ANALYTICAL STUDY ON SPATIO-TEMPORAL CHANGES IN CROP COMBINATION OF NADIA DISTRICT, WEST BENGAL

Subarna Bandyopadhyay[1],
Research Scholar under RTMNU
And Assistant Professor
Department of Geography
Subhas Chandra Bose Centenary College
Lalbagh, Murshidabad, West Bengal

Dr. Kalpana Deshmukh[2],
Associate professor,
Department of Geography,
Dhanwate National College,
Nagpur, Maharashtra

Abstract:

 In country like India where agriculture is the backbone of Economy, all the economic and socio-cultural development directly or indirectly is affected and affecting agricultural system. In the present work a district from a state in eastern part of India is been selected. The selected district Nadia is within the second most densely populated state West Bengal, and the district itself observes a fast growth of population. The district also plays an important role in production of commercial crops like jute and food crop production. The following study runs with an aim to highlight the temporal change in agricultural pattern specially on crop combination after Weaver's method (1954) during 1993-94 and 2013-14.The discussion runs with the observation of published statistical data with an analytical study highlighting on relevant issues to the changes in crop combination with a keen notice in changes of production during the mentioned time span.
Key words: crop combination, crop production, temporal change, spatial change.

Introduction: Agriculture is a dynamic event related both with the changing demand and adaptation of improved of technology. The selected study area is within fertile zone of new alluvial deposit covering part of the Gangetic delta. Fast growths of population of about 19.57 % and 12.24 % respectively in last two decades cause as an influencing agent in change of agriculture. Such changes not only cause increasing demand for better production, but introduction of advance technology has caused changes in agricultural intensity, crop combination and total production. To identify the trend of such change an interval of two decades i.e. 1993-94 to 2013-14 is been considered in the present study.

The study area covers the entire Nadia district with an area of 3927 sq.km and with the latitudinal and longitudinal extension of $22^0 53''$N to $24^0 11''$N and $88^0 09''$ E to $88^0 48''$ E respectively. From

agro ecological point of view the district is under hot moist sub-humid[1] region and is suitable for the production of crops throughout the year covering food-crops as well as cash crops. Present work runs with an aim to analyze crop combination in block level study, trend of combination zones in a temporal trend and identify probable causes and effects of such change.

Objective of the study:

The study runs with the following objectives:

- Block wise changes in crop combination in the decided temporal interval.
- Find out the causes behind such changes and its impact on agricultural production.
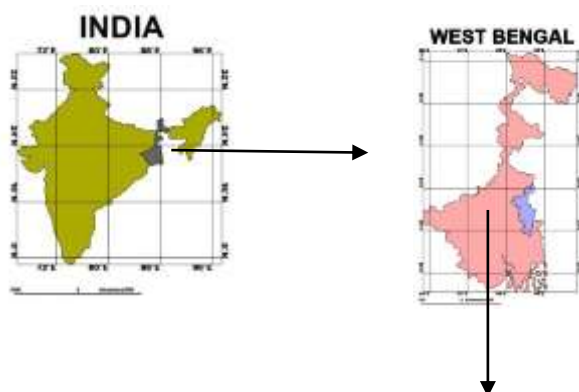
Methodology:

- The study is based on secondary data sources collected from District Statistical Hand book of Nadia District prepared by Bureau of Economics and Statistics, Govt. of West Bengal.
- Weaver's technique (1954) of calculating crop combination has been used.
- Thematic maps were prepared in TNT Mips 2012.
- Analysis of data following quantitative and qualitative study.

Discussion:

- ➢ **Study on crop combination:** To identify level of crop combination technique introduced by Weaver (1954) is used here.

Weaver's crop combination identification is based on method of minimum deviation using standard deviation method, further to simplify the formula instead of standard deviation its square i.e. variance was used. The formula used here is

Fig-1:   LOCATION MAP OF THE STUDY AREA

---

[1] SOILS OF WEST BENGAL FOR OPTIMISING LAND USE by NBSS Pbl-27, p 21

d=$\sum$ d²/n, where d= the variance and d²= the square of differences between the expected* value and the observed value, n= number of crops.

*Expected value as per Weaver's method (1954) are 100 for mono crop, 50 for two crop combination, 33.33 for three crop combination and so on.

Before using the formula we must concentrate on block wise share of crops in the selected two years, as published by the Bureau of Applied Economics and Applied Statistics.

TABLE-1: BLOCK WISE STUDY ON SHARE OF IMPORTANT CROPS TO GROSS SOWN AREA IN 1993-94

Blocks	% share of each crop to gross sown area										
	Aus	Aman	Boro	Jute	Wheat	Potato	Masur	Maskalai	Till	Mustard	Total
Karimpur-I	15.56	14.37	6.62	22.37	20.9	.35	7.52	6.28	1.22	4.81	100
Karimpur-II	8.19	9.88	9.99	23.61	21.49	_	12.16	_	_	14.68	100
Tehatta-I	4.28	18.06	10.05	27.87	8	_	14	.92	2.82	14	100
Tehatta-II	11.81	15.17	9.03	25.06	18.45	.04	4.73	.79	.43	14.49	100
Kaliganj	7.95	37.68	17.05	13.1	12.45	.11	2.03	.66	1.83	7.14	100
Nakashipara	16.08	23.06	17.05	18.02	7.07	.1	1.98	.36	4.41	11.87	100
Chapra	13.01	20.83	15.3	22.9	13.29	_	2.33	_	.11	12.23	100
*Krishnaganj	6.58	19.59	13.58	35.6	9.74	.2	.02	_	_	12.49	97.8
Krishnagar-I	13.24	29.93	22.6	13.63	2.43	.05	2.05	2.72	1.14	12.21	100
Krishnagar-II	26.05	14.8	6.33	17.28	9.7	_	2.3	9.53	6.27	7.74	100
Nabadwip	27.1	5.32	18.82	18.99	7	_	10.24	_	_	12.53	100
Santipur	22.85	20.01	27.01	9.39	3.07	1.02	1.74	2.24	2.7	9.97	100
Hanskhali	6.66	30.76	26.27	14.97	2.55	_	3.98		1.98	12.83	100
Ranaghat-I	12.69	17.46	17.39	20	5.37	.9	7.46	3.66	3.66	11.41	100
Ranaghat-II	13.91	30.06	25.3	12.17	2.57	.62	2.9	2.04	3.11	7.32	100
Chakdaha	13.7	24.4	26.21	15.3	7.8	1.18	.86	0.05	_	10.5	100
*Haringhata	14.38	28.97	23.12	12.55	1.61	6.69	1.5	_	.17	10.11	99.1

* some other crops are present in negligible %.

TABLE-2: BLOCK WISE STUDY ON SHARE OF IMPORTANT CROPS TO GROSS SOWN AREA IN 2013-14

Blocks	% share of each crop to gross sown area													
	Aus	Aman	Boro	Wheat	Jute	Potato	Masur	Maskalai	Khesari	Gram	Mustard	Till	Sugarcane	Total
Karimpur-I	2.12	8.2	.78	23.35	39.9	_	10.30	1.81	.08	.35	8.92	4.17		100
Karimpur-II	.75	7.91	5.33	23.37	38.16	.25	2.1	.67	.19	.53	19.15	1.57	.01	100
Tehatta-I	3.33	2.12	9.12	15.08	26.31	.21	10.58	2.38	1.36	4.23	14.96	10.37		100
Tehatta-II	8.38	6.44	6.86	12.31	30.95	.57	12.32	.67	_	4.8	11.99	4.37	.3	100
Kaliganj	10.69	20.87	17.86	6.52	18.79	.56	5.67	1.87	.14	2.32	3.48	7.25	3.98	100
Nakashipara	14.81	6.18	26.2	5.96	29.48	5.63	1.01	.41	.02	.14	4.38	5.78	_	100
Chapra	8.64	33.15	22.06	1.4	12.02	.04	.69	4.23	_	.29	13.87	3.61	_	100
Krishnaganj	7.2	7.67	11.5	3.21	29.46	.31	5.47	3.74	_	.63	17	13.46	.04	100
Krishnagar-I	6.83	30.7	12.66	2.51	14.32	.44	.84	.92	_	.25	26.31	4.19	_	100
Krishnagar-II	10.53	13.95	13.3	4.36	16.99	1.32	4.72	5.57	.49	.15	18.26	10.27	.09	100
Nabadwip	7.32	5.48	13.35	26.58	22.96	2.29	3.96	.36	_	.74	5.87	6.45	_	*95.46
Santipur	10.45	14.36	12.09	4.41	12.03	.33	2.97	2.45	_	.57	38.55	1.77	_	100
Hanskhali	11.5	2.53	24.42	5.36	19.87	.64	1.3	6.72	_	.39	20.61	6.57	_	100
Ranaghat-I	23.47	21.7	20.04	.53	18.4	.02	4.5	.01	_	.73	5.41	5.19	_	100
Ranaghat-II	15.47	1.25	25.77	5.07	19.86	.16	6.5	4.83	_	1.48	14.31	5.21	_	100
Chakdaha	3.26	5.21	51.92	1.27	26.67	.17	2.49	1.06	_	.6	3.39	3.79	.01	100
Haringhata	4.74	58.67	13.45	3.09	5.61	1.26	5.23	.24	_	.06	6.1	1.55	_	100

*For Nabadwip block maize production covers 4.64% of gross sown area.

Data source: District Statistical Handbook, Nadia, 2014, page no.18.1; and District Statistical Handbook, Nadia, 1994, page no; computation done by the researcher.

As per Weaver's technique of crop combination block-wise study for the district shows the following scenario:

TABLE-3: BLOCK WISE STUDY ON TEMPORAL CHANGES IN CROP COMBINATION

Blocks	Crop combination		Major crops as per combination	
	1993-94	2013-14	1993-94	2013-14
Karimpur-I	5th	6th	J, W, Au, Am, Masur	J, W, M, Am, T, Au
Karimpur-II	6th	4th	J, W, M, Masur, B, Am	J, W, M, Am
Tehatta-I	6th	6th	J, W, Am, M, Au, B	J, W, M, Masur, T, B
Tehatta-II	6th	7th	J, W, Am, M, Au, B	J, W, M, Masur Au, B, Am
Kaliganj	6th	6th	Am, B, J, W, Au, M	Am, J, B, Au, T, M
Nakashipara	5th	5th	Am, J, B, Au, M	J, B, Au, Am, T
Chapra	6th	5th	J, Am, B, W, Au, M	Am, B, M, J, Au
Krishnaganj	5th	6th	J, Am, B, M, Au	J, M, T, B, Am
Krishnagar-I	5th	4th	Am, B, J, Au, M	Am, M, J, B
Krishnagar-II	7th	6th	Au, J, Am, Mask, M, B, T	M, J, Am, B, Au, T
Nabadwip	5th	6th	Au, J, B, M, Masur	W, J, B, Au, T, M
Santipur	5th	5th	B, Au, Am, M, J	M, Am, B, J, Au
Hanskhali	4th	5th	Am, B, J, M	B, M, J, Au, Mask
Ranaghat-I	6th	4th	J, Am, B, Au, M, Masur	Au, Am, B, J
Ranaghat-II	5th	4th	J, Am, B, Au, M	B, J, Au, M
Chakdaha	5th	2nd	B, Am, J, Au, M	B, J
Haringhata	5th	3rd	Am, B, Au, J, M	Am, B, J

Data source: District Statistical Handbook, Nadia, 2014, page no.18.1; and District Statistical Handbook, Nadia, 1994, pp 166-189; computation done by the researcher.

BLOCK WISE CROP COMBINATION IN NADIA DISTRICT IN 1993-94

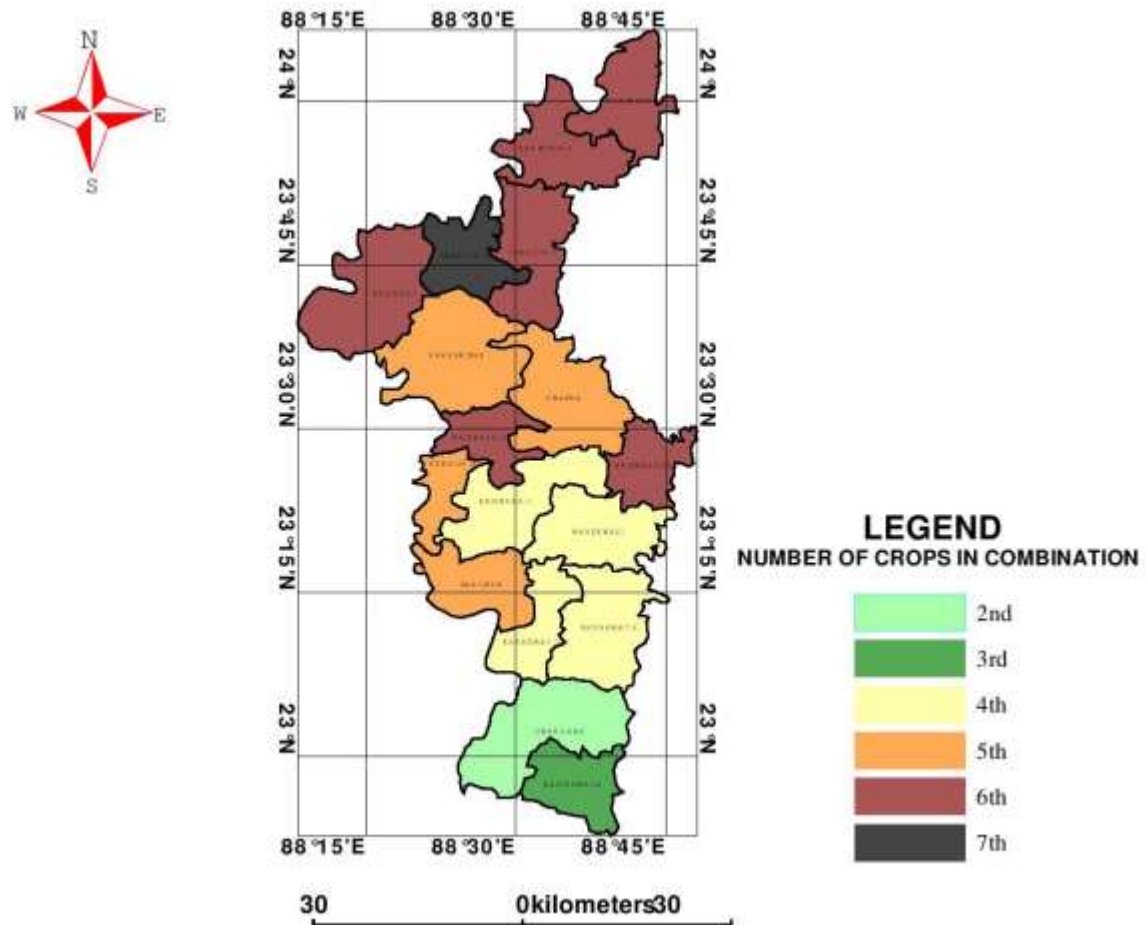BLOCK WISE CROP COMBINATION IN NADIA DISTRICT DURING 2013-14

Figure2. Temporal changes in crop combination for a block wise study

> **Block wise analysis on temporal changes of crop combination**:

All the blocks of Nadia district are considered in three categories following their changes in crop combination:

- **Increase in crop combination:**

  Crop combination analysis is an alternate method to identify degree of crop diversification. The blocks of Nadia under this criteria are_1. Karmpur-I, 2.Tehatta-II, Krishnaganj, 4. Hanskhali and 5. Nabadwip. Most interesting element related to the blocks is rise in production in oil seeds and grams. Basic food crops and commercial crops which once dominated during 1993-94 are still in the front list.

- **Crop combination in static form:**

  Blocks under these groups are 1) Tehatta-I, 2) Kaliganj,3) Nakashipara, and 4) Santipur. From the point of crop combination as well as diversification those blocks are in static

condition, but dominating crops have changed. Gradual growth in share for the production of Mastard and Til like oil seeds is common for this category, too.

- **More crop concentration:**
  Decrease in ranking for crop combination is an indirect indicator of increase in crop concentration. For this district most remarkable event is the concentration of eight blocks under this category. The blocks are_ a) Karimpur-II, b) Chapra, c) Krishnagar-I, d) Krishnagar-II, e) Ranaghat-I, f) Ranaghat-II,g) Chakdaha, h) Haringhata. So, more than 50% of the total blocks are in an tendency of reducing crop diversity. For these blocks more concentration on food crops like paddy and commercial crop like jute is observed.

  From the view point of changes in crop combination most polarized situation is of Chakdaha block which concentrates on Jute as crop of Monsoon season and Boro as crop of Post Monsoon season.

  ➢ **Changes related to major crop production:**

- **Blocks with Paddy as dominating crop:**

Among this category for blocks like Klaiganj, Cahpra, Krishnagar-I and Haringhata Aman is of major domination. 20years before study is also the same for those blocks, only in Chapra the 1st ranking crop was Jute during 1993-94.

Boro is of prior influence in blocks like Hanskhali, Ranaghat-II, Chakdaha. For all the three blocks importance of Aman is decreasing in comparison to Boro.

In Ranaghat-I Aus is the 1st ranking crop which is quite in a reverse trend in comparison to the district.

Wheat is 2nd important crop for blocks like Karimpur-I and II, Tehatta-I and II, and it is 1st ranking crop for Nabadwip block. The first four mentioned blocks continue production of wheat in both the selected years for study, but for Nabadwip it is a new introduction.

- **Blocks with Jute as dominating crop:**
  All the four blocks of Tehatta subdivision covering Karimpur-I and II, Tehatta-I and II are under this category in both the study periods. Nakashipara which is the newly introduced block under this category was of Aman as major crop during 1993-94.

- **Blocks with domination in crops other than paddy and Jute:**
  Santipur and Krishnagar-II are under this category and during study of 2013-14 Mastard is considered as the first ranking crops. For Santipur it was Boro and for Krishnagar-II it was Aus earlier.

  ➢ **Change in total production for different crops:**
  As per the collected data from district statistical hand book of 1995 and 2014 scenario of total production for major crops in the entire district is as follows:

TABLE-4: COMPARISON OF MAJOR CROP PRODUCTION DURING 1993-94 AND 2013-14

Crop	Production in '000 tones		
	In 1993-94	**In 2013-14**	**Changes at a glance**
Aus	128.18	114.531	Negative
Aman	277.77	268.862	Negative
Boro	350.27	351.024	Positive
Wheat	99.87	149.021	Positive
*Jute	1551.8	2087.72	Positive
Maize	negligible	1.961	Positive
Masur	9.99	24.631	Positive
Maskalai	2.92	9.591	Positive
Khesari	negligible	0.846	Positive
Gram	negligible	7.291	Positive
Til	9.71	34.637	Positive
Masatrd	50.48	90.771	Positive

Data source: District Statistical Hand Book, Nadia 1995 and 2014, computation done by the author.
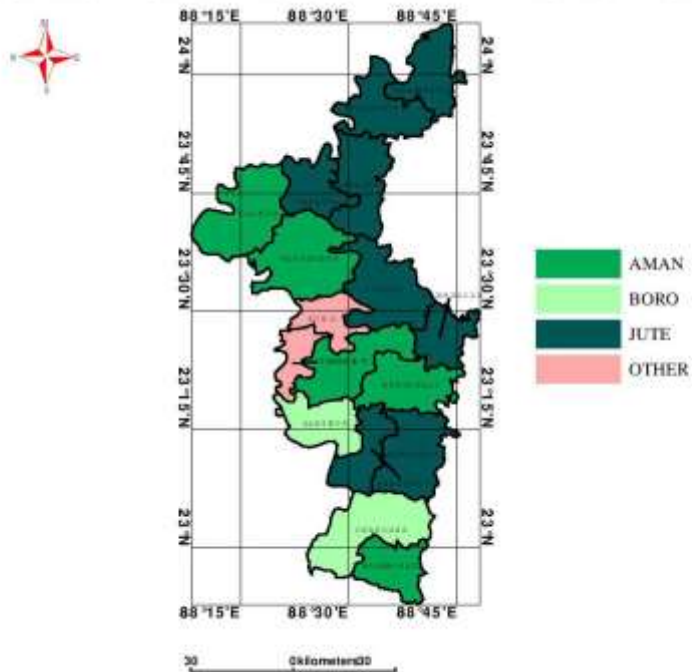
*production in bales of 180 kg

Change in production is most remarkable for paddy, specially for Aus and Aman, continuous growing trend of production for commercial crops rather than traditional food grains is observed.

➢ **Changes from spatial angel:**

Change in crop combination is clear for blocks in southern part of the district. Continuous decrease in figure for crop combination is clear for blocks like Chakdaha, Haringhata, Ranaghat-I and Ranaghat-II. In northern and central portion of the district large figure in crop combination is observed in both the study periods.
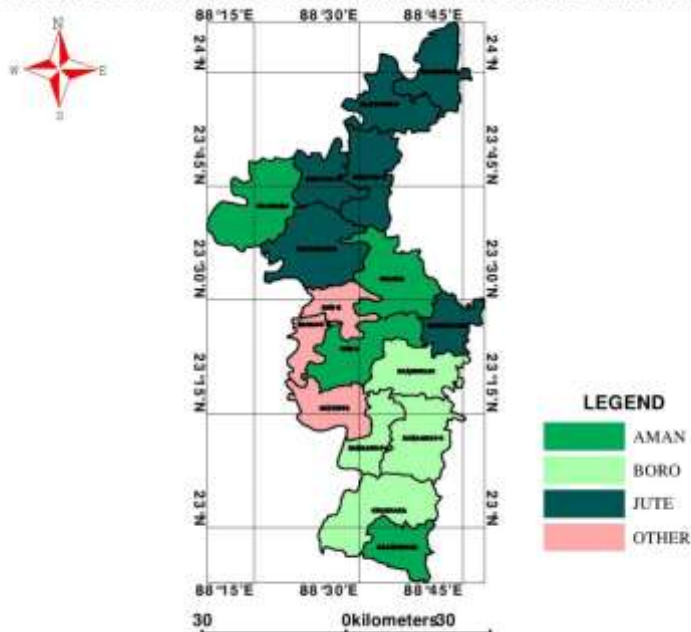
Figure2: Temporal changes in dominating crop in a block wise study

The spatial difference in crop combination here is been represented in comparison with population growth and urbanization in surrounding areas. In the given table percentage of urban population to total population and population growth rate in block level are compared with increase or decrease in crop combination:

TABLE-4: BLOCK WISE COMPARISON OF URBANIZATION, POPULATION GROWTH RATE AND CHANGES IN CROP COMBINATION DURING 1991 AND 2011 CENSUS PERIODS

Subdivision	Blocks	% of urban population		Population increase in %	Changes in crop combination
		In 1991	In 2011		
Tehatta	Karimpur-I	0	12.34	27.65	Increase
	Karimpur-II	0	0	33.07	Decrease
	Tehatta-I	0	0	31.25	Unchanged
	Tehatta-II	0	0	31.89	Increase
Krishnagar subdivision	Kaliganj	0	8.57	40.27	Unchanged
	Nakashipara	8.79	8.89	41.21	Unchanged
	Chapra	0	4.55	35.52	Decrease
	Krishnagar-I	0	9.19	40.57	Increase
	Krishnagar-II	4.75	3.9	31.51	Decrease
	Nabadwip	29.52	43.66	29.45	Increase
	Krishnaganj	0	0	29.97	Increase
Ranaghat	Santipur	23.47	36.01	43.59	Unchanged
	Hanskhali	7.81	16.09	35.48	Increase
	Ranaghat-I	34.93	47.97	24.42	Decrease
	Ranaghat-II	13.44	14.69	30.44	Decrease
Kalyani	Chakdaha	6.08	22.51	33.69	Decrease
	Haringhata	7.21	10.22	29.97	Decrease

Findings from the study:

➢ Regions with paddy dominance are becoming more dependent on rice produced in winter season.

➢ Jute is considered as major crop in Monsoon period for most of the blocks, shifting of rice dominated zone to commercial crop producing zone is also observed.

➢ Difference in rate of urbanization influences crop combination, for instance most of the blocks in Ranaghat and Kalyani subdivision are highlighting on two or three major crops, whereas- those blocks with relatively less urban growth still utilize the land throughout the year for production of several crops.

➢ Combination of numerous crops also highlights on relatively unstable economy which is a real fact for blocks in northern part of the district.

References:

Chakraborty, A. (2012, July). A Study of Crop Combination Regions in the District of Murshidabad, West Bengal. *Reasearch Gate* , 1-7.

(1995,2014). *District Sattistical Hand Book- Nadia.* Kolkata: Bureau of Applied Economics and Statistics, Govt. of West Bengal.

Mandal, R. (1990). *Land Utilization: Theory And Practice.* New Delhi: Concept Publishing Company.

Ogale, D. S. (2014). A STUDY OF CROP COMBINATION REGION OF BARAMATI TEHSIL IN PUNE DISTRICT (MAHARASHTRA STATE). *IJISR* , 329-334.

Rahane, B. B. (18.04.12). *Spatio Temporal Analysis of Agricultural Land- Use in Thane District.* Tilak Maharashtra Vidyapeeth, Geography. Sodhganga: Inflibnet.ac.in.

Siddika, F. R. (2016). Spatio-Temporal Analysis of Crop Combination in Birbhum District, West Bengal. *Imperial Journal of Interdisciplinary Research (IJIR) , 2* (5), 250-254.