curbs on movement, stocking, trading, credit, processing and exports. Suitable land policy to improve the land propriety rights and security of land tenure are the major factors in determining farmers' willingness to invest in land amelioration. The farmers should be integrated with futures markets through market intelligence services to use future markets as a tool to take proper decision. Apart from it, contract farming by providing necessary backward and forward market linkages to the farmers, consolidation of supply chain and establishment of rural business hubs having facilities for processing and value addition where farmers can sell their produce at the best price are some of the measures to boost profit of chickpea farmers. The establishment of private market yards, direct purchase centres, consumers/farmers market for direct sale and promotion of public-private partnership (PPP) in the management of development of agricultural markets are also the need of the hour.

Development of Dryland Agriculture: A Snap Shot of Agricultural Marketing Infrastructure

M.S. Jairath and P. Mallikharjuna Charyulu*

A strong market infrastructure and marketing institutional set-up enables the agricultural sector to be vibrant and dynamic. The information about their availability is scarce, scanty and sporadic. The study addresses and examines the availability of agricultural marketing infrastructure for marketing of the produce and offer suggestions to improve the dry land agriculture. The selected dry land area is known for spice crops, i.e., cumin, fennel, fenugreek and chillies. The study indicates that the area served by each regulated market in dry land area as well as arid state is extremely poor and requires promotion of number of regulated markets for serving farming community of the region. The share of fruits and vegetables markets in total regulated markets is low. Most of the regulated markets at present still lacks facilities for handling produce due to less space for auction platform, inadequate number of shops and godowns in the premises etc. and hence reduces the effective participation of the traders. The storage density is only 0.12 in dry land areas. The number of godowns available is much lower, i.e., 2.60. The cold storage capacity available in the dry land area is nearly non-existent. The density of number of trucks per 00' sq. km. area is much below than the state average of 27.88. The availability of trucks for handling per 000' tonnes of agriculture and horticulture produce in the dry land area was a shade below (i.e., only 2.61) than the average of 2.65 in the State. The densities of Agmark laboratories per 00' sq. km. area in the dry land area is much low compared to the State. Similarly, there is only one MIS center for one-lakh tonnes of agricultural produce in dry land areas. Besides the available different infrastructural facilities are extremely poor in the dry land areas as compared to the State both in terms of physical accessibility, i.e., on per 00'sq. km of area and for handling agriculture and horticulture produce, i.e., per thousand tonnes of produce. Their availability is very pathetic in some of the districts of dryland areas which are agriculturally also poorly developed. Thus, there is need for augmenting expansion of marketing infrastructures in the dryland areas in general and in poorly developed districts in particular which needs to be strengthened so that the farmer-producers of the dryland area are also benefited as compared to their counter-parts pursuing agriculture in other parts of the State. To enhance the availability of marketing infrastructure, the study suggests that (a) infrastructural facilities like selling platforms weigh bridges, drinking water facilities, sanitary blocks, cattle trough, internal roads, electricity and market information system should be developed; (b) The State Agricultural Marketing Boards and the private sector should be encouraged to provide the grading facilities in the growing regions of the crops by setting up of grading and packing houses; (c) To meet the increasing storage requirements in

*Director, National Institute of Agricultural Marketing, Ministry of Agriculture, Government of India, Jaipur – 302 033 (Rajasthan).

future for production of agricultural as well as horticulture produce, the private and co-operative sectors be encouraged to create more of rural godowns, cold storages and scientific storage structures in the producing regions in addition to their construction in public sector; (e) Refrigerated and rapid transportation system for transport of perishable agricultural commodities needs to be promoted in dry land areas by specifically designed scheme to attract participation of private sector; (f) Introduction of integrated system of bulk handling, transportation and storage would open new vistas in agriculture and horticulture in dry land areas; (g) There is an urgent need to develop and promote post-harvest technology for different crops grown in the area. The arrangements for overcoming the problems of excessive field heat, pre-cooling arrangements, preservation of techniques and local storage methods be developed; (h) The MIS should be extended to cover all important agricultural markets and important commodities produced by the farmers. (i) There is need for augmenting agro-processing units in the dry land areas especially for spices and condiments. Oil extraction, cotton ginning and processing of fruits and vegetables at a small scale needs to be introduced; and (j) producer-growers of dryland areas needs to be made aware on marketing practices, orderly marketing such as cleaning, grading, packing, labeling, food safety etc., intensively by launching extension campaign on war-footing in the dryland areas.

Impact of Water Harvesting System (Watershed) in Bundelkhand Region of Uttar Pradesh

Babu Singh, Birendra Kumar, Anjani Kumar Singh and Balwan Singh[†]

The study aims to assess the impact of the completed watershed development project in Bandh village of Jalaun district in Uttar Pradesh in terms of its improvement in income and employment surrounding the project area. The study observed the average net cultivated area to be 108.50 ha and 182.12 ha, before and after watershed project implementation. It is concluded that implementation of watershed development project has resulted in area expansion, increase in livestock population and improvement in crop productivity. Besides the project has helped to arrest degradation of both arable and non-arable lands. All these have enhanced farmers income and employment opportunities at the local level and Small holders have been benefited more and have improved their livelihood. Besides it has also improved the vegetation in the command area, which in turn has improved the quality of life of the rural masses.

[†]Department of Agricultural Economics and Statistics, C.S. Azad University of Agriculture and Technology, Kanpur-208 002.

Free Electricity for Agriculture and Its Implications for Farmers' Well-Being, Farm- and Non-Farm Employment and Crop Productivity in Andhra Pradesh

Jin Kathrine Fosli and A. Amarender Reddy*

This paper is a part of an exploratory study conducted by the team at ICRISAT on the impact of 'free electricity policy on farmers well being'. The team interviewed all the stakeholders' farmers, academicians, irrigation specialists and administrators who are directly involved with the policy and affected by it. The study team also visited four villages in Andhra Pradesh and conducted focus group interaction with farmers to know the impact of the policy. The opinions are substantiated and cross checked with data wherever possible. While it is fair to say that free electricity for agriculture is a small amount compared to the subsidies received by the farmers in command areas, it can also be argued that the state should recover adequate costs for canal water supply instead of providing the subsidy. On the other hand, the policy is seen as a lifeline to a crisis-ridden agricultural sector in drought prone non-command areas. In addition, subsidies of some kind may be a necessity to sustain rural livelihoods and avoid urban migration causing pressure on the cities and infrastructure. But there is a danger of the policy causing farmers to take unbearable risks, which may be aggravated by the fact that farmers under bore-wells in general have a low level of co-operation. Under the current regime, strengthening institutional mechanisms such as minimum support prices and enhancing alternative methods such as 'bore well water users association' and sharing and entering into joint ventures, may relieve risk burdens. There is room for improved efficiency in electricity and water usage in general among borewell farmers. In addition, tanks should be maintained as an additional water source.

Pearl Millet - Status in Dry Land Agriculture of India

Arjinder Kaur, Sukhjeet K. Saran and Parminder Kaur[†]

Pearl millet has emerged as an important cereal crop of dry land agriculture due to its adaptability to prevalent climate there and good yield potential as compared to competitive crops. It has depicted highest average growth rate of production and productivity from 1950-51 to 2011-12 among all the principal crops of India. The area under this crop has declined over time due to dominance of superior cereals since the inception of new technologies, but its production and productivity has increased. This growth can be attributed to improved varieties and increased demand potential of this crop. It is mainly a crop of arid climates of Rajasthan, being a leading producer followed by Uttar Pradesh, Gujarat and Maharashtra. Procurement

*Institute of History, Archeology and Conservation, University of Oslo, Norway and International Crops Research Institute for Semi-Arid Tropics (ICRISAT) Hyderabad – 502 324 (Andhra Pradesh), respectively.

[†]Department of Economics and Sociology, Punjab Agricultural University, Ludhiana-141 004.

of this crop is lacking on the part of public agencies, but minimum support price as well as harvest prices of this crop has shown an increasing trend. Pearl millet is mainly considered as the poor man's staple diet, so a major part of its production is used for self consumption by the producers, showing a fluctuating trend in the marketed surplus ratio (MSR) among the states. Overall, increase in MSR in the last decade has indicated acceptability of the grain in the changing demand scenario. An overall declining trend has been observed in foodgrain consumption in India since 1993-94, both in rural as well as urban areas. But the share of pearl millet in the consumption of coarse cereals has shown an increase over time, hinting at its preference for consumption among the coarse grains. Thus it can be concluded that pearl millet is an important *kharif* crop of dry lands being a staple diet of many civilisations. Its increasing popularity among the consumers is sure to create a demand-led growth for this crop. The increasing research in its nutritional value is bound to add to its acceptability in the foodgrains market.

Impact of Food Prices on Food Security: A Distribution-Sensitive Analysis for Rural Households of Rajasthan and Gujarat

Sumit Mahajan*, Shiv Raj Singh and K.K. Datta***

The rapidly growing population and rising incomes are placing great pressures on food security in India. A vast area of India is arid/semi-arid and therefore rural population residing in these areas are exposed to food price spike due to frequent droughts. Rising food prices increase food insecurity. A large area of Gujarat and Rajasthan is rainfed and is vulnerable to food insecurity in the event of natural calamities. The paper uses representative data from the National Sample Survey Office (NSSO) on household consumption expenditures of rural households of Rajasthan and Gujarat covering the years 2009-2010 in order to analyse the effects that food price changes have on food expenditure and calorie intake in these states. Besides documenting the extent of malnutrition in different quantiles of the population, this paper shows a clear and strong negative effect of price rise on calorie intake. The negative impact of prices of foods particularly wheat and, milk is more on richer than on poorer households as they have the capability to cut calorie intake in the event of a price rise. But this is opposite in the case of coarse cereals. The food prices particularly, milk, wheat and, pulses also have highly positive influence on food expenditure of poorer households. Rice does not have much significant effect on food security in both the states. The government should re-orient the structure of public distribution system and make it more location-specific. Measures should be taken to stabilise the prices of food products. As the women-headed households were

*Ph.D. Research Scholar and Head, respectively, Division of Dairy Economics, Statistics and Management, National Dairy Research Institute, Karnal – 132 001, **Assistant Professor, Dairy and Food Business Management, Sardarkrishinagar Dantiwada Agricultural University, S. K. Nagar-385 506 (Gujarat).

found to be more food secure, gender-sensitisation programmes regarding health and nutrition should be carried out.

Impact of MGNREGS on Dry Land Agriculture in Karimnagar District of Andhra Pradesh

D. Kumara Swamy and C.V. Hanumanthaiah[†]

A study was conducted in Karimnagar district of Andhra Pradesh to assess the impact of Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) on dry land crops cultivation by choosing three prominent rainfed oriented crops, viz., redgram, jowar and groundnut and various economic parameters in cultivation. For the purpose, a sample of 128 farmers was selected comprising equal number of farmers from high and low MGNREGS implemented mandals of the district and also equal number of beneficiaries and non-beneficiaries of the scheme. The results revealed that the percentage of area under the selected crops out of the total cultivated area by the sample farmers was very less in the case of beneficiaries than the non-beneficiaries. In low implementation area, non-beneficiaries were spending more money than the beneficiaries on cost of cultivation and also getting 30.1 per cent higher income from livestock than beneficiaries. But in high implementation area, there was not much difference between beneficiaries and non-beneficiaries in the case of cost of cultivation but interestingly livestock income was higher for beneficiaries by 12.4 per cent than the non-beneficiaries of the programme. It was found that with the various types of works that were being taken up in MGNREGS simultaneously along with providing of guarantee employment it was believed to address almost all the severe problems of dry land agriculture.

Sustainable Agricultural Development through Watershed Programme in Rainfed Areas: A Case Study in Coimbatore District of Tamil Nadu

Subhash Chand, Alok K. Sikka, M. Madhu, D.V. Singh, V. Selvi, R. Ragupathy, P. Sundrambal and V.N. Sharda*

A study was conducted in Salaiyur watershed in Annur block of Coimbatore District in Tamil Nadu state of India with the aim to develop social fencing against natural resource degradation in project area. To improve ground water availability, 231 ha-cm additional rainwater storage capacities was created by rejuvenation of the existing percolation ponds and construction of new check dams and percolation ponds through watershed committee. The lining of surface water storage pond was done which has resulted in 33 per cent water saving. Water saving of 29 per cent was

[†]Ph.D Scholar and Professor, Department of Agricultural Economics, College of Agriculture, Acharya N.G. Ranga Agricultural University, Hyderabad-500 030 (Andhra Pradesh).

*Central Agricultural Research Institute, Port Blair – 744 105, Andaman & Nicobar Islands.

observed due to adoption of drip irrigation for growing banana and sugarcane. Horticulture and agri-horticulture were taken up on a large scale for raising mango, tamarind, sapota, amla etc., by adopting improved micro site and pitting methods as diversified land use system. The mechanical pitting with improved micro site condition recorded better growth performance than the manual pitting. The mulberry was introduced in the watershed which has resulted good returns to the farmers. Various productivity indicators show the positive impacts of the different activities undertaken in the watershed. A total of 8389 man-days of employment was generated in the watershed. The contributions by farmers towards different works varied from 10 to 50 per cent of the total cost of work in terms of cash and kind. The project has encouraged good women's participation. Overall, the impacts of the watershed project have been encouraging in terms of technological, socio-economic and participatory aspects. This watershed also has become a model for state government academicians, NGOs, students etc. for creating awareness towards natural resources conservation. These agencies are regularly visiting the watershed and bringing the stakeholders for exposure visits.

Is Economics of Rainfed Crops Worsening than Irrigated Crops? An Exploratory Analysis from 1971-72 to 2009-10

A. Narayanamoorthy, P. Alli and R. Suresh[†]

An attempt is made in the paper to study and understand the economics of cultivation of seven important crops, namely, jowar, bajra, maize, tur, gram, groundnut and cotton grown under two distinct conditions, namely, irrigated and rainfed in different states in India. For each crop, two states have been selected each of which cultivate the crop in relatively more irrigated and less irrigated/rainfed condition. The cost of cultivation data published by the Commission for Agricultural Costs and Prices for the period 1971-72 to 2009-10 has been mainly used for this study. The profit of various irrigated and rainfed crops is computed by deducting the cost C2 from the value of output at 1986-87 prices. The study shows that there is no marked difference in the profitability of cereal crops (jowar, bajra and maize) cultivated between irrigated and rainfed conditions. The farmers cultivating these crops have incurred substantial losses more number of times than the other crops selected for the analysis. Unlike the cereal crops, the pulse crops (tur and gram) unbelievably turned out to be profitable to the farmers under both the irrigated and rainfed conditions. The rainfed pulses have performed equally well in terms of profitability as compared to the irrigated pulse crops. In the case of groundnut crop, the rainfed state of Gujarat has outshined the irrigated Tamil Nadu state where farmers have suffered losses more number of times as compared to its counterpart

[†]NABARD Chair Professor and Head and Ph.D. Fellow respectively, Department of Economics and Rural Development, Alagappa University, Karaikudi-630 003 (Tamil Nadu).

farmers in Gujarat. The cotton crop has proved to be a massively loss making crop under rainfed condition, while it proved to be a quite profitable venture under irrigated condition. Because of fast increase in the cost of cultivation, the profitability of the crops has been severely hit mostly during the agrarian crisis period, which is from 1995-96 to 2009-10. The analysis of these selected crops has not completely supported the long held view that irrigated crops are more profitable than rainfed crops.

Supply Response Analysis of Major Pulse Crops in India

S.M. Vembu, T.K. Immanuelraj and M.B. Dastagiri*

Supply response studies in the past were based on traditional econometric techniques like classic linear regression and the Nerlovian framework. The results of traditional econometric techniques are reliable when the time series data are stationary. However, there is a possibility that some macroeconomic time series data are non-stationary and the results obtained are invalid. Time series annual data for all the major pulses during the period from 1970-71 to 2010-11 were used for estimation. This paper specifically attempted to quantify the relationship between pulse production and the price and non-price factors, viz., land productivity, annual rainfall, irrigated area and revenue difference between cereals and pulses, when the data for different variables are neither stationary nor non-stationary of the same order of integration. The results indicated that yield is a significant variable in the selected pulse crops, implying in the long run the stagnation can be overcome by varietal development and improvements in cultivation practices. Cereal crops are certainly competitors of major pulses. However, they are not found to be competitive in the case of black gram and green gram. The prices of pulses have been consistently increasing during the last few years. However, producers are still not attracted towards pulses cultivation. The reason for this may be the relative difference in revenue generated from pulse crops and their competing crops. Revenue generated is a function of the production technology and the price of the crop concerned. Since the farmer is a net income maximiser, he cultivates crops which are more remunerative. As revenue obtained from pulse crop is less than competing crops it fails to attract the farmers' attention. To increase pulses production, either technological change has to be brought about or the prices of pulses have to be increased to such an extent that revenue from a pulse crop becomes higher than that from its competing crops. The finding of this study thus concludes that rainfall and revenue difference between the prices of cereals and pulses are the major determinants of pulse production.

*Ph.D. Scholar, Division of Agricultural Economics, Indian Agricultural Research Institute, New Delhi – 110 012 and Scientist and Principal Scientist, National Centre for Agricultural Economics and Policy Research, New Delhi – 110 012.