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A temporal analysis of changing land use pattern and cropping intensity in Mahamaya Nagar district of Uttar Pradesh

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Abstract

In the present paper an attempt has been made to analyse the general land use pattern and to outline the temporal changes of land use pattern and cropping intensity and examine the relationship between changing land use pattern under various categories with cropping intensity in the region. The study is based on secondary sources of data obtained from Census of India (2011) and Sankhyikiya Patrika (SP) published by Economics & Statistical Division (ESD), Government of Uttar Pradesh 2001 & 2014. Blocks have been taken as the unit of study. Pie diagrams as well as bar diagrams have been prepared to show the land use pattern and cropping intensity of the district. Correlation between changing land use pattern and cropping intensity has been made by using SPSS software. After analysis, we found that there is shrinking of fallow land, barren land and forest toward area under non agriculture use land which reflects bad impression on cropping intensity. Thus, it is the intensification of crop on limited land resource to meet demands of food for the fastest growing population of India.

Keywords : *1. Land Use, 2.Cropping Intensity, 3.Correlation, 4.Green Revolution.*

Introduction:

India has made massive progress in agriculture since few decades. It has happened due to intense efforts of millions of small and marginal farming families which forms the backbone of Indian agriculture as well as Indian economy. Of the India's total population, 52.7 percent as a whole including 68.9 percent of rural population are directly or indirectly dependent on agriculture as a means of livelihood. India has experienced remarkable changes in crop yield and production of land through the use of machinery, irrigation and chemical fertilizer since the inception of Green Revolution (1966-67). Despite the substantial improvements in the productivity in case of major crops, the trend of productivity in India is far below than those of many developed nations. Thus, producing additional food with limited land resource and providing economic access of food to such a large population would be a major challenge for the nation.

Land use refers to utilization of the available land by humans for the purpose of agriculture, industry and residence in a given period of time. Zimmermann (1951) rightly pointed out that 'the limits of land use are either set up by nature or by culture human attitudes and action which determine the range of actual and probable use of land within the limits.' Land use statistics help to understand the purpose of use of land in different categories like cultivated land, fallow land, waste land, forest land, non-agricultural land etc. Since independence, cultivated land has been increased by 20 percent and presently 60.4 percent of total country's land is used for agricultural practice. But, still India is the home of 217 millions undernourished people about ¼ of the world and nearly a third of the world's food insecure people (FAO, 2012-13) mainly because of extreme high population. To feed such a growing population and optimum utilization of land, it is necessary to intensify cropping over the existing cultivated land.

Cropping intensity means growing a number of crops from the same field during one agricultural year. Cropping intensity implies the high proportion of net sown area is being cropped more than once during one agricultural year and applied more and more modern technologies, irrigation and chemical fertilizers and enhanced land productivity. It is the intensification of crop on limited land resource to meet demands of food for the fastest growing population in India.

Many geographers have focused their work in this direction such as land utilization survey of Howrah district (West Bengal) by Chatterjee (1952), land use and classified the land categories and their capability by Shafi, M. (1969), land use in the Tarai region of Uttar Pradesh by Singh, V.R. (1989), agricultural land use pattern in Satara district of Maharastra by Barakade A.J, Dr. Tonape L.B & Dr. Lokhande T.N. (2011), Relation between land use and settlement planning in Gyanpur tahsil, Varanasi by Prasad (1989), agricultural development and planning in Faizabad district by Tripathi (1999), changing land use pattern and cropping intensity: A case study of Dadri block, Gautam Buddh Nagar district of Uttar Pradesh by Siddiqui S.H., Ahmed M., & Shafi S.P. (2010), Regional Variation in the level of Agricultural Land use in Sant Kabir district in Uttar Pradesh by Ahmad, M., Siddiqui, S.H. & Nooruzzama (2010). These studies provide a base for land use pattern and its impact on cropping intensity.

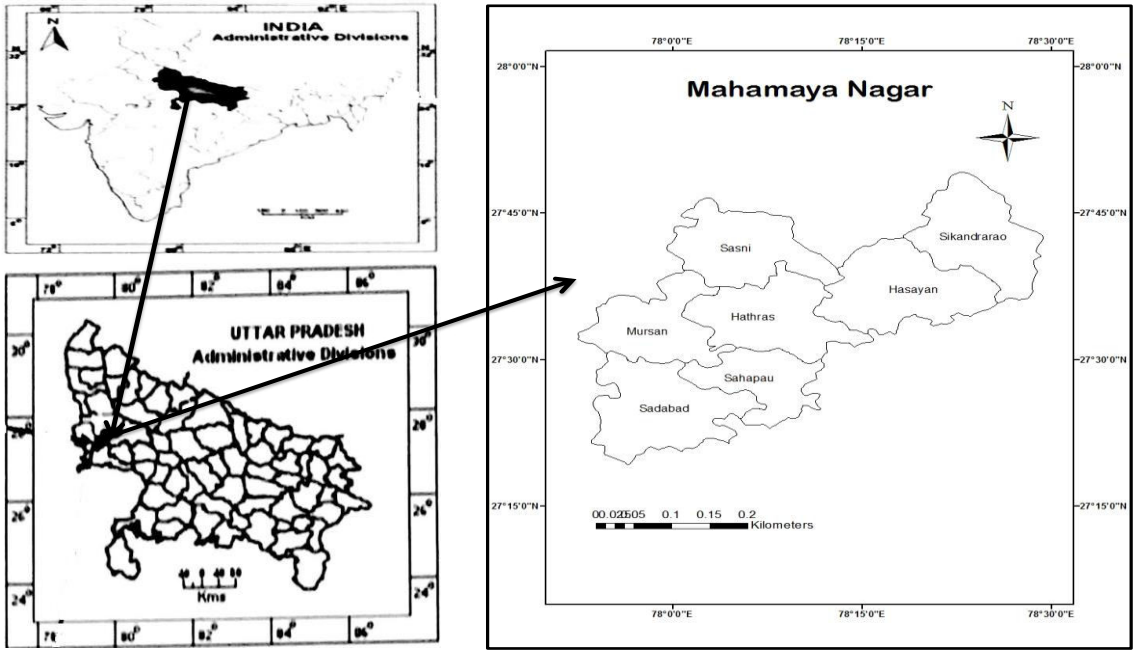
Objectives of the study:

1. To analyze general land use pattern of the district.
2. To outline the temporal changes of land use pattern in Mahamaya Nagar district.
3. To examine the relationships between changing land use pattern and Cropping Intensity.

Study Area:

Mahamaya Nagar (previous name was Hathras), a newly created district (vide Govt. notification No. CM –70/1-5/97-85/97-R5 dated 6.5.1997) of Uttar Pradesh curved out from Aligarh, Agra, Mathura and Eta is extending between $25^0$27’ and $26^0$11’ latitudes and $75^0$26’ to $76^0$37’ east longitudes. It has 1840 Sq.Km (0.72 percent area of the state) of total land and approximately 90 percent of it has been devoted to agriculture. Cropping intensity of the district was 164.09 percent in 2001-02 which has been increased to 166.52 percent in 2013-14. About 21.3 percent people live in urban area which signifies that 78.7 percent of rural people are dependent on agriculture as means of livelihoods. But the climatic character of hot summer and dry winter with unpredictable rainfall in monsoon season creates major hurdle for farmers. This district of western Uttar Pradesh comes under the influence of green revolution since 1960s. Fertile alluvial soil, approximately 97 percent assured irrigation, fertilizers, high input of mechanical tools, high rural literacy etc. make this district agriculturally well develop.

Study Area



Source: Census of India, 2011

Fig: 1

Database and Methodology:

The study is entirely based on secondary sources of data collected from Census of India (2011), and Sankhyikiya Patrika (SP) published by Economics & Statistical Division (ESD), Government of Uttar Pradesh 2001 & 2014. Blocks have been taken as the unit of study. Simple percentage method has been applied to calculate data of changing land use pattern and cropping intensity. Land use pattern of the district has been divided into seven categories i.e. Net Sown Area, Area Sown more than once, Forest (also include area under bush, forest and garden), Barren Land (includes barren cultivated waste, barren and uncultivated land), Non Agriculture use Land, Pasture land, Fellow land (includes present fallow land and other fallow land).

Percentage of land under various categories has been taken by considering the total area of the concern block.

Cropping Intensity (CI) = Gross Cropped Area/ Net Sown Area x 100.

Pie diagrams as well as bar diagrams have been prepared to show the land use pattern and cropping intensity of the district. Correlation between changing land use pattern and cropping intensity has been done by using SPSS software.

Result and Discussion:

Land is the most precious natural resource and constitutes the spine of all kinds of development. Land use statistics is the most determinant factor to understand the direction of economy and man-environment relationship of the region. The temporal land use information helps to make understand

changes occurred in different land use categories. It also indicates occupational status and progress and backwardness of the area.

Land Use Pattern (2001-02):

Table: 1 Block wise Land use pattern under different categories, 2001 (area in hectare).

Block	Total Reported Area	Gross Sown Area		Forest	Barren Land	Non Agriculture Use	Pasture Land	Fallow Land
		Net Sown Area	Area Sown more than once					
Sasni	27078	22323 (82.44)	11997 (44.31)	307 (1.13)	1290 (4.76)	2189 (8.08)	104 (0.38)	865 (3.19)
Hathras	25703	21245 (82.64)	11341 (44.11)	149 (0.58)	656 (2.55)	2631 (10.23)	85 (0.33)	937 (3.64)
Mursan	23075	19949 (86.45)	13874 (60.13)	173 (0.75)	234 (1.01)	2262 (9.80)	63 (0.27)	394 (1.71)
Sadabad	28810	24606 (85.41)	16458 (57.13)	64 (0.22)	323 (1.12)	2590 (8.99)	142 (0.49)	1085 (3.77)
Sahapao	17548	14851 (84.63)	9406 (53.60)	67 (0.38)	180 (1.03)	1699 (9.68)	171 (0.97)	580 (3.31)
Sikandrarao	25980	20195 (77.73)	14132 (54.40)	236 (0.91)	2527 (9.73)	1711 (6.59)	186 (0.72)	1125 (4.33)
Hasayan	30774	22467 (73.01)	16122 (52.39)	1328 (4.32)	2773 (9.01)	2633 (8.56)	260 (0.84)	1295 (4.21)
Total District	178968	145636 (81.37)	93330 (52.15)	2324 (1.30)	7983 (4.46)	15715 (8.78)	1011 (0.56)	6281 (3.51)

Figure within bracket shows percentage from the reported area of the block.

Source: Based on Data obtained from Economics & Statistical Division (ESD), Government of Uttar Pradesh 2001- 02

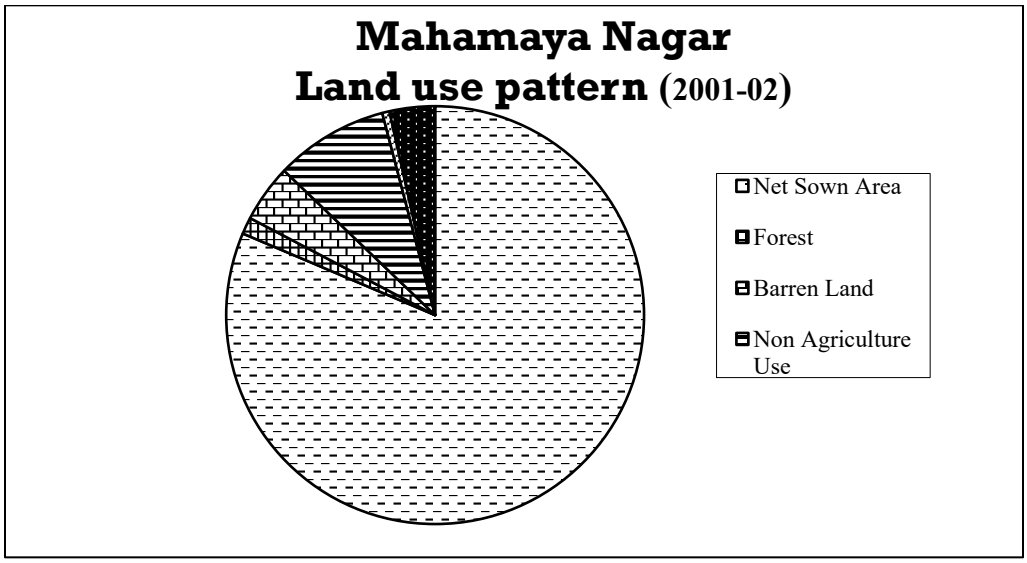


Fig. 2

Table 1 depicts that the total geographical area of the district is 178968 hectare out of which a large proportion of 145636 hectare (81.37 percent) is under net sown area followed by non agriculture use land 15715 hectare (8.78 percent), barren land 7983 hectare (4.46 percent), fallow land 6281 hectare (3.51 percent), forest 2324 hectare (1.30 percent) and pasture land 1011 hectare (0.56 percent) during 2001-02. (Figure 2)

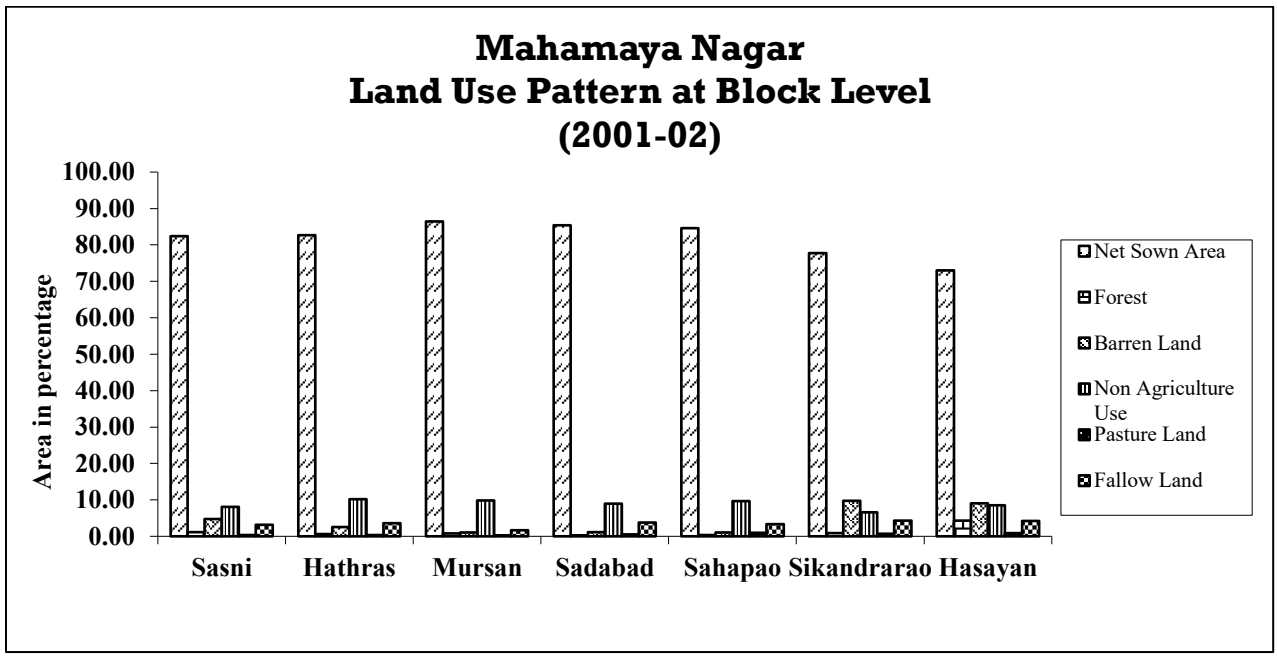


Fig. 3

Land use pattern under various categories at block level has been shown by figure 3 (2001-02). It clearly depicts (table 1) that highest proportion of the total reported area of all blocks come under net sown area such as Mursan (86.45 percent) followed by Sadabad (85.41 percent), Sahapao (84.63 percent), Hathras (82.64 percent), Sasni (82.44 percent), Sikandrarao (77.73 percent) and Hasayan (73.01 percent). Area under non agriculture use land has been reported highest at Hathras (10.23 percent) followed by Mursan (9.80 percent), Sahapao (9.68 percent), Sadabad (8.99 percent), Hasayan (8.56 percent), Sasni (8.08 percent) and Sikandrarao (6.59 percent).

Maximum reported area under barren land are found in Sikandrarao (9.73 percent) followed by Hasayan (9.01 percent), Sasni (4.46 percent), Hathras (2.55 percent), Sadabad (1.12 percent), Sahapao (1.03 percent) and Mursan (1.01 percent). Next to the Barren land, highest percentage of fallow land are reported in Sikandraro (4.33 percent) followed by Hasayan (4.21 percent), Sadabad (3.77 percent), Hathras (3.64 percent), Sahapao (3.31 percent), Sasni (3.19 percent) and Mursan (1.71 percent). Fallow lands followed by forest area are reported highest in Hasayan (4.32 percent) followed by Sasni (1.13 percent) and others block accounted below 1 percent during 2001-02. Pasture land has been reported below 1 percent in all blocks of the district.

Land Use Pattern (2013-14):

In 2013-14, the total geographical area of the district is 180155 hectare (table 2) out of which a vast proportion of 149138 hectare (82.78 percent) is under net sown area followed by non agriculture use land 19955 hectare (11.08 percent), fallow land 4335 hectare (2.41 percent), barren land 3696 hectare

(2.05 percent), forest 2003 hectare (1.11 percent) and pasture land 1031 hectare (0.57 percent) which is shown by figure 4.

Table: 2 Block wise Land use pattern under different categories, 2014 (area in hectare).

Block	Total Reported Area	Gross Sown Area		Forest	Barren Land	Non Agriculture Use	Pasture Land	Fallow Land
		Net Sown Area	Area Sown more than once					
Sasni	27363	22276 (81.41)	15820 (57.82)	263 (0.96)	940 (3.44)	3056 (11.17)	111 (0.41)	717 (2.62)
Hathras	25759	20978 (81.44)	13767 (53.45)	101 (0.39)	456 (1.77)	3576 (13.88)	89 (0.35)	525 (2.04)
Mursan	23135	19678 (85.06)	14201 (61.38)	143 (0.62)	237 (1.02)	2619 (11.32)	68 (0.29)	390 (1.96)
Sadabad	28641	24468 (85.43)	8542 (29.82)	28 (0.10)	307 (1.07)	2928 (10.22)	145 (0.51)	735 (2.57)
Sahapao	17557	15042 (85.68)	8514 (48.49)	29 (0.17)	154 (0.88)	1908 (10.87)	196 (1.12)	228 (1.30)
Sikandrarao	26267	21972 (83.65)	17340 (66.01)	107 (0.41)	694 (2.64)	2443 (9.30)	172 (0.65)	852 (3.24)
Hasayan	31433	24724 (78.66)	21352 (67.93)	1332 (4.24)	880 (2.80)	3375 (10.74)	250 (0.80)	874 (2.78)
Total District	180155	149138 (82.78)	99536 (55.25)	2003 (1.11)	3696 (2.05)	19955 (11.08)	1031 (0.57)	4335 (2.41)

Figure within bracket shows percentage from the reported area of the block.

Source: Based on Data obtained from Economics & Statistical Division (ESD), Government of Uttar Pradesh 2013-14

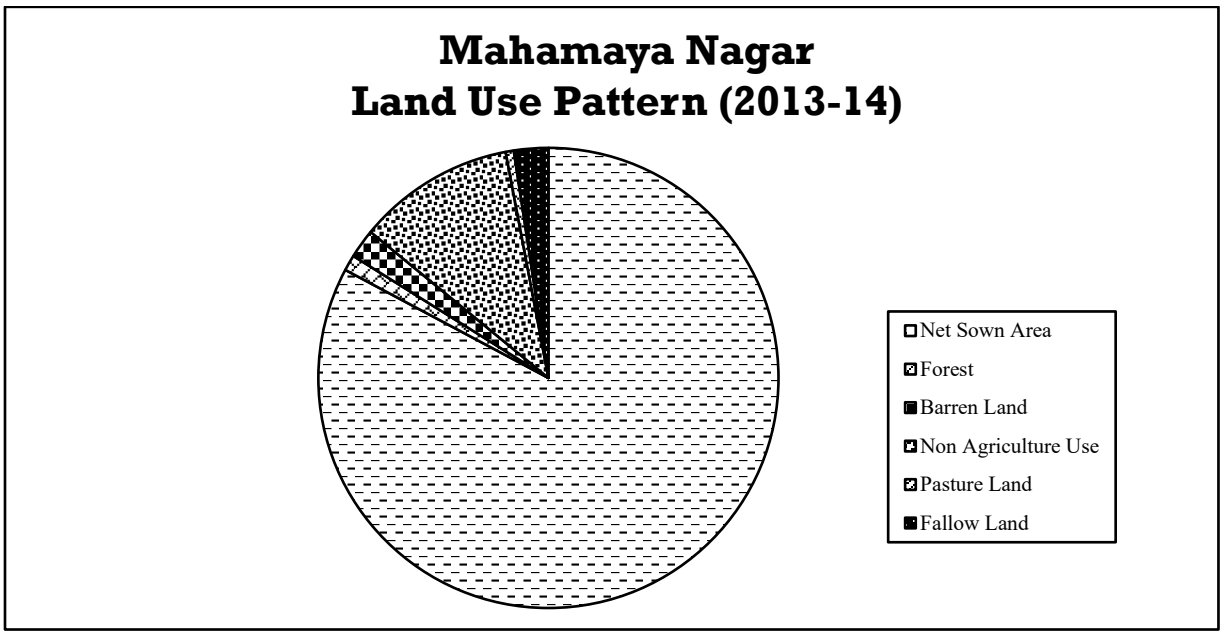


Fig.4

In 2013-14, block wise analysis of land use pattern under different categories are shown by figure 5. It clearly depicts (table 2) that highest proportion of the total reported area of all blocks come under net sown area figuring in Sahapao (85.68 percent) followed by Sadabad (85.43 percent), Mursan (85.06 percent), Sikandrarao (83.65 percent), Hathras (81.44 percent), Sasni (81.41 percent) and Hasayan (78.66 percent).

Non agriculture use land has been reported highest at Hathras (13.88 percent) followed by Mursan (11.32 percent), Sasni (11.17 percent) Sahapao (10.87 percent), Hasayan (10.74 percent), Sadabad (10.22 percent), and Sikandrarao (9.30 percent) while highest percentage of fallow land are reported in Sikandraro (3.24 percent) followed by Hasayan (2.78 percent), Sasni (2.62 percent), Sadabad (2.57 percent), Hathras (2.04 percent), Mursan (1.96 percent) and Sahapao (1.30 percent) during the same period.

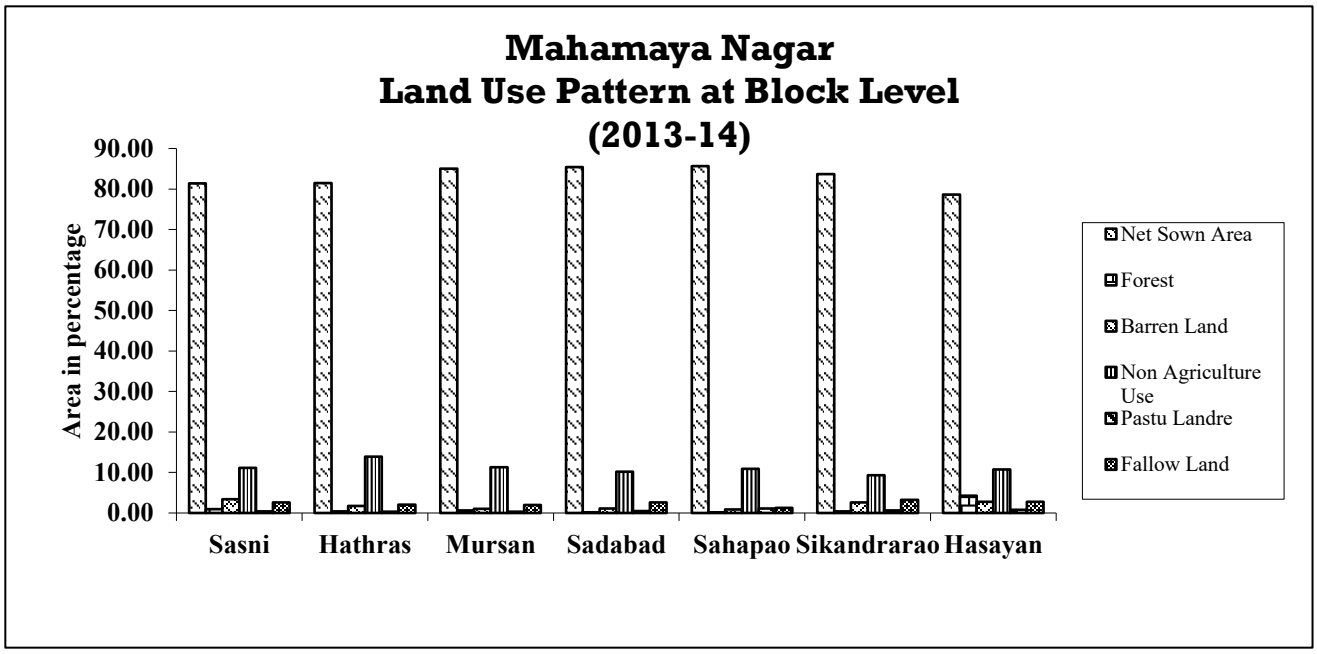


Fig.5

Barren and uncultivated waste land has been accounted high in Sasni (3.44 percent) followed by Hasayan (2.80 percent), Sikandrarao (2.64 percent), Hathras (1.77 percent), Sadabad (1.07 percent), Mursan (1.02 percent) and Sahapao (0.88 percent). Hasayan reported 4.24 percent area under forest which is higher than the district average 1.11 percent while remaining blocks accounted below 1 percent. Highest pasture land reported in Sahapao (1.12 percent) followed by Hasayan (0.80 percent) and remaining blocks account below the district average (0.57 percent) during 2013-14.

Temporal Analysis of changing Land Use Pattern (2001-14):

Net Sown Area:

This represents the total area sown by various crops. About 82.78 percent of the total reported lands are under net sown area in 2013-14 whereas it was 81.37 Percent in 2001-02, increased by 1.41 percent due to decreases of area under barren land (-2.41 percent), fallow land (-1.10 percent) and forest (-0.19 percent) in the district. But there is a high variation at block level such as highest increase at Sikandrarao (5.92 percent) followed by Hasayan (5.65 percent), Sahapao (1.04 percent) and Sadabad (0.02 percent) while highest decrease reported at Mursan (-1.40 percent) followed by

Hathras (-1.20 percent) and Sasni (-1.03 percent) mainly because of increased area under non agriculture use to the total reported area. (Table 3)

Table: 3 Block wise temporal changes of Land use pattern under different categories, 2001-14 (area in hectare)

Block	Net Sown Area	Area Sown more than once	Forest	Barren Land	Non Agriculture Use	Pasture	Fallow Land
Sasni	-47	3823	-44	-350	867	7	-148
	(-1.03)	(13.51)	(-0.17)	(-1.33)	(3.08)	(0.02)	(-0.57)
Hathras	-267	2426	-48	-200	945	4	-412
	(-1.20)	(9.33)	(-0.19)	(-0.78)	(3.65)	(0.01)	(-1.61)
Mursan	-271	327	-30	3	357	5	-4
	(-1.40)	(1.26)	(-0.13)	(0.01)	(1.52)	(0.02)	(-0.02)
Sadabad	-138	-7916	-36	-16	338	3	-350
	(0.02)	(-27.30)	(-0.12)	(-0.05)	(1.23)	(0.01)	(-1.20)
Sahapao	191	-892	-38	-26	209	25	-352
	(1.04)	(-5.11)	(-0.22)	(-0.15)	(1.19)	(0.14)	(-2.01)
Sikandrarao	1777	3208	-129	-1833	732	-14	-273
	(5.92)	(11.62)	(-0.50)	(-7.08)	(2.71)	(-0.06)	(-1.09)
Hasayan	2257	5230	4	-1893	742	-10	-421
	(5.65)	(15.54)	(-0.08)	(-6.21)	(2.18)	(-0.05)	(-1.43)
Total District	3502	6206	-321	-4315	4190	20	-1960
	(1.41)	(13.1)	(-0.19)	(-2.41)	(2.30)	(0.01)	(-1.10)

Figure within bracket shows percentage from the reported area of the block.
Source: Based on Data obtained from Economics & Statistical Division (ESD), Government of Uttar Pradesh 2001-14

Area Sown more than once:

This represents the total area sown once or more than once in a particular year and it counted once at gross sown area which is very essential for cropping intensity. Such type of land was 52.15 percent in 2001-02 which is increased to 55.25 percent in 2013-14 in the district. Highest increase of land under this category are found at Hasayan (15.54 percent) followed by Sasni (13.51 percent), Sikandrarao (11.62 percent), Hathras (9.33 percent) and Mursan (1.26 percent) due to decreased area of other land use categories whereas maximum decrease reported at Sadabad (-27.30 percent) followed by Sahapao (-5.11 percent) of the total reported area at each block. (Table 3)

Forest:

As per census of India (2011), this includes all lands classed as forest under any legal enactment dealing with forests or administered as forests, whether state-owned or private, and whether wooded or maintained as potential forest land. The area of crops raised in the forest and grazing lands or areas open for grazing within the forests remain included under the forest area. The study area reported 1.30 percent forest area in 2001-02 and it decreased to 1.11 percent in 2013-14 due to increased area under non agriculture use and gross sown area. All blocks shows decreased area under forest such as highest at Sikandrarao (-0.50 percent) followed by Sahapao (-0.22), Hathras (-

0.19 percent), Sasni (-0.17 percent), Mursan (-0.13 percent), Sadabad (-0.12 percent) and Hasayan (-0.08 percent). (Table 3)

Barren Land:

This includes all barren and uncultivable land which cannot be brought under cultivation. The study area has been reported decrease of barren land by -2.41 percent. Maximum decreased account at Sikandrarao (-7.08 percent) followed by Hasayan (-6.21 percent), Sasni (-1.33 percent), Hathras, Sahapao, Sadabad and Mursan. (Table 3)

Non Agriculture Use Land:

This includes all lands occupied by buildings, roads and railways or under water, e.g. rivers and canals and other lands put to uses other than agriculture. About 11.08 percent of the total reported lands are under non agriculture use in 2013-14 whereas it was 8.78 Percent in 2001-02 increased by 2.30 percent in the district. Such increase is maximum at Hathras (3.65 percent) followed by Sasni (3.08 percent), Sikandrarao (2.71 percent), Hasayan (2.18 percent), Mursan (1.52 percent), Sadabad (1.23 percent) and Sahapao (1.19 percent). (Table 3)

Pasture Land:

This includes all grazing lands whether they are permanent pastures and meadows or not. Village common grazing land is included under this head. The study has been reported slightly increase of pasture land by 0.01 percent in the district. (Table 3)

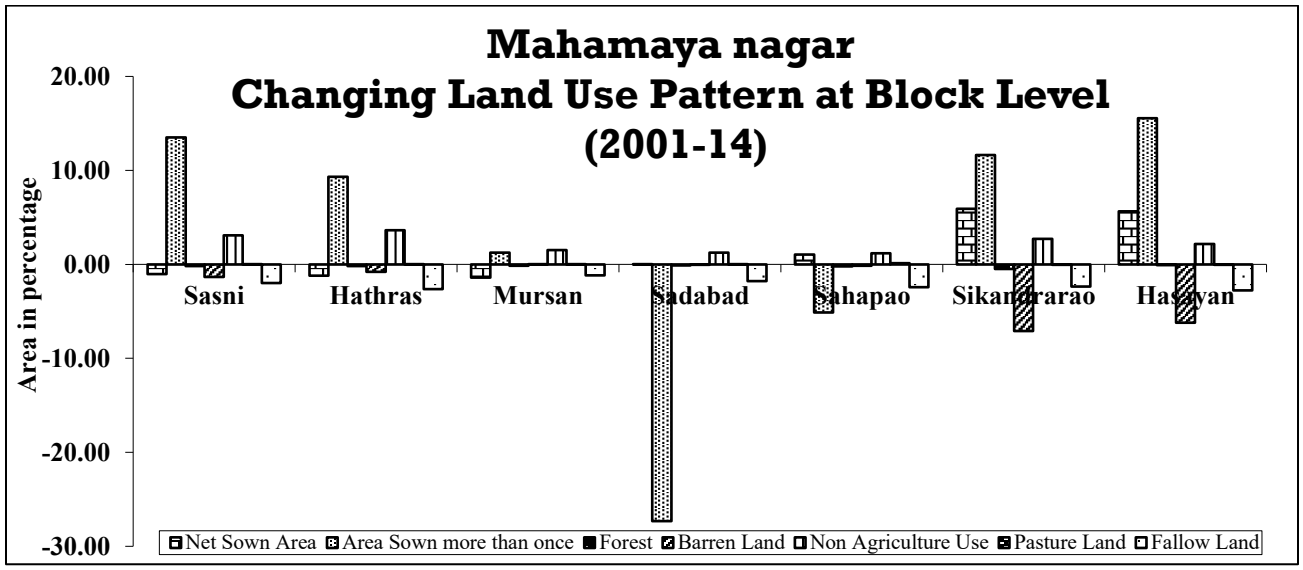


Fig: 6

Fallow Land:

This includes those lands which were used for cultivation before one year to five years. It registered for 3.51 percent in 2001-02 which is decreased to 2.41 percent in 2013-14 to the total reported area of the district. All blocks show decreased area under fallow land such as highest at Sahapao (-2.01) followed by Hathras (-1.61 percent), Hasayan (-1.43 percent), Sadabad (-1.20), Sikandrarao (-1.09 percent), Sasni (-0.57 percent) and Mursan (-0.02 percent). (Table 3)

Temporal Analysis of Cropping Intensity (2001-14):

Cropping Intensity of the district was 164.09 percent in 2001-02 which is increased to 166.52 percent (table no. 4). But there are uneven enhancement of cropping intensity depend upon net sown area and area sown more than once at block level. It has been observed from the table 4 that highest cropping intensity increased in Sasni (17.28 percent) followed by Hasayan (14.60 percent) Hathras (12.24 percent) Sikandrarao (8.98 percent) and Mursan (2.62 percent) during 2001-14, mainly because of increase area under area sown more than once of about 13.51 percent, 15.54 percent, 9.33 percent, 11.62 percent and 1.26 percent respectively to the total reported area of each block. Sikandrarao (5.92 percent) and Hasayan (5.65 percent) have also reported the highest increase under net sown area in the district. Table no. 4 also indicates highest decrease of cropping intensity in Sadabad (-31.98 percent) followed by Sahapao (-6.73 percent) due to maximum decline of area sown more than once -27.30 percent and -5.11 percent respectively to the total reported area of the block during 2001-14.

Table: 4 Block wise temporal changes of Cropping Intensity 2001& 2014

Block	Cropping Intensity		Change in percentage (%)
	2001-02	**2013-14**	
Sasni	153.74	171.02	17.28
Hathras	153.38	165.63	12.24
Mursan	169.55	172.17	2.62
Sadabad	166.89	134.91	-31.98
Sahapao	163.34	156.60	-6.73
Sikandrarao	169.98	178.96	8.98
Hasayan	171.76	186.36	14.60
Total District	164.09	166.52	2.43

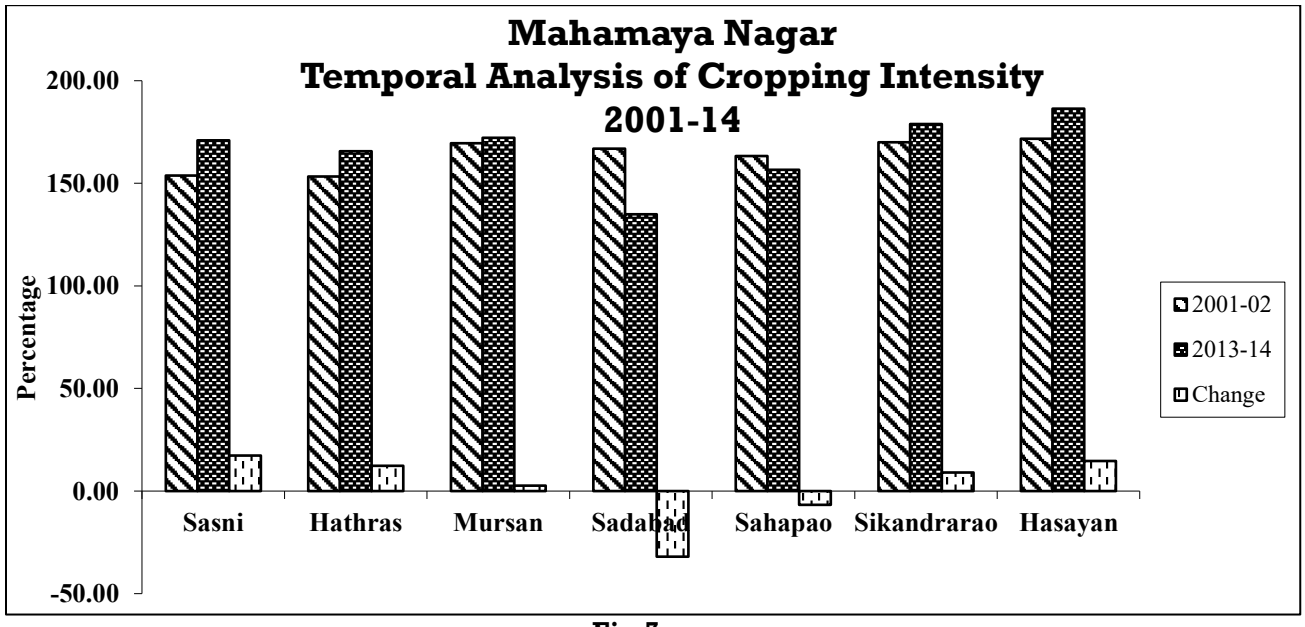


Fig.7

Correlation between changing Land use pattern and cropping intensity:

Table 5.Result of correlation between temporal changes of Land use pattern and cropping intensity in Mahamaya Nagar (2001-14)

Land use category	Cropping Intensity
Net Sown Area	.213
Area Sown more than once	.990**
Forest	-.166
Barren Land	-.462
Non Agriculture Use	.733
Pasture Land	-.337
Fallow Land	.159

**Correlation is significant at the 0.01 level (2- tailed)

Pearson's correlation of coefficient has been used in order to correlate the changing pattern of land use with the dependent variable of changing cropping intensity during 2001-14. The correlation of coefficient between changing land use pattern and cropping intensity are shown in table 5. It is observed from the table that only one land use category of area sown more than once is very strongly positive significant at 99 percent level of confidence with cropping intensity. The table also reveals that net sown area is positively significant with cropping intensity. There are two land use categories such as area under non agriculture use and fallow lands have positive correlation with cropping intensity but these lands are non agricultural lands. The area under forest, barren land and pasture land has been reported negative relationship with cropping intensity. The overall analysis of relationship between changing land use pattern with changing cropping intensity leads to conclusion that area sown more than once and net sown area in other word gross sown area is the major determinant factor for cropping intensity.

Conclusion and Suggestions:

Land is the most precious natural resource and forms the basis of all kinds of development. The present modern era is witnessing the destruction of forest and decline of cultivated land mainly because of high population. This scenario is also applicable for India and the district Mahamaya Nagar is not exception of it. After analysis, we found that there is shrinking of fallow land, barren land and forest towards area under non agriculture use land which reflects bad impression on cropping intensity. It is also mentioned that those block which have large area under area sown more than once reported high cropping intensity. Here is the only option to intensify crops on limited land resource to meet demands of food for the fastest growing population of India. Thus, there should be the need to provide greater attention for enhancement of cropping intensity by adopting latest mechanical tools, convert of barren land, dry land and fallow land into cultivated land by improving irrigation system and chemical fertilizer, practicing crop rotation and mix cropping and use of organic manures to retain soil fertility.

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