Original Research Article

On farm evaluation of urd bean and mung bean for climate change adoption in Bundelkhand

Abstract

The study was carried out in Prathvipura, Karguwan and Pura Badaura villages of district Jhansi in Bundelkhand region during Kharif, 2021. Total ten front line demonstrations were conducted on Urd bean and Mung bean in 10 hectare area by the active participation of the farmers with the objective of improved technologies of Urd bean and Mung bean production potentials. The improved technology consisted of improved varieties Virat (Mung bean) and IPU 2-43 **(**Urd bean), balanced fertilizers (based on soil testing) application and integrated weed, diseases and insect pests management, etc. Under FLDs of Urd bean and Mung bean, the average additional yield of the crops was obtained at 25 kg/ha and 165 kg/ha, while the increased yield over the local check was 23.86 and 23.10 % from respective varieties. The mean extension gap, technology gap, and technology index for Urd bean crops were recorded as 25kg/ha, 870 kg/ha & 87.0% where, in the case of Mung bean, it was 165 kg/ha, 357.5 kg/ha, and 32.5%, respectively. Average and maximum net returns of Rs. 1890 & Rs. 21910.63 and the cost-benefit ratio were recorded 0.30 and 1.56 from FLD of Urd bean and Mung bean, respectively, followed by local checks.

Keywords: Bundelkhand, Front Line Demonstration, Mung bean, Urd bean, Economics.

Introduction

According to the Ministry of Agriculture & Farmers Welfare, 2021-22, pulses are being produced in India on an area of 28783.32 thousand hectares and thereby 25463.12 thousand tonnes were produced (Fig.1). Madhya Pradesh has the first place in the production of pulses in India, whereas Rajasthan is in terms of area. Uttar Pradesh is at fifth place on the basis of area of pulses and fourth on the basis of production. According to the year 2020-21, after studying the last ten years, there has been an increase in the area under Mung bean (Fig.2), while it has seen fluctuations under Urd (Fig.3). But the production capacity in the hair of both the pulses has been achieved more than last year. At the state level, Mung bean and Urd bean are grown the most in Rajasthan and Uttar Pradesh region. On the basis of Mung bean production, Madhya Pradesh ranks first and Rajasthan in Urd bean (Fig.4 & 5).

Bundelkhand region of Uttar Pradesh is a central semi-arid plateau of India that spans seven districts in Uttar Pradesh state comprising Jhansi, Jalaun, Lalitpur, Hamirpur, Mahoba, Banda, and Chitrakoot districts and covering over 7.1 million hectares area. The living difference is widely disparity in terms of condition in different districts of Bundelkhand region. Northern part is more developed as compared to southern part [1]. The region is characterized by a hot climate with temperature variation ranging from 3.0^{o}C to 47.8^{o}C and undulating topography. The zone receives about 867 mm of average annual rainfall. Despite its complexity, rainfed nature, risk, under-investment, vulnerability, and socioeconomic heterogeneity, the region is ethically distinctive, agrarian, and backward [2]. Agriculture is the mainstay of this drought-frequented region. The average irrigation intensity in the zone is approximately 108 percent, with the gross

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Comment [R2]: Please rectify the sentence, this journal has some standard and you need to avoide silly grammatical errors.

Comment [R3]: The authors need to revisit this sentence and clarify, how come there could be a temperature variation from 3.0°C to 47.8°C.

irrigated area accounting for 48 percent of the gross area sown. The Bundelkhand region is among the most vulnerable regions of India concerning climate change [3]. Variability in temperature and rainfall has adversely affected the livelihoods of farmers in this region [4].

The village Babina is located in Jhansi tahsil of Jhansi in Bundelkhand region of the state of Uttar Pradesh in India, and the Babina Gram Panchayat governs it. It comes under Babina Community Development Block. The nearest town is Jhansi, about 27 kilometers away from Babina (Rural). The area under the Babina block is 885.9 km^2. The population was 528654 in 2020, and the density was 597 people per km^2. The sex ratio was 1:1.12. In this region, deep soil, Rakar, Parwa, Kabar, and Maar are the type of soil, while some are un-irrigated, and somewhere irrigated land is available. Black gram, green gram, groundnut, sesame, pigeon pea, sorghum, and paddy are major crops grown in the Kharif season, while wheat, barley, chickpea, field pea, vegetable pea, lentil, mustard, and linseed are grown during rabi season. More than half of the total pulse area in Uttar Pradesh comes from Bundelkhand. However, productivity remains below the state average, which requires technological interventions, infrastructure development, and marketing strategies. Additionally, the region's production, processing, and marketing of pulses are constrained. Therefore, policies should embrace technology and infrastructure to keep balance and keep the interest of both consumers and producers [5].

Field demonstrations, called front-line demonstrations, are a new concept aimed at demonstrating newly released varieties in farmer's fields in different agroclimatic regions and under different farming situations with improved practices, technologies, and management practices. By selecting a suitable variety with technology, Mung bean and Urd bean productivity per unit area can be increased through feasible, scientific, and sustainable management practices. Systematically, front-line demonstrations were conducted in farmer's fields to demonstrate high-yielding new varieties and convince them of the potential of improved production technologies to enhance urd bean and mung bean yields.

Materials and Methods

The frontline demonstrations were conducted by Rani Lakshmi Bai Central Agricultural University, Jhansi, Uttar Pradesh, India. During Kharif, 2021. A total of 10 frontline demonstrations and in which, five for each on Mung bean and Urd bean of variety Virat and IPU 2-43, respectively, were conducted at farmer's fields in three villages viz., Prathvipur (Nayakheda), Karguwan, and Pura Badaura in Babina block district Jhansi (UP). Five farmers were selected from the village Prathvipur, four from Karguwan, and one from Pura Badaura. The team members selected the farmers by visiting the identified villages, meeting the farmers, and visiting their fields. Under these FLDs, the cost of critical inputs like 15kg seed of variety, bio-fertilizers, plant protection chemicals, and herbicides (table 1) for a one-hectare area is provided to selected farmers. At the time of seed distribution, the scientists gave the farmers all kinds of information related to the crop. The problems related to the farmers' crops were also heard, and their solutions were discussed. During the crop season, the team members visited selected farmers' fields and assessed the crop.

Comment [R4]: Mention under which scheme the University has conducted the FLDs. If the demonstrations were conducted by KVKs, then mention it too

Comment [R5]: What was the sampling procedure followed need to be mentioned here

Along with this, the members kept in constant touch with the farmers through mobile, communicated from time to time, and kept getting information about the crop status. Furthermore, the yield and economic performance of frontline demonstrations and the data on output were collected from fields and a local cultivar of the same crops. Finally, the grain yield, cost of cultivation, and net returns with the benefit-cost ratio were worked out.

A well-structured interview schedule was used to collect data from personal contacts. Then, according to the study's objectives, the gathered data were processed, tabulated, classified, and analyzed in terms of mean percent scores and ranks. There was a significant difference between beneficiaries and non-beneficiaries of more than 10 percent. The extension gap, technology gap, and technology index were calculated using the formula suggested by Samui *et al.* [6].

Extension gap (qha^{-1}) = Demonstration yield - Farmer's yield

Technology gap (qha^{-1}) = Potential yield- Demonstration yield

Technology index (%) = $\frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential yield}} x100$

Results and Discussion

A comparison of the productivity level between front-line demonstrations and local checks is shown in **table 2**. The result shows that under the demonstrated plot, the performance of Urd bean and Mung bean bean yield was sustainable and higher than that in the local check-in in both villages. Yield in Urd bean and Mung bean under demonstration ranged from 125-135 kg/ha and 235-1250kg/ha, respectively, during the crop season. The technological intervention, thus, enhanced Urd bean and Mung bean yield to a tune of 23.86 to 25 percent and 14.63 to 31.58 percent, respectively, over the local check. The yield in the front-line demonstration and the crop's potential yield were compared to estimate yield gaps. These gaps were different categories as technology and extension gaps. The technology gap indicates a gap in demonstration Urd bean yield over the potential yield, which was 875 and 865kg/ha, where it was 865 and -150 kg/ha (table 3). The technology gap was observed due to the change in the weather at the time of sowing. As a result, the crops of Urd bean were greatly affected this year. The farmers of villages Prathvipur and Karguvan could not sowed their crops on time due to excessive moisture in the fields due to rain and could not prepare the fields properly with the help of machinery. Some farmers sowed only in wet soil; in some places, there was heavy rain immediately after sowing, due to which the germination of seeds was hampered; due to heavy rains, the soil fertility appeared low in sloping fields and was in leveled fields. Due to the accumulation of water, farmers faced problems in crop production.

Additionally, some farmers could not sow the crop in the fields identified by the team due to excess rainfall, so they had to sow it on another field. The farmers could not benefit from a good crop due to the soil needing to be more fertile. The farmers of Pura Badaura village had rains at the time of sowing, but from the time of sowing till the maturity stage of the crop, there was less rainfall. Rainfall fall did not have any harmful effect on crop production.

Both villages recorded an extension gap of 25kg/ha for Urd bean but between 30-300kg/ha for Mung bean (table 3). The vast extension gap demonstrates the need for farmers to be educated using a variety of methods in order to adopt improved production technologies. It may be possible to bridge the gap between demonstration and farmer's yields if new, improved production technologies are applied to high-yielding varieties. Farmers may eventually discontinue obsolete varieties due to new technologies. The technology index indicates the feasibility of a variety in the farmer's field. With the Urd bean crop, the technology index value was 86.5-87.5, while the Mung bean crop was 78.64 from Prathvipura village and -13.64 percent from Pura Badaura village.

Comment [R6]: The university conducted demonstrations, please write properly how, there was a vast "Extension Gap". In concluding remark, there must be a mention of these observations and few suggestions to improve..

Comment [R7]: The authors need to clarify how the calculated technology index were good and feasible for farmers. Basically they need to substantiate their claim through a description and a literature to be cited to that effect.

The exhibition yield of the Mung bean crop was additionally significant than the potential yield. The technology gap was documented at -150kg/ha, and the technology index was recorded at -13.64 percent (table 2), which generated additional potential due to farmer approaches with advanced technology. The furnished technology enabled the refinement of the Mung bean crop exhibition. Additionally, Singh and Singh [7] find that by bridging the technology gap, using the latest varieties and improved packages of practices under cluster frontline demonstration significantly increases pulse productivity and profitability in the field (Dwivedi *et, al.*, [8]; Singh *et al.*, [9]; Mitnala *et al.*, [10]; Saikia *et al.*, [11], Singh *et. al.*, [12] and Ola et al., [13]). The conclusions align with the investigation by Udhad et al. [14]. These outcomes are even pursuing the determinations of Dhaka et al. [15], Mitnala et al.[10] and Singh et al. [9]. Therefore, higher benefit-cost ratios demonstrated the economic viability of the technological interventions and convinced farmers that they were helpful. Increasing farmers' income and self-sufficiency in pulses production could be achieved through large-scale cluster frontline demonstrations for other pulse crops.

The assessed economics of unwinding Urd bean and Mung bean crops under front-line demonstrations and consequences are presented in table 3. Economic analysis of outcome implementation publicized that excluding more increased production, participating agriculturalists in FLDs recognized a more elevated price than produce corresponded to local checks during the study period in the FLDs because of the better quality of the crop. Consequently, front-line demonstrations resulted in higher gross returns of Rs. 7875 and Rs. 8505 (Urd bean) and Rs. 17096.25 and Rs. 60625.0 (Mung bean), and net returns of Rs. 1675 and Rs. 2105 (Urd bean) and 11296.25 & Rs. 32525.0 (Mung bean) with benefit-cost ratios of 0.27 & 0.33 and 1.95 & 1.16 (table 4) compared to our local check. These findings are consistent with those of Kumar *et al.* [16] and Singh *et al.* [17]. As Singh *et al.* [18] reported, the improved technology gave higher gross and net returns with a higher benefit-cost ratio than farmers' practices when studying FLD's impact on pulse yields. In their study, Raj *et al.* [19] and Singh *et al.* [20] reported similar findings.

Conclusion

Based on the overhead conclusions in the present study, it is extrapolated that front-line demonstrations substantially diminish the technology gap, directing to expanded Urd bean and Mung bean productivity in Babina block, district Jhansi, in Bundelkhand. FLDs also enhanced linkages between farmers and scientists and built conviction to assume the improved technology. Furthermore, productivity enhancement underneath FLDs over farmer conventions of Urd bean and Mung bean cultivations increased awareness. It motivated other farmers not growing Urd bean and Mung bean to embrace improved technologies of pulses crops, i.e., Urd bean and Mung bean. Bundelkhand's uneven rainfall has directly affected crop production of Urd bean and Mung bean this year, and it can be inferred that farmers are using new high yielding varieties to increase their crop production. The farmers are willing to adopt the suggestions and techniques given., to improve the soil of their fields, make it more fertile, and do farming scientifically.

Comment [R8]: What is overhead conclusion? Please clarify

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Table 1 Details of recommended package of practices for Urd bean and Mung bean

S. No.	Technological intervention	Recommended packages of Practice followed in FLDs	
		Urd bean	Mung bean
1.	Variety	IPU-2-43	Virat
2.	Field preparation	First week of June, 2021	First week of June, 2021
3.	Sowing time	Second fortnight 2021	Second fortnight 2021
4.	Seed rate	15kg/ha	15kg/ha
5.	Seed treatment	Thiram @3gm/kg seed	Thiram @3gm/kg seed
6.	Sowing method	Line sowing at 5cm deep	Line sowing at 5cm deep
7.	Spacing	30cm x 10cm R x P	30cm x 10cm R x P
8.	Nutrient management	15kgN; 50kg P_2O_5; 30kg K_2O	15kgN; 50kg P_2O_5; 30kg K_2O
9.	Weed management	Application of weedicide (Pendimethalin @1.0 kgha-1) immediately after sowing	Application of weedicide (Pendimethalin @1.0 kgha-1) immediately after sowing
10.	Irrigation	One light irrigation at flowering stage	One light irrigation at flowering stage
11.	Insect-pests management	Emamectin Benzoate 5% SG foliar spray @ 88gm/acre at the time of insect infestation	Emamectin Benzoate 5% SG foliar spray @ 88gm/acre at the time of insect infestation
12.	Disease management	Imidacloprid 17.8% SL @ 1.5ml/L and Mancozeb 75% WP @ 2.0gm/L water	Imidacloprid 17.8% SL @ 1.5ml/L and Mancozeb 75% WP @ 2.0gm/L water

Table 2 Yield and yield difference of Urd bean and Mung bean bean under front line demonstrations

Name of village	Yield (kg/ha)		Additional yield over local check (kg/ha)	Per cent increase yield over local check
	FLD	Local check		
Urd bean				
Prathvipur	125	100	25	25
Karguwan	135	110	25	22.73
Mean	130	105	25	23.86
Mung bean				
Prathvipur	235	205	30	14.63
Pura Badaura	1250	950	300	31.58
Mean	742.5	577.5	165	23.10

Table 3

Yield gap and technology index in front line demonstrations

Name of village	Technology gap (kg/ha)	Extension gap (kg/ha)	Technology index (%)
Urd bean			
Prathvipur	875	25	87.5
Karguwan	865	25	86.5
Mean	870	25	87.0
Mung bean			
Prathvipur	865	30	78.64
Pura Badaura	-150	300	-13.64
Mean	**357.5**	**165**	**32.50**

***Potential yield: Mung bean-12q/ha and Urd bean-10q/ha**

Table 4 Economics of front line demonstrations

Name of village	Cost of cultivation (Rs/ha)		Gross return (Rs/ha)		Net return (Rs/ha)		Benefit cost ratio	
	FLD	Local check	FLD	Local check	FLD	Local check	FLD	Local check
Urd bean								
Prathvipur	6200	7500	7875	6300	1675	-1200	0.27	-0.16
Karguwan	6400	7800	8505	5335	2105	-2465	0.33	-0.32
Mean	6300	7650	8190	5817.5	1890	-1832.5	0.30	-0.24
S.dev	12068.84	9470.52	4491.37	3204.59	16555.05	12663.33		
S.Em	3816.50	2994.84	1420.30	1013.38	5235.17	4004.50		
Mung bean								
Prathvipur	5800.00	8650.00	17096.25	14913.75	11296.25	6263.75	1.95	0.72
Pura Badaura	28100.00	24550.00	60625.00	69112.50	32525.00	44562.5	1.16	1.82
Mean	16950.00	16600.00	38860.63	42013.25	21910.63	25413.13	1.56	1.27
S.dev	12344.72	9183.27	24820.68	31293.78	27076.34	18791.34		
S.Em	3903.74	2904.01	7848.99	9895.96	8562.29	5942.34		

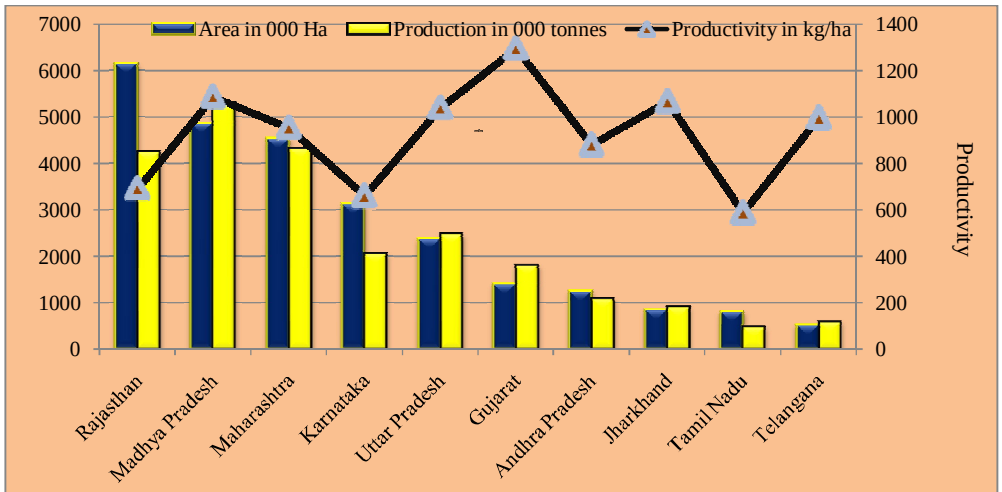

Fig.1 Area, production and productivity under the top ten states of India, 2020-21

Sources: MAFW, Govt. of India, 2020-21

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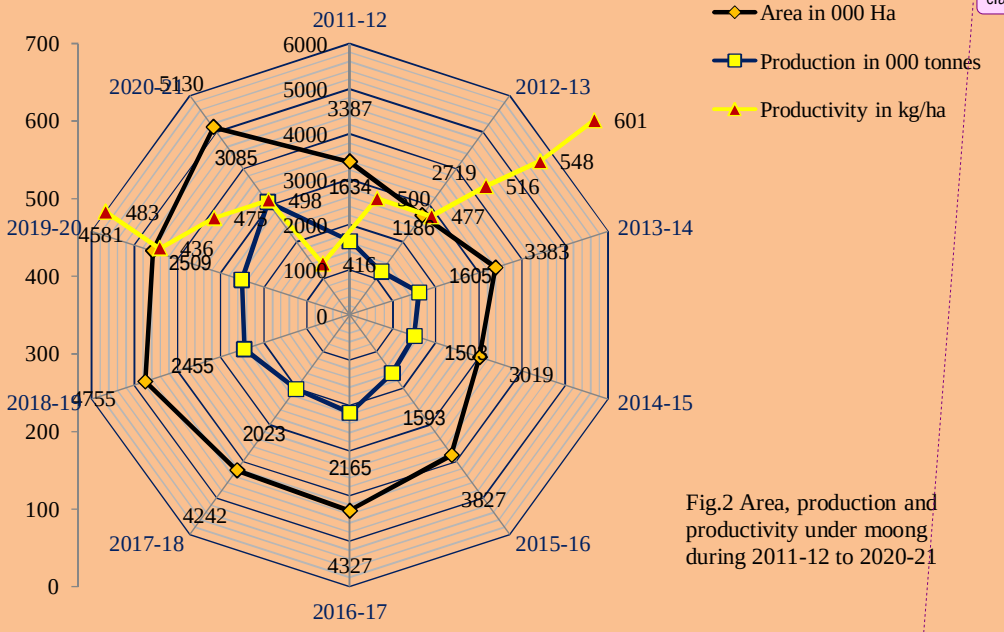

Fig.2 Area, production and productivity under moong during 2011-12 to 2020-21

Sources: MAFW, Govt. of India, 2020-21

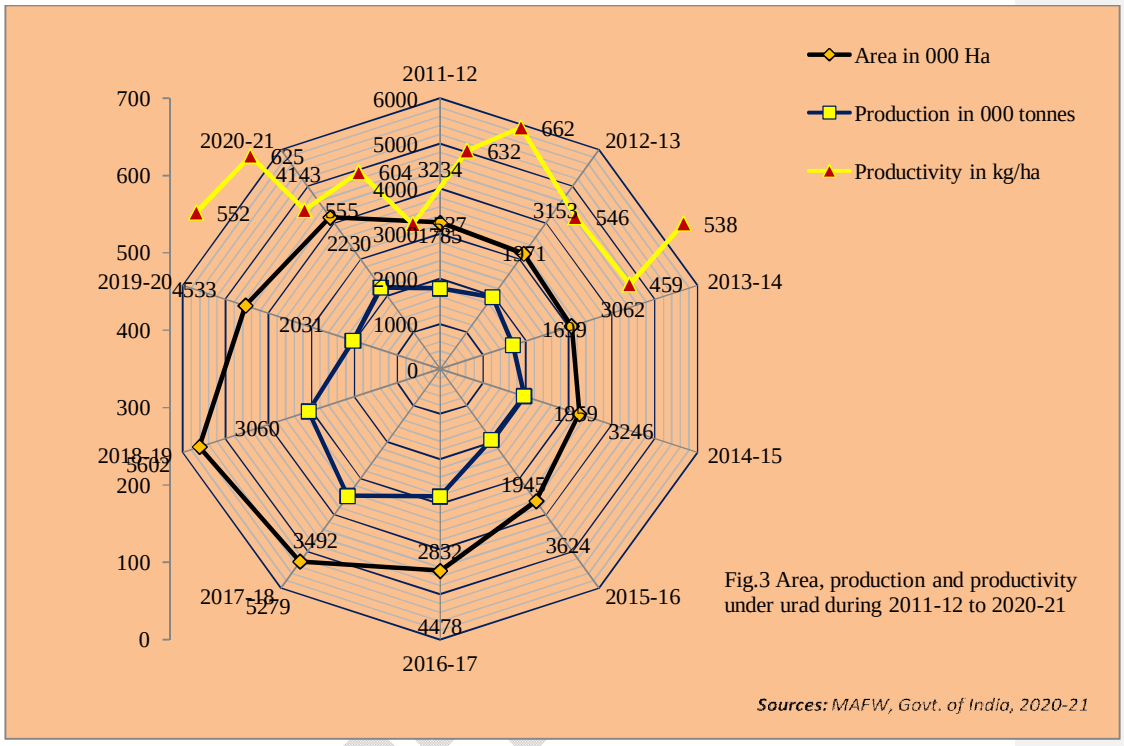

Fig.3 Area, production and productivity under urad during 2011-12 to 2020-21

Sources: *MAFW, Govt. of India, 2020-21*

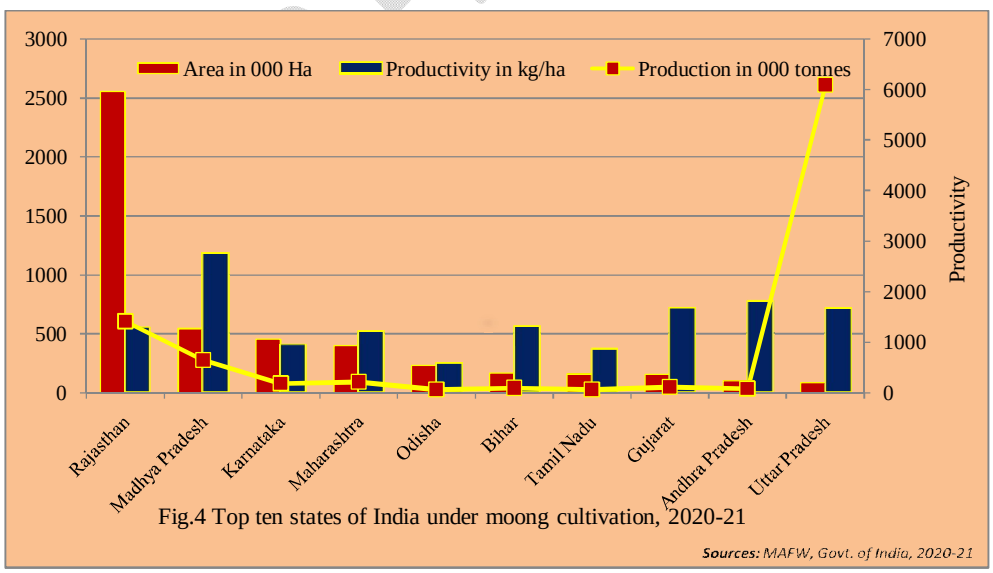

Fig.4 Top ten states of India under moong cultivation, 2020-21

Sources: *MAFW, Govt. of India, 2020-21*