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SUMMARIES

SOCIO-ECONOMIC IMPACT OF MINOR IRRIGATION SCHEME: A CASE STUDY

V. B. Jugale*

Irrigation is an old technique adopted to increase agricultural production. It helps in the modernization of inputs, and growth in production. Agriculture in India is largely dependent on rainfall which is erratic. And therefore, a number of major, medium and minor irrigation schemes have been introduced. The paper attempts to analyse the growth of irrigation and its impact of land use, crop pattern, crop productivity, agricultural technology, etc., in Shiron tehsil (district Kolhapur) in Maharashtra State during the period from 1969-70 to 1980-81 when nearly 42.27 per cent (14,030 hectares) of the area has been brought under irrigation. During the study period, the gross cropped area has decreased by 0.34 per cent and the total holdings by 1.72 per cent because of widening of roads, construction of new roads, etc., and the cultivable waste increased by 0.39 per cent. After the installation of irrigation schemes in the tehsil, the sugarcane area has increased from 4,239 hectares (8.61 per cent) to 12,484 hectares (31 per cent) and the area under cereals and pulses has decreased from 16,135 hectares (32.79 per cent) and 3,550 hectares (7.21 per cent) to 6,014 hectares (14.93 per cent) and 344 hectares (0.85 per cent) respectively.

Immediately after irrigation the average yield of sugarcane (a leading crop) has increased to 43 tonnes, but at present it has declined to 26 tonnes. This is due to either shortage of irrigation water or heavy doses of fertilizers and water. The number of tractors as well as their use, and the use of threshers, harvest combines, etc., have increased after irrigation. The number of wooden ploughs and iron ploughs has increased from 606 and 1,980 to 1,138 and 2,467 respectively. The use of fertilizers has increased from 150 kg. to 900 kg. per acre. The use of HYV of jowar, rice, sugarcane, wheat and groundnut has also increased. The use of recreation facilities and durable goods utensils has been intensified. The literacy has increased from 42 per cent to 65 per cent. The irrigation facilities have generated employment opportunities in sugar factory, farm units, agro-service centres, input industries, etc. But the irrigation has created the salinity and alkalinity problems. Irrigation is a crucial factor in agricultural practices.

ECONOMIC EVALUATION OF DEEP TUBEWELL SCHEMES IN JORHAT SUB-DIVISION OF ASSAM

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The study was taken up in 1982-83 with the objective of examining the economic feasibility and management efficiency of deep tubewell schemes in

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Jorhat sub-division of Assam using different capital budgeting parameters like benefit-cost ratio, net present worth, internal rate of return and pay-back period. These parameters were worked out in respect of the existing irrigated area, 50 per cent of the total potential area and total potential area. The study was based on a sample of 40 beneficiary and 35 non-beneficiary holdings. The analysis brought out that at 12 per cent discount rate the benefit-cost ratios were 0.61, 0.95 and 1.90, the net present worths Rs.22,835.55, Rs.1,834.75 and Rs.16,836.35 per hectare, the internal rates of return 3.75, 11.00 and 30.84 per cent and the pay-back period 45.88, 26.52 and 12.20 years for the existing size of irrigated area, 50 per cent of the command area and total command area respectively. All these parameters indicated that the deep tubewell schemes would be economically viable propositions only if irrigation facilities could cover more than 50 per cent of the command area under the schemes. At the current size of irrigated area, it was economically infeasible. Inefficiency in management of the schemes was due to lack of land levelling, less capacity of motors and pumps and lack of co-ordination among concerned departments. Hence, the beneficiaries faced the problems of untimely and inadequate supply of water.

ECONOMIC IMPACT AND EFFICIENCY OF WATER USE — A CASE STUDY OF DANTIWADA CANAL IRRIGATION PROJECT IN GUJARAT

Arun S. Patel and Haribhai F. Patel*

In this paper an attempt is made to present the different aspects of the direct economic effects of Dantiwada irrigation project in Gujarat. The paper also discusses the efficiency of water use at the farm level in the command area. The analysis is based on the relevant data collected from a proportionate stratified random sample of the farmers, 12 from each of the 12 representative sample command villages of the project. Here, the economic impact is judged on the basis of a comparison between irrigated and rainfed farming practised by the sample cultivators. The reference year of the study is 1979-80. The study made here clearly reveals that the crop pattern and input structure in the irrigated farms are distinctly different from those observed for the rainfed farms. Consequently, the per hectare net income in the irrigated farms is found to be higher by Rs.896 over that in the rainfed farms. On the other hand, the employment of human labour in the irrigated farms is found to be higher by 34 man-days per hectare or by 61 per cent over the one used in the rainfed farms. On the whole, the overall distribution of benefits of irrigation remains unfavourable for the marginal and small farmers as against that for the medium and large farmers. Although the impact of irrigation is clearly visible in the area under study, allocation of water among crops is not found to be efficient. There is, therefore, a need for reallocation of water from less paying to high paying crops. Besides, the proper water use techniques along with the required quantity of the use of strategic inputs should be practised to obtain the possible higher return per unit of land.

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AN EVALUATION OF WATER MANAGEMENT PROGRAMMES IN THE PUNJAB STATE

Rajinder Singh*

Water management programmes in Punjab were started primarily on cultivators' fields to increase agricultural production and income of the farmers through efficient use of water resources. In this paper, an attempt is made to evaluate their economic viability and examine their impact on farmer's income. The study was conducted in two subdivisions—Sangrur and Bhatinda—of Soil and Water Conservation Department, Punjab. The study covered randomly selected 47 farms—11 beneficiary and 11 non-beneficiary farms for underground water pipelines; and 15 beneficiary and 10 non-beneficiary farms for lining of canal watercourses. The analysis for 1980-81 indicated that the percentage of cropped area under more remunerative crops like sugarcane and paddy was significantly higher on the beneficiary farms as compared to that on the non-beneficiary farms for underground water pipelines. In the case of lined canal watercourses, the cropping pattern was not very much affected. The cropping intensity in the case of lined and non-lined canal watercourses was 182.26 per cent and 175.58 per cent respectively, while it was 200 per cent on the beneficiary and non-beneficiary farms in the case of underground water pipelines. This happened through the increase in the availability of irrigation water. The use of major inputs was significantly higher on the beneficiary farms than that on the non-beneficiary farms. The difference in yield levels of wheat, paddy, sugarcane and cotton between the beneficiary and non-beneficiary farms was statistically significant due to higher use of inputs on the beneficiary farms. The net income of the beneficiaries was significantly higher than that of the non-beneficiaries by Rs. 508.29 for underground water pipelines and Rs. 331.43 for lined canal watercourses. Over a project life of 50 years for underground pipelines and ten years for lined watercourses, using a discount rate of 12 per cent, the net present value of future flow of incomes per acre was Rs. 3,397.17 and Rs. 1,360.99 respectively for underground pipelines and lined canal watercourses. The benefit-cost ratio indicated that an investment of one rupee resulted in a benefit of Rs. 5.14 and Rs. 3.66 respectively for underground pipelines and lined canal watercourses. The internal rate of return and pay-back period for underground pipelines were 61.91 per cent and 1.91 years respectively while these indicators were 64.33 per cent and 1.81 years respectively in lined canal watercourses. The findings indicated that the programmes significantly increased the farmers' incomes and were economically feasible.

RELATIVE EFFICIENCY OF DIFFERENT TYPES OF IRRIGATION CROSS-BARS VS. LIFT IRRIGATION

C.J. Joseph†

This paper aims at examining the relative efficiency of cultivation under two types of minor irrigation projects in Kerala lifts and cross-bars—in terms of input use, output, productivity and profitability. Regarding cost differences, for the year as a whole, the total cost per unit net sown area and the total cost

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per unit gross cropped area were not significantly different between both types of irrigation systems. They declined with an increase in the size of farms under both. No significant differences existed in the application of inputs as between the two types of areas. The output per unit of land cultivated (net sown area) was higher by 24 per cent under lift irrigation; gross output declined almost steadily with an increase in the size of holdings in both the types of areas. Among the factors which account for this difference are differing land fertility, intensity in input use and enhanced productivity and the last one seems to play a dominant role. The higher output under lift irrigation shows the superior efficiency of this method of irrigation.

Both net income and farm business income were higher in the lift irrigation than those under cross-bar irrigation. Thus lift irrigation is superior to cross-bars when profitability per unit area of land holdings alone is considered. The foregoing analysis excluded from its purview the relative cost of providing irrigation per unit area. Hence, it may be alleged to be unrealistic. The cost of providing irrigation seemed to be higher in lifts than in cross-bars. The latter enjoyed a higher benefit-cost (B-C) ratio. However, the higher B-C ratios did not confirm that cross-bars were more efficient and desirable. First, these two systems of irrigation cannot be substituted for each other; they are location-specific. Secondly, they economise costs, but yield a low level of output. Hence, B-C ratios cannot be taken as reliable guide for economic policy in an economy plagued by unemployment and under-employment and where maximization of B-C ratios should yield precedence to output maximization.

IMPACT OF IRRIGATION ON CROPPING PATTERN AND FARM INCOME UNDER OPTIMAL SOLUTION (A CASE STUDY IN FOOT HILLS OF H.P.)

D.V. Singh and S.P. Saraswat†

All efforts to increase agricultural production will fail if the crops do not get the required water. Thus, irrigation facilities become the necessary prerequisite for productive agriculture. The farmers of Himachal Pradesh are more or less dependent upon rains. However, with the planned development of agriculture in the State much emphasis was given to bring more areas under irrigation. Since the topography of land in the State restricts the expansion of irrigation facilities, the only areas left for the further development of irrigation infrastructure are the valleys in the State. The study of marginal, small and medium farmers in the valleys of Himachal Pradesh State suggests that the existing cropping patterns are sub-optimal, indicating thereby that even without bringing additional lands under cultivation, agricultural production can be substantially increased by adopting optimum crop plans with the existing resources base and irrigation facilities. The present farm incomes can be increased by Rs.89 on the marginal farms, by Rs.160 on the small farms and by Rs.262 on the medium farms. Thus, expansion of irrigation can boost the

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income of farmers by increasing the productivity of land. The optimum cropping pattern involves fewer crops, indicating thereby a trend towards crop specialisation and suggests the scope for farm management extension programmes.

To enhance the irrigation facilities of the State, (i) more emphasis should be given on the development of minor irrigation projects and (ii) ground-water resources should be exploited by establishing tubewells, etc., in the valleys of the State. For better development of irrigation, government should construct the necessary infrastructure facilities and hand them over to the farmers for their use. The investment in these projects should be recovered in instalments from the beneficiaries involved and some amount of subsidy be also provided for the encouragement of farmers' participation.

A COMPARATIVE STUDY OF THE IMPACT OF SURFACE AND LIFT IRRIGATION SYSTEMS ON THE CROPPING PATTERN, INCOME DISTRIBUTION AND ECONOMIC EFFICIENCY ON THE PUNJAB FARMS

P.L. Sankhayan and Inder Pal Singh*

Data pertaining to the agricultural year 1980-81 for 200 farms following different systems of irrigation were analysed to know the effect of the systems of irrigation on the cropping pattern, income distribution and economic efficiency in the Punjab. The results of the study revealed that the cropping pattern followed on the lift irrigated farms was characterized by a high proportion of area under cereals as compared to that under the canal+lift and canal systems of irrigation. On the contrary, pulses, cash crops, oilseeds and fodder were the more dominant crops under the canal and canal+lift irrigated farms. The cropping intensity was highest under lift irrigation (189.97 per cent), followed by the canal+lift and canal irrigated farms (184.03 and 172.65 per cent).

Though the distribution of income (net) was relatively the best under the canal+lift irrigated farms followed by the lift+canal irrigated farms, yet it was attributed more to the distribution of area of operational holdings rather than to the system of irrigation. There appeared no conclusive evidence to believe that the system of irrigation in any way influenced the distribution of income. Finally, the economic model used did not indicate any difference in the economic efficiency on the purely canal irrigated farms as compared to those which were purely lift irrigated.

RURAL TRANSFORMATION THROUGH WELL IRRIGATION: KARNATAKA EXPERIENCE

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This study seeks to examine the role of well irrigation development in bringing about rural change in Karnataka using secondary data. The pattern

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of development of minor irrigation seems to be lacking any premeditated planning for backward regions (districts). The institutional credit policy relies mainly on the factors which may further accentuate the skewed distribution of resources across regions. The study further tries to analyse how far the growth in well irrigation has helped in stabilising and increasing the productivity of foodgrains. Surprisingly, the empirical results suggested that well irrigation has positive significant impact on yield instability and negative significant impact on the productivity of foodgrains. The analysis of the changes in cropping pattern after the advent of irrigation on individual farms clearly showed that commercial crops competed with foodgrains for resources and were awarded better part of them. This has not only resulted in a decrease in the productivity of foodgrains but also increased its instability due to sub-optimal use of other modern inputs following irrigation. The analysis reveals that well irrigation will help the small and marginal farmers to improve their incomes.

WELL IRRIGATION AND SHIFT TOWARDS COMMERCIAL CROPS

C. Arputharaj and R. Rajagopalan *

An attempt is made in this paper to assess the changes brought about by well irrigation in the cropping pattern in the holdings of small and marginal farmers. Data for the year 1981-82 collected from a sample of 150 small and marginal farmers in South Arcot district have been used. Well irrigation has helped to increase the area under irrigated crops. The number of farmers growing irrigated crops also increased. A very important impact of well irrigation was the pronounced shift towards commercial crops like sugarcane, groundnut and cotton. The farmers were able to allocate larger areas to commercial crops. The area under commercial crops on the small farms formed 41.93 per cent of the gross cropped area in 1981-82, whereas it was only 17 per cent before the advent of well irrigation. On the marginal farms the proportion of area under commercial crops to the gross cropped area was only 9.62 per cent prior to well irrigation and it was 44.39 per cent in 1981-82. The number of small and marginal farmers growing commercial crops also increased. Prior to well irrigation, the average per farm area under commercial crops was 0.15 hectare for the small farmers and 0.16 hectare for the marginal farmers. In 1981-82, this has increased to 1.03 hectare and 0.52 hectare for the respective size-groups of farms. Thus, more number of the small and marginal farmers were able to go in for commercial crops, the average per farm area under commercial crops had increased and the proportion of area under commercial crops to the gross cropped area had gone up significantly. Still, the full potential of the irrigation provided by the wells has not been realised. Suitable cropping pattern, supported by necessary agricultural inputs and adequate credit are needed to derive the maximum benefit from well irrigation.

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IMPACT OF IRRIGATION ON EMPLOYMENT, FARM PRODUCTIVITY
AND INCOME UNDER KAKATIYA CANAL OF SRIRAMSAGAR
PROJECT IN ANDHRA PRADESH

S. Adinarayana †

The impact of irrigation on formation of capital assets, cropping pattern, employment, farm productivity and income has been studied in Metapalli taluka of Karimnagar district covered by the first phase of Kakatiya Canal of Sriramsagar project in Andhra Pradesh. The impact of irrigation on assets formation is significant. The increase is nearly three times on fixed assets while it is only marginal on working assets of the irrigated farms compared to the unirrigated farms. There is a shift in the cropping pattern in favour of high value commercial crops on the irrigated farms, while the unirrigated farms show distinct favour towards low income millet crops. The increase in the employment of human labour on the irrigated farms is more than hundred per cent. The increase is not only due to irrigation but also due to inclusion of high proportions of labour intensive non-foodgrains crops in the cropping pattern of the irrigated farms. The farm productivity of the irrigated farms has increased by more than 200 per cent. Irrigation tends to narrow down the income gap between the small and large farms. Concerted efforts should be made to expand irrigation facilities. These measures not only provide the necessary fillip to agricultural development but also act as potent means to solve the problem of unemployment and under-employment in the rural areas.

THE IMPACT OF FILTERPOINT PUMPSET VIS-A-VIS CANAL IRRIGATION
ON FARM HOUSEHOLD INCOME DISTRIBUTION IN NELLORE
DISTRICT OF COASTAL ANDHRA PRADESH

I. Bhavani Devi and S. Seetharaman *

In the context of increasing farm production, productivity, income and employment, irrigation is one of the key parameters. In spite of sufficient river systems for watershed development, Andhra Pradesh faces a serious problem of water shortage for irrigation. In order to overcome this problem, several minor irrigation programmes have been initiated in the State to exploit groundwater resources. An attempt is made to examine the income effects of filterpoint pumpsets and canal irrigation systems in Nellore district of Coastal Andhra Pradesh. Three villages and 80 farmers using filterpoint pumpsets as well as canal as a source of irrigation were selected at random in Indukurpet of Nellore district. To study the impact of pumpset irrigation on

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farm household income, Lorenz curve, Gini concentration ratios and other measures of inequalities were employed. The main points emerging from this study are that additional benefits accruing from the irrigation systems have been distributed among farmers of all size-groups. The share of gross farm household income, however, tended to increase with the farm size under pumpset irrigation, whereas the relative share of off-farm income was more in the canal irrigation system. The production as well as family expenditure was affected by the size of farms and the type of irrigation system. The surplus disposable income was relatively more with the pumpset farm households and the pumpset irrigation system tended to increase the income disparity over the size and mode of irrigation.

UTILIZATION OF PUMPSETS IN MEHSANA DISTRICT OF GUJARAT STATE

M. R. Patel and S. B. Singh †

An attempt has been made in the present paper to examine the extent of utilization of irrigation potential created by different types of pumpsets, *i.e.*, electrical tubewell (ETW), electrified dug-cum-bore well (EDBW) and dieselised dug-cum-bore well (DDBW) and factors responsible for its under-utilization in Mehsana district of Gujarat State. The study covers 111 pumpsets (24 ETW, 31 EDBW and 56 DDBW), which were selected from six villages of the district. Further, stratified random sampling technique was used for the selection of the sample villages. The data were collected by survey method. The analysis regarding the utilization of pumpsets reveals some interesting trends which can be useful for the policy makers. Overall, the pumpsets utilized little more than half of the irrigation potential created by them. The extent of utilization was highest in ETW, followed by EDBW and DDBW. The main reasons for under-utilization were more number of pumpsets than required, inadequate pipeline, scarcity of fuel and frequent break-down of electricity and prime movers. The analysis regarding further investment reveals that 49,100 feet underground pipeline is required, which will cost Rs.2,45,500 and if this amount could be arranged and invested on underground pipeline, then it is possible to bring an additional area of 359 hectares under irrigation. Moreover, in order to increase the utilization of pumpsets, following suggestions are made. (a) Institutional agencies should provide finance to pumpset owners for underground pipeline. (b) There is an overall need to educate the pumpset owners and other farmers regarding management of pumpset irrigation and cropping pattern to be followed. (c) Some restrictions should be put on the installation of pumpsets by the government to avoid unhealthy competition. (d) The arrangement for adequate and timely supply of fuel/power should be done.

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NORMATIVE DEMAND FOR IRRIGATION AND IMPACT OF IRRIGATION
ON INCOME AND EMPLOYMENT—A SEASONWISE APPROACH

A. K. Ray *

The main objectives of this study are (a) to develop the seasonwise optimal plans and compare them with the existing irrigated and unirrigated plans, and (b) to derive the normative demand functions for irrigation water. The study reveals that in the absence of irrigation, both types of farms mainly grew crops like pulses and mustard in the *rabi* season. With the expansion of irrigation facilities, these crops have gradually been replaced by more profitable crops such as high-yielding paddy, potato and wheat. The small farmers grew traditional paddy varieties, while the medium farmers grew both traditional and high-yielding varieties of paddy in the *kharif* season. The net returns per acre improved significantly from the existing plan I to II and in the optimal plans, and the improvement was more on the small farms in the *kharif* season while in the *rabi* season it was more on the medium farms. The demand for variable inputs increased substantially due to expansion of irrigation, specially in the *rabi* season. The study further confirmed the widely accepted view that demand for water, irrespective of the size of farms, is higher in the *rabi* season than in the *kharif* season.

PROMOTION OF IRRIGATION AND ITS SOCIO-ECONOMIC IMPACT IN
HARYANA

T. M. Dak and M. L. Sharma †

The time-honoured contribution of irrigation in augmenting agricultural production is widely known. However, attempts to examine its role in shaping and changing the total socio-economic life are quite few. Using macro level analysis and official data from Haryana, this paper seeks to trace the growth of irrigation potential and examine the accompanying changes in the socio-economic structure over the period and across the regions. Both direct and derivative effects of irrigation were taken into account. The study showed that with the growth of irrigation potential over the years and with the change in the levels of irrigation, there were corresponding changes in the cropping pattern, agricultural technology, productivity and incomes, health and education, transport and communication and institutional development. The findings call for further increase in irrigated potential.

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IMPACT OF IRRIGATION ON AGRICULTURE: A FARM LEVEL ANALYSIS

A.S. Charan *

Based on data collected for two talukas, namely, Sinor and Karjan for 480 cultivators, *i.e.*, irrigators and non-irrigators in the Socio-Economic Bench-Mark Survey study of Narmada command in Vadodara district of Gujarat State, the impact of irrigation on agriculture is analysed in this paper. The study reveals that though the overall cropping intensity is comparatively less in conventional terms, improved cropping pattern of irrigated holdings is the reflection of the impact of irrigation. The gross returns in different size-groups were two to three times more on the irrigated holdings as compared to the unirrigated holdings. Similarly, the total man-days of employment are significantly high on the irrigated holdings as compared to the unirrigated holdings. It has also enhanced the demand for modern inputs in this region. Further, since the marginal and small farmers among various classes of farmers have performed equally well, a judicious approach to allocation of water will be necessary to bring about favourable income distribution in the area.

IMPACT OF MINOR IRRIGATION PROJECT (FINANCED BY STATE BANK OF INDORE) ON CROPPING PATTERN, FARM INCOME AND EMPLOY- MENT OF FARMERS IN RATLAM DISTRICT, MADHYA PRADESH

R. S. Mishra and S. K. Gupta *

An attempt is made in this paper to study the impact of minor irrigation project on the cropping pattern, cropping intensity, farm income and employment pattern of the sample farmers. Jaora block was selected for the study because the State Bank of Indore (ADB) had financed the entire block, consisting of 150 villages. Out of 150 villages, five villages which received maximum amount of loan for the minor irrigation project were chosen. Ten farmers from each village were selected at random, keeping in view that it comprised marginal (0.0-1.0 ha.), small (1.0-2.0 ha.), medium (2.0-4.0 ha.), and large farmers (4.0-10.0 ha.). The data for the agricultural years 1978-79 and 1981-82, *i.e.*, before and after borrowing of the loan for digging of new wells, renovation of old wells, installation of electric pumps and for the purchase of diesel pumps were collected. The maximum change in the cropping pattern of marginal farmers was brought about by the installation of electric pumpset during the *rabi* season. The crops which shared more area were wheat in the *rabi* and maize in the *kharif*. In the case of small farmers, the gross cropped area which was 2.75, 3.75, 3.95 and 3.44 hectares before availing the loan in-

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creased to 4.75, 5.40, 5.65 and 5.37 hectares after taking the loan in the case of new well, renovation of old well, diesel pumpset and electric pumpset respectively. The change in the gross cropped area of medium farmers ranged from 9.93 hectares in the case of new well to 10.93 hectares in electric pumpset. In the case of large farmers, the gross cropped area, after availing loan, increased by about 26, 38, 50 and 35 per cent respectively on new well, renovation of old well, diesel pumpset and electric pumpset.

Similarly, the cropping intensity also increased to a great extent especially in the case of electric pumpset followed by diesel pumpset, renovation of old wells and sinking of new wells respectively among all the four categories of farmers. The production also increased after the introduction of minor irrigation sources in all the size-groups. The net farm income increased by 64.07, 54.39, 29.88 and 36.40 per cent respectively under new well, renovation of old well, diesel pumpset and electric pumpset and the corresponding percentage changes in the family labour income were 68.60, 57.09, 32.12 and 38.70 per cent. There was an increase of 69.69, 64.28, 32.37 and 38.97 per cent in the farm business income in the case of new well, renovation of old well, diesel pumpset and electric pumpset respectively. The maximum change in family labour employment was brought under the renovation of old well (17.62 per cent) followed by diesel pumpset (16.85 per cent), new well (14.80 per cent) and electric pumpset (11.96 per cent), while the hired labour days increased to 192.40 (20.68 per cent), 220.00 (20.29 per cent), 208.39 (20.05 per cent) and 295.01 (23.40 per cent) days in the case of new well, renovation of old well, diesel pumpset and electric pumpset respectively. It can thus be concluded that the minor irrigation sources made available by the bank loans would not only increase the physical quantities, but will also be beneficial in terms of increased employment opportunities and will thereby automatically raise the farm income.

IMPACT OF KUKADI IRRIGATION PROJECT ON CROPPING PATTERN AND ADOPTION OF CROP PRODUCTION TECHNOLOGY

S. B. Dangat and R. K. Rahane †

The Government of Maharashtra has prepared a master plan for the development of Godavari and Krishna basins. One of the projects included in the plan was Kukadi Irrigation Project. A sample of 105 cultivators, 35 each from the small, medium and large size-groups of holdings were selected randomly. Information from the selected cultivators was collected for two years, *i.e.*, a year just before the availability of canal irrigation water (1980-81) and the year of the availability of canal irrigation water (1981-82). An attempt is made to study the impact of this newly established irrigation project on the cropping pattern and adoption of crop production technology. The average size of farm was 2.09, 4.64 and 7.63 hectares in the case of small, medium

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and large size-groups of holdings respectively. Canal was the major source of irrigation contributing to 60 per cent of the total irrigable area on these farms and the remaining 40 per cent was served by wells. No land remained as current fallow in any size-group of holdings after the availability of canal irrigation as compared to the 5 per cent current fallow before the canal irrigation. The double cropped area increased raising the intensity of cropping from 102.15 per cent to 112.94 per cent. There was an increase in the area under *rabi* jowar whereas the area under bajra declined marginally. Wheat and gram were cultivated under irrigated conditions only after the availability of canal irrigation water. The share of groundnut in the gross cropped area increased from 6.84 per cent prior to the canal irrigation to 9.44 per cent after the canal irrigation. The main reasons for under-utilization of water by the farmers were the delay in sanction for the use of water, undulating land, defective distributaries and inadequate funds with the cultivators. As irrigation facilities in the study area were made available for the first time during the year of study, the level of adoption of improved cultural practices was low. Though they started using fertilizers after the availability of irrigation facilities, the doses applied were lower than the recommended levels. The plant protection measures were adopted on a very small scale. This warrants the need for imparting training to the farmers and conducting demonstrations on improved technology.

IMPACT OF IRRIGATION ON PRODUCTION AND FACTOR USE —
A CASE STUDY OF MAYURAKSHI CANAL IN WEST BENGAL

Sib Ranjan Misra *

This paper seeks to examine the effect of irrigation technology on paddy production in Mayurakshi Canal irrigated areas of Birbhum district of West Bengal and also the factor bias of this technological change. The study is based on primary data collected from 70 farms producing *kharif* paddy, 40 farms of which are situated in irrigated regions and the rest 30 in the rainfed tract in Birbhum district over which Mayurakshi Canal flows. This exercise, with the help of Chow test of employing dummy variable, provides an empirical support for the fact that the introduction of irrigation caused an upward shift of the production function in a neutral way. Another conclusion that emerges from this study is that following Binswanger's method of factor share analysis, irrigation technology is biased in favour of capital and against labour. Irrigation is found to be capital-using and labour-saving in the study area. Adequate availability and better control of water motivated the risk-averting farmers to increase the expenditure on the modern inputs like seeds, fertilizers, chemicals, etc. Paddy crops require sustained water supply which an irrigated farm alone can provide in full measure.

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IMPACT OF IRRIGATION ON INCOME AND EMPLOYMENT —
A CASE STUDY IN A BENGAL VILLAGE

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Attempts have been made in this paper to show (1) to what extent irrigation had been effective in increasing income and human labour employment and (2) how the seasonal pattern of employment had been affected. The study is confined to one village in the district of Burdwan, West Bengal. Data refer to the period between 1967-68 and 1975-76. The sample village had been receiving irrigation water from the Damodar Valley Canals. But the supply of water was limited to the *kharif* season. However, in 1966-67, a year after the introduction of High-Yielding Varieties Programme (HYVP) in this district, the area received irrigation water during the summer season from the same canal. As a result, the entire area witnessed a great change in the cropping pattern and became instrumental in enhancing income and employment opportunities for the rural labour force.

The ratio of gross cropped area to net cultivated area had gone up to 1.90. Rice followed by rice became the rotation pattern. The area per farm under rice during the summer season increased from 0.49 hectare in 1967-68 to 1.68 hectare in 1975-76, forming 82 per cent of the net cultivated area in this season, and the entire area was covered under high-yielding seeds. This was obviously due to the availability of irrigation water during this season (summer). The proportion of area under HYVP in the *kharif* went up from 7.16 per cent in 1967-68 to 50.80 per cent in 1975-76. There had been a sharp rise in income per farm, the percentage of increase being 163. The labour employment went up by 135 per cent due to two factors, *viz.*, (i) increase in the cropping intensity and (ii) higher labour needs of the high-yielding seeds of rice. The cultivation of summer paddy on a wide scale had also helped to wipe out the seasonal pattern of employment of agricultural labourers. An adult male labourer secured wage employment for 313 days as compared to only 192 days in single cropped area and the proportion of employment days was evenly distributed between different months of the year. Hence, great importance should be given to foster irrigation works, so that labour intensity and productivity in the agricultural sector will simultaneously increase.

MINOR IRRIGATION — PROBLEMS AND PERSPECTIVE
IN WEST BENGAL (A CASE STUDY)

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The present paper attempts to analyse the limitations of canal irrigation and tank irrigation and the uneven distribution of net irrigated area in differ-

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ent districts of North Bengal and South Bengal. Tapping of underground water resources for irrigation purposes has not received due consideration. Of the two sources of minor irrigation, deep tubewells (DTW) and shallow tubewells (STW), the latter enjoys some advantages. Although the DTW can irrigate much more land (150 to 200 acres), the main drawbacks were (1) the unduly long time taken by the administrators and policy makers in the site selection, (2) the high cost of installation (Rs.1,35,000 at the 1975-76 prices against only Rs.5,000 to Rs.6,000 for STW), (3) the gestation period of a DTW is much longer, (4) the exorbitant water rates of DTW in *rabi* and summer seasons, (5) malpractices regarding inclusion of individual cultivator's land to be benefited in these seasons and (6) the long time taken to repair DTW. If the government can make a network of STW alongside DTWs in the form of social infrastructure, it may help to achieve the desired results.

IMPACT OF IRRIGATION ON PRODUCTIVITY OF WHEAT

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The present study was undertaken with the objectives of (1) comparing input utilization and production, (2) estimating the output-cost ratios and (3) examining the productivity of input factors on the dry and irrigated wheat farms. The study was conducted in Nagpur district of Maharashtra State and was based on the data of 50 farmers, 25 farmers each growing dry and irrigated wheat. The study pertained to the year 1980-81. Simple tabular analysis and production function analysis were used to evaluate the objectives. Per hectare input utilization, particularly human labour, fertilizer and seed was higher on the irrigated wheat farms. The higher level of input use resulted in higher per hectare yields on the irrigated farms (13.14 quintals) as compared to the dry wheat farms (5.58 quintals). The output-cost ratio was also higher for irrigated wheat than that for dry wheat. Production function analysis revealed that the production response of capital (mainly fertilizer and irrigation) was higher in irrigated wheat, indicating a higher marginal product of these factors on the irrigated wheat farms. The study, therefore, concludes that the use of irrigation in combination with other input factors results in increased production of wheat and higher marginal products of input factors.

MODERNIZATION OF GUNDAMGERE TANK: A CASE STUDY

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In this paper an attempt is made to assess the impact of modernization on the socio-economic conditions of the people in the Gundamgere and cluster villages which come under the tank command. The tank came into opera-

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tion during 1967 with a command area of 202 hectares. The storage capacity of the tank was increased during 1974-75 and this brought an additional area under the tank command. The transmission losses in the tank channels were estimated to range from 20 to 25 per cent. To prevent this loss, the channels were lined. The farmers were persuaded to change the cropping pattern from wet crops to semi-dry crops. The lining of channel and assurance of timely and protective irrigation served as incentives to change the cropping pattern. The farmers, who were growing a single crop of paddy during the *kharif* season, were not getting sufficient water at some stages. The new cropping pattern of growing semi-dry crops such as maize and *ragi* in the *kharif* and another semi-dry crop such as groundnut in the *rabi*, was introduced. The new cropping pattern increased the production per unit area in the tank command. The net income of the small, medium and large farmers in the tank command also increased. In addition to this, the employment of agricultural labour increased after the modernization. Technological changes such as application of chemical fertilizers and use of HYV were brought about in a comparatively short time.

EFFECT OF IRRIGATION ON PROFITABILITY OF CROPS AND FARM BUSINESS INCOME IN K.C. CANAL AREA OF ANDHRA PRADESH

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The pace of agricultural development in terms of profitability of crops and farm business income in K.C. Canal area in Nandyal taluk of Kurnool district in Andhra Pradesh is estimated. To examine the effects of irrigation, a method of matched sample was followed as the canal is the old one and the data before irrigation are not available. This method of matched sample facilitated the study of the two areas which are practically identical except in respect of irrigation. One hundred-twenty farmers spread over six villages (three in the project area and three in the non-project area) were studied. The profitability of crops due to irrigation differs from crop to crop. The income due to irrigation input is considerably higher. Net profit per hectare is far more in the project area. The average increase in the total farm business income per hectare of operated area is Rs.2,087 in the project area as against Rs.850 in the non-project area. The higher total farm business income to the tune of Rs.1,237 per hectare in the project area is obviously due to irrigated farming.

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ECONOMIC EFFICIENCY OF TUBEWELL IRRIGATION IN
KANPUR DISTRICT, UTTAR PRADESH (A CASE STUDY)

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An attempt has been made to make an economic appraisal of a tubewell project in Sheorajpur block of Kanpur district in Uttar Pradesh during the year 1982-83. The study is based on an intensive enquiry of 20 farmers owning tubewells. Data for the pre- and post-project periods were collected by survey method. The average initial investment cost of a tubewell with an electric engine of 7.5 H.P. came to about Rs.10,000 and the average cost of water channel to Rs.3,100 whereas the average maintenance and operational cost per annum was Rs.14,000. There was a major shift in the cropping pattern. The area under low remunerative crops was replaced by high-yielding varieties and other high pay-off cash crops in the post-irrigation period. The input cost, value of output and net profit per hectare in almost all the crops were significantly higher in the post-project period as compared to the pre-project period. The higher input cost per hectare in the post-project period was due to more use of production-oriented cash inputs like manure, fertilizers, HYV, plant protection measures, etc. The simple rate of return under the post-project period came to 152.30 per cent. This reveals a very high profitability of the initial investment of the tubewell project in the study area. If the rate of interest on long-term investment is supposed to be 12 per cent, the rate of return, as worked out, is very high with **1.52** unit rate of return. The profitability on the investment made on the **tubewell** was fairly high. The cost-benefit ratio came to 1:2.09. The project not **only** boosted the productivity of the various crops per unit of land but also increased the labour employment on the farms significantly during the post-project period as compared to the pre-project period. Thus, it may be concluded that the installation of a tubewell project on an eight-hectare farm is technically feasible and economically viable.

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