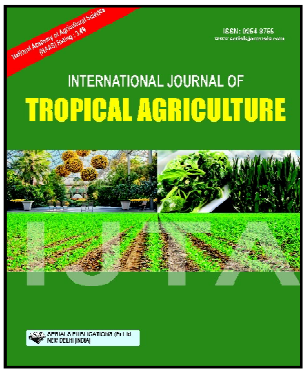

INTERNATIONAL JOURNAL OF TROPICAL AGRICULTURE

ISSN : 0254-8755

available at http: www.serialsjournals.com

Volume 36 • Number 1 • 2018

Nutrient Rich Crops: Coarse Cereals and Millets

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Abstract: In India production of coarse cereals has shown a mixed growth trend over the past years. With the exception of maize, most other coarse cereals have lost their growth momentum due to lower productivity and profitability. The present study investigates the economy of coarse cereals in India by analysing the commodity specific trend, regional variation and cost and return of selected coarse cereals in major producing state. Increasing demand from the growing feed and starch industry, increased use of hybrid seeds and increasing export demand gave a fillip to production of maize, which has registered a steady growth over the past few years. Variability analysis signifies that the yield enhancement is the essential component for increasing the production of coarse cereals in the country. Although the government has included coarse grains in the National Food Security Act to be distributed through the PDS, no substantial distribution is likely unless the government starts procuring coarse grains. Currently, Indian maize is not export competitive. MSP of maize is lower than the domestic prices but it is much higher than international prices. Cost and return from coarse cereals had been computed by using cost of cultivation data.

Key words: Cost and return; MSP; profitability; small millets; variability; Yield gap.

INTRODUCTION

The coarse cereals are mainly grown in poor agro-climatic regions, particularly rainfed areas of the country. These crops are grown in areas with high temperature and are called dryland crops because can be grown in areas with 50-100 cm rainfall. These crops are less sensitive to soil deficiencies and can be grown in inferior alluvial or loamy soil. Currently, India holds 4th position in the world in coarse cereal production (1267 million tonnes during 2011-2016) after USA, China and Brazil but the amount produced is only 3.3% (41.8 million tonnes during 2011-2016) of the global coarse cereal production. As per 2016 figures, Rajasthan, Karnataka and

Madhya Pradesh are the top coarse cereal producer states of India. In India, yield of coarse cereals is about 1433 kg/ha as compared to world average yield of 3512 kg/ha. The highest productivity of 8946 kg/ha was recorded in USA. In global production of Maize India ranks 8th th after USA, China , Brazil, Argentina, Mexico and Ukraine and in Millets India ranks first (FAOSTAT 2016).

In India production of coarse cereals has shown a mixed growth trend over the past years. With the exception of maize, most other coarse cereals have lost their growth momentum due to lower productivity and profitability, wide year-to-year fluctuations and the lack of an effective market support mechanism unlike that for wheat and rice. Competition from commercial crops such as soybeans and cotton has caused erosion in planted area under most of these crops. With this backdrop present study investigate the economy of coarse cereals in India by analysing the commodity specific trend, regional variation and cost and return of selected coarse cereals in major producing state.

COARSE CEREALS PRODUCTION

Coarse cereals are grown over an area of 25.19 million ha (20.4% of total food grains), with a production of 41.35 million tonnes during 2011-12 to 2015-16 and contributed about 16% to national food basket **Figure 1**.

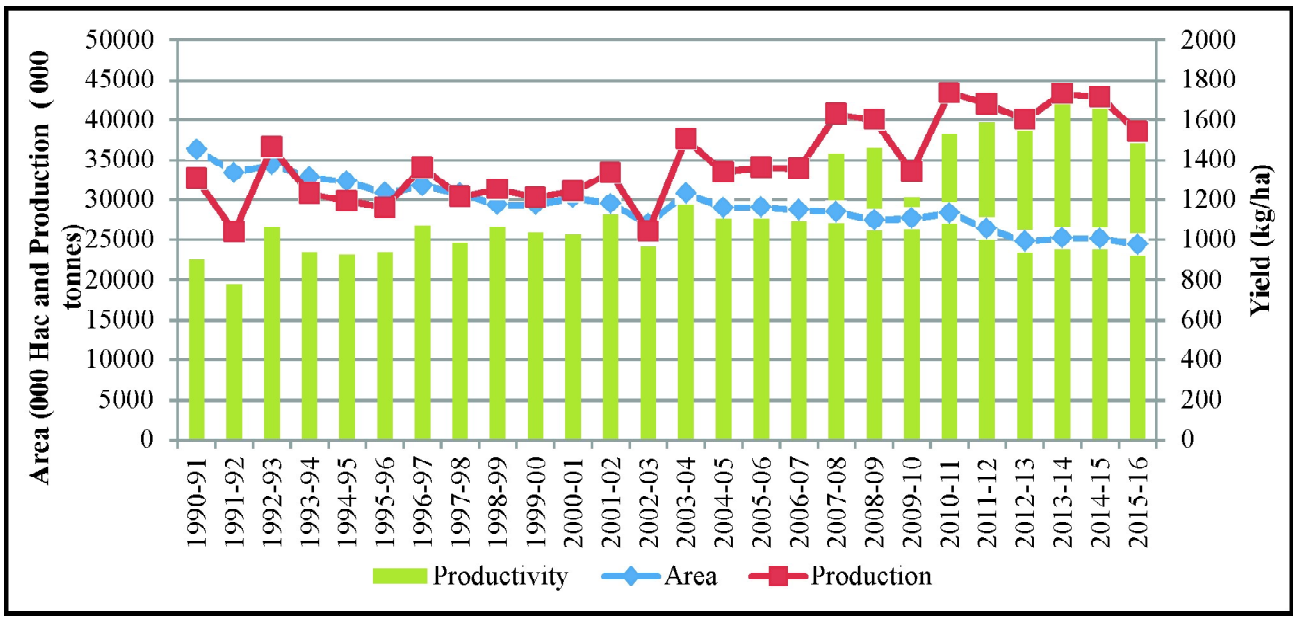


Figure 1: Area, Production and Yield of Coarse Grains

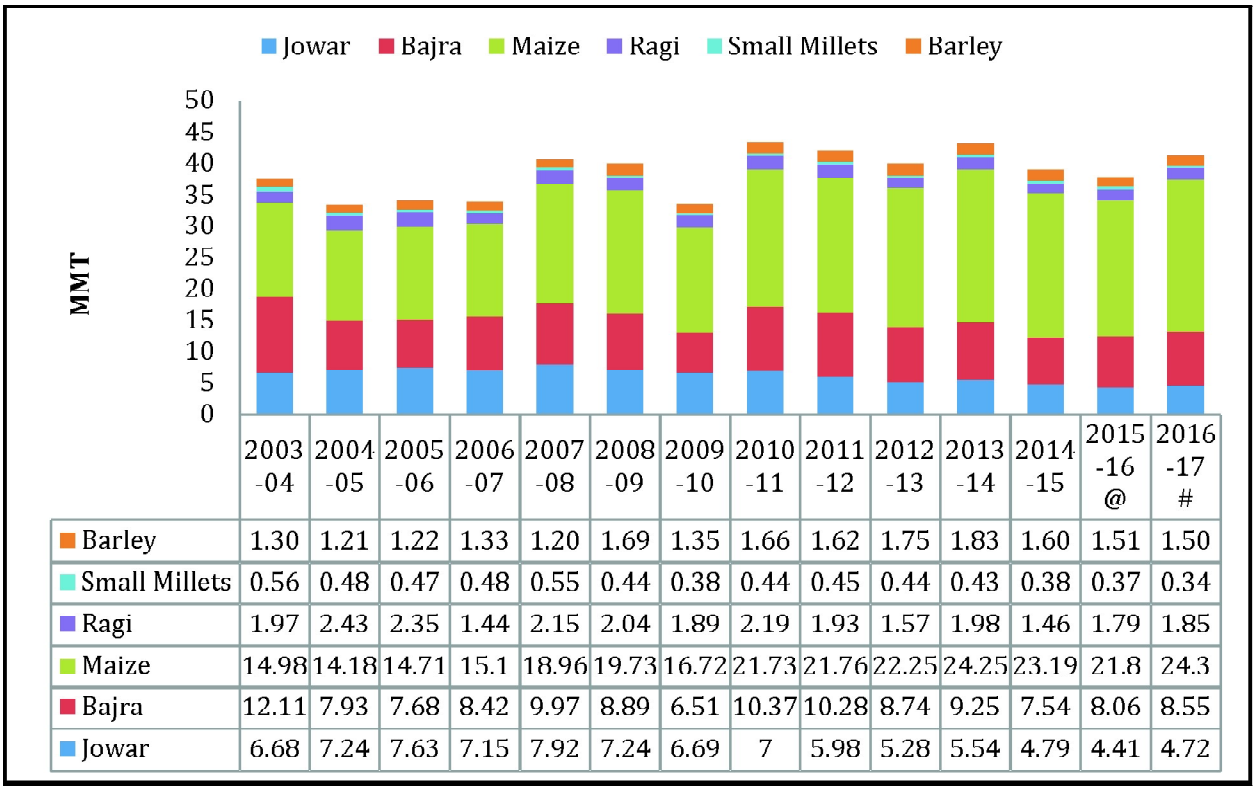
Source: Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, GOI

Increasing demand from the growing feed and starch industry, increased use of hybrid seeds and increasing export demand gave a fillip to production of maize, which has registered a steady growth over the past few years.

Jowar and millet cultivation has slowed down in the recent years on weakening demand and profitability compared to other competing crops. Absence of any significant major productivity enhancing technological (varietal or agronomic) breakthrough, lack of industrial sector demand and growing consumer preference for wheat/rice have influenced farmer planting decisions for jowar and millet. Over the last two decades, traditional

cultivated area under jowar and millet has shifted to commercially viable crops like corn, cotton, soybean and other commercial crops.

Production of barley, a relatively small winter crop in north India, has been relatively steady at around 1.5-1.8 MMT on demand from the malting and brewing industry. Traditionally barley production in India consists of feed quality, six-row varieties, unsuitable for malting and mostly used for food and animal feed purposes. Recently, a few new, high quality malting grade barley varieties have been developed through public-private breeding programs, and these varieties are steadily replacing older varieties. Trade sources report that some malting and brewing companies are promoting the cultivation of the malting grade barley varieties under contract farming (buy-back arrangement) in the traditional growing areas of Rajasthan, Punjab, and Haryana. There is a great potential to expand production and consumption of millets particularly ragi (finger millets), as they are highly nutritious, use less water and have high drought tolerance.



	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16 @	2016-17 #
Barley	1.30	1.21	1.22	1.33	1.20	1.69	1.35	1.66	1.62	1.75	1.83	1.60	1.51	1.50
Small Millets	0.56	0.48	0.47	0.48	0.55	0.44	0.38	0.44	0.45	0.44	0.43	0.38	0.37	0.34
Ragi	1.97	2.43	2.35	1.44	2.15	2.04	1.89	2.19	1.93	1.57	1.98	1.46	1.79	1.85
Maize	14.98	14.18	14.71	15.1	18.96	19.73	16.72	21.73	21.76	22.25	24.25	23.19	21.8	24.3
Bajra	12.11	7.93	7.68	8.42	9.97	8.89	6.51	10.37	10.28	8.74	9.25	7.54	8.06	8.55
Jowar	6.68	7.24	7.63	7.15	7.92	7.24	6.69	7	5.98	5.28	5.54	4.79	4.41	4.72

Figure 2: Production of Coarse Cereals by type

Source: Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, GOI

STATE-WISE GROWTH RATES, VARIABILITY AND YIELD GAP

In crop area wise India ranks first in wheat, rice, and pulses, second in sugarcane third in coarse grains and oilseeds. Among the major coarse cereals producing states Rajasthan has maximum share in area (24.6 %) and production (16.49 %) both followed by Karnataka in production (15.60 %) and Maharashtra in area (20.4%).

Differentials in yields across states suggest that likely gains can be had by raising the yield levels in the lower-yield states to the level of the higher yields

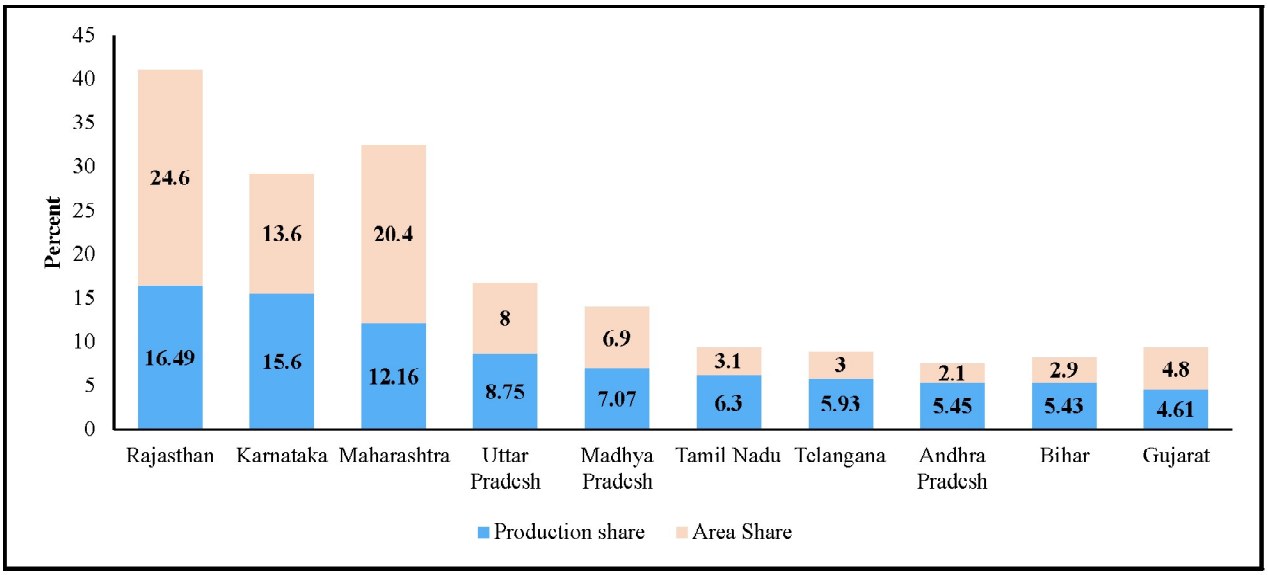


Figure 3: State-wise Production and Area Share of Coarse Cereals (Average of 2011-12 to 2015-16)

Source: Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, GOI

achieved in other states. While agro-climatic and technological conditions may constrain the low-yield states from reaching the highest yield levels achieved elsewhere, the gaps between the highest yield and the actual yields in individual states also point to such likely differences at the micro level.

MAIZE

In maize Tamil Nadu (22.6%) followed by West Bengal (16.98%) and Maharashtra (12.60%) registered maximum growth in production. Most of the increase was attributed to growth in area, except in Tamil Nadu, where yield growth was the highest. In Uttar Pradesh, Himachal Pradesh and Jammu and Kashmir, production growth rate was negative. At the national level, production growth was 5.2% equally contributed by area (2.3% per year) and yield (2.9% per year) (Table 1). However, the high production growth rate was also associated with high production variability, which ranged from 79 % in Tamil Nadu to 37% in Andhra Pradesh. Lowest production variability was observed in Jammu and Kashmir (11.16 %). The yield gap is highest in Gujarat, Rajasthan, Uttar Pradesh, Madhya Pradesh and Jammu and Kashmir with the deficit relative to maximum yield is more than 2 tonnes per hectare. In Karnataka, Bihar, Himachal Pradesh and Maharashtra, the yield gap is between 1 and 2 tonnes per hectare. Hence significant future increase in maize production can come from yield improvement in these states.

JOWAR

With the exception of Rajasthan and Tamil Nadu all major states registered a decline in jowar production during the period 2000-01 to 2015-16, largely due a declining trend in area. At the national level, production declined at the rate of 2.85 % per year during the period of 2000-01 to 2015-16. Area also declined by 3.7% per year but yield rose by 1 % per year to reduce the production decline. In Rajasthan area increased by a modest rate of 0.2% per year and production by 6.63% and in Tamilnadu area declined by 1.5 % and Production by 2.8%. Competition from other crops such as soybean, maize and cotton has led to decline in Jowar acreage. Most states have registered a positive growth rate in yield, which ranged from as high as 6.5% in Rajasthan

Table 1
State-wise Growth rates, Variability and Yield Gap of Maize, 2001-2015-16

State	*CG%*			*CV (%)*			*(Kg/ ha)*	
	Area	*Yield*	*Production*	*Area*	*Yield*	*Production*	*Av. Yield*	*Yield Gap*
Andhra Pradesh	4.40	2.96	7.49	21.92	19.49	36.58	3990	0
Bihar	1.16	2.40	3.58	6.16	18.22	23.56	2624	-1366
Gujarat	-0.22	1.94	1.72	10.06	27.18	28.04	1395	-2596
Himachal Pradesh	-0.25	0.20	-0.05	2.46	13.80	14.30	2248	-1743
Jammu and Kashmir	-0.69	0.26	-0.44	3.66	11.31	11.16	1601	-2389
Karnataka	6.14	1.10	7.31	27.85	14.14	34.68	2780	-1211
Madhya Pradesh	0.96	0.92	1.89	10.07	22.55	31.20	1593	-2398
Maharashtra	9.30	3.02	12.60	40.08	23.13	50.97	2147	-1844
Punjab	-2.11	3.20	1.02	10.57	16.59	11.38	3246	-744
Rajasthan	-0.61	2.44	1.81	7.39	23.65	26.38	1447	-2544
Tamil Nadu	9.63	11.82	22.59	38.63	53.51	78.92	3645	-345
Uttar Pradesh	-1.67	1.53	-0.17	10.07	12.83	14.21	1538	-2452
West Bengal	11.33	5.07	16.98	48.09	24.31	66.78	3340	-650
India	**2.30**	**2.87**	**5.24**	**10.93**	**15.05**	**24.83**	**2221**	**-1770**

Source: Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, GOI

to 2.95 % in Karnataka. UP and Maharashtra registered negative growth rate in yield. Production variability was the highest in Rajasthan with CV at 45 % even as it registered high rate of growth of production. The CV of production was the lowest in Karnataka at 19.4%. At the national level, production variability measured by CV was a modest 16%, with area variability at 18% and yield variability at 11%. With the exception of Rajasthan, the yield gap in Jowar is not significant in most states implying

Table 2
State-wise Growth rates, Variability and Yield Gap of Jowar, 2001-2015-16

State	*CG%*			*CV (%)*			*(Kg/ ha)*	
	Area	*Yield*	*Production*	*Area*	*Yield*	*Production*	*Av. Yield*	*Yield Gap*
Andhra Pradesh	-7.72	4.31	-3.74	40.99	22.73	23.71	1312	0.00
Karnataka	-3.68	2.95	-0.84	18.22	22.34	19.37	973	-338
Madhya Pradesh	-7.95	5.80	-2.61	36.41	29.32	23.84	1284	-27
Maharashtra	-3.63	-1.69	-5.26	18.09	16.92	26.91	765	-546
Rajasthan	0.17	6.46	6.63	10.09	41.92	44.88	506	-805
Tamil Nadu	-1.55	4.39	2.77	20.13	27.57	34.97	962	-350
Uttar Pradesh	-4.89	-0.03	-4.91	26.21	14.37	27.38	991	-321
India	-3.73	0.92	-2.85	18.19	11.44	15.67	854	-457

Source: Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, GOI

that potential for increasing production from bridging the yield gap at the present level of technology is limited. However, some scope exists in Maharashtra and Karnataka with about 5 million hectares of area under Jowar where the yields are lower than the best yields.

BAJRA

Bajra production growth was high in Madhya Pradesh, Rajasthan and Uttar Pradesh exceeding 4% per year, whereas in Gujarat and Maharashtra the growth rate was negative. During the last decade, Bajra production increased by 1.6% per year in Karnataka and 1.04% in Haryana. Area growth was minimal and the production growth was driven by yield increases in most states. At the national level annual production growth was 1.6%, fuelled by 3.5% growth in yield despite a marginal negative growth in area. Being a mostly rainfed crop, variability in production is high in Bajra, both due to variability in yield and to a lesser extent by volatility in area. At the national level the CV of production and yield is at around 20% and 12% in area. Among major Bajra producing states, the yield gap is largest in Maharashtra, Rajasthan and Karnataka (Table 3). Hence future growth in Bajra production should be focused on these three states by narrowing the yield gap.

Table 3
State-wise Growth rates, Variability and Yield Gap of Bajra, 2001-2015-16

State	*CG%*			*CV (%)*			*(Kg/ha)*	
	Area	*Yield*	*Production*	*Area*	*Yield*	*Production*	*Av. Yield*	*Yield Gap*
Gujarat	-4.83	3.89	-1.12	24.36	22.64	20.56	1370	-232
Haryana	-2.75	3.89	1.04	17.91	21.42	25.47	1602	0.00
Karnataka	-3.10	4.88	1.63	27.06	31.71	37.67	785	-816
Madhya Pradesh	1.67	4.59	6.34	14.50	24.54	38.35	1554	-47
Maharashtra	-5.45	0.31	-5.16	28.61	23.35	29.55	748	-854
Rajasthan	-0.53	4.61	4.06	13.95	33.17	37.43	751	-850
Uttar Pradesh	0.77	3.19	3.98	5.52	16.23	20.00	1597	—5
India	-1.77	3.45	1.61	11.99	20.72	20.32	979	-622

Source: Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, GOI

RAGI

In Ragi except Tamilnadu production growth was negative in all states. At the national level annual yield growth rate was 1.77% whereas both production and area registered negative growth rates of 0.97 and -2.69% respectively. Production variability was highest in Andhra Pradesh, Bihar, Gujarat and Karnataka, both due to variability in yield and to a higher extent by volatility in area. At the national level the CV of production yield and area is at around 18 %, 14% and 15 % respectively (Table 4). Among major Ragi producing states, the yield gap is largest in Odisha, Gujarat, Bihar and Maharashtra. Hence future growth in Ragi production should be focused on these four states by narrowing the yield gap.

SMALL MILLETS

The three highest CGRs in small millet production during the past decade were registered by Andhra Pradesh (7.02%) followed by Arunachal Pradesh (5.39%) and Odisha (3.52%). Most of the increase was attributed to growth in yield, except in Odisha,

Table 4
State-wise Growth rates, Variability and Yield Gap of Ragi, 2001-2015-16

State	*CG%*			*CV (%)*			*(Kg/ha)*	
	Area	*Yield*	*Production*	*Area*	*Yield*	*Production*	*Av. Yield*	*Yield Gap*
Andhra Pradesh	-6.44	-1.25	-7.61	33.30	8.97	39.60	1141.0	-955
Bihar	-8.16	3.69	-4.77	40.55	28.83	38.83	936.3	-1159
Gujarat	-2.26	-0.08	-2.33	18.39	18.40	27.13	869.8	-1226
Karnataka	-2.45	1.59	-0.90	16.28	17.89	24.82	1655.7	-440
Maharashtra	-2.40	0.66	-1.76	12.33	10.65	16.40	1009.2	-1086
Odisha	-3.22	1.91	-1.37	16.20	13.78	13.91	640.9	-1455
Tamil Nadu	-2.38	4.63	2.14	20.16	29.85	35.33	2095.6	0
Uttarakhand	-2.18	1.27	-0.94	11.99	9.00	8.13	1304.3	-791
West Bengal	-2.11	-0.49	-2.59	12.69	5.08	15.51	1150.6	-945
India	-2.69	1.77	-0.97	15.06	14.22	18.37	1478.4	-617

Source: Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, GOI

where area growth was the highest. In rest of the state's production growth rate was negative. However, the high production growth rate was also associated with high production variability, which ranged from 46 % in Andhra Pradesh to 10% in Uttarakhand (Table 5). Except Tamilnadu, Gujarat, Arunachala Pradesh and Andhra Pradesh the yield gap is very high in all the states. Hence significant future increase in small millet production can come from yield improvement in these states.

Table 5
State-wise Growth rates, Variability and Yield Gap of Small Millets, 2007-2015-16

State	*CG%*			*CV (%)*			*(Kg/ha)*	
	Area	*Yield*	*Production*	*Area*	*Yield*	*Production*	*Av. Yield*	*Yield Gap*
Andhra Pradesh	1.22	5.73	7.02	27.80	25.09	45.68	785	-418
Arunachal Pradesh	2.47	2.85	5.39	9.09	8.64	15.36	958	-245
Chhattisgarh	-7.49	-1.74	-9.09	21.78	14.33	32.15	209	-994
Gujarat	-11.32	-0.82	-12.05	39.22	8.69	40.96	1045	-158
Karnataka	-3.94	-0.26	-4.19	17.97	12.48	17.31	474	-729
Madhya Pradesh	-8.74	8.67	-0.82	25.39	28.70	15.28	375	-828
Maharashtra	-0.46	-1.66	-2.11	16.59	11.74	21.80	465	-738
Orissa	3.22	0.29	3.52	14.81	6.00	15.87	503	-700
Rajasthan	-1.80	4.71	2.82	12.72	42.36	42.24	403	-800
Tamil Nadu	-2.39	3.30	0.83	10.81	11.51	11.01	1067	-136
Uttarakhand	-2.91	1.64	-1.31	9.09	7.87	10.07	1203	0
India	-5.85	3.46	-2.59	17.45	11.16	11.78	563	-640

Source: Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, GOI

BARLEY

With the exception of Rajasthan, Haryana, Madhya Pradesh and Himachal other states registered a decline in Barley production during the period 2000-01 to 2015-16, largely due a declining trend in area. At the national level, production increased at the rate of 1.67 % per year during the period of 2000-01 to 2015-16. Area declined by -0.3% per year but yield rose by 2 % per year. In Rajasthan area increased by at highest rate of 3.97% per year and production by 6.47% (Table 6). Production variability was the highest in Punjab (33%) followed by Rajasthan (33%) and Haryana (30%). At the national level, production variability measured by CV was a modest 14%, with area variability at 7% and yield variability at 12%. The yield gap is highest in Bihar, Himachal Pradesh and Madhya Pradesh with the deficit relative to maximum yield is more than 2 tonnes per hectare. In Uttar Pradesh and Rajasthan, the yield gap is between 1 and 1.3 tonnes per hectare. Hence significant future increase in Barley production can come from yield improvement in these states.

Table 6
State-wise Growth rates, Variability and Yield Gap of Barley, 2001-2015-16

State	*CG%*			*CV (%)*			*(Kg/ha)*	
	Area	*Yield*	*Production*	*Area*	*Yield*	*Production*	*Av. Yield*	*Yield Gap*
Bihar	-5.24	1.16	-4.14	28.54	11.88	25.39	1216	-2292
Haryana	1.31	2.22	3.56	22.46	12.53	30.64	3147	-361
Himachal Pradesh	-1.72	2.86	1.09	9.60	26.80	24.02	1301	-2208
Madhya Pradesh	0.67	2.17	2.85	14.01	16.56	26.74	1380	-2128
Punjab	-7.05	0.87	-6.24	36.57	5.54	33.10	3508	0
Rajasthan	3.97	2.41	6.47	22.63	13.65	32.76	2606	-903
Uttar Pradesh	-4.18	0.62	-3.59	23.07	12.32	23.49	2210	-1298
India	**-0.33**	**2.01**	**1.67**	**7.36**	**11.76**	**13.81**	**2207**	**-1301**

Source: Directorate of Economics and Statistics, Ministry of Agriculture and Farmers' Welfare, GOI

This analysis signifies that the yield enhancement is the essential component for increasing the production of coarse cereals in the country.

CONSUMPTION OF COARSE CEREALS IN INDIA

They are rich in dietary energy, vitamins, several minerals especially micronutrients such as iron and zinc. Finger millet is the richest source of calcium and small millets are a good source of phosphorus and iron. In view of these nutritional properties these coarse cereals have of late been also designated as nutri-cereals. Despite all the nutritional benefits of millets there has been drastic reduction in their consumption.

Per capita consumption of coarse cereals has declined from around 38 kg in 1987-88 to 11.6 kg in 2011-12 in rural households and from 19 kg to 9.5 kg in urban households. However, the decline in human consumption of coarse cereals has resulted in larger availability of feed grains to the poultry and livestock sector, which has registered a significant growth in recent years (Figure 4).

For promoting cultivation and consumption of millets, Government of India introduced Scheme on "Initiative for Nutritional Security through Intensive Millet Promotion (INSIMP)" in 2011-12. These

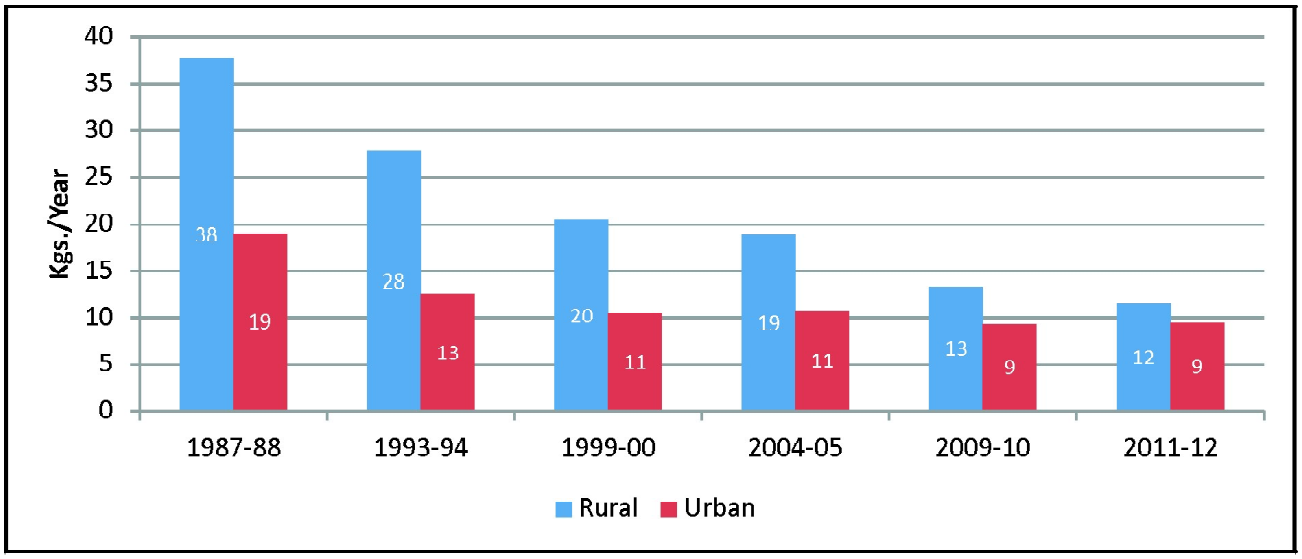


Figure 4: Trends in Per Capita Coarse Grains Consumption

Source: Various Rounds of Consumer Expenditure Survey, NSS

crops have been included as an integral part of National Food Security Mission during XII Plan. Coarse cereals have also been included in Public Distribution System at subsidized rates after introduction of National Food Security Act. Although the government has included coarse grains in the National Food Security Act to be distributed through the PDS at a subsidised rate of Rs. 1 per Kg, no substantial distribution is likely unless the government starts procuring coarse grains. Although food use of maize has shrunk, there has been a significant increase in the non-food usage of corn – mainly for feed and starch and starch derivatives in recent years. According to industry sources almost two-third of annual maize production goes for feed use and about 16% for industrial use mainly starch. A growing poultry sector is generating increased demand for maize for feed use.

EXPORT OF COARSE CEREALS (MAIZE)

USA, Brazil, Ukraine and Argentina account for more than 80% of total world exports of maize. Japan, EU, Mexico, South Korea and Egypt account for 41.5% of global imports. It may be seen from Figure 5 that India's exports of maize increased from 4.2 lakh tonnes in 2005-06 to a high of 47.9 lakh tonnes in 2012-13. However, exports of maize declined to 39.8 lakh tonnes in 2013-14, 28.3 lakh tonnes in 2014-15 and only 7 lakh tonnes in 2015-16 mainly due to low world prices and fall in domestic production.

It may be seen from (Figure 6) that domestic wholesale prices of maize were lower than the international prices from 2012 (Q1) to 2013 (Q3) but higher than international prices from 2013 (Q4) onwards. Currently, Indian maize is not export competitive. MSP of maize is lower than the domestic prices but it is much higher than international prices.

PROFITABILITY OF COARSE CEREALS IN INDIA

In order to promote the cultivation of coarse cereals by the farmers and also to improve nutritional security the Government of India has increased the MSP of these crops during recent years. The improved varieties of certain coarse cereals and favourable policy measures seem to have motivated the farmers to increase their production.

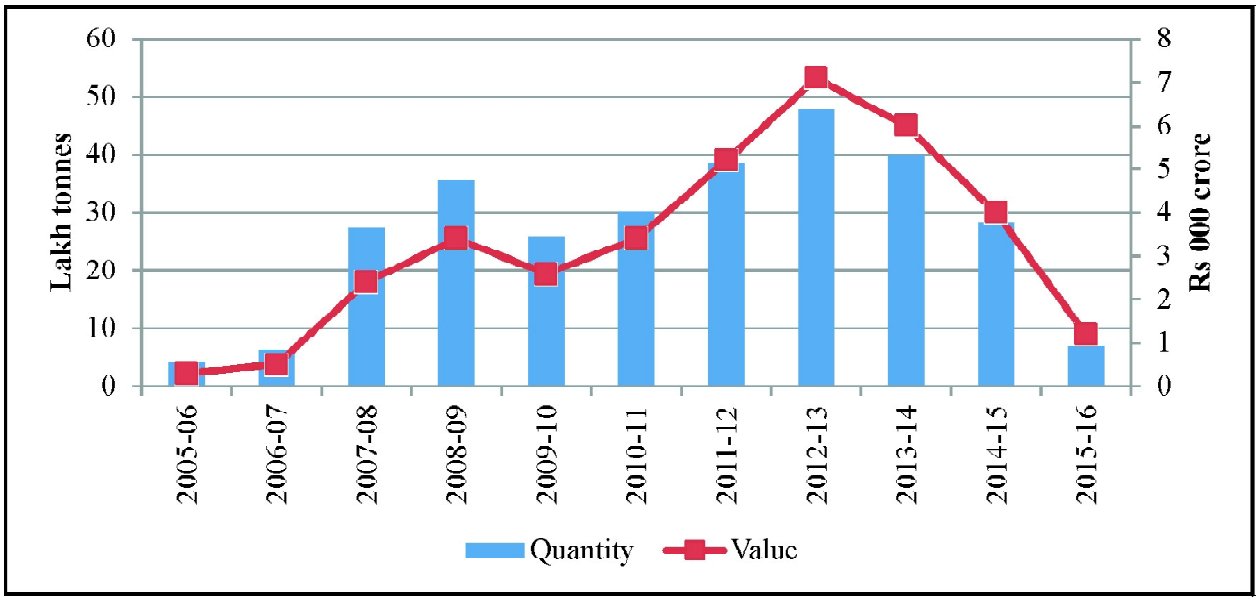
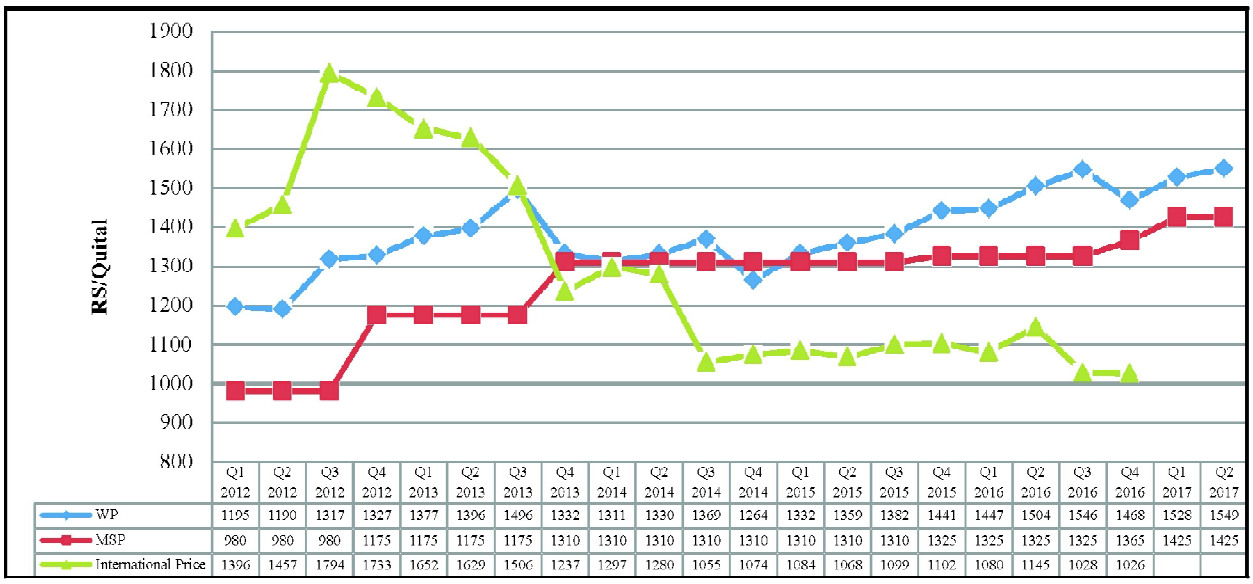


Figure 5: India's Export of Maize, 2005-06 to 2015-16

Source: CACP Reports



	Q1 2012	Q2 2012	Q3 2012	Q4 2012	Q1 2013	Q2 2013	Q3 2013	Q4 2013	Q1 2014	Q2 2014	Q3 2014	Q4 2014	Q1 2015	Q2 2015	Q3 2015	Q4 2015	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017
WP	1195	1190	1317	1327	1377	1396	1496	1332	1311	1330	1369	1264	1332	1359	1382	1441	1447	1504	1546	1468	1528	1549
MSP	980	980	980	1175	1175	1175	1175	1310	1310	1310	1310	1310	1310	1310	1310	1325	1325	1325	1325	1365	1425	1425
International Price	1396	1457	1794	1733	1652	1629	1506	1237	1297	1280	1055	1074	1084	1068	1099	1102	1080	1145	1028	1026		

Figure 6: MSP, Domestic and International Prices of Maize, 2012 to 2018

Note: 1. Maize (US), No.2, yellow, f.a.b. US gulf ports

2. Weighted wholesale price of AP, Bihar, Gujarat, Karnataka, MP, Maharashtra, Punjab, Rajasthan, TN and UP

Source: CACP

Cost and return from coarse cereals had been computed by using cost of Cultivation Data. It was observed that the average cost of cultivation of Maize and Gross return was highest in Tamil Nadu ie Rs. 70866/ h and Rs7450/ ha respectively and lowest in Uttar Pradesh ie Rs 32476/ ha and Rs 25858/ha respectively (Table 7). Even though yield was highest in Tamil Nadu BCR was observed to be

Table 7
Profitability of Maize in India, TE 2014-15

Items	*Andhra Pradesh*	*Bihar*	*Gujarat*	*Karnataka*	*Madhya Pradesh*	*Rajasthan*	*Tamil Nadu*	*Uttar Pradesh*
Operational Cost	37892	25078	31079	29430	21410	32178	53320	21299
Fixed Costs	22943	9728	7237	11545	9395	9453	17546	11177
Total Cost	60836	34805	38316	40976	30806	41631	70866	32476
Gross Return (Rs/ha)	68966	42493	31831	41831	32198	37752	74530	25858
Cost A2 (Rs/ha)	32409	19912	20978	25079	16527	15249	44075	12337
Net Return over A2 (Rs./ Ha)	36557	22581	10853	16752	15671	22503	30455	13521
Profitability (Net return as % of A2)	112.8	113.4	51.7	66.8	94.8	147.6	69.1	109.6
Cost C2 (Rs/ha)	60836	34805	38316	40976	30806	41631	70866	32476
Net Return over C2 (Rs./ Ha)	8130	7688	-6485	856	1393	-3879	3665	-6619
Profitability (Net return as % of C2)	13.4	22.1	-16.9	2.1	4.5	-9.3	5.2	-20.4
Yield (Qtl./Ha)	50	30	15	32	23	20	54	17
Gross Return (Rs/qt)	1391	1407	2116	1316	1376	1848	1373	1523
Cost of Production C2 (Rs/qtl)	1173	982	1737	1195	1132	1602	1247	1659
BCR	1.13	1.22	0.83	1.02	1.05	0.91	1.05	0.80

Source: CACP

low due to high cost of cultivation. Net Return over Cost C2 shows a mixed picture Out of 8 states, three states have shown a negative return from maize cultivation. This implies that despite an increase in the gross value of output, the overall increase in the total cost is turning maize cultivation in these states into a non-viable option.

The Cost of cultivation data on Jowar has been compiled for four states namely, Andhra Pradesh Karnataka Madhya Pradesh and Maharashtra. The average cost of cultivation of Jowar was highest in Maharashtra (Rs38630/ha) and lowest in Karnataka (Rs. 22063/ha) whereas gross return was highest in Andhra Pradesh (Rs. 40008/ ha) and lowest in Madhya Pradesh (Rs 17779/ha) (Table 8). Yield and BCR was highest in Andhra Pradesh due to high gross return. Lowest yield was observed in Karnataka and lowest BCR in Madhya Pradesh. However, the average net return over cost C2 was found to be negative in Madhya Pradesh and Maharashtra. Despite an increase in gross return, a more than proportionate rise in cost has led to negative return over Cost C2 in these states. This implies that the cultivation of Jowar in these states is turning out to be non-viable.

Details about cost of cultivation of Bajra were collected for five states namely Gujarat, Haryana, Maharashtra, Rajasthan and Utarr Pradesh. In Bajra average cost of cultivation of was highest in Gujarat (Rs39524/ha) and lowest in Uttar Pradesh (Rs. 24074/ha) and gross return also was highest in Gujarat (Rs. 51282/ ha) and lowest in Maharashtra (Rs 17468/ha (Table 9). Even though yield was highest in Gujarat BCR was observed to be high due to high gross return/hac. Lowest yield and BCR was observed in Maharashtra.

However, the amount of return from cultivation of Bajra change drastically when total cost of cultivation is taken into consideration. Except Gujarat, other states have registered either negative or negligible return over cost C2. Since Bajra is largely

Table 8
Profitability of Jowar in India, TE 2014-15

Items	*Andhra Pradesh*	*Karnataka*	*Madhya Pradesh*	*Maharashtra*
Operational Cost	23768	15414	18145	27366
Fixed Costs	13587	6649	5731	11264
Total Cost	37354	22063	23876	38630
Gross Return (Rs/ha)	40008	22417	17779	31803
Cost A2 (Rs/ha)	17269	12375	14397	22777
Net Return over A2 (Rs./ Ha)	22739	10042	3381	9025
Profitability (Net return as % of A2)	131.68	81.15	23.49	39.63
Cost C2 (Rs/ha)	37354	22063	23876	38630
Net Return over C2 (Rs./ Ha)	2654	354	-6097	-6828
Profitability (Net return as % of C2)	7.10	1.61	-25.54	-17.67
Yield (Qtl./Ha)	21	10	11	12
Gross Return (Rs/qt)	1895	2334	1549	2683
Cost of Production C2 (Rs/qtl)	1511	1972	1838	2067
BCR	1.07	1.02	0.74	0.82

Source: CACP

cultivated in dry land regions the use of family labour is relatively high consequently the imputed value of family labour use might have contributed to an increase in total cost.

Table 9
Profitability of Bajra, TE 2014-15

Items	*Gujarat*	*Haryana*	*Maharashtra*	*Rajasthan*	*Uttar Pradesh*
Operational Cost	29143	23184	20205	24940	16465
Fixed Costs	10381	11267	5318	8683	7609
Total Cost	39524	34452	25523	33623	24074
Gross Return (Rs/ha)	51282	28191	17468	27932	24296
Cost A2 (Rs/ha)	22930	12450	15302	19017	9408
Net Return over A2 (Rs./ Ha)	28352	15740	2166	8914	14888
Profitability (Net return as % of A2)	123.65	126.42	14.16	46.87	158.24
Cost C2 (Rs/ha)	39524	34452	25523	33623	24074
Net Return over C2 (Rs./ Ha)	11758	-6261	-8055	-5691	222
Profitability (Net return as % of C2)	29.75	-18.17	-31.56	-16.93	0.92
Yield (Qtl./Ha)	27	19	11	16	14
Gross Return (Rs/qt)	1933	1497	1566	1797	1690
Cost of Production C2 (Rs/qtl)	1052	1389	1903	1519	1136
BCR	1.30	0.82	0.68	0.83	1.01

Source: CACP

CROP WISE RELATIVE RETURNS

Per hectare returns of different crops that are substitutes for each other are computed. The relative returns measured in percentage terms over A2, A2+FL and C2 for coarse cereals with reference to that of paddy were calculated (Table 10). It is observed that relative gross returns over cost A2 for coarse cereals crops vary from 36% in Jowar and ragi to 69% in maize. The relative gross returns over A2+FL varies from 6 percent in ragi to 58 percent in maize. Out of all the coarse cereals, the ratio of net returns is the positive only for maize (11%)

Table 10
Crop-wise Relative Returns (Per cent), TE2014-15

Crops	*Relative Gross Returns over A2 with Respect to Paddy*	*Relative Gross Returns over A2+FL with Respect to Paddy*	*Relative Net Returns with Respect to Paddy*
Paddy	100	100	100
Maize	69	58	11
Jowar	36	28	-81
Bajra	47	30	-22
Ragi	36	6	-180

Source: CACP

To sum up coarse cereals have been known for their rich nutrient contents and drought resistance quality. These are comparable and at times even better than wheat and rice in to other sources of dietary components. The emphasis, therefore, should be on exploiting the potentially useful intrinsic qualities of these grains to produce unique and alternative value-added products. Commercialization of coarse cereal grains for alternative and health food uses needs to be viewed in a broader context from production to utilization and emerging challenges and opportunities, in the backdrop of good potential for food processing industry and promising health beneficial effects.

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