Study on Crop Diversification through Area Status of Crops in Kharif Season of Chhattisgarh

ABSTRACT

In the State of Chhattisgarh, nicknamed as Rice Bowl of India, about 80% of the population is engaged in agriculture. It has been mostly engaged in the paddy-based mono-cropping system fora long period. So, crop diversification (a shift of area away from a less profitable crop toward more profitable ones) is one of the measures, expected to enhance the economic growth of the farmers in this State. Therefore, the present study attempts to assess the status of the area under different crops in the Kharif season in Chhattisgarh, based on secondary data for the period of 19 years, i.e., 2000-01 to 2018-19.For the Kharif season, the area is under crops such as Arhar and maize have, in general, increased over the period 2001-19. while the area under Moong and Sesamumover the same period has decreased.

Keywords: Crop Diversification, status of area, Kharif season

1. INTRODUCTION

Chhattisgarh is a State that was created in 2000 by separating it from Madhya Pradesh. With a geographical size of 13,790 ('000 ha) and a net sown area of 4677 ('000 ha), it is India's tenth largest State.Agriculture employs over 80% of the population in the State, while arable land under cultivation is 43% of the total land area. The principal crop of Chhattisgarh is paddy and the central plains of the State are popularly known as the "Rice Bowl of Central India."

Due to lack of required agricultural infrastructure, such as seed processing centres, farmer training centres, fertiliser, and go downs, the State's production of various crops is lower than those of other established States. Following the establishment of the State in 2000, the State government embarked on a crop diversification drive, as a consequence of which the pace of agricultural growth accelerated due to the State government's increased emphasis for crop-based agricultural programmes.

Crop diversification was designed to provide farmers of Chhattisgarh wider options for growing a range of crops, allowing them to increase their production activities in order to reduce risk of crop failure in a particular season due to drought, flood, etc. and to improve their economy. Crop diversification is typically defined as a shift of area away from a less

profitable crop toward more profitable ones. Crop shift (diversification) occurs as a result of government policies and thrusts on certain crops throughout a given period, such as the formation of the Technology Mission on Oilseeds (TMO), to promote oilseed production and minimize reliance on imports.

Crop diversification is also induced by interactive effects of many factors such as (a) resource-related factors like irrigation, rainfall, and soil health; (b) household-related factors like food, fodder, some self-sufficiency requirements and investment constraints; (c) technology-related factors, like seed, fertilizer, marketing, water use, storage and post-harvest processing; (d) Institutional and infrastructure-related factors like size of land holding and tenancy difficulties, as well as government research, extension, and regulatory policies; (e) price-related elements like output and input prices, as well as trade and various other economic policies that impact prices. These elements are intricately linked. While factors like farm size, food and fodder self-sufficiency and investment constraints are critical factors shaping the area allocation pattern among small and large farmers, among whom the latter have the capacity to bypass resource constraints tending to prioritise economic considerations based on the relative crop prices over other non-economic considerations.

The following factors have varying degrees of influence on crop diversification: (a) more than 60% of the cropped area is dependent on rainfall; (b) inadequate supply of improved and quality seeds and planting material of improved cultivars; (c) sub-optimal and over-use of resources like water and land resources; (d) inadequate basic infrastructure such as rural power, roads, transportation and communications; (e) fragmentation of farm land; (f) lack of agriculture mechanisation due to investment limitations and size of farm land; (g) inadequate post-harvest technologies and infrastructure for post-harvest handling of perishable produce; (h) poor Agro-based industry; (i) inadequately trained farmers and widespread illiteracy among farmers; (j) poor research-extension-farmer connections; (k) emerging pests and diseases that affects crop plants; (l) inadequate agricultural investments; (m) dismal database for horticulture crops.

Sound research and development initiatives are required to promote crop diversification. Instead of traditional subsistence agriculture, future agriculture will be based on scientific knowledge and expertise.

2. MATERIAL AND METHODS

Choice of Area and Period of Study

The Chhattisgarh state was selected as the area of study for the present work. Chhattisgarh state came into existence on 1st November 2000, as a result of the bifurcation of the state of Madhya Pradesh. Chhattisgarh state, situated in Eastern India, is located between 17º 46‟ N and 24º 5‟ N latitudes and 84º 15‟ E and 84º 24‟ E longitudes.

The period of study has been selected from year 2000-01 to 2018-19.

Selection of Crops

TheAgronomic crops of Chhattisgarh were used for crop diversification after the formation of the State in 2000, namely, Arhar and Maize, Moong, Sesamum.

Collection of Data

The annual time series data on area of different crops in different districts of Chhattisgarh has been collected from the website of Area and Production Statistics by Ministryof Agriculture and Farmers Welfare, *http://aps.dac.gov.in/APY/Public_Report1.aspx*and website of Directorate Agriculture, Chhattisgarh Raipur by Agriculture Development and Farmer Welfare and Biotechnology Department, *http://agriportal.cg.nic.in/agridept/AgriEn/Default.aspx* for the study period, i.e. 2000-01 to 2018-19 as per availability.

Software Used

In the present study, Statistical analyses have been carried out using the powerful software "R: The Project for Statistical Computing" which is also being used currently at various Universities, not only in Statistical Departments but also in many other applied branches of science.

Analytical Methods:

To study the status of area and their graphical assessment for different crops in Kharif and Rabi seasons of Chhattisgarh, "R: The R Project for Statistical Computing" (2020) available *at https://www.R-project.org/* has been used, which has excellent graphics and programming capabilities.

3. RESULT AND DISCUSSION

The status of area and their graphical assessment for different crops in Kharif and Rabi seasons of Chhattisgarh.

The analysis of status of area of different crops in Kharif and Rabi seasons of Chhattisgarh provides changing scenario of area under different crops. For analyses of area status of a particular crop, entire area of Chhattisgarh was grouped into three Agro-climatic zones i.e., Northern Hills, Chhattisgarh Plains and Bastar Plateau. Since the Chhattisgarh

Plains is largest containing 15 districts, to make district-wise analyses easier this was further divided into two zones, namely, Northern Chhattisgarh Plains adjoining Northern Hills climatic zone and Southern Chhattisgarh Plains adjoining the Bastar Plateau climatic zone. According to these Agro-climatic groups the district-wise graphical presentation of area of the crops under study have been made in this section.

Graphical assessment of area of Arhar

The graphical presentation has been made in the following order:

1. The combined graphical status of Arhar for all the zones combined, i.e., of Chhattisgarh is presented in Fig. .1.
2. The graphical status of the Northern Hills Agro-climatic zone of Chhattisgarh is presented in Fig. 2
3. The graphical status of Northern Chhattisgarh Plains Agro-climatic zone adjoining Northern Hills of Chhattisgarh is presented in Fig. 3
4. The graphical status of Southern Chhattisgarh Plains Agro-climatic zone adjoining Bastar Plateau of Chhattisgarh is presented in Fig. .4
5. The graphical status of Bastar Plateau Agro-climatic zone of Chhattisgarh is presented in Fig. .5

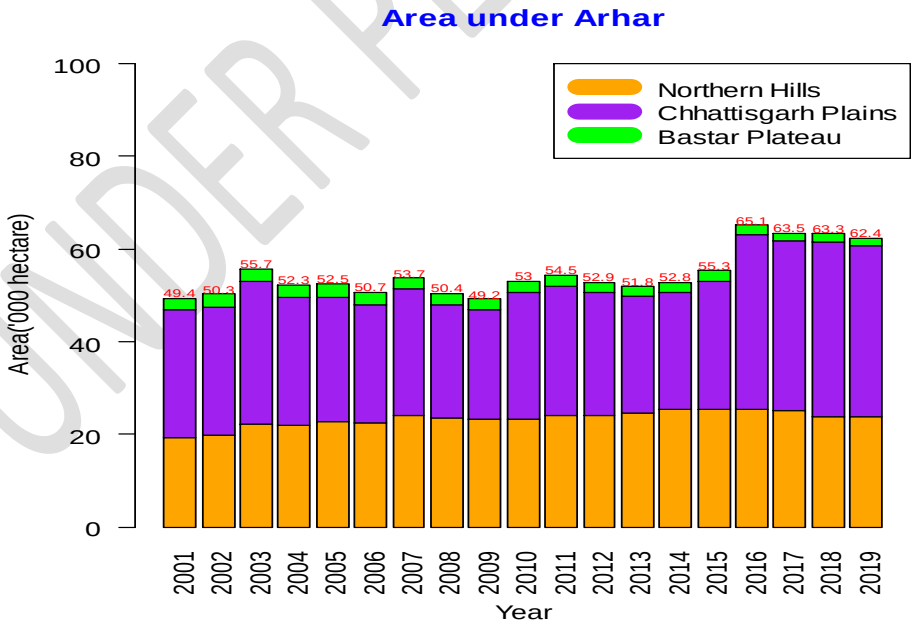

Fig. .1: Area under Arhar

On perusal of Fig. .1, the following may be concluded:

1. The maximum area coverage of Arhar has been observed to be 551.39 (‘000 ha) (53%) in Chhattisgarh Plains on the average followed by Northern Hills with 443.63 (‘000 ha) (43%) on the average and Bastar Plateau with 44 (‘000 ha) (4%) on the average. However, for a particular year, the maximum area coverage was 37.93 (‘000 ha) (60%) in 2017-18 in Chhattisgarh plains, 25.47 (‘000 ha) (39%) in 2014-15-16 in Northern Hills and 2.85 (‘000 ha) (5.54%) in 2003-04 in Bastar plateau.
2. The area under Arhar in Chhattisgarh was maximum (65.1 ‘000 ha) in 2014-15 with maximum contribution from Chhattisgarh Plains; which was minimum (49.2 ‘000 ha) in 2008-09.
3. The area coverage of Arhar in Bastar plateau has almost been uniformed to the average level of 2.32 (‘000 ha).
4. The area coverage of Arhar in Northern Hills too has been more or less same with a nominal increase from 2000-01 (19.17 ‘000 ha) to 2018-19 (23.83 ‘000 ha) around the average level of 23.34 (‘000 ha).

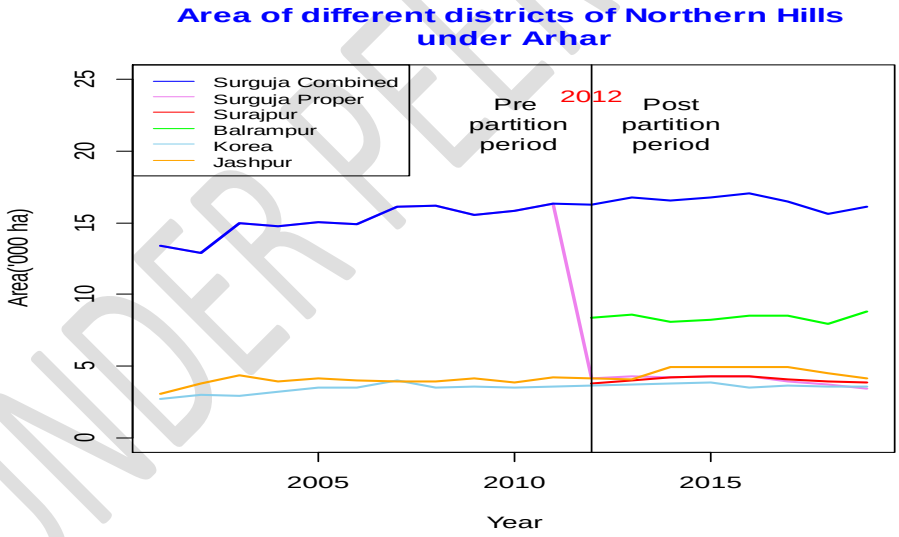

Fig. 2: Area of different districts of Northern Hills under Arhar

On perusal of Fig..2, the following may be inferred about the area coverage of Arhar in Northern Hills:

1. Before 2012: In decreasing order, the area coverage of the districts under Arhar has been sequentially of Surguja (165.86 ‘000 ha), Jashpur (43.32 ‘000 ha) and Korea (36.96 ‘000 ha).

2. After 2012: The area coverage of the districts under Arhar in decreasing order has been sequentially of Balrampur (67.02 ‘000 ha), Jashpur (36.58 ‘000 ha), Surajpur (32.33 ‘000 ha), Surguja (32.3 ‘000 ha) and Korea (29.26 ‘000 ha).
3. Surguja had increasing trend in area under Arhar up to 2010-11 after which its area started decreasing. *It may be noted that prior to 2011-12, most of the area contribution in Surguja was due to Balrampur and Surajpur, however, after partition in 2011-12, the area under Arhar in Surguja fell even below Balrampur.*
4. There is no noticeable trend in the area coverage of Arhar in Surajpur and Balrampur in post 2011-12 partition period, while Jashpur and Korea showed no trend in area in both and pre and post partition 2011-12 periods.

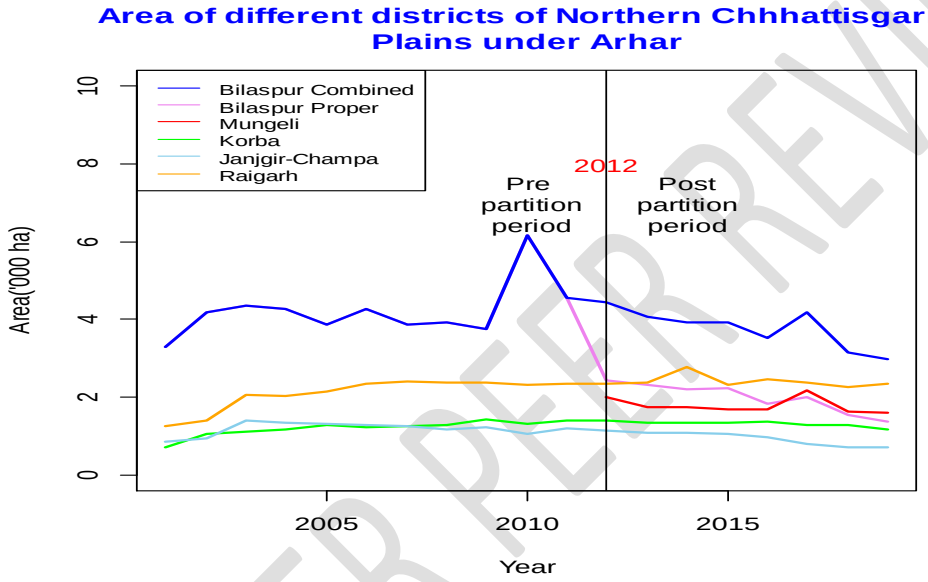

Fig. .3: Area of different districts of Northern Chhattisgarh Plains under Arhar

According to Fig. .3, the following can be deduced regarding the area coverage of Arhar in the Northern Chhattisgarh Plains:

1. Before 2012: The districts arranged in descending order of area coverage before the partition year 2011-12 were Bilaspur (46.45 ‘000 ha), Raigarh (23.02 ‘000 ha), Korba (13.18 ‘000 ha) and Janjgir-Champa (13.06 ‘000 ha).
2. After 2012: Similarly, the districts arranged in decreasing order for post partition year 2011-12 were Raigarh (19.21 ‘000 ha), Bilaspur (15.92 ‘000 ha), Mungeli (14.26 ‘000 ha), Korba (10.51 ‘000 ha) and Janjgir-Champa (7.5 ‘000 ha).
3. Janjgir-Champa has been showing decreasing trend.

4. Bilaspur had increasing trend in area under Arhar up to 2009-10 and after that its area started decreasing.
5. Korba showed slight increasing trend in pre partition period.
6. There is no noticeable trend in the area coverage of Arhar in Mungeli in post 2011-12 partition period, while Raigarh showed no trend in area in both and pre and post partition 2011-12 periods.

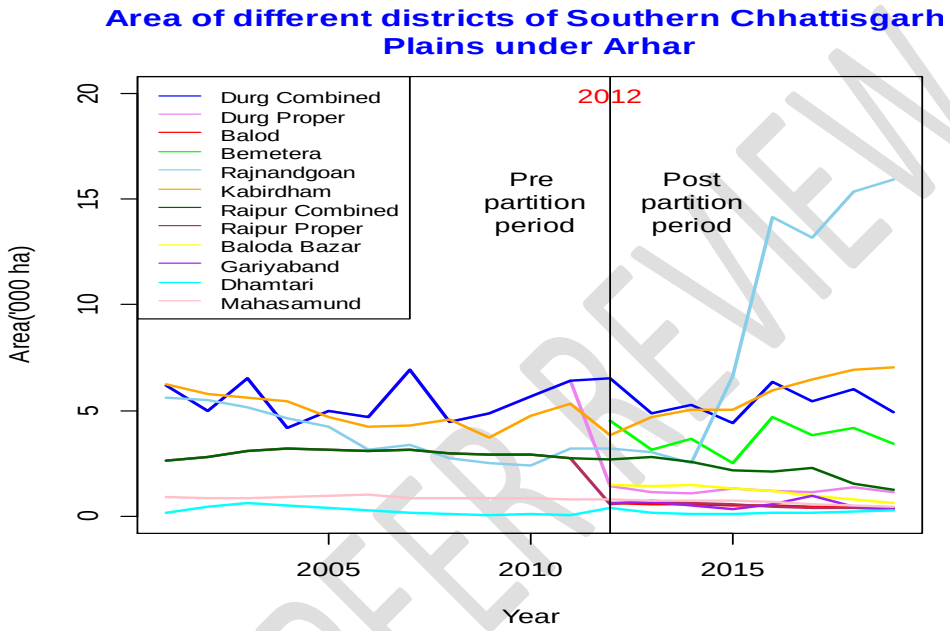

Fig. .4: Area of different districts of Southern Chhattisgarh Plains under Arhar

According to Fig. .4, the following can be determined about area coverage of the Arhar in the Southern Chhattisgarh Plains:

1. Before 2012: In decreasing order, the area coverage of the districts under Arhar has been sequentially of Durg (59.75 '000 ha), Kabirdham (54.6 '000 ha), Rajnandgoan (42.44 '000 ha), Raipur (32.56 '000 ha), Mahasamund (9.57 '000 ha) and Dhamtari (2.77 '000 ha).
2. After 2012: In descending order, the area coverage of the districts under Arhar has been sequentially of Rajnandgoan (74.02 '000 ha), Kabirdham (44.93 '000 ha), Bemetera (29.9 '000 ha), Durg (9.74 '000 ha), Baloda Bazar (9.19 '000 ha), Mahasamund (5.05 '000 ha), Gariyaband (4.27 '000 ha), Balod (4.02 '000 ha), Raipur (3.91 '000 ha) and Dhamtari (1.56 '000 ha).

3. Raipur and Baloda Bazar have been showing nominal decreasing trend.
4. In Kabirdham, there were nominal decreasing trend in pre-2011-12 partition period on the average, while this situation slightly improved to increasing trend on the average in the post partition 2011-12 period.
5. In Rajnandgoan, there were nominal decreasing trend in pre-2011-12 partition period on the average, while this situation got completely transformed to increasing trend on the average in the post partition 2011-12 period.
6. In Durg, there were no noticeable trend in both pre and post partition 2011-12 period. *However, it was observed that its major constituent district was Bemetera, whose area under Arhar was higher than Durg itself after the 2011-12 partition period, although another constituent district of Durg, namely, Balod had lesser contribution to Arhar area after partition period in 2011-12.*
7. There is no noticeable trend in the area coverage of Arhar in Balod, Bemetera and Gariyaband in post 2011-12 partition period, while Dhamtari and Mahasamund showed no trend in area in both and pre and post partition 2011-12 periods.

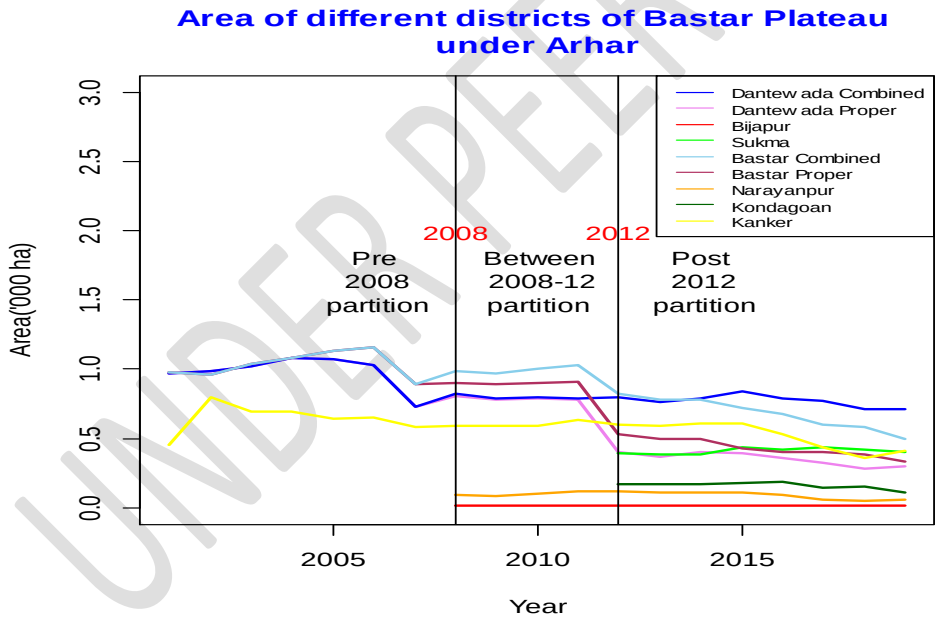

Fig. .5: Area of different districts of Bastar Plateau under Arhar

Followed by an analysis of Fig. .5, the following conclusions can be drawn regarding area coverage of Arhar in Bastar Plateau:

1 Before 2008: The districts arranged in descending order of area coverage before the partition year 2007-08 were Bastar (7.24 ‘000 ha), Dantewada (6.89 ‘000 ha) and Kanker (4.5 ‘000 ha).

2 Between 2008-12: The districts arranged in descending order of area coverage before the partition year 2011-12 were Bastar (3.6 ‘000 ha), Dantewada (3.16 ‘000 ha), Kanker (2.4 ‘000 ha), Narayanpur (0.39 ‘000 ha) and Bijapur (0.04 ‘000 ha).

3 After 2012: Similarly, the districts arranged in decreasing order for post partition year 2011-12 were Kanker (4.15 ‘000 ha), Bastar (3.47 ‘000 ha), Sukma (3.27 ‘000 ha), Dantewada (2.82 ‘000 ha), Kondagoan (1.28 ‘000 ha), Narayanpur (0.71 ‘000 ha) and Bijapur (0.08 ‘000 ha).

4 Narayanpur had a slight increasing trend up to the partition year 2011-12 after which it showed to slight decreasing trend.

5 Kanker displayed slight decreasing trend continuously throughout the study period from 2000-01 to 2018-19.

6 Bastar combined had slight increasing trend up to 2007-08 and after that it started a decreasing trend when Narayanpur was separated from it, between 2007-08 to 2011-12, beyond which it again had a decreasing trend when Kondagaon was also further separated from it.

7 Dantewada displayed decreasing trend continuously through the study period from 2000-01 to 2018-19. It was observed that decrease in area under crop in Dantewada is mainly due to its component district Sukma.

8 There is no noticeable trend in the area coverage of Arhar in Bijapur in post 2007-08 period and Sukma and Kondagoan had the same too in post 2011-12 period.

Graphical assessment of the area of Maize

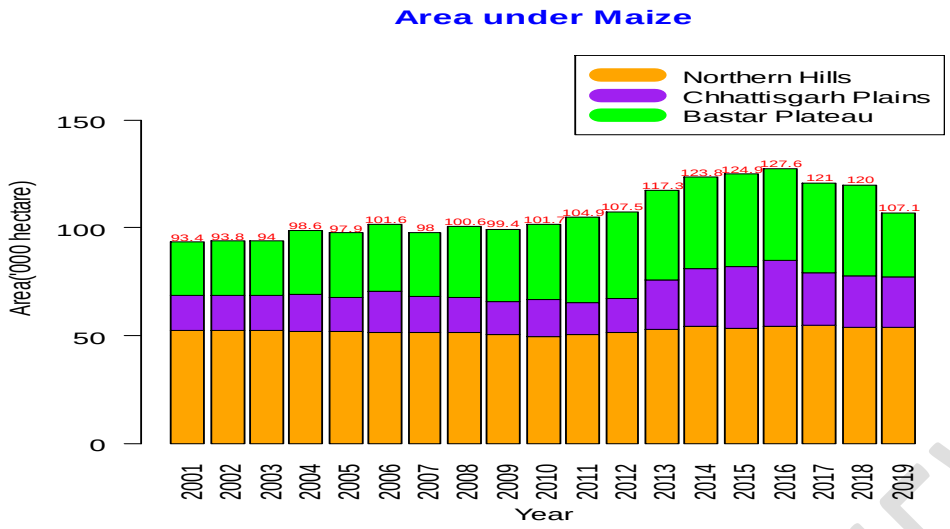

Fig. 6: Area under Maize

On perusal of Fig. .6, the following may be concluded:

1 The maximum area coverage of Maize has been observed to be 994.62 (‘000 ha) (50%) in Northern Hills on the average followed by Bastar Plateau with 659.69 (‘000 ha) (32%) on the average and Chhattisgarh Plains with 378.83 (‘000 ha) (18%) on the average. However, for a particular year, the maximum area coverage was 30.68 (‘000 ha) (24%) in 2014-15-16 in Chhattisgarh plains, 55.02 (‘000 ha) (45%) in 2016-17 in Northern Hills and 42.67 (‘000 ha) (34%) in 2014-15 in Bastar plateau.

2 The area under Maize in Chhattisgarh was maximum (127.6 ‘000 ha) in 2014-15-16 with maximum contribution from Chhattisgarh Plains; and was minimum (93.4 ‘000 ha) in 2000-01.

3 The area coverage of Northern Hills to Maize has been almost uniform to the average level of 52.35 (‘000 ha).

4 The area coverage of Bastar Plateau to Maize has been almost increasing throughout the study period from (24.71 ‘000 ha) in 2000-01 to (29.61 ‘000 ha) in 2018-19.

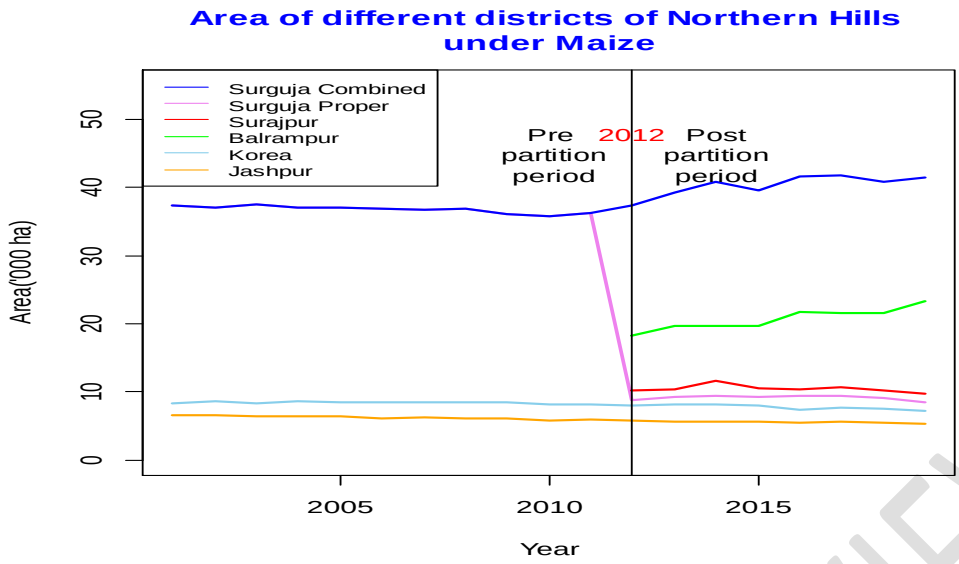

Fig. 7: Area of different districts of Northern Hills under Maize

The following are the findings drawn from Fig. .7 regarding the area coverage of Maize in Northern Hills:

1 Before 2012: In decreasing order, the area coverage of the districts under Maize has been sequentially of Surguja (404.59 '000 ha), Korea (92.23 '000 ha) and Jashpur (68.7 '000 ha).

2 After 2012: The area coverage of the districts under Maize in decreasing order has been sequentially of Balrampur (165.47 '000 ha), Surajpur (83.87 '000 ha), Surguja (73.09 '000 ha), Korea (62.2 '000 ha) and Jashpur (44.47 '000 ha).

3 Surguja had no trend in area under Maize. *However, it may be noted that prior to 2011-12, most of the area contribution in Surguja was due to Balrampur and Surajpur, however, after partition in 2011-12, the area under Maize in Surguja fell even below Balrampur and Surajpur.*

4 Balrampur showed increasing trend post 2011-*12* partition period.

5 There is no noticeable trend in the area coverage of Maize in Surajpur in post 2011-12 partition period, while Jashpur and Korea showed no trend in area in both and pre and post partition 2011-12 periods.

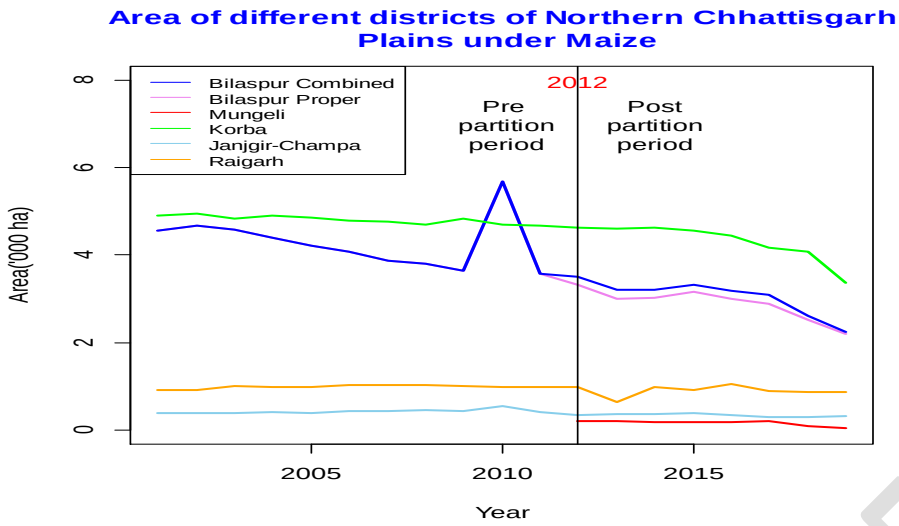

Fig. .8: Area of different districts of Northern Chhattisgarh Plains under Maize

According to Fig. 8, the following can be deduced regarding the area coverage of Maize in the Northern Chhattisgarh Plains:

1. Before 2012: The districts arranged in descending order of area coverage before the partition year 2011-12 were Korba (52.91 '000 ha), Bilaspur (47.1 '000 ha), Raigarh (10.79 '000 ha) and Janjgir-Champa (4.59 '000 ha).
2. After 2012: Similarly, the districts arranged in decreasing order for post partition year 2011-12 were Korba (34.51 '000 ha), Bilaspur (23.1 '000 ha), Raigarh (7.18 '000 ha), Janjgir-Champa (2.67 '000 ha) and Mungeli (1.26 '000 ha).
3. Bilaspur and Korba has been showing decreasing trend in area under Maize throughout the study period.
4. There is no noticeable trend in the area coverage of Maize in Mungeli in post 2011-12 partition period, while Raigarh and Janjgir-Champa showed no trend in area in both and pre and post partition 2011-12 periods.

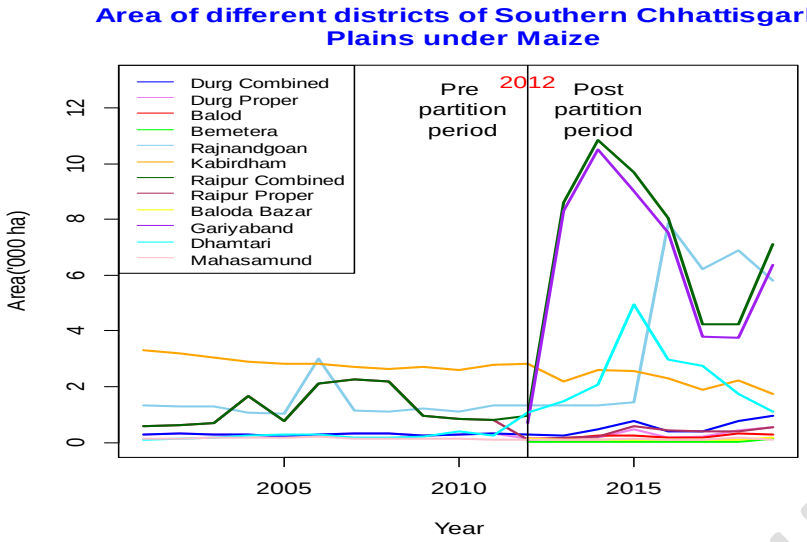

Fig. 9: Area of different districts of Southern Chhattisgarh Plains under Maize

According to Fig. .9, the following can be determined about area coverage of the Maize in the Southern Chhattisgarh Plains:

1. Before 2012: In decreasing order, the area coverage of the districts under Maize has been sequentially of Kabirdham (31.47 '000 ha), Rajnandgoan (14.95 '000 ha), Raipur (13.45 '000 ha), Durg (3.2 '000 ha), Dhamtari (2.47 '000 ha) and Mahasamund (1.63 '000 ha).
2. After 2012: In descending order, the area coverage of the districts under Maize has been sequentially of Gariyaband (74.02 '000 ha), Rajnandgoan (44.93 '000 ha), Kabirdham (29.9 '000 ha), Dhamtari (9.74 '000 ha), Raipur (9.19 '000 ha), Durg (5.05 '000 ha), Balod (4.27 '000 ha), Mahasamund (4.02 '000 ha), Baloda Bazar (3.91 '000 ha) and Bemetera (1.56 '000 ha).
3. Kabirdham have been showing decreasing trend in area under Maize.
4. Rajnandgoan and Gariyaband showed increasing trend in area under Maize in post 2011-12 partition period.
5. In Dhamtari, it was observed that in post 2011-12 partition period it first showed increasing trend upto 2014-15 but decreasing trend thereafter.
6. In Raipur, there was no noticeable trend in pre-2011-12 partition period while increasing trend was observed in post partition 2011-12 period. *It was observed that its major constituent district was Gariyaband, whose area under Maize was higher than Raipur itself after the 2011-12 partition period, although another constituent district of Raipur, namely, Balod Bazar had lesser contribution to Maize area after partition period in 2011-12.*

7. There is no noticeable trend in the area coverage of Maize in Balod, Bemetera and Baloda Bazar in post 2011-12 partition period, while Durg and Mahasamund showed no trend in area in both and pre and post partition 2011-12 periods.

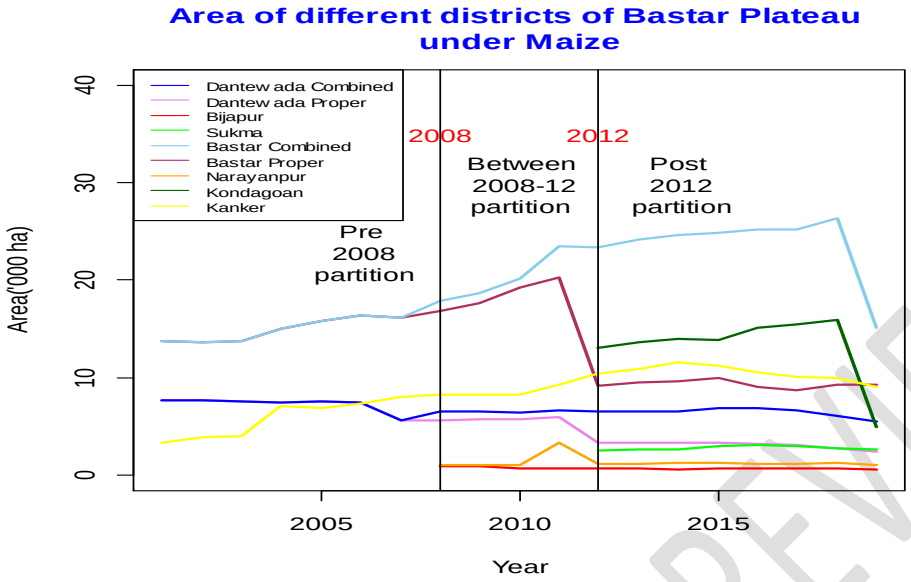

Fig. 10: Area of different districts of Bastar Plateau under Maize

Followed by an analysis of Fig. 10, the following conclusions can be drawn regarding area coverage of Maize in Bastar Plateau:

1. Before 2008: The districts arranged in descending order of area coverage before the partition year 2007-08 were Bastar (104.54 '000 ha), Dantewada (50.68 '000 ha) and Kanker (40.3 '000 ha).
2. Between 2008-12: The districts arranged in descending order of area coverage before the partition year 2011-12 were Bastar (73.98 '000 ha), Kanker (33.99 '000 ha), Dantewada (22.93 '000 ha), Narayanpur (6.22 '000 ha) and Bijapur (3.1 '000 ha).
3. After 2012: Similarly, the districts arranged in decreasing order for post partition year 2011-12 were Kondagoan (105.73 '000 ha), Kanker (83.51 '000 ha), Bastar (74.42 '000 ha), Dantewada (24.63 '000 ha), Sukma (21.9 '000 ha), Narayanpur (8.92 '000 ha) and Bijapur (4.84 '000 ha).
4. Kanker and Kondagoan showed increasing trend in the area under Maize.
5. Bastar had slight increasing trend up to 2010-11 and after that it started a decreasing trend when Kondagaon was separated from it in 2011-12, beyond which it had no trend in area under Maize.

6. Dantewada displayed decreasing trend continuously through the study period from 2000-01 to 2018-19. It was observed that decrease in area under crop in Dantewada is mainly due to its component district Sukma.
7. There is no noticeable trend in the area coverage of Maize in Bijapur and Narayanpur in post 2007-08 period and Sukma had the same in post 2011-12 period.

Graphical assessment of area of Moong

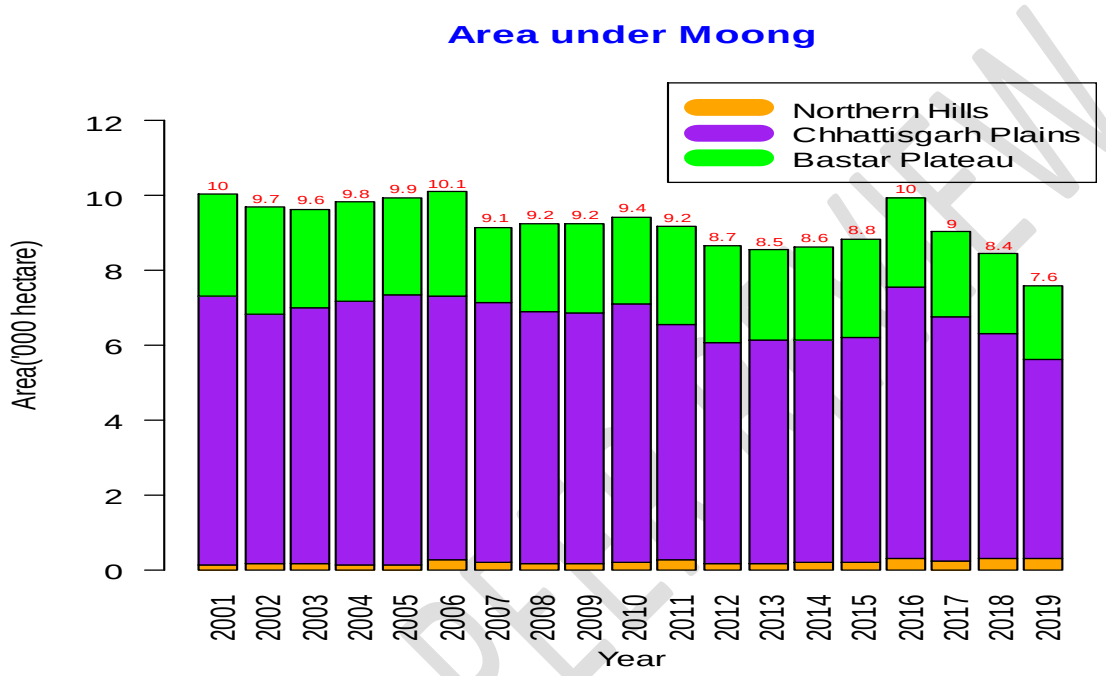

Fig 11: Area under Moong

On perusal of Fig. .11, the following may be concluded:

1. The maximum area coverage of Moong has been observed to be 124.56 (‘000 ha) (71%) in Chhattisgarh Plains on the average followed by Bastar Plateau with 46.8 (‘000 ha) (27%) on the average and Northern Hills with 3.69 (‘000 ha) (2%) on the average. However, for a particular year, the maximum area coverage was 7.25 (‘000 ha) (73%) in 2014-15-16 in Chhattisgarh plains, 0.29 (‘000 ha) (3%) in 2014-15-16 in Northern Hills and 2.84 (‘000 ha) (29%) in 2001-02 in Bastar plateau.
2. The area under Moong in Chhattisgarh was maximum (10.1 ‘000 ha) in 2005-06 with maximum contribution from Chhattisgarh Plains; and was minimum (7.6 ‘000 ha) in 2018-19.
3. The area coverage of Bastar Plateau to Moong has been almost uniform to the average level of 2.46 (‘000 ha).

4. The area coverage of Northern Hills to Moong has been almost increasing throughout the study period from (0.13 ‘000 ha) in 2000-01 to (0.29 ‘000 ha) in 2018-19.

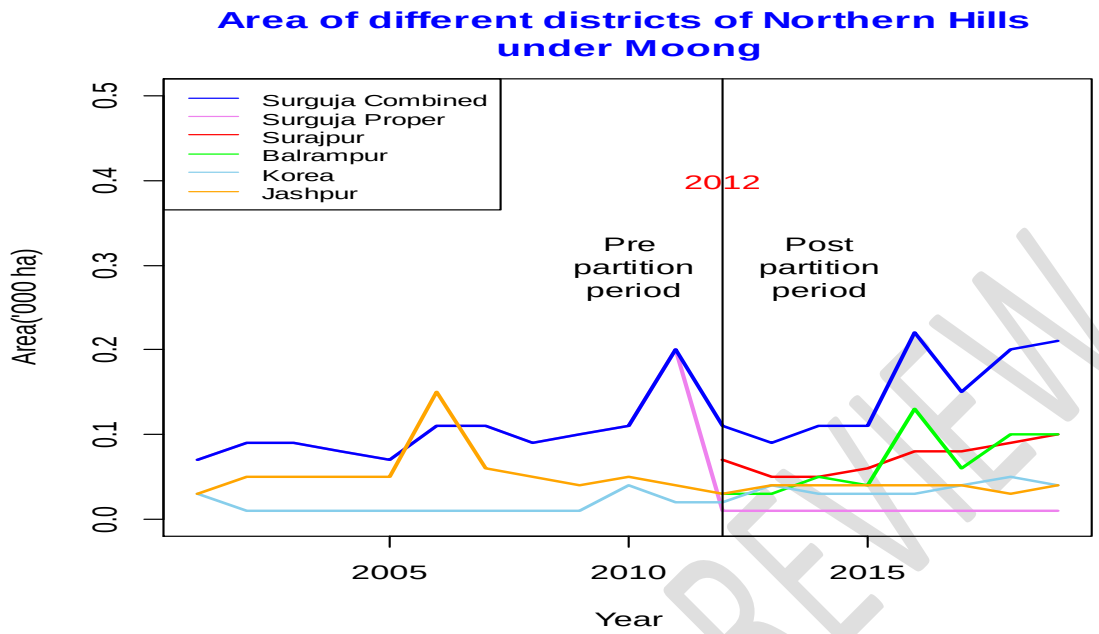

Fig. .12: Area of different districts of Northern Hills under Moong

The following are the findings drawn from Fig. .12 regarding the area coverage of Moong in Northern Hills:

1. Before 2012: In decreasing order, the area coverage of the districts under Moong has been sequentially of Surguja (1.12 ‘000 ha), Jashpur (0.62 ‘000 ha) and Korea (0.17 ‘000 ha).
2. After 2012: The area coverage of the districts under Moong in decreasing order has been sequentially of Surajpur (0.58 ‘000 ha), Balrampur (0.54 ‘000 ha), Korea (0.28 ‘000 ha), Surguja (0.08 ‘000 ha) and Jashpur (0.3 ‘000 ha).
3. Surguja had increasing trend in area under Moong in pre-2011-12 period but after that it showed no trend. *However, it may be noted that prior to 2011-12, most of the area contribution in Surguja was due to Surajpur and Balrampur, however, after partition in 2011-12, the area under* Moong *in Surguja fell even below Balrampur and Surajpur.*
4. Balrampur, Surajpur and Korea showed increasing trend post 2011-*12* partition period.
5. There is no noticeable trend in the area coverage of Moong in Jashpur in both and pre and post partition 2011-12 periods.

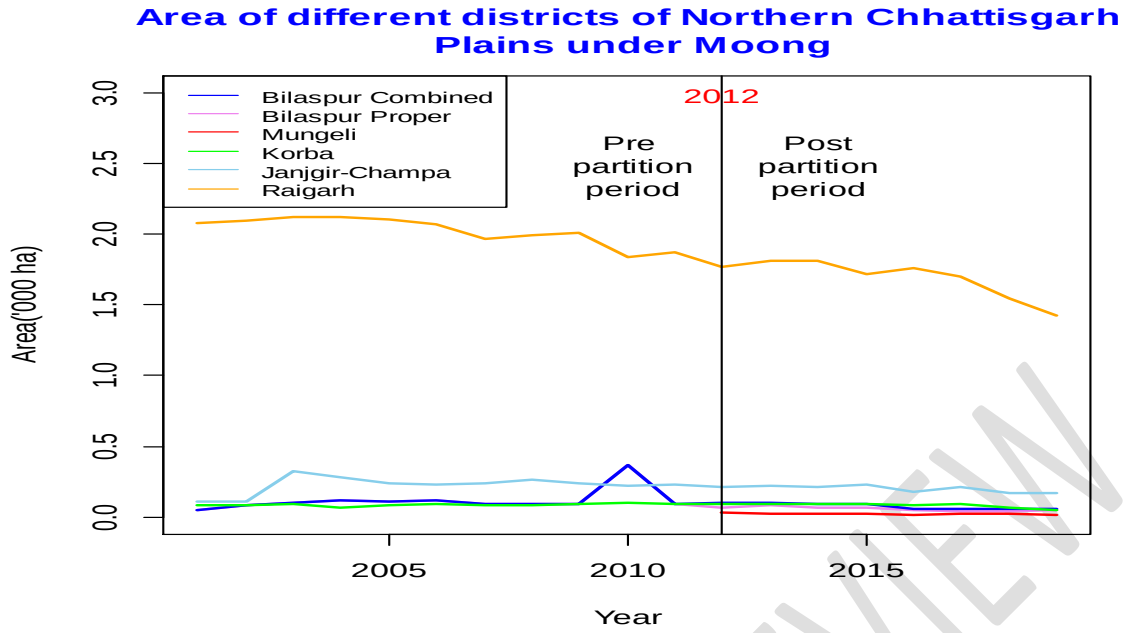

Fig. .13: Area of different districts of Northern Chhattisgarh Hills under Moong

According to Fig. .13, the following can be deduced regarding the area coverage of Moong in the Northern Chhattisgarh Plains:

1. Before 2012: The districts arranged in descending order of area coverage before the partition year 2011-12 were Raigarh (22.28 '000 ha), Janjgir-Champa (2.48 '000 ha), Bilaspur (1.31 '000 ha) and Korba (0.93 '000 ha).
2. After 2012: Similarly, the districts arranged in decreasing order for post partition year 2011-12 were Raigarh (13.55 '000 ha), Janjgir-Champa (1.6 '000 ha), Korba (0.65 '000 ha), Bilaspur (0.47 '000 ha) and Mungeli (0.15 '000 ha).
3. Bilaspur has been showing decreasing trend in area under Moong in post 2011-12 partition period, while Raigarh showed decreasing trend in area in both and pre and post partition 2011-12 periods.
4. There is no noticeable trend in the area coverage of Moong in Mungeli in post 2011-12 partition period, while Korba and Janjgir-Champa showed no trend in area in both and pre and post partition 2011-12 periods.

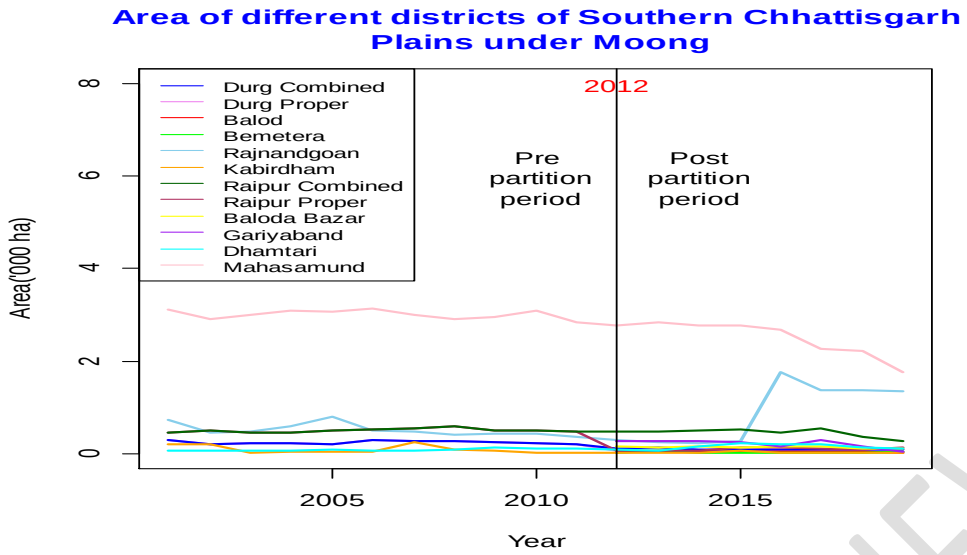

Fig. .14: Area of different districts of Southern Chhattisgarh Hills under Moong

According to Fig. .14, the following can be determined about area coverage of the Moong in the Southern Chhattisgarh Plains:

1. Before 2012: In decreasing order, the area coverage of the districts under Moong has been sequentially of Mahasamund (33.1 '000 ha), Rajnandgoan (5.6 '000 ha), Raipur (5.46 '000 ha), Durg (2.63 '000 ha), Kabirdham (0.92 '000 ha) and Dhamtari (0.87 '000 ha).
2. After 2012: In descending order, the area coverage of the districts under Moong has been sequentially of Mahasamund (20.1 '000 ha), Rajnandgoan (6.87 '000 ha), Gariyaband (1.7 '000 ha), Dhamtari (1.13 '000 ha), Baloda Bazar (1.08 '000 ha), Raipur (0.8 '000 ha), Durg (0.31 '000 ha), Balod (0.26 '000 ha), Bemetera (0.17 '000 ha) and Kabirdham (0.14 '000 ha).
3. Mahasamund have been showing decreasing trend in area under Moong throughout the study period.
4. Rajnandgoan showed slight decreasing trend in area under Moong upto 2014-15 but 2014-15 onwards increasing trend was observed.
5. In Raipur, there was no noticeable trend in pre and post partition 2011-12 period. *It was observed that its major constituent district was Gariyaband, whose area under* Moong *was higher than Raipur itself after the 2011-12 partition period, although another constituent district of Raipur, namely, Balod Bazar had lesser contribution to* Moong *area after partition period in 2011-12.*

6. There is no noticeable trend in the area coverage of Moong in Balod, Bemetera, Gariyaband and Baloda Bazar in post 2011-12 partition period, while Durg, Kabirdham and Dhamtari showed no trend in area in both and pre and post partition 2011-12 periods.

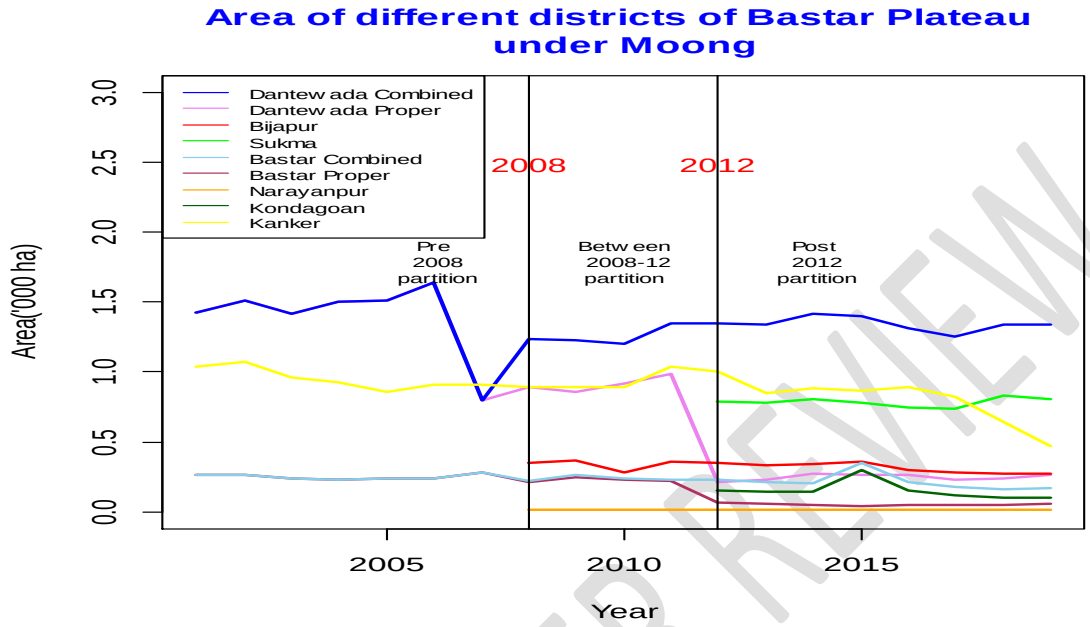

Fig. .15: Area of different districts of Bastar Plateau under Moong

Followed by an analysis of Fig. .15, the following conclusions can be drawn regarding area coverage of Moong in Bastar Plateau:

1. Before 2008: The districts arranged in descending order of area coverage before the partition year 2007-08 were Dantewada (9.81 '000 ha), Kanker (6.68 '000 ha) and Bastar (1.75 '000 ha).
2. Between 2008-12: The districts arranged in descending order of area coverage before the partition year 2011-12 were Kanker (3.71 '000 ha), Dantewada (3.66 '000 ha), Bijapur (1.36 '000 ha), Bastar (0.91 '000 ha) and Narayanpur (0.04 '000 ha).
3. After 2012: Similarly, the districts arranged in decreasing order for post partition year 2011-12 were Kanker (6.42 '000 ha), Sukma (6.29 '000 ha), Bijapur (2.5 '000 ha), Dantewada (1.96 '000 ha), Kondagoan (1.2 '000 ha), Bastar (0.43 '000 ha) and Narayanpur (0.08 '000 ha).
4. Kanker showed decreasing trend in the area under Moong in post 2011-12 partition period.
5. Bastar had no trend in area under crop but when Kondagaon was separated from it in 2011-12, there is sudden fall in area under Moong.

6. Dantewada displayed decreasing trend continuously through the study period from 2000-01 to 2018-19. It was observed that decrease in area under crop in Dantewada is mainly due to its component district Sukma.
7. There is no noticeable trend in the area coverage of Moong in Bijapur and Narayanpur in post 2007-08 period and Sukma and Kondagoan had the same in post 2011-12 period.

Graphical assessment of area of Sesamum

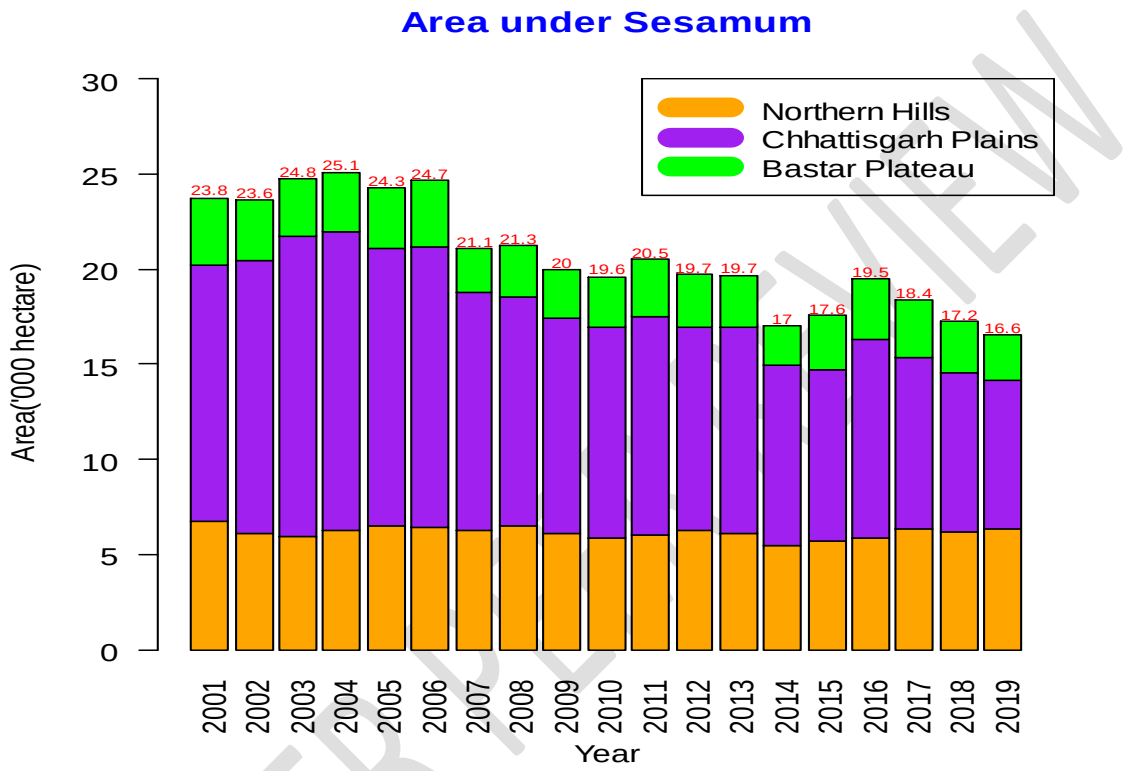

Fig. .16: Area under Sesamum

On perusal of Fig. 16, the following may be concluded:

1. The maximum area coverage of Sesamum has been observed to be 222.51 (‘000 ha) (56%) in Chhattisgarh Plains on the average followed by Northern Hills with 117.12 (‘000 ha) (30%) on the average and Bastar Plateau with 54.61 (‘000 ha) (14%) on the average. However, for a particular year, the maximum area coverage was 15.75 (‘000 ha) (64%) in 2002-03 in Chhattisgarh plains, 6.73 (‘000 ha) (28%) in 2000-01 in Northern Hills and 3.51 (‘000 ha) (15%) in 2000-01 in Bastar plateau.

2. The area under Sesamum in Chhattisgarh was maximum (25.1 ‘000 ha) in 2003-04 with maximum contribution from Chhattisgarh Plains; and was minimum (16.6 ‘000 ha) in 2018-19.
3. The area coverage of Bastar Plateau to Sesamum has been almost decreasing throughout the study period from (3.51 ‘000 ha) in 2000-01 to (2.41 ‘000 ha) in 2018-19.
4. The area coverage of Chhattisgarh Plains to Sesamum has been almost decreasing throughout the study period from (13.51 ‘000 ha) in 2000-01 to (7.83 ‘000 ha) in 2018-19.

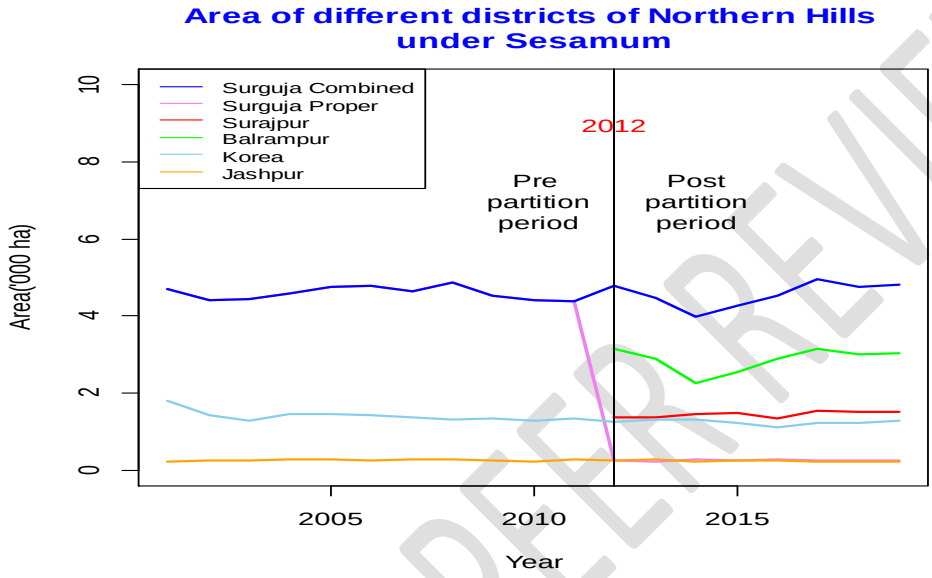

Fig. .17: Area of different districts of Northern Hills under Sesamum

The following are the findings drawn from Fig. .17 regarding the area coverage of Sesamum in Northern Hills:

1. Before 2012: In decreasing order, the area coverage of the districts under Sesamum has been sequentially of Surguja (50.48 ‘000 ha), Korea (15.47 ‘000 ha) and Jashpur (2.82 ‘000 ha).
2. After 2012: The area coverage of the districts under Sesamum in decreasing order has been sequentially of Balrampur (22.93 ‘000 ha), Surajpur (11.55 ‘000 ha), Korea (9.92 ‘000 ha), Surguja (2.04 ‘000 ha) and Jashpur (1.91 ‘000 ha).
3. Surguja had no trend in area under Sesamum in both pre and post 2011-12 period. *However, it may be noted that prior to 2011-12, most of the area contribution in Surguja was due to Balrampur and Surajpur, however, after partition in 2011-12, the area under Sesamum in Surguja fell even below Balrampur and Surajpur.*

4. There is no noticeable trend in the area coverage of Sesamum in Surajpur and Balrampur in post partition 2011-12 period while Jashpur, Korea and Surguja showed same in both and pre and post partition 2011-12 periods.

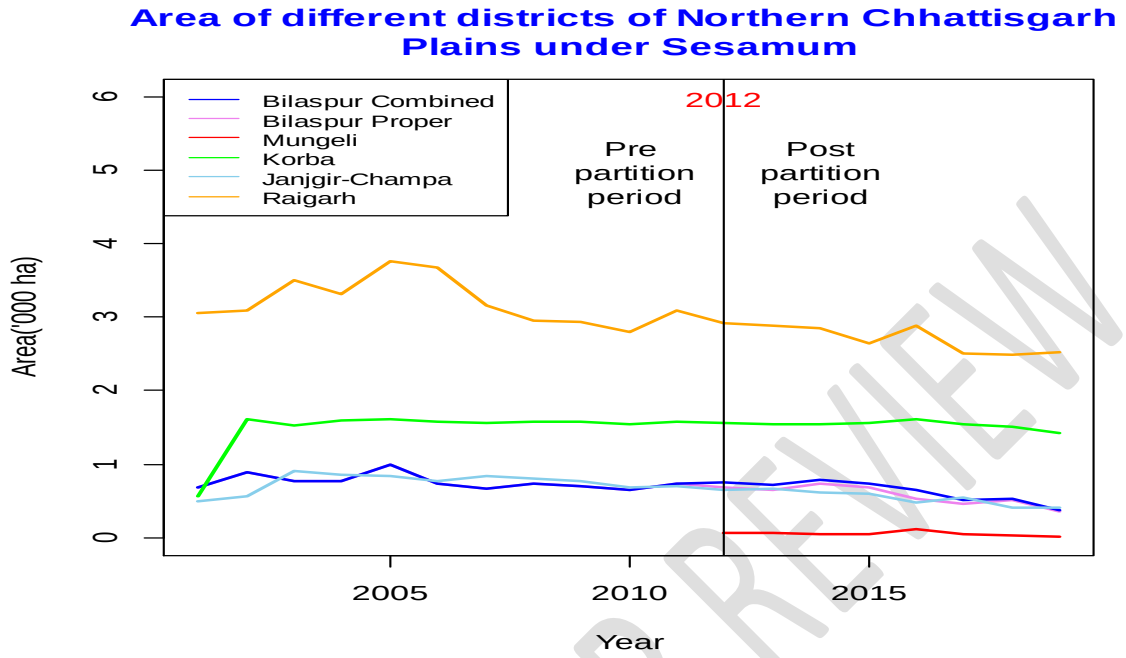

Fig. .18: Area of different districts of Northern Chhattisgarh Plains under Sesamum

According to Fig. 18, the following can be deduced regarding the area coverage of Sesamum in the Northern Chhattisgarh Plains:

1. Before 2012: The districts arranged in descending order of area coverage before the partition year 2011-12 were Raigarh (35.38 '000 ha), Korba (16.31 '000 ha), Bilaspur (8.33 '000 ha) and Janjgir-Champa (8.2 '000 ha).
2. After 2012: Similarly, the districts arranged in decreasing order for post partition year 2011-12 were Raigarh (21.71 '000 ha), Korba (12.32 '000 ha), Bilaspur (4.61 '000 ha), Janjgir-Champa (4.36 '000 ha) and Mungeli (0.41 '000 ha).
3. Bilaspur has been showing decreasing trend in area under Sesamum in post 2011-12 partition period, while Raigarh and Janjgir-Champa showed decreasing trend in area in both and pre and post partition 2011-12 periods.
4. There is no noticeable trend in the area coverage of Sesamum in Mungeli in post 2011-12 partition period, while Korba showed no trend in area in both and pre and post partition 2011-12 periods.

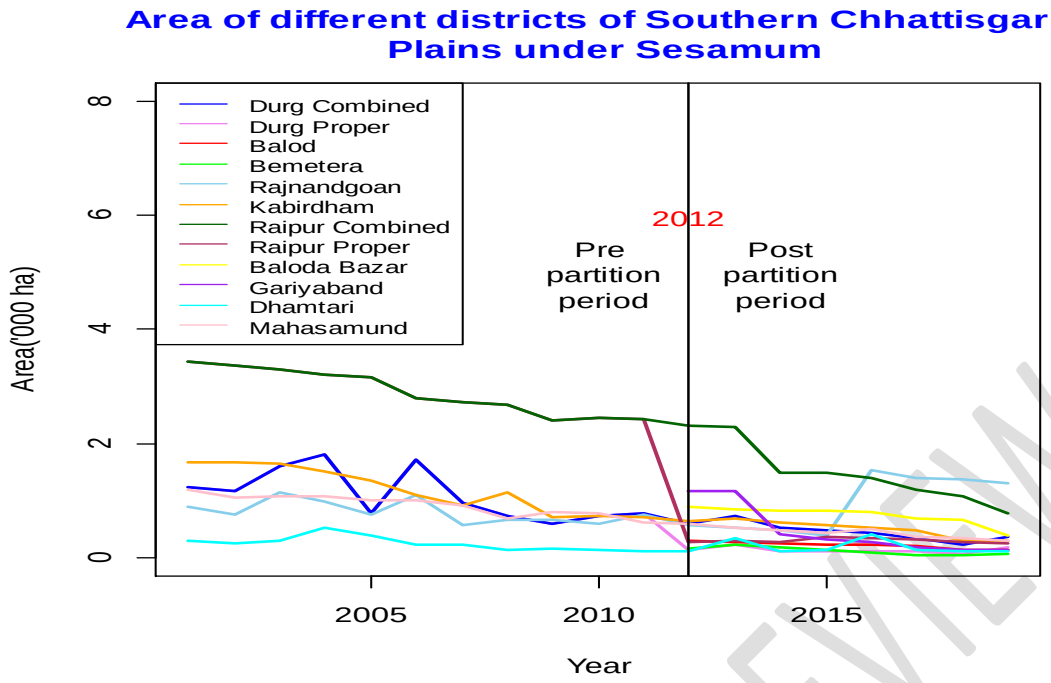

Fig. 19: Area of different districts of Southern Chhattisgarh Plains under Sesamum

According to Fig. .19, the following can be determined about area coverage of the Sesamum in the Southern Chhattisgarh Plains:

1. Before 2012: In decreasing order, the area coverage of the districts under Sesamum has been sequentially of Raipur (31.93 '000 ha), Kabirdham (13.12 '000 ha), Durg (12.09 '000 ha), Mahasamund (10.14 '000 ha), Rajnandgoan (8.81 '000 ha) and Dhamtari (2.66 '000 ha).
2. After 2012: In descending order, the area coverage of the districts under Sesamum has been sequentially of Rajnandgoan (7.55 '000 ha), Baloda Bazar (5.88 '000 ha), Kabirdham (4.05 '000 ha), Gariyaband (3.77 '000 ha), Mahasamund (3.49 '000 ha), Raipur (2.35 '000 ha), Balod (1.73 '000 ha), Dhamtari (1.42 '000 ha), Durg (1 '000 ha) and Bemetera (0.89 '000 ha).
3. Mahasamund and Kabirdham have been showing decreasing trend in area under Sesamum throughout the study period, while Gariyaband, Baloda Bazar and Bemetera showed the same in post 2011-12 partition period.
4. Rajnandgoan showed slight decreasing trend in area under Sesamum upto 2014-15 but 2014-15 onwards increasing trend was observed.
5. In Raipur, there was decreasing trend in pre partition 2011-12 period, while no trend was observed in post partition 2011-12 period. *It was observed that its major constituent*

districts were Gariyaband and Baloda Bazar, whose area under Sesamum were higher than Raipur itself after the 2011-12 partition period.

6. In Durg, there was decreasing trend in pre partition 2011-12 period, while no trend was observed in post partition 2011-12 period. *It was observed that its major constituent district was Balod, whose area under Sesamum was higher than Durg itself after the 2011-12 partition period, although another constituent district of Durg, namely, Bemetera had lesser contribution to Sesamum area after partition period in 2011-12.*
7. There is no noticeable trend in the area coverage of Sesamum in Balod, in post 2011-12 partition period, while Dhamtari showed no trend in area in both and pre and post partition 2011-12 periods.

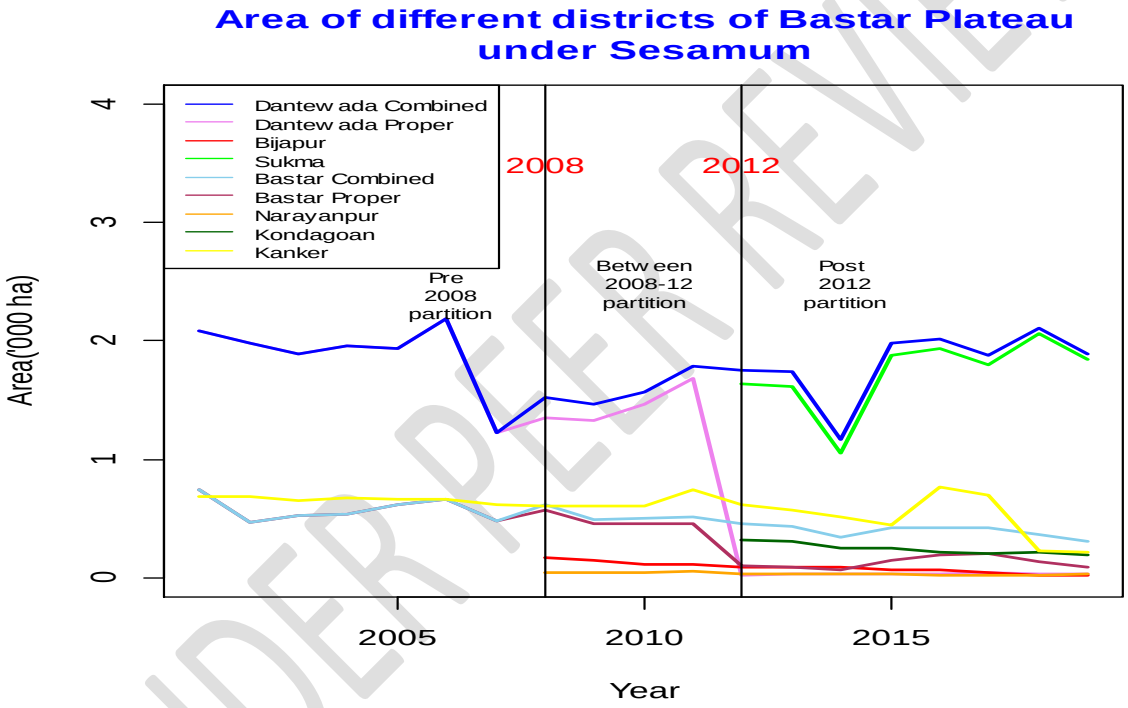

Fig. .20: Area of different districts of Bastar Plateau under Sesamum

Followed by an analysis of Fig. .20, the following conclusions can be drawn regarding area coverage of Sesamum in Bastar Plateau:

1. Before 2008: The districts arranged in descending order of area coverage before the partition year 2007-08 were Bastar (13.27 '000 ha), Dantewada (4.61 '000 ha) and Kanker (4.01 '000 ha).
2. Between 2008-12: The districts arranged in descending order of area coverage before the partition year 2011-12 were Dantewada (5.82 '000 ha), Kanker (2.54 '000 ha), Bastar (1.94 '000 ha), Bijapur (0.53 '000 ha) and Narayanpur (0.17 '000 ha).

3. After 2012: Similarly, the districts arranged in decreasing order for post partition year 2011-12 were Sukma (13.82 ‘000 ha), Kanker (4.03 ‘000 ha), Kondagoan (1.94 ‘000 ha), Bastar (1 ‘000 ha), Bijapur (0.48 ‘000 ha), Dantewada (0.24 ‘000 ha) and Narayanpur (0.21 ‘000 ha).
4. Sukma showed increasing trend in the area under Sesamum.
5. There is decreasing trend in the area coverage of Sesamum in Bijapur in post 2007-08 period and Kondagoan had the same in post 2011-12 period, while the same is observed in Kanker throughout the study period.
6. Bastar had slight decreasing trend upto 2011-12 partition and after that it again started a decreasing trend when Kondagaon was separated from it in 2011-12, beyond which it had no trend in the area under Sesamum.
7. Dantewada displayed a decreasing trend continuously through the study period from 2000-01 to 2018-19. It was observed that the decrease in area under crop in Dantewada is mainly due to its component district Sukma.
8. There is no noticeable trend in the area coverage of Sesamum in Narayanpur in post 2007-08 period.

Conclusions

Based on the objectives of the study and the methods of analysis, some general conclusions are outlined below

- Chhattisgarh- It was found that Maize and Arhar had increasing trends in the area during 2001-19 while Moong and Sesamum showed decreasing trends in the area during 2001-19.
- Chhattisgarh Plains- It is found that Arhar and Maize had increasing trends in the area during 2001-19 while Sesamum showed decreasing trends in the area during 2001-19. However, no trend was observed in area under Moong.
- Bastar Plateau- It is found that Maize had increasing trends in area during 2001-19 whileSesamum showed decreasing trend in area during 2001-19. However, no trend was observed in area under Moong, Arhar.
- Surguja- It is found that Moong, Arhar and Maize had increasing trends in area during 2001-19. However, no trend was observed in area under Sesamum.
- Surajpur- It is found that Moong had increasing trends in area during 2012-19. However, no trend was observed in area under Maize, Sesamum and Arhar.

- Balrampur- It is found that Moong and Maize had increasing trends in area during 2012-19. However, no trend was observed in area under Sesamum and Arhar.
- Korea- It is found that Moong had increasing trends in area during 2001-19. However, no trend was observed in area under Arhar, Maize and Sesamum.
- Bilaspur- It is found that Arhar, Maize, Moong and Sesamum showed decreasing trend in area during 2001-19.
- Korba- It is found that Arhar had increasing trends in area during 2001-19 while Maize showed decreasing trend in area during 2001-19. However, no trend was observed in area under Moong, Sesamum.
- Janjgir-Champa- It is found that Arhar and Sesamum had decreasing trends in area during 2001-19. However, no trend was observed in area under Moong and Maize.
- Raigarh- It is found that Moong and Sesamumshowed decreasing trend in area during 2001-19. However, no trend was observed in area under Arhar and Maize.
- Durg- It is found that Maize had increasing trends in area during 2001-19 while Sesamum, showed decreasing trend in area during 2001-19. However, no trend was observed in area under Moong and Arhar.
- Balod- It is found that no trend was observed in area under Arhar, Moong, Maize, Sesamum, during 2012-19.
- Raipur- It is found that Maize had increasing trends in area during 2001-19 while Arhar and Sesamumshowed decreasing trend in area during 2001-19. However, no trend was observed in area under Moong.
- Baloda Bazar- It is found that Arhar had decreasing trends in area during 2012-19 while no trend was observed in area under Moong, Maize and Sesamum.
- Gariyaband- It is found that Maize had increasing trends in area during 2012-19 while Sesamum had decreasing trends in area during 2012-19. However, no trend was observed in area under Arhar and Moong.
- Rajnandgoan- It is found that Arhar, Maize and Sesamum had increasing trends in area during 2001-19. However, no trend was observed in area under Moon.
- Kabirdham- It is found that Arhar had increasing trends in area during 2001-19 while Maize and Sesamumshowed decreasing trend in area during 2001-19. However, no trend was observed in area under Moong.
- Dhamtari- It is found that no trend was observed in area under Arhar, Sesamum Moong and Maizeduring 2001-19.

- Mahasamund- It is found that Moong showed decreasing trend in area during 2001-19. However, no trend was observed in area under Arhar, Maize andSesamum.
- Bastar- It is found that Maize had increasing trends in area during 2001-19 while Arharshowed decreasing trend in area during 2001-19. However, no trend was observed in area under Moong and Sesamum.
- Narayanpur- It is found that Arhar showed decreasing trend in area during 2008-19 while no trend was observed in area under Moong, Maize and Sesamum.
- Kondagoan-It is found that Maize had increasing trends in area during 2012-19 while Sesamum had increasing trends in area during 2012-19. However, no trend was observed in area under Arhar and Moong.
- Dantewada- It is found that Arhar and Moongshowed decreasing trend in area during 2001-19. However, no trend was observed in area under Maize and Sesamum.
- Bijapur- It is found that Sesamum had decreasing trends in area during 2008-19 while no trend was observed in area under Moong, Maize, Arhar.
- Sukma- It is found that Sesamum had increasing trends in area during 2012-19. However, no trend was observed in area under Arhar, Moong and Maize.
- Kanker- It is found that Maize had increasing trends in area during 2001-19 while Arharand Sesamum showed decreasing trend in area during 2001-19. However, no trend was observed in area under Moong.

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