

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 Bhubaneswar 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:

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

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,

ρ = 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

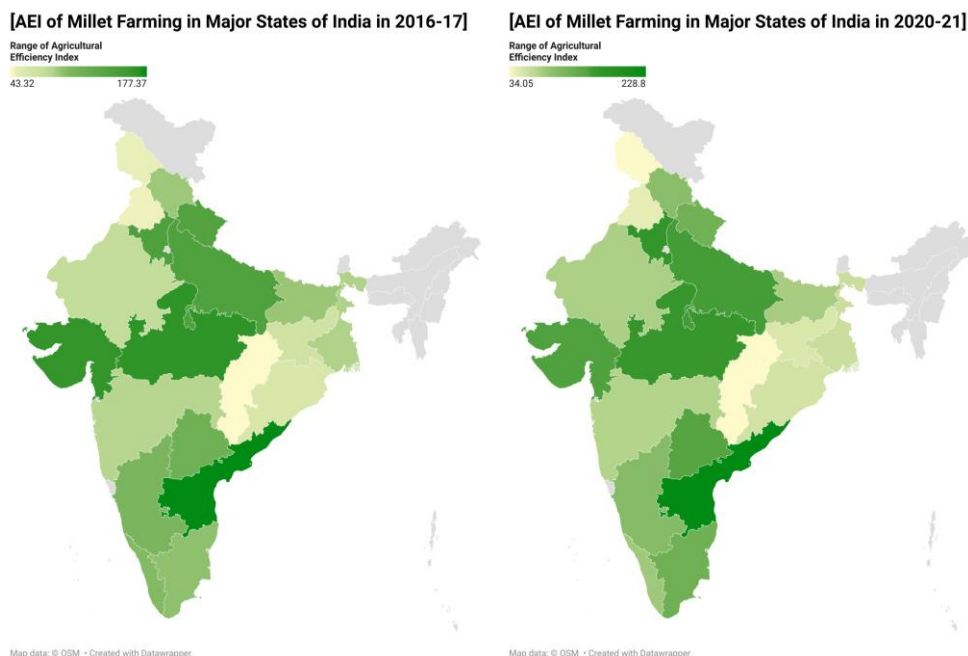
In this section, we will delineate the outcomes of all our objectives. This will offer a comprehensive overview of the evolving landscape of millet farming in India's top 20 states during the period from 2016-17 to 2020-21.

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	Rank	AEI	Rank	Change in	Change in
	2016-17	2016-17	2020-21	2020-21	AEI	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.

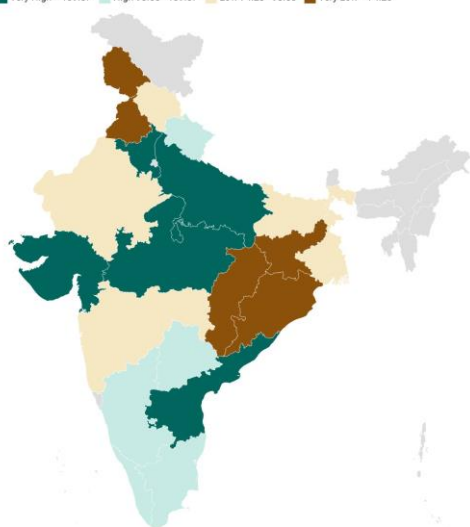
TABLE 2: CHANGING PATTERN OF STATE-WISE AGRICULTURAL EFFICIENCY IN MILLET FARMING

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	Telangana (N)	Kerala (D)	Odisha (N)
Madhya Pradesh	Telangana	Himachal Pradesh	Odisha	(N)	Tamilnadu (N)	Bihar (N)	Jharkhand (N)
Gujarat	Karnataka	Kashmir	Jammu & Kashmir	(N)	Uttarakhand	Rajasthan	Punjab (N)
Haryana	Kerala	West Bengal	Punjab	Haryana (N)	(N)	(N)	Jammu & Kashmir (N)
Uttar Pradesh	Tamil Nadu	Maharashtra	Chhattisgarh	Madhya Pradesh (N)	Karnataka (N)	Maharashtra (N)	
		Rajasthan		Uttar Pradesh (N)	Himachal Pradesh (I)	West Bengal (N)	Chhattisgarh (N)
				Gujarat (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.

[AEI of Millet Farming in Major States of India in 2016-17]

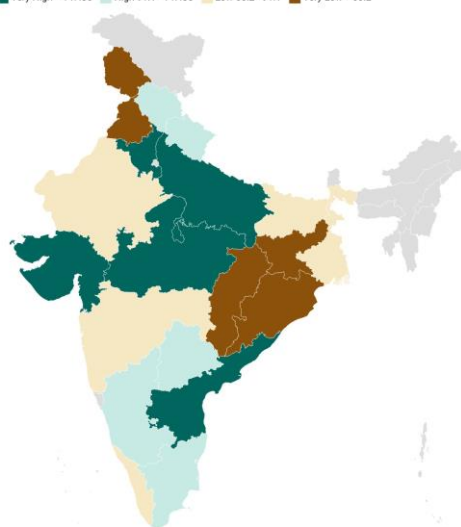
Degree of Agricultural Efficiency Index
 Very High > 139.87 High 93.58 – 139.87 Low 74.28 – 93.58 Very Low < 74.28



Map data: © OSM • Created with Datawrapper

[AEI of Millet Farming in Major States of India in 2020-21]

Range of Agricultural Efficiency Index
 Very High > 147.35 High 91.1 – 147.35 Low 60.2 – 91.1 Very Low < 60.2



Map data: © OSM • Created with Datawrapper

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)	Bajra Production (Kg)	Ragi Production (Kg)	Small Millets Production (Kg)	Jowar Production (Kg)	Bajra Production (Kg)	Ragi Production (Kg)	Small Millets Production (Kg)
	2016-17	2016-17	2016-17	2016-17	2020-21	2020-21	2020-21	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	1500000	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	6.5860378	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 $r = .331$, $N = 38$, $p < .05$