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Strategy for Micro-Level Agricultural Planning with Special Reference to North-Eastern Ghat Agro-Climatic Zone of Orissa

Dibakar Naik*

Orissa is broadly divided into ten agro-climatic zones based on the amount and distribution of rainfall, irrigation, soil characteristics and cropping patterns. The North-Eastern Ghat is the largest agro-climatic zone occupying an area of 28,644 sq. km., comprising 18.38 per cent of the total geographical area of the State. The physiography of this zone is quite different from one area to another. Wide intra-variations in climatic conditions are observed in the zone. In this paper an attempt is made to identify the micro-agro-ecological units (sub-zones) within the agro-climatic zone and to examine the agro-climatic differences among the agro-ecological units with special reference to agricultural planning. The North-Eastern Ghat agro-climatic zone is classified into seven agro-ecological situations depending upon the amount and distribution of rainfall, irrigation, soil characteristics, elevation and cropping patterns. This zone occupies broadly brown forest soil (1,29 lakh hectares), red and yellow soil (0.76 lakh hectares), red loam soil (2.22 lakh hectares), black soil (one lakh hectares), alluvial soil (1.67 lakh hectares) and lateritic soil (1.34 lakh hectares). The elevation of this zone varies from zero to 1,000 metres from mean sea level. The amount and distribution of rainfall which plays a crucial role in crop planning have recorded significant differences among the agro-ecological units during 1975 to 1984. The study indicates gross disparity in irrigation potential among the agro-ecological units of the zone.

Thus each individual agro-climatic factor affects the distribution of crops of a particular agro-ecological unit. The variation in soil types, elevation, irrigation potential and rainfall pattern among the situations tend to develop dissimilar scenario for crop growth. Hence crop planning at micro level with similar agro-climatic factors will be very crucial for encouraging agricultural growth. Therefore, special attention should be given for developing plan at the level of sub-agro-ecological units.

Agro-Climatic Zonal Planning for Sustained Growth in Crop Pattern

Suresh Pal and D.K. Bahl†

This study attempts to (*a*) examine the growth and instability in various agro-climatic zones and (*b*) suggests policy measures for sustained growth in crop production. Compound growth rates, coefficient of variation and probability of shortfall in yield were computed for analysing the growth and instability in rice production.

The results revealed that the growth in rice yield and production was appreciably high in the Upper and Trans-Gangetic Plains and Western and Southern Plateau and Hill Zones.

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These were stagnant or declining in Lower and Middle Gangetic Plains, Eastern and Central Plateau and Gujarat Plains. The production instability was fairly low due to low instability in area and yield in Upper and Trans-Gangetic Plains and West Coast Plains. In seven out of 13 zones studied, yield instability was the major cause of production instability. Further, the probability of shortfall in yield varied from 33 per cent in West Coast Plains to 46 per cent in Central Plateau and Hills.

The high as well as stable yield in Upper and Trans-Gangetic Plains suggests that an increase in area under rice in these zones would stabilise the production. But this may not be sustained as the water potential in these zones has been exploited to a great extent. The area under rice should be increased in high rainfall and high water potential zones like Coastal Plains and Lower and Middle Gangetic Plains. However, yield-increasing policies like increased use of modern inputs, water management and adoption of suitable varieties should be strengthened in these zones. In Plateau and Gujarat Plains, protective policies such as water conservation and dryland farming should be encouraged for sustained growth. In addition, the instability or risk consideration in product price would bring the risk parity among the zones and stimulate the growth in high instability zones. For this, the increase in per quintal price of rice needed to compensate the yield risk varied from Rs. 4.39 in Eastern Himalayan Zone to Rs. 22.39 in Central Plateau and Hills.

Zonal and Risk Efficient Farm Planning in Punjab

K.K. Jain*

Crop yield in a region depends upon the resource endowments and weather conditions prevailing during the crop growth period. As weather conditions differ less in the contiguous regions, so resource endowments remain the main source of yield differentials. One most important resource is the nature and volume of irrigation availability. In this study stratification of tehsils into different zones was made with the help of irrigation and crop complex. Also it is the widely held view that irrigation reduces instability in agricultural production. So with the help of Schultz indices and MOTAD (Minimisation of Total Absolute Deviation) model, risk levels in yields and returns were estimated for different zones. Schultz indices indicated that in the most developed zone V where modern technology had an earlier inception, the instability in yields was less, *i.e.*, with the diffusion of new technology instability in risk levels in yield declines. With the help of MOTAD analysis it was indicated that risk efficient farm plans demand reorganisation of resources in favour of less riskier enterprises and also it indicated that in the most developed zone V, risk levels in returns were the least in the existing plan as well as in risk efficient plans while these were highest in the least developed zone of the State. It is therefore concluded that risk level varies inversely with the level of development of a region, which in turn is determined by the extent and quality of irrigation.

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An Assessment of Risk Taking and Subsidy in Paddy Production: Use of Profit Function Approach

K. Dhanasekaran†

There is no consensus among researchers and agricultural economists on the definition or measurement of risk. Most of the studies that attempted to measure risk used time-series district level observations on yields of crops, employing coefficient of variation as the measure of risk. Some studies used standard deviation as the measure of risk in a choice-theoretic framework. But these approaches suffer from the following limitations: (*a*) variation in the aggregated data like district averages is recognised to be an underestimate of the variation at the farm level and (*b*) it does not permit us to work out the variation of yield with different varieties or at different levels of fertiliser application. With this background, the present study attempts to quantify the risk in paddy production, using farm level data. Also it determines the form and level of subsidy for bridging the risk gap.

The term risk taking is interpreted here in the context of fertiliser application to the optimum level and the risk gap is defined as the difference between the optimum investment and the actual farm expenditure on fertilisers. The optimum level of fertilisers and corresponding yield level were determined by applying the cubic function which was found to explain better. The study concludes that there is scope for tapping yield and income potential of the farming technology. The results indicate that there is considerable under-investment (risk gap) in fertilisers by small farmers leading to gaps in yield and net return to the optimum investment. The policy prescription is to fix differential input prices according to the need of the particular category of farmers concerned. The state should encourage the less efficient farmers to reach the optimum level of investment per acre through a complementary support of its production policies such as supply of fertilisers, seed and credit along with proper extension services. Since the conditions differ from area to area, an in-depth study of constraints inhibiting investment in modern inputs at various places is necessary to devise appropriate strategies.

Yield and Gross Income Variability in Different Agro-Climatic Regions of Haryana - An Application of Risk Evaluation Model

K.N. Rai, J.C. Karwasra, S.P. Singh and Shri Niwas*

Risk and uncertainty play an important role in the decision-making process of the farmers. Agriculture is exposed to various types of risks and uncertainties. A farmer will be hesitant to apply capital intensive inputs, if his crop yield and income frequently suffer from wide fluctuations. This may be one of the reasons for varying level of adoption of new technology in different agro-climatic regions. Fluctuations in farm income stem from acreage, yield and price fluctuations which are influenced by many variables in an unpredictable manner. In

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the present study an attempt has been made to estimate the extent of variability (uncertainty) in yield and income of important crops, gross income per farm and per hectare in different agro-climatic zones of Haryana State. Risk evaluation model was used to quantify risk involved in crop farming in different agro-climatic zones of the State. The findings of the study indicate that the yield and gross income risks were lower for all those crops which had higher area under assured irrigation. Stable crop yields also reduced price risk. It is also observed that besides irrigation, the type of crops grown has also an impact on income risk. For example, in the case of gram and rapeseed and mustard, the income variability was more than in other crops. The income obtained from these crops in relatively less irrigated zones (Zones III, IV and V) is also higher, which indicates that more paying crops have greater risk. This appears to be one of the limiting factors due to which the farmers with limited/no irrigation facility do not grow more paying crops. The total crop production risk as well as total gross income risk per farm and per hectare was found to be higher in the agro-climatic zones reporting higher gross income per farm than in those zones with relatively less gross income per farm.

The Adjustment of Risk and Uncertainty through Crop Diversification in Different Agro-Climatic Regions of Punjab

Tarvinder Singh Chahal†

The paper attempts to study the yield uncertainty of important crops of Punjab, estimate their comparative economics and formulate policy for crop diversification for different agro-climatic regions of the State. Data were collected from secondary sources relating to the year 1986-87. The selection of crops for diversification was based on adjusted income estimated after making deductions for the yield variation from normal income of different crops. Rank orders were prepared for developing policies for diversification. There was a trend towards specialisation as paddy-wheat rotation dominated 71 per cent of the area and it was fast picking up in the rest of the State. Paddy was prone to highest yield variations (29 per cent) followed by gram, cotton, wheat, sugarcane, bajra, groundnut and maize. Sugarcane gave the highest income of Rs. 5,238 per hectare per season followed by paddy, cotton, groundnut, maize and bajra in *kharif* season and wheat and gram in *rabi* season. The adjusted income did not make any difference in the ranking of other crops except paddy and cotton which went down to the third and the fifth position giving second and forth place respectively to wheat and cotton. Thus there was a dire need to effect crop diversification after neutralising the effect of yield and uncertainty in incomes of different crop enterprises.

The Flood Plain region may continue to grow paddy crop to face the vagaries of nature (flooding due to rains) because of its best suitability. The other five regions may be diversified according to the criterion of income stability of different crop alternatives. Sugarcane, the most profitable crop both at normal and adjusted levels, may be added to reduce the over-dominance of paddy-wheat rotation in Central Plain and Western Plain regions and

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maize-wheat combination in Sub-mountain Undulating region of the State. Oilseeds may be encouraged to diversify crop production by reducing area under paddy-wheat rotation in Undulating Plain region and cotton-wheat combination in Western region of the State. Depending upon the agro-climatic suitability, the third crop alternative in the process of crop diversification may be taken up by cultivating paddy in Submountain Undulating, maize in Undulating Plain and Central Plain, cotton in Western Plain and bajra in Western region of the State.

Regional Disparities in Gains from Agricultural Growth

K.J.S. Satya Sai*

The paper seeks to examine the spatial gains in agricultural development among different broad regions of India. More specifically, it proposes to test the widely held view that North-Western wheat belt region - consisting of Punjab, Haryana and West Uttar Pradesh - accounts for a lion's share in national level gains from agricultural growth. In India, during the period between the triennia ending 1952-63 and 1984-85, the aggregate crop output, measured in terms of 'rice equivalent units', rose from 67 to 177 million tonnes. In other words, over a period of 33 years, the increment to aggregate crop output is about 110 million tonnes of rice equivalent units. Of this increment, about one-fourth is shared by North-Western wheat belt region, followed by Western India with a share of about 22 per cent. Southern and Eastern regions, on the other hand, each accounted for 18 to 19 per cent of the total output gains. The Central region accounted for only 12 per cent of the output gains.

It is also found that North-Western India has a share in output gains of India that is two and a half times that of its share in the country's 1961 population. On the other hand, the ratio of the shares in output gains and population is 0.66 and 0.75 for Southern and Eastern regions respectively. North-Western India also shows a higher share in output gains compared to its share in the country's gross cropped area, *i.e.*, higher yields per unit of cropped area. The study further indicates that the North-Western India strengthened its share in output gains over time. Consequently, the shares of other regions declined over time.

Statewise analysis shows that just four States, *viz.*, Punjab, Haryana, Uttar Pradesh and Andhra Pradesh accounted for about half of the total incremental production at all-India level. Especially, in Punjab and Haryana, the increment per net sown hectare is 2.6 and 1.2 tonnes respectively which is well above the national average of 0.5 tonne. Thus the agricultural growth in India has been concentrated in North-West region which, however, cannot be said to have a major share in the growth. But, the share of the region has risen over time. This reflects the differential initiative in terms of development of irrigation and infrastructure across States.

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A New Criterion for Delineating Agricultural Regions and Agro-Irrigation Zones in Madhya Pradesh

S. Murty†

A region is a specific area defined for a particular purpose. An agricultural region is a territory with broadly homogeneous natural, topographical or climatic conditions and cropping patterns. Different institutions and economists have tried to divide India and its States in several agricultural regions on the basis of different criteria mainly based on climate and cropping pattern. This paper attempts to use "river-irrigation possibilities" as a criterion for delineating agricultural regions, because irrigation is the most important single factor affecting agricultural production, especially in India where agriculture mostly depends on monsoon. In this study the State of Madhya Pradesh has been divided into twelve agro-irrigation regions, and care has been taken to match these twelve regions with the already prevalent crop zones and administrative regions of the State. The twelve proposed regions are: (1) Chambal Sindh basin; (2) Sindh Betwa basin; (3) Sonar basin; (4) Sone Basin; (5) Mahanadi Northern Bed and Shivnath; (6) Mahanadi Southern Bed; (7) Indravati Basin; (8) Shipra, Chambal, Kalisindh Basin; (9) Parvati Betwa Basin; (10) Narmada Tapti West Basin; (11) Narmada Central Basin; and (12) Narmada Tapti East Basin and Bainganga Basin.

Risk and Uncertainty in Agriculture on the Periphery of Shimla Town

Amar S. Guleria, Yamini Utreja and Amboj Kaushal*

An attempt has been made in this paper to explain the concept and elements of risk and uncertainty. Given the various methods of measuring risk, an attempt has also been made to estimate the extent of risk in agriculture on the periphery of Shimla town. The study is based on a sample survey of the 131 households (different farm sizes) in 14 selected villages located around Shimla town (15 km. radius) during 1988-89. The study found that farming enterprise involved risk to the extent of around 55 per cent in terms of land allocation. In terms of productivity per unit of land, the extent of risk was estimated at 36, 64, 76 and 55 per cent for the marginal, small, medium and large farms respectively. But in terms of net returns per unit of land under the existing farm practices, the element of risk and uncertainty was about 65, 15, 13 and 40 per cent for the marginal, small, medium and large farms respectively. The application of linear programming model suggests that risk could be eliminated from 8 to about 58 per cent across farm sizes in the study area.

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Regional Imbalance in Crop Productivity in Maharashtra State

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Time-series data were collected relating to area and yield of all major cereals, pulses and oilseed crops in all the districts of Maharashtra for the period 1969-70 to 1987-88 from Season and Crop Reports and Epitome of Agriculture. Yield indices were estimated, using the yield index of Chang (1965) with slight modifications in the formula by utilising the yearly information of individual crops. The triennium average of yield indices for the first triennium 1969-72 and 1985-88 were compared for all the 29 districts (excluding Bombay) in Maharashtra State. Four groups of highly developed, developed, under-developed and highly under-developed districts were made on the basis of their ranks in cereals, pulses and oilseeds by working out the quantities.

The results of the study revealed that Kolhapur, Satara, Jalgaon, Raigad, Sindhudurg and Buldhana are highly developed districts in the case of cereals , whereas Nanded, Bhandara, Osmanabad, Nasik, Solapur, Latur and Ahmednagar districts are observed to be highly under-developed. In the case of pulses, Kolhapur, Jalgaon, Amravati, Yeotmal, Buldhana, Akola are found to be highly developed whereas Aurangabad, Latur, Beed, Osmanabad, Solapur and Chandrapur are the most under-developed districts. As regards oilseeds, Kolhapur, Sangli, Satara, Parbhani, Beed, Jalna and Nanded are highly developed and Dhule, Bhandara, Chandrapur and Gadchiroli are highly under-developed. On the basis of the study, two groups of highly under-developed and under-developed districts are made as per their rank performance. These districts are placed if they occur subsequently in at least two crops of under-developed category. Thus the study suggested two groups of districts as highly under-developed and under-developed in yield performances for overall crop development such as Group 1 consisting of Pune division, Bhandara and Chandrapur in Nagpur division and Osmanabad and Latur in Aurangabad division and Group 2 consisting of Gadchiroli and Wardha in Nagpur division, Aurangabad district in Aurangabad division and Sangli from Kolhapur division respectively.

Inter-State Disparity in Agricultural Productivity and Growth

A.K. Das*

This paper has the twin objective of analysing agricultural productivity and growth at an aggregative level for the farm business as a whole. Value productivity per hectare has been compared between the States for the agricultural year 1980-81. An attempt has been made to relate it with outstanding institutional finance per hectare by using Kendall's Tau test. Rank correlations between productivity per hectare of gross cropped area (GCA) and institutional credit per hectare of GCA and productivity per hectare of net sown area and

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finance per hectare were found to be positive and significant at 5 per cent level. The authors have fitted exponential function $Q_t = a(1+r)^t u_t$ in linearised form to study the stability/instability in agricultural growth for different States as follows: $\text{Ln } Q_t = c + dt + v_t$ where c = log a = a constant, v_t = log u_t and d = Ln(1+r), r being the annual compound growth rate.

The coefficient of time (d) is actually the continuous rate of growth. As it closely approximates the annual compound growth rate, the standard errors of (d) may be taken as standard errors of r which provide a convenient measure of the stability factor associated with growth. In other words, they represent the extent of deviations around the time trend which are units comparable across time and space as long as time periods compared are of equal length.

The study has brought out that States like Gujarat, Karnataka, Madhya Pradesh and Orissa with a lower productivity per hectare of area (gross or net) have also exhibited lower rates of growth and comparative lack of stability. On the other hand, such States as Haryana, Punjab and Uttar Pradesh showing a higher level of productivity in terms of both gross and net area have also registered higher rates of growth of nominal output with greater stability. This implied that the regional disparities in the levels of agricultural productivity are generally on the increase. These disparities could be reduced through increase in the flow of institutional credit to agriculture.

Inter-Regional Inequalities in Agricultural Efficiency in Punjab: A Temporal Analysis

Inder Pal Singh, G.S. Mander and Invinder Pal Singh†

The shifts in cropping pattern over time and its impact on agricultural efficiency in different regions of Punjab, as classified on the basis of proportionate area under principal *kharif* season crops in the State, have been studied for the period 1972-73 through 1987-88. The requisite districtwise data were collected from the Statistical Abstracts of Punjab and Department of Economics and Sociology, Punjab Agricultural University, Ludhiana. The relative agricultural efficiency in different regions was compared by working out their efficiency indices and agricultural value productivity per hectare of net sown area for different years.

After the introduction of high-yielding varieties (HYVs) of paddy, the majority of the Punjab farmers shifted towards this crop because of its relatively high profitability; resistance to insect pests and diseases; low variability in yield and prices and above all assured marketing facilities for its disposal as compared to its main competing crops. The impact of these shifts on technical efficiency indices over time did not show any specific trend. The overall agricultural value productivity in Punjab increased during the seventies and relatively sharp increases were observed during the eighties. The areas, where paddy was adopted during the transitional phase of Punjab agriculture, relatively gained more in terms of agricultural value productivity in comparison with the regions specialising in other crops as well as traditional paddy growing regions. It is suggested that emphasis should be laid

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on research and marketing development activities with respect to competing crops to bring them on par with paddy in terms of profitability with a view to reverse or at least break the trend of specialisation in Punjab agriculture.

A Delphi Approach to the Study of Constraints in Rice Production in the Agro-Climatic Regions of Kerala

R. Prakash and G.T. Nair*

The study aimed at identifying the production constraints of rice in the different agro-climatic regions of Kerala. It was conducted in all the five National Agricultural Research Project regions of the State, *viz.*, Southern, Central, Northern, High Range and Problem Regions. Delphi technique - the methodology for eliciting expert opinion - was used for the identification of constraints. Conversion of lands, drought and lack of irrigation were the major production constraints in rice cultivation in the Southern Region while non-availability of farmyard manure, low profitability and high cost of production were the constraints in the Central Region. Difficulty in rice cultivation, non-availability of farmyard manure and fragmentation of holdings were the production constraints ranked high in the Northern Region. The high wage rate of agricultural labour, indebtedness and high cost of production ranked high in the High Range Region while in the Problem Region, the major production constraints were floods, low profitability and high cost of farmyard manure.

Inter-District Yield Variations in Haryana Agriculture

Ram Niwas, Himmat Singh, B.S. Panghal and O.P. Chhikara†

The study is based on the secondary data available from various issues of the Statistical Abstract of Haryana covering the period from 1972-73 to 1988-89. All the important crops of the State, namely, wheat, paddy, bajra, sugarcane, gram, rapeseed and mustard, cotton and barley which constitute more than 80 per cent of the total cropped area have been included in the study. Exponential functions were fitted to estimate the growth rates in the yield of different crops. Coefficients of variation were calculated to determine the degree of inter-district disparities in agricultural productivity. To measure the agricultural productivity in each district, composite productivity indices were worked out. Factor analysis was done to measure the degree of influence of different variables associated with the inter-district yield variations in major crops of the State.

The results have shown that there existed wide inter-district variations in the growth rates of yield of major crops in the State during the period selected for study. The growth rates of different crops for the State as a whole indicated that the yields of all the crops except gram and cotton have increased over time. In the case of gram, cotton *desi* and cotton American, the yields have decreased marginally by 0.34, 0.04 and 0.82 per cent respectively per annum. Further, the inter-district variations in yields of wheat, paddy, cotton (*desi*) and

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barley have decreased over time, meaning thereby that the new technology has narrowed down the inter-district yield variations in these crops. The infrastructural variables which constitute the first factor (F_1) in the analysis supported by technical inputs explained 86.6 per cent of the inter-district yield variations. The second factor (F_2) which includes the size of holding explained about 26.5 per cent of the inter-district variations. The size of holding individually explained only 3.07 per cent of the variations which is a pointer to intensive agriculture to be followed in future to improve the overall production in agriculture without the need for more area which is already being utilised to almost its maximum availability.

Major Constraints Limiting Agricultural Production in the Southern Region of Kerala

Elsamma Job*

The disparity between the technology evolved and technology adopted has resulted in a gap between potential productivity and realised productivity. There are a large number of constraints limiting the adoption of improved technologies. An attempt was made here to analyse the major constraints faced by the farmers in the production of major crops like paddy, tapioca, banana, coconut and pepper in the southern districts of Kerala. Data were collected from 319 farmers selected through stratified multi-stage random sampling. The economic constraints were the most important limiting factor in the region. The economic constraint that ranked first was high cost of labour, reported by about 85 per cent of the farmers. The next important constraint was high cost of manures and fertilisers (61 per cent) followed by the low price for the produce (59 per cent). The major infrastructural constraint noticed was the non-availability of water resources for irrigation (41 per cent) followed by lack of irrigation canals and channels to bring water from the source (32 per cent). Important technological constraints were the non-availability of skilled labour for special work like spraying, dusting, seed treatment, etc., which was reported by 38 per cent of the farmers. The problems of leaf rot and root wilt diseases were reported by about 36 and 30 per cent of the farmers respectively. These two constraints are reported mostly by the large farmers. Most of the constraints were found to be increasing with the increase in the size of holding. There is much scope for increasing agricultural production and productivity if proper price policies are adopted, extension efforts are intensified and other economic, infrastructural and technological constraints are solved.

Options for Development of Dry Western Region of India

S.S. Acharya, A.S. Solanki and Sunita Verma†

Dry western region, which accounts for nearly five per cent of the geographical area of India poses typical problems of development. Agro-ecological characteristics and options available for the development of this region have been analysed in this paper. The region has all the characteristics of hot desert, scanty and erratic rainfall, high evaporation and non-existence of perennial rivers. The region is sparsely populated with a density of only

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58 persons per sq. km. Forests cover only 1.2 per cent and pastures occupy 4.3 per cent of the area. Wastelands and fallow lands occupy 42 per cent of the geographical area. Irrigation facility is available only for 6.3 per cent of the cultivated area. So far, groundwater has been the main source of irrigation but further possibility of expansion is negligible. The cropping intensity is only 105 per cent. *Kharif* crops account for 90 per cent of the gross cropped area and their per hectare yields are very low. The region has 19 million livestock heads with promising breeds of cattle, sheep and camels. But livestock productivity is low due to lack of fodder resources and market support for their products. The infrastructural facilities are also inadequate. The existing development programmes in the region leave much to be desired both in terms of content and scale.

The options available to improve the economic conditions of people of this region include better methods of water resource conservation and management, improvement of quality of cows, sheep and goats, development of fodder resources through expansion and qualitative improvement of pastures, buffer stocking of fodder and training of farmers in silage making, improving the productivity of existing adapted crops, promotion of arid fruits plantations, large scale afforestation and sand dune stabilisation, promotion of agro-based industries and provision of inputs and services to support these activities. The exercise conclusively establishes that regional approach can increase the overall pace of development as well as reduce the inter-regional disparities.

Quantification of Risk in Dryland Farming of Anantapur District, Andhra Pradesh

S. Subba Reddy and A. Kandaswamy*

Dryland farming is fraught with risk and uncertainty conditions due to predominant weather risk. The risky nature of its production and consequent risk averse attitude of dryland farmers keep them intact in vicious circle of poverty. An attempt is made in the paper to measure the risk component in yields, farm harvest prices and gross income of the farms in the selected talukas of Anantapur district of Andhra Pradesh. The magnitude of risk in gross income of major crops in the district ranged from 14 to 85 per cent. The risks in the productivity of crops (8 to 80 per cent) and farm harvest prices (15 to 45 per cent) were equally alarming though relatively less. Among dry crops productivity risk is conspicuous (22 to 80 per cent) while price risk is prominent in irrigated crops of the district. The high risk in the productivity of dry crops was mainly due to scanty and ill-distributed rainfall and lack of requisite levels of high potential inputs and suitable dryland technology. Price risk was mainly due to tied-up and forced sales within the villages by the farmers because of lack of market finance, storage facilities, well defined marketing functions and price manipulation by middlemen especially at the time of harvest. In brief, high income commercial crops were comparatively more risky than the low income cereal crops in the district. The high magnitude of risk in dry and irrigated crops is alarming and calls for much concerted efforts by farmers to follow scrupulously risk management strategies coupled with adoption of

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suitable policy and planning for the development of the hitherto neglected Anantapur district. The present system of crop insurance scheme which is limited to borrowers and a few crops should be extended to all crops and the farmers in the district.

Analysis of Inter-District Disparities in Himachal Pradesh's Agricultural Development

M.S. Jairath and Shanti Sarup†

Agricultural development in India has not proceeded in a regionally balanced manner both at the inter-State and intra-State levels. The hilly areas are no exception. Keeping this aspect in view, a study has been undertaken in Himachal Pradesh, a north-western hill State in India to determine the level of agricultural development at the district level and to estimate the extent of regional disparities in the State. In order to examine inter-regional disparities, various researchers in the past have generally utilised the techniques such as tabular analysis, simple ranking method, indices method and principal component analysis. In this paper taxonomic method, the concept of average values, has been used to estimate the disparities. The composite index for each district is computed based on 12 indicators reflecting different characteristics of agricultural development. The value of composite index ranged from 0.61 to 0.99. Una district ranked the first and Lauhal-Spiti the last. Five districts such as Shimla, Chamba, Kinnaur, Kullu and Lauhal-Spiti have been classified as agriculturally backward districts (having composite index above 0.75). The main causes of agricultural backwardness are lack of irrigation facilities, lower availability of net area sown per cultivator, poor spread of HYV seeds and poor availability of infrastructural facilities. The above analysis suggests that there is a need for recasting the strategies with the main focus on agricultural technology, extension, larger flow of credit, creation of infrastructural facilities and providing main attention to produce off-season vegetables, hops, saffron and horticultural crops.

Farm Planning in a Dry Zone - Systems Approach to Improve Income and Employment Prospects

T.M. Gajanana and B.M. Sharma*

Predominance of rainfed cultivation dictates the prospects or otherwise of Indian agriculture and more so of Karnataka where over 80 per cent of the land is rainfed. In such areas, though farmers usually combine subsidiary enterprises like dairy, sericulture, sheep rearing, etc., with crop cultivation, available literature indicates that this practice is not pursued on systematic lines by many a farmer. An understanding of the potential of different farming systems encompassing crop and other subsidiary enterprises and the various optimum

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combinations of the enterprises would help formulate policies for improving the prospects of dryland farmers. Keeping this in view, the present study was undertaken in one of the drought-prone districts of Karnataka with the following objectives: *(a)* to examine the potential of different farming systems, *(b)* to study the impact of credit and technology on income and employment and *(c)* to suggest appropriate farming systems for the study area.

Input-output data for the agricultural year 1987-88 were collected from 130 farmers (29 marginal, 54 small and 47 large) from 10 randomly selected villages in Sira taluka of Tumkur district. Linear programming was used as the major analytical tool. The results of the study indicated the possibilities of increasing income and employment through reorganisation of the existing resources. The availability of unlimited capital and technology further accelerated the pace of development in terms of increased returns and employment on all categories of farms. Further, the capital starved small and marginal farms were found to use capital more judiciously than the large farmers. Farming systems with crop, sericulture, dairy and sheep offered more scope for enhancing the returns and labour absorption than crop farming system. However, since sheep rearing was confined to a particular community called Kurubas, the next best farming system, crop+sericulture+dairy is suggested on all farms in the study area. It is further suggested to strengthen the extension network and to introduce flexibility in the credit delivery system in the financial institutions and extend the veterinary health care to a larger number of dairy farmers. Participation of farmers in the watershed development programmes is likely to meet not only their food, fuel and fodder requirements but also ensure the ecologically sustainable farming in the study area through soil and water conservation measures, besides afforestation.

Inter-Regional Disparities in Technological Change and Agricultural Growth in India

Chhotan Singh and Puran Chand†

An attempt has been made in this paper to examine the changes that have taken place over one and a half decades in the technological factors among the various States (regions) in the country and to analyse the inter-State disparities in the growth of agricultural production and productivity during this period. Statewise time-series data pertaining to the period 1970-71 to 1986-87 on production, technological parameters, infrastructural factors, mechanical power and total foodgrains production as well as productivity collected from secondary sources have been used. Statewise changes and growth rates of the aforesaid parameters have also been worked out.

The results of this study reveal that there are large imbalances in the growth of agricultural production among the States (regions) in the country. The crucial factors which could be held responsible for inter-State disparities in the growth of agricultural production are the differential rates of change in the adoption of modern crop production technology, variations in the infrastructural facilities and use of mechanical power in the States over the period. In States like Punjab, Haryana and Uttar Pradesh, where the changes in the adoption of new technology, development in the infrastructural facilities and use of machinery and implements had taken place, agricultural production and productivity had increased tremendously.

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Conversely, the backward States, such as Orissa, Madhya Pradesh, Rajasthan and West Bengal, where the aforesaid changes were negligible, had achieved relatively low growth rates in agricultural output. The policy implication of the study is that in order to reduce the imbalances in the growth of agricultural production among the States in the country, special extension efforts should be made towards popularising the adoption of modern crop production technology in terms of use of high-yielding variety (HYV) seeds, chemical fertilisers and plant protection measures for increasing agricultural production in the backward States or regions. In addition to this, more attention needs to be paid to investments in the development of infrastructure facilities for irrigation, water management, land improvement, consolidation of holdings, marketing etc., in the identified States. Besides, adequate institutional finance should be made available in the backward States for purchasing the crucial inputs such as seeds of HYVs, fertilisers, pesticides and insecticides which should be provided at subsidised rates as an incentive to the poor farmers. Long-term credit should be advanced by the financial institutions for the purchase of agricultural machinery and implements.

Regional Pattern of Agricultural Development in India Since Independence (An Institutional Approach)

Hem Chandra Lal Das*

Based on the criterion of homogeneity in agro-characteristics, the Planning Commission of India has divided the country into 15 agro-climatic regions. But in this exercise the Planning Commission has laid too much emphasis on technological factors and has completely left out the institutional factors. As a matter of fact, the development of an economy depends on the interaction between institutions and technology. On the basis of different agrarian systems prevailing in the different parts of India during the colonial period, the country has been divided into four regions, namely, Zamindari, Ryotwari, Mahalwari and Jagirdari in the present paper. Agricultural development has been expressed in terms of 'agricultural efficiency' represented by a composite index of five indicators, like crop intensity, irrigation intensity, per agricultural worker availability of net area sown, area under commercial crops and per unit area productivity of principal crops. The study covers the period of 40 years from 1946-47 to 1985-86, sub-divided into two sub-periods of pre-green revolution (1946-47 to 1965-66) and post-green revolution (1966-67 to 1985-86).

Considering the whole period of 40 years, the Mahalwari region (comprising Punjab and Haryana) has been found consistently with the highest index of agricultural efficiency. In contrast, the Zamindari region (comprising West Bengal, Bihar, Orissa, Uttar Pradesh and Assam) has been found to have the lowest index of agricultural efficiency. The economies of Punjab and Bihar have produced a picture of regional contrast with the former having the highest index and increasing trend and the latter having the lowest index and decreasing trend. The uneven dispersal of agricultural development may be attributed to the colonial mode of exploitation, uneven distribution of investment of public funds, differential use of technological inputs and the institutional constraints like semi-feudal mode of agrarian relations. For balanced regional agricultural development in India, institutional changes should precede the technological change or both these changes should go side by side.

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Agro-Climatic Decentralised Planning for Sustainable Agricultural Development in Hilly Regions

J.P. Bhati and Ranveer Singh†

In this paper the need for regionalisation in agricultural planning and a criterion for delineating developmental regions are discussed. Intra-regional disparities and the major constraints on agricultural development in different agro-climatic zones within Western Himalayan region are also discussed. The study concludes that delineation of the whole country into broad regions on the basis of physical features and agro-climatic conditions is necessary but it is not sufficient to take due care of the local needs and the resources available. Since there are wide variations and heterogeneity within broad regions regarding physical conditions, soil characteristics and micro climates which result in different farming systems in different sub-regions/zones, it is, therefore, desirable that the regions be further sub-divided into somewhat homogeneous smaller zones for formulating agricultural development strategies. Within each zone actual plan formulation and implementation should be done on the integrated watershed management basis with the active participation of local people.

Instability in Productivity of Oilseed Crops Grown in Nagpur Division

M.D. Korde and Y.P. Mahalle*

In this study an attempt has been made to assess the instability in yields of important oilseed crops grown in different districts of Nagpur division of Maharashtra State. The yield data pertain to the period from 1967-68 to 1986-87. The exponential trend was fitted to yield data for the entire period of 20 years. The risk or instability in yields of groundnut, sesamum and linseed crops is measured in terms of *(i)* coefficient of variation, *(ii)* probability of crop failure which shows the percentage of crop failure years to the total number of years and *(iii)* crop loss ratio. The crop failure year is defined as a year in which the actual yield obtained is less by 10 per cent or more than the estimated trend yield for that year. Crop loss ratio is defined as aggregate losses in yields of a crop during the years of crop failure expressed as percentage to aggregate of trend estimates of yields for these years. These measures of risk or instability in productivity were worked out districtwise as well as separately for two periods, *i.e.*, 1967-68 to 1976-77 (period I) and 1977-78 to 1986-87 (period II).

It was observed that in period II although the productivity of all the selected oilseed crops has increased in absolute terms in all the districts, it also registered larger variability as compared to period I. However, the districtwise compound growth rates of yields worked

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out for the entire period were non-significant at 5 per cent level of significance, except sesamum crop in Bhandara district where it was 3.44 per cent. It was further observed that the probability of crop failure was inversely related with the crop loss ratio in respect of all the oilseed crops. The instability in productivity of crops measured in terms of probability of crop failure had increased in most of the districts in period II as compared to period I. In the case of groundnut crop, the lowest instability was observed in Bhandara district and the highest instability in Chandrapur district. In respect of sesamum crop, Chandrapur district showed the lowest yield instability and Nagpur and Bhandara districts recorded the highest instability. The linseed crop yield instability was comparatively the lowest in Wardha district and the highest in Chandrapur district.

Measurement of Risk in Yields of Important Crops Grown in Amaravati Division of Maharashtra State

N.A. Gadre and D.P. Wahile†

The specific objective of this study is to quantify the risk in yield from different angles for a period of 12 years from 1974-75 to 1985-86 for different districts in Amaravati division of Maharashtra State, with triennium ending 1974-75 average as the base. Secondary data have been used for the purpose. Six principal crops grown in the region, *viz.*, rice, *kharif* jowar, cotton, *tur*, wheat and gram have been selected for the study. Yield risk has been quantified by using the following statistical tools, *viz.*, *(i)* Coefficient of variation: $\frac{\text{Standard Deviation}}{\text{Mean}} \times 100$; *(ii)* Compound growth rate: Compound growth rates in yields were estimated for the selected crops by fitting exponential function ($y = ab^x$); *(iii)* Probability of crop failure: Productivity of a crop is defined as failure if observed yield during a year is found below the trend estimate of that year by 10 per cent or more. Percentage of years of crop failure in total years is then defined as probability of crop failure; *(iv)* Crop loss ratio: It is defined as aggregate of losses in yields during the years of crop failures expressed as percentage of aggregate of trend estimates of yields worked out for those years.

It was observed that cotton, *kharif* jowar and *tur* are the prominent crops of Amaravati division and these together occupied 77.72 per cent of the gross cropped area. The study revealed that the yield of cotton crop was most inconsistent and that of wheat crop was highly consistent. Yavatmal district showed more consistency in the yield of selected crops. The study further indicated relatively more chances of crop failure in cotton and gram and lower chances in the case of wheat. Lower magnitudes of losses are observed in *kharif* jowar and wheat while larger losses in cotton and rice. It is interesting to point out that the magnitude of losses has an inverse relationship with the probability of crop failure. Significant growth rates of yields were observed only in *kharif* jowar crop, except in Akola district.

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Agro-Climatic Regional Planning in Uttar Pradesh

G.N. Singh and Ram Iqbal Singh*

On the basis of various studies done in the past, the country has been divided into 15 broad agro-climatic zones by the Planning Commission. Uttar Pradesh falls under four agro-climatic zones, *viz.*, Zone I (Western Himalayan Region), Zone V (Upper Gangetic Plains Region), Zone IV (Middle Gangetic Plains Region) and Zone VIII (Central Plateau & Hills Region). Out of these four zones, the entire area of Zone V falls in Uttar Pradesh alone while the area of the other three zones extends to other States also.

Zone V comprises three sub-zones spread over 34 districts of Uttar Pradesh. Out of the total population of about 66.2 million in this zone, 57 per cent are cultivators. The climate of the zone is sub-humid, semi-desertic and semi-arid. The temperature ranges between 3° C during the winter to 46.5° C during the summer. The average annual rainfall varies from 593 to 1,107 mm. The zone has vast expanse of alluvial soils developed from the alluvium of river Ganga and its tributaries. The water resources comprise both surface and ground-water. Canals and tubewells are the main sources of irrigation. The net sown area accounts for 70 per cent of the total reported area. Wheat, rice and sugarcane are the main crops which accounted for 34 per cent, 17 per cent and 8 per cent of the gross cropped area respectively. Mango, guava and citrus are the main fruit crops. Land reclamation and development, crop production and irrigation, drainage and water management deserve top priority for agri-cultural development.

Zone I consists of eight hill districts of Uttar Pradesh with a population of 4.84 million. The climate of the region is temperate. The average annual rainfall varies between 936 and 1,932 mm. The net sown area accounted for only 13.5 per cent of the reported area. Rice, wheat and smaller millets are the main crops. All types of temperate fruits are grown widely. Soil and water management, improvement in fruit production programmes, development of agro-industries based on fruits and development of transportation, marketing and processing of fruits need top priority.

Zone IV consists of 15 districts of Eastern Uttar Pradesh with a population of 34 million. The climate of the zone is sub-humid and the average annual rainfall varies between 725 and 1,628 mm. The net sown area accounted for 64.50 per cent of the total reported area. Rice, wheat, pulses and sugarcane are the main crops. Canals, tubewells and masonry wells are the main sources of irrigation. Mango, guava, jack fruits are the main fruit crops. Along with development of irrigation and drainage, flood control and protection from waterlogging deserve top priority. Water management and improvement in crop production need special significance.

Zone VIII consists of five districts of Bundelkhand region of Uttar Pradesh with a total population of 5.43 million. The average annual rainfall varies between 780 and 850 mm. The main crops are wheat, gram, *arhar*, lentil and soyabean. Out of the total reported area, about 63 per cent is under net sown area. Monocropping is the main feature of this region. Programmes of soil and water conservation, water management, crop production

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improvement and reclamation of banjar land deserve top priority. Watershed development and adoption of new dry farming technique are the key strategy for the agricultural development of this zone.

The central paradigm of development in Uttar Pradesh has to be a massive land and water development strategy combined with an optimal crop mix and technology and economic support packages to make this strategy effective. Effective employment generation plans will have to be related with questions of land and water development and crop planning and improvement of agricultural productivity along with the development of agro-based industries.

Prospects and Problems of Agricultural Development in Cold Deserts of Himachal Pradesh

T.V. Moorti, R.C. Oberoi and A.K. Sharma†

The data obtained through two-stage stratified random sampling design from 65 farmers of cold desert of Spiti Valley reveals that the agriculture of cold desert areas is mostly traditional, primitive and subsistence in nature. The problems of cold deserts are region-specific which need specific strategy to tackle them. Improved technology was not found to have any significant impact in the study area. The optimum farm plans suggested that with the introduction of improved technology and re-allocation of resources as high as 50 per cent increase in farm income could be attained. The vast potential of agriculture in the study area remained untapped because of a number of geographical, social and economic constraints. The major economic constraints responsible for non-adoption of improved technology are inadequate and untimely supply of farm inputs, small holdings, scarcity of capital, inadequate irrigation facilities and lack of adequate extension services in the study area, all of which can be attributed to the highly rugged, mountainous, snow-bound conditions prevalent in the cold desert area. The working season is only 4 to 5 months, the means of transportation are not developed and the cost of construction of infrastructure is very high. Once the constraints responsible for poor agricultural development are removed, wide scope exists for improving tribal agriculture. The study also suggested that keeping in view the non-economic constraints, there is a need to follow the psycho-social approach for the agricultural development of the cold deserts.

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Districtwise Disparities in Agricultural Growth in the Arid and Semi-Arid Areas of Rajasthan in relation to the Rest of the Districts of Rajasthan

Shiv Ram Dass and Ikbal Singh*

Based on time-series data pertaining to the period 1966-67 to 1986-87, the study reveals that disparities in the agricultural development of arid and semi-arid areas of Rajasthan and their districts in relation to the rest of the districts of Rajasthan have widened substantially over the period. For the annual average of the triennium ending 1968-69 and 1986-87, while the proportion of area under cereal crops in the total area under cereal crops in the State remained approximately equal for arid (43 per cent), semi-arid (13 per cent) and the rest of the districts (44 per cent), the proportion of cereal production in the total cereal production of the State declined from 17 per cent to 12 per cent for the arid and from 17 per cent to 12 per cent for the semi-arid areas but it increased from 64 per cent to 73 per cent for the rest of the districts of Rajasthan during the same period. Similar was the case for most of the individual district. The yield of a crop in the arid areas as a proportion of yield of the corresponding crop in the rest of districts declined from 44 per cent in 1968-69 to 26 per cent in 1986-87 for bajra and from 25 per cent in 1968-69 to 17 per cent in 1986-87 for total cereals. Similar was the case for semi-arid areas. While the increase in the growth of cereal output in the arid and semi-arid areas was both due to increase in the area and yield, in the rest of districts, it was mainly due to increase in yield. Gini coefficients also showed that the disparity in the production of cereals in the arid and semi-arid areas in relation to the rest of the districts increased substantially. Absence of irrigation and rainfall are the main bottlenecks for the agricultural development of these areas. The challenge of Indian economy lies in initiating the process of development of these less endowed areas.

Agro-Climatic Planning and Regional Development in Tamil Nadu

C. Arputharaj, Sheila E. Jane and V. Saraswathi†

Agriculture, being the central concern of the country, the Planning Commission has undertaken to plan more meticulously on the basis of soil characteristics, climate, rainfall and water availability. It has delineated the regions into fifteen agro-climatic zones. Tamil Nadu consists of three zones and seven sub-regions. The paper attempts to examine the growth trends, particularly for paddy, sugarcane and cotton in the State. Paddy is cultivated in all the sub-regions while sugarcane in only sub-regions 1 to 3, cotton in sub-regions 1 to 5, with a negative growth rate in sub-region 3. The yield of paddy is considerably high as compared to the other two crops.

For the achievement of optimum capacity in production, various factors are responsible,

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namely, cropping pattern and pattern of land use, wasteland development, irrigation, etc.

There is a decline of 0.6 per cent in the share of food crops over the years. The sub-regions have a far lesser forest area cover than the recommended area of 33 per cent. The cultivation of minor crops and the usage of land for non-agricultural purposes have reduced the area under wastelands. There is an increase of about 15.20 per cent in the net are irrigated. However, there is a reduction in the irrigation intensity in the State as a whole as well as in the four sub-regions. To increase the agricultural production in Tamil Nadu, several strategies are suggested: *(i)* land re-distribution, *(ii)* afforestation, *(iii)* reclamation of saline soil, *(iv)* social forestry programme, *(v)* rehabilitation of canal irrigation system, *(vi)* renovation of tanks, *(vii)* wasteland development programmes, *(viii)* groundwater recharging, and *(ix)* drainage and irrigation management. These strategies have been chalked out on the basis of previous experience and they are recommended to be taken up at the Panchayat Union level. A similar exercise could be done by other States too.

Inter-Regional Disparities in Rice Production, 1950-1985

G. Subramaniyan and V. Nirmala*

There are a large number of studies in India focusing attention on the growth rate at aggregate level, while studies on individual crops at the State and zonal levels are highly limited. Keeping this point in view, an attempt has been made in this paper to examine the growth rate with regard to area, production and yield at the all-India, zonal and State levels. The study is based on time-series data for the period 1950-85. This period has been further split into pre- and post-green revolution periods to understand the change in one period over the other. Growth rate was estimated using a semi-log equation of the form: $\log Y = a + b_1 t + b_2 (t D)$, where $D = 0$ representing period from 1950-1970 and $D = 1$ representing period from 1971-1985. In the equation, b_1 represents the growth rate in period I and $b_1 + b_2$ in period II. The significance of the coefficient b_2 would enable us to understand whether the growth in period II differs from period I. The equation was estimated on the basis of the principle of least squares, for different States and zones in India. The analysis revealed that the growth rate in the Southern and Northern zones are relatively better compared to the other zones in rice cultivation in India. Only the Nothern zone was observed to have recorded significant increase in growth rates in the post-green revolution period. This may be attributed to the increased irrigational and other infrastructural facilities provided by the States to their rice farmers. Tamil Nadu in the South, Orissa in the East, Maharashtra and Gujarat in the West and Punjab and Haryana in the North are observed to have a major impact on the growth patterns of rice in the respective zones with regard to area, production and yield. Finally, all the regions, zones and States under consideration recorded positive growth rates in both the pre- and post-green revolution periods.

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Regional Disparities in Rural Income, Output Growth and Input Use in Indian Agriculture

Ramesh Chand and S.C. Tewari†

The study has been undertaken to provide indicators of regional imbalances in terms of growth in per capita income of rural population and growth in area, production and yield of major crops. The direction of change in inter-regional disparities has been studied for the past 15 to 20 years, using the above-mentioned indicators. Besides, the factors underlying the growth in the agricultural sector in various States have been analysed. It has been observed that the inter-State imbalances in respect of per capita rural income, growth in agricultural output and use of modern agricultural inputs were increasing. The results of the study can be used as a basis for delineating agricultural efficiency regions and for formulating strategies for balanced regional development.

Production Potentials of Crop Sequences in Different Agro-Climatic Zones of Various States in the Country

K.C. Bhatnagar and G.L. Khurana*

Research on alternative high intensity crop sequences accommodated within a year on the same plot of land has led to identify promising crop sequences in the respective agro-climatic zones of various States in the country. By utilising the data of Production Potential Experiments conducted under the auspices of All India Coordinated Agronomic Research Project (ICAR) in nine agro-climatic zones of various States during 1979-85, the performance of different crop sequences in a zone was statistically assessed in terms of agronomic productivity, monetary returns and calories equivalent in a study conducted at Indian Agricultural Statistics Research Institute, New Delhi. The most promising crop sequence(s) for each zone are highlighted below.

In the sub-tropical zone of Jammu & Kashmir, rice-wheat-fallow sequence was the most promising one, giving a grain yield of 8,603 kg./ha with a monetary return of Rs. 10,976/ha and 29.71 k x 10^6 calories/ha whereas in the southern humid plain zone of Rajasthan, rice-wheat-greengram proved best with a total grain yield of 7,387 kg./ha with a monetary return of Rs. 8,423/ha. However, in the irrigated north-western plain zone of Rajasthan, it was bajra-wheat-fallow which provided the highest productivity (8,603 kg./ha) though in terms of monetary returns and calories equivalent, groundnut-wheat-fallow was found best (Rs. 14,027/ha and 30.12 k x 10^6 units/ha respectively).

In the northern dry zone of Karnataka, jowar-wheat-jowar produced 9,055 kg./ha of grains compared to 7,837 kg./ha of jowar-gram-bajra (fodder) in the scarcity zone of Maharashtra. However, in the former zone, higher returns (Rs. 14,906/ha) were obtained from blackgram-cotton-sunflower and in the latter zone from jowar-gram-bajra (fodder)

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(Rs. 16,765/ha).

Rice-jowar-greengram was found to produce the highest (7,246 kg. grains/ha and 25.06 k x 10^6 calories/ha) in north Konkan Central zone of Maharashtra. Higher grain productivity was obtained from maize-wheat-greengram (7,487 kg./ha) in south-western semi-arid zone of Uttar Pradesh and maize-mustard-greengram sequence gave higher returns of Rs. 10,190/ha.

Rice-potato-jute was the most profitable sequence giving a return of Rs. 28,680/ha as also releasing 33.22 k x 10^6 calories/ha in the new alluvial zone of West Bengal while in the southern zone of Kerala, rice-rice-groundnut gave the highest return (Rs. 12,990/ha) for a production of 7,662 kg./ha.

Inter-Regional Variations in Agricultural Development - A Case Study in Madhya Pradesh

M.C. Athavale and S.K. Gupta†

In this paper an attempt is made to examine the *(i)* the inter-regional disparities in agricultural growth, *(ii)* constraints of agricultural development and *(iii)* to suggest strategies for agricultural development in 12 agro-climatic regions of Madhya Pradesh. The 12 agro-climatic regions of the State are distributed in three agro-climatic zones of the country, namely, Eastern Plateau and Hills Region, Central Plateau and Hills Region and Western Plateau and Hills Region. Madhya Pradesh is the largest State of the country, accounting for 13.80 per cent of the country's area. It has a low density of population and low literacy percentage. The annual rainfall in the State varies from 1,600 mm in eastern regions to 600 mm in northern regions. The climate and soil texture also vary from region to region. The availability of per capita cultivable area was the highest (0.59 ha) in Bastar Plateau and the lowest in Kymore Plateau and Chhattisgarh Plains (0.35 ha). The irrigation intensity varied from 100 per cent to 109.97 per cent in different sub-regions with an average of 103.67 per cent. The cropping intensity varied from 102.86 per cent in Bastar Plateau to 123.21 per cent in Malwa Plateau. The percentage of food crops was the highest in Bastar Plateau (94.89) closely followed by Chhattisgarh Plains (93.06) and Kymore Plateau (90.42). It was lowest in Nimar Plateau (64.31 per cent).

The undulating topography, under-developed irrigation potential, practice of *kharif* fallows, large proportion of rainfed farming, large proportion of small holdings, high proportion of low value crops, large amount of cultivable wasteland, low coverage under high-yielding varieties, non-availability of genotypes suitable to rainfall pattern are the major problems impeding growth of agriculture. For the balanced development of agriculture, following strategies are suggested: soil and water conservation, development of irrigation potential, rationalisation of cropping through crop substitution and diversification including horticultural development, development of grass lands/pastures to increase fodder supply, and improvement in livestock and expansion of poultry activity in different regions of the State.

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Disparities in Agricultural Production and Need for Regional Planning

J.P. Misra and H.N. Singh*

An attempt has been made in the paper to examine the variations in the production of major crops, input use and consumption expenditure made on poverty alleviation programme in different regions of India. Secondary data are used for the analysis in the study. Analysis of socio-economic indicators portrays that there are large variations in the percentage of urban population, percentage of agricultural labour, net irrigated area, average daily employment in factories and per capita income. Consumption of chemical fertiliser per hectare was the highest in the Punjab (128 kg./ha) and it was the lowest in Assam (4 kg./ha). Similarly, the percentage of irrigated area to net sown area varied from 11 per cent in Maharashtra to 85 per cent in the Punjab. Therefore, these factors are responsible for variations in agricultural productivity too. The average productivity of principle crops also varied from State to State. The compound growth rate of crop production, animal husbandry, forestry and fishing indicates variation among the various States. The per capita plan outlay indicates that the amount invested during the first three plans was higher in the Punjab and Gujarat but in the later plan periods, it recorded a further increase in Haryana and Punjab. The per capita income, average rural consumption and expenditure and per capita expenditure on poverty alleviation were higher in the Western and Northern regions than in the Eastern and Central regions. Therefore, for balanced economy it is necessary that regional planning must be followed on need basis.

Constraints on Agricultural Growth in Meghalaya

N. Venkata Rao and K. Kamraju†

This paper examines the present trends of various crops in Meghalaya which falls in Sub-region 2 under agro-climatic zone No. 2. Specifically, the paper analyses the contribution of various components to change in production of crops, the role of cropping pattern changes and its contribution to the growth of value of output in agriculture from 22 forecast crops, and the various constraints to agricultural growth in the State for the period from 1970-73 to 1986-89. Cropping pattern changes revealed that the share of rice and castor remained the same, but that of all fibre crops, potato, sweet potato, sugarcane, turmeric and rapeseed and mustard declined, while for the remaining crops their share increased. Analysis of contribution of area, yield and interaction effects revealed that during the whole period, the entire contribution came from area effect in the case of rice, tobacco and banana, whereas yield effect was the sole contributor for cotton and jute, while interaction effect was the sole contributor for wheat, small millets and other cereals, castor and soybean crops. The negative

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yield effect which was confined to two crops in the first period (1970-73 to 1978-81), disturbingly increased to 11 crops during the second period (1978-81 to 1986-89), while the negative area effect increased from two crops to six crops.

Under the impact of these disturbing trends in the second period in respect of negative area and yield effects, there was a net decline of Rs. 2.5 crores in the value of agricultural output at constant prices, whereas there was a net addition of Rs. 16.1 crores to the same in the first period. In the first period the negative cropping pattern effect was negligible while the yield effect contributed dominantly followed by area effect, while in the second period, the negative yield effect was so pronounced that it caused a decline in the overall value of agricultural output in the State.

Lack of adequate local agricultural research base, insufficient allocation of funds for the agricultural sector especially for agricultural research and education, lack of adequate infrastructure facilities, indiscriminate exploitation of forest resources for timber by traders leading to degradation of land resources, lack of proper congenial marketing environment, lack of access to markets, lack of processing facilities nearby producing centres, ultimately resulting in very poor agriculture-industry linkages and interactions, are the major constraints responsible for the disturbing and disquieting performance of agriculture in Meghalaya.

Inter-Regional Disparities in Farm Incomes in Punjab

H.S. Bal and Bant Singh*

The present study was conducted to examine the inter-regional disparities in farm incomes among different agro-climatic regions of Punjab and the various regional constraints leading to these disparities. The data for this study were taken from the "Comprehensive Scheme to Study the Cost of Cultivation of Principal Crops in Punjab" and pertained to the year 1985-86. The study brought out that farm income (gross value output minus Cost A_1 expenses) was higher in Region II (which includes the central districts of Punjab, *i.e.*, Jalandhar, Kapurthala, Ludhiana and parts of Patiala and Sangrur districts) as compared to Region I (consisting of Amritsar, Gurdaspur and Hoshiarpur districts and parts of Ropar, Patiala and Ferozepur districts) and Region III (comprising Bathinda and Faridkot districts and Barnala and Fazilka tehsils of Sangrur and Ferozepur districts). Per hectare farm income amounted to Rs. 6,095 in Region II as against Rs. 5,259 in Region I and Rs. 4,796 in Region III. The reasons for lower incomes in Region I and III were mainly inadequate irrigation facilities compared to those in Region II. Therefore, to increase the income earning capacity of farmers in Regions I and II and thus reduce regional disparity in farm incomes among different agro-climatic regions of the State, irrigation facilities, which are basic for agricultural development, need to be augmented in Regions I and III. Since a large part of Region I is sub-mountaneous area with uneven land surface, the scope for extending canal irrigation is limited. Also, the groundwater table in these areas is too deep to be exploited through ordinary pumping sets by the farmers. This can be exploited by installing deep tubewells either on community basis or on public basis. The stress in this region should be to popularise horticulture and forestry along with increasing the productivity of field crops through

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intensive farming and better management. Region III is a drier region and is faced with shortage of irrigation water. Groundwater in larger part of this region is not fit for irrigation because of higher concentration of salts which are injurious to plants. Therefore, canal water is the main source of irrigation in this region which is much inadequate in relation to its need. Therefore, supply of canal water needs to be augmented by way of lining canals and water courses in the area and constructing more dams at the up-streams.

Inter-State Disparities in Growth Rates and Constraints in Oilseed Crops Production in North-Eastern India

G.D. Diwakar†

The present paper attempts to analyse the cropping pattern, inter-State disparities in growth rates of area, production and productivity, quantification of factors responsible for higher production and spatial and temporal yield variability in seven States of North-Eastern India. Analysis of data revealed that rapeseed and mustard ranked second, next only to paddy with a share of 7.76 per cent of the total cropped area in the North-Eastern region. In the first period (1970-71 to 1978-79), the highest and lowest growth rates of area of 26.71 and -0.558 per cent per annum were observed in Mizoram and Manipur States respectively. In the second period (1979-80 to 1987-88) the growth rate of area was estimated at 22.16 and 0.69 per cent in Nagaland and Meghalaya respectively. The growth rate of production was found to be the highest in the first period in Meghalaya, being 8 per cent per annum and negative in Manipur. In the second period, it was found to be the highest in Nagaland (33 per cent) and the lowest in Meghalaya (1.48 per cent). The yield growth rate was found to be the highest at 6.41 per cent per annum in Nagaland in the first period and it was 13.5 per cent per annum in Mizoram in the second period. In Assam, Meghalaya and Tripura, the yield growth rate declined significantly but it increased in the other three States. Taking the region as a whole, the picture was not healthy as the yield growth rate of total five oilseed crops was found to be 1.83 per cent per annum and insignificant.

The contribution of area was a major factor in enhancing total production in the region, with a share of 81.5, 77.2 and 75.50 per cent during the three periods (1970-71 to 1978-79, 1979-80 to 1987-88 and 1970-71 to 1987-88) respectively. Yield contribution was meagre, being only 12.15, 15.52 and 10.96 per cent during these three periods respectively. Interaction effect was very low, being 6.37, 7.24 and 13.54 per cent in the three periods respectively. The average yield of five major oilseed crops was substantially lower at 435 kg./ha than the all-India average (562 kg./ha.). The coefficient of variation of yield was found to be 139.64, 37.77, 62.58 and 29.06 per cent in Arunachal Pradesh, Manipur, Mizoram and Nagaland respectively. The fluctuations in yield in the second period were found to be higher than in the first period. This is the major concern of all the agencies which are involved in increasing oilseed production in the region. For systematic development of oilseed crops production in the region, physical, biological, institutional, socio-economic and technological constraints need to be removed through the development of infrastructural facilities, enhancing the awareness about modern technology and making their availability at subsidised rates through village co-operatives in the region.

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Agricultural Development in Western Himalayan Region: Problems and Priorities

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An attempt has been made in this paper to identify the constraints in agricultural development and to suggest a strategy for higher agricultural growth in Western Himalayan Region comprising Jammu & Kashmir, Himachal Pradesh and eight hill districts of Uttar Pradesh. This region has a hilly terrain with varied climatic, geographical and geo-physical characteristics resulting in varying land use and cropping pattern. The region is rich in forest and water resources but land is a scarce resource as far as cultivation is concerned. Agriculture in this region is not being supported enough by new farm technology due to many factors and lack of irrigation is most important of them. All possible efforts are being made in different sub-regions to increase agricultural production so as to become self-sufficient in this front.

Some problems which have caused difficulties in the smooth development of the agricultural sector are as follows: *(i)* land and water management, *(ii)* low agricultural production, *(iii)* small and scattered holdings, *(iv)* inadequate income and employment opportunities, *(v)* inadequacy of socio-economic infrastructure to support and sustain development and *(vi)* lack of recognition of the role of women.

Keeping in view the development potential in the agricultural sector, thirteen priorities are identified: soil and water conservation; land use policy and control; social forestry; forestry; fruit crops development; high value crops; seed production; transport and communication; marketing and storage; agro-processing; livestock production and fodder development; irrigation management; crop production and fisheries development. Soil and water conservation has been given top priority in Himachal Pradesh and Uttar Pradesh Hills and irrigation management in Jammu & Kashmir. Land use policy has also been given high preference as second priority is accorded to it in Himachal Pradesh and Uttar Pradesh Hills. Keeping in view the importance of forests in this region, third priority is given in Himachal Pradesh and Uttar Pradesh Hills to social forestry and forestry development while in all the sub-regions fourth priority is given to the development of fruit crops.

It is, therefore, suggested that while formulating the plans for this region, more emphasis has to be laid on the development of crop husbandry in general and horticulture in particular. Emphasis on the expansion of minor irrigation is also strongly stressed. A shift in priority of investment in animal husbandry would lead to the development of the people in the hills of this region in general and the tribals in particular. The opportunities for agro-based industries particularly of 'Vodica' from potatoes, cider from apples, beer from hops, aroma from flowers, etc., should be explored. The investment made in these industries would generate employment for the people in this region.

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Agro-Climatic Zonal Planning for Doubling Agricultural Production and Income of Farmers in Hills

D.S. Thakur,* K.D. Sharma† and A.S. Saini†

This paper describes the agro-climatic zonal planning and regional development principles and methods for evolving the optimum farming systems including improved cropping systems, dairying, horticulture, farm forestry systems as well as off-farm and supplementary enterprises and sources of income and employment in Himachal Pradesh. It attempts to estimate the production potential and farm income in different zones of the State. It clearly shows the need for regionalisation in agriculture for substantial increase in farm production and income, focuses on the criteria for delineating the agro-climatic zones or regions and inter-regional disparities in agricultural growth at the inter-State levels. The paper shows that the income of a small farmer with a size of holding of about 2 ha is as high as one lakh of rupees or even more where farmers have adopted the optimum farming systems evolved on the basis of the location-specific agro-climatic zonal planning including the need-based, production-oriented and problem-solving approach of the composite farming systems.

The existing farming systems, production potential and actual farm income under the existing farming systems have been presented agro-climatic zonewise. The optimum farming systems for different agro-climatic zones have been evolved and implemented during the last five years ending 1989-90. Keeping in view the small size of holdings, emphasis has been put on part-time and side-line farming to supplement and increase total production and income of farmers through the optimum farming systems. The actual farm income under these optimum farming systems increased by about three-times to Rs. 1.35 lakhs to Rs. 1.50 lakhs on the sample farms where these optimum farming systems were actually implemented. Suggestions are given for the successful development, implementation and replication of the optimum farming systems on the basis of appropriate agro-climatic zonal planning and regional development.

Inter-State Disparities in Agricultural Growth in India

M.R. Alshi, C.K. Joshi and S.S. Marawar*

The present study attempts to examine the disparities in agricultural growth among different States in the country consequent upon the adoption of new technology. The specific objectives of the study were to examine the disparity in foodgrains productivity and to explain it in the context of adoption of new technology in the form of high-yielding variety (HYV) seed, chemical fertiliser and irrigation. The data for the present study were collected from secondary sources and pertained to the year 1970-71 to 1985-86. Triennial averages at 1970-73 and 1983-86 were worked out to smooth out cyclical variations. The study revealed that the annual growth rates of foodgrains productivity per hectare were higher in

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the States of Andhra Pradesh, Haryana, Punjab and Uttar Pradesh and lower in the other States. Thus disparities in agricultural growth existed in different States during 1970-73 to 1983-86. The proportion of area under HYV seed of foodgrains was substantially higher in the States of Punjab, Haryana, Tamil Nadu and Uttar Pradesh. The States of Bihar, Jammu & Kashmir, West Bengal, Uttar Pradesh and Haryana recorded higher growth rates in fertiliser consumption per hectare. In 1983-86 the highest per hectare fertiliser consumption was observed in the Punjab followed by Andhra Pradesh, Haryana and Uttar Pradesh. Irrigation facilities also expanded at varying rates in different States during the period under study. Cropping intensity increased relatively more in those States where irrigation is abundant. The study thus indicates that there are large disparities in the adoption of new technology in various States and this has created inter-State disparities in foodgrains productivity in the country. Appropriate policy measures like special agricultural development programmes, expansion of irrigation facilities and liberal credit facilities for the purchase of inputs in low agricultural growth areas would help to reduce inter-State disparities in agricultural growth.

Disparities in Agricultural Growth

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

The joint effect of stability of a few crops and instability in others have significant impact on supply position, price level and shift in resource allocation. Against this background, the paper attempts to examine the growth pattern of different crops and the effect of crop production instability on resource allocation in the district of Gurgaon of Haryana, on the basis of primary and secondary data. For agricultural growth, availability of vital basic inputs like water for irrigation, chemical fertilisers and HYV seeds, is the primary condition. Studies based on correlation and regression analysis reveal high degree of correlation between the rate of fertiliser consumption and the proportion of area irrigated and the area under HYV seeds and also the amount of fertiliser subsidy per hectare. These factors significantly influence the level of fertiliser application. The survey data further show that a large percentage of holdings are in very low, low and nil fertiliser application groups. It further reveals that in the case of *kharif* cultivation demand for fertiliser is very poor as compared to *rabi* crops, and within a season wheat in *rabi* and bajra in *kharif* attract better fertiliser consideration. In addition to imbalanced input application, other factors resulting in imbalanced crop growth are lack of related infrastructure, unsuitable soil and sub-soil water condition and supply of basic vital inputs.

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Strategies for Regional Agricultural Development - An Analysis of Transfer of Technology in Coconut Farming in Kerala

A.M. Santha*

The various aspects of technology transfer have to be analysed before launching programmes for coconut development. The improvement in coconut productivity will certainly contribute towards economic development of the State. A survey on transfer of technology in coconut farming was conducted among 241 farmers in Trivandrum district of Kerala in 1984. The study revealed that the adoption was low for all the practices, the extent of adoption being only 15.35 per cent, 4.97 per cent, 6.22 per cent and 19.58 per cent in growing hybrid varieties, application of correct dose of manures and fertilisers and use of chemicals for plant protection respectively. Non-availability of seedlings (24.5 per cent), lack of awareness (24 per cent) and lack of conviction (15.2 per cent) contributed to non-adoption of hybrid varieties. The correct dose of organic manures and fertilisers was not applied by 40.66 per cent and 51.45 per cent of the farmers respectively because of inadequate capital. Lack of awareness of the recommendation and lack of conviction were the other contributing factors. Lack of knowledge of the recommendation (40.21 per cent) and lack of awareness of the seriousness of the disease (23.32 per cent) were the reasons for not using chemicals for plant protection. A strong extension drive along with a stable price for coconuts will go a long way in increasing production by the adoption of new technologies.

Major Crop Regions of India

R. Srivastava, Sujay K. Lal and S.B.L. Gupta†

The present study is an attempt to recognise the major crop regions of the country in relation to the main climatic elements, physiography, soil types and groundwater reserves. It depicts and describes the distribution of important crops coming under cereals, gram and other pulses, oilseeds, commercial and plantation crops. In the aforesaid description, areas specially under one or few crops are illustrated on the maps and their occurrence, continuous or in patches, is described. The main crop regions are depicted on a separate map, prepared after considering the distribution of crops. In all, fifteen such regions have been recognised. In the nomenclature of these regions, only the main crop or their combinations are considered. Other crops raised in those regions but are of much lesser importance do not appear in demarcating the regions. The map showing the distribution of climatic factors indicated that the more moist and warm parts of the country are used for raising rice, tea, coffee and coconut. The sub-humid regions are utilised for wheat, sugarcane, pulses and oilseeds. In the semi-arid regions are grown jowar, bajra and cotton. Similarly, when we consider the edaphic factor we find that the fertile alluvial soils are devoted to rice and wheat cultivation,

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whereas comparatively poor soils of rugged terrains are utilised for hardy crops like maize, pulses and oilseeds. The black cotton soil is mainly utilised for growing cotton. Suitable relief (hill crops) combined with high rainfall has been responsible for tea and coffee cultivation, whereas the moist coastal strip has favoured cultivation of coconut.

Regional Disparities and State's Incentive Policies in Indian Agriculture

Sibranjan Misra*

The paper examines the implications of the incentive policies of the state for promoting regional equity in India. There has been a remarkable accentuation of regional disparities in the performance of Indian agriculture. The States in the eastern and central regions recorded a much lower rate of growth of agricultural commodities. A few prosperous States which had already access to water, power and fertiliser cornered a disproportionately larger share of benefits emanating from a combination of the state's incentive programmes - comprising price support, input subsidies and subsidised credit. The impact of such a regionally inegalitarian incentive framework has been quite serious so far as the eastern States are concerned. The technological lag in the eastern States is entirely due to non-availability of technology suited to the agro-climatic environment of the region. In fact, the basic growth impetus should come from non-price policy related to massive public investment in irrigation, flood control, structural reforms and institutional changes.

An Analysis of Regional and Temporal Variations in Rice Yields among the Districts of Andhra Pradesh State

B.S. Kulkarni, I. Narender and G.V. Krishna Rao†

An attempt has been made to study the relative variability in the rice yields among the districts of Andhra Pradesh by applying the principal components procedure. The 33 years of yield data covering 1956-57 to 1988-89 used for the analysis clearly indicated the existence of two sub-periods with 1966-67 as the cut-off year. The analysis revealed that the total variation among the districts can be summarised to a greater extent with the first two principal components which represent respectively the 'trend' and the 'within-year' or seasonal effects. The sub-period analysis of the crop yields showed a differential behaviour - the new technology period yields accounting for a greater share of the trend effect than those under the old technology period; while the seasonal effect had its larger share in the old technology period (than in the new technology period). The differential behaviour of the yield variability in the two components suggested that under a sub-period, groups of districts with relatively 'homogeneous' yield variability can be formed separately with regard to the trend and seasonal variations. Under the old technology period there existed two groups of districts

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which exhibited respectively year to year increase and decrease in the yield level. The districts which were relatively more weather sensitive under this period were found to be less sensitive in the new technology period and vice verse. In view of this differential behaviour of yields under the two sub-periods, the orderings obtained with the analysis of overall data of the two sub-periods were not suggested for drawing meaningful conclusions.

Productivity Differentials Lead to Regionalisation Policies in Maharashtra

V.R. Shete, S.N. Tilekar, P.P. Pawar and A.V. Gavali*

A major part of Maharashtra falls in Western Plateau and Hills Zone. Within this zone, there are 12 agro-climatic zones in the State. The main objective of the present paper is, therefore, to verify whether there are any differentials in the productivity of major crops between these zones in the State. Secondary data were used for the present analysis. The data were obtained from the Directorate of Agriculture, Maharashtra for the years 1978-79, 1981-82 and 1983-84. It is observed that the productivity of almost all crops is higher in regions 4 and 5 (scarcity region), because the districts which are covered by these regions are served by canal irrigation. Since there is assured irrigation, the productivity is higher. As against this, the productivity of the same crops is the lowest in region 10 which is dependent on rains. Productivity differentials between the zones for some crops are estimated. Interestingly, it is noticed that productivity differentials in jowar and bajra are positive for all zones. For all other crops, the values of productivity differentials are negative between zones. Input supply and agricultural product marketing policies, therefore, will have to be based on the zonal needs of the State. Not only that, it is necessary to establish separate development councils for each of the zones, *viz.*, Vidarbha, Marathwada and Konkan, if there has to be balanced development in Maharashtra.

Agro-Climatic Zonal Planning and Regional Development

M.N. Upadhyay†

This paper examines the constraints inherent in agricultural growth in a region, with specific reference to institutional credit. At present institutional credit requirements for the agricultural sector are being provided by Commercial Banks, Central Co-operative Banks, Regional Rural Banks and Land Development Banks which generally avail refinance facilities from the Reserve Bank of India and the National Bank for Agriculture and Rural Development. The co-operative credit structure presents a none-too-happy picture suffering from chronic deficiencies like growing overdues, lack of professional management, domination by local vested interests and above all a lack-lustre operational performance. The rising levels of overdues under the co-operative structure and weakness and sickness has

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made the National Bank stipulate measures like rehabilitation of weak banks/societies, prescribe eligibility criteria for availing of refinance facilities from NABARD/RBI. This implies that a bank with a percentage of overdues to demand exceeding 60 per cent will not be in a position to avail of refinance facilities from the National Bank, thus restricting its resources. The volume of refinance given decreases with increasing overdues between 60 per cent and 40 per cent of demand. Thus only banks with overdues of 40 per cent and less of demand will be in a position to avail of refinance which would preclude many banks from availing this facility. This is also generally true in regard to commercial banks and RRBs whose capacity to carry the heavy deadweight of increasing overdues and shrinking operational margins is dwindling. In an agro-climatic zone cutting across some States and many districts, credit institutions would be in varying states of financial health and operational soundness. The basic fact is that over 50 per cent of the overdues are wilful and the number of these is growing at an alarming rate. Measures like writing off of loans only act as an incentive for non-repayment of dues. It may be necessary to evolve a policy frame focusing on the productivity of an agro-climatic zone and its total credit requirements based on the endowment of an area, rather than on the 'borrowing power' or loan eligibility of the farmer or societies. Similar disparities could also be available within the zone in regard to infrastructural facilities and the crux of the problem would be to contain the diversity within the homogeneity of an agro-climatic zone. Zone 10 comprises of Southern Plateau and hilly areas of Andhra Pradesh, Karnataka and Tamil Nadu spread over 36 districts in these States. The zonal profile recommends a 'single window' and integrated loan system making different amounts of loans as a package for development. Further, it states that the kind components of loan will have to be emphasised more than the cash components. In view of the foregoing, it may be necessary to evolve a fresh policy guideline so that credit requirements are computed in terms of total requirement of an area and repayments are accepted in terms of produce so as to build up a national buffer-stock of foodgrains and other commodities.

Disparities in the Level of Agricultural Development in the Districts of Tamil Nadu

A. Pushpavalli*

An attempt is made in the paper *(a)* to select a list of measurable, objective and meaningful indicators of agricultural development in the district of Tamil Nadu and *(b)* to rank the districts of the State according to the levels of agricultural development attained by them. Only 13 indicators have been used for the purpose. The particulars regarding the indicators are collected from secondary sources. The period of study relates to the year 1983-84. Since some of the district have been bifurcated after this period, Madras district is not included in the study as it is urban based. All the districts of the State have been assigned scores on the basis of the indicators. For each indicator, the most advanced district was given the highest score. The next district received one score less and so on. In case two or more districts obtained the same rank with respect to the particular indicator, the ranks were added and simple average of the ranks was assigned to each of the districts.

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The results of the exercise are as follows: *(a)* The range of total scores varied from 72 to 138. Thus the highest position is secured by Thanjavur district and the lowest position by Kanyakumari district. *(b)* As many as seven districts are concentrated in the score range of 95-114. The remaining districts fall within the range of 75-94 and 115 and above equally. *(c)* It is noted that three districts, *viz.*, Thanjavur, Chengalpattu and Coimbatore which obtained 25 per cent of the total scores are classified as advanced districts. Nilgiris, Ramanathapuram, Pudukkottai, Dharmapuri and Kanyakumari districts are classified as backward districts. The remaining districts are classified as average.

Regional Disparities in Agricultural Growth Rates and Productivity Levels in Karnataka State

R.V. Dadibhavi and S.S. Masali†

The paper attempts to examine the rate of growth of agricultural output, inter-district variations in the levels and growth of land productivity per hectare and the nature of association between the productivity levels and the use of modern inputs in Karnataka districts during 1962-65 to 1980-83. The data for the study were collected from secondary sources. The data analysis reveals that the growth of crop output of 19 major crops in Karnataka recorded 2.02 per cent per annum during 1962-65 to 1970-73 and slowed down (1.47 per cent per annum) during 1970-73 to 1980-83. The growth of crop output is mainly attributed to the yield component as the area component showed a negative growth during both the periods. The growth of crop output which showed wide variations across the districts, ranged between - 1.50 per cent (Bijapur) to 7.66 per cent (Chitradurga) per annum during 1962-65 to 1970-73 and - 2.16 per cent (Tumkur) to 4.50 per cent (Bidar) per annum during 1970-73 to 1980-83.

Further the growth in the area and yield components also showed variations across the districts. The area component being negative in all the districts except for Chikmagalur, Kodagu, Mysore, Shimoga and Uttar Kannada during 1962-65 to 1970-73, showed a positive growth in as many as 12 districts during 1970-73 to 1980-83.

There are considerable inter-district variations in the level and the rate of growth of productivity per hectare during 1962-65 to 1970-73 as well as during 1970-73 to 1980-83. Although the average productivity increased from Rs. 795 in 1970-73 to Rs. 925 in 1980-83, the State recorded a sharp deceleration in per hectare productivity during 1970-73 to 1980-83 in comparison with the period 1962-65 to 1970-73.The inter-district disparities in the yield levels tended to increase in the early eighties though they showed a decline in the early seventies. However, the number of districts in the low productivity range declined from 9 to 4 and increased in the high productivity range from 4 to 9 during 1962-65 to 1980-83. During the same period Bijapur and Gulbarga remained as the most lagging districts and Mandya and Kodagu emerged as the most rapidly advancing districts. Further, the data showed that the weight of area and output of the low productivity districts (*viz.*, less than Rs. 0 - 750 per hectare) declined and that of the high productivity districts (*viz.*, Rs. 1,250 and above per hectare) has increased.

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It is also observed that there is a high degree of association between the level of agricultural productivity and the use of modern inputs. It is found that the use of modern inputs, *viz.*, percentage of irrigated area, use of fertiliser, tractors and pumpsets is considerably high in the high productivity districts and low in the low productivity districts. In addition, the backward districts are unfavourably situated in comparison with the developed districts. Thus the growth of crop output, in the present study, is mainly attributed to the yield component and the yield component shows positive correlation with the use of modern inputs in Karnataka.

Regional Analysis of Temporal and Spatial Variations in Cropping Intensity in Madhya Pradesh

P.K. Awasthi,* J.K. Gupta† N.K. Raghuwanshi* and A. Mishra*

The paper attempts to analyse the districtwise and regional cropping intensity in Madhya Pradesh and indicates policy implications for improving cropping intensity and agricultural production. Data for sixteen years (1970-71 to 1984-85) on area sown, irrigated area, rainfall precipitation, fertiliser consumption, ratio of cultivators to agricultural labourer, etc., were averaged for each district, which were later on grouped into twelve agro-climatic regions, namely, Chhattisgarh plains, Bastar plateau, Northern hills region of Chhattisgarh, Kymore plateau and Satpura hills, Vindhya plateau, Central Narmada valley, Gird region, Bundelkhand region, Satpura plateau, Malwa plateau, Nimar valley and Jhabua hills. With about 16 per cent of the net sown area under irrigation, the State is characterised by a very low cropping intensity (117 per cent) which ranged from 104 per cent in Bastar plateau to 126 per cent in Chhattisgarh plains. The cropping intensity in the State is closely linked up with the traditional nature of cultivation. This is substantiated by the significant positive correlation between cropping intensity and the number of bullock pairs. Tractorisation and irrigation facilities are inversely related in some of the agro-climatic regions; Vindhya plateau has the largest number of tractors but has 108 per cent cropping intensity only. The number of pumpsets, fertiliser consumption, per capita cultivated land, ratio of cultivators to agricultural labourers are the other factors which are examined in relation to cropping intensity. The low cropping intensity of the State is an index of its tradition bound crop cultivation with disregard to soil and water management and an appropriate cropping system for rainfed and irrigated conditions of the various agro-climatic regions of the State. The age-old practices of soil and water management and traditional crop varieties need to be gradually replaced through soil-based research on cropping systems for each region. Suitable legislative measures may also be needed to curtail seasonal fallow lands and improve the efficiency of limited irrigation facilities.

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Regional Disparities in Agricultural Growth: A Case of Himachal Pradesh

S.P. Saraswat, N.K. Sharma and K.R. Sharma†

Economic activity of Himachal Pradesh is dominated by agriculture from both income and employment point of view. Therefore, the importance of agriculture in the State's economy hardly needs any emphasis. There are two major problems concerning agricultural development, *i.e.*, there exists a wide disparity in agricultural productivity among different regions and the agricultural production fluctuates from year to year but the extent of fluctuations varies from one region to another. For the study purpose, the State is divided into three climatic zones, *i.e.*, *(a)* low hills elevation up to 3,000 ft. *(b)* mid hills elevation from 3,000 to 5,000 ft. and *(c)* high hills elevation above 5,000 ft. One district from each zone has been selected for the study purpose. To examine the effect of price, value productivity of important crops grown in the area was worked out and component analysis developed by Vaidyanathan and Minhas was used to see the impact of production factors on the out-turn. The analysis revealed that higher growth rates at variable and constant prices were observed in low hills in comparison to mid and high hills. Comparing the growth rates cropwise, maize, wheat and paddy growth rates showed almost positive trends in all the zones. The component analysis showed that in the case of maize, wheat and all crops, all the factors of growth indicated positive signs in almost all the interaction and individual effects.

Farming Efficiency in Drought-Prone Areas: A Case Study in Southern Plateau

Rajagopal*

This paper examines the existing farming system and constraints to large scale dryland farming in five villages of Ranga Reddy district in Andhra Pradesh. This region has been identified by the Planning Commission as Southern Plateau and Hill Region agro-climatic zone. The study region in particular falls in sub-zone 3 of the above main agro-climatic zone. The study reveals that the farmers have adopted some of the improved cultivation methods, like contour cultivation, vegetative bunding for retention of *in situ* moisture conditions and control of soil erosion. However, the use of HYV seeds and pesticides and the level of risk resistance among farmers have not increased significantly. The yield and price levels have significantly affected the area under the sorghum and castor crops. The pigeon-pea, which is taken as an inter-culture crop with sorghum, has been found to be an inferior crop in the region. As regards marketing of these commodities, there are three channels involved in trading, namely, *(i)* private traders in village market, *(ii)* agents of processing units and *(iii)* regulated markets. Of these, the study shows that the regulated markets are efficient in the marketing of sorghum while the processing units showed marketing efficiency in the case of castor as compared to the alternative channels. Since the pigeon-pea is an inferior crop, it is sold in weekly markets in small quantity. However, the private channel in weekly markets is not found to be efficient. The study suggests that

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subsidy for pesticides may be provided to the small and marginal farmers. It also advocates an alternative farming system based on fruit crops for farmers' sustainability against droughts.

Agro-Climatic Zones and Regional Development: Case of Hill Regions

Amalesh Ch. Banerjee†

The new agricultural policy is a broad-based comprehensive action plan encompassing agriculture and allied activities. But the hill regions deserve special attention. A modified approach is essential to meet the growing deprivation and discontent among the people of these regions. The avowed objectives of agro-climatic zones are scientific and sustainable use of natural resources, generation of additional employment and supply-demand balance of major commodities. Given the geo-physical features of hill zones, a different decentralised and composite action plan comprising agriculture, small scale operation forestry, dairy, orchard, transport and servicing will generate the process of income generation and employment opportunities in the hill region. Some supportive factors of such diversified and holistic approach to hill region development are infrastructure, marketing, credit and training and skill formation. The micro level activity has to be encouraged by these supportive factors of the major diversified agricultural and industrial and service programmes. Thus it requires a coordinated action at different levels: *(a)* macro level diversified agricultural and industrial programmes have to be co-ordinated with the micro level operation; *(b)* co-ordination of supportive factors and major industrial and agricultural programmes; and finally *(c)* co-ordination between the national and zonal programmes.

Agro-Climatic Zonal Planning in Haryana

Veena Manocha, S.D. Chamola and Raj Kumari*

The main objective of the paper is to suggest the formulation of projects on the basis of agro-climatic zonal planning. The State of Haryana has been delineated into three zones: arid, semi-arid and wet zone. It has been found that demographic parameters such as density of population, rural-urban distribution and participation of workers are influenced by agro-climatic zones. The proximity of Zone II to metropolitan city like Delhi greatly influences the economy in general and the agricultural sector in particular. Agriculturally advanced zone does not lead to much urbanisation because job opportunities are created in the agricultural sector itself. The per capita value of gross output is high where wheat-paddy rotation prevails. The growth in wheat and paddy has been found higher in those zones where irrigation facilities reached late as compared to the zone where irrigation facilities were already available. The area under coarse grains is declining in all the zones whereas their productivity has been found increasing in most of the cases. It has also been found that

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the government followed the right policy to divert its resources to the traditionally backward zones. The implication is that agro-climatic zonal planning at the decentralised level should form the basis of government plans.

Agro-Climatic Optimum of Cropping Pattern

Prafulla C. Sarkar and Sadhan C. Kar†

Theodore Schultz attracted the attention of the academic community when he stated that Indian farmers are efficient subject to the state of markets. We know what Schultz failed to notice. Given the facilities of both the input and output markets, the Indian farmer is efficient subject to tradition. The low quality of agro-climatic planning of crops is a function of this tradition. The absence of tradition as well as of markets can be corrected wholly by grass-root rural area planning on the basis of homogeneity of topography, flood-proneness or otherwise, heat and humidity in different months. Apart from the rules of the game determined nationally, the grass-root democracy may be supplemented by an institutional framework to implement the code and to remove the complaints of the operators. On the basis of the analysis of data of the grass-root rural area economies of Cooch Behar including those on the use of gross cultivable area, it is estimated that 45 per cent of the cultivable lands can be used, without loss of existing output, to raise sugarcane which will facilitate the setting up of two big sugar complexes in the district. Similar introduction of new products in other districts will depend on meticulous weighing of the relevant agro-climatic characteristics and land use data of the grass-root rural area economies of the concerned districts.

Regionalisation in Punjab Agriculture

Inder Sain and R.P. Singh*

Although the Punjab State has been the foremost in spearheading the green revolution, yet this State represents sharp inter-regional disparities in agricultural growth. The inter-regional differentials in topography, climate, soil texture and level of development of surface and underground irrigation infrastructure are the factors behind these disparities. Even such factors as roads, marketing infrastructure and electric power also play a vital role. Therefore, an attempt has been made in this paper to delineate the different agro-climatic zones on the basis of these crucial parameters. The analysis of the variables under study paved the way for clubbing the areas of the State into four agro-climatic homogeneous zones. The geographical contiguity of the areas proved to be consistent with zone formation. The various zones formed on the basis of analysis are *(a)* paddy-maize-sugarcane-wheat zone (zone I) - consisting of the districts of Amritsar, Kapurthala, Jalandhar and Gurdaspur (excluding Pathankot) lying in the north-east of the State, *(b)* maize-paddy-wheat zone (zone II) comprising Pathankot tehsil of Gurdaspur district and Hoshiarpur and Ropar districts, *(c)* paddy-wheat zone (zone III) consisting of Ludhiana, Patiala, Sangrur districts and Zira and

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Ferozepur tehsils of Ferozepur district and Moga tehsil of Faridkot district, and *(d)* cotton-paddy-wheat zone (zone IV) consisting of Fazilka tehsil of Ferozepur district, Faridkot district (excluding Moga tehsil) and the whole of Bathinda district. This zone lies in south-western side of the State. In terms of the intensity of development oriented variables, the trend was quite consistent with the development of the areas falling in different zones delineated in the State. Paddy-wheat zone (zone III) is the most productive followed by zone I, zone IV and zone II respectively. The pattern is quite obvious in the light of the intensity of development infrastructure of different variables in the different delineated zones in the State.

Agro-Climatic Region - The Case of Western Dry Region

K. Anantha Ram and D.L. Vyas†

The need and adequacy of variables considered for the classification of agro-climatic regions have been examined with particular reference to the western dry region. The case of 11 arid districts of western Rajasthan which forms a part of the dry region has been specifically studied. Besides the five variables, *viz.*, per capita net sown area, gross irrigated to gross cropped area, cropping intensity, density of population and per cent of workforce to population considered by the Planning Commission, the linear growth rates of major foodgrain crops and their variability over time and space have been examined. It is observed that the growth of crop yields is negative in over 50 per cent of major crops, mostly *kharif*, with high variability often exceeding 40 per cent and above. Only wheat and barley showed significant growth rates with least variation. In the light of crop yield growth and variations observed for the regions of the State and the arid districts in particular, the adequacy of variables considered for the classification of regions has been examined for four micro zones of arid western Rajasthan. By ranking the variables for the individual zones and scoring, it is observed that the micro zones ended with almost similar total scores despite vide variations in agro-climatic conditions between the micro zones, leading to the inference that the variables considered are not adequate enough for micro level planning. Since irrigation is highly associated with crop yield variability in dry regions, it is surmised that an index of crop yield variability of major crops of the region as an additional variable should give proper signal to micro level planning. It is suggested that all regions with a crop yield coefficient of variation of 20 per cent and above, in major crop/crop groups, should get priority in allocation of funds, preferably for creating irrigation infrastructure/water harvesting technology.

An Economic Analysis of Variations in Productivity of Paddy and Wheat Crops in Bihar

R.P. Singh*

The present paper purports to study the variations in productivity per hectare of paddy and wheat crops in twenty districts and two economic regions (*i.e.*, Plain region and Cho-

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tanagpur region) of Bihar. Twenty districts consisting of 16 from the Plain region and four from Chotanagpur region, under the foodgrain production thrust programme, were purposively selected. Time-series data on area and production of paddy *(kharif)* and wheat through 1966-67 to 1987-88 and on rainfall from 1970-71 to 1987-88 for these two natural regions were collected. The compound growth model was used for computing productivity growth rate of paddy and wheat. To examine the effect of rainfall on productivity, linear regression equation was fitted separately for districts and regions with rainfall in mm as independent variable and productivity in quintal per hectare as dependent variable.

The analysis indicated wide variations amongst the two regions in the existing level of productivity of paddy and wheat crops. The productivity of crops was higher in the Plain region than in the Chotanagpur region. The results of the growth model indicated that the overall growth rate of productivity of paddy and wheat was of the order of 2.80 and 3.50 per cent respectively in the State during 1966-67 to 1987-88. The productivity growth rate in the Plain region was higher than in the Chotanagpur region during the same period. It was also observed that the productivity growth rate was higher in wheat than in paddy in both the regions during the same period. The results obtained from the regression equation indicated that 52 to 89 per cent of the variation in inter-district productivity of paddy and wheat was explained by rainfall while only 14 to 19 per cent of the variation in inter-regional productivity of the same crops was explained by rainfall. The regression coefficient of rainfall was found to be positive and significant for both the crops. Regionwise analysis showed that the coefficient of rainfall was found to be negative in the case of paddy and vice versa in wheat but it was statistically non-significant in both the cases. It implies that so far as inter-district variation in the productivity of paddy and wheat is concerned, rainfall plays a significant role. The foregoing empirical analysis indicated wide variations amongst districts and regions in the existing level of agricultural production and productivity. It is essential that conditions are created whereby the backward areas are able to contribute their maximum and their potentials are optimally utilised, otherwise the regional imbalances would act as a drag on the overall growth rate of the State's economy.

Drought-Prone Area Programme: A Case Study of Midnapore District of West Bengal

Sachinandan Sau[†]

Agricultural planning exercises in India have created regional imbalances which have prompted planners to take up the drought-prone area programme for improving the ecological balance of the area and agricultural and economic conditions of the region by means of proper development of land and water resources. The review of the performance of the programme in seven blocks of Midnapore district shows that its physical and financial performances have been satisfactory, but its impact on raising agricultural productivity and removing backwardness of the region has not been significant, mainly on account of the inadequacy of the programme in relation to the size of the problems. The extent of irrigation and dryland farming is low and per capita investment in different sectors of the programme is poor. A sample survey of 51 households in a Gram Panchayat of the project area reveals

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that the majority of the beneficiary households do not get the requisite level of calorie, though the daily per capita calorie intake for them is higher than for the non-beneficiaries. The use of simple linear regression model reveals that irrigation, land productivity and productive assets including animal husbandry are significant factors determining family income.

Agro-Climatic Zones Versus Agricultural Systems in relation to Economic Parameters - A Case Study of Rajasthan

K.A. Varghese and S.S. Gupta*

A clear demarcation of agro-climatic regions classifying homogeneous zones in respect of climate, physiography, topography, soil type, cropping pattern, water resources and other related agricultural features has wider relevance and significance. Such a system of zones for a country or State could be a base to devise developmental plans so as to minimise regional imbalances in economic growth and development. Generally homogeneous agro-climatic regions represent homogeneous agro-climatic base and hence resource based planning for a region becomes feasible and appropriate. Accordingly, an attempt was made to review various systems of zonalisation carried out for the State of Rajasthan by different agencies and also to assess the behaviour of micro level economic variables like income, investment and savings in distinct agricultural systems within a homogeneous zone of Rajasthan. As many as eleven systems of zoning made by various agencies to demarcate Rajasthan into homogeneous zones were located. The purpose of zoning, the zonal boundaries, the number of zones and the unit of zoning were different for different agencies. It reveals that the subject of agro-climatic zonalisation is still a flexible topic and there is a great need to streamline the basic variables to be taken into account while drawing any meaningful system of zoning. The micro level behaviour of crucial economic variables like income, investment and savings is found to vary between agricultural systems even within a homogeneous agro-climatic zone. It clearly shows that while devising strategies for development of a homogeneous zone, the possible defferences in economic variables at micro level should not be ignored.

Estimation of Components of Regional Variability in Oilseeds Production of Himachal Pradesh

O.P. Sambhar*, B.S. Chandel† and Parkash Mehta†

High variability of oilseeds production has been considered a main hindrance to raise production. The present study was undertaken to analyse the components of changes in variability of oilseeds production in different regions and separately for selected oilseed crops of Himachal Pradesh. The production variability was measured by using coefficient of variation in two time periods. The components of change in variance of production were

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analysed using statistical identities which take into account all components of variation rather than one like Hazell's model. The results show that the contribution of district Una was the highest in increasing production variability of sesamum. The interaction between change in mean area and yield variance seems to be the major components of variability. The contribution of Solan district to the change in variance of mustard production was the highest and change in yield variance was the major source. The overall variability of linseed production decreased in the State for which the contribution of district Kangra was the highest. The change in yield variance was the major component which affected production variance to decrease.

Zonal Variations in Cost of Cultivation in West Bengal

Partha Basu*

A computerised statistical analysis has been carried out cropwise on the basis of primary data to ascertain if the operating costs of cultivation per hectare and per quintal differ significantly from one cluster of village to another within a particular zone as well as within the whole of West Bengal Plains. The variables of interest being in the nature of ratios, the Kruskal-Wallis test and the Wileoxon test have been used in preference to F and t tests.

The results obtained indicate that the cluster of villages selected from the different parts of the entire region under investigation differed significantly in terms of yield rates, per hectare and per quintal overall operating costs along with their constituents and the rates of physical input use, in conformity with the findings of C.H. Hanumantha Rao (1965). In many *(but not all)* cases, such differences persist even among the clusters selected from a particular zone. Hence, the total cost of cultivation and credit requirements for a State or a country should not be estimated on the basis of a crude average. Rather estimates should be made separately for different crops and different agro-climatic zones. Then these estimates should be pooled together to arrive at an overall estimate.

Economics of Regionalisation and Regional Development Planning - An Inter-Linked Approach

R. Balasubramaniyan†

This paper discusses the necessity of an inter-linked approach to regional planning and provides a framework to make the regional planning exercises conducive to development with economic and social justice. Regional economics has been widely recognised in both developed and developing countries as a necessary tool for a more comprehensive and effective planning for regional development. But, in India, planning has so far been sectorial, and regional aspects have not been given the importance they deserve. In determining agricultural zonal regions of India, factors like natural vegetation, rainfall, temperature, soils, crops, etc., are taken into account. What strikes one is their ununiformity (disparity) over wide belts of territory embracing many States. Regional development planning aims

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at removing not only regional imbalances but also at integrating factors like economic, social, political and cultural in the nation's life.

The objective of an inter-linked approach for regional development is *(a)* to analyse the impact of the decision on the development of various regions, *(b)* to reduce the disparities between the rich and the poor regions of the country, *(c)* to accelerate the process of social and cultural advancement of the community through the techniques of economic planning and *(d)* to achieve balanced regional growth.

Keeping the above objectives as base for regional planning, more inter-linked growth centres should be established in all regions to provide services like agricultural input distribution, marketing, storage, transport, fertilisers, credit to small and marginal farmers, irrigation, road building, etc., in rural areas. If intensive studies are carried out in all regions with regard to resource availability, employment opportunities, viability of projects, etc., perhaps the tasks of integration will not appear as difficult as they are generally made out to be, provided the required political will to co-ordinate planning is available.

Problems and Prospects of Hill Area Development: A Case Study of Sikkim

M.G. Ghosh*

Sikkim falls within the Eastern Himalayan Zone. Being a part of inner ranges of mountains of Himalayas, it is wholly a hilly State. Only 11 per cent of the State's area is under cultivation and 36 per cent under forests. Spring water, the only source of irrigation, covers about 14 per cent of the State's net sown area. The crop-structure is predominated by foodgrain crops. Among non-foodgrain crops, cardamom and oilseeds are important which have recorded higher yield rates in the State than in the country. Allied agricultural activities, such as rearing of livestock and poultry birds and cultivation of horticultural crops occupy an important place in the State's economy. There are small-scale and cottage industries which provide employment to a considerable number of workers in the State. The State lacks in basic infrastructural facilities, such as roads and transport services, power, financial and technical institutions, etc.

The study suggests that measures should be taken to arrest soil erosion which affects 50 per cent of the cultivable land in the State and harvest rain water. Efforts should be made to introduce high-yielding variety seeds of crops suitable for lands of different altitudes and valleys and extend the area under cardamom and horticultural crops. The State has an ideal agro-climatic condition for growing these crops. There is a vast scope for development of agro- and forest-based small-scale industries in the State. Priority should, however, be given to provide necessary infrastructural facilities to the entrepreneurs. Sikkim being gifted with scenic beauty, efforts should be made to attract tourists by providing necessary amenities to them. Lastly, the success of all programmes ultimately hinges upon the development of awareness and consciousness among the masses.

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A Study on Inter-Regional Disparities in the Pattern of Land Utilisation in Uttar Pradesh

Rajendra Singh†

The present study was carried out in the problematic areas of all the five agro-climatic regions of Uttar Pradesh during the agricultural years 1988-89 with a view to identify and categorise different types of land in various regions, to find out cultivable and non-cultivable wastelands, to categorise cultivable land including irrigated and unirrigated land in different regions and to suggest suitable schemes for the optimum utilisation of available land in the State. In all, 35 development blocks out of 69 in all the five selected districts from the five agro-climatic regions were selected for this study.

The study revealed that the Hill Region has the highest area under forests, permanent pastures, grazing land, tree crops and groves, non-culturable wastelands and land put to non-agricultural uses which is presently lying unused or is not being used to its optimum potential due to certain constraints. The area sown more than once and the total cropped area as well as the intensity of cropping have been found the highest in the Eastern Region and lowest in the Hill Region. Irrigation by wells is still prevalent in the State particularly in the Bundelkhand Region. Canals are more prevalent in the Central Region. While tubewells are more common in the Western and Eastern Regions.

The Bundelkhand Region has the highest (about 37 per cent) and the Eastern Region has the lowest (about 7 per cent) area under cultivable wastelands. Thus the Bundelkhand Region has the highest potential for the expansion of cultivable area. Of the total cultivable wastelands, the maximum area (about 12 per cent) has been occupied by *banjars* and about 4 per cent by fallows which can be easily converted into cultivable area by dry farming practices.

For the optimum utilisation of available land, mixed farming and raising of goat and sheep herds on large scale in the hill areas may be practised. The slops of hill areas in the State can be successfully utilised by planting temperate fruits like apple, pears, walnut, apricot, peach and plum which have great demand. The present wasteland mapping through Remote Sensing Agency undertaken by the National Wastelands Development Board should be further strengthened for obtaining the best and reliable information at the regional and local level.

Operational Holdings in Orissa: A Regional Analysis

Adwait K. Mohanty*

The number and size of operational holdings have crucial bearing on agricultural production technique and income distribution in the rural sector. Hence, the need for a factor analysis of variations in size distribution of holding is considered important. The data show that the number of operational holdings has increased in Orissa, while the area under the plough has shown a declining trend between 1970-71 and 1985-86, as a result of which the

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average size of holding has been declining over time. Medium and large holdings are disintegrating. The small holdings have decreased in number under pressure of subdivision of ownership holdings and merged with semi-medium holdings. Marginal holdings have increased due to redistribution of surplus land, giving ownership rights to the landless.

Convergence of small holdings on the one hand and medium and large holdings on the other, towards semi-medium (2-4 hectares) category elect it as the equilibrium holding size for Orissa. The small holdings (1-2 ha) have failed probably because of lack of adequate supportive services as they are not dearth of labour. The medium and large holdings have proved non-viable due to high cost of hired labour. The semi-medium holdings use mostly own labour and occasionally hired labour. Any further increase in the wage rate (as announced by the State Government recently) would reduce the equilibrium size further, and hence, it is welcome, provided the produce sells at a higher price; otherwise the wage hike to Rs. 25 would be self-defeating and detrimental to agricultural production.

The operational holdings have decreased in number in districts with high literacy ratio. The rate of decrease in the average size of holdings is slower in districts experiencing high industrial expansion. Realising that primarily the literates make their way to the industrial sector for employment, it may be concluded that spread of literacy creates aversion for agriculture in the present conditions. So, the unemployment problem prevailing among even the semi-educated youths in the State cannot be solved by the development of the agricultural sector alone.

Inter-State Disparity in Dairy Development and Productivity

A.K. Sharma and A.K. Chauhan†

An attempt has been made in this paper to analyse bovine population and its composition in various States and also to visualise the regional disparity in milk production and per capita availability of milk among the different States of the country. As a result of dairy development programmes of Central and State Governments along with operation flood programme, India's milk production has increased from 225 lakh tonnes in 1971 to 461 lakh tonnes in 1987-88. However, all the States have not been benefited equally from these programmes. There is wide disparity in the production and per capita availability of milk among different States of the country. The population of milch cattle is more than that of buffaloes in all the States except Punjab and Haryana. But there is a trend towards buffaloes in the States like Andhra Pradesh, Gujarat, Uttar Pradesh and Rajasthan where buffaloes constituted 31 to 40 per cent of the total bovine population. A significant improvement in milk production was noted during 1971-1985 in the States of Manipur, Meghalaya, West Bengal, Kerala, Assam and Tamil Nadu, whereas States like Karnataka, Madhya Pradesh, Andhra Pradesh and Maharashtra showed moderate increases in milk production in 1984-85. But the States like Bihar, Nagaland, Rajasthan and Union Territories did not show any significant improvement in this regard whereas Orissa recorded a declining trend in milk production. As regards per capita availability of milk, it showed a declining trend in Orissa and stagnation in Rajasthan. A significant increase in per capita availability of milk was recorded during 1971-87 in Assam, Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Punjab, Tamil Nadu and West Bengal. Further, on the basis of per capita availability of milk the States of India may be classified as milk surplus States like Punjab, Haryana, Himachal

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Pradesh, Rajasthan and Gujarat with per capita availability of milk more than 210 gm., whereas in Andhra Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Tamil Nadu, Uttar Pradesh and West Bengal, the per capita availability of milk was in the range of 100-210 gm. It is a matter of concern that in States like Assam, Bihar, Orissa, Meghalaya, Nagaland, Tripura and Union Territories the per capita availability of milk was less than 100 gm. Therefore, suitable dairy development programmes, based on local resources of the States are required to be implemented, especially in low productive States in order to minimise regional imbalances in dairy development and productivity.

Inter-Regional and Inter-Class Disparities in Dairy Sector of Rural Punjab

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This paper deals with the study of extent of inter-regional and inter-class inequalities in various measures of milk productivity in the Punjab by stratifying the State into three milk zones and five land size-groups. Besides, the effects of herd size, herd composition and the percentage of wet animals on such inequalities are also examined. The data were obtained through special bovine survey of 300 farms in 1986. It was found that the highest inter-regional difference was observed in average productivity of dairy animals in milk between zones I and II in the case of medium land size class and it was as high as 3.30 litres per day. The problem of inter-class disparities was more severe. For instance, the highest statistically significant inequality was as high as 7.11 litres per acre of operational area between marginal and very large farms of zone II. However, its level of significance was 10 per cent. The next largest magnitude of this disparity was between marginal and very large farms of zone I, which was as high as 6.13 and it was significant at 1 per cent level. It was inferred that higher intensity of dairy animals per acre had positive effect on intensity of milk per acre upto certain extent and beyond such limit the negative effect of higher intensity of milch cattle on intensity of milk per acre was observed. Herd composition and the proportion of wet animals could not establish a systematic relationship with the productivity of milch cattle. This leads to the conclusion that proper feed management may have a more important role to play in mitigating inter-regional and inter-class disparities in the performance of dairying.

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