Agricultural Economics Research Review
Vol. 30 (Conference Number) 2017 pp 183-191
DOI: 10.5958/0974-0279.2017.00033.7

Strategies for Doubling Farmers' Income in Nutri-Cereals by 2022: Impact of Reduction of Yield Gaps and Inclusion of Fallow and Wasteland under Cultivation

B. Dayakar Rao*, Deep Narayan Mukherjee and Vilas A. Tonapi

ICAR-Indian Institute of Millets Research, Hyderabad-500 030, Telangana

Abstract

To achieve the target of doubling farmers' income by 2022, the study has suggested a practical measure of increasing focus on production of millets in the country. For increasing the productivity of millets and consequently income of farmers, the study has looked into the impact of reduction in yield gap and inclusion of fallow and waste lands under cultivation. The study has also suggested a way to absorb the additional production of millets in the country. Several value-added products of millets have been reported whose demand can be created and farmers' income can be increased. In addition, policy and incentive support for federating farmers, farm gate warehouse and processing in village clusters, linking farmers to the value chains of both nutri-grains and nutri-fodder and the platform of e-NAM can enable better price and enhanced income to farmers.

Key words: Doubling farmers' income, nutri-cereals, millets, yield gaps, productivity gains, fallow and waste lands, value-added products

JEL Classification: Q16, Q15

Introduction

India has attained the goal of self-sufficiency in food grain production raising it from merely 82 million tonnes in 1960-61 to 273 million tonnes in 2016-17 (3rd advanced estimates) and has made India a potential exporting country in food grain besides maintaining a buffer stock of 60 million tonnes (Narayanmoorthy, 2016). The major driving forces behind green revolution were introduction of high-yielding production technologies like HYV seeds (Suresh, 2013), chemical fertilizers, intensive irrigation, input subsidization and incentives to farmers through remunerative pricing policies for some crops, public investments in agricultural research and education and institutional reforms. These reform measures led to significant increase in agricultural production and resulted in 45 per cent increase in per capita food availability (Chand, 2017). But the success of green revolution in India has raised one significant question: how far Indian farmers have been well off with the success of green revolution?

The crops that received importance during green revolution were rice and wheat. On the other hand, the dryland crops of India, viz., pulses, millets, etc. suffered significant losses in their share. The consumption level of millets also has come down significantly. These crops are cultivated under a wide range of climatic conditions and marginal conditions of soil and irrigation. Millets are traditional staple food for the rural poor in dry land regions of the country. Millets also termed as Nutri-cereals, are highly nutritious and contribute substantially to food and nutritional security in the country. Millet crops perform well in marginal (dryland) environments and are superior in nutritional

* Author for correspondence
Email: dayakar@millets.res.in

Table 1. Trend of farmers' income in India: 1993-94 to 2015-16

Year	Total farm income of all farmers (in ₹ crore)		Total cultivators	Farm Income per cultivator (₹)	
	Market price	Real price	(in crores)	Current price	Real price
1993-94	177954	303814	14.39	12365	21110
1999-00	335631	372923	13.88	24188	26875
2004-05	434160	434160	16.61	26146	26146
2011-12	1157128	632514	14.62	79137	43258
2012-13	1312730	596695	14.36	91416	41553
2013-14	1477159	602922	14.10	104763	42760
2014-15	1558223	597020	13.85	112507	43106
2015-16	1634625	598764	13.60	120193	44027

Source: Chand (2017); Base year (2004-05=100)

properties with high micronutrient with low glycemic indices.

Trends in Farmers' Income in India

There were no comprehensive studies on the estimates of farmers' income in India prior to the study of Chand *et al.* (2015) on estimation of farmers' income from time series data. The NSSO has published reports on Situation Assessment of Agricultural Households, 2013 (70th Round) which provides information on the key indicators of agricultural households in India. The average monthly income per agricultural household during the agricultural year July 2012- June 2013 was ₹ 6426/-. The same was ₹ 6642/- and ₹ 6249/-, respectively, during July 2012- December 2012 and January 2013- June 2013. Recently, Chand (2017) has estimated the farmers' income for the past 22 years, 1993-94 to 2015-16. The study has estimated the both nominal and real income by dividing the total farm income of all farmers by the total number of cultivators.

Nutri-cereals

Millets possess unique nutritional characteristics, they contain complex carbohydrates, dietary fibres, phenolic compounds and phytochemicals having medicinal properties. Millets are natural source of iron, zinc, calcium and other nutrients that are essential for mitigating the problem of malnutrition in India. Epidemiological studies have shown that diets rich in plant foods, including whole grains are protective against the non-communicable diseases like diabetes, cancer and cardiovascular diseases, due to protective effects of health promoting phytonutrients. They are non-acid forming and hence easy to digest and are also non-allergenic. It is well recognized that, the incidence of diabetes mellitus and gastro-intestinal tract related disorders are minimal among the population using these grains as staple food. Figure 1 depicts the area, production and yield of millets in India during 2014-15.

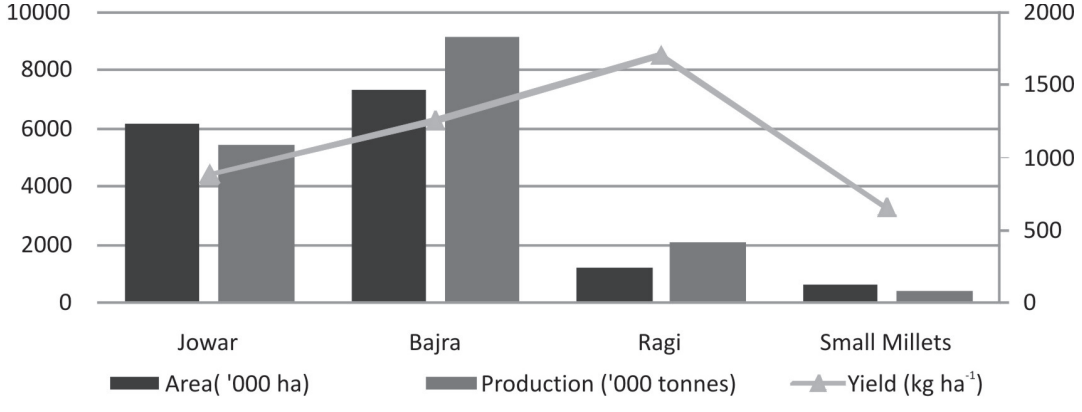

Figure 1. Area, production and yield of millets in India during 2014-15
Source: Directorate of Economics and Statistics, GoI.

Despite all the nutritional benefits of millets, there has been a drastic reduction in their consumption in India. The main reasons for decline of the millets crops in India are low remuneration as compared to other competing crops, lack of input subsidies and price incentives, subsidized supply of fine cereals through PDS, and change in the consumer preferences. These factors had led to shift from production of millets (jowar in particular) to other competing crops such as soybean, maize, cotton, sugarcane and sunflower in the country as a whole.

The present levels of returns from millets cultivation have been computed in Table 2 using cost of cultivation (CoC) data for millets (2013-14). Since the CoC data for small millets were not available, it was approximated from the primary survey conducted by the IIMR in Madhya Pradesh and Uttarakhand during 2016-17 on kodo, little and barnyard millets. The gross returns earned by the jowar, bajra and ragi farmers during 2013-14 from CoC data were taken as current year income and the target is set to be 2.5-times the base year income to avoid the time lag from 2014-15 to 2016-17. It can be seen that contribution of price growth has been targeted to be 25 per cent of the total income growth as compared to 20 per cent from yield growth. The growth of price is directly related to the growth in demand for millets products. The rest 45 per cent of the income growth has to be generated from value addition and reduced yield gaps.

The yield enhancement is the essential component for increasing the production of millets in the country. The current level of growth rate of millets reveals (Table 3) that except for sorghum (-0.44%), all other millets have shown positive trends during the past two decades. Table 3 summarizes the target yield level and annual growth during the period of next five years. In the case of sorghum, the yield target is fixed to bring a positive growth during next five years, and for other millets, the target yield level will keep the pace of increasing yield level.

Production and Productivity of Millets

The expansion in area under nutri-cereal crops is a big limitation given the limited supply of lands and increased demand for lands for non-agricultural purposes. The attitude of farmers favouring the cultivation of fine cereals also hinders area expansion of millets. Therefore, increase in the productivity of millets remains the most viable option for enhancing agricultural production in the country. For increasing yield, bridging yield gaps is the most important initiative that Indian dryland agriculture should take

Table 2. Growth projection of income of millets farmers and required contribution of yield and price growth

Item		Jowar#	Bajra#	Ragi#	Small millets*
Cost of Cultivation (₹/ha)	A1	16395	16659	18488	3470
	C2	30771	32361	40400	23512
Value of main product (₹/ha)		25692	27933	35376	20547
Value of by-product (₹/ha)		7344	6439	5229	5150
Gross return (₹/ha)		33037	34373	40606	25697
Net return over A1 (₹/ha)		16641	17713	22117	22227
Net return over C2 (₹/ha)		2266	2011	205	2185
Current (2014-15) yield level (q/ha)		8.84	12.55	17.05	6.5
Current price level (2016-17)		1625	1330	1725	2220
Gross Income Projected in 2022 (2.5-times for jowar, bajra and ragi)		82593	85933	101515	51395
Contribution of yield growth @20%		16518	17186	20303	10279
Contribution of price growth @25%		20648	21483	25378	12848

Sources: # Directorate of Economics and Statistics, GoI.

* Estimates of ICAR-IIMR based field survey of kodo, little and barnyard millets from the states of Madhya Pradesh and Uttarakhand.

@ Current price level is MSP during 2016-17 for major millets. For small millets it is the price realized by sample farmers.

Table 3. Annual productivity growth targets across millets for doubling farmers' income

Crops	Current level		Yield growth targets				
	Yield (kg/ha)	CAGR (%) 1996-97 to 2014-15	2017-18 (%change over 2014-15)	2018-19 (Annual increase, %)	2019-20 (Annual increase, %)	2020-21 (Annual increase, %)	2021-22 (Annual increase, %)
Sorghum	884	-0.44	900 (1.83)	950(5.55)	1000(5.25)	1050(5.00)	1150(9.5)
Pearl millet	1255	2.62	1275(1.59)	1300(1.96)	1350(3.84)	1400(3.70)	1425(1.78)
Finger millet	1706	1.47	1750(2.58)	1775(1.42)	1800(1.40)	1850(2.77)	1900(2.70)
Small millets	654	2.04	750(14.59)	775(3.33)	800(3.22)	820(2.5)	850(3.65)

Source: ICAR-IIMR (2017).

Table 4. Gain in additional output of sorghum due to reduction in yield gap in India

State/ UT	SAY (q/ha)	FLD (q/ha)	Area ('000 ha)	SAY-to-FLD ratio	Target SAY-to-FLD ratio	Target SAY (q/ha)	Additional yield (q/ha)	Additional output ('000 quintals)	Share of additional output (%)
Kharif									
Andhra Pradesh	9.98	32.15	102.67	0.31	0.45	10.98	1.00	102.46	4.14
Gujarat	10.65	25.85	85.00	0.41	0.45	11.72	1.07	90.53	3.66
Madhya Pradesh	13.47	22.90	426.37	0.59	0.65	14.82	1.35	574.32	23.21
Maharashtra	12.04	23.40	978.50	0.51	0.57	13.24	1.20	1178.11	47.61
Rajasthan	4.23	18.10	646.90	0.23	0.45	4.65	0.42	273.64	11.06
Tamil Nadu	8.29	12.10	171.61	0.69	0.75	9.78	1.49	255.70	10.33
All-India Average	9.78	22.42	401.84	0.46				2474.76	100.00
Rabi									
Andhra Pradesh	14.47	50.05	157.62	0.29	0.54	15.92	1.45	228.08	7.30
Karnataka	10.54	12.42	1070.00	0.85	0.93	11.59	1.05	1127.78	36.10
Maharashtra	6.23	13.19	2837.50	0.47	0.54	6.85	0.62	1767.76	56.59
All India	10.41	25.22	1355.04	0.54				3123.62	100.00

Source: ICAR-IIMR (2017).
SAY= State average yield, FLD= Field level demonstration

on the production front. While the impressive performance came in some cases of jowar, bajra and ragi; it is important to note that in irrigated agricultural ecosystem it has come from large size and not from per unit yield achievements. The yield levels of Indian millets still lag behind the global average.

The field level demonstration (FLD) data for estimating the impact of yield gap reduction on generating additional output of millets was compiled from the Status Report on Coarse Cereals, 2014, published by the Directorate of Millets Development, Government of India. The ratio of State Average Yield (SAY) to FLD yield was computed and the states were classified as underperforming or above-performing as compared to the national average SAY-to-FLD ratio. The states with lower ratio have been pushed to the national average and those states having the ratio equal to more than the national average are pushed 10 per cent as target to be achieved in in the period of next three years in order to increase the farmers' income through reduction in yield gaps.

Sorghum — The all-India average of SAY-to-FLD ratio for *kharif* sorghum was 0.46. Based on this the states Andhra Pradesh and Rajasthan were classified

Table 5. Gain in additional output of finger millet due to reduction in yield gap in India

State/ UT	SAY (q/ha)	FLD (q/ha)	Area ('000 ha)	SAY-to-FLD ratio	Target SAY-to-FLD ratio	Target SAY (q/ha)	Additional yield (q/ha)	Additional output ('000 quintals)	Share of additional output (%)
Andhra Pradesh	11.24	18.07	46.8	0.62	0.68	12.36	1.12	52.603	2.38
Chhattisgarh	2.71	20.08	8.5	0.13	0.55	3.25	0.54	4.607	0.21
Gujarat	8.71	17.76	18.2	0.49	0.55	10.98	2.27	41.314	1.87
Jharkhand	5.92	25.17	11.3	0.24	0.55	7.10	1.18	13.379	0.61
Karnataka	17.88	22.94	781.4	0.78	0.86	19.67	1.79	1397.143	63.29
Maharashtra	10.07	17.4	124.8	0.58	0.64	12.08	2.01	251.347	11.39
Odisha	6.83	22.08	62.7	0.31	0.55	8.20	1.37	85.648	3.88
Tamil Nadu	21.98	22.05	84.9	1.00	1.10	24.18	2.20	186.610	8.45
Uttarakhand	13.48	16.29	129.6	0.83	0.91	14.83	1.35	174.700	7.91
All-India average	10.98	20.20	140.91	0.55				2207.353	100.0

Source: ICAR-IIMR (2017).
SAY= State average yield, FLD= Field level demonstration

as underperforming states having the ratio 0.31 and 0.23, respectively. The ratio in all other major states cultivating sorghum was above the state average. Based on the estimation procedure described above an additional output of 2.47 million quintals of sorghum could be produced during the target period. In the case of *rabi* sorghum, the national average of SAY-to-FLD ratio was estimated to be 0.54, with Karnataka (0.85) performing far above the national average, while Andhra Pradesh (0.29) and Maharashtra (0.47) performing below the national average. Through yield gap reduction measures an additional output of 3.12 million quintals of sorghum would be produced from these three states during the target period, of which 56.59 per cent would come from Maharashtra and 36 per cent from Karnataka.

Finger Millet — The SAY-to-FLD ratio for finger millet (ragi) was calculated to be 0.55. Based on this estimation of yield gap reduction between SAY and FLD, it was estimated that 2.21 million quintals of ragi could be produced from these states in the target period. Karnataka will alone contribute about 63 per cent of the total additional output due to reduced yield gap measures followed by Maharashtra (11%).

Pearl Millet — In bajra, the national average of SAY-to-FLD was 0.61. The states Tamil Nadu (0.75) and Haryana (0.70) performed well above the national average, whereas Rajasthan (0.49) and Maharashtra (0.40) were far below the national average. With a target of increasing production and farmers' income, the states were assigned target SAY-to-FLD ratio to be achieved during the target period. An estimated 1.44 million quintals of bajra could be produced through reduction in the yield gaps during this period.

Small Millets — The SAY-to-FLD ratio of small millets in India stood at 0.54. This ratio in Maharashtra, Odisha and Uttarakhand were well above the national average with values 0.69, 0.77 and 0.69, respectively. On the other hand, Andhra Pradesh and Chhattisgarh were underperforming as compared to the national average. It was estimated that an additional quantity of 1.11 million quintals of small millets could be produced during the target period.

It could be seen from Tables 4-7 that in a period of 3-4 years an additional amount of 7.88 million quintals of total millets could be produced in India through only reduction in yield gaps. This signifies the importance of reduction in yield gaps and its impact on the farmers' income.

Measures to Bridge the Yield Gaps of Millets Production

(i) For adopting location-specific technologies, the farmers need to be provided proper training along with follow-up measures post release of improved technologies.

Table 6. Gain in additional output of pearl millet due to reduction in yield gap in India

State/ UT	SAY (q/ha)	FLD (q/ha)	Area ('000 ha)	SAY-to-FLD ratio	Target SAY-to-FLD ratio	Target SAY (q/ha)	Additional yield (q/ha)	Additional output ('000 quintals)	Share of additional output (%)
Rajasthan	7.79	15.86	496.80	0.49	0.61	8.569	0.78	387.01	26.95
Gujarat	13.87	21.31	74.30	0.65	0.72	15.257	1.39	103.05	7.18
Haryana	18.14	25.84	56.89	0.70	0.77	19.954	1.81	103.20	7.19
Tamil Nadu	16.09	21.54	50.00	0.75	0.82	17.699	1.61	80.45	5.60
Karnataka	8.58	13.81	28.82	0.62	0.68	13.36	4.78	137.76	9.59
Madhya Pradesh	16.49	24.96	17.44	0.66	0.73	18.139	1.65	28.76	2.00
Maharashtra	8.50	21.13	91.20	0.40	0.61	13.36	4.86	443.23	30.86
Uttar Pradesh	17.44	27.19	87.62	0.64	0.71	19.184	1.74	152.81	10.64
All India	13.36	21.45	112.88	0.61				1436.27	100

Source: ICAR-IIMR (2017).
SAY= State average yield, FLD= Field level demonstration

Table 7. Gain in Additional output of small millets due to reduction in yield gap in India

State/ UT	SAY (q/ha)	FLD (q/ha)	Area ('000 ha)	SAY-to-FLD ratio	Target SAY-to-FLD ratio	Target SAY (q/ha)	Additional yield (q/ha)	Additional output ('000 quintals)	Share of additional output (%)
Andhra Pradesh	6.3	19.19	30.80	0.33	0.54	6.93	0.63	19.40	1.74
Chhattisgarh	2.18	6.84	178.5	0.32	0.54	4.69	2.51	448.04	40.19
Karnataka	4.77	9.06	32.00	0.53	0.58	5.25	0.48	15.26	1.37
Madhya Pradesh	2.88	6.17	297.1	0.47	0.54	4.69	1.81	537.75	48.24
Maharashtra	4.83	7.00	71.40	0.69	0.76	5.31	0.48	34.49	3.09
Orissa	4.89	6.35	18.10	0.77	0.85	5.38	0.49	8.85	0.79
Uttarakhand	6.95	10.13	73.40	0.69	0.75	7.65	0.70	51.01	4.58
All India	4.69	9.25	100.19	0.54				1114.80	

Source: ICAR-IIMR (2017).
SAY= State average yield, FLD= Field level demonstration

(ii) Farmers' should be made well aware about the extent of yield reduction due to weed infestation and should be made equipped for weed management.

(iii) Soil health condition of these millets growing regions should be recorded in Soil Health Cards and farming practices should be provided based on the nutritional status of the soil.

(iv) The non-governmental organisations (NGOs) working on millets development programmes should be involved in policy development.

(v) The focus should be on improving the resource-use efficiency and adoption of recommended farm management practices so that the farmers are able to realise the full genetic potential of the variety or at the minimum FLD level production.

Increase in Production of Millets

For increasing the production of millets, the following measures may be adopted:

(i) Bringing the Fallow and Waste Lands under Cultivation

Production of millets in India can be significantly increased through inclusion of fallow and waste lands in the country. The total waste and fallow lands in India were more than 36 million hectares during 2015-16.

Table 8. Projected increase in production of millets in India with additional areas from waste and fallow lands during 2017-18 to 2021-22

(Area in '000 ha; Production in '000 tonnes)

Component		2017-18	2018-19	2019-20	2020-21	2021-22
Waste lands (Projected)		12111	12051	11991	11931	11872
Total fallows (Projected)		24391	24270	24149	24029	23910
Total waste and fallow lands		36502	36321	36141	35961	35783
Additional area under millets		5% of total land	10% of total land	20% of total land	30% of total land	40% of total land
		1825	3632	7228	10788	14313
Millets-wise share	Sorghum	739	1472	2929	4372	5801
	Pearl millet	867	1726	3436	5129	6805
	Finger millet	138	275	548	819	1086
	Small millets	79	157	313	467	620
Target yield level (kg/ha)	Sorghum	900	950	1000	1050	1150
	Pearl millet	1275	1300	1350	1400	1425
	Finger millet	1750	1775	1800	1850	1900
	Small millets	750	775	800	820	850
Additional output	Sorghum	665	1398	2929	4591	6671
	Pearl millet	1106	2244	4639	7180	9697
	Finger millet	242	489	987	1515	2064
	Small millets	59	122	250	383	527
	Total	2073	4254	8807	13670	18960

Source: ICAR-IIMR (2017).

Based on the growth rate in the previous decade, the area under waste and fallow lands was projected for the next five year during which farmers' income is to be doubled. The target to bring the lands under cultivation of millets is fixed at 5 per cent, 10 per cent, 20 per cent, 30 per cent and 40 per cent during next five years. The share of different millets in the increased area has been estimated as per ratio of cropped areas of these millets during 2015-16.

It has been estimated that an additional amounts of 48 million tonnes of millets could be produced in the next five years if the waste and fallow lands are brought under cultivation of millets at above mentioned rates. This significant increase in the millets production can increase the income of dryland farmers in the coming years. Millets can be successfully cultivated in water-stress conditions. Thus, in the states like Tamil Nadu, Madhya Pradesh, Odisha, Maharashtra and Gujarat there is a huge scope of increasing the production of millets by bringing fallow lands under cultivation. Some states like Tamil Nadu are already incentivising millet cultivation in identified waste/ fallow lands in the state.

Rice Fallows — During the past one decade there has been a gradual increase in area under sorghum along with maize cultivation in the Guntur district of Andhra Pradesh in paddy fallows due to low inflows of water discouraging second paddy crop. This is spreading to other locations in the states such as Odisha. Thus, there is an increasing scope to enhance millet cultivation in the country.

(ii) Increasing Cropping Intensity in Dryland Agriculture

Most of the farmers in dryland parts of the country go for a single crop in a year due to unavailability of water to irrigate the crops. This significantly reduces the national cropping intensity which stands to be 145 per cent. This calls for a proper crop planning to utilize all the three seasons of *kharif, rabi and summer* in the dryland conditions. Millets are the most viable solution in maintaining the all-year cropping system in the dryland agriculture. Most of the millets are of short-duration (generally 65-80 days) and can be successfully grown in the post-*kharif* fallows. Given the minimum requirement for water, small millets like *kodo, little*

and barnyard millets can be successfully grown in the post-*kharif* fallows with the residual moisture in drylands of the country. This will significantly increase the cropping intensity and yield in dryland agriculture and provide throughout the year income generation for the farmers. For instance, sorghum can be successfully grown throughout the year. In many parts of the country, sorghum is cultivated both in *kharif and rabi* seasons.

Demand Generation for Millets through Value Addition

To absorb the additional output of millets due to increased yield levels, a value chain model is needed with emphasis on development of value-added products. The ICAR-IIMR has taken the lead role in this direction by developing and commercialising several value-added products of millets, namely Jowar Atta, Jowar rich Multigrain Atta, Jowar Pasta, Instant Pongal Mix, Jowar Vermicelli and so on through value chain approach on pilot scale. IIMR has assessed the impact of value chain model in reviving the demand for sorghum /millets in the long-term through interventions in backward supply chain management, on farm value addition, processing, product development, nutritional testing, marketing, policy and generation of awareness. The pilot model was sealed where backward and forward linkages were well established and the impact was visible among various stakeholders in the value chain, especially the farmers who first time realised the productivity increase and thereby increase in their incomes two or three times. The farmers shifted their sorghum cultivation from marginal lands to better lands after realising the profits based on four years past experimentation in their fields.

Conclusions and Way forward

The low level of farmers' income even after 50 years of attaining the green revolution has been a major cause of concern for the policy makers in the country. The corrective measures to overcome inequalities among various agro-ecologies and crop commodities in the Indian agriculture during green revolution since1960s need to be advocated and implemented, especially in the dryland crops. For doubling farmers' income by 2022, the study has advocated revitalization of nutri-cereals cultivation in the country. Given the inelastic supply of lands, the income of millets farmers can be increased by productivity enhancement of millets by reducing yield gaps, incorporating fallow and wastelands under millets cultivation, TFP improvement through technological breakthrough, development of HYVs and hybrids, development of bio-fortified millets varieties and establishment of seeds village. The major findings of the study are:

- For doubling farmers' income, the required yield growth of sorghum is from 884 kg/ha to 1150 kg/ha, for bajra from 1255 kg/ha to 1425 kg/ha, for ragi from 1706 kg/ha and for small millets from 654 kg/ha to 850 kg/ha during the period 2014-15 to 2021-22.
- An additional amount of 48 million tonnes of millets could be produced in the next five years if the waste and fallow lands are brought under cultivation of millets and in a period of 3-4 years.
- Additional amount of 7.88 million quintals of total millets could be produced in India only through reduction in yield gaps.
- The cost of cultivation of millets could be reduced by adoption of recommended package of practices and increased resource-use efficiency, technological upgradation and adoption of water-saving technologies.
- Resource-use efficiency can be increased by adopting conservation agriculture and blending indigenous and modern technologies of millets cultivation.
- The demand for millets can be increased by value addition which will provide remunerative prices to the farmers and double millets farmers' income.
- Development of product-specific varieties, farm-level grading and standards and primary processing machinery along with conducting bioavailability and shelf-life studies will create demand for millets in the country. Setting up of nutrition-cum-referral labs on nutrition in IIMR will significantly contribute towards "branding of millets value chain" in the country.
- Addition of nutri-rich fodder in the millets value chain and other millets subsector development will significantly help in doubling farmers' income.

In addition, the policy and incentive support for federating farmers, farm gate warehouse and processing

in village clusters, linking farmers to the value chains of both nutri-grains and nutri-fodder and the platform of e-NAM can enable better price and enhanced income to farmers.

Acknowledgements

The authors acknowledge the contributions made by various resource persons from different institutes. We are highly grateful to Dr Ashok Dalwai, Additional Secretary, Department of Agriculture and Cooperation and Chairman, Committee on Doubling Farmers' Income by 2022 for his continuous encouragements. We also acknowledge the suggestive and critical contributions of Dr Vijay Raghavan, former Director, IARI and Dr Mohammed Osman, CRIDA, Hyderabad and support of Ravi Kumar, Vikram Sankaranarayan, Sridhar Iriventi during drafting the document.

References

Chand, R. (2016) Why doubling farmers' income by 2022 is possible? *Indian Express*, Opinion page, April 15.

Chand, R. (2017) *Doubling Farmers' Income: Rationale, Strategy, Prospects and Action Plan*. NITI Policy Paper No. 1/2017. NITI Ayog, New Delhi.

Chand, R., Kumar, P. and Kumar, S. (2011) *Total Factor Productivity and Contribution of Research Investment to Agricultural Growth in India*. Policy Paper 25. National Centre for Agricultural Economics and Policy Research, New Delhi.

Chand, R., Saxena, R. and Rana, S. 2015. Estimates and analysis of farm income in India, 1983–84 to 2011–12. *Economic & Political Weekly* **L**(22): 139-145.

ICAR-Indian Institute of Millets Research (IIMR) (2017) Various estimations and projection for doubling millets farmers' income by 2022. Hyderabad.

Narayanmoorthy, A. (2016) *Farm Income in India: Myths and Realities*. Key Note Paper on 76th Annual Conference of the Indian Society of Agricultural Economics. 21-23 November, 2016. Jorhat, Assam.

Suresh, A. (2013)Technical change and efficiency of rice production in India: A Malmquist total factor productivity approach. *Agricultural Economics Research Review*, **26** (Conference No.): 109-118.