Quantifying the Yield and Income Enhancement vis-à-vis Growth Rate of Chickpea in Madhya Pradesh

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ABSTRACT

Chickpea is the most important pulse accounting for more than 70 per cent of the global production in India. It is the cheapest source of protein and essential for every Indian to be healthy and fit. India has to import chickpea up to 1.5 Million tons every year to meet its domestic requirements though there is there is a scope for expanding chickpea production in approximately 12 m ha rainfed fallow lands in central and eastern India. In Madhya Pradesh, during 2011-12, area, production and productivity of chickpea was 3.04 million ha, 3.29 million tones and 1082 kg/ha. On the basis of the productivity, all 50 districts could be divided in three categories – High (18 districts), medium (15 distt.) and low (17 distt.), though comparative analysis showed the increasing trend in the productivity level. Empirical evidences shows that due to limited farmers' participation and lack of positive attitude towards yield and productivity, farmers are not practicing chickpea at the large scale results into the less production which in turn lead to demand-supply imbalance. Besides, there are some production constraints of which poor crop management practices assume prime position. The on-farm demonstrations supported by the mobile messaging showed that the improved agro-technologies viz., high yielding variety having tolerance, sowing technique for moisture retention and drainage, IPM module, etc. evolved in recent years are capable of enhancing the chickpea productivity in the state. Scientists and KVK felt that quality seed is very crucial and essential for increasing the production and productivity of chickpea in the changing climatic situation in the rainfed farming situation. Therefore, aggressive efforts are required to popularize the improved production technologies involving the farmers and department personnel in convergence mode.

Key words: *Impact; Participatory approach; Chickpea yield;*

The immediate objective of the food policy is to increase production of pulses along with stabilization at regional level (*Hazell, 1984, Rangi et al, 2002*), so that consumers benefit from higher supplies with stable prices and producers from reduced risk and increased profitability. Pulses will form a major source of protein for a huge section of India particularly for the poor, backward classes and most of the traditionally vegetarian population (*Reddy, 2004*). Chickpea is the most important pulse accounting for more than 70% of the global production in India. Chickpea is the cheapest source of protein and is the inseparable part of the daily diets of every Indian. In spite of being the largest producer, India has to import chickpea up to 1.5 Million tons every year to meet its domestic requirements. It is unlikely that area under chickpea will ever increase in the irrigated regions of the country. However, there is a scope for expanding chickpea production in approximately 12 mha rainfed fallow lands in central and eastern India.

In recent years, the role of pulses in sustaining soil productivity has also been recognized under intensive cropping systems of irrigated areas. Globally, India has the largest area under pulse crops (22.40 million ha and production 13.38 million tonnes. However, their productivity is quite low (598 kg ha^{-1}). Chickpea is one of the major pulse crop of the country occupying area of around 8.5 million with annual production of 8.83 million tonnes (DAC, 2012-13). However, their productivity is quite low (1036 kg ha^{-1}). Among various constraints, poor crop management practices assume prime position. The on-farm demonstrations show that the improved agro-technologies evolved in recent years are capable of doubling the pulse productivity. Therefore,

aggressive efforts are required to popularize the improved production technologies. The quality seed is very crucial and essential for increasing agricultural production and productivity. The present study is a strategy analysis of pulses in Madhya Pradesh.

METHODOLOGY

The present study was conducted in Madhya Pradesh KVKs involving 36 KVKs in 2011-12 and 48 KVKs in 2012-13 having technological interventions on the chickpea at farmers' fields as depicted in the concerned table. The performance of the chickpea growing districts was also worked out on the basis of the average production of the chickpea in the Madhya Pradesh. Besides, the economic performance of the chickpea cultivation was also calculated using B:C Ratio as one of the economic indicator of the profitability of the intervention. Further, the growth rates in area, production and productivity in the state were calculated using the compound interest formula as given below:

$$Y = ab^t$$

Where,

Y = Area / production / productivity,
t = Time in years,
b = Compounding factor and b = (r+1).
a = Compound growth rate in area / production / productivity per annum

$$Y = a\,(r+1)t$$

Where,

r = Compound growth rate in area / production / productivity per annum

Thus, On making log transformation of this equation:

Log Y = Log a + t log (1+r)

Or Log Y = Log a + t log b

Compound growth rate "r' = [(Antilog of log b)–1] x 100

RESULTS AND DISCUSSION

Classification of the districts according to their chickpea productivity: The scientific community is striding hard to enhance the biological yield of the chickpea and other pulse crops as it has many limiting factors and shows sensitivity to the environmental variations.

Performance of the Technological Intervention: Madhya Pradesh being chickpea state, all KVKs are striding hard to enhance the chickpea productivity through technology assessment, refinement and its demonstration for enhancing the crop performance at farmer fields using the technological interventions coupled with capacity building programmes and wide scale extension activities at farmers fields.

Table 1. Categorization of the districts on the basis of their chickpea productivity in M.P.

Name of district	No.	Productivity status
Jabalpur, Betul, Harda, Hoshangabad, Rajgarh, Bhopal, Ashoknagar, Shivpuri, Gwalior, Bhind, Sheopur, Dewas, Burhanpur, Dhar, Rewa, Chhatarpur, Narsinghpur, Chhindwara	18	High
Vidisha, Raisen, Sehore, Datia, Sagar, Guna, Morena, Neemuch, Khandwa, Khargone, Indore, Damoh, Panna, Tikamgarh, Balaghat	15	Medium
Katni, Shajapur, Ratlam, Mandsaur, Ujjain, Alirajpur, Barwani, Jhabua, Shahdol, Anuppur, Umaria, Sidhi, Singroli, Satna, Seoni, Mandla, Dindori	17	Low

Table 2. Performance of ICM at farmers fields

Year	Tech. demo.	No.	Area (ha)	Yield (q/ha)		% change
				Demo.	Check	
2011-12	JAKI-92-18, JG16, JG11, JG130, JG216	823	267.12	13.28	9.4	42.46
2012-13	JAKI-92-18, JG16, JG11, JG130, JG216	630	229.0	16.09	12.05	37.13

During two years viz., 2011-2012 (36 KVKs) and 2012-13 (42 KVKs) KVKs have conducted 2513 frontline demonstrations under different thematic area INM, IPM, IDM, Varietal evaluation and sowing method with covering 902.3 ha area. These technologies have considerable impact on yield of the chickpea in the region.

Integrated Crop Management (ICM): KVKs implemented ICM using the suitable variety coupled with the appropriate package of practices for demonstrating at the farmer's fields so that farmers could orchestrate the same in their fields at the larger scale. Results given in Table 2 indicate that during two years, total 1453 farmers had learned about the ICM covering the area of 486.12 ha. As a result of efforts of these KVKs, yield enhancement was recorded as 42.46 and 37.13 per cent during 2011-12 and 2012-13, respectively.

Integrated Disease Management (IDM): KVKs demonstrated IDM using the available seeds/variety and

seed treatment with *Trichoderma* @ 5 gm/ kg of seed at the farmers fields so that farmers could be trained the same in applying in their fields at the larger scale. Results given in Table 3 indicate that during two years, total 95 farmers had learned about the IDM covering the area of 34.8 ha. as a result of efforts of these KVKs, yield enhancement was recorded as 7.13 and 26.76 per cent during 2011-12 and 2012-13, respectively. Maximum 26.76 per cent increased the yield was mainly by the control of wilt disease in the crop at the right stage upto a certain level.

Table 3. Performance of IDM at farmers fields

Year	Tech. demo.	No.	Area (ha)	Yield (q/ha)		% change
				Demo.	Check	
2011-12	Seed treated with Tri* of seed	20	07	9.8	8.48	7.13
2012-13	Seed treated with Tri* of seed	75	27.8	14.78	11.63	26.76
Total		95	34.8			

*Trichoderma @ 5 gm/ kg

Integrated Nutrient Management (INM): KVKs implemented INM using bio-fertilizes+ NPK 20:60:20 + 5 kg Zn/ha for demonstrating at the farmers fields so that farmers could learn and apply the same in their fields at the larger scale. Results given in Table 4 indicate that during two years, total 95 farmers had learned about the INM covering the area of 29.62 ha. As a result of efforts of these KVKs, yield enhancement was recorded as 19.26 and 17.52 per cent during 2011-12 and 2012-13, respectively. Under INM maximum 19.26% increased the chickpea yield mainly through biofertilizes+ NPK 20:60:20 + 5 kg Zn/ha in both the year. *Thiyagarajan et al. (2003)* reported that the use of sulphur and micronutrients (Zn, B, Mo and Fe) improved productivity of pulse crops considerably. Balanced nutrition is indispensable for achieving higher productivity also reported by *Sachdev et al. (1992)*. Similarly, *Shinde and Mane (1996)* also reported that the balanced application of fertilizers based on soil testing improved the yield of chickpea by 47 per cent.

Integrated Pest Management (IPM): KVKs demonstrated IPM using the available seeds/variety and controlling the pod borer in chickpea, Indoxacarb 14.5 per cent SC along with the other biological methods at the farmers fields so that farmers could be trained the same in applying in their fields at the larger scale. Results given in Table 5 indicate that during two years, total 304 farmers had learned about the IPM covering the area of 105.1. As a result of efforts of these KVKs, yield enhancement was recorded as 20.84 and 23.81 per cent during 2011-12 and 2012-13, respectively. In IPM, maximum 23.81% increased the yield by the control of Pod borer.

Improved Variety (IV): KVKs demonstrated improved varieties of chickpea recommended for the region at the farmers fields so that farmers could believe the same and use the seeds for their fields at the larger scale.

Table 4. Performance of INM at farmers' fields

Year	Tech. demo.	No.	Area (ha)	Yield (q/ha)		% change
				Demo.	Check	
2011-12	Bio-fertilizes +NPK20:60:20 + 5 kg Zn/ha	55	13.12	19.5	16.35	19.26
2012-13	biofertilizes+ NPK 20:60:20 + 5 kg Zn/ha	40	16.50	18.74	16.08	17.52
Total	95	29.62				

Table 5. Performance of IPM at farmers' fields

Year	Tech. demo.	No.	Area (ha)	Yield (q/ha)		% change
				Demo.	Check	
2011-12	Pod borer in chickpea, Indoxacarb 14.5% SC	214	67.4	15.85	13.3	20.84
2012-13	Pod borer in chickpea, Indoxacarb 14.5% SC	90	38.7	15.97	12.99	23.81
Total		304	105.1			

Table 6. Performance of Improved variety at farmers' fields

Year	Tech. demo.	No.	Area (ha)	Yield (q/ha)		% change
				Demo.	Check	
2011-12	JG-11, JG130, JG16, JG6, JGK3	45	18.0	16.38	12.34	28.76
2012-13	JG-11, JG130, JG16, JG6, JGK3	521	218.2	13.86	10.25	37.30
Total		566	236.2			

Table 7. Economic performance of technologies at farmers' fields

Year	Thematic area	Economics of Demonstration (Rs. Per ha.)				Economics of farmers practice (Rs. Per ha.)			
		Gross Cost	Gross Return	Net Return	BCR	Gross Cost	Gross Return	Net Return	BCR
2011-12	ICM	14004	29729.6	15725	2.1	12204.6	21057.66	8853	1.7
2012-13	ICM	16900.9	49174.6	32794.5	2.9	15281.5	38114.9	22900.7	2.5
2011-12	IDM	10000.0	27240.0	17240.0	2.7	9000.0	21200.0	12200.0	2.4
2012-13	IDM	17748.8	44089.0	27955.6	2.5	16643.8	35011.7	21161.2	2.1
2011-12	IPM	11425.7	35240.6	23815.0	3.1	10025.6	29661.6	19636.0	3.0
2012-13	IPM	15314.2	49229.1	33803.3	3.2	14624.6	41088.7	26263.6	2.8
2011-12	INM	11250.0	30675.0	19425.0	2.7	10800.0	35153.0	24353.0	3.3
2012-13	INM	18227.5	60051.1	41823.7	3.3	17138.5	51450.9	34312.4	3.0
2011-12	IV	12739.5	38980.0	26240.5	3.1	10667.5	29378.0	18710.5	2.8
2012-13	IV	13541.3	43639.3	30090.3	3.2	11863.0	32302.1	20469.1	2.7

Results given in Table 6 indicate that during two years, total 566 farmers had learned about the IV covering the area of 236.2. As a result of efforts of these KVKs, yield enhancement was recorded as 28.76 and 37.30 per cent during 2011-12 and 2012-13, respectively. However, varietal evaluation showed that JG-6 obtained 39.01 per cent yield increase, while by sowing with Zero till – drill in residual moisture to enhance the yield 9.34 per cent further.

Economics of demonstrated technology at farmers fields: During 2011-12 and 2012-13 economics were calculated in improved technologies viz. ICM, IDM, INM, IPM and IV was compared to farmers practice in same condition. Under thematic area, selected demonstrated plot showed best performance and resulting BCR ratio range from 2.1 to 3.3 as compared to farmers practice. Maximum yield increased was observed by using resistant varieties, IPM in both years.

Growth in area production and productivity of chickpea: The results of growth in area, production and productivity are given in Table 1. The results show that production of chickpea has increased more than three times during the period of 1980-81 to 2012-13 increasing at the rate of 2.73 per cent per annum. The increase in production was more because of technology interventions as productivity increase contributed more than 56 per cent while area contributed nearly 44 per cent. The contribution of productivity was highest (63%) during 1990,s followed by current decade. The productivity has just doubled while area has increased by 1.5 times during last 32 years. The growth in production is gradually increasing from around 2 per cent in 1980's to more than 5 per cent during the current decade. The quantum jump in production during current decade might be due to new initiatives in pulses like Technology Demonstration for Harnessing Pulses Productivity by Krishi Vigyan Kendras, TSP Pulses, etc. The existing technology has the potential of doubling production at national level without increasing area under chickpea if farmers adopt the recommended package of practices (*Reddy et al. 2007*).

Table 8. Compound Annual Growth in area, production, productivity in Madhya Pradesh

Periods	Area (000'ha)	Production (000'tonnes)	Yield (q/ha)
TE 1980-81	1906.57	1006.20	5.28
TE 1990-91	2285.37	1628.50	7.13
TE 2000-01	2405.23	2206.27	9.17
TE 2010-11	3012.70	2925.70	9.71
TE 2012-13	3094.83	3263.10	10.54
CAGR 1980's	1.05	2.09	1.02
CAGR 1990's	1.59	4.38	2.75
CAGR 2000's	2.71	5.12	2.35
CAGR	1.18	2.73	1.54

CAGR=Compound Annual Growth Rate (%)

Problem in Pulse production in Madhya Pradesh: Transfer of improved technology to the farmers in Madhya Pradesh, is slow, hence efficient extension programme is required in the region. The farmers growing chickpea are poor and do not have the resources to invest on inputs because of risk of insect and diseases. As chickpea is grown in rainfed conditions,

the crops are subjected to various biotic stresses. Farmers grow the old varieties seeds having low yield potential with susceptibility to diseases and insects. New varieties with desirable features suitable to the area should be multiplied and supplied to the farmers. These are major constraints for productivity -

- Poor storage technology.
- Lack of plant protection.
- Low productivity.
- Low seed replacement rate.
- Erratic winter rainfall.

Future strategy for sustaining chickpea production: KVKs have been evolved with new mandate from vocational training institution to technology assessment and refinement and to work as a resource and knowledge centre of agricultural technology for supporting initiative of public, private and voluntary sector for improving the economy of the district (*Kokate et al., 2011*).

- Intensive awareness campaign on chickpea production technology.
- Demonstration and training on application of recently released variety along with recommended production technologies.
- Preparing the database of the chickpea growers along with their production & other problems for better technological backing.
- Assured availability of the desired input at the proper time of sowing.

CONCLUSION

Despite the availability of the improved technology and its awareness, it is also important that farmers should accept and apply the same so that the chickpea productivity enhancement could take place. Hence, attitudinal change of the farming community is also a challenge for the technology transfer group and it should be given due attention in the future activities also. It seeks serious attention on the part of the policy makers and planners to make the suitable strategy and implement the same. On the basis of above results it could be concluded that farmers are more convinced about the ICM and improved varieties than the other components of the production technology of chickpea crop in Madhya Pradesh.

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REFERENCES

Anonymous (2011-12). Agricultural Statistics at a Glance 2012. Department of Economics & Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India.

Hazell P B R. (1984). Sources of increased instability in Indian & U.S. Cereal Production, *American J. of Agril. Eco.*, **66**:302-311.

http://mpkrishi.org/krishinet/Compendium/AreaProduction_DifferentCrop.asp: accessed on 12.10.2014

Kokate, K.D., Mehta, A.K., and Singh, A.K. (2011). Future Agricultural Extension. Westville Publishing House, New Delhi.

Rangi P S, Jagdeep Kaur and Marsimran Kaur (2002). Present Status and Future Prospects of Pulses in India. *Economic Affairs* **47** (1) : 32-36.

Reddy A A, Mature V C, Yadav M and Yadav S S. (2007). Profitability in Chickpea cultivation. Pages 292-321 in The Chickpea Breeding and Management (Yadav SS, Redden B, Chen W and Sharma B, eds.). Wallingford, Oxon, UK: CAB International.

Reddy, A. A. (2004). Consumption patter, trade and production potential of pulses. *Eco. and Pol. Weekly*, **34**(44):4854-4860.

Sachdev P, Chatterjee SR and Deb DL. 1992 . Seed yield, harvest index, protein content and amino acid composition of chickpea as affected by sulphur and micronutriets. *Annals of Agril. Res.*, **13** : 7–11.

Shinde PB and Mane DA. (1996). Influence of balanced fertilizer application in improving yield of Bengal gram. Page 24 in Strategies for increasing pulses production in Maharashtra (Wanjari KB, Raut BT and Potdukhe SR, eds.). Directorate of Research, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India.

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