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## Summaries

1. Post-Green Revolution Scenario in Haryana Agriculture *R.K. Khattar,  
S.D. Chamola and  
Veena Manocha*
2. Green Revolution and Inequality in India with Special Reference to Punjab *M.S. Toor and  
R.P. Singh*
3. Economic Analysis of Marginal and Small Farms of Green Revolution Belt and Non-Green Revolution Belt - A Case Study *R.P. Singh and  
R.K. Pandey*
4. Employment, Wage and Income of Agricultural Labourers in the Post-Green Revolution Belt of Saurashtra Region with Special Reference to Dhoraji Taluka *B.H. Joshi*
5. Labour Employment and Income Pattern under Different Farming Systems in Scarcity Zone of Maharashtra State *S.B. Dangat,  
D.L. Sale and  
D.S. Nawadkar*
6. Impact of Diversified Farming System on the Rural Poor in Haryana *R.S. Kadian,  
C.R. Kaushik and  
Ram Kumar*
7. Impact of Green Revolution on Cropping Pattern, Agricultural Growth and Average Value Productivity in Sriganganagar District of Rajasthan *R.C. Verma,  
J.M. Dhaka and  
S.S. Gupta*
8. Agricultural Development and Non-Farm Employment Changes in Hisar District of Haryana *K.N. Rai and  
M.K. Modi*
9. Agricultural Development in the Post-Green Revolution Period: A Reflection (Case Studies of Two Villages in West Bengal) *Saroj Kanti Cheudhuri*
10. Changing Structure of Rural Assets in Punjab and Himachal Pradesh: A Comparative Study *K.K. Kaushik*
11. Inequality in the Distribution of Income and Assets among the Different Farmers' Groups in Green Revolution Belt (A Case Study of a Village in District Karnal) *A.R. Rathore and  
A.K. Chauhan*

12. Optimum Farming Systems for Quantum Jump in Farm Production and Income in Post-Green Revolution Belt *D.S. Thakur, K.D. Sharma and A.S. Saini*
13. Risk Efficient Farming System for Small Vegetable Farms in Kangra District of Himachal Pradesh (An Application of Parametric Risk Programming) *A.K. Sharma and T.V. Moorti*
14. Income and Employment Increasing Potentiality in Various Farming Systems on Marginal Farms in Mid-Western Uttar Pradesh *A.K. Singh, L.R. Singh and J.S. Sharma*
15. Economic Potential of Dairy Enterprise in Weaker Section Households in Green Revolution Belt *Kuber Ram and A.K. Sharma*
16. A Comparative Study of Wheat-Paddy Versus Wheat-Cotton Farming Systems in the South-Western Punjab *Inder Sain*
17. Variations in Cost of Production with Farm Size in Punjab *K.K. Jain and H.S. Bal*
18. Technological Change and Agricultural Production in Post-Green Revolution Belt in India *Chhotan Singh and Puran Chand*
19. Farmers' Response to New Technology in the Post-Green Revolution Belt of Orissa: A Micro Study *Dibakar Naik, Bikaram Keshari Pattanaik and Binod Chandra Mohanty*
20. Credit and Marketing Institutions: Missing Link in Data Base for Agro-Climatic Zones *V.V. Ghanekar*
21. Role of Sericulture Industry for Development of Diversified Farming *G. Madhava Swamy*
22. Rice Economy of Tamil Nadu during Post-Green Revolution Era *B. Mathavan and G. Subramaniyan*
23. Comparative Studies on Income and Employment Potentials of Integrated Farming Systems on Small Holdings *S.N. Singh, K.P. Singh, L.R. Gupta, V.S. Kadian and N. Singh*
24. Impact of Technological Change on Farm Investment and Farm Income Distribution in Haryana Agriculture *Invinder Paul Singh, Sunita Verma and A.C. Gangwar*

25. Post-Green Revolution Inter-District Inequalities in Supporting Institutions - A Study of PACS in Uttar Pradesh *M.M. Bhalerao, D.K. Shukla and Asha*
26. Differential Responses to New Technologies in Some Sub-Situations in Post-Green Revolution Belt in West Bengal *K. Sain*
27. Inter-Regional Differences in the Farming Systems in Madurai District *S. Iyyampillai and D. Swamikannan*
28. Changes in Crop-Mix in Sub-Region of Raipur District in Madhya Pradesh *M.R. Chandrakar, A.K. Koshta and K.G. Agrawal*
29. Resource Costs, Returns and Resource Use Efficiency under Different Farming Systems in Drought-Prone Area of Western Maharashtra *P.D. Deshmukh, D.S. Hange, N.K. Kale and Jg. R. Pawar*
30. Relative Economics of Different Farming Systems in Western Maharashtra *S.S. Bhosale and B.B. Gawade*
31. Impact of Agro-Climatic Zones on Cropping Pattern, Production and Employment in Aurangabad District of Maharashtra *P.R. Waghmare, V.B. Tak and D.N. Hedgire*
32. Employment and Wages of Agricultural Workers in the Post-Green Revolution Period in Punjab *J.S. Chawla and T.S. Chahal*
33. Impact of Risk on Resource Allocation and Cropping Pattern - A Case Study *S.P. Bhardwaj, U.N. Dixit and H.C. Gupta*
34. A Study of the Impact of Green Revolution in Agra District of Uttar Pradesh *Balisher and Roshan Singh*
35. Hill Farming System: A Study of Himachal Pradesh *M.L. Sharma, N.K. Sharma and C.S. Vaidya*
36. Post-Green Revolution Changes in the Cropping and Production Patterns in Haryana Agriculture *V.K. Singh and Himmat Singh*

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## Post-Green Revolution Scenario in Haryana Agriculture

R.K. Khatkar,\* S.D. Chamola\* and Veena Manocha†

Agricultural production has increased manifold due to the introduction of high-yielding varieties (HYVs) along with the use of improved production practices. In this paper, an attempt has been made to examine the changes in the cropping pattern and use of improved inputs and their impact on soil and water management, dryland agriculture, farming system, ecological imbalance and change in the composition of livestock. The data were taken from the various issues of Statistical Abstracts of Haryana.

Cereals have become more important in the cropping pattern in the state replacing coarse cereals and pulses. The area under coarse cereals has declined from 45 per cent during period I (1955-56 to 1957-58) to 34 per cent during period II (1964-65 to 1966-67) and further to about 19 per cent during period III (1986-87 to 1988-89). Similarly, the area under pulses declined from 31 per cent to 29 per cent and to 12 per cent during periods I, II and III respectively. The annual compound growth rates in area, production and productivity of major crops during period I (1950-51 to 1965-66), period II (1966-67 to 1980-81) and period III (1981-82 to 1988-89) have indicated that the area and production increased significantly at a higher rate in period I almost in all the crops. But the productivity of wheat and pulses showed a declining trend (-3.70 per cent and -3.10 per cent respectively). The area, production and productivity showed an increase specially in the case of rice and wheat due to the evolution of HYVs in period II. On the other hand, there was a decline in the area, production and productivity of pulses at the rate of -4.30 per cent, -0.02 per cent and -2.10 per cent per annum respectively. In period III, the increase in area under rice and wheat was non-significant and the area under pulses showed a decline. On the other hand, non-foodgrains area increased by 4.31 per cent. It is surprising that the productivity of rice in period III declined by -0.70 per cent. The rate of growth in the productivity of wheat during period III was lower (4.53 per cent) than that in period II (5.85 per cent), indicating a stagnation of productivity in crops using higher technology. There is a need to find out ways and means for breaking this stagnation stage for feeding the ever increasing population.

The existing cropping pattern mainly rice-wheat rotation and indiscriminate use of water have resulted in creating ecological imbalance and created the problem of salinity/alkalinity and waterlogging in about 4.5 lakh hectares, thereby causing heavy losses to the society. In some areas non-judicious pumping of groundwater in rice growing region has caused a decline in the water table to the extent of 14 to 33 cm per year. Hence, there is a need to solve these problems through measures like land reclamation, adoption of suitable cropping pattern and judicious use of water. Further, keeping in view that 40 per cent of the total cultivated area is still rainfed, more emphasis should be given for developing suitable technology for dryland farming.

The integration of farming systems should be given due importance to shift the population from the agricultural sector. The arable farming should be integrated with any combination of dairying, sheep, goat, poultry, piggery, bee-keeping, fish culture, vegetable cultivation, horticulture and mushroom cultivation. The proximity of the state to Delhi will provide vast

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potential marketing infrastructure for integrated farming system, yielding additional income, besides providing additional employment opportunities to the surplus family labour especially in the case of small and marginal farmers.

## **Green Revolution and Inequality in India with Special Reference to Punjab**

**M.S. Toor and R.P. Singh<sup>†</sup>**

This study examines the implications of green revolution for sustainability of the farming system and inequality in growth during the period 1975-76 to 1986-87. Various factors like per hectare agricultural income, per cent area irrigated, cropping intensity, per cent area under foodgrains, net sown area and culturable waste were analysed to study the inter-state inequalities. In the case of Punjab, the micro level analysis pertaining to the inter-district inequalities and the shifts therein created by the green revolution were studied by examining the fertiliser consumption, number of tractors, per cent area under high-yielding varieties, cultivable area per agricultural worker and percentage of agricultural workers to total workers along with the variables covered in the inter-state analysis.

The study indicated that the green revolution has not been an unmixed blessing. It has resulted in non-sustainable increase in agricultural production and productivity due to the disturbance of the hydrological balance and emergence of micro-nutrient deficiencies. Besides, it has aggravated the inter-state and intra-state disparities in agricultural development. It has been suggested that these problems can be avoided by adopting the farming system approach. It has been further suggested that a strategic research plan for future farming system development scenario for some important agro-ecological zones in India is needed.

## **Economic Analysis of Marginal and Small Farms of Green Revolution Belt and Non-Green Revolution Belt - A Case Study**

**R.P. Singh and R.K. Pandey\***

This study attempts to examine the income on the farms in the green revolution belt and non-green revolution belt and also to compare the employment opportunity and prevailing wages of agricultural labourers in these belts. Two districts of Bihar State, viz., Patna which is predominantly a green revolution belt and Ranchi where the farming is still carried on in the traditional way, were selected purposively for the study. One block each, namely,

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Phulwarisharif and Kanke, was selected at random from Patna and Ranchi districts respectively. Sixty farmers, 30 each from marginal (below one hectare) and small farmers (1-2 hectares) were selected randomly from four selected villages of these blocks. Finally, 120 farmers, 60 each from the green revolution belt and the non-green revolution belt were chosen and the data were collected by the survey method for the crop year 1987-88.

The results of the analysis of factors affecting employment and income of various categories of farms in the green revolution belt and non-green revolution belt indicated that cropping intensity, irrigational facilities, productivity of crops and livestock units were the main factors affecting employment and income of the selected farms of these regions. The intensity of cropping was significantly higher (218 per cent) in the green revolution belt and it was low (only 124 per cent) in the non-green revolution belt. It was also observed that only about 17 per cent of the cultivated area of the farms in non-green revolution belt was irrigated against 100 per cent of the cultivated area of the farms irrigated in the green revolution belt. The productivity of all crops except maize was very much higher on the farms in the green revolution belt than on the farms in the non-green revolution belt. A better livestock position including milch animals was seen on the sample farms of the green revolution belt. A high fixed capital investment per hectare (Rs. 17,422 and Rs. 19,474) was also observed on marginal and small farms in the green revolution belt as against Rs. 8,637 and Rs. 10,589 in the respective categories of farms in the non-green revolution belt. The analysis of data relating to employment of human, bullock and machine labour indicated that the farms in the green revolution belt provided more employment (about 240, 16, 120 per cent more for human, bullock and machine labour respectively) opportunity as compared to the farms in the non-green revolution belt. The higher employment was mainly due to diversification of farm business in the green revolution belt. The overall gross income, net income, family labour income and farm business income in the green revolution belt were very much higher than in the non-green revolution belt. The per rupee return from investment was Rs. 2.16 and Rs. 2.07 on small and marginal farms in the green revolution belt against Rs. 1.70 and Rs. 1.61 in the respective categories of farms in the non-green revolution belt. The higher income improved the living standards of the farm family in the green revolution belt by increasing the per capita income. The wages of agricultural labourers (male and female) for all types of operations were markedly higher on the farms of the green revolution belt. Thus it is concluded that the green revolution brought about a positive impact on the productivity of crops which might have changed the pattern of employment and income of the farmers in the green revolution belt. These changes have significantly increased the wages of agricultural labourers and ultimately improved the quality of life of the people living in green revolution belt as compared to the non-green revolution belt.



## **Employment, Wage and Income of Agricultural Labourers in the Post-Green Revolution Belt of Saurashtra Region with Special Reference to Dhoraji Taluka**

**B.H. Joshi<sup>†</sup>**

An attempt has been made in the paper to examine the level of employment, wage and income of agricultural labourers in the post-green revolution belt as compared to the non-green revolution belt in Saurashtra region of Gujarat. To examine the impact of the green revolution on agricultural labourers of Dhoraji taluka in the Saurashtra region, all the 30 villages of the taluka were grouped under two clusters on the basis of per cent of land under high-yielding varieties of seeds to total land under cultivation and per cent of irrigated land to total cultivated land. From each cluster, three villages were selected by random sample method and from six selected villages 10 per cent of the total households of agricultural labourers were selected. Data on employment, wage and income of agricultural labourers were collected by personal interview method.

It was observed that in the post-green revolution belt, employment for 283 man-days per annum was available to the agricultural labourers as against 119 man-days of employment in the non-green revolution belt. Moreover, wage rates for men, women and children for different agricultural operations were also higher and hence the incomes of the agricultural labourers were higher in the post-green revolution belt than in the non-green revolution belt.

## **Labour Employment and Income Pattern under Different Farming Systems in Scarcity Zone of Maharashtra State**

**S.B. Dangat, D.L. Sale and D.S. Nawadkar\***

In this paper an attempt has been made to study the labour employment pattern and the magnitude of cash income received under different farming systems, based on analysis of data collected from a sample of 384 cultivators from the bajra growing region and 192 cultivators from the jowar growing region in Western Maharashtra. The results showed that in the dry bajra zone more than double the male and female days were utilised in the case of farming system with livestock component as compared to the farming system without milch animals. In the case of irrigated farms, less than half the male and female days were utilised in farming system without milch animals as compared with that on irrigated farms with milch animals. Similar trends of labour employment were observed in jowar base area. In the dry bajra base area, livestock production and wage earnings accounted for a major share of 33 per cent and 31.6 per cent respectively in the total income under the farming system with and without milch animals. In the irrigated bajra base area the total family income was Rs. 18,389 and Rs. 11,164 in the farming system with and without milch animals

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respectively.

As regards the jowar base area, under rainfed condition, the per family total income of the farming system with and without milch animals was observed as Rs. 10,940 and Rs. 8,737 respectively while in the case of the irrigated bajra base area, the corresponding figures were Rs. 13,074 and Rs. 9,808. Thus the study concludes that either in the irrigated or dry jowar base and bajra base areas, it is advisable to maintain the livestock which will help in generating employment opportunities and increasing the incomes of the farm families.

## Impact of Diversified Farming System on the Rural Poor in Haryana

R.S. Kadian, C.R. Kaushik and Ram Kumar<sup>†</sup>

Agriculture is the main source of livelihood of the rural masses in Haryana. In this paper, an attempt has been made to examine the impact of diversification on the income and employment of the rural poor. The data were collected from about 140 respondents from Mahendragarh and Kurukshetra districts of Haryana comprising dry and wet region of the state respectively. The data pertained to the years 1985-86 (before diversification of enterprises) and 1988-89 (after diversification).

The economic analysis of different enterprises indicated that camel and cart enterprise was more paying (Rs. 2,960) followed by sheep enterprise (Rs. 2,537) in Mahendragarh district due to suitable agro-climatic conditions and more opportunities available for transporting the stones from hills for construction and stone crushing units. While in Kurukshetra district, *jhotta-buggy* enterprise was paying more (Rs. 2,602) followed by buffalo (Rs. 1,886). The cost-benefit ratio of all the enterprises was found more than one, indicating that all the enterprises tended to be economically viable. The additional employment created by the adoption of new enterprises was found highest in the case of camel and cart (141 man-days) followed by sheep (136 man-days) and *jhotta-buggy* (133 man-days).

The diversification has also affected the pattern of income generation. The relative share of wages and services has been reduced mainly due to the creation of additional employment opportunities. The income generated by the new enterprises adopted by the respondents ranged from 15 per cent in the case of cow in Kurukshetra district to 44 per cent for sheep enterprise in Mahendragarh district. Thus the diversification of farming has a vital scope provided the taking up of new enterprises is accompanied by the creation of the required infrastructure. The animals selected should be of good quality and high-yielding. The goat enterprise should be taken up in Mahendragarh district. There is scope for poultry, bee-keeping, piggery and mushroom cultivation enterprises mainly due to the proximity of Delhi market.

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## **Impact of Green Revolution on Cropping Pattern, Agricultural Growth and Average Value Productivity in Sriganganagar District of Rajasthan**

**R.C. Verma, J.M. Dhaka and S.S. Gupta\***

The present study was conducted in Sriganganagar district of Rajasthan as it is one of the most important districts of the state from the agricultural production point of view. It contributed 13 and 15 per cent to the total foodgrains and oilseeds production respectively in the state during 1988-89. The total irrigated area in the district was 1.14 million hectares in 1988-89 which accounted for 26 per cent of the total irrigated area of the state. The impact of the green revolution was first of all observed in this district of the state and the farmers are continuously maintaining the tempo of the green revolution.

An attempt has been made in the paper to analyse the changes in the cropping pattern during the post-green revolution period (1966-67 to 1988-89) over the pre-green revolution period (1956-57 to 1965-66) in Sriganganagar district and to study the trends in agricultural output and average value productivity per hectare from the major crops grown in the district over time. Time-series secondary data pertaining to the area and production of major crops and crop groups and farm harvest prices of major crops for the period 1956-57 to 1988-89 were used. To assess the changes in the cropping patterns over the years, Spearman's Rank Correlation Coefficient and Kendall's Coefficient of Concordance were calculated and tested for their significance. Compound growth rates, percentage change in the cropped area and the share of various crops in the gross cropped area were also worked out.

The results of the study revealed that the gross cropped area, net area sown and area sown more than once remained stagnant during the pre-green revolution period while these showed a significant increase at the rate of 1.84, 1.16 and 6.93 per cent per annum respectively during the post-green revolution period. There was no change in the rankings of major crops grown in the district during the study period. With regard to the percentage share of crop groups in the gross cropped area, it was observed that in the post-green revolution period, food crops were being replaced by non-food crops, such as oilseeds, fibres and others. Oilseeds and cotton (which is the main fibre crop of the district) improved their relative position significantly during the post-green revolution period. Other crops which include guar, sugarcane, fodder crops, fruits and vegetables increased their relative share in area from 16.71 per cent in 1956-57 to 27.35 per cent in 1988-89.

It was also observed that the average value productivity during the pre-green revolution period increased by 2.80 per cent per annum whereas during the post-green revolution period it increased at the compound rate of 10.10 per cent per annum. The aggregate crop output in the district also increased significantly at the rate of 3.49 per cent during the post-green revolution period as against a significant negative growth rate (-9.72 per cent) during the pre-green revolution period. Thus the green revolution has helped the agriculture of Sriganganagar district to move at a faster rate as compared to the pre-green revolution period.

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## **Agricultural Development and Non-Farm Employment Changes in Hisar District of Haryana**

**K.N. Rai and M.K. Modi<sup>†</sup>**

It is believed that the introduction of new agricultural production technology will create more non-farm employment and generate additional income to the surplus labour. A number of studies have been conducted to examine the effect of new technology on non-farm employment, giving conflicting views. However, there are very few systematic, scientific and empirical studies concerning the effects of new crop production technology on non-farm employment. This paper, therefore, examines the changes in non-farm employment between 1980 and 1990 in Hisar district of Haryana.

To achieve the objectives of the study, both primary as well as secondary data were used. The findings presented in the paper reveal significant and positive impact of agricultural modernisation on creation of non-farm employment. As agricultural modernisation takes place, labourers who are not directly absorbed into more productive agricultural jobs may be absorbed indirectly into non-farm jobs in industry directly or indirectly related to agriculture. Further, increased consumption expenditure of farm population resulting from increased income may lead to creation of more jobs in other industries producing durable as well as consumable goods.

## **Agricultural Development in the Post-Green Revolution Period: A Reflection (Case Studies of Two Villages in West Bengal)**

**Saroj Kanti Chaudhuri\***

The present study examines the agricultural development in the post-green revolution period in two villages situated in two adjacent districts, namely, Burdwan and Birbhum in West Bengal, based on a survey conducted during 1985-87. In West Bengal agriculture, paddy/rice occupies a predominant place due to the vast area under this crop and it is also a major food item of the people. It was observed that Burdwan district enjoys better infrastructural advantages compared to Birbhum district, in terms of area irrigated from government canals and also distribution of groundwater structures; the use of deep and shallow tubewells and the government sources of irrigation led to higher intensity of cropping and use of chemical fertilisers as compared to Birbhum district.

The village level analysis revealed that the cultivators of Burdwan were in a better position in regard to the institutional framework. More than 50 per cent of the cultivators in Burdwan village used tractors while the farmers of Birbhum village lagged much behind those of Burdwan in the use of pumpsets and tractors. The Birbhum village can well be distinguished from the Burdwan village by the complete absence of canal irrigation during

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*rabi* and summer seasons. Use of shallow tubewells is also found prominently in the agricultural scenario of Burdwan village. Consequently, the intensity of cropping in Burdwan village was as high as 209 against 132 in Birbhum village. This has greater significance in terms of employment potentiality which was reflected in 72 man-days of hired human labour per acre of net sown area in Burdwan village against only 54 man-days in Birbhum.

Judged by another important criterion of net return per acre of net sown area, it was found that Burdwan village cultivators obtained an average net return of about Rs. 5,000 which was more than four times that of the Birbhum village cultivators (Rs. 1,175). This trend was observed even for size class distribution.

The investment pattern also showed that the Burdwan village cultivators invested a sizeable amount in fixed capital items such as tractors, threshers, shallow tubewells, etc., even before 1975, which were completely absent in Birbhum village. Even after 1975, investment by the Birbhum cultivators on these capital items was insignificant compared to the Burdwan villagers. Thus the growth potential of the Burdwan village far excels that of the Birbhum village. It may be inferred that the green revolution has failed to remove the disparity in development across regions and even across cultivators within the same region.

## **Changing Structure of Rural Assets in Punjab and Himachal Pradesh: A Comparative Study**

**K.K. Kaushik<sup>†</sup>**

An attempt has been made in this paper to examine the temporal and regional variations in the asset structure of rural households in the Punjab and Himachal Pradesh during 1971-72 and 1981-82. There is now ample evidence to suggest that new agricultural technology in India has been associated with major changes in the agricultural production, on the one hand, and widening inequalities in rural assets among the farmers and across the size-groups, on the other. The analysis is based on the data collected in the 26th and 37th Rounds of National Sample Survey (NSS). Data on distribution of assets are taken from All India Debt and Investment Survey, 1971-72, Reserve Bank of India and NSS 37th Round, January-December 1982.

The data relating to the asset structure for Punjab, agriculturally the most productive and wealthy state, are however very interesting and are in sharp contrast to those of Himachal Pradesh. The most striking difference between Punjab and Himachal Pradesh is that the asset structure was far more skewed in the former state, with concentration in the operational holdings at the top. These features become even more striking if the distribution of operational holdings is compared with the distribution of ownership holdings in both the years. The structure of ownership has remained more skewed than access to land. The dichotomy between ownership and access structures in the Punjab indicates that a large proportion of owners of marginal holdings leased out their land to the owners of semi-medium, medium and large holdings, whereas in Himachal Pradesh the structure of access to land was much

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less skewed and the operational holdings were not characterised by top concentration.

The average value of total assets per rural household increased by 203 per cent in the Punjab, whereas the corresponding increase was 176 per cent in Himachal Pradesh. Over the period, no significant change has taken place in the composition of assets in both the states. The only phenomenon worth noting is the rather sharp increase in the 'share of durable household assets' in Himachal Pradesh. It is interesting to note that Punjab registered the highest increase in the 'share of implements and machinery' in the total assets of cultivator households. There is no indication of diversification of rural economy in these states, judging by the insignificant share of non-farm business equipment in total assets. Even the share of livestock and poultry has tended to decline in both these states. This decline is more pronounced in the case of Himachal Pradesh.

It is interesting to see that the so-called green revolution belt, where inter-class inequalities are supposed to have escalated, the increase in the share of durable household assets was the least. It was 22 per cent in the case of Punjab whereas it was 46 per cent in Himachal Pradesh. The surplus is dissipated in different types of durable household assets in Himachal Pradesh, leaving stock of productive capital unchanged whereas the contrary is true in the case of Punjab. The study indicates that inequalities in asset distribution has comparatively tended to increase in the green revolution belt.

## **Inequality in the Distribution of Income and Assets among the Different Farmers' Groups in Green Revolution Belt (A Case Study of a Village in District Karnal)**

**A.R. Rathore and A.K. Chauhan\***

The paper attempts to study the inequality in the distribution of land, livestock, investment and income among the different size-groups of farmers in the Amritpur Kalan village of Karnal district in Haryana. For the purpose of study, a sample of 81 households was selected from the village and the data pertained to the year 1989-90. The study revealed that the majority of the landless agricultural labourers (71 per cent) and marginal farmers (73 per cent) depended on wage labour for their livelihood. Agriculture was the main occupation of all the medium and large farmers and 91 per cent of the small farmers. The average size of the family consisted of 6.39 members. It was observed that the size of family increased with the increase in the size of land holdings.

About 60 per cent of the family members were illiterate, 31 per cent were below matric, about 8 per cent were matric and the remaining about one per cent were graduates. An inverse relationship was observed between size of land holdings and the rate of illiteracy. The average size of operational holdings was 5.91 acres out of which 98.65 per cent was owned by the family. It was observed that every ten households in the study area maintained 13 cows and 22 buffaloes. They also maintained ten cow calves and 20 buffalo calves. A

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positive relationship was observed between the total number of animals maintained and the size of land holdings. The average per capita income of the sample households amounted to Rs. 6,603 per annum and there was positive relationship between family income and the size of land holdings. As regards inequality in land ownership among the farmers, the study revealed that about 26 per cent of the rural households did not own any land whereas only 16 per cent of the large farmers owned as much as 72 per cent of the total land area in the village. But in the case of livestock, the magnitude of inequality was less for the landless agricultural labour households with a share of 4.07 per cent in the total livestock maintained whereas the share of the large farmers was as high as about 48 per cent. Almost a similar trend was observed in the case of investment on farms. The degree of inequality in income was higher among landless agricultural labourers with a share of only 3.2 per cent in the gross income whereas the share of the large farmers was as high as 59 per cent.

The Lorenz curves showed that the magnitude of inequality was the highest in the case of land followed by gross income, livestock and investment. This was also supported by Gini ratio of concentration which was estimated to be 0.7547 for land, 0.7183 for income, 0.6335 for livestock and 0.6274 for investment on farms. The study clearly indicated that there is a wide disparity among the different size-groups of farmers in the distribution of income, land, livestock and investment. Land is the major source of inequality in the distribution of income and assets among different categories of farmers. Therefore, specific schemes for dairy development, fish farming, bee-keeping, poultry and other related enterprises should be given more encouragement along with financial support and infrastructural facilities to increase the income of the weaker section in the rural areas.

## **Optimum Farming Systems for Quantum Jump in Farm Production and Income in Post-Green Revolution Belt**

**D.S. Thakur, K.D. Sharma and A.S. Saini<sup>†</sup>**

An attempt has been made in the paper to examine and compare the cropping pattern, cropping systems, production and income of farmers under the existing farming systems, improved farming systems and optimum farming systems in the mid hills and humid zone II of the progressive hill state of Himachal Pradesh. The data related to the year 1989-90. The study shows that farming has been constantly improved and modernised first by evolving optimum cropping and mixed farming patterns. This was followed by new technology and improved cropping systems that resulted in the green revolution. However, as income from farming alone is not sufficient, farming systems approach which is holistic in nature is being followed increasingly in the post-green revolution belt for achieving a quantum jump in farm production and incomes of farmers which can be replicated elsewhere.

Under the farming systems approach, supplementary farm enterprises like fishery,

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apiculture, mushrooms, sericulture, poultry, etc., and off-farm work have been included, in addition to the improved cropping and livestock systems. The optimum farming systems have been formulated and developed by using an integrated linear programming model.

The study reveals that under the optimum farming systems, production and incomes of the farmers increased nearly three times by intensification of farming. On an average, gross farm income which was only Rs. 47,651 per farm in the existing farming systems increased to Rs. 1,35,830 under the optimum farming systems. Similarly, net income increased to Rs. 77,430 from Rs. 26,320. Moreover, farmers need to be ensured of better irrigation, new technology, farm inputs, credit, training, transport and marketing facilities, support prices and timely procurement of their produce for achieving higher production and income.

## **Risk Efficient Farming System for Small Vegetable Farms in Kangra District of Himachal Pradesh (An Application of Parametric Risk Programming)**

**A.K. Sharma and T.V. Moorti\***

The study pertains to Kangra and Nagrota development blocks of Kangra district of Himachal Pradesh. The sample of 120 small farms (less than one hectare) was chosen from farms having assured *kuhl* irrigation throughout the year, on the basis of two-stage simple random sampling technique. The data were obtained by survey method and pertained to the agricultural years 1981-82 to 1986-87. The average size of operational holding was 0.55 hectare. After examining the existing farming system along with gross margins and risk associated with it, the risk efficient farming system was developed for the synthetic farm situation representing the characteristics of sampled farms. The risk efficient farm plans were developed using the Minimisation of Total Absolute Deviation (MOTAD) Model.

The vegetable farmers grew cereals too on their farms for home consumption, as they have developed a taste for local varieties and do not relish the foodgrains purchased from the market. The study indicated that there is a need to reallocate the existing resources on small farms. By optimising the existing resources with existing technology, the returns of small farmers could be increased by as much as 52.4 per cent (from Rs. 13,780 to Rs. 21,000). The introduction of supplementary enterprises into the cropping system like dairy and poultry not only increased the returns but reduced risk too. In risk efficient plans the units of cross-bred cow and poultry showed continuous increase with increase in gross margins. However, the unit of local buffalo showed increase in the initial two plans and then decreased in the final two plans (plan III and plan IV), showing that local buffalo is less profitable than cross-bred cow in the study area. The study has evaluated different risk efficient plans showing different levels of risk and income associated with them. Therefore, the farmers have an option to choose different plans suggested by the model, as per their income-risk criterion.

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## **Income and Employment Increasing Potentiality in Various Farming Systems on Marginal Farms in Mid-Western Uttar Pradesh**

**A.K. Singh, L.R. Singh and J.S. Sharma<sup>†</sup>**

An attempt is made in this paper to examine the (i) existing levels of income and employment in various farming systems and (ii) potentialities of income and employment in various optimal farming systems. In the mid-western zone of Uttar Pradesh, two districts, Moradabad and Budaun were selected purposely as they ranked first and second respectively with respect to the number of small and marginal land holdings in the zone. From each of these two selected districts one development block was selected randomly. A preliminary investigation was made to identify the different farming systems on the basis of crop and livestock enterprises that generated at least 10 per cent of the total family income on marginal farms. Thus six farming systems were identified, viz., (i) crop farming, (ii) crop + dairy farming, (iii) crop + goat farming, (iv) crop + dairy + goat farming, (v) crop + goat + poultry farming and (vi) crop + piggery farming. Out of these identified farming systems, 10 per cent of the total farmers with a minimum of ten farmers in each of these farming systems were selected randomly. Thus the total marginal farmers finally selected was 83 from both the blocks. The data pertained to the agricultural year 1983-84. Optimum farming systems for marginal farmers following different farming systems were developed using linear programming models with the incorporation of cash borrowing activity, improved technology and unconstrained livestock units.

The levels of existing crop rotation followed on the farm have drastically changed in different optimal farming systems and all the crop rotations considered with improved level of technology have appeared in the optimal plan. Buffaloes (local and murrh) and piggery with improved feeding practices and goat with existing feeding practices have appeared in the various optimal farming systems. The number of these livestock enterprises has also increased over the existing level. Wherever dairy constituted a component of optimal farming systems, it has appeared as a major source of income. Poultry and goat-rearing failed to compete with dairying under optimal farming system with unconstrained number of milch animals.

Optimisation of resource use indicates maximum potentialities as reflected through the percentage increase in income over the existing level in crop + piggery farming followed by that in crop + goat + poultry farming, crop + goat, crop + dairy + goat farming and crop + dairy farming. In crop farming, however, the percentage increase in income was the lowest. The optimum combination of enterprises in a farming system is helpful in augmenting the levels of employment tremendously. In all the optimal farming systems, excepting crop farming, there has been complete absorption of available family labour days on marginal farms.

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## Economic Potential of Dairy Enterprise in Weaker Section Households in Green Revolution Belt

Kuber Ram and A.K. Sharma\*

It is almost an established fact that in the post-green revolution belt, the income disparity has generally increased due to skewed distribution of land resource in the rural areas. However, in the sugarcane growing tract of Western Uttar Pradesh, where about 30 per cent of the total cropped area is devoted to this enterprise, the weaker section households, particularly the landless agricultural labour, marginal and small farmers, got an unique opportunity to develop dairy enterprises for increasing their income and employment due to free availability of sugarcane top as a source of cattle feed. Good marketing infrastructure through a network of dairy co-operatives, milk plants and agro-based sugar industries have further increased the scope for dairy enterprise for the land starved sections of the population. The present investigation explores the milk production potential of the weaker section households in the sugarcane growing area of Saharanpur district of Western Uttar Pradesh. The sample consisted of 195 households selected from eight villages of the district, on random sample basis, comprising landless cattle owners, marginal farmers and small farmers. The data pertained to the year 1987-88.

It was observed that 43.3 per cent of the total rural households did not have any share in land, but owned 24 per cent of the total livestock resources, whereas the large farmers who constituted only 4 per cent of the total households owned 26.4 per cent of the land and 13.2 per cent of the livestock in the area. This is an indication of the wide disparity in the distribution of land in the green revolution belt. This has been supported by the Gini ratio of concentration which was 0.81 and 0.68 for land and livestock respectively. It may also be noted that the magnitude of inequality was more pronounced in the distribution of land resource as compared to that in livestock resource among the rural households.

The average gross income per family per annum from different sources was estimated at Rs. 5,304, Rs. 11,381 and Rs. 20,910 for the landless, marginal and small farmers respectively, out of which dairying contributed 51, 23 and 15 per cent of the total family income of the three respective categories of households. Thus the share of dairy enterprise in the total family earnings of the landless cattle owners in the sugarcane belt in the post-green revolution period was substantially high. The investment in the livestock was observed to be 58, 58 and 42 per cent for the landless cattle owners, marginal and small farmers respectively. The buffaloes constituted 79, 76 and 69 per cent of the total milch animals in the case of landless labourers, marginal and small farmers respectively, indicating the dominance of buffaloes in the area.

The milk yield per day per buffalo was the highest for the small farmers (4.65 litres), followed by the landless cattle owners (4.54 litres) and marginal farmers (4.17 litres). The net per litre cost of milk production was observed to be higher for the small farmers (Rs. 3.09) than the landless cattle owners and marginal farmers (Rs. 3.02). The estimated quadratic cost functions explained 51 to 56 per cent of the variation in per litre cost of milk due

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to the level of milk output. The estimated optimum level of milk production per day per buffalo was 10.00, 10.64 and 10.75 litres for landless cattle owners, marginal farmers and small farmers respectively.

It may be concluded that a wide disparity persists in the distribution of land and livestock resources, but the magnitude of inequality is more in the case of land as compared to livestock. The contribution of dairying is significant for all the three categories of weaker section households, but its share is substantial in the case of landless cattle owners. There is enough scope for increasing the income of these households through improved management and optimum level of milk production. Thus the study clearly demonstrates that there is a vast potential for dairy development in the sugarcane growing regions, particularly for the weaker section households. This requires financial support, improvement in infrastructural facilities for dairy development and specific schemes for land starved section of the rural population.

## A Comparative Study of Wheat-Paddy Versus Wheat-Cotton Farming Systems in the South-Western Punjab

Inder Sain†

The study of farming systems is important not only from the viewpoint of planners but from the viewpoint of farmers also. The planners are mainly concerned with the framing of policies in the national interest while the farmers are interested in maximising their profit. The importance of such type of studies is more in a state like Punjab which scaled great heights in the development of agriculture and planning to enter the phase of industrialisation based on agriculture. The present study is an attempt in this direction and seeks guidance from the analysis of different farming systems followed in the south-western Punjab. The data used in this analysis have been taken from the project: A Study into the Economics of Farming in Punjab for 1988-89. A sample of 90 farm households selected from six villages in the south-western Punjab was selected for the study. Twentyfive of them were identified as wheat-paddy growers while 33 were growing wheat-cotton with *kharif* fodder as a common crop. Thus wheat-paddy and wheat-cotton farming systems were identified on the basis of *kharif* crops grown in the area while the *rabi* crops grown were common on both the farming systems.

The analysis revealed that 75 per cent of the total operational area was put under paddy or wheat-paddy farming system against 81 per cent under cotton or wheat-cotton farming system. Though the per hectare operational expenditure did not differ significantly between the two farming systems, significant differences were noted in the case of break-up of expenditure. Wheat-paddy growers spent more on fertiliser, fuel and mobile oil and electricity while wheat-cotton growers spent more on seeds, insecticides/pesticides and hired human labour. The total expenditure per hectare was Rs. 5,270 on wheat-paddy system and Rs. 5,084 on wheat-cotton farming system in the study period. With respect to the investment in fixed resources, the wheat-paddy growers invested Rs. 58,614 which was almost twice that of the wheat-cotton farms (Rs. 30,724). With respect to the extent of returns per hectare,

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wheat-paddy growers obtained Rs. 7,375, Rs. 10,684, Rs. 5,988, Rs. 9,044 and Rs. 4,843 as returns to owned land and capital, operational expenditure, family labour, farm investment and owned land respectively. The corresponding figures on wheat-cotton farming system were Rs. 2,966, Rs. 6,518, Rs. 2,502, Rs. 3,811 and Rs. 4,408. This trend indicates that wheat-paddy farming system was more efficient in terms of returns than wheat-cotton farming system in the south-western Punjab. The sound resource base and unmatched development in technical breakthrough in paddy on wheat-paddy farms are obviously the reasons behind this efficiency.

Since the state is already under heavy pressure with respect to the concentration of area under wheat-paddy crop rotation resulting in the depletion of soil nutrients in large quantities, it is desirable to get rid of this wheat-paddy dominance in the state agriculture and to divert area from paddy to cotton. This would also be consistent with the needs of cotton industry being established in the south-western Punjab. It would be possible only if the cotton crop competes with paddy. Therefore, more emphasis should be given on cotton research leading to the evolution of hybrid varieties, which could compete with paddy. Apart from this, a favourable price support policy in the light of risk and volatile fluctuation in the prices of cotton would pave the way for diversification in crop enterprises. This would be the most suitable strategy leading to higher production and capable of feeding the agro-industries particularly, the cotton industry in the south-western Punjab.

## Variations in Cost of Production with Farm Size in Punjab

**K.K. Jain and H.S. Bal\***

Support price policy basically is a sort of insurance cover to the cultivators against the possibility of post-harvest crash in market price. The support price is determined primarily on the basis of cost of production estimates. How this cost of production varies with farm size is the centre of the problem in this study. This study has made an attempt to estimate (i) the per quintal cost of production of wheat, paddy and cotton on different farm size-groups over two periods of time, (ii) the level of inputs and output on different farm size-groups and (iii) to examine the role of different factors in explaining the cost efficiency for these crops. The study has made use of the extensive data collected under "Comprehensive Scheme to Study the Cost of Cultivation of Principal Crops in Punjab" which is being in operation since 1970-71. The study has revealed that market intervention operation through support price policy has reduced the gap between the highest and the lowest price received by the farmers over time. Profit margins have declined for wheat over time. In wheat, large farms were cost efficient producers except the marginal farms in 1986-87. In paddy and cotton, profit margins have increased over time. Diffusion of modern technology between the intervening period of study years has resulted in increasing the yields of wheat, paddy and cotton through the increased use of fertilisers and insecticides. Regression analysis revealed the inverse relationship of per quintal cost of production with the area under the crop (size of farm), *i.e.*, economies to the scale of production for wheat and cotton in both the periods

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and for paddy in the earlier study year. In paddy, the analysis revealed further scope of increasing the irrigation input to the benefit of the society. It also highlighted that for paddy, the area under the crop (farm size) had no effect on the cost efficiency. For this crop, increase in yield has a salutary negative effect on the per quintal cost of production, indicating the benevolent effect of modern technology in terms of distribution of gains.

## **Technological Change and Agricultural Production in Post-Green Revolution Belt in India**

**Chhotan Singh and Puran Chand<sup>†</sup>**

The continuous growth of new crop production technology coupled with intensive use of mechanical power brought about the green revolution in the country. How did the various regions in the country respond in terms of adoption of new technology which affected the growth of agricultural production? An attempt has been made in this paper to examine the extent of growth of new technology in the green revolution and non-green revolution belts in the country and to compare the growth of agricultural production and productivity between the two belts during the post-green revolution period. For this study a few states where the intensity of green revolution was high during the last 15 years, were selected. For comparison, some states in which the intensity of green revolution was low, were selected as the non-green revolution belt. For the selected states of both the belts, time-series data pertaining to the period 1970-71 to 1986-87 on technological parameters, infrastructural factors, mechanical power, total foodgrains production and productivity were collected. For the different states under each belt, changes and growth in the aforesaid parameters are worked out.

The results of the study revealed that the uneven adoption of modern technology was responsible for bringing about the green revolution with different intensities in the different belts of the country during the recent past. In the states of the green revolution belt such as Punjab, Haryana and Uttar Pradesh where the adoption of modern technology and intensive use of agricultural machinery and implements had taken place because of adequate infrastructural facilities, the agricultural production and productivity increased with steady growth. Hence, in the post-green revolution belt, there is a need to develop a better crop technology in order to move agriculture at a faster pace. Conversely, in the belt of non-green revolution states, namely, Orissa, Madhya Pradesh and Rajasthan, where the adoption of new technology was relatively low and the infrastructure was poor, the agricultural production and productivity increased only marginally. Therefore, in this belt, in order to enhance agricultural production for meeting the needs of the population of the region, special efforts should be made, especially through agricultural extension services, to popularise the adoption of available modern crop production technology. In addition to this, more attention needs to be paid to investment in the development of infrastructural facilities for irrigation and land improvement in the states of this belt.

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## Farmers' Response to New Technology in the Post-Green Revolution Belt of Orissa: A Micro Study

Dibakar Naik, Bikaram Keshari Pattanaik and Binod Chandra Mohanty\*

Recognising the importance of modern technology in increasing agricultural productivity, the Government of India and also the governments of different states launched the extension education programmes on agriculture to orient and inculcate among the farmers about high-yielding varieties (HYVs) of various crops of local needs and their connected package of practices in a systematic manner through convenient modalities. In this paper an attempt is made to examine the impact of extension education on the adoption of technology. The specific objectives of the study are (1) to know the adoption practices of farmers who received extension education and those who did not get extension education, (2) to examine the adoption practices of tenants, small and medium farmers getting extension education and those who did not get extension education and (3) to study the relationship between farmers' knowledge and their level of adoption of technology.

A study was conducted in Puri district of Orissa, where 150 farmers were contacted from both the groups in 15 villages. While selecting villages, five villages were purposively chosen where systematic extension education was being imparted and the rest of the ten villages were selected where farmers did not get any extension education. The analysis of data relating to the overall adoption score of the farmers getting extension showed an adoption score of 20.96, which is significantly higher than the adoption score of those who did not get extension education (6.0). This reveals that the extension education has a positive and significant impact on adoption of HYVs of paddy.

The adoption indices of tenants, small and medium farmers were 81.12, 86.12 and 87.71 per cent respectively. The calculated 'F' value is not significant at 0.05 level of probability, indicating that there is no significant difference among the tenants, small and medium farmers in adopting technology with facilities of extension education. The adoption indices were 21.54, 29.67 and 31.17 per cent in the case of tenants, small and medium farmers respectively without extension education facilities. Thus the rate of adoption is significantly higher with the tenants, small and medium farmers when they are trained by agricultural experts as compared to their counterparts without such facilities. The study confirms that a greater degree of knowledge of illiterate, literate (primary and middle) and literate (secondary and above) farmers is positively correlated with a greater degree of adoption. Depending upon the higher adoption index of the contact farmers, a proportion of the non-contact farmers may be substituted each year before the cropping season to extend the coverage of farmers under extension education programme. The study of the extent of adoption of technologies recommended by extension agencies on different size-groups of farms and their adoption constraints particularly in the green revolution belt will help the scientists to re-orient their research programme and priorities of research as per local needs.

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## Credit and Marketing Institutions: Missing Link in Data Base for Agro-Climatic Zones

V.V. Ghanekar\*

The attempt of the Planning Commission in building up a data base for 15 agro-climatic zones, and within these for 73 sub-zones so as to provide a basis for decentralised regional planning should be commended. Even more important is the involvement of regional and state level institutions such as agricultural universities and agro-economic research centres in assembling data for identifying thrust areas and in evolving strategies unique to each region and sub-region after intensive dialogue with the state, regional, and district level administration. For the first time agricultural universities with vice-chancellors as the chairmen of zonal planning teams have been actively associated with planning. This should be considered a good beginning in institution building for decentralised regional planning. Yet, apart from issues pertaining to linkages between macro planning and regional planning, inter-regional planning, and the valid distinction between an agro-climatic zone and a regional planning unit, there are important missing links in the data base.

The missing links may be outlined as follows: Firstly, there is no recognition of the linkages between physical factors and technology, on the one hand, and institutional factors and the consequent impact on employment and poverty. Secondly, the working papers on profiles and issues do not show a recognition of the importance of tenurial data in the identification of issues for agro-climatic regional planning. Thirdly, there is a need for strengthening local level institutions for assisting the regional level planning units in the process of selection among alternative projects within a given time profile and in locational decisions.

An obvious missing link is data on credit and marketing institutions. Despite growth of commercial banks, co-operatives continue to be the most important institutional agency for short-term productive credit. The status of the district central co-operative banks as viable credit institutions and in providing leadership to the primary co-operative credit societies for planned requirements is important for the success of regional planning. Similarly, marketing institutions are critical when zonal planning envisages new products. Such considerations are important because there is a vicious circle of low development of physical infrastructure and low level of development of credit and marketing institutions. This is quite obvious in the middle and lower Gangetic regions.

A vertical integration of co-operatives implies integration of all the activities/processes related to one single commodity through a co-operative structure, *i.e.*, it is an integration of production, processing, marketing and a host of other activities related to only one and one commodity. This, in a way, is quite a different approach compared with the old-fashioned multi-product marketing co-operatives, service co-operatives or agricultural credit co-operatives based at village level. There is a need to integrate all these activities for a producer farmer; otherwise he gets exploited at each level, which adversely affects his earnings and consequently the development of that area.

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## Role of Sericulture Industry for Development of Diversified Farming

G. Madhava Swamy<sup>†</sup>

This paper examines the role of sericulture in diversified farming in increasing the labour absorption and net returns over sole crop enterprise system in the post-green revolution period. During this period the area under irrigation increased with intensive cultivation. A large number of farmers diverted to sericulture industry besides crop enterprise, because it is a labour intensive agro-based industry with special features like economical use of water, low investment, creating more labour employment potential and high net returns compared to other commercial crops. As a result, this type of diversified farming with sericulture increased tremendously in Andhra Pradesh from 260 ha in 1970-71 to 57,570 ha in 1990-91 and thus the state occupies the second position in India. Labour absorption also increased from 3,200 to 7.10 lakh persons in sericulture industry. Diversified farming with sericulture not only reduces the risk but also becomes a source of continuous income throughout the year. This would also introduce an element of complementarity on the farm. Because of these advantages the present study was undertaken to quantify the employment potential and net returns per hectare, besides the problems that arose due to increase of area under sericulture.

Kurnool district in Rayalaseema area of Andhra Pradesh was selected because of its importance in sericulture cultivation. From two predominantly sericulture growing mandals and from four villages, 30 diversified farms with sericulture and an equal number of sole crop enterprise farmers were selected randomly. Operationwise information for different crops grown in both the types of farms was collected, besides information on the cultivation of mulberry, rearing of silkworms and marketing of cocoons in Ramnagar area of Karnataka State.

The operational size of a diversified farm with sericulture was 1.55 ha with 1.8 family labour units and that of the crop enterprise farm was 1.61 ha with 1.6 family labour. Irrigated area constituted 87 per cent in the diversified farm and 75 per cent in the crop enterprise farm. The popular dry crops were sorghum and mungari cotton and the irrigated crops were groundnut, rice and mulberry. In the diversified farming system, on an average, 0.80 ha was under mulberry cultivation and three or four crops are grown in a year. The results of the analysis revealed that about 90 per cent of the farmers in the study area transported the cocoons to Kamnagar area of Karnataka State as the reeling units in this district were insufficient. Due to this, the farmers faced a lot of problems in the marketing of the produce. The marketing cost for one hectare of the produce amounted to Rs. 2,000. Hence, there is an urgent need to install the reeling units either in the government sector or in the private sector for increasing the net returns further. This will also facilitate small and marginal farmers to adopt sericulture in a large way.

Due to diversified farming with sericulture, the additional employment potential created

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was 596 man-days and additional net returns were Rs. 7,879 per farm over sole crop enterprise farm. The data also revealed that per hectare additional employment was more by 393 man-days and net returns were by Rs. 5,475 in the diversified farm over the crop enterprise farm. The net returns will be further enhanced if more number of reeling units are established in Rayalaseema region by curbing the transportation of cocoons to Karnataka State. For each additional man-day of employment, the additional net returns were Rs. 13.90 due to diversified farming with sericulture. Hence, the State Government should help to develop the sericulture industry with a view to enabling the farmers to realise increased net returns in the agricultural sector, besides creating more employment potential in the state.

## Rice Economy of Tamil Nadu during Post-Green Revolution Era

### B. Mathavan and G. Subramaniyan\*

Among the food crops, rice occupies a prominent place in Indian agriculture. The area under rice in the country is the largest, accounting for one-third of the world's area under the crop. Tamil Nadu is one of the prominent states in India accounting for 7.6 per cent of the total area under paddy, but contributes 13.75 per cent of the total rice production in the country. There has been tremendous changes in area, production and yield of rice during the post-green revolution period in Tamil Nadu. This phenomenon has encouraged us to examine the trends in area, production and yield of rice at state and district levels in Tamil Nadu. The study is based on time-series data from 1970-71 to 1987-88. The main source of data for this study is Season and Crop Reports, pertaining to Tamil Nadu.

A semi-log quadratic equation  $\log Y = a + bt + ct^2$  and the Kinked exponential model  $\log Y = a + b(d_1t + d_2k) + C(d_2t - d_2k) + u$  have been used to understand the trends in area, production and yield of rice in the state. In the above Kinked exponential model,  $d_1$  and  $d_2$  are dummy variables.  $b$  and  $c$  represent growth rates in period I (1968-69 to 1977-78) and in period II (1978-79 to 1987-88) respectively. The following broad conclusions emerge from the analysis:

There has been neither an acceleration nor a deceleration in the growth rates of area under rice in most of the districts in Tamil Nadu during this period. The growth rate in area has been negative, ranging from -1.13 per cent to -3.71 per cent per annum. The negative trend is visualised in most of the districts and the state as a whole. Regarding trends in production, the coefficients corresponding to the growth rates are negative and statistically insignificant, indicating that the production of rice remained stagnant during the period under study. As far as yield is concerned, there has been acceleration in the growth rate in six districts (South Arcot, North Arcot, Salem, Coimbatore, Tiruchirapalli and Tirunelveli) out of eleven districts in Tamil Nadu. The trends in yield is quite reverse to that of area and production of rice in Tamil Nadu during the period. By and large, one can infer that the rise

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in yield has compensated the decline in area and consequently production remains stagnant during the post-green revolution period.

Comparing the trends in area, production and yield of rice between period I and period II, changes were discernible in the later period as compared to the former. Unlike declining trends in area and production, there has been positive trends in yield of rice in Tamil Nadu in both the periods. The growth rate in yield is relatively higher in the second period compared to first period in almost all the districts and in the state. By and large, the fall in rice production due to the fall in area has been compensated by rise in yield during the period under study. The study indicates that there has been diversion of area from food crops to commercial crops during the post-green revolution era in Tamil Nadu. On the whole, the farming system in Tamil Nadu has undergone perceptible changes during the period under study.

## **Comparative Studies on Income and Employment Potentials of Integrated Farming Systems on Small Holdings**

**S.N. Singh, K.P. Singh, L.R. Gupta, V.S. Kadian and N. Singh<sup>†</sup>**

Studies were conducted at Haryana Agricultural University, Hisar for developing most remunerative farming systems in relation to the agro-socio-economic conditions of Western Haryana. Three types of farming systems, viz., mixed farming with three cross-bred cows, mixed farming with three murrah buffaloes and arable farming with or without one milch animal were compared each on one hectare of canal irrigated land of Hisar. The results obtained during six years (1984-85 to 1989-90) of the study revealed that mixed farming with three milch animals was always better than arable farming in all respects. Mixed farming with three cross-bred cows gave the highest net return of about Rs. 21,000. The unit of three buffaloes could give an income of about Rs. 10,000 while arable farming yielded an income of about Rs. 7,000 or less. The cost-benefit ratio of arable farming and cross-bred cows unit was comparable but three times higher income from mixed farming of cows proved the superiority of this system over arable farming.

In mixed farming systems, more than 80 per cent of the expenditure was incurred on animal component and income from this component was also around 80 per cent. Labour, green fodder and concentrates were the major items of expenditure in animal components of mixed farming system. It also generated the highest man-days of employment, which varied between 612 in cross-bred cows unit and 649 in buffaloes unit. Therefore, the employment potential in agriculture increases with the inclusion of milch animal in arable farming system which is also evident from employment potential of arable farming with one milch animal.

On the basis of the different farming systems studied, it may be recommended that under

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canal irrigated condition of Western Haryana, small farmers, having a land holding of about one hectare can adopt mixed farming systems throughout the year for earning better income and gain more employment with uniform distribution. However, mixed farming systems can only be successful if better marketing facilities are available for the disposal of milk and other by-products of these systems.

## Impact of Technological Change on Farm Investment and Farm Income Distribution in Haryana Agriculture

Invinder Paul Singh, Sunita Verma and A.C. Gangwar\*

Technological change has led to significant change in the pattern of farm investment and has also widened income disparities. An attempt has been made in the paper to study the impact of technological change on farm investment and farm income distribution in Haryana agriculture at two points of time, viz., 1963-64 and 1986-87. A study entitled "Studies in Economics of Farm Management in Punjab" was conducted in 1963-64 and this study was taken as the base for comparison. The above-said study was conducted in Karnal, Kurukshetra, Rohtak, Jind and Sonapat which are now part of Haryana. These districts were purposively selected for the present study in 1986-87. In all, 200 cultivators were studied. The results revealed that the Lorenz curve for the post-green revolution period (1986-87) lay far away from the line of complete equality as compared to 1963-64. This finding confirmed that income inequalities have increased in the post-green revolution period. It was even more confirmed when Gini concentration ratios were worked out for the two periods. It was 0.35 in the pre-green revolution and 0.57 in the post-green revolution period. Lorenz curves for each of the five districts were also drawn and Gini ratios, too, were worked out. The analysis revealed that the Lorenz curve for Jind district was closest to the line of complete equality with minimum Gini ratio (0.42); whereas the Lorenz curve for Rohtak district lay far away from the line of complete equality with the highest Gini ratio (0.63), indicating that farm income inequalities are less in Jind and are very acute in Rohtak district. These findings were also confirmed by Theil index. The pattern of farm investment, too, underwent a significant change. The study revealed that there was a direct relationship between the percentage of investment on self-cultivated land and the size of holding in both the periods. The percentage of investment on implements and machinery increased with an increase in the size of holding in the post-green revolution period whereas just the opposite trend was observed in the pre-green revolution period. However, the size of holding did not make any impact on the percentage of investment on milch cattle in 1986-87 whereas in 1963-64, there was a tendency for the percentage of investment on milch cattle to decrease with the increase in the size of holding.

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## **Post-Green Revolution Inter-District Inequalities in Supporting Institutions - A Study of PACS in Uttar Pradesh**

**M.M. Bhalerao, D.K. Shukla and Asha<sup>†</sup>**

The impact of the green revolution seems to have increased the inter-regional inequality in agricultural productivity, incomes and employment and also in the performance of co-operatives like the Primary Agricultural Credit Societies (PACS). Hence, the need for such a macro study. The objective of the present study is to analyse the extent and trends in inter-district inequality in the performance of PACS in 54 districts of Uttar Pradesh during the period 1973-74 to 1982-83 for which comparable data were available. With the help of statistical tools such as coefficient of variation (COV) and Lorenz curves, the inter-district inequality in the performance of PACS was analysed.

The increase in COV from 1973-74 to 1982-83 as well as the Lorenz curves for both these periods indicated that the inequality has increased. This was obvious because of the inequality between western and central Uttar Pradesh districts and eastern, hilly and Bundelkhand region districts as regards irrigation facilities and infrastructure development. The policy implications of the study for achieving the social objective of balanced regional development of Uttar Pradesh are that greater efforts will have to be made to revitalise and reorganise PACS in backward districts and to expedite faster development of infrastructure in these districts.

## **Differential Responses to New Technologies in Some Sub-Situations in Post-Green Revolution Belt in West Bengal**

**K. Sain\***

This exercise aims at assessing the response of farm output in general and of some principal crops in particular to the application of new farm technologies including modern inputs and crop varieties in some regions of West Bengal belonging to distinct strata of development and endowed with diverse agro-climatic environment during certain specific time periods and thereby at gauging relative potentialities of such new farm technologies in contributing to growth of farm production and farm income. Secondly, it aims at indicating the necessity to reallocate limited available resources more rationally among distinct sub-situations for realising largest possible outturn from existing resources. Finally, a few suggestions are put forth for maximising farm returns. Recognised tools of analysis including linear multiple regression technique and log linear production function are applied to quantify the observations. Estimates are put to relevant statistical tests to assess their reliability. Farm output as well as yield of principal crops responded differentially to the application of different types of farm inputs and technologies in the distinct sub-situations

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in the post-green revolution belt in West Bengal. Their per hectare yields increased more on application of modern and innovative inputs and techniques including HYV seeds and plant protection chemicals than the traditional varieties. Sub-situations favourably endowed with natural conditions and socio-economic infrastructures recorded larger use of inputs per hectare with higher yield in comparison to less favoured areas. Rates of return or net revenue per rupee of cost incurred in the cultivation of crops are observed to be different in different agro-climatic areas. Estimates of rates of return though appreciably positive for HYV crops and other crops in developed areas were still lower than those in moderately developed areas and in less developed areas owing to already greater use of improved farm inputs in the more advanced areas in comparison with the other areas, according to the principle of diminishing returns to scale. These warrant reallocation of available limited resources in favour of more productive and innovative chemical, mechanical and biological inputs and farming techniques away from traditional ones and in favour of sub-situations which so far obtained an inadequate share of such resources and which have demonstrated higher potentialities for accelerated growth through higher marginal productivities of key agents of production and higher rates of return. It is necessary that differential treatment is meted out to distinct areas for maximum benefit from limited efforts and resources: More assistance in the form of still superior and innovative inputs and farming techniques for relatively developed sub-situations like Burdwan with assured irrigation facilities and greater assistance for exploiting groundwater table and harnessing natural fertility through scientific means for less developed sub-situations like Nadia and Bankura lacking surface irrigation facilities and favourable climatic conditions. Optimal use of resources also requires advanced and adequate test of soil and its secondary and micro-nutrients like boron (B) in particular and prescription of remedies for observed deficiencies and their adoption by the farmers concerned through sustained demonstration and extension activities.

## Inter-Regional Differences in the Farming Systems in Madurai District

S. Iyyampillai and D. Swamikannan<sup>†</sup>

One of the crucial variables that influence the farming systems is availability of water. Hence, the farming systems vary in different eco-types depending upon the level as well as source of irrigation. As a result, as many studies have already reported, even the socio-economic structure of the villages would undergo changes in due course. The introduction of irrigation also influences the input mix patterns and input-output relations. To understand the extent to which the well irrigation has influenced the changes in farming system, the present study seeks to analyse the cotton cultivation systems in four selected villages, of which two are dry and two are wet (random sample size being 57 and 86 farmers respectively), in Madurai district of Tamil Nadu. The analysis examines mainly the costs incurred on the raw materials used for the cultivation of cotton and their relation to the value of output

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and net revenue. For finding out the total cost incurred, first, the values of family labour and own raw materials used for cultivation have been systematically imputed and added to the value of purchased inputs. The individual cost items, total cost of cultivation and gross and net revenue in dry and wet villages are compared using student 't' ratios.

The data show that the mean of the per acre value of cotton harvest differs significantly across the dry (Rs. 3,361) and wet (Rs. 5,829) regions. However, they do not differ between small and big farm groups within the respective regions.

The difference in the cost structure across the regions or even across the farm sizes is not statistically significant. In both the eco-types and in both the farm sizes, almost 40 per cent of the total cost of cultivation is on human labour. However, the mean of the cost of cultivation per acre (Rs. 2,041 for dry region farmers and Rs. 4,249 for wet region farmers) differs significantly across the regions (but not between the farm sizes within the respective regions). The differences in the case of costs of many individual inputs are statistically significant across the regions, but not across the farm sizes. The means of the per acre values of hired female labour, fertiliser, pesticides, irrigation and family labour (female) are significantly higher in wet region, whereas the means of the per acre values of seed and manure are higher in dry region.

The size of per acre net revenues (gross revenue minus total cost) does not differ across the regions or even across the farm sizes within the regions. This point raises a question that why should the farmer in wet region is prepared to bear higher cost of cultivation by irrigating cotton fields, if his net revenue is not significantly higher as compared to that of his counterpart in dry region. This is explained by the variables other than net revenue. That is, even if net revenue for irrigated cotton is not very high, the farmers cultivate cotton in wet lands due to some other reasons such as maintaining the flow of water in the well for future also and acting according to the crop selection adopted by the neighbouring farmers.

## Changes in Crop-Mix in Sub-Region of Raipur District in Madhya Pradesh

M.R. Chandrakar, A.K. Koshta and K.G. Agrawal\*

District level agro-climatic planning needs detailed study to diagnose the problems of farming system in rainfed and protected irrigated (canal) areas on sub-region basis. The study would provide the changes needed in these farming situations for overall development. In Chhattisgarh region of Madhya Pradesh there exists wide variability in farming situations between different districts of the region and within the sub-region of a district too. Thus a study was undertaken to examine the changes in the crop-mix in the sub-region of Raipur district of Madhya Pradesh. The specific objectives of the study were (i) to find out the proportionate changes in net irrigated area to net cultivated area over two periods and to work out the contribution of different sources of irrigation and (ii) to analyse the changes made in the crop-mix between and within the sub-region over the period of study.

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Raipur district was selected for the study on the basis of rainfall, canal irrigated area and forest based farming. It has nearly 30 to 35 per cent of net irrigated area to total net cultivated area under canal source and the average annual rainfall about 1,100 mm. It has been categorised under five sub-regions such as Raipur, Gariyaband, Dhamtari, Mahasamund and Balodabazar. The secondary data were recorded on various parameters relating to land use, irrigation distribution and cropping pattern for these sub-regions for two periods of the post-green revolution belt, namely, average of 1975-76 to 1977-78 and average of 1987-88 to 1989-90. Absolute and percentage changes in various parameters were computed for different sub-regions over these two periods.

The study revealed that in the sub-region of high rainfall with canal and well irrigation the share of area under gram among pulses significantly increased. However, it needs more emphasis on summer groundnut. Forest and tribal based sub-region with high rainfall and canal water has shifted more area under *arhar* and sesamum. It requires extension in tank irrigation for planting summer groundnut. Out of three low rainfall sub-regions with canal water base, rational change has been noticed in the crop-mix in a sub-region which has got more well/tubewell water by allocating more land under gram and linseed. Under such a situation the sub-region with tank water has brought better change in the crop-mix by shifting more area to *urid/arhar* among pulse crop and summer groundnut among oilseed crop. Thus both the situations of sub-regions of low rainfall area have registered more changes in the crop-mix than the sub-regions having high rainfall with more canal water. Thus improvement in farming situations can be brought about only by enhancing the well, tubewell or tank irrigated area even in high rainfall/canal irrigation areas. Canal is used only for raising single *kharif* paddy crop in the study area and in fact no change can be brought about under such a farming situation.

## Resource Costs, Returns and Resource Use Efficiency under Different Farming Systems in Drought-Prone Area of Western Maharashtra

P.D. Deshmukh, D.S. Hange, N.K. Kale and Jg. R. Pawar<sup>†</sup>

An attempt has been made in this paper to discuss the costs and returns structure and production elasticities of different resources in the crop production of different farming systems with a view to indicating resource use efficiency/inefficiency of different farming systems in the drought-prone area of Western Maharashtra. The major farming systems considered for the study are (i) bajra-based irrigated farming system, (ii) bajra-based rainfed farming system, (iii) jowar-based irrigated farming system and (iv) jowar-based rainfed farming system.

The study is based on the micro level data of 480 sample farms with bajra-based and jowar-based farming systems in seven districts coming under the drought-prone area of Western Maharashtra. The study revealed that the proportion of cultivated area in the total

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holding, the proportion of irrigated area and the cropping intensity were relatively high in the case of the bajra-based farming systems as compared to the jowar-based farming system. The per farm as well as per cropped hectare use levels of all the resources were higher in the case of the bajra-based farming systems than those in the jowar-based farming systems. Similarly, the per farm total production costs, gross returns, farm business income, farm investment income and net income in respect of the crop production activity were relatively high in the case of the bajra-based farming systems as compared to the jowar-based farming systems.

From the estimated Cobb-Douglas type of production functions, it was revealed that the production elasticities of gross cropped area and expenditure on manures and fertilisers were relatively high on irrigated farms as compared to rainfed farms under the bajra-based and jowar-based farming systems. Under the bajra-based farming systems, the production elasticities were non-significant for human labour on irrigated farms; whereas in the case of the jowar-based farming systems the production elasticities of bullock labour, expenditure on manures and fertilisers, other working capital and gross cropped area have turned out to be statistically non-significant. The comparison of marginal value products of different resources with their per unit acquisition costs revealed that there existed a high level of inefficiency in the use of resources under different farming systems. Efforts are, therefore, needed to optimise the use of individual inputs under different farming systems in order to enhance the income levels of crop production activity. The scope for increasing farm income through resource optimisation is, however, more in the case of non-conventional inputs under all types of farming systems.

## **Relative Economics of Different Farming Systems in Western Maharashtra**

**S.S. Bhosale and B.B. Gawade\***

The present investigation is based on the micro level data on different types of farming systems obtained from a sample of 480 farms selected from ten villages coming under the bajra and jowar growing zone in the scarcity zone of the Western Maharashtra. The data on resource use structure and output of crop are analysed to work out the estimates of per farm costs and returns of the individual farming systems. The data collected related to the year 1989-90.

The study revealed that in bajra-based farming system under irrigated condition, the per farm human labour and bullock labour use and application of manures were found to be relatively more in the farming system with milch animals than that on the farms without milch animals. Under rainfed conditions, per farm use of all the resources was almost the same excepting manure, which was slightly higher in the farming system with milch animals.

In jowar-based farming system, per farm use of manure was slightly more on farms with milch animals. The use of all other resources remained the same in different farming systems.

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In bajra-based area, profit per farm over the working cost (farm business income) from crop enterprise under irrigated condition was Rs. 13,906 and Rs. 11,555 on farms with milch animals and without milch animals respectively. Under rainfed conditions profit per farm was Rs. 3,212 and Rs. 2,753 in respect of the above farming systems. In jowar-based area, profit per farm over working cost under irrigated condition on farms with milch animals and without milch animals was Rs. 7,148 and Rs. 6,249 respectively. Under dry conditions the same was Rs. 2,008 and Rs. 1,356 respectively. On the whole, it was observed that per farm resource use, profit and income were relatively more in bajra-based area than in jowar-based area.

## Impact of Agro-Climatic Zones on Cropping Pattern, Production and Employment in Aurangabad District of Maharashtra

P.R. Waghmare, V.B. Tak and D.N. Hedgire<sup>†</sup>

Maharashtra State is divided into nine agro-climatic zones. The districts of Marathwada region of Maharashtra State mostly consist of assured rainfall and scarcity zones. Aurangabad district is a typical district with varying soil types and rainfall. According to soil types, the talukas of Aurangabad district can be classified into three agro-climatic zones such as (a) assured rainfall zone with shallow to medium type of soil and hills (Aurangabad, Kannad and Soyegaon talukas), (b) assured rainfall zone with shallow to medium soils (Sillod and Khultabad talukas) and (c) scarcity zone with different soil depths (Paithan, Gangapur and Vaijapur talukas). The main aim of the present paper is to study the effect of ecological factors such as soil types and rainfall on the farming system and its effect on employment in each zone of the district after the green revolution period.

The data relating to average area, yield and production were obtained from the published sources for the various crops grown in each taluka for the two triennia 1977-80 and 1987-90. The changes in the cropping pattern were studied for the two triennia with the help of rank correlation analysis. The decomposition analysis of production for each crop was done for the two triennia by using the decomposition model of P.B.R. Hazell (1982). The cropping zones were earmarked by taking into consideration the change in the cropping pattern, change in yield and relative performance of yield in the district as per criteria used by S.S. Johl and R.S. Sidhu (1988). Taking into consideration the above-said parameters, crop zones were made with sequential priorities. The employment opportunities for various categories of farm population were also studied.

The results revealed no change in cropping pattern for the assured rainfall zone with soil types as shallow to medium and scarcity zone. However, the change in the cropping pattern was significant in talukas of assured rainfall zone with shallow soils and hills. The mean yield of wheat negatively contributed to production in the district for all types of zones. The yields of bajra and paddy contributed substantially to the total production in the scarcity zone, whereas mean yield of *tur* and *kharif* groundnut in the case of zone A and bajra, *rabi* jowar, *kharif* groundnut and paddy were the major crops contributing to production in zone

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B. The interaction of mean yield and mean area was largely responsible for increasing the production of bajra, gram, *kharif* groundnut and safflower in zone A, of *tur* and *kharif* groundnut in zone B and of *kharif* jowar, bajra and safflower in zone C. The per capita land availability did not change substantially for cultivators and agricultural labourers in zone C.

## Employment and Wages of Agricultural Workers in the Post-Green Revolution Period in Punjab

J.S. Chawla and T.S. Chahal\*

The study, based on secondary data, seeks to examine the changes in employment and wages of agricultural workers on bullock holdings in different zones of the Punjab in the post-green revolution period at three points of time, *i.e.*, 1971-72, 1981-82 and 1984-85. The average size of holding decreased from 6.08 hectares in 1971-72 to 4.73 hectares in 1984-85. The size of holding decreased in all the zones, except zone I due to fast mechanisation and the tendency of small farmers to sell their lands. The number of bullocks per holding in the state diminished by 28.13 per cent. The decline occurred in all the zones except in zone III, the reason being that zone II is the most advanced in terms of infrastructural support for agriculture and zone I is sub-mountainous. Due to less irrigation and large holding size, zone III showed a preference for draft power. The number of workers per holding decreased in all the zones. The decline was maximum in zone II because of its developed agriculture and higher concentration of population in industry. With the decline in the size of holding and number of bullocks per holding, the area per pair of bullocks increased from 4.12 hectares in 1971-72 to 4.48 hectares in 1984-85, with the zones showing a mixed trend. The area per permanent worker in the face of stable workforce on land went down by 14.93 per cent in the state. This was also true for all the zones. Due to the decline in the holding size and the dependence of population on agriculture, the number of workers per plough increased in the state as well as in the zones. Per hectare gross and net income in the state increased by 234.26 and 408.82 per cent in 1984-85 over 1971-72 respectively.

On per hectare basis, employment of manual and bullock labour increased by 50.72 and 64.88 per cent respectively in 1984-85 compared to 1971-72. On yearly basis, employment of workers and bullocks increased from 216.9 man-days and 103.5 pair-days in 1971-72 to 384.8 man-days and 193.6 pair-days in 1984-85 respectively. Among the zones, zone II showed the maximum increase in employment followed by zone III and zone I. On daily basis, a permanent worker worked for 4.27 to 5.29 hours in different zones of the Punjab in 1971-72. In 1984-85 he worked for 6.83 to 9.6 hours per day in different zones. Use of bullock pair also went up from 2.26 hours in 1971-72 to 4.24 hours in 1984-85, showing an

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increase of 77.84 per cent. Similar increases were found among the zones, zone II showing the maximum increase and zone I the minimum increase. Annual and daily wages of permanent worker doubled in 1984-85 as compared to 1971-72. Daily wages per permanent worker ranged from Rs. 8.93 to Rs. 10.51 in 1984-85 as against Rs. 4.12 to Rs. 4.43 in 1971-72 in different zones. Returns per family worker varied from Re. 1.92 to Rs. 4.14 in 1984-85 as against Rs. 2.03 to Rs. 3.36 in 1971-72 in different zones of the Punjab. The increase in returns per worker was 62.56, 23.21 and 18.33 per cent in zones I, II and III respectively. Though the wages of permanent and family workers increased over the years, yet the family workers were paid less than the permanent workers. Therefore, it may be concluded that in the post-green revolution period, employment and wages of the agricultural workers have gone up.

## **Impact of Risk on Resource Allocation and Cropping Pattern - A Case Study**

**S.P. Bhardwaj,\* U.N. Dixit\* and H.C Gupta**

The introduction of improved agricultural technology has brought about structural changes in crop activities. There has been a significant increase in area, output and productivity of some crops but the same is not true in many other crops. Despite rise in product prices, in some cases like oilseeds and pulses quite significantly, there has been no growth since 1966-67. Empirical data reveal that yield variability associated with some crops and instability in the others jointly are responsible for the unbalanced growth in agricultural production.

In farm decision-making process, natural and economic conditions change over time and contribute to the existence of risk factor, which affects both productivity (technical efficiency) and optimal resource use (allocative efficiency) and hence the economic efficiency at farm level. The present study examines the impact of risk on cropping pattern and resource allocation among a sample of 72 farmers selected from six villages in Gurgaon district in Haryana, using parametric linear programming technique. The study showed that risky crops like gram, mustard and barley do not find significant allocation on small farms but these crops are grown on large farms. Similarly, the rates of fertiliser application differed among different categories of farms and also among crops. Again risky crops are preferred less in the allocation of large doses of fertiliser as compared to stable crops like wheat. The optimal crop planning for the risky crops entered the solution at higher levels of risk. The element of risk (yield and price) has a significant impact on cropping pattern of farmers under study.

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## A Study of the Impact of Green Revolution in Agra District of Uttar Pradesh

Balishter and Roshan Singh<sup>†</sup>

The paper makes an attempt to examine the changes in the farm economy and human labour use on account of changing technology in agriculture in Sadarban village of community development block Bichpuri in Agra district of Uttar Pradesh on a census basis during 1965-66 to 1985-86. All the farm families owning land in the village have been included in the study and have been categorised into four groups on the basis of owned holdings, viz., marginal (upto 1 ha), small (1-2 ha), medium (2-4) and large (above 4 ha). The year 1965-66 represents the pre-green revolution year, 1975-76 the green revolution year and 1985-86 the post-green revolution year. The results of the study indicate that during the period of two decades, the proportion of marginal farmers in the total farm families increased from about 22 per cent in 1965-66 to about 40 per cent in 1985-86, that of small farmers from about 24 per cent to about 35 per cent, while the proportion of medium farmers declined from about 21 per cent to 17 per cent and that of large farmers from about 33 per cent to only about 8 per cent. The average size of holding has declined from 3.23 ha in 1965-66 to 2.56 ha in 1975-76 and further to 1.81 ha in 1985-86. During the green revolution period the average size of marginal farmers declined to less than half from 0.73 ha to 0.36 ha while in the case of small and medium farmers it increased by about 8 per cent and in the case of large farmers by over 25 per cent. Thus inequality in the land holdings increased as is apparent from the changes in the average farm size.

Over time not only the number of farm families has increased rather fast, but also the average size per family showed a continuous increase. This growing population against the fixed land base has resulted in a sharp decline in the availability of land per capita. This decrease in land availability per capita was more than compensated through increase in land productivity during the green revolution period (1965-66 to 1975-76) but not so during the post-green revolution period (1975-76 to 1985-86). This situation is bound to result in growing poverty of the farm and rural sector at an increasing pace unless a substantial part of the farm population is shifted away from the farm. During the green revolution period there has been a shift in the cropping pattern in favour of *rabi* and *zaid* crops. In 1975-76, *kharif* crops occupied about 33 per cent of the cropped area while *rabi* crops and *zaid* crops occupied about 65 per cent and 3 per cent respectively. This pattern was sustained in the post-green revolution period. A similar trend was also observed in all the farm size-groups. In view of the development of assured irrigation, the farmer is inclined to reduce his dependence on rains for growing crops successfully. As regards the shifts in particular crops, it is noted that among the *kharif* crops, the area under bajra has increased during the green revolution and post-green revolution periods while the area under jowar has declined marginally and the area under other *kharif* crops (cotton/sugarcane) has declined very sharply. The area under *kharif* vegetables has shown an increase. Among the *rabi* crops

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there was not only a marked increase in the area under wheat during the green revolution period, but there was also a substitution of local varieties with HYV almost completely. The area under mustard and *rabi* vegetables has shown an increase during the green revolution and post-green revolution periods while the area under other *rabi* grains (coarse grain crops and crop mixtures) has shown a sharp decline. This shows that the degree of diversification in *rabi* cropping has been considerably reduced showing a clear trend towards increased specialisation and also there has been a shift from low income crops to high income crops in this season.

The average yields of bajra, wheat and mustard increased by about 46, 119 and 104 per cent respectively during the green revolution period. It may, however, be noted that the increase in crop yields in the post-green revolution period has been almost negligible in the case of wheat and bajra while it was somewhat significant in the case of mustard. Wheat yield during the post-green revolution period increased only marginally, indicating that it has reached a stage of stagnation. There is, therefore, a pressing need to explore further possibilities for increasing crop yields, particularly in the case of wheat.

The growth of farm income among the different farm size-groups, with the exception of marginal farmers, has been very substantial and the relationship between the growth of income and farm size is direct. Comparing the growth of farm income and the share of different categories of farmers, it is observed that as a result of the green revolution, the gap in income between the small and large farms has increased substantially, leading to accentuation in income inequalities. The labour use per cultivated hectare and cropped hectare increased considerably during the green revolution period but it showed a declining trend in the post-green revolution period, due to the growing use of labour-saving technology in the form of machines. There is a negative relationship between farm size and labour use per cultivated as well as cropped hectare. The higher cropping intensity, more intensive labour use in various farm operations and less use of machines in the case of marginal and small farms may explain this situation. This contribution of hired labour in total labour use in crop production also increased during the period of two decades. Comparing the labour use in different activities during the period, it is observed that though employment in the non-farm sector has increased, this increase is negligible in view of the excess capacity of rural labour.

## Hill Farming System: A Study of Himachal Pradesh

M.L. Sharma, N.K. Sharma and C.S. Vaidya\*

Mixed farming is the general rule in Himachal Pradesh and production of fruits and vegetables is popular. Except fruits and vegetables, the state has very little to sell and therefore the use of purchased inputs is very little. Agriculture (including horticulture), animal husbandry and forestry are the major resources for various farming systems. 'Farming Systems' are the result of past decisions by farmers, communities or government institutions.

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Accordingly, the farming system of the state can be categorised into three divisions, viz., High hills, Ridges and Valleys. Variation in the resource endowments and supporting activities like climate, soil, rainfall and temperature in different areas of the state have resulted in varying cropping patterns. Rains are often erratic and not well spread. These factors have influenced the adoption of new farm technology, resulting in the emergence of developed, developing and under-developed farming systems in the state.

In this paper, an attempt has been made to identify the regions where the potentials of land have not been utilised after the green revolution. Maize and wheat were the main crops of the state with a share of 41 and 32 per cent of the total cropped area respectively. In the case of supporting activities, i.e., sheep and goat-rearing in high hills, tending cattle on commercial lines in ridges and services and business in valleys were the sources of income.

After the introduction of green revolution, high growth rates in area, production and yield of wheat influenced the farmers to adopt diversification in the cropping patterns over a period of ten years. During 1974-86, the compound growth rates in area, production, yield of crops and income from foodgrain crops showed a sharp decline. On the other hand, the growth rate of horticultural and vegetable crops increased markedly, indicating higher diversification towards cash crops.

Regionwise picture of farming system showed that higher growth rates in area, production, yield and returns in the hilly region helped it to move to a developed stage. Due to low yield of citrus and high returns from vegetables, the farming system in the valleys is in a developing stage while the ridges are under-developed due to low yields of temperate fruits and foodgrains. When considering the contribution of ridges in the state, this region supports over one million cattle, which account for more than 60 per cent of total livestock population of the state. A sizeable number of such cattle from the region is made available to the valleys where the mortality rate of bullocks is more due to hard labour in intensive farming coupled with the constraints of clay soil and less availability of fodder. On the other hand, this region provides grazing land and fodder for 1.1 million heads of sheep and goats. But the region is still in an under-developed stage due to lack of irrigation facilities as water table is much below the mark.

With a view to knowing the potentials of this region, cost and returns were worked out for 50 beneficiaries availing of lift irrigation in the sampled cluster of villages. It was found that the per hectare net returns in the irrigated area were Rs. 2,297 and Rs. 7,624, on an average, in the *kharif* and *rabi* seasons respectively, while the average per hectare net returns in the unirrigated area were Rs. 1,814 and Rs. 727 for the corresponding crop seasons. The diversification in the cropping pattern was also reported after the introduction of irrigation and due to this, the farmers have shifted their area from cereals to off-season vegetables which fetch higher returns to them. Since the state has vast capacity for generation of electricity, attention should be given to lift irrigation which requires electricity for its functioning. Secondly, the marketing system under co-operative societies will prove helpful in the development efforts of the state.

## Post-Green Revolution Changes in the Cropping and Production Patterns in Haryana Agriculture

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In the present paper an attempt has been made to study the changes in the cropping and production pattern in Haryana agriculture between 1966-67 (pre-green revolution year) and 1988-89 (post-green revolution year), based on secondary data. The study has shown that the area under rice and wheat has increased at the rate of 9.28 per cent and 6.34 per cent per annum respectively during 1966-67 to 1988-89. The area under food crops like jowar, bajra, maize and barley and the area under important pulse crops have declined during this period. The total area under total foodgrains, however, has increased at the rate of 0.85 per cent per annum. Among oilseed crops, the area under rapeseed and mustard and sesamum increased by 4.07 per cent and 12.02 per cent per annum respectively during this period. The area under groundnut and sugarcane has showed a decreasing trend.

Though the total production of foodgrains has increased at the rate of 11.60 per cent per annum during this period, the total production of jowar, maize, barley, gram and other pulse crops has decreased. Efforts need to be made to increase their productivity. The total production of oilseed crops has increased by 18.53 per cent per annum during the same period. However, the production of groundnut and sugarcane needs to be increased by increasing their productivity.

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