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Climate Vulnerability and Yield of Rice in Assam: An Assessment

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The paper assesses the climatic vulnerability with the help of adaptive capacity, exposure and sensitivity analysis for rice crop in Assam. With the help of detrending approach and centre moving average, yield of rice has been divided to contributing factors of both climatic and non-climatic factors while calculating trend for various climatic variables and indices. The results show that sensitivity was at very low level; exposure increased from low to very high level and adaptive capacity ranged initially from low to very high and vulnerability was at very high level except for hill zone of Assam. It is clearly visible that the magnitude of exposure, vulnerability and adaptive capacity has increased since 2011. Increase in adaptive capacity leads to climate change mitigation, which is possible due to adoption of agronomic practices, technological adoption and socio-economic progress. Such assessment may help policy makers and concerned stakeholders to identify the hotspots of vulnerability and allocate their resources at disposal to mitigate the effect and implement appropriate programmes.

Challenges and Opportunities Towards an Inclusive Sustainable Development Strategy: A Search for an Accelerating Rural Income and Employment Policy in the North Eastern Region (NER) of India

K.K.Datta,† Singyala † and Uttam Bhattacharyya‡

The paper attempts to explore some suitable possible avenues towards accelerating income and employment of the farmers in the NER. It also tries to address how the present pandemic (the COVID-19) and the Ukraine Russian war could emerge as an opportunity to restructure the economy of the region. The findings of the study try to provide pathways to enhance household levels income, employment and welfare of the local people through certain policy measures, such as developing value chains, agricultural diversification, developing agro-business, and tourism, introducing community based management etc. These measure could lead the NER economy towards a sustainable inclusive development goal, as proposed in the Sustainable Development Goals (SDGs) of the United Nations.

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Role of Agriculture and Some Other Macro Economic Variables for Unemployment Reduction- A Panel Data Analysis of Some G -20 Nations

Kanchan Datta *

The paper tries to investigate the role of agriculture value addition and some other macro-economic variables for unemployment reduction specially youth unemployment, using panel data regression model. Some selected G20 nations are considered and the data are collected from World Development Indicators published by World Bank. This study finds that fixed effect model is better than random effect model, and gross fixed capital formation play an important role for the reduction of youth unemployment for selected the G-20 nations. Gross fixed capital formation playing an important role for the reduction of youth unemployment for the G- 20 nations. Globalisation or openness which is measured by trade as a percentage of gross domestic product is positively related to youth unemployment, though the estimated coefficient is not statistically significant and agriculture value addition declines youth unemployment but the estimated parameter is not statistically significant.

Changing Household Level Crop Diversification in India and Its Implications

Amit Kumar Basantaray and Shailesh Acharya†

The present study has re-examined the issue of crop diversification in India and its implications by comparing the 77th round (2018-19) and 70th round (2012-13) survey level data of national sample survey office. Using the crop count method, it is noted that extent of diversification in the country's crop sector as well as in the crop sector of marginal, small, semi-medium, and medium households have declined. For the first time, large households have diversified their cultivation practice. And it is the diversified category of farmers whose efficiency is higher both in terms of gross and net returns per unit of land. Results of regression models show that there exists a strong and positive relationship between diversification and income from cultivation for all households, in general and among marginal and small households, in particular. The positive and significant relationship holds even after controlling for such variables as household size, education, technical education, and irrigated land.

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Agricultural Development Strategies and Incomes from Rice Cultivation: Case Studies from Kerala, India and the Mekong Delta Region, Vietnam

Deepak Johnson*

The paper has focused on the relative contribution of price and non-price factors in agricultural development using case studies of rice cultivation from Kerala, India and the Mekong Delta Region, Vietnam. The importance given for rice cultivation in these similar agro-ecological regions have led to different state interventions that had a bearing on agricultural growth and incomes. Using household survey data from both regions, the study has examined the role of state intervention in rice farmers obtaining their current levels of agricultural incomes. The analysis indicate that the farmers in Kerala earn higher per-hectare income from rice cultivation for a single season than in Vietnam. However, the annual per-hectare income from rice cultivation is similar in both regions, on account of multiple cropping in Vietnam. Price policy, enhanced by local support measures, has been a major contributor to the current levels of incomes from rice cultivation in Kerala. In Vietnam, income enhancement has occurred because of increasing the growing period of rice and by adoption of short-duration high-yielding varieties of rice. This contrasting experience brings out the conditions in which non-price factors work for improving agricultural incomes. While Kerala also had seen public investment in irrigation, the lack of suitable short-duration rice varieties and limited agricultural research and extension services implied that price support measures are effectively the only means for increasing incomes and sustaining rice cultivation.

An Econometric Analysis of Agriculture Food Production and Yield Per Hectare in India: An Evidence from Stationarity, Cointegration and Structural Break

Alok Kumar Pandey, Annapurna Dixit and Pawan Kumar Singh*

The study has examined the time-series behaviour of production and yield of total food grains production and yield per hectare from 1951 to 2021. Primarily the study is based on testing for the stationary, structural break of univariate and cointegration analysis and ECM for the bivariate series. The Augmented Dickey-Fuller test and Zivot and Andrews test are carried out for a comparative purpose and for determining

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the nature of the data generating process for the variables under consideration. Detecting structural breaks in the series in the context of multiple structural changes in a single equation has also been presented in the paper. Structural change in the series of total agricultural food production if yield per hectare is treated as an independent variable, break years are 1984 and 2000, and structural change in the series of yield per hectare if total agricultural food production is treated as an independent variable, break years are 1984, 2000 and 2011. These show that the effect of shocks appears in both the series. Further, Engel Granger's cointegration results reveal that the long-run relation holds in both the series. Creating a more productive, internationally competitive, and diversified agricultural sector would require a shift in public expenditures away from subsidies to productivity-enhancing investments. The agricultural research and extension systems need to be strengthened to improve access to productivity-enhancing technologies and regionally differentiated strategies, with a strong focus on the lagging states. Several factors are responsible for low productivity in the agriculture sector, that is, illiteracy, insufficient finance, and inadequate marketing of agricultural products.

Impact of Groundnut Seed Subsidy on Farm Efficiency in Ananthapuramu District of Andhra Pradesh

U. Sandhyarani, S. Hymajyothi ‡ , A. Amarender Reddy,* S. Rajeswari † and B. Ramanamurthy⁑**

An attempt has been made to study farm efficiency of groundnut seed subsidy in Ananthapuramu district of Andhra Pradesh. For this purpose, two mandals viz., Kanaganapalli, and Gudibanda were selected based on highest number of subsidy benefited farmers and the data were collected for the year 2021 kharif season from 64 seed subsidy beneficiary and 136 non-beneficiary farmers. The data was collected from each respondent through personal interviews with the help of structured schedules. Data Envelopment Analysis (DEA) was employed to analyse technical efficiency and scale efficiency of the farmers. For better comparison, all the farmers were divided into two categories, viz. subsidised and non-subsidised and propensity score matching is also used. The empirical results observed that the overall mean Variable Returns to Scale (VRS) efficiency was 0.760, Constant Returns to Scale (CRS) efficiency was 0.70. The positive impact of seed subsidy is visible, as seed subsidy beneficiary farmers mean VRS efficiency was 0.916 which is greater than non-subsidized farmers, i.e., 0.716. The variation is because of high input costs incurred to the non-subsidised farmers. The regression results also indicate that seed

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subsidy is positive influence on VRS efficiency, CRS efficiency and scale efficiency to the extent of up to 20 per cent increase in efficiency. Yet it has also been noticed that farmers still rely on non-subsidised sources for their seed requirement, because they could not meet the conditions of availing seed subsidy from the Andhra Pradesh state government.

How Diversified is Assam's Horticulture? A Zonal Level Analysis

R. Nidhishree*

The paper attempts to explore the extent of diversification in the horticultural sector in the state of Assam at the zonal level for a period of 10 years using Simpson's diversification Index. The analysis indicate that the diversification from the year 2009-10 to the recent years 2019-20 is more or less equal to 0.75, which according to the index value was close to 1. Thus the diversification of the horticulture sector of Assam was found to be high. To understand the pattern of diversification in a more detailed way, the diversification of different agro climatic zones was also calculated using the Simpson's diversification index. The index value of Lower Brahmaputra Valley Zone, North Bank Plain zone, Central Brahmaputra Valley Zone, Upper Brahmaputra Valley Zone, Barak Valley Zone and Hill Zone was 0.797, 0.719, 0.807, 0.815, 0.768 and 0.822, respectively. Out of these six zones, Hills Zone was found to have comparatively more diversification while North Bank Plain Zone recorded the lowest. In this Hills Zone, due to predominance of jhum/ shifting cultivation, more crops were found to be grown by the farmers. The index values of all the zones were close to 1, showing a higher diversification in the horticultural sector in almost all the zones of the state.

Sustaining Agribusiness in Imposition Times: Evidence from Rural Assam

Md. Aktar Hussain and Pradyut Guha§

Using farm level survey data collected from the central Brahmaputra valley region of Assam the study attempts to examine the question of sustaining agribusiness in terms of value of crops damaged and farm income loss following pandemic induced national lockdown. The estimated results show that income loss was directly proportional to unsold quantity and value of damaged crops across the sampled households. Beside marketing inconveniences caused by bureaucratic delay,

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law and order situation during lockdown period a significant section of farmers reported about limited access to storage facility (such as cold storage) and absence of any processing facility (such as agro processing unit) at the village level contributed towards damage of the perishable crops at harvesting stage. Policies designed towards promotion of agribusiness through creation of rural marketing infrastructure such as storage and processing units may serve as an alternative destination of harvested crops for farmers rather excessively relying on conventional local market under situation of emergency as experienced in recent history of global health crisis. Steps towards regularity in procurement of farm product by Agricultural Produce Market Committee in rural areas and farm gate sale ensuring minimum support price can also be helpful in long run sustainability of agribusiness.

Estimation of Bovine Breed Diversity in India and Its Determinants

Biswajit Sen, Udita Chaudhary, Gunjan Bhandari[*]

The declining species diversity pose a threat to many ecological and economic aspects of a region. Over the years, farmer's choice towards superior and economically profitable breed choice may lead to declining breed diversity in cattle and buffalo. The present study attempted to delineate different agro-ecological and environmental factors which determine breed diversity in cattle and buffalo. For the purpose breed wise population data were collected from the latest breed survey conducted by the Government of India i.e., Breed Survey, 2013 which consist of breed wise segregated population data of nearly 190 million cattle and 100 million buffaloes. Temperature, rainfall, pasture cover along with artificial insemination practice was found significant in determining breed diversity in cattle and buffalo in India. Artificial insemination was found to be beneficial in maintaining pure breed and reducing difficulties faced by farmers during natural service. The study calls for development of suitable action plan in artificial insemination practice to develop and maintain pure breeds in cattle and buffalo and maintaining required breed diversity.

Extent and Determinants of Crop Diversification across Major States of India

S. H. Malik[†]

The present study examines the extent and determinants of crop diversification in 21 major states during 2012-13 and 2018-19 using unit level data from 70 th and 77 th round situation assessment surveys. The results show that the extent of crop diversification has decreased in most of the states both measured by diversification

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index, proportion of area under non-food grain crops including fruits and vegetable and also in terms of area under fruits and vegetables. The average household income has increased by varying amount practically in all the states and across all size categories of holdings. The results of the study show a positive correlation between diversification index and area under non-food crops, area under fruits and vegetables and average household income. The results of multiple log linear regression analysis indicate that household size, occupational profile of a household, education of the head of the family and size of landholdings are important determinants of crop diversification.

Regional Disparities in Farm Profitability of Major Crops in India

P. Aishwarya, D. Suresh Kumar and V. Saravana Kumar*

The main objective of this paper is to bring out the disparities in farm profitability of major crops across different regions of India. The study tries to bridge the gap by comparing the farm profitability of six major crops, viz., wheat, paddy, cotton and groundnut sugarcane and gram at three different periods from 2004-05 to 2018-19 across five regions of India. This paper also looked at the relationship between the Minimum Support Price (MSP) and the cost of production for six major crops from 2009–10 to 2020–21. Assessing farm profitability across India's regions would enable us to create region-specific strategies that will enhance farm revenue and the socio-economic circumstances of Indian farmers. The study demonstrated that all six major crops had inter- and intra-regional variations in their profitability and cost of inputs. In order to increase agricultural profitability across all regions, the government must provide knowledge interventions based on agroclimatic zones. Farm profitability can be increased primarily by improving the crop productivity, so the main goal is to increase the gross value of output by increasing the yield and reducing input costs through technology adoption.

Agricultural Growth and Crop Diversification in India: A State Level Analysis

Nikkita Gupta and Elumalai Kannan†

The paper has analysed India's agricultural growth pattern by endogenously computing structural breaks in agricultural gross domestic product (GDP) from 1981-82 to 2019-20 using Bai-Perron multiple breakpoint method. It also analyses the relationship between crop agricultural growth and level of crop diversification. At the

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national level, five structural breaks in agricultural GDP were identified: 1987-88, 1992-93, 1997-98, 2003-04, and 2011-12. There exists variation in structural break points at state level indicating state-specific changes in policy or occurrence of extreme climatic events. Agricultural growth and crop diversification index are positively correlated with a high degree of association found during 1998-99 to 2003-04. The southern, western, and central regions have highly diversified cropping pattern, whereas eastern and northern regions follow a specialised cropping pattern. Panel data regression results show that per capita income and urbanisation had positive and significant effect on crop diversification. While availability of irrigation encourages crop diversification, fertiliser use and cropping intensity are associated with specialisation. Rural literacy and proportion of agricultural workers have positive effect on crop diversification. However, coefficient of industry value added was negative and statistically significant implying that there exists industry-crop relationship leading to cultivation of certain specialised crops required for the industry. Crop diversification will hold the key to sustain the current momentum in India's agricultural growth.

Sustainable Agriculture: Issues and Challenges-A Case of Agriculture in Tribal Areas in Chhattisgarh State

M. Gopinath Reddy*

The thrust of the paper is to understand these constraints and challenges regarding tribal agriculture in Chhattisgarh state of the Central India. Specifically, the paper has delved into what ails tribal agriculture in the state. Taking three important districts – two fully Scheduled Areas (FSA) of Bastar and Sarguja and one Partially Scheduled Area (PSA) of Ghariabanda district of Chhattisgarh State, a total of 400 sample households were selected to understand the difficulties and challenges faced by the farmers in the tribal areas of Chhattisgarh. The results indicate that low productivity and subsistence nature of agriculture in the study regions due to lack of agriculture extension networks, coupled with imperfect markets, non-inclusiveness of financial institutions. The state government should make earnest efforts to address these deficiencies being faced by the tribal agriculture to make it more sustainable and yet economically viable.

Drivers of Agricultural Transformation in India: A District-level Analysis

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The agriculture sector has been contributing much to the Indian economy. Nevertheless, its share of GDP has been declining over the years. Therefore, a detailed analysis of the factors influencing agriculture growth is taken up in this study using both descriptive and panel data analysis. Specifically, the study aims (1) To analyse the trend in the share of agriculture in GDP; (2) to examine the factors responsible for determining agriculture's share of GDP; and (3) to analyse the relative effects of factors change across zones in India. For the purpose of study, a total of 535 districts from 20 states have been selected based on the availability of comparable data during the sample period. The results indicated that 28 per cent of the variation in agriculture's share of GDP is explained by the terms of trade, capital-labor ratio and technology. While terms of trade and capital-labour ratio are negative and significant, implying an inverse relationship with agricultural growth, technology has determined positively and significantly agricultural growth. Hence, the study suggests an expansion of technology adoption to accelerate agricultural development.

India's Agricultural Growth Across Crops: Emerging Trends and Patterns

Vinod Kumar*

The paper has analysed the trends and pattern in agricultural growth and crop output growth at the national level, using time series data from 1967-68 to 2020-21 from published sources. The area under foodgrains in gross cropped area (GCA) declined by 11.62 per cent mainly due to the fall in area under coarse cereals by 16.78 per cent between triennium ending (TE) 1970-71 and TE 2020-21. Among crop groups, fruits and vegetables accounted for the largest share of the total value of crop output followed by cereals, oilseeds, fiber and pulses in TE 2020-21. While the contribution of cereals declined from 32.46 per cent in TE 1970-1971 to 27.41 per cent in TE 2020-21, the share of fruits and vegetables increased considerably from 14.11 per cent to 27.77 per cent during the same period. There was a definite shift from foodgrains to non-foodgrains, such as fruits and vegetables, oilseeds, fiber, and condiments and spices, whose share in both area and in value of output has been increasing during the study period. The study also reveals that diversification towards high value crops (HVCs) offers great scope to enhance farmers' income. The staple crops such as cereals, pulses and oilseeds occupy 77.33 per cent of the gross cropped

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area (GCA) but contribute only 46.37 per cent. Interestingly, almost same value of output was contributed by HVCs (fruits and vegetables, fibres, condiments and spices and sugarcane which occupy 20.12 per cent of GCA during TE 2020-21. These changes in the relative shares of crops in agricultural growth provide a clear indication of the growing importance of high-value crops in Indian agriculture. However, the long-term growth rate (during 1967-68 to 2020-21) shows that not a single crop registered production growth of more than 4.0 per cent per annum. The results of the crop output growth model indicate that better irrigation facilities, normal rainfall and improved fertiliser consumption will help boost crop output in the country. It may be concluded that there is also a need to improve productivity of small and marginal farmers through development and implementation of small holding farm technologies. The regenerative agriculture through suitable integrated farming system (IFS) models is the need of the hour to improve soil health, make agriculture profitable and sustainable in the long run. Crop diversification towards oilseeds, pulses and horticulture needs to be given priority by addressing the core issues of irrigation, investment, credit and markets in their cultivation. While the Government has adopted the use of MSP as signal to encourage crop diversification, there is also a need for coordinated action from the State Governments to facilitate the shift to high value and less water guzzling crops to enable realisation of the objective of doubling farmers' income in a sustainable way.

Pattern and Determinants of Income Diversity of Agricultural Households in North East India

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The present study uses the data from the 77th round Situation Assessment Survey of NSSO to examine the income sources of agricultural households of north east India and the determinants for income diversification. The multivariate probit regression and Tobit regression models were used for analysis. Income from agriculture and allied activities are the major source of income in northeast India, except in Tripura and Assam where the main income source is wages and salary. The study found a low level of income diversification in the north-eastern region with a mean degree of diversification of 0.343. Among the eight states, households from Nagaland have the highest SID value with an average of 0.418 while it was lowest in Sikkim (0.298). With growth in income, agricultural households often shift from less lucrative economic activities (crop production) to more valuable non-farm activities (wages and salaries and non- farm businesses). Various socio-economic characteristics of the household also influenced the choice and intensity of activities.

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There is a need to boost productivity and income through technical, market-driven interventions and infrastructure development because the region's potential for the development of the agricultural and related industries is constrained by a number of factors.

Determinants of Crop Diversification in Odisha: Empirical Insights from Panel Corrected Standard Error (PCSE) Technique

Rakesh Meher and Lopamudra Mishra*

The study primarily (i) to investigate the nature of agricultural diversification in Odisha; (ii) to examine the extent of crop diversification in Odisha and (iii) to explore the factor affecting crop diversification in Odisha from 1995-96 to 2018-19. The level of crop diversification was evaluated using Simpson's index of diversity which is calculated based on the proportion of gross cropped area under different crops cultivated in 30 districts of Odisha during the period of 1995-2019. It has been observed crop diversification is high in tribal populated districts of south Odisha. Even though the growth of crop diversification in the state is sluggish but the pace of diversification in the districts Boudh, Sonepur, Puri, Jharsuguda, and Sundargarh is very impressive. An unbalanced panel data model was used to identify factors affecting farm household crop diversification by using the Panel Corrected Standard Error approach (PCSE). The research outcomes reveal that fertiliser consumption, irrigation intensity, and high-yielding variety seed promote monocropping culture, whereas access to credit, cropping intensity, and rural roads positively influence crop diversification.

Impact of Public Investments on the Growth of Agricultural Sector in Manipur

Anjoo Yumnam,† Nivedita Deka,‡ N. Uttam Singh† and Pampi Paul †

The study intends to examine the trend and pattern of public investments in agricultural sector in Manipur and the impact it has on the agricultural growth. The bounds test approach or Autoregressive distributed lagged model (ARDL) to cointegration was used to find the relationship between the dependent variable GSDP from agricultural sector and the independent variables, viz., public investment in agriculture and allied activities, major and medium irrigation and flood control, rural development and special area programmes. The annual data was collected for the period 1990-91 to 2018-19 from RBI, State finances: A Study of Budgets. The study revealed that the investments in agriculture and allied activities showed an overall absolute decline over the whole period with a negative CGR of -2.76 per cent. Apart

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from agriculture and allied activities, public investments in rural development schemes and programmes have decreased while the investments in major and medium irrigation and Special Area Programmes have increased significantly. The ARDL model estimates showed that in the long run, investment in agriculture and allied activities had a significant negative effect on agricultural GSDP (-0.45), whereas investments in Special Area programmes had a significant positive effect. Public investments in Irrigation and Rural Development were however insignificant in the growth of the agricultural sector. The negative effect of investments in agriculture and allied activities implied unproductive expenditure in the many components which did not create positive returns. An analysis on the return to investment of these components will throw some light on the efficient reallocation of the investments for a positive return.

Implementation and Impact of Climate Resilient Zero Budget Natural Farming: A Case Study of AF-EC CNF in Anantapuramu District, Andhra Pradesh

M. Srinivasa Reddy and Brajaraja Mishra *

The paper discusses about the implementation of Climate-Resilient Zero-Budget Natural Farming in the state of Andhra Pradesh by taking a case of one of its drought-prone districts Anantapuramu. Natural farming has been promoted by the Central Government across many Indian states through its nationalised scheme Paramparagat Krishi Vikas Yojana with the aim of production sustainability and generating viable income for the marginalised sections in the society. The farming practice is based on various agro-ecological principles which are traditionally practiced by the Indian farmers since long and its impact on production and productivity is scientifically tested through lab-research. Andhra Pradesh is one of the leading states which has adopted this scheme on a large scale through the involvement of grassroot organisations like Self-help Groups with adequate financial support from national and international agencies. The farming practice spread from farmer-to-farmer through demonstration and knowledge sharing. Localization of inputs, use of family labour, lower dependency on irrigation and mechanization reduces production cost. Further, value addition from the farming is much higher if compared to that of chemical farming due to lower cost and also improved yield rate. As such the farming is getting more popular among the poor, tenant and lower landholding class, women and economically vulnerable farmers.

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Impact of Employment Generation Programmes on Livelihood Security of the Rural Poor in Manipur

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An attempt is made to examine the effect of employment generation programmes implemented by the Government of India to secure livelihood of the rural poor. Among the various employment generation programmes, Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) and Swarnajayanti Gram Swarojgar Yojana (SGSY) were opted for this study. Data were collected from 185 respondents from Imphal East and Churachandpur districts. A Livelihood Security Index (LSI) comprising seven components was used to assess the impact. The findings revealed that statistically significant changes in livelihood security of the respondents before and after MGNREGA and before and after SGSY were observed. A significant difference among the four groups in terms of livelihood security was also observed, with highest mean score of 49.97 obtained by beneficiaries of both theprogrammes. Thus, a positive impact on livelihood security was observed on the beneficiaries of employment generation programmes in comparison to non-beneficiaries.

Sensitivity Analysis of Breakeven Output for Major Crops of Madhya Pradesh

Ankita Rajput and Gourav Kumar Vani*

A study was conducted to evaluate breakeven output coupled with sensitivity analysis for major crops of Madhya Pradesh. The study is based on secondary data obtained from DES, India for the period 2000-01 to 2016-17 for sorghum, cotton, maize, chickpea/gram, black gram, red gram, lentil, rapeseed and mustard, soybean, paddy and wheat crops. The results revealed that break-even output for red gram, cotton, gram, jowar, lentil, mustard, black gram and wheat were inelastic with respect to changes in average variable cost (AVC). Breakeven output for paddy, and soybean, were highly elastic w.r.t. changes in AVC. For all crops breakeven output was elastic with respect to output price. Cotton remained unaffected by changes in average variable cost. The important policy suggestions include that breakeven elasticities must be calculated on regular basis, coupled with knowledge of best fit distribution for output of farmers.

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Component Analysis of Dynamic Changes in Aggregate Crop Revenue in Kymore Plateau Agro-Climatic Zone of Madhya Pradesh

Poonam Chaturvedi and P.K.Awasthi†

A study was conducted to analyse the dynamic changes in the value of aggregate crop revenue in five districts viz., Jabalpur, Katni, Panna, Satna and Sidhi of Kymore plateau agro-climatic zone of Madhya Pradesh by using Logarithmic Mean Divisia Index (LMDI) method, for the period from 2007-08 to 2016-17. The crops considered in the study were wheat, paddy, maize, jowar, linseed, gram, tur, mustard and sesamum. The aggregate crop revenue was decomposed into area, yield, price and cropping pattern effect. Yield effect emerged as the major contributor in the aggregate value of crop revenue of the selected districts during the study period, followed by price effect, except in Jabalpur district where price effect was predominant. Cropping pattern effect had the least contribution among the various constituents of aggregate revenue. The analysis indicated that farmers in Jabalpur district were more inclined towards cereal crops while in Katni and Panna district more inclination towards oilseeds was observed. In Sidhi district relative change for almost all the crops were observed to be negative other than wheat, gram and tur. There is growth potential in the high value crops and intensification of these crops can help the farmers of the zone in realising greater revenue. Therefore, efforts should be made by the policy makers to encourage farmers towards market-led-extension for encouraging shift towards high value crops. The contribution of cropping pattern effect needs to be improved and policies directed towards the same may be emphasised.

Status and Growth Trends in Area, Production and Productivity of Assam Lemon in Nalbari District of Assam

Debasmita Baruah*

Based on secondary sources of data a study was conducted to examine the trends and variation of area, production and productivity of Assam lemon in Assam as well as in Nalbari (undivided) district from 2009-10 to 2018-19. The study confirmed that the compound growth rate of area, production and productivity was found to be positively significant and showed an increasing trend for all the three parameters indicating that there was significant increase in area, production and productivity of

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Assam lemon. This could be attributed to adoption of modern technology, adoption of recommended package of practices use of disease-free planting materials and extensive use of improved inputs. However considerable instability in area, production and productivity was observed in the Nalbari district and Assam. The study is first of its kind as no literature has been available that studied the growth trends in Assam lemon in the study area. There is ample scope to increase the area and production under Assam lemon and improvement in yield level.

How Diversified is Assam's Horticulture? A Zonal Level Analysis

R. Nidhishree[†]

The paper attempts to explore the extent of diversification in the horticultural sector in the state of Assam covering different agro-climatic zones based on data from secondary sources. The diversification of the horticultural sector of Assam for the period of 10 years was calculated using Simpson's diversification Index. The findings of the study indicate the diversification of the horticulture sector of Assam to be high. To understand the pattern of diversification in a more detailed way, the diversification of different agro climatic zones was also calculated using the Simpson's diversification index. The index value of Lower Brahmaputra Valley Zone, North Bank Plain zone, Central Brahmaputra Valley Zone, Upper Brahmaputra Valley Zone, Barak Valley Zone and Hill Zone was 0.797, 0.719, 0.807, 0.815, 0.768 and 0,822, respectively. Out of these six zones, Hills Zone was found to have comparatively more diversification while North Bank Plain Zone recorded the lowest. In this Hills Zone, due to predominance of jhum/shifting cultivation, more crops were found to be grown by the farmers. The index values of all the zones were close to 1, showing a higher diversification in the horticultural sector in almost all the zones of the state. The study has emphasised that though the state lagging in modernisation and mechanisation in agriculture, the better diversification pattern can improve the economy of the farming households.

Impact of Crop Diversification on Cropping Pattern, Income and Employment in Mandi District of Himachal Pradesh

Madhavi Gautam, Harbans Lal, and Shivalika Sood [*]

The paper attempts to assess the impact of crop diversification on cropping pattern, income and employment in Mandi district of Himachal Pradesh. The study was based on primary data collected from 60 farmers selected randomly from

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selected villages of two blocks namely, Sadar and Sundernagar. The data related to the agricultural year 2016-17. The results indicated that after crop diversification, maximum proportion of total cropped area, i.e., 66.97 per cent was allocated to vegetable crops of which 29.60 per cent was under kharif season vegetables and 37.37 per cent was under rabi season vegetables. On an average farm, the maximum employment was generated through farm activities followed by non-farm activities. The average total annual income on average category of farms was recorded to be Rs. 230310 of which about 48.79 per cent was generated from farm activities. There appeared a direct relationship between the diversification index and per hectare net agricultural income which showed that with the increase in crop diversification, the net agricultural income per hectare also increased in the study area. There exist great potential of increasing farmers' income through creating more off-farm and non-farm employment avenues in the study area. The Government has to make strong efforts to regulate and control the vegetable markets to provide remunerative prices to farmers.

An Economic Analysis of Agricultural Growth in Odisha's Post- Green Revolution Period

Sarba Narayan Mishra† , Smaranika Das,± and Pujalipta Behera*

The study aims to analyse the growth in agricultural sector in Odisha from the period 1980-81 to 2019-20. Log linear equation was fitted to data and CAGR was calculated. Hazell's decomposition technique was used to identify the sources of change in variance of production as well as change in mean production. Production exhibited positive rates of growth for rice, maize, and total food grains while negative growth rates for ragi, pulses and oilseeds. The results of decomposition analysis show that yield variance accounted for 127.01 per cent change in variance of production of total food grains. Therefore, the state government must focus on crop diversification, water harvesting techniques, and popularize agroforestry systems and frame appropriate policies for sustainable and significant growth in the agricultural sector.

Differential Growth of Agricultural Sector Across Indian States – A Review of Causes and Remedies

K. K. Bagchi, * Archita Nayak ** and Kanti Paul **

The present study intends to analyse (a) the scenarios of uneven growth of agricultural sector across Indian states, (b) reasons for differential growth and their

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remedies, (c) different government schemes for the benefits of agriculture and farmers along with their implementations and (d) suggest policy measures. Some of the Indian states like West Bengal, Andhra Pradesh, Gujarat, Uttar Pradesh and Haryana etc. lead in the performance of its agricultural sector. Proper manpower with sufficient training and equipped with modernised scientific equipments and infrastructures in Indian agricultural sector may lead India to a prosperous position. Some of the policy recommendations in the present context are strengthening of water resources and irrigation systems; modernisation and innovations of agricultural system; stressing on organic cultivation, mixed farming and contract farming and search for new markets particularly international ones etc.

Increasing the Farm Income in Rainfed Regions through Maize Farming - A Study in Tamil Nadu

B. Keerthika† and R. Jayapriya†

A study was conducted Ariyalur district, one of Tamil Nadu's major dry farming districts, to estimate the production of maize and identify different marketing channels of maize by the farmers and how cultivation of maize has increased the farm income of the sample respondents. The main crops cultivated in the study district are rice, groundnuts, sugarcane, maize, and sorghum, with maize accounting for 11.2 thousand hectares and primarily being used as poultry feed. For the purpose of analysis 80 sample households cultivating only maize were selected by using three stage random sampling technique from eight revenue villages from the study district and ten years of data (2008-09 to 2017-18) for area, production, and productivity were used. The compound growth rate of area, production, and productivity in maize shows an upward trend, indicating that there is opportunity for maize production in the study area to increase the farm income of the maize farmers. The regression analysis showed the over-use of labour input which leads to high expenditure on wages for labour and sub-optimal use of other inputs excluding seed which is non-significant. Thus sensitisation of farmers about the sub-optimal usage and extension efforts to follow the recommended dosage in these inputs are urgently needed. Maize specific mechanical weeder and other implements could be developed and supplied at subsidised rate to the farmers, which may in turn help in reducing labour requirement and also the expenditure on labour. Innovative technologies and high yielding varieties should be adopted by the farmers to enhance the productivity of maize. Marketing efficiency analysis indicated that channel II was efficient, thus the farmers may be advised through appropriate extension programmes to sell their product through Channel ll. Fixing a fair minimum support price for maize may help the

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farmers from the fluctuating market price can help improving the return from maize cultivation.

A Study on Crop Diversification under Different Sources of Irrigation in Balasore District of Odisha

Avisweta Nandy, [*]Maitreyee Tripathy ** and Debi Kalyan Jayasingh **

The study analyses the changes in cropping patterns and diversification under different sources of irrigation in the Balasore district of Odisha. For the purpose of study three villages having the highest sources of irrigation were selected namely Srirampur, Nepura, and, Nikhira and a total of 93 respondents were selected using proportionate random sampling and data pertained to the agricultural year 2018-19. The cropping pattern was studied both before and after the introduction of irrigation facilities in the region. The Simpson's index was used to calculate the diversification under various sources of irrigation. There were three prominent sources of irrigation namely shallow tube wells, lift irrigation, and river irrigation. The scenario post irrigation availability pointed towards increased diversification in the area. The diversification is both temporal and spatial. The availability of irrigation resulted in gradual shift towards cultivation of higher remunerative crops like oilseeds and vegetables. Thus, the study establishes a positive relationship between irrigation and crop diversification.

Comparative Methodological Approaches for Assessing Soybean Yield Risks at District Level in State of Madhya Pradesh

Shruti Mishra and S.B. Nahatkar[†]

The purpose of the study is to determine the risk associated with production of soybean crop in major soybean producing districts of the Madhya Pradesh. Production risk was estimated using the Cuddy Della Valle Instability Index (CDVI), yield deviation from mean, and Sustainable Yield Index (SYI) methods. The results of the study revealed that Madhya Pradesh state as a whole fall in low instability zone for area and production under soybean crop while in medium instability zone for productivity. The compound growth rate (CGR) for area, production and productivity of soybean crop in the state was positive but it is insignificant for production and productivity mainly due to moderate instability and poor growth rate in productivity. The most desirable situation of low instability with high growth rate in production of

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soybean was observed in Jhabua district but it is not a major soybean-growing district at present. Majority of the districts i.e.,23 districts out of 33 selected districts under the study yield of soybean was consistently less than the mean yield. Therefore, these 23 districts were placed in most risky zone. These districts accounts for an area of 3053.79 thousand ha which is 54.82 per cent of the total area of soybean in the triennium ending year 2019-20. Similarly, these districts account for production of 2749.80 thousand tonnes which is about 55 per cent of the total production of the state. While on the basis of Sustainable Yield Index method districts having most sustainable yield covered an area of 3825.58 thousand ha that contributed to production of 3542.82 thousand tonnes (70.92 per cent). The study infers that SYI consider mean yield, standard deviation and maximum yield and therefore this can be a better measurement of yield risk rather than considering only actual and mean yield.

Is Apiculture a Sustainable Agricultural Diversification Practice? - Evidence from Kerala

A. A. Amrutha, Alinda George and Pritee Sharma[*]

Apiculture, the scientific way of beekeeping, has been traditionally practiced in Kerala. It has now risen to a potential agricultural diversification sector, especially after the COVID 19 pandemic, due to relatively better income with less cost and low price, lack of proper transport facilities and high demand for the products due to the high agribusiness linkages. This study tries to understand whether apiculture, i.e., beekeeping, can be adopted as a sustainable diversification strategy. For this, a study was conducted among the beekeepers across Kerala to collect the details regarding their beekeeping practices, possible constraints and viable solutions to reduce them. Lack of proper marketing facilities, high transportation cost, exploitation by intermediaries, limited knowledge about the market, and limited knowledge about the prices constrained the beekepers in realizing a better price and income for their products. The study emphasised that apiculture can be practiced as a sustainable agricultural diversification strategy in Kerala with proper government support for marketing and input supply. Proper policy measures should be undertaken to encourage the entry of women into this sector.

Sustainable Agriculture and Natural Farming in Andhra Pradesh

Rajani Adikarla[†]

The paper aims to assess sustainability of Andhra Pradesh Community Managed Natural Farming (APCNF) in relation to chemical-based agriculture. The evaluation

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methodology adopted was "with and without" approach wherein the outcomes of a random sample of APCNF farmers cultivating a set of selected crops are compared with the outcomes of a random sample of farmers cultivating the same set of crops using chemical inputs. The APCNF has contributed to sustainable agriculture through linking raising crop yields and incomes (growth) with improvement in soil fertility and farmers' annual household income. The increase in crop incomes, benefits of soil improvement and income accrued to the farmers are the pointers to the sustainable agriculture in Andhra Pradesh. Some of the measures suggested include crop yield to be included along with the agro ecological services of APCNF to assess the contribution of APCNF and the principle of five-layercropping pattern with a different combination of suitable crops for each layer is recommended for cultivation under APCNF keeping in mind the agro climatic conditions of the regions to ensure regular flow of income throughout the agricultural year.

Technological Interventions for Sustaining Productivity and Profitability- A Case Study of Sugarcane Farmers in Nimar Region of Madhya Pradesh

L. S. Gangwar, A. Baitha, S. N. Singh and S.S Hasan*

A study was conducted in three districts of Nimar region of Madhya Pradesh to examine and identify of the problems being faced by the sugarcane farmers due to scarcity of farm labour for agricultural operations. The study is based on the data collected from 50 selected respondents involved in sugarcane based farming and allied activities during year 2021-22 through primary data survey with the help of Participatory Rural Appraisal (PRA) technique. The study revealed that the implementation of Employment Guarantee Scheme such as MGNREGS has provided employment opportunities to rural workers and has checked their migration from villages to metro-cities and nearby industrial townships. The respondent farmers reported that they were facing acute shortage of labourers during peak crop planting and harvesting season. The labour wages have increased significantly from ₹150 to ₹350 per day during past five years. The total cost (Cost C 3) of sugarcane production was ₹204650 and ₹183863 per ha in traditional and Innovative Sugarcane Production Techniques (ISPT) method. The farmers cultivate pulses (chick pea, white gram etc.), wheat and vegetables as inter crops in October-November planted cane under ISPT to use wider row space (135-150 cm). They earned net income ₹85000 to ₹154300/ha from inter crop grown and market price of crop produce. The study has concluded that the minimum wages under Government scheme should be increased cautiously keeping in view its impact on sugarcane and other crop production activities. The productivity gain and cost reduction would be key facts to enhance farmers' income.

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The study concludes that the government should take policy decision to address sugar mills and farmers' problem to enhance per unit profitability to realise the goals of farmers' income by adoption of technologies, entrepreneurship development and diversifying production, processing and allied activities in villages. The black cotton soils with good water holding capacity, low to medium organic carbon, available nitrogen and zinc content. Majority of sugarcane farmers apply water with drip irrigation system to reduce losses of water in summer season. The respondents' reported that the autumn planted sugarcane at wider row spacing 135-150 cm intercropped with gram was the most profitable as compared to the other competing crops and also enrich soil fertility through nitrogen fixation in soils.

Strategies for Enhancing Income of Smallholder Farmers of Odisha through Agricultural Diversification

B.B. Barik*

The objectives of the study are (i) To examine the existing constraints encountered by smallholder farmers of Odisha for agricultural diversification and (ii) To suggest possible measures to overcome the bottlenecks of agricultural diversification and for augmentation of income. The study is based data from secondary sources. The findings of the study indicate that the backwardness of agriculture in the state is due to large percentages of smallholders including ST farmers and use of low level of agricultural technology Besides they faced several constraints in adoption of agricultural diversification including small size of holding, sub-optimal use of different inputs, low adoption of agricultural technology, inadequate development of infrastructural facilities, low per capita income and recurrence of natural calamities. In order to improve the income of smallholders including ST farmers the adoption of different strategies of agricultural diversification like increasing the operational land area by raising cropping intensity, switching to high-value crops, promotion of irrigation facilities like micro irrigation, solar irrigation, watershed development and increasing the utilization of created irrigation potential, higher use of fertilizers and pesticides, increasing access to agricultural credit, adoption of agricultural technology comprising use of quality and certified seeds, small scale farm mechanisation and effective delivery of agricultural extension services, development of infrastructural facilities covering development of roads, consumption of electricity, use of ICT and mitigation of disaster are required to enhance their income. Besides the smallholder can be linked to different governmental marketing agencies, FPOs/FPCs for facilitating the value addition and sell their produce at remunerative prices. The agricultural diversification strategies

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will be helpful in enhancing the agricultural production, productivity and growth rate of the state and income of smallholders.

Cultivation of Stone-Fruits in Uttarakhand: Market Accessibility of Farmers and Monopsonist Behaviour of Intermediaries

Taniya Sah†

The study has focused mainly on two important supply-side factors responsible for farmers' low income in India- dependence on intermediaries, and lack of market accessibility due to poor infrastructure to analyse the supply chain of stone-fruits in Uttarakhand in northern India. Uttarakhand is the leading producer of stone-fruits (peach, plum, apricot and pear among others) in India. The study is based original survey data constructed through a primary survey conducted in Nainital district of Uttarakhand using multi-stage stratified random sampling data were collected from 200 farmers and the intermediaries in the hub-market of Haldwani for the purpose. The findings indicate that high post-harvest marketing cost coupled with poor infrastructure and information asymmetry helps traders in wielding power over the farmers. Rich farmers fare relatively well as compared to their poor and smaller counterparts. Also, because the intermediaries deal in bulk and help the farmers dispense-off their produce quickly in the absence of storage amenities, farmers prefer to deal with them over other actors, even if this implies additional cost in the form of high commission. Policy implications include an urgent need to develop storage and food-processing infrastructure. It is felt that only implementation of Information and Communication Technologies (ICT) could do very little to increase farmers' profits, but has to be done in conjunction with an improvement in credit-lending and agricultural marketing institutions.

Cost, Revenue and Income of Milk Production: An Economic Analysis of Milk Producing Farmers of Bhatsana Village, Haryana

Devesh Birwal*

The objective of this paper is to examine the production, cost and returns that rural households incur from livestock based on a case study of Bhatsana village in Rewari district of Haryana. The analysis was carried out around two important variables that have a significant implication for the households involved in raising bovines, viz. land holdings and social group to which the household belongs. The calculations are made both herd size wise as well as per animal holding of the farmer households. The average cost, revenue and income of maintaining bovine per farmer

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household was Rs.32102, Rs.120670 and Rs.88568 respectively. The annual consumption cost of feed and fodder per farmer households was Rs.25902, which was 80 per cent of total cost. Among all type of feed and fodder per farmer household spending on dry fodder, green fodder and feed are Rs.7543, Rs.2245 and Rs.16113 respectively. The results show that number of adult female bovine and feed cost incurred by the household positively affect the total revenue of households, while cost of dry fodder has a negative impact on revenue from bovines. As expenditure on feed increases, total production of milk products increases which in turn raises the total revenue of the farmers. Revenue earned is also affected by caste group, with the dominant landholding caste group earning higher revenue than other castes. Relationship between landholdings, cost, revenue and income from bovine holdings is positive, mainly due to higher productivity of the bovines and larger size of herds maintained by the households with larger land holdings. Better species maintained and better feeding translates to higher per milch animal expenditure especially on feed and fodder. Likewise, dominant land holding caste group (i.e. Heer) earns higher revenue, while they also bear higher cost of rearing bovines. Among various heads of cost of raising bovines, expenditure on feed and fodder constitutes the highest proportion of total cost. Even within feed and fodder, the proportion spent on feed is not only high but also significant. Since irrigation facilities are not much developed in the study village, dependence on feed to increase production of milk from their bovines is high.

Diversification of Rural Household Incomes: A Study of Two Villages in Tamil Nadu

Tapas Singh Modak and Madhura Swaminathan[†]

The paper attempts to describe and analyse the patterns of rural income generation and livelihoods in two villages of Nagapattinam district in Tamil Nadu and its variations across class, caste groups and gender. The specific focus of the study is to understand the nature and process of income diversification and the role of the non-farm sector in the rural economy. Diversification of incomes through participation in non-farm occupations is found to be a prominent feature in this region. Income from agriculture was meagre and salaried employment opportunities were limited; rural households thus engaged in multiple activities, particularly in non-farm occupations. The risks of agricultural production are one reason for diversification of income sources. Notwithstanding, a quarter of households were estimated to have incomes below the two dollar a day poverty line, and more than 50 per cent of households fell below the four dollar a day poverty line. There were significant differences in income levels across class and social groups. Most

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strikingly, there was a large number of female-headed households in both villages, reflecting the fact of male migration in search of employment and the mean household income of female headed households was much lower than male headed households is of concern. This is largely on account of the absence of employment opportunities for women in non-agriculture in and around the village, and the large and persistent gender gap in agricultural wages as well as the inadequacy of remittances. In this context, it is argued that among Indian States, Tamil Nadu stands out in terms of structural transformation in respect of employment and output. The findings in the study district are in line with observations for the state of Tamil Nadu. At the same time, the data reveal the persistence of poverty and sharp inequalities across caste, class and gender suggesting that all sections of society have not benefited equally from economic growth.

Climate Sensitivity of Major Crop Yields: Evidence from Telangana State, India

Rajeshwar Moulkar and Dayakar Peddi*

The paper addresses the climatic impacts on major crops yield in Telangana, India. In order to achieve the objective, the study employs the statistical method to empirically estimate the historical weather data and major crops yield relationships using district level panel data of five major crops- viz., rice, maize, cotton, groundnut and red gram for Telangana state during 1974-2015 (42 years) period. In particular, the comparative sensitivity of major crop yields to specific weather measures (temperature max and temperature min, rainfall, droughts) corresponding to seasonal variations is assessed. The results show the intra-seasonal impacts of climate change on major crops yield. More specifically, major crops in monsoon season (kharif) are more sensitive to temperature and precipitation changes, whereas crops in rabi remain largely resilient to changes in the levels of climate variables. In the kharif season, an increase in the maximum temperature significantly affects yield of rice, maize, groundnut, and cotton, whereas, increasing minimum temperature has a significant positive effect on rice, maize, and cotton. Although rainfall has positive effects on rice, maize, and redgram crops yield, there is negative effect on groundnut and cotton. These findings bring out the peculiar climatic impacts on agriculture in Telangana, India and stresses the need for location and season-specific adaptation policies to prevent future climate stress.

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Is Diversification Ensuring Income and Sustainability? - An Empirical Assessment from Kerala

A.Prema†, Nanda Baiju†, M.C. Abhinav† and Anu Susan Sam‡

The rice based integrated farming in Kerala is a system where in farmers grow crops and raise livestock and/or together on the same piece of land or in their farm stead. This analytical cross-sectional study was conducted in one of the special agro-ecological units Kuttanad (AEU 4), the rice-bowl of Kerala based on the primary data collected from 100 farmers practising IFS using stratified sampling procedure and 11 rice-based farming systems models were identified for the purpose. Economic analysis was carried out for a farm of average size of 1.8 ha. The best three most profitable level of farming systems identified were Rice + Banana+ Dairy+ Duck, Rice – Fish sequential and Rice+ Fish+ Poultry+ Dairy. The highest level of farm business income, family labour income, net income and farm investment income was observed for the model Rice+ Banana+ Dairy+ Duck. The study pointed that the general observation that integrating dairy farming and an additional enterprise would enhance the income of farmers, was not true. Integration of dairy farming has helped farmers to save the otherwise huge amount spent for manuring the rice fields along with transportation and loading charges. Rearing of indigenous cattle breeds and the large share of imputed family labour involved in dairy could not be compensated by other enterprises in the system. The sustainability of the different IFS models analysed using the Sustainability Value Index (SVI) and the System Economic Efficiency (SEE) revealed the model, Rice+ Banana+ Dairy+ Duck is the most sustainable one with a SVI of 0.73 and SEE of ₹1133/day. The study concluded in Kerala where the scope of horizontal expansion of agriculture is limited, vertical expansion with thrust on Integrated Farming Systems (IFS) models ensured income and a sustainable livelihood for the farming communities in Kuttanad region. The IFS models could be replicated all over the production belts with localised alterations as an alternative solution for limited horizontal farming, and as a renowned model of sustainable and subsistent farming practice.

A Structural Break Analysis on Coconut Production in India

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The present study attempts to investigate the presence of structural change in growth of area, production and productivity of coconut for major coconut producing

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states in India from 1990-91 to 2020-21. Kerala, Tamil Nadu, Karnataka, and Andhra Pradesh are the states in the country where coconut trees are widely farmed and produced in huge quantities. These states account for over 90 per cent of overall production in the country and contribute around 89 per cent of the total land for coconut farming. The CGR and structural break analysis were employed to examine the growth rates and multiple break period respectively. The results show the structural break year of area, production and productivity for major states in India was found after 1996, 2005 and 2011 which shows the impact of WTO, NHM and establishment of Coconut Development Board (CDB). Coconut production and productivity were reported to be increasing at a rapid rate in Karnataka, Tamil Nadu, and Andhra Pradesh. It suggests that these states, which are India's top producers of coconuts, have a potential future in the industry. Kerala's negative growth rate shows that other crops in the state show slow growth of production of other crops relative to coconuts. Even though the CDB established a Technology Mission on Coconut, the yield of the coconut crop has not significantly increased. Therefore, it is suggested that improved coconut cultivation technology be used and the CDB must successfully implement programmes to increase productivity in large coconut-growing states that have a greater impact on economic growth.

Factors Influencing Income and Crop Diversification: A Case Study of the Rural Area of Assam

Jahidul Haque and Nissar A. Barua[†]

An attempt has been made to analyse the impact of various socio-economic, infrastructural, and institutional factors on the income and process of crop diversification in three districts, viz., Barpeta, Nagaon and Sonitpur of Assam. These districts have the highest production in allied activities such as fishery, horticulture, and dairy farming and have been purposively selected for the study. The results of regression analysis indicate that farmers' level of education, age, irrigation, transport and communication, agricultural crises, and market density have positive influence on the income diversification of the farmers in Assam's rural economy. Crop diversification is positively related to the level of education of the farmers, their age, the occurrence of agricultural crises, access to irrigation facilities, use of high-yielding variety seeds and market density, whereas only the size of land holdings is negatively related to crop diversification.

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Risk Minimization through Crop Diversification: The Case of Riverine Area Farmers of Upper Brahmaputra Valley Zone of Assam, India

R.N.Barman and Amvrin Baruah*

The study aims to to analyse the crop production risks and suggest risk minimizing optimal crop diversification plans for the riverine farmers of the Upper Brahmaputra Valley Zone of Assam, India. Altogether sixteen risk factors influencing crop production were identified and examined. The riverine farmers of the zone diversify crop enterprises to minimize risks associated with inundation of crop fields due to flood and soil erosion. Herfindahl and Simpson Indices were computed to study the crop diversification. Crop diversification in riverine areas of the zone are higher as compared to overall crop diversification of the zone. The calculated mean values revealed that flood and excessive rainfall was the most important risk factor for the riverine area farmers in the study area followed by soil erosion. A MOTAD model was used in the study to develop risk minimized optimal plans. The objective function of the programming model was defined by dual criteria of parameterization of expected return and minimization of risk associated with the expected return. Altogether five optimal plans have been developed with increment in the expected income by 20,000.00 in each optimal plan. The cropping intensities have increased across various plans and plan-3 indicated maximum cropping intensity of 202.60 percent and plan-4 and 5 indicated the cropping intensity of 198.96 percent. The suggested risk minimization plans are considered feasible for the study area under the situation of resource availability and flexibility constraints.

An Analysis of Marketing Pattern of Potato in East Khasi Hills District of Meghalaya

Binodini Sethi, Vidhu Bala M. and Mumadi Rajavardhan†

The study has analysed the marketing patterns of potato in East-Khasi Hills district, of Meghalaya. This district was selected purposively as it contributes 63.63 per cent of total area and 68.90 per cent of total production of potato in the state and 36 respondents each were selected separately for summer as well as winter potato, from three different markets namely Regulated market (Mawiong), daily market (Bara Bazar) and weekly market (Smit market) were purposively selected to assess the marketing channels and various marketing parameters.. The highest marketing cost and marketing margin was recorded in channel I followed by channel II. Whereas the channel I had the highest marketing cost, marketing margin and price

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spread indicating the lowest producer's share in consumer rupee. It is attributed to the fact that there are more intermediaries in channel I, therefore, recorded the lowest marketing efficiency. Therefore, creation of direct markets like, Apni Mandis can help to eliminate the exploitation of farmers by middlemen. Additionally, increasing the storage godowns can facilitate the farmers to sell their produce in times of higher price can provide them with remunerative prices.

Sugarcane Growth in India: Source Assessment and Development Strategies

A.K. Sharma, Brahm Prakash Rajesh Kumar and A.D.Pathak*

The study attempts to identify the potential areas suitable for sugarcane crop in major sugarcane growing states of India and analyse the factors or the sources of sugarcane growth in these areas. Twenty-seven districts accounting for 59 to 62 per cent of sugarcane area in these states were identified for the purpose and data on sugarcane area, production and productivity was compiled for the last 30 years from 1989-90 to 2018-19in respect of major sugarcane growing areas from published as well as from online data sources. The sugarcane growth scenarios (trends in area, production and productivity) were analysed for three periods P1 (1989-90 to 198-99), P2 (1999-00 to 2008-09) and P3 (2009-10 to 2018-19) at national and regional (sub-tropical and tropical regions). The results of the analysis indicate the sugarcane growth in India is susceptible to substantial uncertainties. Though the growth at the national level was moderate at 1.8 per cent per year, regional disparities in growth were quite prominent. The growth was negative in tropical region as well as in its major sugarcane growing states during the last decade. On the contrary, the growth was quite impressive in sub-tropical region due to area as well as productivity growth. There is immense potential to increase sugarcane area and its productivity levels in sub-tropical region, and this region must be given emphasis for future sugarcane crop planning. Therefore, the potential areas need better research and development focus for developing technologically advanced solutions and transferring them through more innovative methods. Also advanced techno-infrastructure facilities and more investments and innovations in irrigation technology suitable for sugarcane cultivation are called for. The development plan to be framed for the potential districts must be made complementary to the food grain cultivation also.

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Scope and Opportunities of Agricultural Diversification for Increasing Farmers' Income in Bihar

Aniruddha Roy, N. Ahmad, T. Kumari, K. M. Singh, D. K. Sinha and K. Kumar†

The paper has assessed the diversification scenario of agriculture and horticulture crops in Bihar during the period 2000-01 to 2019-20 which was further divided into two sub-periods: 2000-01 to 2009-10 and 2010-11 to 2019-20 to have an understanding of decadal performance. Simpson's Index of Diversification (SID) was used for the estimation of crop diversification in Bihar and the study relied on both primary and secondary data collected from various sources. The analysis indicated that the horticulture sector is more diversified as compared to agriculture sector because the share of the rice and wheat to the total area of the agriculture sector was estimated to be more than 70 per cent which makes that the rice and wheat farming as a specialized one. The total area under crops during 2000-01 was 7701.09 thousand hectares and SID worked out to be 0.34. During 2019-20 the area under crops was 7296.81 thousand hectares and SID for the same period was estimated to be 0.33. It was clear from the analysis that no significant change has been observed in the diversification index between the two periods in spite of the substantial decrease in area. The highest SID was found during the year 2010-11 and the index value was 0.40. Among the horticultural crops, marginal and small farmers allocate the area in the range of 60-75 per cent for the vegetable crops and 5-7 per cent for fruit crops to the total area under horticultural crops. Through primary survey, the potential crops identified for diversification on the basis of increasing farmers' income were mango, guava, pineapple, litchi, banana, citrus, gingers, turmeric, tomato, brinjal, cabbage, cauliflower and capsicum. High value crops should be given priority in the diversification to reap the benefit of the emerging marketing scenario in the wake of globalisation and liberalisation.

Labour Out-Migration and Its Impact on Bihar Agriculture: A Case Study of Some Districts in North Bihar *

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An attempt is made in the paper to assess the impact of out-migration on agriculture in north Bihar. The empirical analysis of this study is based on a survey of

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360 households comprising 180 each of migrant and non-migrant households from twelve villages in Samastipur, Darbhanga and Madhubani districts of north Bihar, as more migration was reported from these districts in Census 2011. The descriptive analysis revealed that majority of migrant as well as non-migrant households were from marginal farm category. The required data related to cultivation of major cereal crops such as paddy, wheat and maize cultivated in the study area was collected by interview method on pre-tested schedules. Non-linear Cobb-Douglas production function was used to estimate the efficiencies of production parameters like area, capital, human labour, machine labour and irrigation cost for three crops for migrants as well as non-migrants. Regression coefficients of area under paddy, capital and machine labour were found to be positive and statistically significant indicating that one per cent increase in each input, viz., land, capital and machine labour, keeping other factors constant may lead to an increase in output by 0.79 per cent, 0.40 per cent and 0.02 per cent, respectively. The results further pointed out that the potential of these factors of production can further be explored by migrant households. In case of wheat, it was observed that coefficients of all the variables of production, except machine labour were found to be positive and significant. The estimates of different variables in maize cultivation indicated that regression coefficients of land, human labour and machine labour were found to be positive and statistically significant. Capital and irrigation were found having positive impact on production of maize. The study concluded that migrant farms use capital, human labour and machine labour optimally and in a well-planned manner.

Economic Impact and Decomposition Analysis of Income Change Vis-à-vis Drip and Conventional Irrigation Methods in Banana: A Study of South Gujarat Region

Deepa Hiremath, J.J. Makadia and Shreeshail Rudrapur†

The alarming water scarcity in Gujarat state justifies the adoption of water efficient technologies like drip irrigation. Effective transfer and implementation of banana cultivation practices with improved irrigation system as a water saving device is important as banana is a water intensive crop. The study aims to assess the economic impact of drip irrigation method as well as decompose the income difference between drip and conventional irrigation technologies in banana cultivation. Primary data was collected from 120 banana growers each practicing drip and conventional methods of irrigation. The results of economic analysis revealed that average total cost, ₹ 294436.76/ ha, under drip method was found to be less than the total cost under conventional irrigation method, ₹ 328363.19/ ha, despite higher

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initial capital investment on the drip system. The benefit-cost ratio was higher on drip irrigated farms as compared to non-drip farms. The output decomposition model revealed that adopters of drip irrigation technology produced 17.26 per cent higher income implying income of banana growers practicing drip irrigation would be higher even if they used the same mean level of inputs as farmers practicing conventional method of irrigation. Moreover, drip irrigation technology alone contributed 24.02 per cent increase in income, while the overall contribution of change in input levels was found to be negative to the tune of -6.76 per cent. This calls for intensive extension efforts through appropriate institutional support systems for rapid upscaling of the technology.

Comparative Study of Rice Production in Northeastern States of India: Decomposition and Trend Analysis

Nivetina Laitonjam,[*] A. K. Tripathi and H. Dkhar***

The study aimed to analyse the contribution of yield and area to the total production of rice in North Eastern (NE) India using decomposition analsis. The study was conducted based on time series data for 54 years (1966-67 to 2019-20) on state-wise area, production and yield of rice in the region. The entire period was divided into three phases viz., phase I (1966-67 to 1983-84), phase II (1984-85 to 2001-2002), phase III (2002-03 to 2019-20) that makes almost two decades each and the overall period being phase IV (1966-67 to 2019-20) based on data available. During 1966-2019, there was positive significant growth in area, production and yield of rice in NE India. Yield effect contributed the most to overall increase in production of rice in the region. The study reveals that Tripura registered the highest growth in yield of rice with low instability while, Manipur indicated the lowest growth in yield of rice with medium instability. Among the eight NE states, five states namely Assam, Manipur, Meghalaya, Mizoram and Sikkim were deficit in rice production during 2019. The total requirement of rice production in NE was worked out to be 7549 thousand tonnes and 8347 thousand tonnes during 2022 and 2035, respectively.

Role of Bio-Pesticides in Enhancing Organic Production– A Case of Cabbage in Meghalaya

P. Harigovind[†]

An attempt has been made to explore the economic advantage derived by cabbage farmers by using bio-pesticides in two districts of Meghalaya. Ri-bhoi and

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East khasi hills districts were selected purposively and a total of 4 blocks and 4 villages were selected from the districts purposively based on the number of adopter farmers. A total of 150 respondents were selected using random sampling with proportionate allocation to population size, out of which 100 were adopters. In terms of cost the expenditure of adopters was found to be less than non-adopters in case of most of the factors and conflictingly, returns marked the increment obtained by the adopters. Cost of cabbage cultivation was found to be less by 13.65 per cent than non-adopters and gross return was 14.61 per cent more which resulted in a 36.8 per cent increase in B-C ratio. Calculation of farm efficiency measures concluded, 61.49 per cent increment in family labour income for adopters. Farm business income, Farm investment and Net farm income was also found to be more by 57.20 per cent 70.35 per cent and 77.78 per cent for adopters respectively. By usage of bio-pesticides cabbage farmers were able to control pest and diseases up to a great extent and thereby reducing the crop loss which contributed for the increase in yield. Financial viability was underlined by the increased B-C ratio and higher net farm income by using bio-pesticide which is a part of sustainable and eco-friendly farming practices. The study concluded that the bio-pesticide use has an added advantage in Meghalaya and North east as a whole since there exists a close relationship between organic agriculture and maintenance of biodiversity i.e., maintaining biodiversity as well as improving the income of the farmers through increasing the production in a sustainable manner.

Sustainable Agriculture and Crop Diversification through Assured Prices

Sukhpal Singh and M. K. Sekhon*

The study seeks to work out the adequacy of announced prices and the required outlay for price assurance as investment security in agriculture. The MSP announced for 23 agricultural commodities is inadequate, because the declared MSP is not generating sufficient returns over cost and second MSP is not effective for all crops and for whole quantity leading to low income of the farmers. The most common reason of farm debt was claimed as low income of farmers. If the public sector procures the entire arrival of major crops, the total value of market arrivals works out to be Rs. 8.47 lakh crore. This would not only ensure crop diversification but would also settle farmers' appreciations regarding farm viability, optimum use of natural resources and crop sustainability. The MSP for all the crops should be used as the 'floor price' for bidding auctions in the market for all private purchase. Therefore, cost C2 should be fixed as per formula given by RCC and margins of 50 per cent should be given to the farmers. The Government must encourage the farm sector which provides vast employment and in turn boost the other sectors of the economy.

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Inter-State Growth and Dynamics of Maize Production in Northeast India

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The study attempts to examine the state wise growth scenario, variation and decomposition analysis of production of maize crop in North East Region (NER). The study period from 1975 to 2019 was categorised into three phases of 15 years each viz., Phase I (1975-89); Phase II (1990-2004) and Phase III (2005-2019) and the entire period (1975-2019) depending upon the availability of data and for better understanding of the phases. Structural breaks were detected using Bai-Perron test for the entire region during the whole study period. The results showed that during the third phase, growth of area and production of maize was more than 10 per cent in Tripura and Manipur. All the states in the region apart from Mizoram showed positive annual growth in the recent phase. Considering the four and half decade scenario, it was observed that Nagaland recorded consistent growth in all the variables, followed by Arunachal Pradesh. Arunachal Pradesh, Meghalaya and Sikkim states showed lower instability in area and production. Decomposition analysis showed that the changes in production of maize is due to both area effect as well as productivity effect. In terms of maize output and area, there were two structural breaks in 1980 and 1987, and there were two breaks in productivity and production in 2001 and 2013 as well. This could be attributed to a significant increase in the derived demand for maize in terms of industrial use and livestock feed. Given the centrality of maize, the North east region has the potential to increase maize output by greater promotion of modern technology, such as hybrids, improved cultivation techniques, etc., so that the region would become a leading producer of maize in the country.

Study of Economic and Resource Use Efficiency of Orange Production in Arunachal Pradesh and Sikkim

Daniel Torchi Kadu,* Abujam Anuradha Devi, P.P.Dabral and Anil Datta Upadhyay

A study was conducted to analyse the economics and resource use efficiency of orange production orange fruit in Arunachal Pradesh and Sikkim. Specifically the study has dealt with the following issues (i) costs and return analysis of orange production, (ii) study of the allocative efficiency to determine the optimum value of

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the resource used and (iii) finally to study the various constraints faced by farmers growing mandarin orange in these states. Purposive and simple random sampling method was used to draw sample respondents of 30 farmers, 15 each from Arunachal Pradesh and Sikkim respectively. The socio-economic analysis indicates that maximum farmers were in the age of 40-60 years, most of them were literate and pursued agriculture as their primary occupation. The economic analysis was worked for seven years which shows that planting materials and cost of land preparation were the important parameters for cost structure in both states. However, total cost of production was more in Sikkim than Arunachal Pradesh. The returns were estimated for four years including initial production of seventh years for both states. Gross and net returns of orange production were more in Arunachal Pradesh than Sikkim. BCR for orange production found more than 1 in both states. The losses due to fruit fall were found to be 50 per cent of the total fruits harvested from the orchard. The production function of orange farms in the study shows gap filling and age of the orange plant was positive and statistically significant in Arunachal Pradesh and all the explanatory variables for orange production in Sikkim were found statistically non-significant. In Arunachal Pradesh, the expenditure on gap filling was excessively utilised in orange production and age of the plant shows potentiality and scope to increase production as age of the plant increases. Fluctuation of market prices, pest and diseases infestation, high transportation charges, losses due to weather and adequate government subsidies were the major constraints faced by the farmers in both the states.

Inter-Temporal Analysis and Determinants of Soil Fertility Management: An Empirical analysis in Semi-Arid Regions of India

B. Suresh Reddy[†]

The paper attempts to discuss the inter-temporal analyses of key variables related to SFM over the past three decades in three states Uttar Pradesh, Madhya Pradesh and Jharkhand so as to understand the impact of changes in these key variables on SFM in semi-arid regions. An inter-temporal analysis of farmers' perception revealed that soil fertility has declined in 2015 as compared to 2005. Based on the field work done in semi-arid regions of Madhya Pradesh, Uttar Pradesh and Jharkhand, the study highlights the contribution of organic matter by traditional soil fertility management practices in maintaining the soil fertility. Regressional analysis revealed that large ruminants emerged as a key variable influencing the soil fertility. The empirical results of this study call for an argument to be made for an approach to supporting soil fertility management by farmers which is more tuned to their needs and best suits the long term productivity of soils.

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A Study on Market Efficiency of Tomato in West Jaintia Hills District of Meghalaya

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A study was taken up understand the marketing efficiency of tomato crop in West Jaintia hills district of Meghalaya. Using multistage sampling method a total of sample 80 farmers and 18 market intermediaries were selected for the study purpose. To achieve the objective, the marketing channels were identified on the basis of information collected from farmers and market intermediaries by personal interview through pre-tested schedule. On the basis of the identified marketing channels, the producer's surplus, marketing cost, marketing margins, percentage share of market margin, producer share, price spread, market efficiency were calculated. In the study area, three marketing channels identified, where channel I with no market intermediaries found to be more efficient than channel II and III. Overall all the channels were providing farmer above 60 per cent share in consumer rupee and prove to be efficient.

Economic Assessment of Muga Culture in Lakhimpur District of Assam

A. Geethika Reddy†

Muga culture is an ancient Assamese culture and is strongly linked to its wealthy legacy. Assam's Brahmaputra valley is the only region in the world where muga rearers have historically reared muga silk since time immemorial. Keeping in view the above the study was undertaken to determine the cost incurred and the economic efficiency of Muga culture in Lakhimpur district of Assam. For the purpose of study a total of 75 respondents were purposively selected based on the number of Muga rearers from two blocks and two villages of the study district. A notable feature about the muga rearing is that its host plant provides feed for muga rearing only after its fourth year of establishment which indicates that returns can be obtained only from fifth year of the host establishment. Thus the Benefit cost ratio (BCR) over comprehensive cost was found to be greater and increasing from fifth year onwards in the study area and the study concludes that muga culture an economically viable enterprise.

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An Analysis of Factor Demand and Output Supply of Jowar in Karnataka: Implications for Fixing a Scientific Minimum Support Price

L. K. Atheeq,[*] K. B. Vedamurthy and R. Rangegowda****

The paper attempts to study the economics of cultivation of jowar crop in Karnataka based on data from the Commission of Agricultural Costs and Prices (CACP) pertaining to the agricultural year 2017-18. The study employed the Translog cost function for the analysis. The major reasons for fall in cultivation area are incessant drought, low productivity and high input costs. Though the market price is reasonable, due to the high cost, the farmers are at a loss in the production of jowar. In most of the years under study market prices have remained below the Minimum support price . The result of study indicate that all own- elasticities of factor demand had correct sign, which was negative. Change in wage rate of labour did not appear to influence machine labour demand significantly. It should be pointed out that the demand for labour was influenced much more by change in bullock labour prices than by change in wage rate and fertilizer prices, since they are close substitute for certain crop production activities. The reduction in fertiliser prices through subsidy may expand the fertilizer use stimulating the use of other inputs. The supply elasticity of wheat for the western states of India was (0.38). It implies that if 10 per cent increase in wheat prices than the supply of wheat will increase by 3.8 per cent. The analysis clearly shows the method of announcing MSP on the basis of historical growth in prices, for jowar, is unscientific and need to explicitly consider the cost escalation of the vital factors of production and alsoreckoned with the increase in productivity due to technology.

Support for Development of Marketing and Value Chain of Ginger for Better Farm Income in the State of Arunachal Pradesh

L.Geetarani Devi, A.S.Maillappa, and L.D.Hatai [†]

The study tries to map the different stakeholders involved in the value chain of ginger in East Siang district,in of Arunachal Pradesh. Mebo and Pasighat collection centres have been selected as well as two blocks of the district were considered for the study. The total cost of cultivation worked out to ₹ 80029.75/ha. On mapping the stakeholders involved in the value chain of ginger in East Siang district, a total of 13 actors had been identified. The percentage of marketable surplus of ginger was observed in the state of Arunachal Pradesh with 80.82 per cent in East Siang district.

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Since, the price spread was high in Channel II, it is suggested for strengthening of Channel IV due to less price spread and the price received by the producer was more in channel-IV. No distress sale was reported in the selected area which signified good retention power of the ginger growers. The study has recommended for strengthening of this channel (Channel IV) and actions points needed for various stakeholders for strengthening of channel IV, like strengthening farmers' collectives, scope for formation and promotion of FPO with Ginger as product cluster can be taken up, since, there is no Farmer Producer Organizations of Ginger farmer in East Siang district of Arunachal Pradesh.

Impact of Climate Change on the Livelihood of Farmers with Special Reference to the North-Eastern Hill Region

Jigyasa Singh[*]

. The study attempts to review earlier research works in order to understand the impact of climate change on the livelihood of farmers with special reference to the northeast mountain regions. It is observed that due to climate change, the mountainous regions particularly the north-eastern areas are experiencing the loss of life, changes in livestock conditions, and the emergence of invasive species. The biggest impact seems to be in the agricultural industry which accounts for most of the small and marginal farmers. Farming techniques that helped people to succeed in the past may not continue to work effectively as the environment shrinks, population fluctuations, and rapid changes taking place in the world put a lot of pressure on different communities. It is therefore important to educate people about climate change, mitigation, and adaptation options, equip them with the necessary skills, and encourage them to develop sustainable practices.

Livestock Product Scenario of Assam: An Economic Analysis

Nabanita Borah[†]

A study was conducted with the objective of analysing the supply demand gap of livestock products in Assam. The data on production and other related variables of livestock in Assam were collected from different published sources. The analysis indicates a huge gap between the demand and supply of the commodities and the deficit continues up to 2030. It was observed that for all the commodities i.e. milk, egg and meat, we consume less than the minimum recommendation by ICMR. This is attributed to unclean environment, lack of proper vaccination, using local breeds etc.

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Based on the findings the study suggests that this gap could be reduced through proper nutrition, management, disease control, and environmental conditions. etc.

Millet Scenario in Assam: A Zonal Level Analysis

Pranjal Protim Mudoi and Rinumoni Buragohain*

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The study tries to assess the status of millet production in the state of Assam.. by covering six agro-climatic zones of the state. To analyse growth rate and instability status, Compound growth rate, coefficient of variation and Cuddy-Della Valle index were used based on the time series data on millets collected for the years 2007-2021. The growth in area, production and productivity was found to be positive. The zonal level analysis indicated that the highest growth in area in Upper Brahmaputra valley zone (UBVZ), production growth was higher also in Upper Brahmaputra valley zone (UBVZ) and the yield was higher in Lower Brahmaputra valley zone(LBVZ). Instability in area ranged from 12.253 in hill zone to 33.463 in Central Brahmaputra valley zone (CBVZ), Similarly production instability ranged from 16.939 in Barak valley zone (BVZ) to 43.319 in North bank plain zone (NBPZ) and yield instability ranged from 6.194 in Central Brahmaputra valley zone(CBVZ) to 22.304 in Barak valley zone(BVZ). Considering the low input requirement in millet production having high nutritional benefit, the farmers of the state might be encouraged to cultivate millets to meet the ever-growing food demand

Are Adaptation Strategies Alone Sufficient to Curb Climate Change Impact on Agriculture? Evidence from Northeast India*

Anwesha Mahanta, and Ratul Mahanta†

The study attempts to comprehend climate change and its impact on agriculture through the lens of the farming communities. It basically focuses on exploring how farmers in North East India have perceived climate change and the shift in the agricultural practices that they have adapted to mitigate this crisis. Using multi-stage stratified random sampling method a total of 450 farmers residing in the Northeastern Region of India (NER) were interviewed. The findings indicate that majority of the farmers perceived a change in temperature, decline in rainfall and decrease in water resources and reported that these factors have negatively influenced their agricultural production. To combat this climate change crisis the farmers have adopted various adaptation strategies. Although these strategies have a significantly positive impact

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on agricultural production but the influence is very negligible because of the hazards faced by them while applying these strategies effectively. Many farmers have also perceived pests attack and crop diseases as potential threats to agricultural production. Moreover, the study also explores the role of informal economic association (SHG) in agricultural system. A positive influence of self-help groups on agricultural production is reported. Thus, there is an imperative need to create a sustainable agricultural system in NER and adopt a holistic and integrated approach that includes extension programs for farmers, subsidies on farm inputs and easy access to agricultural credit.