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CROPPING PATTERN CHANGES AND CROP DIVERSIFICATION IN MANIPUR, A NORTH EASTERN STATE OF INDIA - ITS TREND AND EXTENT

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ABSTRACT

This paper analyses the temporal and spatial changes in the cropping pattern, the trend and extent of crop diversification in Manipur, a north eastern State of India for the period from 1980-81 to 2019-20, using secondary data. It adopts the definition of crop diversification as shifting in the allocation of area from the traditionally cultivated crop(s) which are usually of less profitable towards other crops that are of higher values and more profitable ones. Simpson index (SI) of crop diversification is computed to measure both temporal and spatial crop diversification. The present study suggests that there has been a gradual shift in the cropping pattern in the State of Manipur particularly from paddy/ cereals towards non-paddy/non-cereals crops like pulses, oilseeds, potato and other miscellaneous crops. Reduction in the acreage under paddy/cereals and simultaneous increase in other non-paddy/non-cereal crops in the state clearly indicate a silent revolution of crop diversification being happening state although at a gradual pace. It is concluded from the finding that the quantum of inter-district variation in the extent of crop diversification has also been much reduced than before *i.e.,* co-efficient of variation of the inter-district diversification index values decreased from 35.10 % in 2000-01 to 21.61 % in 2019-20, thereby, implying that crop diversification across different districts in the state are now becoming more uniform than before.

(Key words: Cropping pattern, Crop diversification, High Value Crops (HVCs), Simpson Index Diversification)

INTRODUCTION

The choice of crops by farmers both for own consumption and commercial purposes vary over time and spaces depending on various economic and non-economic factors (Calogero *et al.,* 2017). Accordingly, farmers would choose the crop that is to be produced and will decide the extent to which a particular crop will be either to specialize or diversify. The proportion of area allocated under different crops, by farmers, at different points of time is termed as cropping pattern (Ghosh, 2011, Nayak *et al.,* 2022). It is usually determined by various factors like agro-climatic conditions, farm size, prices of the crops, profitability and government policies (Anonymous, 2018).

Cropping pattern in a particular region has significant implications for its agricultural growth and development and livelihood of millions of farmers (Mandal *et al.,* 2013; Feliciano, 2019; Dalal *et al.,* 2018). Cropping pattern refers to the proportion of area under different crops at a given point of time (Khumdemo *et al.,* 2021, Singh *et al.,* 2021). Change in cropping pattern implies a change in the proportion of area under different crops, and is essentially the result of introducing new crops and the intensification of crop cultivation through multiple cropping (Ghosh, 2011) by the farmers thereby taking into consideration of the several (economic and non-economic) factors that impact crop cultivation directly or indirectly. Cropping pattern in an area depends largely on agro-climatic conditions, technical and institutional factors (Anuja *et al.,* 2022). It occurs as a result of the interactions of the following five groups of factors:

1. Resource related factors - Irrigation, rainfall and soil fertility.

2. Technology related factors - Seed, fertilizer, irrigation, storage and processing.

3. Household related factors - Food and fodder for self-consumption and sales.

4. Price related factors - Output and input prices, trade policies and other economic policies that affect these prices either directly or indirectly.

5. Institutional and infrastructure related factors - Farm size and tenancy arrangements, research, extension and marketing systems and government regulatory policies.

These factors, however, are not independent of each other, rather they are inter-related (Anonymous, 2001). Studies around the world exhibit a shift in the cropping

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pattern especially from cereal to non-cereal crops. Experiences from Southeast Asian and Latin American countries show that there has been a shift in the production portfolio in favour of high-value food commodities/crops (HVCs), and this offers growth opportunities, poverty alleviation and improves agricultural sustainability (Pingali and Rosegrant, 1995).

Crop production is the most important economic activity of the rural areas of any region and it makes a significant contribution to GDP of many countries especially developing countries (Mohammad, 2018). Also, crop sector has strong linkages with other sectors of the economy such as livestock, trades and commerce with other sectors of the economy such as livestock, trade and commerce, and industries, whose output levels are significantly influenced by the performance of crop sector. So, the growth rate of the crop sector is an important determinant of the overall economic growth of many countries (Anonymous, 2001; Jafari *et al.,* 2022). In India, as in other countries, diversification has taken placed both across and within the sub-sectors *viz.* crop sector, livestock sector, fishery sector, forestry, etc. (Singh *et al.,* 2006; Dev, 2018). But, more significant changes have been taking place within the crop-sector, as is evident from the changes in the cropping pattern (Singh *et al.*, 2006). A study in West Bengal during 1970 to 2005 found that there was reallocation of land towards some crops albeit at a slower pace. While the growth of *boro* or summer rice has been increasing over the past three decades, the cultivation of pulses, wheat, other cereals, sugarcane, etc. has been on the decline over time, thereby reflecting a change in the cropping pattern in the state (De, 2013).

In the flood affected areas of Assam plain, studies found that flood proneness has restricted the cropping season in the region (Mandal, 2011). Moreover, the scope of expanding the cultivable area is limited by the inelastic nature of land supply. Farmers are thus compelled to adopt diverse cropping pattern mainly to ensure the maximum possible utilization of the available land particularly during the flood-free period. The study showed that diversified cropping pattern have contributed to increase farm income of the farmers but this cannot be generalized as a risk mitigation strategy in the study area. Because, cropping patterns in the intermittently flood prone areas are not found significantly more diverse than in the flood free regions of Assam state (Mandal and Bezbaruah, 2013).

In the efforts of the present government on doubling the farmers' incomes by the year end of 2022-23 (Anonymous, 2017; Dev, 2018), diversification of crops towards high value crops (HVCs) such as vegetables, fruits fibres, spices and other cash crops, offer a great opportunity to improve farmers' income (Anonymous, 2013; Chand, 2017). There seems to be a gradual qualitative shift in the way that peasants conduct their production and alternative employment opportunities in agricultural sector. Peasants are increasingly looking for survival autonomies through farming intensification and crop diversification. Diversification of crops towards high value commodities (HVCs) is catching on fast in different villages of the state (Priyoranjan and Ishworchandra, 2013). Though many studies have been made by researchers in the field of crop diversification in other states and different parts of the world, there exist very limited and negligible studies on crop diversification in the state of Manipur, in spite of the enormous potential benefits it could provide in terms of income and employment generation, risk minimization, environmental sustainability and many others. In the light of these reflections, the paper attempts to (i) To highlight the temporal and spatial changes in cropping pattern in the state of Manipur from the year 1980-81 to 2019-20, and (ii) To estimate the trend and extent of crop diversification in Manipur during the study period stated above.

MATERIALS AND METHODS

The paper is completely based on secondary data collected and compiled from several publications of the Directorate of Economics and Statistics (DES), and Department of Agriculture, Government of Manipur such as Statistical Abstract of Manipur, Statistical Hand Book of Manipur, Statistical Year Book of Manipur, Economic Survey, etc.

To analyze the temporal changes in the cropping pattern for the period from 1980-81 to 2019-20, data on area under different major crops/crop groups are compiled from different issues of Economic survey published by DES, Government of Manipur. Then, to find out the spatial changes in the cropping pattern in the state, district-wise data on area under different crops are compiled from the data published in the website of the Department of Agriculture, Government of Manipur. Main reason for referring to different database published by different departments is that these data are not found for the same crops/crop groups, and referring to different available data sources would enable to highlight a broad picture on the changes in the cropping pattern of the state.

The paper adopts the definition of crop diversification as shifting in the allocation of area from the traditionally cultivated crop(s) which are usually of less profitable towards other crops that are of higher values and more profitable ones. Then, to examine the extent of crop diversification in the state during the study period, Simpson Index (SI) is estimated for measuring both temporal and spatial crop diversification. For data analysis, statistical tables, line charts and histograms are used and descriptive statistics are computed using MS Excel 2019 and necessary interpretations made.

RESULTS AND DISCUSSION

Temporal changes in cropping pattern, trend and extent of crop diversification

Date regarding the area under different crop groups

in the state of Manipur for the period from 1980-81 to 2019-2020, and these are given in Table 1. A close observation of the table shows that there has been a change in the cropping pattern in the state during the study period. It reflects the temporal changes in the cropping pattern of the state.

It is evident that area under cereals declined during the study period with fluctuations in some years. It declined from 1.985 lakh hectare (84.87 %) in 1980-81 to 1.778 lakh hectare (72.28 %) in 2019-20. However, there was an increase in the total area as well as area under non-cereals (It represents the combined areas under other crops as given in Table 1 other than cereals) during the same period. Total area declined from 2.338 lakh hectare in 1980-81 to 2.461 lakh hectare in 2019-20. Moreover, area under non-cereal crops increased from 3.538 lakh hectare to 6.822 lakh hectare during the same period with ups and downs in some years. This can also be seen from Figure 1.

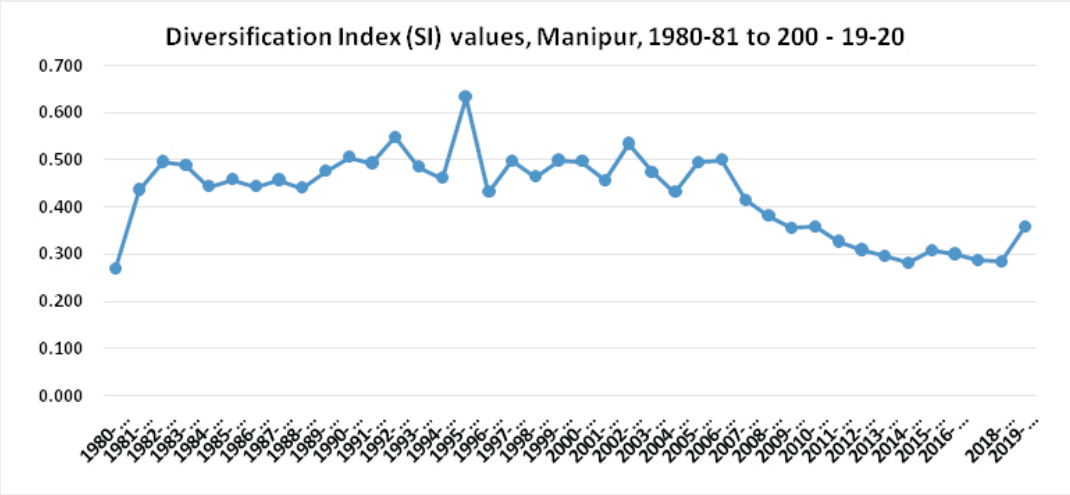

Figure 1. Trend of crop diversification (SI index values) in Manipur, 1980-81 to 2019

From these, it may be concluded that cropping pattern in the state has undergone a change over time, though gradually, from cereals with paddy being a majorly dominated crop towards other non-cereal crops. Similar pattern is evident not only in other parts of the country but also in different parts of the world at varying degree with determinants differing from one region to another region.

In this paper, crop diversification is referred to as shifting of crops by the farmers from their traditionally cultivated crop (s) that are usually having less market value especially the paddy/ cereal (s) towards other non-paddy/ non-cereal crops which are more profitable. To examine the extent of crop diversification in the state, Simpson index (SI) was computed for the entire study period. Simpson index (SI) of crop diversification was computed as -

$SI = 1-(\sum Pi^2)$,

Here, $Pi = Ai/\sum Ai$, where Pi = proportion of area under i^{th} crop,

Ai = actual area under i^{th} crop, and

$\sum Ai$ = total area under i^{th} crop, and i ranges from 1 to n.

Value of Simpson index from 0 to1, wherein larger the value indicates higher level of crop diversification and vice-versa. Thus, from Table 1, it is evident that there was a silent revolution of crop diversification taking place in the state of Manipur even though the extent may not be very significant. For oilseeds, sugarcane and cotton crops, their acreages showed a declining trend, while other crop groups like pulses and miscellaneous crops were on the rise during the study period. Besides, area under different vegetables showed an increase over the years, for instance, it increased from 1.141 lakh hectares in 2004-05 to 1.755 lakh hectares in 2019-20 (Anonymous, 2021). Jafari *et al.* (2022) used the Shannon diversity index and predicted that the Iranian agricultural system might have prevalence of monoculture crops *viz.,* wheat and barley. They also warned that such monoculture had a probability of damage from abiotic and biotic factors in the crops which may resulting to lessen the adaptability of crops and production decline in the future.

Spatial Cropping pattern changes and crop diversification and its extent :

Cropping pattern at district level was analysed at two different time period (2000-01 and 2019-20) to capture the spatial changes in the area under different crops for which secondary data on their acreage are available, and to analyze the inter-district extent of crop diversification. Inter-district cropping pattern and the extent of crop diversification in terms of Simpson index (SI) for the year 2000-01 and 2019-20 are shown in Table 2 and 3 respectively.

From Table 2 and 3, it is noticed that acreage of paddy which is the principal staple crop of the state declined in all the districts of Manipur except in Thoubal and Bishnupur. Acreage of paddy declined from the year 2000-01 to 2019-20 in all the districts of Manipur excepting Thoubal and Bishnupur districts with its state total acreage declined by 10.61 % (i.e. during this period). However, total area under different non-paddy crops increased by 39.45 % (i.e. 29.04 thousand hectares'). This implies that there has been

a shift in the cropping pattern in the state over time from paddy towards non-paddy crops.

The extent of crop diversification, as measured by Simpson index values, also reveals that state-total diversification index value increased from 0.360 in the year 2000-01 to 0.550 in 2019-20. In the year 2000-01, Imphal East (diversification index value of 0.215) and Senapati (diversification index value of 0.623) were found to be the lowest and highest crop-diversified districts respectively. But in the valley region of the state, Thoubal was the most crop-diversified district with index value of 0.501 which was above the state total index value of 0.360.

For the year 2019-20, Chandel and Imphal West districts were having the highest and the lowest diversification index values of 0.746 and 0.408 respectively. For this year too, Thoubal district happened to be the most crop-diversified district in the valley region with diversification index value of 0.538. Table 2 and 3 showed that in both the periods, hill districts happen to be more diversified from paddy towards other non-paddy crops than the valley districts. One plausible reason for this could be that hills are not so much appropriate and profitable for paddy cultivation due to its topographic features, and hence most of its cultivable land are suitably used for growing non-paddy crops.

Spatial and temporal variation in the extent of crop diversification in Manipur is analyzed in the following Table 4 and Figure 1. The SI index values for all the districts were found to be higher in 2019-20 than in 2000-01. It is Figure 1. Inter-district variation in the extent of crop diversification is seen improved in the last two decades as is evident from the decreasing value of the co-efficient of variation from 35.10 % in 2000-01 to 21.61 % in 2019-20. This conveys that the process of crop diversification in the state depicts a more even than what was before two decades.

Changes in the SI values of the districts over the last two decades suggests that the biggest changes in the extent of crop diversification was occurred in Imphal West and Imphal East districts and the smallest changes in Thoubal and Bishnupur districts. One probable reason for this could be that Thoubal and Bishnupur had been engaged more actively in crop diversification processes and Imphal West and Imphal East districts have been moving forward in later years. In one report investigated by Anuja *et al.* (2022) used the spatially disaggregated district-level data and employing bivariate copula function for the study of status of food crop diversification in India for 2015–16. They had drawn the conclusion from this study that there exists a strong negative relationship between food crop diversification and undernutrition status of the districts. In another finding, investigated by Agness and Ng'ombe (2021), they suggested that promotion of agricultural growth and ideal strategy for Climate Smart Agricultural (CSA) in Northern Ghana can be possible only by crop diversification which can significantly improves efficiency and reduces income variability.

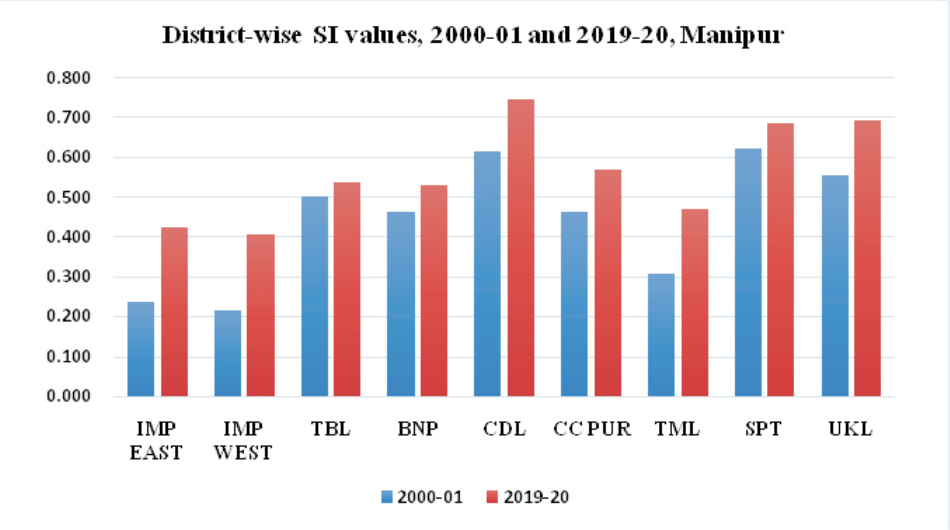

Figure 2. SI Index, District-wise, Manipur 2000-01 and 2019-20

However, more accurate reasons could be found out by taking up a new study in this regard.

Non-availability of data on acreages for all-inclusive crops other than some major crop groups grown in the state sets a limitation in making a more detailed study in this regard. However, due efforts have been put in the study to ensure optimum utilization of available data.

From the present study, it is inferred that there has been a gradual shift in the cropping pattern in the state of Manipur particularly from paddy towards non-cereals/non-paddy crops like pulses, oilseeds, potato and other miscellaneous crops. Reduction in the acreage under paddy/cereals and simultaneous increase in other non-paddy crops clearly indicate that the process of crop diversification has got a new impetus in the state although at a gradual pace. It is in line with what is happening in different parts of the country as well as the world but at varying degrees and patterns. This obviously is a good opportunity for the

farmers of the state where the number of small and marginal farmers constitute a larger proportion. Because, many studies suggest crop diversification to be a viable alternative for ensuring agriculture sustainable and is more favorable for small and marginal farmers. The level of inter-district variation in the extent of crop diversification has also been much reduced than before. This suggests that there has been convergence of districts in terms of crop diversification than before albeit at a slower rate.

Table 1. Cropping pattern in Manipur from 1980-81 to 2019-20

(Area in '000 Hectare)

Year	Cereals	Pulses	Oilseeds	Sugar - cane	Cotton	Other Misc. crops	Total Area	SI=1 ($\sum Pi^2$)
1980-81	198.46 (84.87)	4.62 (1.96)	5.59 (2.39)	2.25 (0.96)	0.31 (0.13)	22.61 (9.67)	233.84 (100)	0.269
1981-82	173.89 (82.50)	6.85 (3.25)	4.09 (1.94)	2.25 (1.07)	0.59 (0.28)	23.10 (10.96)	210.77 (100)	0.436
1985-86	170.34 (81.73)	6.56 (3.16)	5.3 (2.54)	2.28 (1.09)	0.57 (0.27)	23.37 (11.21)	208.42 (100)	0.458
1990-91	162.02 (80.08)	9.26 (4.58)	2.68 (1.32)	1.86 (0.92)	0.14 (0.07)	26.37 (13.03)	202.33 (100)	0.505
1995-96	137.47 (76.10)	5.26 (2.91)	3.08 (1.71)	1.18 (0.65)	0.11 (0.06)	33.54 (18.57)	180.64 (100)	0.633
2000-01	161.66 (77.53)	6.67 (3.20)	2.76 (1.32)	0.74 (0.35)	0.06 (0.03)	36.61 (17.56)	208.50 (100)	0.497
2005-06	166.26 (99.96) *	-	-	0.07 (0.04)	-	-	166.33 (100)	0.494
2010-11	173.8 (66.89)	15.36 (5.91)	1.72 (0.66)	0.79 (0.30)	0.08 (0.03)	68.07 (26.80)	259.20 (100)	0.358
2015-16	180.58 (68.06)	12.25 (4.61)	0.72 (0.27)	-	-	71.79 (25.43)	265.34 (100)	0.307
2019-20	177.84 (72.28)	9.04 (3.67)	0.43 (0.18)	0.57 (0.23)	-	58.18 (23.64)	246.06 (100)	0.358

Figures within parenthesis indicate percentage

* Percentage figure elevated due to non-availability of data for other crops and "- "indicates data not available

Source : Economic survey, Government of Manipur (different issues) and author's computation of index values

Table 2. District-wise area under different crops and crop diversification for the year 2000-01, Manipur (in '000 hectares)

District/State level	Crops								Crop Diversification Index $SI = 1 - (\sum Pi^2)$
	Paddy	Maize	Wheat	Pulses	Oilseed	Sugar cane	Potato	Gross Area	
Imphal East	31.40	0.45	0.14	1.65	1.34	0.22	0.83	36.03	0.236
Imphal West	33.74	0.47	0.09	1.70	0.98	0.44	0.75	38.17	0.215
Thoubal	25.66	1.50	0.20	2.81	5.07	0.91	1.22	37.37	0.501
Bishnupur	26.86	0.72	0.16	2.79	4.76	1.07	1.17	37.53	0.464
Chandel	10.89	1.54	0.00	2.98	2.36	0.70	0.37	18.84	0.617
Churachandpur	31.18	5.19	0.15	2.57	3.77	0.11	0.55	43.52	0.461
Tamenglong	29.01	2.15	0.00	2.45	0.78	0.06	0.65	35.10	0.307
Senapati	13.06	2.80	0.26	2.39	3.05	0.10	1.06	22.72	0.623
Ukhrul	10.60	1.68	0.00	2.84	0.64	0.05	0.92	16.73	0.555
State Total	212.40	16.50	1.00	22.18	22.75	3.63	7.52	286.01	0.360

Source: Department of Agriculture, Government of Manipur and author's computation of index values

Table 3. District-wise area under different crops and Crop diversification for the year 2019-20, Manipur (in '000 hectares)

District/State level	Crops								Crop Diversification Index $SI = 1 - (\sum Pi^2)$
	Paddy	Maize	Wheat	Pulses	Oilseed	Sugarcane	Potato	Gross Area	
Imphal East	28.45	1.19	0.15	2.78	3.98	0.50	1.10	38.15	0.426
Imphal West	33.46	1.29	0.35	2.96	3.85	0.87	1.25	44.03	0.408
Thoubal	26.81	2.08	0.33	3.23	4.71	1.16	2.30	40.62	0.538
Bishnupur	27.74	1.05	0.32	4.41	4.70	1.25	2.25	41.72	0.530
Chandel	7.84	3.67	0.02	2.96	2.89	0.28	1.70	19.36	0.746
Churachandpur	16.08	1.87	0.35	2.54	2.52	0.20	1.80	25.36	0.567
Tamenglong	27.27	2.38	0.01	2.87	3.29	0.25	2.09	38.16	0.469
Senapati	12.10	4.82	0.45	2.62	2.89	0.25	1.17	24.30	0.684
Ukhrul	10.12	2.72	0.01	3.08	3.60	0.21	1.08	20.82	0.692
State Total	189.87	21.07	1.99	27.45	32.43	4.97	14.74	292.52	0.550

Source: Department of Agriculture, Government of Manipur and author's computation of index values

Table 4. Inter-district variation in the Simpson index values in Manipur for the year 2000-01 and 2019-20

District	SI index, 2000-01	SI index, 2019-20	Change in SI values
Imphal East	0.236	0.426	0.189
Imphal West	0.215	0.408	0.193
Thoubal	0.501	0.538	0.037
Bishnupur	0.464	0.530	0.066
Chandel	0.617	0.746	0.130
Churachandpur	0.461	0.567	0.106
Tamenglong	0.307	0.469	0.162
Senapati	0.623	0.684	0.061
Ukhrul	0.555	0.692	0.137
Coefficient of Variation:	35.10 %	21.61 %	

Source: Computed from the data of Dept. of Agriculture, Govt. of Manipur

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