

Change of Crop Combinations in Tehatta and Krishnanagar Subdivisions of Nadia District in West Bengal during 1985-86 to 2016-2017

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Abstract : Agriculture is the most important occupation in India and West Bengal, with cropping patterns evolving to meet the increasing demand for agricultural production. Crop combination is the method by which the importance of any crop in an area can be easily identified. The study area consists of two subdivisions Tehatta and Krishnanagar of Nadia district, West Bengal. This paper attempted to delineate crop combination regions in the study area from 1985-86 to 2016-2017. Throughout the year agricultural land is covered with shades of green waves, important food crops are paddy, pulses, wheat, and oilseeds along with cash crops like jute, sugar cane, flowers, vegetables, etc. are also grown here. The crop combination varies with time and shows that rice is the main crop of this area followed by jute, oilseeds, pulses etc. Rice is the main staple food of West Bengal so the farmers grow it for their consumption and marketing. The study reveals that the agro-climatic conditions are suitable for various agricultural production. The progressive farmers of the study area easily adopted new crops for economic benefits, so the crop combination varies over time. The various agriculture regions were found during the study year and this may be used for the C.D. block level planning. In the study about crop combinations importance was highlighted for agricultural planning and development, land use planning, economic benefits, and soil health (Chakraborty, 2012).

Key words: cropping pattern, agriculture region, crop combinations, agriculture production.

Introduction

The study of agriculture is an important aspect of geography and all branches of social sciences. The district Nadia had an agriculture-based economy before the 1970s the vast area of the northwest part was known as *Kalantar* or infertile low-land. Mono-crop agriculture was practiced in the district through the indigenous process. The situation changed gradually after the seventies, with the introduction of various irrigation schemes with other advantages, there was a drastic change found in the agricultural field of this area. Kaur et al. (2022) described the connection between irrigation facilities with agricultural advancement and shifts in crop combinations. Chakraborty et al. (2017) demonstrated the relationship between irrigation, diversity of crops, and sustainability; groundwater is a more reliable source than canal irrigation and provides more crop intensity as well as crop diversity. The population pressure is always high

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and the use of agricultural fields is maximized in this area. As a result, the cropping pattern is also changing due to the availability of modern techniques and combinations of crops are also changing over time. The Green Revolution started in Indian agriculture from the seventies onwards. The revolution period was divided into two divisions according to Pingali (2012) the first one was the Green Revolution period which was from 1966 to 1985 and the next two decades were demarcated as the Post-Green -Revolution period. At that time huge investments in agriculture, crop genetic changes and scientific advancement were made for the staple food not only in developed countries, benefits rich also in developing countries. Agriculture trade liberalisation was another turning point in the Indian economy The true effect of liberalization in Indian agriculture started after the WTO Uruguay round agreement on agriculture in the year 1995. The import and export of agricultural products increased with temporal variations. Not only increased exports of agricultural products and hike in GDP but also had a positive impact on food security and minimisation of poverty level. Various internal laws and policies have changed due to the impact of the global market in India. (Kumar, 2020). Globalization, not only opened up world trade but also introduced new technology, seeds, new agricultural practices, various data and ideas (Ramesha, 2019). Pal, B. (2017) Described crop combination as a scientific approach to understanding the spatial interconnections among various crops. Crop combination regions are demarcated based on the number of crops harvested in a geographical area in a year. Eighties onwards there was huge positive changes were found in the agricultural field of Nadia district with the introduction of HYV seeds, the use of fertilizers, pesticides, and irrigation facilities. The number of crops grown in the C.D. block changed with time in tune with the demand of the market and the introduction of new technology. In the study area, the crop regions were selected for five years which are 1985-86, 1991-92, 2001-02, 2011-12 and 2016-17 respectively by Weaver's method (1954). Based on this crop combination the area is divided into different crop regions. Throughout these years the cropping has been changed significantly on a spatial basis.

Objectives

The objectives of the study are:

- (1) To analyze the spatiotemporal variations in crop combinations of different C.D. blocks of the study area.
- (2) To understand the cropping pattern of the area.
- (3) To identify the important crops of the area which are affected the socio-economic condition of local people.

Study Area

The Nadia district is located in the southern part of West Bengal and consists of four administrative subdivisions - Tehatta, Krishnanagar, Ranaghat and Kalyani. The agriculturally

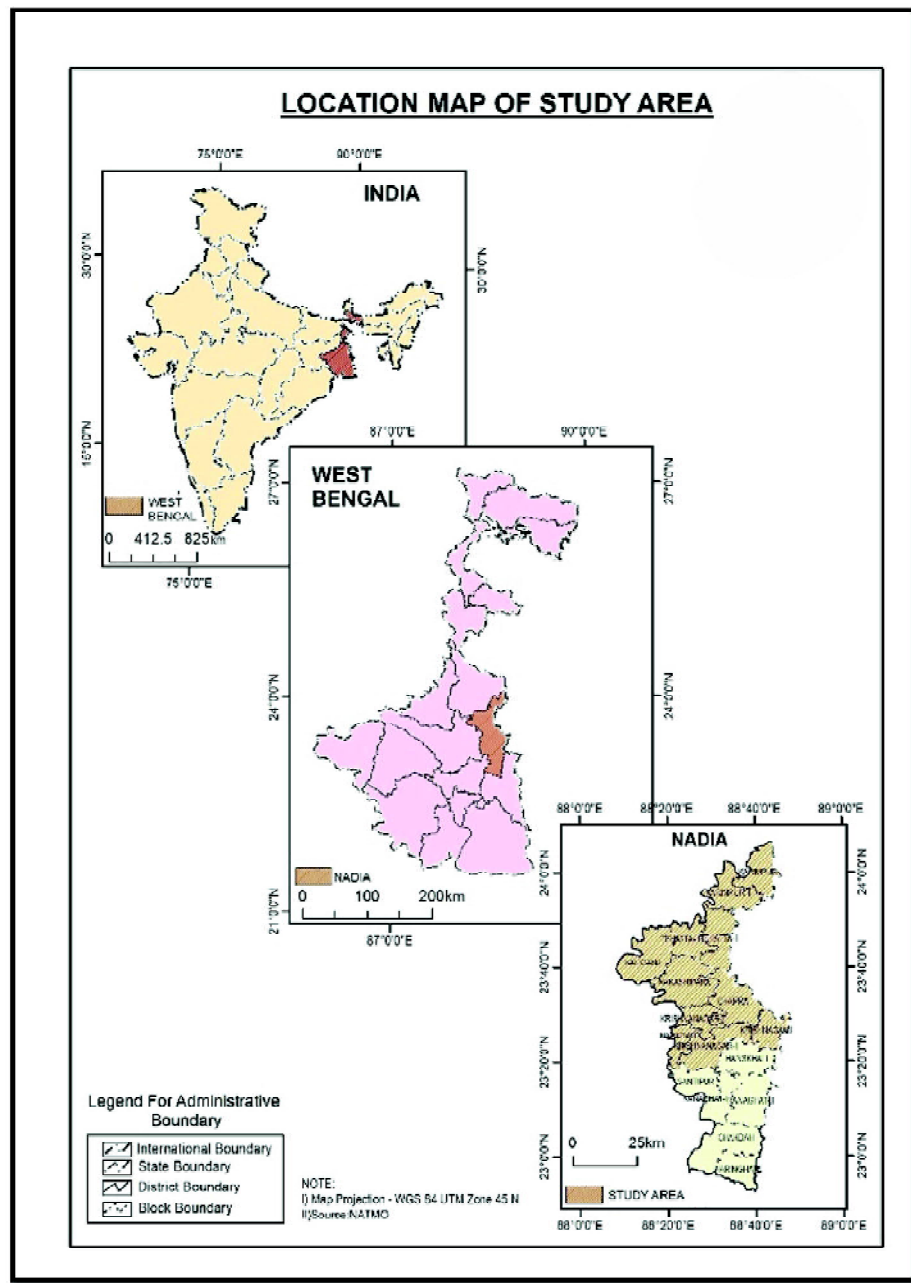


Fig. 1: Location map of the study area, Tehatta and Krishnanagar Subdivisions in Nadia District, West Bengal

developed Tehatta and Krishnanagar subdivisions of the northern part of the district have been chosen (Figure -1) for the study of crop combinations.

There are eleven C.D. blocks as per administrative divisions. But as per agricultural divisions, there are ten agricultural C.D. blocks in Nadia district, the Karimpur I and II C.D. blocks are taken as single-block. According to Rudra (2020), the Ganga Brahmaputra delta formed within a basin at the convergence zone of the Indian plate, Burmese plate, and mountain Himalayas. According to a report from the Deputy Director of Agriculture (Administration), Nadia; the district consists of alluvium soil and the low-lying area is rich with new alluvial deposition. The area belongs to the lower Gangetic plains (Sengupta et al., 2022) and the river Hooghly flows through the western boundary of this area, climatic conditions are hot humid summer and short dry winter.

The district Nadia is one of the most densely populated districts of West Bengal, it ranked 18th position in India according to the 2011 Census. The main occupation of this area is agriculture and more than 80 % of the agricultural area has irrigation facilities. This area is surrounded by Bangladesh to the east, Murshidabad to the north, Hooghly and Bardhaman districts to the west and the Ranaghat C.D. block of the same district in the south. The study area is extended from 23° 18' N to 24° 11' N latitudes and from 88° 09' E to 88°48' E longitude and covers about 2520 sq. km.

Database and Methodology

Crop combination is an important aspect of agricultural regionalisation in planning of rural development which is the base of our economy. The population is growing very fast worldwide and the West Bengal is one of the most densely populated states. So, we need to produce more crops in the same field. Season wise various crops were cultivated in the study area (Table-1).

Table -1: Season wise crop cultivated in Tehatta and Krishnanagar subdivisions.

Sl.No.	Cropping season	Months	Crops
1	Pre-kharif (Zaid)	April to June	Jute, Aus paddy, fruits and vegetables etc.
2	Kharif	July to October	Aman paddy, vegetables etc.
3	Rabi	November to March	Boro paddy, mustard, pulses, flowers, wheat, vegetables, fruits etc.

The block-wise agricultural data was collected for different years from 1985-86 to 2016-2017, from the Office of Director of Agriculture (Administration), Nadia, West Bengal and the Bureau of Applied Economics and Statistics, Nadia. Field visits are also done for the verification of agricultural conditions. The study mainly depends on secondary data, but recent agriculture data are not available in Govt. offices.

The crop combination method refers to the analysis of the total percentage of the total area occupied by different crops in each region at a given point of time. It helps to understand agricultural regionalization for development in agricultural production. Weaver in 1954 was the first to use the statistical technique for the demarcation of crop combination regions of the Middle East USA. Here the author has used this technique to identify the crop combination region. The minimum deviation method was taken to determine crop combinations for each C.D. block of Nadia district.

The formula is as follows:

$d = \sum d^2/n$ (d = the difference between the actual crop % in the given region and the appropriate percentage in the theoretical distribution. n = number of crops in each combination.)

The present research work on the crop combination technique by Weaver was applied to understand and identify the agricultural region according to the basis of crop combinations. The method is simple and suitable for handling a huge database. The formula has wide use in the Indian context. According to Kank (2022), the crop combination technique by Weaver helps agricultural regionalization in many ways. The technique helps to understand individual crops; the crop combination itself is a consolidated reality and this is required for setting up a realistic agricultural region. Weaver's method gives a realistic picture of crop combination scenario and the method helps to identify agriculture regions by exact grouping of dominant crops. (Jana. R et. al., 2022)

Discussion and Results

According to the Hypothetical area for different crop combinations after Weaver (1954) are as follows.

Single crop (100/1) = 100% of total cropland, Two crops (100/2) = 50% , 50%, Three crops (100/3) = 33.3%, 33.3%, 33.3%, Four crops (100/4) = 25%, 25%, 25%, 25%, five crops (100/5) = 20%, 20%, 20%, 20%, 20% and so on.

The difference between each crop combination's hypothetical and actual area is calculated, and the result is statistically represented by the minimum deviation method. The crop combination showing C.D. blockwise temporal changes throughout the study period (Table no.2), the important crop in hierarchical manners.

The First Three Ranked Crops in the Crop Combinations

Three is the lowest crop combination of the area so here discussing the first three crops of each C.D. block and study year (Figure-2). In the year 1985-86, fibre was the first-ranking crop in Krishnanagar-I, Krishnanagar-II, Nabadwip and Krishnaganj C.D. blocks while it was the second-ranking crop in Chapra, Tehatta –I, Nakashipara and Kaliganj. In Tehatta –II and Karimpur fiber was grown as a third-ranking crop. Paddy was cultivated as the first-ranking crop in Chapra,

Table- 2. C. D. Blockwise crop combinations in Tehatta and Krishnanagar subdivisions.

Name of the C. D. block	1985 -86		1991-92		2001-02		2011-12		2016-17	
	Num ber	Name of the crops	Num- ber	Name of the crops	Num- ber	Name of the crops	Num- ber	Name of the crops	Num- ber	Name of the crops
Chapra	3	P,Fi,Pu	5	P,Fi,Pu,O,W	5	P,Fi,Pu,O,V&F	3	P,Fi,O	5	P,O,Fi,Pu,W
Kaliganj	5	P,Fi,Pu,O,W	7	P,Pu,Fi,W,O, Oc,S	6	P,O,Fi,W,V&F, Pu	8	P,O,Fi,W,V& F,FPu,Oc	6	P,O,Fi,Oc,W, Pu
Karimpur	3	Pu,P,Fi	4	P,Fi,Pu,O	5	P,Fi,V&F,Pu,O	6	Fi,P,O,Pu,W, V&F	5	Fi,W,O,Pu,P
Krishnanagar	6	Fi,P,Pu,V&F, O,W	5	P,Fi,Pu,O,W	5	P,V&F,Fi,O,W	5	P,Fi,V&F,Pu,O	3	P,Fi,O
Krishnanagar-I	6	Fi,P,Pu,V&F, O,W	7	P,Fi,O,Pu,W, S,Oc	6	P,V&F,O,Fi, W,P	7	P,O,V&F,Fi, W,F,Pu	6	P,O,Fi,Pu,Oc, W
Krishnanagar-II	3	Fi,P,Pu	5	P,Fi,Pu,O,W	6	P,Fi,O,V&F, Pu,W	6	P,Fi,O,V&F, Pu,W	4	P,Fi,O,Pu
Nabadwip	6	Fi,Pu,V&F,O, P,W	5	P,O,Fi,Pu,W	4	P,O,V&F,Fi	4	P,O,V&F, F	4	P,O,Fi,Pu
Nakashipara	5	P,Fi,Pu,O,W	5	P,Pu,O,W,Fi	6	P,O,Pu,W,Fi, V&F	5	P,O,Fi,V&F,W	3	P,Fi,O
Tehatta-I	3	P,Fi,Pu	5	P,Fi,O,Pu,Oc	4	P,Fi,O,V&F	6	P,Fi,O,F,W,Pu	4	Fi,O,P,Pu
Tehatta-II	5	P,Fi,Pu,W,O	5	P,Fi,W,O,Pu	5	P,Fi,W,O,Pu	5	P,Fi,O,W,Pu	4	P,Fi,O,Pu

Where, P-Paddy, Fi-Fiber, W-Wheat, Pu-Pulses, O-Oilseeds, V&F-Vegetables & Flowers, F Fruit, Oc- Other crops, S-Spices.

Data source: The Office of Director of Agriculture (admin), Nadia, West Bengal and the Bureau of Applied Economics & Statistics, Kolkata. Computed by the author.

Tehatta –I and II, Nakashipara and Kaliganj. Krishnanagar –I, Krishnanagar - II, Krishnaganj and Karimpur C.D. blocks paddy was cultivated as a second important crop. Pulses are another important crop which is cultivated as a first crop in Karimpur, as the second crop in Nabadwip and Tehatta-II and the third crop in Krishnanagar I, Krishnanagar II, Chapra, Krishnaganj and Tehatta–I, Nakashipara and Kaliganj. However, it is important to mention that flowers and vegetables came in third rank in Nabadwip.

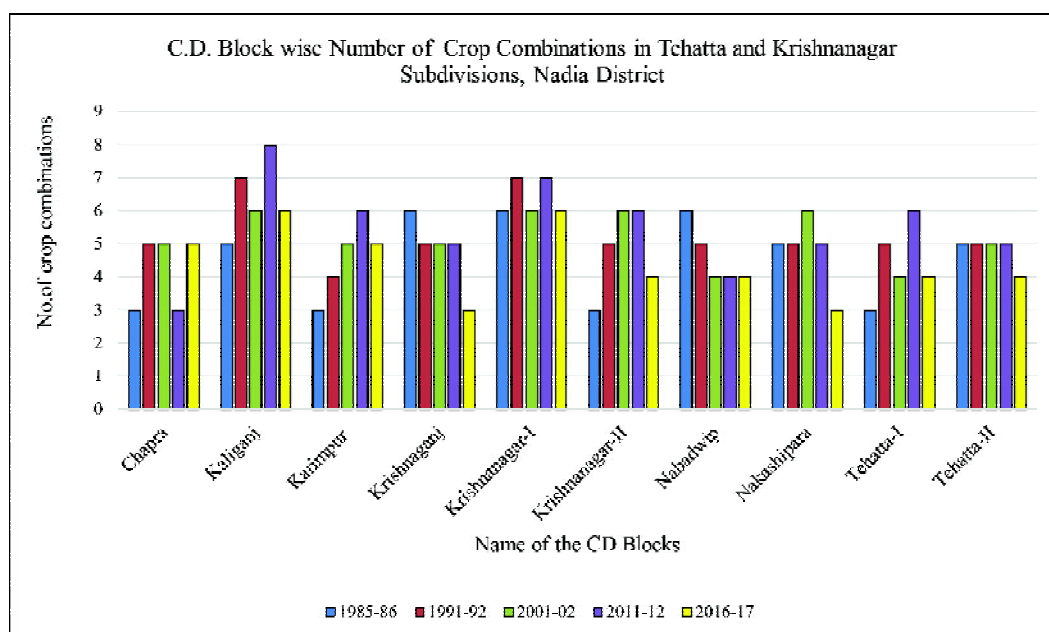


Fig. 2: The number of crop combinations in different C.D. Blocks in different years.

In 1991-92, the pattern almost remained the same with paddy, pulses and fibre playing the predominant role. Paddy was the leading crop for all the C.D. blocks of the study area second important crop was fibre in Krishnanagar -I, Krishnanagar II, Chapra, Krishnaganj, Tehatta -I and Tehatta II and Karimpur and third for Nabadwip and Kaliganj. Pulses were the second-ranking crop for Nakashipara, Kaliganj and the third crop in Krishnanagar-II, Chapra, Krishnaganj and Karimpur I & II. Oilseeds were the second-ranked crop for Nabadwip and the third crop for Krishnanagar -I, Tehatta -I and Nakashipara. Wheat lost its importance and was cultivated as the third crop of Tehatta-II.

In 2001-02, paddy was the dominant crop for all the C.D. blocks. Fibre and oil seeds were cultivated next to paddy, fibre was cultivated in Krishnanagar –II. Chapra, Tehatta –I and II and Karimpur as second-ranking crops and third in Krishnaganj, Kaliganj C.D. blocks. Oil seeds were the second-ranked crop in Nabadwip, Nakashipara, and Kaliganj and third in Krishnanagar -I,

Krishnanagar -II, and Tehatta -I. Vegetables and flowers were cultivated as second-ranking crops in Krishnanagar -I, Krishnaganj and as third-ranked crops in the Nabadwip and Karimpur C.D. blocks. Pulses were cultivated as the third crop in Chapra and Nakashipara. Wheat was cultivated as the third crop in Tehatta – -II and Kaliganj.

The same trend followed in 2011-12, where paddy was predominated except in Karimpur where it was replaced by fiber. Similarly, fibre and pulses dominated as the second crop with fibre being cultivated in Chapra, Tehatta –I , Tehatta II, Krishnaganj and Krishnanagar -II, and oil seeds were cultivated in Nakashipara, Kaliganj, Nabadwip and Krishnanagar –I. oil seeds as a third crop were grown in Krishnanagar-II, Chapra, Tehatta -I, Tehatta -II and Karimpur I & II C.D. blocks. Fibre was cultivated as the third crop in Nakashipara and Kaliganj. Vegetables and flowers were cultivated as the third crop in Krishnanagar -I, Nabadwip, Krishnaganj C.D. blocks. Other crops cultivated in the next orders mainly included pulses, wheat, spices etc.

In 2016-17 paddy was the main dominant crop except for Karimpur I & II and Tehatta-I as in the previous study year this was replaced by fiber. Fibre crop in Tehatta-II, Nakashipara, Krishnaganj, and Krishnanagar -II and the third crop in Kaliganj, Chapra, Krishnanagar -I and Nabadwip. Oil seeds were another dominating crop in the study area. Oil seeds were the second crop in Tehatta -I , Kaliganj, Chapra and Krishnanagar-I and Nabadwip and the third crop in Tehatta-II, Nakashipara, Krishnaganj and Krishnanagar-II. Wheat was the second important crop of the Karimpur C.D. block only.

Year-wise Crop Combination in the Study Area

Scenario of the Crop Combinations in the Year 1985-86:

Among the eleven C.D. blocks of Krishnanagar and Tehatta subdivision, three C.D. blocks showed the highest number of crops grown in a single year. Those C.D. blocks are Krishnaganj, Krishnanagar I and Nabadwip. All three C.D. blocks had six crops grown in a single year (Figure - 3). All the blocks are situated in the southernmost part of the study area. These three C.D. blocks are situated in the vicinity of each other. That was why a spatial correlation can be expected between these C.D. blocks which finally form a continuous region of high crop combination as well as high crop region. The situation in terms of the physical environment and the socio-economic scenario was favourable for this type of diversity in cropping patterns.

The bordering C.D. blocks with this region are Krishnanagar II, Chapra, Tehatta I, Karimpur I and II C.D. blocks show a very low number of crop combinations. Here the number of crops grown was three, this was in the low crop combination region. In between these two extremes, Nakashipara, Kaliganj and Tehatta II C.D. blocks have shown a medium range of cropping regions with five crop combinations. These C.D. blocks are also spatially connected and located at the western part of River Bhagirathi.

Scenario of Crop Combinations in the Year 1991-92:

After six years in 1991-92, the scenario has changed a bit. The change showed a good sign of agricultural progress for some C.D. blocks. The Krishnanagar -I and Kaliganj C.D. blocks increased in terms of several crops (Figure - 4), on a brighter note, the numbers of crops grown in a year have been upraised for these C.D. blocks. It went up from five crops to seven for Kaliganj and six crops to seven crops for Krishnanagar-I. The crop combinations were paddy-fibre, wheat-oilseeds-pulses, spices, and other crops (vegetable- flowers, sugar cane). The high population density, flourishing market and transport system were some of the major driving forces behind the increased crop cultivation in these C.D. blocks. Other blocks like Krishnanagar II, Tehatta-I and Chapra increased from three to five crop combinations. Nakashipara, Tehatta II remained the same crop combinations as the previous studied year and it was five. But as the other bordering C.D. blocks, Krishnanagar and Nabadwip, the crop numbers decreased from six crop to five crop regions. Whereas Karimpur I and II C.D. blocks increased to three to four crop combinations. The number of average crops grown was five in the studied year. This is a positive sign for the overall development of agriculture.

Scenario of the Crop Combinations in the Year 2001-02:

In the year 2001-02, just after the devastating flood in 2000, the growth in agriculture was hampered. Though paddy was the main crop for all C.D. blocks; production of flowers and vegetables increased in that time to prevent crop failure. The trend of increasing numbers of crops grown continued in Krishnanagar II, Nakashipara, and Karimpur I and II blocks. The progress of these C.D. blocks was commendable. The development of C.D. blocks signifies that with the help of proper agricultural planning and policy implementation, a proper developmental goal can be reached. Nakashipara and Krishnanagar -II changed from five to six crop combination (Figure - 5) regions and Karimpur I & II increased with four to five crop regions. Three C.D. blocks remained the same these were Chapra Krishnanagar and Tehatta -II which represented five crop combination regions. In the C.D. block Kaliganj, Krishnanagar -I, Nabadwip and Tehatta -I had a slight decrease due to the effect of the flood. Kaliganj and Krishnanagar -I reduced from seven to six crop combinations and for the Nabadwip and Tehatta -I from five to four. Overall, the year 2001-02 has shown a downfall in crop combinations.

Scenario of the Crop Combinations in the Year 2011-12:

In the year 2011-12, the picture had changed, the highest crop combination was eight and it was in Kaliganj C.D. block where the previous crop combination was six. Krishnanagar-I increased to seven crop regions from six in 2001-02. Bordering C.D. blocks Karimpur I and II showed an increase in Crop combination it was changed from five-crop combination region to six-crop combination region. In Tehatta -I in the previous study year four crop combinations were

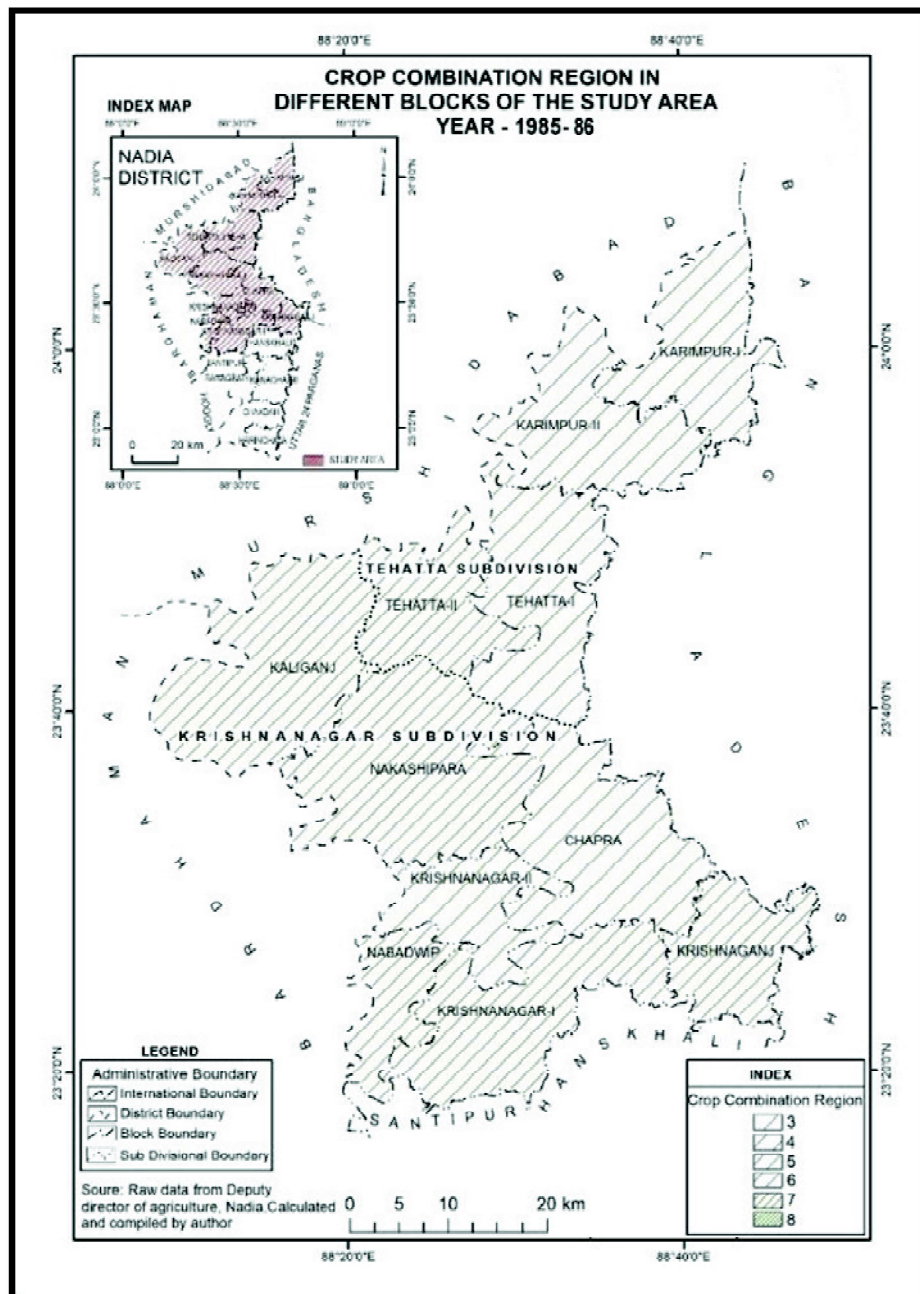


Fig. 3: Crop combination regions in the study area, 1985-86

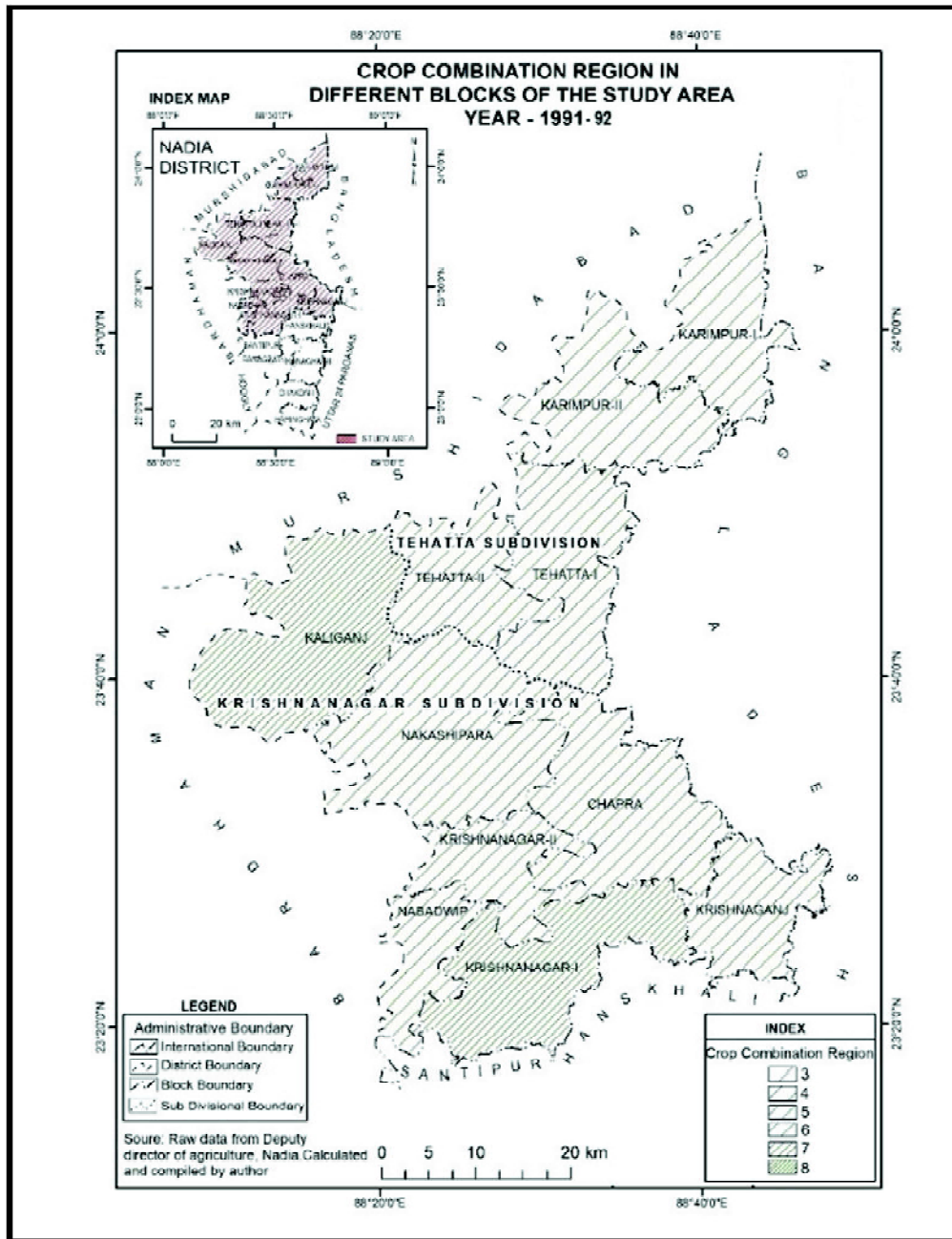


Fig. 4: Crop combination regions in the study area, 1991-92

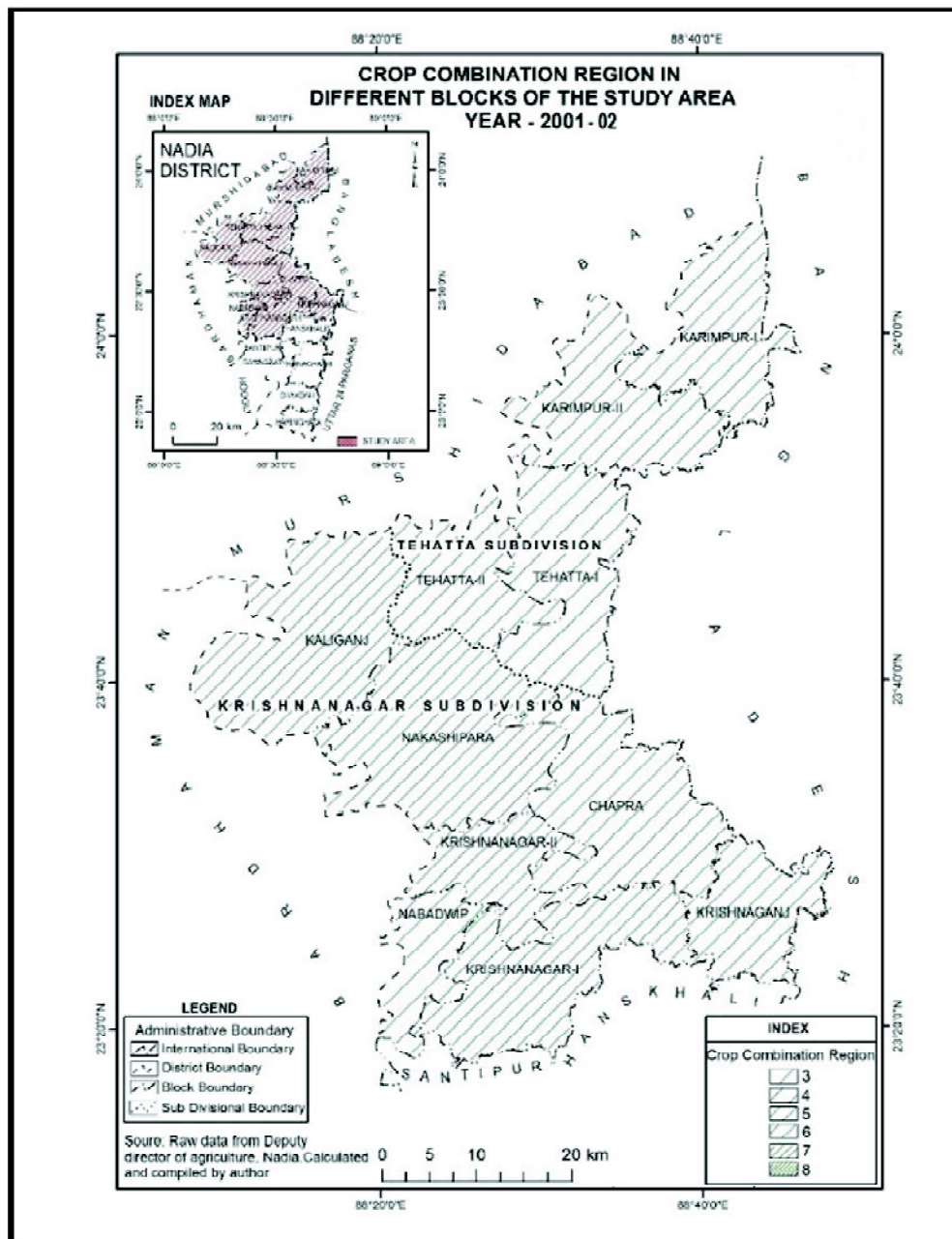


Fig. 5: Crop combination regions in the study area, 2001-02

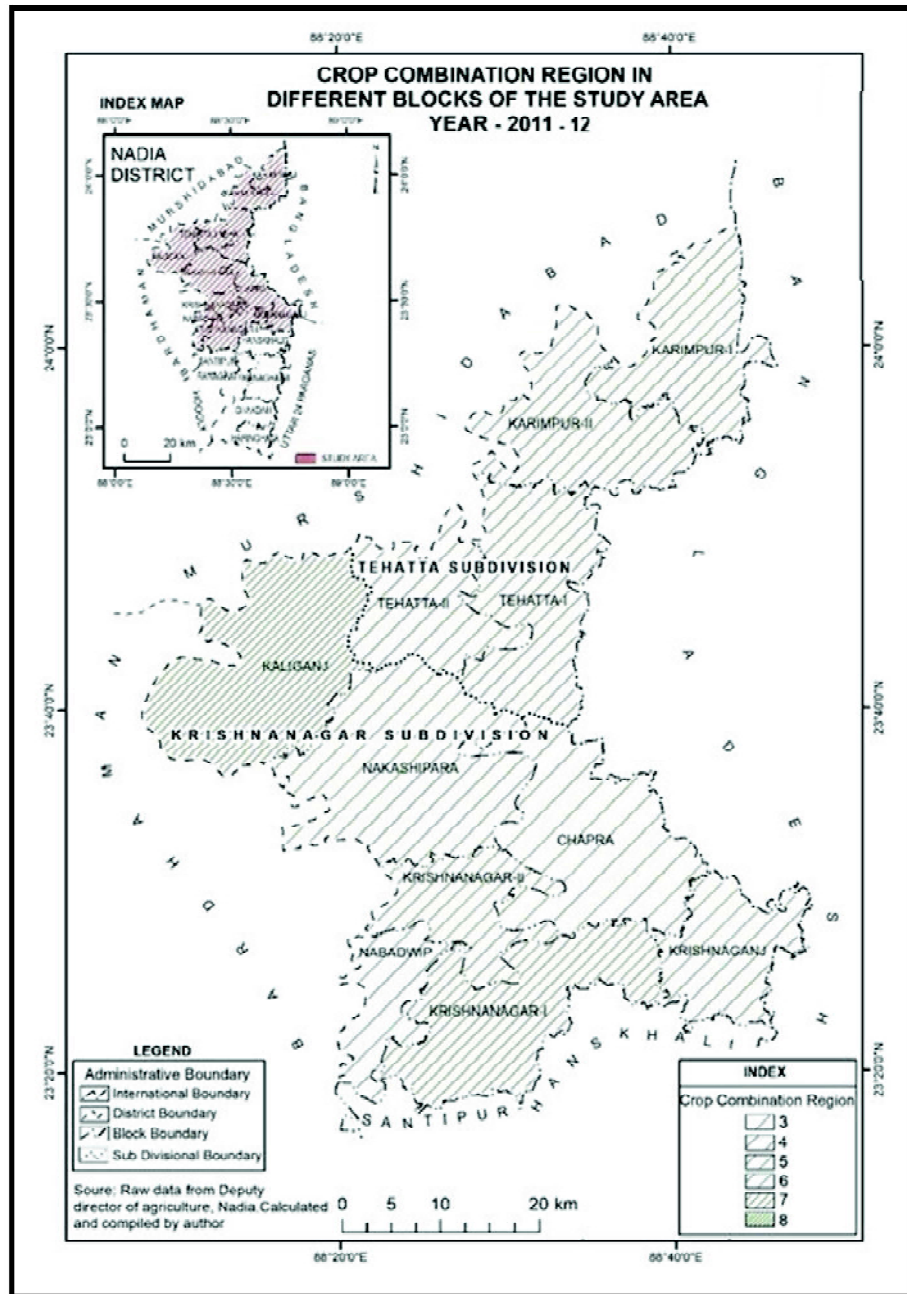


Fig. 6: Crop combination regions in the study area, 2011-12

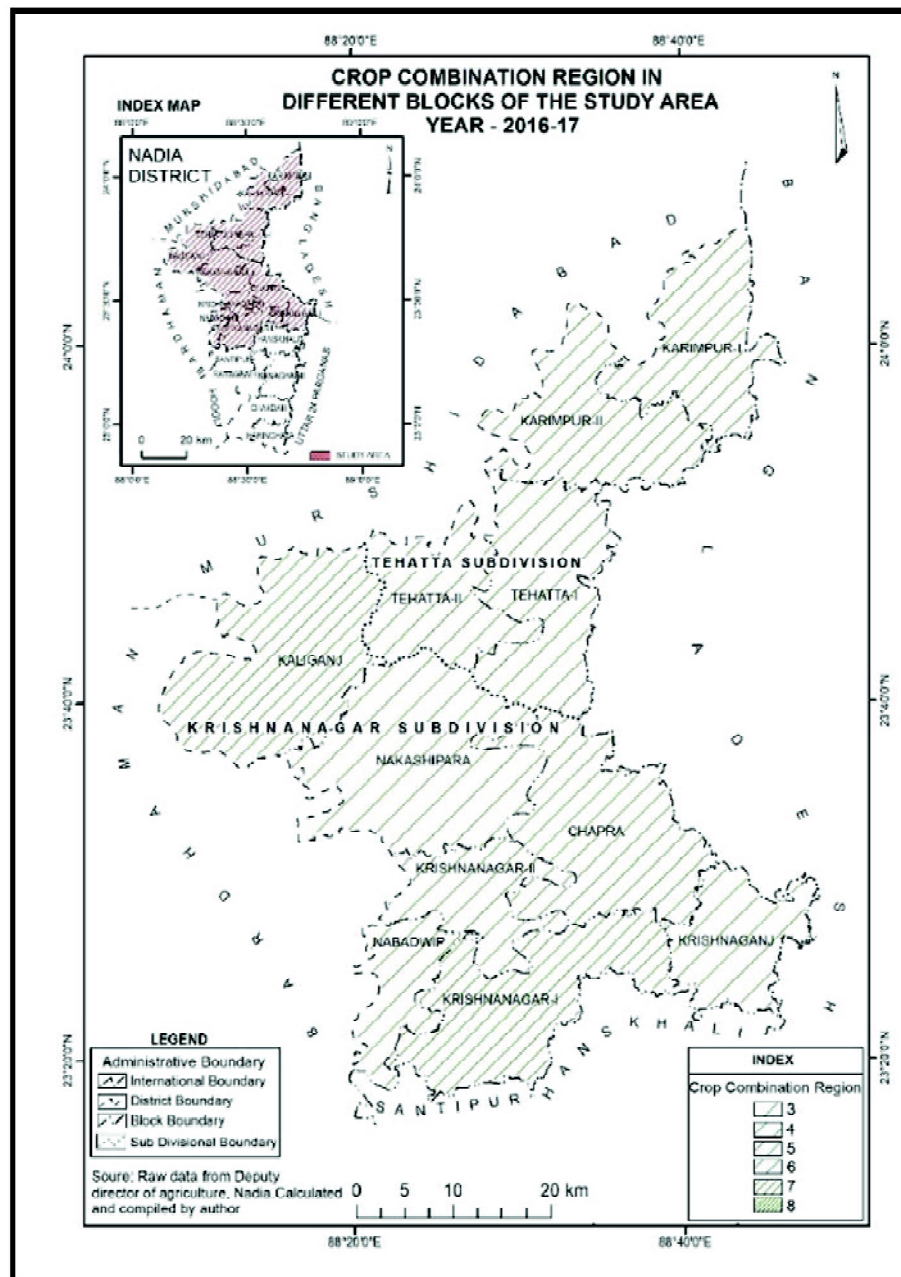


Fig. 7: Crop combination regions in the study area, year 2016-17

observed which changed to six crop combinations (Figure - 6). Krishnaganj, Krishnanagar -II, Nabadwip and Tehatta -II the crop combinations remain the same, as in the previous study year. These were five, six, four and five respectively. In the Chapra C.D. block the crop combinations had drastically reduced, it was changed from five to three in the study year. Nakashipara was reduced to six to five crop combinations.

Scenario of Crop Combinations in the Year 2016-17:

According to data of 2016 -17 the crops grown here were Paddy, fibre, oilseeds, wheat, pulses, and other crops including sugarcane, potato and maize. The number of crop combinations was reduced compared to the previous study year. In Kaliganj and Krishnanagar - I there was six crop combinations found. Chapra and Karimpur -I and II represent five crop combinations (Figure-7), but Chapra shows an increase in crop combinations by one crop. The Karimpur-I and II had decreased from six to five crop regions. Krishnanagar -II and Tehatta -I reduced from six to four crop combinations regions and Tehatta -II declined from five to four regions. Nakashipara Krishnaganj changed from five to three crop combinations region and Krishnanagar -I from seven to six crop combinations region. It happened mainly unavailability of horticulture data, which is the main limitation of the study.

Conclusion

Based on the crop combinations, the C.D. blocks of the study area were categorised into different crop regions. Over the years, the cropping pattern has significantly changed, indicating agricultural prosperity. The use of High Yielding Variety (HYV) seeds has been instrumental in maximizing production in the study area. Local varieties of seeds for paddy and jute have lost their importance due to low productivity, highlighting the necessity of seed banks to protect crop genetic diversity.

The analysis reveals the absence of monoculture or double-crop combination C.D. blocks during the study period. Crop diversification has been steadily increasing since 1985, with the minimum crop combination being three and the maximum being eight. The most common crop combination number was five. Paddy, including Aus, Aman, and Boro varieties, was the main crop cultivated throughout the year, followed by cash crop jute. Previously, paddy, jute, pulses, and oilseeds were important crops, but after the 2000 flood, there was a shift towards cultivating fruits and flowers to generate cash benefits for cultivators. Although C.D. block-wise horticulture data was not available after 2011, a primary survey by the author and district-wise data indicated a substantial increase in horticulture crop production. Crop diversification and an inclination towards cash crops may be attributed to the proximity of the Kolkata market and technical inputs from Bidhan Chandra Krishi Vishwavidyalaya, Mohonpur, Nadia.

According to World Bank indicators, a good transport system is crucial for agricultural development (Liu, 2017). However, the Tehatta subdivision is not well connected by railway lines,

and main roads are often busy and congested throughout the study area. Therefore, there is a need for a robust transport system to maximize agricultural development and boost the economy of the area.

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References:

- Bureau of Applied Economics and Statistics, Govt of West Bengal (2016-17). *District Statistical Handbook, Nadia*.
- Census of India, Directorate of Census Operations West Bengal. (2011), *District census handbook Nadia, Village, and town directory*.
Retrieved from <https://www.census2011.co.in/census/district/10-nadia.html>
- Chakraborty, A. (2012). A Study of Crop Combination Regions in The District of Murshidabad, West Bengal. *Geo-Analyst*, 2(1) Retrieved from <https://www.researchgate.net/publication/296704252>
- Chakraborty, K. and Mistri, B. (2017). Irrigation System and Pattern of Crop Combination, Concentration and Diversification in Bardhaman District, West Bengal. *The NEHU Journal*, XV(2), 45-65.
- Garrett, J.H.E., (1910) (Reprint 2001) *Bengal District Gazetteer Nadia*, Government of West Bengal.
- Prasad, J, Maravi, S.K.. (2021, February). Geographical study of crop combination and crop diversification in Dindori district, Madhya Pradesh. *The Decan Geographer*, 59 (1 & 2), 118-132. Retrieved from <https://www.researchgate.net/publication/368287450>
- Pingali, P. L. (2012). Green Revolution: Impacts, limits, and the path ahead. *PNAS*, 109(31), 12302–12308. <https://doi.org/10.1073/pnas.0912953109>
- Jana, R. S. A. (2022). A study of crop combination regions in the district of Jashpur, Chattisgarh state. *International Journal of Creative Research Thoughts*, 10(6), a870-a880.
- Muhammad, A.R., Zhiqi, W., Yasin, H. Y., Gul, H., Qin, Rehman, U.R., Mahmood, A. Iqbal, Z., Ahmed, Z., Luo, S., Juan, C., Liang, X., Gitari, H. Khalid, M.H.B., Feng, Y. Zhongming (2023) Effect of crop combination on yield performance, nutrient uptake, and land use advantage of cereal/legume intercropping systems, *Field Crops Research*, 304, <https://doi.org/10.1016/j.fcr.2023.109144>
- Kank, B.M., (2022). A Geographical Analysis of Crop Combination Region in Pune District. *Journal of Survey in Fisheries Sciences*, 09((1)), 880-883.
- Kaur, S., Kaur, G., Sohal, K.S. (2022). Changes In Crop Combination Regions in Rajasthan: A Geographical Analysis. *International Journal of Scientific Engineering and Applied Science (IJSEAS)*, 8(9), 1-21.
- Kumar, L., (2020) A study of the impact of liberalization on Indian agriculture. *JETIR*, 7 (9) 339-346
- Liu, Sike. (2017). Transport and agricultural productivity: A cross-national analysis. *Research on Modern Higher Education*. 2. 79-84. <http://dx.doi.org/10.24104/rmhe/2017.02.01012>

- Nadipena, A.N. Desavathu, R.N., Ponnala, S. (2018). Analysis of Crop Combination in Vizianagaram District of Andhra Pradesh: *International Journal of Engineering, Science and Mathematics*, 7(3 Special issue)), 73-82.
- Pal, B. (2017). Crop combination region of Ausgram gram panchayet in West Bengal, India. *International journal of scientific research and management.*, 5((08)), 6855-6858. <https://doi.org/10.18535/ijssrm/v5i8.35>
- Parihar, H. (2018). An Analysis of Crop Combination and Crop Diversification. *International Archive of Applied Sciences and Technology*, 9((01)), 6-12. <https://doi.org/10.15515/iaast.0976-4828.9.1.612>
- Rudra, K., (2014) Changing river courses in the western part of the Ganga–Brahmaputra delta, *Geomorphology*, 227 . 87-100. <https://doi.org/10.1016/j.geomorph.2014.05.013>
- Sengupta, D., Mukherjee, P., Mukhopadhyay, B., Toppo, S., Patel, M. Kumar, J., (2022) Multivariate Statistics Applied on Groundwater Geochemical Data to Identify Arsenic Release Mechanism and Related Microenvironments - A Case Study from Nakashipara, Tahatta-I and II Blocks of Nadia District, West Bengal, India. *Environmental earth science*. Retrieved from <https://www.researchgate.net/publication/359272628>
- Singh & Sidhu (2004). Factors in Declining Crop Diversification: Case Study of Punjab. *Economic and Political Weekly*. 39. 5607-5610. 10.2307/4415976.
- T. Ramesha (2019) Liberalisation Privatisation Globalisation Impact on Agriculture Sector, *IJRAR*, 6 (4), 1-11
- Weaver, J. C., (1954). Crop-Combination Regions in the Middle West. *Geographical Review*, 44(2), 175–200. <https://doi.org/10.2307/212355>