**A Comparative Analysis of Cropping Pattern in the Tribal-Dominated Districts of Madhya Pradesh, India**

**ABSTRACT**

This study attempted to analyse the change in cropping pattern of the tribal dominating districts of Madhya Pradesh for a period of 21 years (2000-01 to 2020-21). Five major tribal districts of Madhya Pradesh with more than 50 percent tribal population were selected for the analysis. The districts included in the study were Barwani, Dhar, Jhabua, Mandla and Dindori. Statistical tools used in the study included absolute and relative change, coefficient of variation and annual growth rate. Secondary data on area under various crops were collected from the official website of Directorate of Economics and Statistics for the selected tribal districts of Madhya Pradesh. The findings revealed more inclination towards cereals particularly wheat and rice and decline in area share under millets as well as oilseeds. In terms of pulses, area under gram and arhar increased in Mandla and Dindori while in Barwani, Dhar and Jhabua area increased only for gram. For cash crops area under cotton increased in Barwani and Jhabua districts only. In oilseeds area increased only for soybean crop.

***Keywords****: Area, cropping pattern, Tribal districts, Millets.*

**JEL Codes: O13, Q10, Q19, P50**

**1. INTRODUCTION**

Madhya Pradesh is home to the majority of tribal people of India, with 46 recognised tribes making up 21.10 per cent of the population of the state (Kurmi et.al,2022). The state has more than 8 per cent of country’s tribal population. In terms of special tribal population, Madhya Pradesh holds first rank among all the states and union territories and it ranks twelfth in terms of the proportion of Scheduled tribes’ population to total population. The term Scheduled tribes’ or "Adivasi" refers to a particular group of indigenous people whose status is recognised by the Indian Constitution. Some of the important Scheduled Tribes (ST) of Madhya Pradesh are Bhil, Gond, Baiga, Agariya, Bhariya, Dhanwar, Halba, Saharia, Muria, Ojha, Pardhan, Saura etc.

The tribal population of Madhya Pradesh is mainly resided in districts like Jhabua, Dhar, Alirajpur, Mandla, Chhindwara, Barwani, Khargone, Dindori, and Balaghat. According to 2011 census of Madhya Pradesh, Alirajpur district has the highest ST population (89 per cent), followed by Jhabua and Barwani with approximately 87 per cent and 67 of tribal population. Bhil is the largest tribe of Madhya Pradesh and they have the highest population in Jhabua district followed by Dhar, Barwani and Khargone district. The main source of income of Bhil tribes is agriculture and their main food includes maize and wheat. The second-largest tribe in the state of Madhya Pradesh and one of its best-known is the Gond. They primarily live in the high terrain of the Vindhya and Satpura region, as well as the districts of Mandla, Chhindwara, Betul, and Seoni. Agriculture, the production of bamboo and cane products, and metal crafts are the principal occupations of the Gond tribe.

Out of the total operational holdings of Madhya Pradesh, 20.58 per cent holdings are owned by tribal population and their holdings in majority falls under the category of small and marginal farmers. Although there is slow pace of development in the agricultural sector of the tribal districts, they are still evolving over the time but recently due to introduction of high yielding varieties of crops like maize, sorghum, wheat, paddy and many other traditional crops like ragi threaten the crop diversity and conservation of germplasms. The practice of monoculture has significantly risen globally throughout the first years of the twenty-first century and 91% of the world's 1.5 billion hectares of arable land are used for large monocultures of crops including maize, soybeans, rice, wheat, and other such crops (Altieri, 2009). In the context of the above theme this study is carried out to examine the shift in cropping pattern and growth pattern of production components of major crops the selected tribal dominating districts of Madhya Pradesh.

**2. LITERATURE REVIEW**

Singh (2008) conducted a study focused on developing a sustainable agricultural development model for hilly and tribal areas of Jhabua district and analysed population ecology, farm ecology, and farm productivity in different ecologic-economic zones using inter-regional and micro-level assessments. To analyse regional variations in agricultural development composite indices were utilized and instrumental variables were identified for strategic policy decisions regarding agro-ecosystem restoration and economic growth. The findings presented strategic framework for promoting sustainable agriculture in Jhabua district and further offered replicable models for other tribal areas of India. Singh & Singh (2011) conducted a study to analyse the pattern of cropping system in inter regional framework and the impact of the pattern change over a period of time in Jhabua district of Madhya Pradesh during the period 1990-91 and 2007-08 using Ginni coefficient, entropy index and localization coefficient. The findings revealed that between 1990-91 and 2007-08, cropping diversity increased across all tahsils, with a shift toward commercial and superior food crops like soybean, cotton, wheat, and maize. Localization declined, indicating diversification, though inferior crops remained in upland areas like Jobat and Alirajpur, while superior and commercial crops concentrated in Petlabad, Thandla, and Jhabua. Rana et. al (2022) conducted a study in Khargone district, focusing on Bhagwanpura block due to its high tribal population. A total of 200 tribal farmers—100 practicing specialized farming and 100 practicing diversified farming—were selected using snowball sampling from ten village panchayats. The findings showed that factors such as age, education, family type and size, income, landholding, housing, social participation, information sources, extension contact, scientific orientation, and risk-taking ability were all significantly and positively related to the adoption of diversified farming practices.

While earlier studies focused on limited regions and timeframes, this study offers a broader and more recent perspective, analyzing growth and variability in crop areas using district-level data. Its findings are crucial for informing region-specific policies aimed at improving tribal livelihoods and promoting sustainable agriculture in Madhya Pradesh’s tribal belt.

**3. METHODOLOGY**

To analyse the shift in cropping pattern, growth and variability in area under various crops grown by tribal in the major tribal districts of Madhya Pradesh, secondary data were collected for the period of 21 years (2000-01 to 2020-21) from the official website of Directorate of Economics and Statistics for the selected tribal districts of Madhya Pradesh. There are 52 districts in Madhya Pradesh out of which five districts, where tribal population was more than 50 per cent to the total population were selected for the study. The selected districts were Jhabua (87%), Barwani (69.42%), Dindori (64.69%), Mandla (57.88%) and Dhar (55.94%). These five districts consist of 8.75 per cent of total population and 27.05 per cent of total tribal population of Madhya Pradesh. The various statistical tools were used to analyse the collected secondary data were described below.

1. **Absolute change (AC): -** Absolute change refers to the overall variation in area under crop over a predetermined period of time. The difference between the initial and final area under the crop was measured in absolute terms by applying the following formula:

**Absolute change = An- Ao**

1. **Relative Change (RC): -** Relative change (RC) is a fraction that expresses the absolute change in relation to the base year value as a percentage. The following formula was used to assess relative change:

**Relative change =** $\frac{An-Ao}{Ao}$ **× 100**

Where,

An= Area under the particular crop in the current year

Ao= Area under the particular crop in the base year

1. **Coefficient of Variation (CV): -**The degree of dispersion around the mean is assessed using the coefficient of variation. It is presented in percentage form:

**CV**= $\frac{Standard deviation}{Mean}$\*100

1. **Annual Growth Rate (AGR):** AGR was used in the study to estimate the growth of area under particular crops in selected tribal districts over the period of time by using the following formula:

**Yt =** abt

**Annual Growth Rate (%) = (Antilog b - 1) × 100**

Where,

Y= Area under particular crop

t= Time in year

b = Regression coefficient

**t –statistic =** $\frac{b}{S.E (b)}$

1. **RESULTS AND DISCUSSION**

 The major inclination of cropping pattern in Barwani district was observed towards wheat and maize as shown by the increase in share in area over the period however area under rice declined as shown in table 1. Among millets area under both jowar and bajra declined over the period. Area of gram showed slight increase with 2.64 per cent share in GCA during current year. For oilseeds decline in share was observed for groundnut however for soybean it remained nearly same. For acreage of cotton, it was 21.79 per cent during current year as compared to 18.91 per cent in base year. The cropping pattern of Dhar district was observed to be inclined more towards wheat crop with highest increase in share among the considered crops. Rice and maize showed decline in share over the period. Among millets area under both jowar and bajra declined showing negative relative change of -88.47 and -70.07 per cent respectively. Among pulses acreage of gram observed commendable increase. Decline in share was observed for both considered oilseeds as well as for cotton however soybean showed positive absolute change of 68.72 thousand hectares. In Jhabua district cropping pattern shift was mainly towards wheat with increase of 20.30 per cent in current year over the base year period. For rice and maize decline in share and negative relative change was observed. For jowar and bajra there was drastic decline in share in current year over the base year. Similar to Dhar and Barwani districts in Jhabua also area under gram increased in current year while that under Arhar crop it was noted to be declined. Among oilseeds soybean showed increase in share with 134.33 per cent relative change while groundnut showed decline with -62.47 per cent relative change over the period. For the district increase in share of area for cotton crop with 10.40 per cent share as compared to 7.08 during the base year period was noted. In all three districts it was observed that the area shares under rice and millets declined over the period. One of the main reasons for this can be the shift towards cash crops and other commercial crops that offer better economic returns. Farmers in these areas are increasingly allocating more area to crops like soybean, maize, and cotton, which are more profitable than traditional crops like rice and millets. The traditional varieties of rice such as Chhinore, Kalimuch etc are being replaced with the increasing adoption of modern agriculture practices and shift towards other crops such as wheat and cotton, soybean. There was more inclination towards wheat in all these districts over the years which could lead to threat of monocropping in these districts, however the adoption of modern agriculture practices can help to prevent this and maintain soil health and biodiversity. It is important for farmers to engage in sustainable agriculture practices that promote crop diversity and maintain soil health.

 Data in table 1 showed that in Dindori district shift in cropping pattern was mainly inclined towards cereals, particularly rice with relative change of 54.51 per cent and pulses. Among pulses increase in share was observed for both gram and arhar with 85.68 and 90.03 per cent relative change respectively. In Dindori district sharp decline in the share of area under millets was observed as well as under oilseeds with negative relative change for both jowar and bajra and for all considered oilseeds except soybean. Among oilseeds slight increase in area was observed only for soybean with relative change of 125.06 per cent. For Mandla district it was observed that there was shift towards rice and wheat compared to other crops. Increase in share over the years was observed for both these cereal crops in Mandla district, however area under maize declined slightly during current year. Wheat recorded an increase in share by 8.31per cent in current year over base year which was the highest. Area under both the pulses increased over the period. However, similar to Dindori district in Mandla district also, share of area under millets and oilseeds was observed to be declining sharply over the years where Bagani small seeded arhar traditionally grown by tribal is at the verge of extinction. Due to implementation of policies by the government to promote the cultivation of rice, maize and wheat, by providing subsidies for fertilizers, seeds, and irrigation farmers are encouraged to shift towards these crops, which offer better economic returns than traditional crops like oilseeds or millets this might be the reason for inclination towards rice and wheat in these districts. Also, procurement policy of MSP further promotes the shifting towards these crops which might lead to the threat of monocropping in these districts in the future. Over the period of time decline in net cropped area was observed for selected tribal districts except for Mandla where forest area was cleared for shifting cultivation by the tribals. However, increase in gross cropped area was recorded for all the selected districts with increased cropping intensity.

From the data presented in table 2 it can be seen that in Barwani district among cereals, wheat and maize showed positive & significant growth rate of 8.90 and 3.49 per cent respectively, however acreage of rice showed negative growth rate of -10.70 per cent. Among cereals highest coefficient of variation was observed in wheat with 64.97 per cent revealing that its acreage allocation depends on rainfall pattern. For both the millet crops decline in growth rate with -7.25 and -3.93 per cent was observed respectively. Acreage of gram showed positive growth rate among pulses with 5.80 per cent CAGR over the years. And among oilseeds positive growth rate was observed in soybean with growth of 2.26 per cent. Further for Barwani district growth in area under Cotton crop was also observed with growth rate of 2.48 per cent. For Dhar district observed positive growth rate was observed, only in wheat with growth rate of 6.47 per cent. For Rice and maize negative growth rates over the period with highest coefficient of variation in rice (76.24 per cent) again revealing that the acreage allocation of rice depends upon rainfall pattern. Among millets area under both jowar and bajra showed negative growth rate. Among pulses gram showed a growth rate of 8.03 per cent whereas negative growth rate was observed for arhar. Soybean showed positive growth rate of 1.67 per cent among oilseeds while growth rate of -3.60 was observed for groundnut. Positive growth rate of 0.50 per cent was observed for cotton crop in Dhar district. For Jhabua district of Madhya Pradesh declining growth rate was observed for rice and maize crops while positive and significant growth rate was noted for wheat with 10.46 per cent. Among cereals wheat showed highest coefficient of variation of 54.72 per cent followed by rice with 43.05 per cent. Among other considered crops except for gram in pulses and soybean in oilseeds all other crops observed negative growth rate over the years. Among all the crops highest growth rate was observed for wheat in Jhabua district while lowest growth rate along with highest coefficient of variation (130.51 per cent) was recorded for Bajra. In Dindori district positive growth rate was observed for all the cereal crops during study period with highest growth in rice with 1.80 per cent. Among millets both Jowar and Kodo-Kutki showed a negative growth rate of -11.50 and -5.16 per cent respectively. Both gram and Arhar showed positive and significant growth rate over the period. However, among oilseeds, positive growth rate was observed for sesamum and soybean only with 0.83 and 4.54 per cent respectively. In Dindori district highest coefficient of variation was observed for jowar (56.38 per cent) while lowest was for maize (2.49 per cent). In Mandla district it was observed that all cereal crops recorded positive growth rate over the years in with highest growth rate of 4.63 per cent in wheat followed by rice (2.11 per cent) among cereals. Among millets both jowar and kodo-kutki showed negative growth rate of -8.95 per cent and -5.86 per cent respectively. Both the pulses showed positive and significant growth rate of 5.90 and 4.70 per cent respectively. However, the entire oilseed crops showed negative growth rate during the study period. The above overall results show that the traditional crops are vanishing given the cropping pattern and new and more remunerative crops are coming up which is actually threatening agri-biodiversity in tribal area.

1. **CONCLUSION**

 This study examined the cropping pattern and its shift in the major tribal dominating districts of Madhya Pradesh. The findings of the study indicated that higher shift was observed towards wheat and rice in the selected districts. Although this shift was accompanied by a decline in the cultivation of millets and oilseeds. For Dhar, Barwani and Jhabua more inclination was towards wheat and maize and for Mandla and Dindori districts more shift was towards rice. Drastic decline in area under millets was observed in all the districts during the study period. The International Year of Millets has emphasized the importance of increasing millet production, particularly in tribal districts. However, the farmers in these districts opted for more profitable crops due to challenges such as the unavailability of quality millet seeds and inadequate processing and marketing infrastructure. Among pulses Dhar, Barwani and Jhabua showed increase in area for gram while in Mandla and Dindori districts area under both gram and arhar increased. For oilseeds area share increased only for soybean in all districts except for Dhar and Mandla which showed slight decline in area share. Barwani and Jhabua showed increase in area share for cotton crop while in all districts the area share declined. The findings suggested the need for increased awareness among farmers about the low-cost and sustainable farming of millets, as well as the provision of subsidies to promote millet production and conserve their germplasm for the protection of agri-biodiversity. To address these issues, the establishment of primary processing centres for millets and the implementation of price protection measures with assured value chain development are necessary. These initiatives would not only safeguard agri-biodiversity in tribal areas but also generate additional income for farmers.

**HIGHLIGHTS**

* The paper examines the shift in cropping pattern of tribal districts of Madhya Pradesh for a period of 21 years (2000-01 to 2020-21).
* Change and annual growth rate of area under various crops were analysed in five important tribal districts of Madhya Pradesh.
* Higher inclination was observed towards cereals in all districts particularly towards wheat and rice.
* Drastic decline in area under millets and oilseeds in all tribal districts.

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**Table 1. Changes in cropping pattern in selected districts of Madhya Pradesh (2000-01 to 2020-21) Unit- (000’hectares)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Crop category | Crops | **Barwani** | **Dhar** | **Jhabua** | **Dindori** | **Mandla** |
| **Po** | **P1** | **AC** | **Po** | **P1** | **AC** | **Po** | **P1** | **AC** | **Po** | **P1** | **AC** | **Po** | **P1** | **AC** |
| Cereals | Rice | 2.60(1.02) | 00.28(0.08) | -2.32(-88.96) | 2.77(0.45) | 0.16(0.02) | -2.62(-94.30) | 22.66(5.99) | 6.47(2.32) | -16.18(-71.44) | 0.07(28.73) | 115.32(38.63) | 40.68(54.51) | 107.12(40.57) | 162.07(45.80) | 54.95(51.30) |
| Wheat | 17.45(6.81) | 103.29(28.89) | 85.84(491.79) | 79.81(12.95) | 314.24(32.78) | 234.42(293.69) | 9.42(2.49) | 72.03(25.79) | 62.62(664.80) | 34.24(13.18) | 42.80(14.34) | 8.57(25.03) | 27.79(10.53) | 66.67(18.84) | 38.88(139.86) |
| Maize | 33.30(12.99) | 62.91(17.59) | 29.59(88.87) | 73.79(11.98) | 68.32(7.13) | -5.48(-7.42) | 106.53(28.18) | 54.59(19.55) | -51.94(-48.75) | 18.09(6.96) | 18.42(6.17) | 0.33(1.84) | 17.96(6.80) | 20.08(5.68) | 2.12(11.82) |
| Millets | Jowar | 50.52(19.71) | 14.12(3.95) | -36.40(-72.06) | 23.00(3.73) | 2.65(0.28) | -20.35(-88.47) | 17.28(4.57) | 1.43(0.51) | -15.85(-91.72) | 0.10(0.04) | 0.008(0.003) | -0.092(-91.39) | 0.19(0.07) | 0.03(0.01) | -0.15(-80.56) |
| Bajra/**#**Kodo-Kutki | 9.94(3.88) | 5.11(1.43) | -4.83(-48.65) | 5.93(0.96) | 1.77(0.19) | -4.15(-70.07) | 16.63(4.40) | 0.006(0.002) | -16.62(-99.96) | 47.86(18.42) | 20.56(6.89) | -27.30(-57.04) | 46.10(17.46) | 18.15(5.13) | -27.95(-60.63) |
| Pulses | Gram | 3.66(1.43) | 9.43(2.64) | 5.77(157.70) | 22.62(3.67) | 79.54(8.30) | 56.92(251.55) | 6.50(1.72) | 15.88(5.69) | 9.38(144.34) | 5.73(2.21) | 10.64(3.56) | 4.91(85.68) | 3.87(1.47) | 10.32(2.92) | 6.45(166.70) |
| Arhar | 5.16(2.01) | 1.81(0.51) | -3.35(-65.0) | 4.61(0.75) | 1.77(0.19) | -2.83(-61.43) | 4.78(1.26) | 2.30(0.83) | -2.47(-51.79) | 2.57(0.99) | 4.90(1.64) | 2.32(90.03) | 2.26(0.86) | 5.22(1.48) | 2.96(130.99) |
| Oilseeds | Groundnut | 17.56(6.85) | 11.07(3.10) | -6.48(-36.93) | 4.52(0.73) | 2.96(0.31) | -1.56(-34.51) | 15.02(3.97) | 5.64(2.02) | -9.38(-62.47) | - | - | - | - | - | - |
| Soybean | 25.73(10.04) | 36.61(10.24) | 10.87(42.28) | 239.55(38.88) | 308.28(32.16) | 68.73(28.69) | 34.76(9.20) | 81.45(29.16) | 46.69(134.33) | 3.44(1.32) | 7.74(2.59) | 4.29(125.06) | 0.42(0.16) | 0.14(0.04) | -0.28(-67.61) |
|  | Sesamum | - | - | - | - | - | - | - | - | - | 0.19(0.08) | 0.16(0.05) | -0.03(-19.06) | 1.57(0.60) | 0.92(0.26) | -0.66(-41.82) |
|  | Rapeseed | - | - | - | - | - | - | - | - | - | 16.99(6.54) | 13.02(4.36) | -3.97(-23.39) | 14.54(5.51) | 10.32(2.91) | -4.22(-29.07) |
|  | Linseed | - | - | - | - | - | - | - | - | - | 5.44(2.09) | 3.65(1.22) | -1.78(-32.87) | 3.86(1.46) | 2.29(0.65) | -1.56(-40.57) |
|  | Niger | - | - | - | - | - | - | - | - | - | 27.66(10.65) | 8.56(2.87) | -19.10(-69.06) | 7.76(2.94) | 2.54(0.72) |  -5.21(-67.20) |
| Cash crops | Cotton | 48.48(18.91) | 77.90(21.79) | 29.41(60.67) | 90.91(14.75) | 124.29(12.97) | 33.37(36.71) | 26.75(7.08) | 29.04(10.40) | 2.29(8.59) | 5.44(2.09) | 3.65(1.22) | -1.78(-32.87) | - | - | - |
| Cropped Area | NCA | 232.42 | 229.56 | -2.85(-1.23) | 505.61(82.06) | 501.60(52.33) | -4.00(-0.79) | 357.93(94.69) | 184.97(66.23) | -172.95(-48.32) | 202.57(1.32) | 195.53(65.49) | -7.05(-3.48) | 212.75(80.58) | 226.03(63.87) | 13.27(6.24) |
| GCA | 256.38 | 357.54 | 101.15(39.46) | 616.17 | 958.62 | 342.44(55.58) | 378.00 | 279.30 | -98.69(-26.11) | 259.80 | 298.55 | 38.75(14.92) | 264.02 | 353.92 | 89.90(34.05) |
| Cropping Intensity (%) | 110.31 | 155.75 | 45.44 | 121.86 | 191.11 | 69.25 | 105.60 | 180.22 | 74.62 | 128.12 | 152.68 | 24.56 | 124.09 | 156.58 | 32.49 |

Base year= Average of triennium ending between 2000- 2002

Current year=Average of triennium ending between 2018-2020

Figures in parentheses indicates percentage

**#**Kodo-kutki for Mandla and Dindori district

**Table 2. Growth rate and variability in area of major crops in selected tribal districts of Madhya Pradesh (2000-01 to 2020-21)**

 **(Percentage)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Crop category | Crops | **Barwani** | **Dhar** | **Jhabua** | **Dindori** | **Mandla** |
| **CV** | **CGR** | **CV** | **CGR** | **CV** | **CGR** | **CV** | **CGR** | **CV** | **CGR** |
| Cereals | Rice | 52.83 | -10.70\*\* | 76.24 | -15.55\*\* | 43.05 | -7.02\*\* | 17.84 | 1.80\*\* | 15.78 | 2.11\*\* |
| Wheat | 64.97 | 8.90\*\* | 42.65 | 6.47\*\* | 54.72 | 10.46\*\* | 17.87 | 0.68 | 38.13 | 4.63\*\* |
| Maize | 26.94 | 3.49\*\* | 12.66 | -0.86\* | 29.45 | -4.18\*\* | 2.49 | 0.07 | 4.54 | 0.33\* |
| Millets | Jowar | 31.52 | -7.25\* | 56.34 | -11.10\*\* | 93.88 | -14.52\*\* | 56.38 | -11.50\*\* | 55.39 | -8.95\*\* |
| Bajra/Kodo-Kutki | 25.33 | -3.93\*\* | 44.50 | -7.49\*\* | 130.51 | -39.92\*\* | 33.23 | -5.16\*\* | 37.19 | -5.86\*\* |
| Pulses | Gram | 56.18 | 5.80\*\* | 55.41 | 8.03\*\* | 37.03 | 3.19 | 23.69 | 3.37\*\* | 42.50 | 5.90\*\* |
| Arhar | 25.63 | -3.93\*\* | 28.77 | -4.04\*\* | 42.51 | -5.28\*\* | 35.26 | 4.73\*\* | 31.14 | 4.70\*\* |
| Oilseeds | Groundnut | 27.82 | -3.58\*\* | 25.97 | -3.60\*\* | 53.96 | -7.16\*\* | -- | -- | - | - |
| Soybean | 15.21 | 2.26\*\* | 10.63 | 1.67\*\* | 37.47 | 5.88\*\* | 27.74 | 4.54\*\* | 96.91 | -4.28 |
|  | Sesamum | - | - | - | - | - | - | 37.39 | 0.83 | 17.76 | -2.63\*\* |
|  | Rapeseed | - | - | - | - | - | - | 10.58 | -1.32\*\* | 15.14 | -1.35\* |
|  | Linseed | - | - | - | - | - | - | 16.17 | -1.67\*\* | 24.56 | -1.44 |
|  | Niger | - | - | - | - | - | - | 30.44 | -6.29\*\* | 33.65 | -7.61\*\* |
| Cash crops | Cotton | 16.13 | 2.48\*\* | 19.81 | 0.50 | 22.06 | -1.36 | -- | -- | -- | -- |
| Cropped Area | NCA | 0.76 | -0.05 | 0.52 | -0.05\*\* | 33.62 | -4.30\*\* | 2.63 | -0.22\* | 3.20 | 0.30\*\* |
| GCA | 12.21 | 1.59\*\* | 14.49 | 2.15\*\* | 26.13 | -2.65\*\* | 5.68 | 0.66\*\* | 10.68 | 1.53\*\* |

\*Significant at 5 %

\*\* Significant 1%

**#**Kodo-kutki for Mandla and Dindori district