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# Comparative Progress of Odisha in Millet Farming: An Inter-State Analysis through Agricultural Efficiency Index

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ABSTRACT

Odisha is an 'agro-ethnic' state located in the eastern region of India. A total of 76 per cent of the state working population is engaged in agriculture and allied sectors along with 22.84 per cent of the total state population is tribal in nature. The colonial period of the pre-Independence era and the green revolution period of the post-Independence era have imposed the mono and duo cropping culture in all states of the country including Odisha and caused the marginalization of millet farming. The basket of millets constitutes the crops like 'Jowar, 'Bajra', 'Ragi', and 'Small Millets'. These are economic, nutrition-rich, disease-resistant, drought-tolerant, and climate-resilient crops in nature. Therefore, to improve both individual and farm health the government of Odisha has initiated the focus on millets production by launching the 'Odisha Millets Mission' (OMM) in 2017-18. As with Odisha, some other states are also functioning with their millets program such as – the Andhra Pradesh Millets Programme (2016) and Telangana Millets Mission (2018). This paved the way for the declaration of the 'National Year of Millets' in 2018 by the Indian Government and the 'International Year of Millets' in 2023 by the United Nations Organisation. This paper intends to analyse the comparative progress of Odisha in millets farming with the other major states in light of its vibrant millets mission program. For this, we have applied the method 'Measures of Agricultural Efficiency' suggested by S.S. Bhatia (1967). The secondary data on the area, production, and yield of four main millets crops, viz., Jowar, Bajra, Ragi, and Small Millets extracted from the Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India enable us to construct the 'Agricultural Efficiency Index' of millets farming for the selected 20 major states of India at two-time points, i.e., 2016-17 and 2020-21. The results from the analysis show that the agricultural efficiency index of Odisha has decreased from 59.73 to 55.58 but in a relative sense the rank of Odisha has improved from the 17th position to the 16th position between the two-time points of 2016-17 to 2020-21. It also states that Himachal Pradesh has increased from the 'low efficiency' category to the 'high efficiency' category, Kerala has decreased from the 'high efficiency' category to the 'low efficiency' category and the remaining 18 states including Odisha have no change in their efficiency category between 2016-17 and 2020-21. The result of Spearman's rank correlation test (.965) also states that the selected states have shown relatively low progress in terms of millet farming as their respective ranks are highly correlated between both periods.

**Keywords: Odisha, Millets, Agricultural Efficiency Index**

**JEL: Q10, Q18**

## I

## INTRODUCTION

Since its inception in 1936, Odisha is predominantly an agricultural state of India located in the eastern region with natural endowments of river basins, mangrove forests, and mineral deposits. The major crops produced in Odisha are rice, pulses, maize, millet, jute, coconut, cashew, mango, papaya, jackfruit, groundnut, cotton, etc. The state comprises 4.87 per cent of the total geographical area and 3.4 per cent of the total population in the country. Its illustrious heritage can be traced back to the Kalinga period, and today, its diverse culture is enriched by the presence of 62 tribes, each contributing to the region's rich ethnicity. It is also blessed with the locational advantages of coastlines having many commercial ports which provides the state a

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beneficial trade linkage toward Southeast Asian countries. The state has ten agro-climatic zones summarised under the four physiographic regions i.e., 'Northern Plateau', 'Central Table Land', 'Eastern Ghat Region', and 'Coastal Plains'. Despite having an abundance of water and natural resources the state agriculture is still in the rainfed category while in terms of economic development, it also lagged, as it ranks at 16th position in gross domestic product (GDP) and 24th position in per capita income due to the inefficient utilisation of resources.

The colonial period of pre-Independence and the green revolution period of post-Independence imposed the mono and duo cropping pattern in the form of wheat or rice concentration in all states of India and marginalized millet farming. However, ignorance of the agro-climatic feasibility in blind demonstration of rice and wheat farming has caused both farm and farmers distress in terms of crop failure and low income respectively. The first decade of the green revolution has also created regional disparities because the growth of agriculture was concentrated in some regions (Punjab, Haryana, and Western Uttar Pradesh) only. The forced cultivation of rice and wheat has caused crop failure and resulted in the farmer's distress in the rainfed and semi-arid regions (Rao, 1977; Bhalla and Singh,1997).

To establish balanced development across the regions the government of India launched various schemes during the 1980s and 1990s. The reform initiatives were started with the establishment of 'NABARD' in 1982 to ensure better availability of credit in rural areas for farm and non-farm practices. Again the 'National Oilseeds Development Program was launched in (1984-85) which was followed by the 'National Pulses Development Programme' (1986) dedicated to the betterment of agricultural practices in the central regions of the country. Similarly, the 'National Watershed Development Programme' (1986-87) and 'Accelerated Irrigation Benefit Programme (1996-97) were launched for the extension of green revolution benefits toward dryland areas of the country. The 'Kisan Credit Card Scheme' (1998-99) and 'National Agriculture Insurance Scheme' (1999-2000) were launched to advance the agriculture sector in the 21st century.

Similarly, to improve both individual and farm health the government has started to emphasise millet crop production to ensure a balanced diet in the food plate of the people and restore the soil fertility of the farmlands through diversification in cropping patterns. In October 2007 the Government of India launched the 'National Food Security Mission' which includes the objective of millets promotion. It also led to the government initiative of the 'Nutritional Security through Intensive Millets Promotion' (INSIMP) from 2011-12 to 2013-14.

Millets collectively known as the group of crops which are grown regionally in the rainfed and semi-arid areas of the country require less water, fertilizers, and pesticides. The basket of millets constitutes the crops like 'jowar' (sorghum), 'bajra' (pearl millets), 'ragi' (finger millet), and 'small millets'. Millets are economic, nutrition-rich, drought tolerant, and climate resilient in nature. Millet consumption is also helpful in controlling several diseases like diabetes, high blood pressure, celiac

disorders, and cardiovascular disease and also plays a key role in balancing body mass index to enjoy a healthy life.

India is the major producer, exporter, and consumer of millet in the world. Millets not only feed the poor section but also generate employment, and earn foreign exchanges for the rainfed, semi-arid, and drought-hit regions. Instead of lagging in rice and wheat productivity, India is ahead in the millet yield with 1352 (kg/ha) than the global average of 972.7 (kg/ha) according to the estimated value of FAOSTAT (2021).

After the spread of the green revolution, the millets rendered as the 'orphan crops' tend to be regionally important but not traded around the Indian & world and also receive no attention from research networks. They are largely grown and consumed by local communities due to the low market demand and price. Despite negligence, millet provides food to the 1.2 billion poor people of the globe, and due to that it is also known as the coarse cereals or the cereals to the poor.

Since the mid of the second decade of the 21st century, the government has focused on the millet's promotion has gained pace with the launching of the Andhra Pradesh Millets Program (2016), Odisha Millets Mission (2017), Telangana Millets Mission (2018). This paved the way for the declaration of the 'National Year of Millets' in 2018 by the Indian Government. In recent times some other states have also come up with millet missions such as – the Chhattisgarh Millet Mission (2021) and Bihar Millet Mission (2023 - as per the fourth agricultural roadmap). The honorable prime minister termed millets 'Sri Dhaanya' in Karnataka because they are tasty, nutrition-rich, and disease-resistant. 'Sri' roughly translates to divine grace and 'Anna' or 'Dhaanya' means food grain. So, 'Sri Anna' means a food grain that has divine grace (Nain, 2018; WFP, 2022; Mukherjee, 2023; Outlook, 2023).

The Indian Finance minister has also described millets as "Shri Anna – as the mother of all grains" during her budget speech (Mukherjee, 2023). This view was also supported by the Prime Minister in his public speech by saying that "the millets will be known as 'Sri Anna' across the country. He described 'Sri Anna' as the best among all food grains. On the proposal of India, the United Nations has declared this year 2023 as the "International Year of Millets'. The International Year of Millets is linked with 5 out of 17 sustainable development goals such as – Goal – 2 of Zero Hunger; Goal – 3 of Good Health and Well-being; Goal – 8 of Decent work and economic growth; Goal – 12 of Responsible Consumption and Production; Goal – 13 of Climate Actions; and Goal – 17 of Partnerships for the goal (Griggs *et al.,* 2017).

The Government of India has also launched various initiatives under the International Millet's Year celebration and linked it with the Azadi Ka Amrit Mahotsav. They have also directed the following steps - Distribution of millets through ICDS once a week; Each state to adopt one focus millet to showcase; Panchayats/ ULBs to be involved with events in millet producing districts; and Conferences at district and state level for promotion of millets.

Similarly, under the flagship programme of Odisha Millets Mission (OMM), the Odisha government has also interlinked it with the women and child welfare programs through the involvement of women self-help groups in various activities, the inclusion of millets in the Integrated Child Development Programme (ICDS) and School's Mid-Day Meals (MDM). The recently held Hockey World Cup 2023 in Bhubaneshwar was also used for the promotion of Odisha Millets Mission (OMM) and International Year of Millets 2023. To help the farmers by ensuring their financial security the Odisha government has also arranged the proper procurement of millet (especially ragi) produce through Tribal Development Cooperative Corporation of Odisha Limited.

It has extended the Odisha Millets Mission from 30 blocks of 7 districts in 2017-18 to 143 blocks of 19 districts in 2022-23 and now 177 blocks of all the 30 districts of the state. It is in this context and background, that the present research work focuses on analysing the change in the agricultural efficiency of major 20 states from 2016-17 to 2020-21. In this inter-state analysis, we have taken Odisha as the benchmark state and 2016-17 as the benchmark year which is just before the launching of Odisha Millets Mission. The constraint of data availability has forced us to limit our analysis till 2020-21.

## II

## OBJECTIVES

The research objectives of this paper are the following: (i) To construct the agricultural efficiency index of millet farming for major 20 states at two points of time 2016-17 and 2020-21 and identify the backward regions. (ii) To understand the change in the index score, rank, and category of major 20 states in millet farming at two points of time 2016-17 and 2020-21.

## III

## DATA AND METHODS

To analyse the comparative progress of major states in millet farming we have extracted the secondary data on the area, production, and yield of four main millet crops ('jowar', 'bajra', 'ragi', and 'small millets') from the Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India. The method suggested by S.S. Bhatia (1967) 'Measures of Agricultural Efficiency' enables us to construct the 'Agricultural Efficiency Index' of millet farming for the selected 20 major states of India at two time points i.e., 2016-17 and 2020-21. Based on the index scores, we have also performed the rank and quartiles classification for the 20 major states and classified them into four degrees of agricultural efficiency based on quartiles classification. Lastly, a non-parametric Spearman's (1904) rank

correlation test was also applied to find out the relative progress of selected states in terms of millet farming between the two time periods. The tried and tested software like 'Ms-excel' is used for the calculation of data while the 'Datawrapper' software is used for map-based visual presentation of the data.

### *Measures of Agricultural Efficiency*

This method of agricultural regionalisation was suggested by S.S. Bhatia in 1967 in his article "A New Measure of Agricultural Efficiency in Uttar Pradesh, India". It is comparatively better than other techniques of agricultural regionalization as it includes the value of both the 'area' and 'yield' of the selected crops into account whereas some other techniques are based on either the value of 'area' or 'yield' of the crops. The method can be expressed as:

$$\text{AEI} = \frac{Iya*Ca + Iyb*Cb + Iyc*Cc + Iyd*Cd.....+ Iyn*Cn}{Ca+Cb+Cc+Cd.....+Cn}$$

Where,
AEI = Agricultural Efficiency Index
Iya = Yc/Yr *100
Yc = yield of crop x in the component areal unit
Yr = yield of crop x in the entire region
Iya, Iyb, Iyc, Iyd…...Iyn is the yield index of the crop a, b, c, d, and n respectively
Ca, Cb, Cc, Cd…. Cn = percentages of the cropland under the different crops

#### *Spearman's Rank Correlation*

After constructing the agricultural efficiency index for both periods, we have also applied Spearman's (1904) rank correlation method to understand the relative progress of selected 20 states in terms of millet farming. It is a non-parametric test that shows the monotonic correlation between the respective ranks of samples on two dimensions or times. It can also be defined as the Pearson correlation between the rank variables. The method can be expressed as:

$$r_s = \rho R(X), R(Y) = \frac{cov(R(X), R(Y))}{\sigma R(X) \sigma R(Y)}$$

Where,
$\rho$ = Pearson correlation of the rank variables
$cov(R(X), R(Y))$ = Covariance of the rank variables
$\sigma R(X) \sigma R(Y)$ = Standard deviation of the rank variables

If all the n ranks are distinct integers, then we can also calculate Spearman's rank correlation by using the following formula:

$$r_s = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

Where,

$d_i = R(X_i) - R(Y_i)$ is the difference between the two ranks of each observation;
n = number of observations.

## IV

## RESULTS AND DISCUSSION

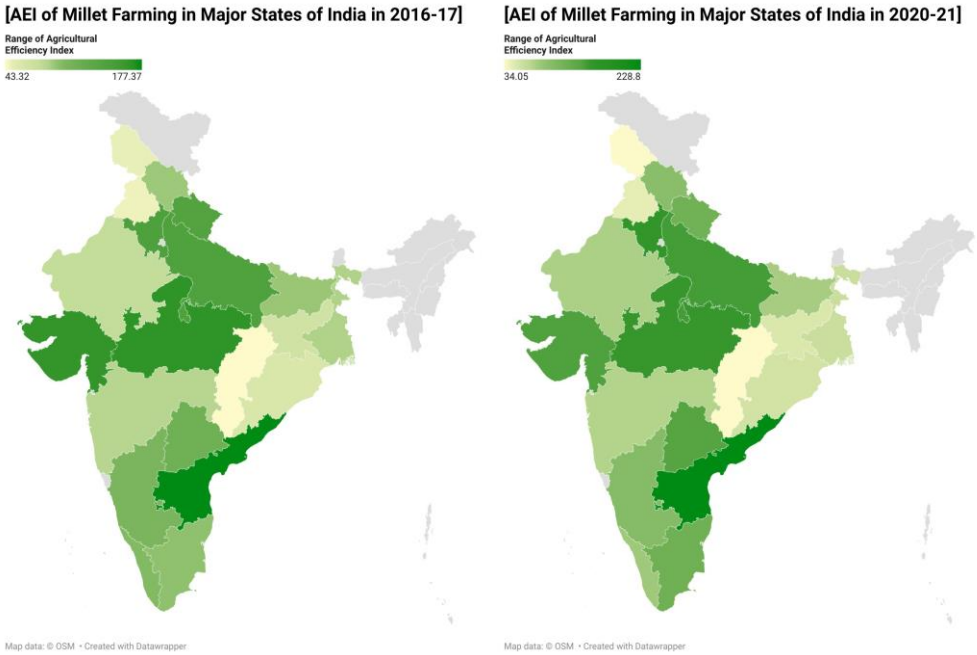
In this section, we will delineate the outcomes of all our objectives. This will offer a comprehensive overview of the evolving landscape of millet farming in India's top 20 states during the period from 2016-17 to 2020-21.

The observation of Table - 1 states that in the case of millet farming, the agricultural efficiency index of 13 states (Bihar, Chhattisgarh, Gujarat, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Uttarakhand, and West Bengal) has been decreased between the two-time points while, the agricultural efficiency of 7 states (Andhra Pradesh, Haryana, Himachal Pradesh, Punjab, Tamilnadu, Telangana, and Uttar Pradesh) has been increased between the two time periods. This change can also be detected with the help of Figure 1 where the contrast of green colour is going to be lighter in efficiency-decreasing states while it is going to be deeper in efficiency-increasing states.

TABLE 1: CHANGING PATTERN OF STATE-WISE AGRICULTURAL EFFICIENCY INDEX IN THE MILLETS FARMING IN INDIA.

| States | AEI 2016-17 | Rank 2016-17 | AEI 2020-21 | Rank 2020-21 | Change in AEI | Change in Rank |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Andhra Pradesh | 177.3689 | 1 | 228.7988 | 1 | Increased | No Change |
| Bihar | 92.48374 | 11 | 78.48606 | 12 | Decreased | Decreased |
| Chhattisgarh | 43.31936 | 20 | 34.05049 | 20 | Decreased | No Change |
| Gujarat | 165.6386 | 3 | 151.2569 | 5 | Decreased | Decreased |
| Haryana | 144.3693 | 4 | 160.8692 | 2 | Increased | Increased |
| Himachal Pradesh | 91.6764 | 12 | 98.93914 | 10 | Increased | Increased |
| Jammu & Kashmir | 45.41648 | 18 | 34.33616 | 19 | Decreased | Decreased |
| Jharkhand | 67.61696 | 16 | 51.46967 | 17 | Decreased | Decreased |
| Karnataka | 103.7638 | 8 | 103.0119 | 9 | Decreased | Decreased |
| Kerala | 99.33048 | 9 | 83.25616 | 11 | Decreased | Decreased |
| Madhya Pradesh | 167.0416 | 2 | 155.8833 | 3 | Decreased | Decreased |
| Maharashtra | 84.38633 | 14 | 73.73956 | 14 | Decreased | No Change |
| Odisha | 59.73094 | 17 | 55.58259 | 16 | Decreased | Increased |
| Punjab | 44.71587 | 19 | 45.7865 | 18 | Increased | Increased |
| Rajasthan | 76.5064 | 15 | 76.41139 | 13 | Decreased | Increased |
| Tamilnadu | 94.67686 | 10 | 121.8685 | 7 | Increased | Increased |
| Telangana | 111.9143 | 7 | 146.0493 | 6 | Increased | Increased |
| Uttar Pradesh | 142.227 | 5 | 153.7546 | 4 | Increased | Increased |
| Uttarakhand | 139.0888 | 6 | 120.4394 | 8 | Decreased | Decreased |
| West Bengal | 86.8531 | 13 | 61.73327 | 15 | Decreased | Decreased |
| Spearman's rho | | | | | | .965 |

Source: Author's calculation.




Author's conceptualization. Maps are not to scale.

Figure 1: Interstate Changing Pattern in the Index of Agricultural Efficiency for Millet Farming in India.

If we look over the rank transformation for both periods, the rank of 8 states (Haryana, Himachal Pradesh, Odisha, Punjab, Rajasthan, Tamilnadu, Telangana, and Uttar Pradesh) has improved while the rank of 9 states (Bihar, Gujarat, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Uttarakhand and West Bengal) has been deteriorated whereas there is no change in the rank of 3 states (Andhra Pradesh, Maharashtra and Chhattisgarh) between the both periods. It is also significant to observe that Andhra Pradesh is the most developed state and Chhattisgarh is the least developed state in terms of millet farming in both periods. The result of Spearman's rank correlation test (.965) also states that the selected states have shown relatively low progress in terms of millet farming as their respective ranks are highly correlated between both periods (see Table A5 of the Appendices). Now after observing the changing pattern in 'efficiency index' and 'ranks' of the states we are going to understand the pattern of change in the 'degree of agricultural efficiency' of the states for millets farming' in Table 2.

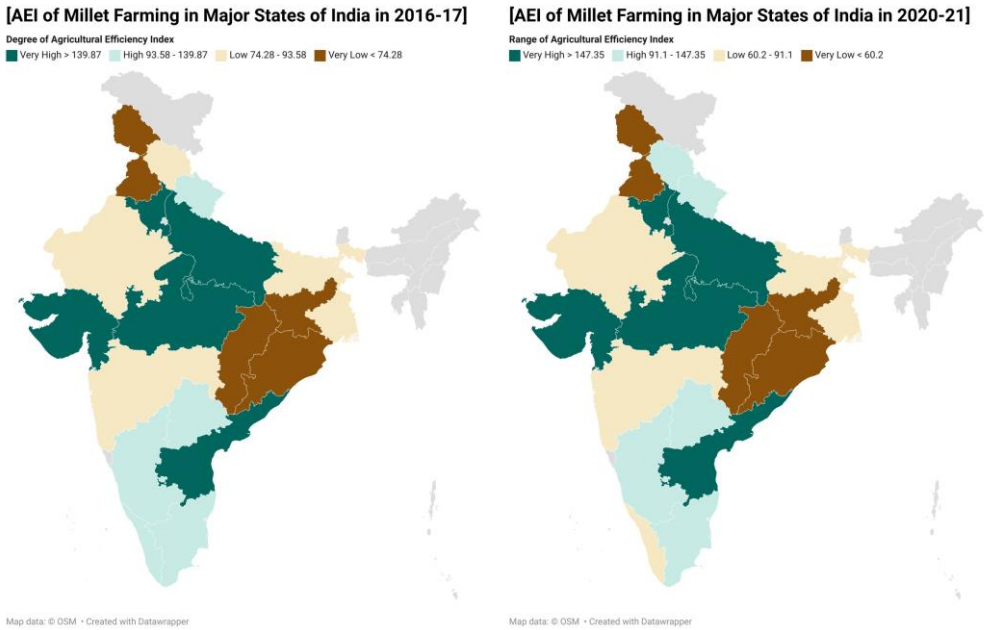
In terms of the degree of agricultural efficiency for millet farming, Tables 1 and 2 along with Figure 2 state that only Himachal Pradesh has improved its category from 'Low' efficient to 'Highly' efficient state while Kerala has deteriorated from the 'Highly' efficient state to 'Low' efficient state. The categories of the remaining 18

states (including Odisha) are the same and have not changed from 2016-17 to 2020-21.

TABLE 2: CHANGING PATTERN OF STATE-WISE AGRICULTURAL EFFICIENCY IN MILLET FARMING

| Degree of agricultural efficiency in 2016-17 | | | | Degree of agricultural efficiency in 2020-21 | | | |
|---|---|---|---|---|---|---|---|
| Very High (1) | High (2) | Low (3) | Very Low (4) | Very High (5) | High (6) | Low (7) | Very Low (8) |
| >139.87 | 93.58 – 139.87 | 74.28 – 93.58 | < 74.28 | >147.35 | 91.1 – 147.35 | 60.2 – 91.1 | < 60.2 |
| Andhra Pradesh | Uttarakhand | Bihar | Jharkhand | Andhra Pradesh (N) | Telangana (N) | Kerala (D) | Odisha (N) |
| Madhya Pradesh | Telangana | Himachal Pradesh | Odisha | Haryana (N) | Tamilnadu (N) | Bihar (N) | Jharkhand (N) |
| Gujarat | Karnataka | West Bengal | Jammu & Kashmir | Madhya Pradesh (N) | Uttarakhand (N) | Rajasthan (N) | Punjab (N) |
| Haryana | Kerala | Maharashtra | Punjab | Uttar Pradesh (N) | Karnataka (N) | Maharashtra (N) | Jammu & Kashmir (N) |
| Uttar Pradesh | Tamil Nadu | Rajasthan | Chhattisgarh | Gujarat (N) | Himachal Pradesh (I) | West Bengal (N) | Chhattisgarh (N) |

*Note*: In parentheses, the D, I, and N are used to represent whether the degree of agricultural efficiency in millet farming has decreased, increased, or not changed in the states in 2020-21 as compared to 2016-17.




Author's conceptualization. Maps are not to scale.

Figure 2: Interstate Changing Pattern in the Degree of Agricultural Efficiency for Millet Farming in India

## V

## SUMMARY AND CONCLUSIONS

The above analysis has indicated that the score of the 'agricultural efficiency index' has decreased in 13 states while it has increased only in 7 states. The main reason behind this is the decline in cropping area under millet crops in the different states due to several reasons. Some significant reasons are, 'high cultivation cost due to low yield in some areas', 'low demand by the public', and 'lower procurement by the government'. Instead of state-wise disparity, the Odisha Millet Mission (OMM) has benefitted the state in terms of both production and prosperity. It is clear from the analysis that (see Tables – A1 to A4 of the Appendices) along with Andhra Pradesh, that only Odisha has achieved an increase in the area, production, and yield of the millet crops between 2016-17 and 2020-21. This is the outcome of a two-way approach between people and the government which has included the millet in the food plate of the people in the state. It is a matter of great concern for other states that despite the government initiatives for millets promotion the crop area under millets is shifting to other crops. This may be because of a lack of adequate nationwide demand for the millet. Therefore, to ensure the farmer's financial security, the government (both at the central and state levels) should promote millet consumption and also ensure the routine procurement of millet crops at the appropriate supporting price level to enhance millet farming. Similarly, to increase the yield the government should provide technical support and extension services to the farmers. This may encourage them to grow the millet with integrated farming practices.

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Table – A 1: Changing Pattern of Area under Millets in Major Indian States.

| | **Jowar Area (Ha) 2016-17** | **Bajra Area (Ha) 2016-17** | **Ragi Area (Ha) 2016-17** | **Small Millets Area (Ha) 2016-17** | **Jowar Area (Ha) 2020-21** | **Bajra Area (Ha) 2020-21** | **Ragi Area (Ha) 2020-21** | **Small Millets Area (Ha) 2020-21** |
|---|---|---|---|---|---|---|---|---|
| Andhra Pradesh | 97000 | 42000 | 32000 | 31000 | 120000 | 31000 | 33000 | 22000 |
| Bihar | 1800 | 3560 | 4780 | 3200 | 1230 | 4220 | 2770 | 2170 |
| Chhattisgarh | 4500 | 100 | 6300 | 89200 | 2060 | 40 | 5480 | 84620 |
| Gujarat | 106000 | 431000 | 19000 | 22000 | 41070 | 460260 | 10470 | 8460 |
| Haryana | 62000 | 478000 | 0 | 0 | 31280 | 569200 | 0 | 0 |
| Himachal Pradesh | 0 | 710 | 2230 | 4910 | 20 | 520 | 580 | 2410 |
| Jammu & Kashmir | 0 | 13870 | 8300 | 9100 | 0 | 13140 | 0 | 8110 |
| Jharkhand | 3950 | 330 | 22690 | 0 | 1870 | 130 | 18770 | 0 |
| Karnataka | 948000 | 242000 | 598000 | 21000 | 750000 | 222000 | 785000 | 26000 |
| Kerala | 140 | 0 | 30 | 10 | 230 | 0 | 230 | 50 |
| Madhya Pradesh | 220000 | 280000 | 2600 | 184000 | 112000 | 327000 | 0 | 78000 |
| Maharashtra | 3050700 | 837100 | 92700 | 83700 | 2078900 | 687500 | 81600 | 37000 |
| Odisha | 5470 | 1840 | 46970 | 27410 | 5500 | 1270 | 41310 | 35250 |
| Punjab | 0 | 1200 | 0 | 0 | 0 | 400 | 0 | 0 |
| Rajasthan | 579310 | 4150310 | 0 | 14670 | 559690 | 4348400 | 0 | 6500 |
| Tamilnadu | 268390 | 49670 | 61360 | 23550 | 405420 | 67410 | 82920 | 24470 |
| Telangana | 90000 | 17000 | 1000 | 1000 | 91000 | 10000 | 1000 | 0 |
| Uttar Pradesh | 183000 | 907000 | 0 | 9000 | 174000 | 907000 | 0 | 12000 |
| Uttarakhand | 0 | 0 | 107000 | 63000 | 0 | 0 | 89000 | 49000 |
| West Bengal | 30 | 170 | 9920 | 2350 | 190 | 70 | 6030 | 760 |
| All India | 5624420 | 7458500 | 1016110 | 619110 | 4377870 | 7652100 | 1159400 | 444050 |

Table – A 2: Changing Pattern of Millets Production in Major Indian States.

| | **Jowar Production (Kg) 2016-17** | **Bajra Production (Kg) 2016-17** | **Ragi Production (Kg) 2016-17** | **Small Millets Production (Kg) 2016-17** | **Jowar Production (Kg) 2020-21** | **Bajra Production (Kg) 2020-21** | **Ragi Production (Kg) 2020-21** | **Small Millets Production (Kg) 2020-21** |
|---|---|---|---|---|---|---|---|---|
| Andhra Pradesh | 198000000 | 72000000 | 35000000 | 24000000 | 411390000 | 70710000 | 39500000 | 19010000 |
| Bihar | 1910000 | 4050000 | 3460000 | 3100000 | 1310000 | 4780000 | 2580000 | 1640000 |
| Chhattisgarh | 5400000 | 40000 | 1500000 | 25400000 | 2730000 | 20000 | 1650000 | 21830000 |
| Gujarat | 150000000 | 931000000 | 27000000 | 28000000 | 57430000 | 1008890000 | 12620000 | 13040000 |
| Haryana | 33000000 | 964000000 | 0 | 0 | 16420000 | 1350140000 | 0 | 0 |
| Himachal Pradesh | 0 | 360000 | 2120000 | 3830000 | 10000 | 290000 | 490000 | 2340000 |
| Jammu & Kashmir | 0 | 8210000 | 3600000 | 3760000 | 0 | 6470000 | 0 | 2140000 |
| Jharkhand | 2740000 | 220000 | 20030000 | 0 | 1230000 | 80000 | 16400000 | 0 |
| Karnataka | 846000000 | 255000000 | 858970000 | 7000000 | 903530000 | 275500000 | 1369830000 | 20230000 |
| Kerala | 110000 | 0 | 40000 | 10000 | 200000 | 0 | 330000 | 40000 |
| Madhya Pradesh | 378620000 | 680610000 | 900000 | 113020000 | 217000000 | 737710000 | 0 | 69420000 |
| Maharashtra | 2170380000 | 799800000 | 111100000 | 44730000 | 1746610000 | 656560000 | 93920000 | 16720000 |
| Odisha | 3440000 | 1130000 | 33130000 | 13840000 | 3470000 | 790000 | 32880000 | 18010000 |
| Punjab | 0 | 700000 | 0 | 0 | 0 | 260000 | 0 | 0 |
| Rajasthan | 349540000 | 4154970000 | 0 | 10190000 | 589910000 | 4561470000 | 0 | 4290000 |
| Tamilnadu | 153870000 | 102260000 | 114430000 | 21220000 | 427220000 | 158890000 | 288640000 | 30510000 |
| Telangana | 88000000 | 15000000 | 1000000 | 1000000 | 155569000 | 9300000 | 1340000 | 0 |
| Uttar Pradesh | 183000000 | 1736000000 | 0 | 5000000 | 274570000 | 2014450000 | 0 | 9180000 |
| Uttarakhand | 0 | 0 | 160000000 | 85000000 | 0 | 0 | 129850000 | 71000000 |
| West Bengal | 10000 | 50000 | 10990000 | 1940000 | 100000 | 30000 | 6470000 | 380000 |
| All India | 4567900000 | 9729860000 | 1385110000 | 441940000 | 4812070000 | 10863170000 | 1998360000 | 346950000 |

Table – A 3: Changing Pattern of Yield of Millets in Major Indian States.

| | **Jowar Yield (Kg/Ha) 2016-17** | **Bajra Yield (Kg/Ha) 2016-17** | **Ragi Yield (Kg/Ha) 2016-17** | **Small Millets Yield (Kg/Ha) 2016-17** | **Jowar Yield (Kg/Ha) 2020-21** | **Bajra Yield (Kg/Ha) 2020-21** | **Ragi Yield (Kg/Ha) 2020-21** | **Small Millets Yield (Kg/Ha) 2020-21** |
|---|---|---|---|---|---|---|---|---|
| Andhra Pradesh | 2041.237113 | 1714.285714 | 1093.75 | 774.1935484 | 3428.25 | 2280.967742 | 1196.969697 | 864.0909091 |
| Bihar | 1061.111111 | 1137.640449 | 723.8493724 | 968.75 | 1065.04065 | 1132.701422 | 931.4079422 | 755.7603687 |
| Chhattisgarh | 1200 | 400 | 238.0952381 | 284.7533632 | 1325.242718 | 500 | 301.0948905 | 257.9768376 |
| Gujarat | 1415.09434 | 2160.092807 | 1421.052632 | 1272.727273 | 1398.34429 | 2192.000174 | 1205.348615 | 1541.371158 |
| Haryana | 532.2580645 | 2016.736402 | 0 | 0 | 524.9360614 | 2371.995784 | 0 | 0 |
| Himachal Pradesh | 0 | 507.0422535 | 950.6726457 | 780.0407332 | 500 | 557.6923077 | 844.8275862 | 970.9543568 |
| Jammu & Kashmir | 0 | 591.925018 | 433.7349398 | 413.1868132 | 0 | 492.3896499 | 0 | 263.8717633 |
| Jharkhand | 693.6708861 | 666.6666667 | 882.7677391 | 0 | 657.7540107 | 615.3846154 | 873.734683 | 0 |
| Karnataka | 892.4050633 | 1053.719008 | 1436.404682 | 333.3333333 | 1204.706667 | 1240.990991 | 1745.006369 | 778.0769231 |
| Kerala | 785.7142857 | 0 | 1333.333333 | 1000 | 869.5652174 | 0 | 1434.782609 | 800 |
| Madhya Pradesh | 1721 | 2430.75 | 346.1538462 | 614.2391304 | 1937.5 | 2255.993884 | 0 | 890 |
| Maharashtra | 711.4367194 | 955.4414049 | 1198.489752 | 534.4086022 | 840.1606619 | 954.9963636 | 1150.980392 | 451.8918919 |
| Odisha | 628.8848263 | 614.1304348 | 705.3438365 | 504.9252098 | 630.9090909 | 622.0472441 | 795.9331881 | 510.9219858 |
| Punjab | 0 | 583.3333333 | 0 | 0 | 0 | 650 | 0 | 0 |
| Rajasthan | 603.3729782 | 1001.122808 | 0 | 694.6148603 | 1053.994175 | 1048.999632 | 0 | 660 |
| Tamilnadu | 573.3075003 | 2058.788001 | 1864.895698 | 901.0615711 | 1053.771398 | 2357.068684 | 3480.94549 | 1246.832857 |
| Telangana | 977.7777778 | 882.3529412 | 1000 | 1000 | 1710.879 | 930 | 1340 | 0 |
| Uttar Pradesh | 1000 | 1914.002205 | 0 | 555.5555556 | 1577.988506 | 2221.003308 | 0 | 765 |
| Uttarakhand | 0 | 0 | 1495.327103 | 1349.206349 | 0 | 0 | 1458.988764 | 1448.979592 |
| West Bengal | 333.3333333 | 294.1176471 | 1107.862903 | 825.5319149 | 526.3157895 | 428.5714286 | 1072.968491 | 500 |
| All India | 812.1548533 | 1304.533083 | 1363.149659 | 713.8311447 | 1099.180652 | 1419.632519 | 1723.615663 | 781.3309312 |

Table – A 4: Percentage of Gross Cropped Area under Millets in Major Indian States in 2016-17 and 2020-21.

| | **Jowar 2016-17** | **Bajra 2016-17** | **Ragi 2016-17** | **Small Millets 2016-17** | **Total Millets 2016-17** | **Jowar 2020-21** | **Bajra 2020-21** | **Ragi 2020-21** | **Small Millets 2020-21** | **Total Millets 2020-21** |
|---|---|---|---|---|---|---|---|---|---|---|
| Andhra Pradesh | 1.30762 | 0.566186 | 0.4313798 | 0.4178992 | 2.723085 | 1.6201289 | 0.4185333 | 0.4455355 | 0.29702363 | 2.7812213 |
| Bihar | 0.023516 | 0.0465095 | 0.0624481 | 0.0418063 | 0.1742798 | 0.0169316 | 0.0580904 | 0.0381304 | 0.02987114 | 0.14302355 |
| Chhattisgarh | 0.0793172 | 0.0017626 | 0.1110441 | 1.5722439 | 1.7643679 | 0.0360613 | 0.0007002 | 0.0959301 | 1.48131447 | 1.61400607 |
| Gujarat | 0.8185738 | 3.3283521 | 0.1467255 | 0.1698927 | 4.4635442 | 0.2789658 | 3.1262914 | 0.0711169 | 0.0574641 | 3.5338382 |
| Haryana | 0.9609642 | 7.4087243 | 0 | 0 | 8.3696885 | 0.4764246 | 8.6694655 | 0 | 0 | 9.14589011 |
| Himachal Pradesh | 0 | 0.0740182 | 0.2324798 | 0.5118726 | 0.8183707 | 0.0022257 | 0.0578689 | 0.0645461 | 0.26820004 | 0.39284073 |
| Jammu & Kashmir | 0 | 1.1783456 | 0.7051383 | 0.7731035 | 2.6565874 | 0 | 1.1819438 | 0 | 0.72949498 | 1.91143877 |
| Jharkhand | 0.1931572 | 0.0161372 | 1.1095539 | 0 | 1.3188483 | 0.1037107 | 0.0072098 | 1.0409896 | 0 | 1.15191016 |
| Karnataka | 8.0482638 | 2.0545146 | 5.0768584 | 0.1782843 | 15.357921 | 5.0303498 | 1.4889835 | 5.2650994 | 0.17438546 | 11.9588182 |
| Kerala | 0.0054179 | 0 | 0.001161 | 0.000387 | 0.0069659 | 0.008953 | 0 | 0.008953 | 0.00194631 | 0.01985234 |
| Madhya Pradesh | 0.9085635 | 1.1563535 | 0.0107376 | 0.7598895 | 2.8355441 | 0.3745472 | 1.0935441 | 0 | 0.26084538 | 1.7289367 |
| Maharashtra | 12.739383 | 3.4956362 | 0.3871049 | 0.3495219 | 16.971646 | 8.3432998 | 2.7591604 | 0.3274873 | 0.148493 | 11.5784404 |
| Odisha | 0.1119924 | 0.037672 | 0.9616605 | 0.5611904 | 1.6725154 | 0.1141254 | 0.0263526 | 0.8571857 | 0.73144025 | 1.729104 |
| Punjab | 0 | 0.015376 | 0 | 0 | 0.015376 | 0 | 0.0051055 | 0 | 0 | 0.00510548 |
| Rajasthan | 2.2250519 | 15.940783 | 0 | 0.0563455 | 18.222181 | 2.1444083 | 16.660553 | 0 | 0.02490424 | 18.8298655 |
| Tamilnadu | 5.2331592 | 0.9684825 | 1.1964181 | 0.4591859 | 7.8572456 | 6.5860578 | 1.0950771 | 1.3470374 | 0.39751575 | 9.42568803 |
| Telangana | 1.5075435 | 0.2847582 | 0.0167505 | 0.0167505 | 1.8258027 | 1.0731953 | 0.1179336 | 0.0117934 | 0 | 1.20292225 |
| Uttar Pradesh | 0.6790725 | 3.3656765 | 0 | 0.033397 | 4.078146 | 0.6418533 | 3.3457523 | 0 | 0.04426574 | 4.03187133 |
| Uttarakhand | 0 | 0 | 9.89095 | 5.8236434 | 15.714593 | 0 | 0 | 8.9283385 | 4.91560212 | 13.8439407 |
| West Bengal | 0.0003119 | 0.0017675 | 0.1031373 | 0.0244327 | 0.1296494 | 0.0018614 | 0.0006858 | 0.0590755 | 0.00744567 | 0.06906836 |

TABLE – A5: DESCRIPTIVE RESULTS OF SPEARMAN'S RANK CORRELATION ANALYSIS.

| Spearman's rho | | Social Development | Agricultural Development |
|---|---|---|---|
| Social Development | Correlation Coefficient | 1.000 | .965 |
| | Sig. (2-tailed) | | .000 |
| | N | 20 | 20 |
| Agricultural Development | Correlation Coefficient | .965 | 1.000 |
| | Sig. (2-tailed) | .000 | |
| | N | 20 | 20 |

Correlation is significant at the 0.05 level (2-tailed).

The variables Social Development and Agricultural Development are significantly and moderately positively correlated $r = .331$, $N = 38$, $p < .05$