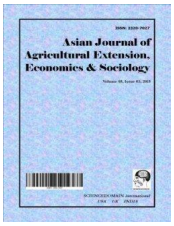

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Impact Assessment of National Food Security Mission (NFSM) on Pulses Production in Karnataka, India - An Economic Analysis

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Authors' contributions

This work was carried out in collaboration between both the authors. Author VRN designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author KRN managed the analyses of the study, literature searches and edited the manuscript. Both the authors read and approved the final manuscript.

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ABSTRACT

The present study was conducted to examine the economic impact of NFSM on pulses economy in the selected districts of Karnataka state. The study period was divided into Period-I (Pre NFSM) from 1998-99 to 2007-08, Period –II (Post NFSM) from 2008-09 to 2015-16 and Period-III (Overall period) from 1998-99 to 2015-16. Primary data for Pigeonpea and chickpea crops were collected from Kalaburagi and Vijayapur districts of Karnataka respectively. The results of the compound growth rate analysis showed that during Period-III both area and production of selected pulses exhibited significant positive growth. The sources of change in the variance of selected pulses production revealed that the change in residual and change in area variance contributed the major

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share towards destabilizing the production of Pigeonpea and chickpea respectively in the state. The results of the budgeting technique revealed that the profit per rupees was more in beneficiary farms as compared to non-beneficiary farms in the cultivation of both the selected pulses.

Keywords: Budgeting technique; chickpea; compound growth rate; instability analysis; national food security mission and pigeon pea.

1. INTRODUCTION

Pulses are an important commodity group of crops that provide high-quality protein complementing cereal proteins for a vegetarian population of the country. Although, being the largest pulse crop cultivating country in the world, pulses share to total food grain is production is only 6-7 per cent in the country. In comparison to other vegetables, pulses are rich in proteins and less expensive. Pulses possess several other qualities such as they improve soil fertility and physical structure, fit in as mixed/inter-cropping system, crop rotations and dry farming and also provide green pods for vegetable and nutritious fodder for cattle as well. The productivity of pulses has increased about 652 kg/ha during 2015-16 from 441 kg/ha during 1950-51. It is imperative to mention that the New Agriculture Technology (NAT) introduced during mid-sixties has increased the production of food-grains from 50.82 million tonnes during 1950-51 to 252.00 million tonnes during 2015-16with the increase in area from 97.32 million hectares to 123 million hectares. The productivity of food grains has also sharply increased to 2056 kg/ha during 2015-16 from 522 kg/ha during 1950-51 [1].

Despite half of the population working in agriculture, the Indian economy was encountering a situation where the supply of food grains fell short of demand for consumption, mainly due to rising population. [2] indicated that 1/3rd of the population is faced with extreme poverty. They further noted that half of the Indian children were malnourished. In order to combat the challenge of deficit food availability in the country, the Government of India launched National Food Security Mission (NFSM) in 2007-08 at the beginning of 11th Five Year Plan (FYP). The NFSM programme targeted to escalate the production of rice, wheat and pulses by 10, 8, and 2 million tonnes, respectively by the end of the Eleventh Five Year Plan [3]. The mission adopted a twofold strategy to bridge the demand-supply gap. The first strategy was to expand the area, and the second was to bridge the productivity gap between the potential and existing yield of food crops. Expansion of area approach was mainly confined to pulses and wheat only, and rice was mainly targeted for productivity enhancement.

The NFSM target was to enhance farm profitability so that the farming community retains its confidence in farming activities. With this strategy and goals, NFSM was implemented in 561 districts in 27 states in the country [4] and resulted in rice production during the end of 11th Five Year Plan increased by 12.1 million tonnes, wheat production by 19.1 million tonnes and pulses production by 2.9 million tonnes as compared to the production during the base year of 2006-07 [5].

National Food Security Mission-Rice (NFSM-Rice) and National Food Security Mission – Pulses (NFSM-Pulses) were implemented in Karnataka during 11th FYP that are also being continued during the 12th plan. Pulses were covered in 13 districts, in the beginning, two years of 11th Plan and later extended to the entire state. The NFSM is extended to 12th Plan due to its success in achieving the targeted goal of food grains production enhancement by 20 million tonnes by the end of 11th Plan. However, new targets have been set to produce additional 25 million tonnes of food grains by 2016-17: 10 million tonnes of rice, 8 million tonnes of wheat, 4 million tones of pulses, and 3 million tonnes of coarse cereals [6]. Under this Scheme, interventions i.e. demonstrations, distribution on subsidy, farm machines, farmers training, Integrated Pest management, local initiatives, micronutrients, production subsidy, project management team, publicity, seed minikits, soil amendments, water management and training of extension workers have been considered for dissemination of technologies and farm management practices.

The study of government intervention in pulses assumes significance since they are mainly grown in rain-fed regions with limited inputs and a high degree of risk. More than 83 per cent of the area under pulses is rain-fed. The NFSM programme can have a significant impact on the livelihood security of smallholder producers in

these regions through its impact on pulse production, yield, instability, technology dissemination and credit uptake [7]. Thus it is essential to evaluate and measure the extent to which the NFSM programme and approach has stood up to the expectations. The study would enlighten the policymakers to incorporate necessary mid-term corrective measures to make the programme more effective and successful with the objectives to study the growth and variability in area, production and yield of pulses in Karnataka during pre and post NFSM periods and to analyze the impact of NFSM on the farm economy of the state. These results will provide useful insights into the impact of the NFSM on farming communities and can suggest policy recommendations for improving the efficacy of the program.

2. METHODOLOGY

2.1 Selection of Study Area and Sample Farmers

The primary data collected from sample farmers in selected NFSM districts of Karnataka. For the selection of crops and farmers, a multi-stage sampling design was used. In the first stage, two major pulses (Pigeonpea and Chickpea) having the highest area under total pulses in the state were selected based on the latest year for which data is available. In the second stage, from the entire NFSM districts one major district which was having the highest area under each selected pulse crop was selected. Thus Kalaburagi for Pigeonpea crop and Vijayapur for Chickpea were selected. Later in the third stage, one taluka from each selected district and two villages from each selected taluka were selected based on the area under each pulse crop. Subsequently, at the final stage, 15 beneficiaries and 15 non beneficiaries were selected randomly from each village for each selected crop, thus the total sample size was 120 (60 for Pigeonpea and 60 for Chickpea).

2.2 Nature and Sources of Data

The study is mainly based on both primary and secondary data. Primary data for the present study on crop yield, input usage and cost of cultivation of beneficiaries and non-beneficiaries were obtained for the year 2016-17 from the selected sample farmers through personal interview method with the help of a pre-tested and well-structured schedule. The secondary data required for the study were collected from the Directorate of Economics and Statistics, Bangalore for the period from 1998-98 to 2015-16. To assess the impact of NFSM, the study period has been divided into Period–I (1998-99 to 2007-08), Period –II (2008-09 to 2015-16) and Period-III (1998-99 to 2015-16). Period-I represents the Pre-NFSM and Period-II represents the Post-NFSM period and Period –III represents the Overall study period.

2.3 Statistical Tools

2.3.1 Compound growth rate analysis

Compound growth rates in the area, production and yield of selected pulses in the selected districts and for the state as a whole were estimated by using the exponential function of the form [8].

$$Y_t = a\, b^t e^{Ut} \quad (1)$$

Where,

Y_t = Area/production/ yield of selected pulses in year 't'.
a = Intercept
b = Regression coefficient
t = Year which takes values 1, 2 … n.
U_t = Disturbance term in year't'.

The equation (1) was transformed into log-linear form and written as

$$\log Y_t = \log a + t \log b + U_t \quad (2)$$

Parameters in Equation (2) are estimated by using Ordinary Least Square (OLS) technique.

The compound growth rate (g) was then estimated by the identity given in equation (3)

$$\text{Annual compound growth rate } (r) = [(\text{Antilog } b_t)] - 1 \times (100) \quad (3)$$

2.3.2 Instability analysis

In order to analyze the sources of instability in the selected pulses production, a method developed by [9] was adopted. This method uses statistical identities to provide an exact decomposition of the components of change in the variance of pulses production.

To estimate the variability of production of selected pulses, the study period was divided into two, Pre - NFSM and Post – NFSM periods. The period-I extends from 1998-99 to 2007-08, while the period – II from 2008-09 to 2015-16. Before using the data for the analysis of

instability, the time series data on area and productivity pertaining to selected pulses were first detrended to remove the trend component, using linear trend equation of the form

$$Y_t = a + b_t + U_t \quad (4)$$

Where,

Y_t = Dependent variable (area in hectare and yield in kg/ha)
t = Time period in years
a = Intercept
b = Regression coefficient
U_t = Residual term

The residual were computed from the equation (4) and were then centered around their respective means for both periods. The resultant detrended time series data were of the following form.

$$Y_t = \overline{Y} + U_t \quad (5)$$

Where,

$\overline{Y}$ = Mean yield
U_t = error in't' year

The production of selected pulses was computed using the following equation.

$$P_t = A_t \times \overline{Y}_t \quad (6)$$

Where,

P_t = Production of selected pulses inyear 't'
A_t = Area under selected pulses inyear 't'
$\overline{Y}_t$ = Yield of selected pulses inyear 't'

The production variance and co-variance were decomposed to know the sources of change between the periods.

The variance in production during the period- I can be expressed as,

$$V(P_1) = \overline{A_1}^2 V(Y_1) + \overline{Y_1}^2 V(A_1) + 2 A_1 \overline{Y_1} \overline{COV}(A_1,Y_1) - COV(A_1,Y_1)^2 + R_1 \quad (7)$$

Where,

$\underline{V}(P_1)$ = Variance of production in period-I
$\underline{A_1}$ = Mean area in period-I
$\overline{Y_1}$ = Mean yield in period-I
$V(A_1)$ = Variance of the area in period-I
$V(Y_1)$ = Variance of yield in period-I
$Cov(A_1,Y_1)$ = Covariance of area and yield in period-I
R_1 = Residuals in period-I

Similarly, each variable in period-II can be expressed in terms of its counterpart in period-I, plus the change in the variable between the two periods.

For example, $\overline{A}_2 = \overline{A}_1 + \Delta\overline{A}$ and $\overline{Y}_2 = \overline{Y}_1 + \Delta\overline{Y}$

$$\Delta\overline{A} = \overline{A}_2 - \overline{A}_1$$

$$\Delta\overline{Y} = \overline{Y}_2 - \overline{Y}_1$$

Where,

Therefore, the change in the variance of production of selected pulses between two periods is given by,

$$\Delta V(P) = V(P_2) - V(P_1)$$

2.3.3 Tabular analysis

Tabular analysis was carried out to analyze the impact of the National Food Security Mission on pulses. Primary data from farmers were used to obtain meaningful results on the impact of NFSM on their crop yield, change in cropping pattern and difference in input usage of beneficiaries and non-beneficiaries.

2.3.4 Budgeting technique

Cost and returns of beneficiaries and non-beneficiaries were analyzed using budgeting technique.

3. RESULTS AND DISCUSSION

3.1 Growth in Area, Production and Productivity of Pulses

The compound growth rates (used as growth rates hereafter) of area, production and productivity of selected pulses in Karnataka and selected districts during the period from 1998-99 to 2015-16 were computed and the results of the analysis are presented in Table 1.

Pigeonpea is one of the major pulse crops in the state. This crop covers about 25 per cent of the area under pulses. The growth analysis of Pigeonpea indicated that in the case of Kalaburagi district growth in the area was found to be positive and significant at one per cent level

of significance during both Period-I (3.71%) and Period-III (1.61%), but during Period-II (-0.57%) it was found negative. Similarly, the growth in production of Pigeonpea was 7.54 per cent,

Table 1. Compound growth rate of area, production and productivity of selected pulses in Karnataka

(Per cent per annum)

Particulars	Pigeonpea		Chickpea	
	Kalaburagi	Karnataka	Vijayapur	Karnataka
Pre-NFSM period				
Area	3.71**	3.07**	10.57**	6.28**
Production	7.54	6.09	5.73	4.97*
Productivity	3.70	2.93	-4.38	-1.23
Post-NFSM period				
Area	-0.57	1.47	7.73	5.64*
Production	1.25	2.64	0.18	5.11
Productivity	0.58	1.15	-7.00	-0.50
Overall period				
Area	1.61**	2.78**	11.74**	7.97**
Production	3.72*	4.73**	10.09**	8.31**
Productivity	1.74	1.90	-1.48	0.31

*Note: ** and * indicates significance at 1 and 5 per cent level respectively*

Table 2. Components of change in average selected pulses production in Karnataka

(Per Cent)

Sl. no	Components of change	Pigeonpea		Chickpea	
		Kalaburagi	Karnataka	Vijayapur	Karnataka
1	Change in Mean yield	50.46	34.61	0.15	6.26
2	Change in Mean Area	46.37	56.12	100.74	86.39
3	Interaction between Changes in mean area and mean yield	6.64	10.18	0.26	6.85
4	Change in yield and area covariance	-3.47	-0.92	-1.15	0.50
	Total	100.00	100.00	100.00	100.00

Table 3. Sources of change in the variance of average selected pulses production in Karnataka

(Per cent)

Sl. no	Components of change	Pigeonpea		Chickpea	
		Kalaburagi	Karnataka	Vijayapur	Karnataka
1	Change in mean yield	-53.83	-96.07	-73.59	-6.82
2	Change in mean area	-13.90	-53.34	-21.29	-9.82
3	Change in yield Variance	22.31	26.06	-8.81	-1.32
4	Change in area variance	23.58	36.15	72.29	58.54
5	Interaction between changes in mean yield and mean area	-0.88	-4.22	-3.54	-1.15
6	Change in area and yield covariance	48.91	58.78	31.07	17.84
7	Interaction between changes in mean area and yield variance	6.26	17.59	9.73	-4.47
8	Interaction between changes in mean yield and area variance	7.24	14.31	11.10	9.65
9	Interaction between changes in mean area and yield and change in area-yield covariance	14.43	31.23	48.19	22.44
10	Change in residual	45.86	69.50	34.81	15.11
	Total	**100.00**	**100.00**	**100.00**	**100.00**

Table 4. Input use pattern and output obtained in the selected pulses cultivation

(Per ha), (n=60)

Sl. no.	Particulars	Units	Pigeonpea		Chickpea	
			Beneficiary	Non-beneficiary	Beneficiary	Non-beneficiary
1	Seeds	kg	11.50	12.43	52.63	54.28
2	Human labour	Man days	80.17	75.80	57.38	62.51
3	Bullock labour	Pair days	15.10	14.65	8.08	8.12
4	Tractor labour	Hours	21.28	19.70	18.32	17.90
5	Farm yard manure (FYM)	MT	0.80	0.20	0.68	0.00
6	Fertilizers					
a.	N	kg	48.28	56.57	60.01	65.38
b.	P	kg	80.92	87.89	112.37	118.25
c.	K	kg	62.28	71.18	-	-
d.	Micronutrients	kg	24.08	18.02	-	-
7	PPC	₹	3038.00	3723.00	2850.00	3025.00
8	Output	Quintal	13.80	10.90	11.75	9.89

Table 5. Costs and returns in cultivation of Pigeonpea

(₹/ha), (n=60)

Sl. no.	Particulars	Beneficiary	Per cent	Non-beneficiary	Per cent
I. Variable cost					
1	Human labour	13699.45	24.41	12952.70	24.33
2	Bullock labour	7674.42	13.67	7445.72	13.98
3	Machine labour	8560.52	15.25	7924.92	14.88
4	Seeds	1725.00	3.07	1243.00	2.33
5	Farm yard manure	2440.73	4.35	610.18	1.15
6	Fertilizers	7370.00	13.13	7988.84	15.00
7	PPC	3038.00	5.41	3723.00	6.99
8	Interest on working capital @ 7%	3115.57	5.55	2932.18	5.51
	Subtotal (I)	**47623.68**	**84.85**	**44820.54**	**84.18**
II. Fixed cost					
1	Rental value of land	6285.00	11.20	6285.00	11.80
2	Land revenue	11.85	0.02	11.85	0.02
3	Depreciation	1365.28	2.43	1289.58	2.42
4	Interest on fixed capital @11%	842.83	1.50	834.51	1.57
Subtotal (II)		8504.96	15.15	8420.94	15.82
Total cost of cultivation (I)+ (II)		56128.65	100.00	53241.48	100.00
Gross returns		77680.20		61356.10	
Net returns		21551.55		8114.62	
B:C		1.38		1.15	
Increase in cost in beneficiary farms over non-beneficiary farms		2887.17			
Increase in returns in beneficiary farms over non-beneficiary farms		16324.10			
Net additional returns		13436.93			

1.25 per cent and 3.72 per cent during Period-I, Period-II and Period-III respectively and it was found significant only during Period-III at five per cent level of significance. With respect to productivity levels of Pigeonpea, the growth rate was positive during all the three periods but found non-significant.

In the case of Karnataka state as a whole, the growth in the area was positive during all the three periods and found significant at one per cent of significance during Period-I (3.07%) and Period-III (2.78%). Similarly, the growth in production of Pigeonpea was growing at the rate of 6.09 per cent, 2.64 per cent and 4.73 per cent per annum during Period-I, Period-II and Period-III respectively and it was found significant only during Period-III at one per cent level of significance. Though the growth in productivity was positive during all the three periods it was only marginal and found non-significant.

Chickpea is also an important pulse crop grown exclusively during *Rabi* season under rainfed conditions. As in the case of Pigeonpea, in the study district and state as a whole, area and production of Chickpea showed positive growth and yield exhibited negative growth (Table 1). During Period-I the growth rates of area, production and productivity of Chickpea in Vijayapur district were10.57 per cent, 5.73 per cent and -4.37 per cent respectively, during Period-II, the growth rates of area, production and productivity were 7.73 per cent, 0.18 per cent and -7.00 per cent respectively and in the Period-III the growth rates of area, production and productivity were 11.74 per cent, 10.09 per cent and -1.48 per cent respectively. During Period-I, only growth in the area was found significant whereas, during Period-III both area and production were found significant at one per cent level of significance.

Similarly with respect to Karnataka state as a whole, during Period-I area (6.28%) and production (4.97%) of Chickpeashowed positive growth and productivity (-1.23%) exhibited negative growth. During Period-II also similar trend was observed as in case of Period-I, where both area (5.64%) and production (5.11%) were

Table 6. Costs and returns in cultivation of ChickPea

(₹/ha), (n=60)

Sl. no.	Particulars	Beneficiary	Per cent	Non-beneficiary	Per cent
I. Variable cost					
1	Human labour	9789.60	21.21	10664.83	23.67
2	Bullock labour	4139.22	8.97	4159.71	9.23
3	Machine labour	7479.32	16.20	7307.85	16.22
4	Seeds	3973.04	8.61	3799.60	8.43
5	Farm yard manure	2125.21	4.60	0.00	0.00
6	Fertilizers	5893.67	12.77	6278.31	13.93
7	PPC	2850.00	6.17	3025.00	6.71
8	Interest on working capital @ 7%	2537.50	5.50	2466.47	5.47
	Subtotal (I)	**38787.57**	**84.04**	**37701.78**	**83.68**
II. Fixed cost					
1	Rental value of land	5815.00	12.60	5815.00	12.91
2	Land revenue	10.65	0.02	10.65	0.02
3	Depreciation	812.27	1.76	798.62	1.77
4	Interest on fixed capital @11%	730.17	1.58	728.67	1.62
Subtotal (II)		7368.09	15.96	7352.94	16.32
Total cost of cultivation (I)+ (II)		46155.67	100.00	45054.72	100.00
Gross returns		56635.00		47669.80	
Net returns		10479.33		2615.08	
B:C		1.23		1.06	
Increase in cost in beneficiary farms over non-beneficiary farms		1100.95			
Increase in returns in beneficiary farms over non-beneficiary farms		8965.20			
Net additional returns		7864.25			

growing positively over the year whereas, productivity (-0.50%) was seen a declining trend. On the contrary during Period-III, the growth in the area, production and productivity were growing at the rate of 7.97 per cent, 8.31 per cent and 0.31 per cent respectively. During Period-I and Period-III both area and production was showed significant positive growth rates whereas during Period-II only growth in the area was found significant. The growth in productivity was found negative during all the periods except Period-III where it is positive but very marginal.

The decelerating growth rate of yield could be mainly due to the absence of improved /high yielding varieties and sensitiveness of the crop to climatic variations like heavy rainfall or drought condition during various developmental stages of the crop. The dismal performance of Pigeonpea was due to the fact that of Pigeonpea is mainly grown in the rainfed situation, as more than 95 per cent area is still rainfed [10]. Farmers do not adopt the recommended package of practices for the crop. Further, inadequate supply of improved varieties and large-scale incidence of pests and diseases are contributing to lower yields.

3.2 Instability in Selected Pulses Production

Individual crop growth rates of area, yield and production help the planners and policy makers in formulating plans and strategies. But an understanding of how the time series variable of area, production and yield are interrelated and their inter-causative effects is also needed to proceed in the right direction while deciding plans and strategies.

3.2.1 Sources contributing to the changes in the average production of selected pulses

The components of change in the average production of Pigeonpea production in Kalaburagi district as well as for Karnataka state as a whole are presented in Table 2. It may be observed that the change in mean yield accounted for 50.46 per cent of the increased average production followed by a change in the mean area (46.37%), interaction between mean area and yield (6.64%) and change in yield and area covariance (-3.47%) in the case of Kalaburagi district. Whereas, in case of Karnataka state as a whole, the major components of change in the average production of Pigeonpea between two periods were change in mean area (56.12%) followed by change in mean yield (34.61%), interaction between mean area and yield (10.18%) and change in yield and area covariance (-0.92%). This was in sharp in line with the findings of [11] reported that Pigeonpea production was contributed by more of yield increments in Kalaburagi district and Karnataka state as a whole between the periods of 1976-77 to 1995-96. [12] found that in most of the districts of Karnataka change in mean area was found to be the major component responsible for increased Pigeonpea production. The interaction term between mean area and mean yield and covariance between area and yield were negligible in all the districts as compared to the major components in each district.

It is evident from the table that, in case of Chickpea, the major component of change in average production was, change in the mean area in both Vijayapur district (100.74%) and Karnataka state as a whole (86.39%). Other minor components were interaction term between mean area and mean yield, change in mean yield and covariance between area and yield which were very negligible in both Vijayapur district as well as Karnataka state as a whole. These findings were in line with [11] and [12] who documented that the area expansion made a significant contribution than that of yield and their interaction in Dharwad, Gulbarga and Karnataka state as a whole.

3.2.2 Sources of instability in selected pulses production

The sources of change in variance in Pigeonpea and Chickpea production between the Post-NFSM period and the Pre-NFSM period are presented in Table 3.

Perusal of the table revealed that, in the case of Kalaburagi district, in area yield co-variance accounted for 48.91 per cent followed by, change in residuals (45.86%), change in area variance (23.58%), change in yield variance (22.31%), interaction between changes in mean area and mean yield and change in area-yield co-variance (14.43%), interaction between changes in mean yield and area variance (7.24%) and interaction between changes in mean area and yield variance (6.26%) accounted positively to change in variance of Pigeonpea production. On the contrary change in mean yield (-53.83%), change in the mean area (-13.90%) and interaction between changes in mean yield and mean area

(-0.88%) contributed to the reduction in the variance of production in the district.

Similarly in case of Karnataka state as a whole, change in residuals contributed 69.50 per cent followed by change in the area yield co-variance (58.78%), change in area variance (36.15%), interaction between changes in mean area and mean yield and change in area-yield co-variance (31.23%), change in yield variance (26.06%), interaction between changes in mean area and yield variance (17.59%) and interaction between changes in mean yield and area variance (14.31%) contributed positively to change in variance of Pigeonpea production. Whereas, change in mean yield (-96.07%), change in the mean area (-53.34%) and interaction between changes in mean yield and mean area (-4.22%) contributed to the reduction in the variance of production in the state. The sources of change in the variance of Pigeonpea production revealed that the change in residual contributed the major share towards destabilizing the production of Pigeonpea in the state. Change in the area and yield co-variance was the second largest component showing destabilizing effect in the Pigeonpea production in the state. It was also observed that most of the components of change showed destabilizing effect towards the production of Pigeonpea but a change in mean yield, change in mean area and interaction between changes in mean yield and mean area showed stabilizing effect. [7] found that there were a significant increase in production in Andhra Pradesh, Karnataka and Maharashtra out of the selected States but only two States (Karnataka and Maharashtra) showed a significant increase in yield levels. The absolute changes in area production and yield of pulses in the selected States also show a trend mirroring the results of intervention analysis.

It could also be seen from the same table that, the major sources of change in the variance of average Chickpea production in Vijayapur district changed in the area variance (72.29%) followed by, interaction between changes in mean area and mean yield and change in area-yield co-variance (48.19%), change in residual (34.81%), change in area and yield covariance (31.07%), interaction between changes in mean yield and area variance (11.10%) and interaction between changes in mean area and yield variance (9.73%) accounted positively to change in variance of Chickpea production. Whereas, change in mean yield (-73.59%), change in the mean area (-21.29%), change in yield variance (-8.81%) and interaction between changes in mean yield and mean area (-3.54%) contributed to the reduction in the variance of production in the district.

Similarly as in case of Vijayapur district, in Karnataka state as a whole also change in area variance was the major contributing factor for change in variance of average Chickpea production to the tune of 58.54 per cent followed by, interaction between changes in mean area and mean yield and change in area-yield co-variance (22.44%), change in area and yield covariance (17.84%), change in residual (15.11%) and interaction between changes in mean yield and area variance (9.65%). On contrary change in mean yield, change in the mean area, change in yield variance, the interaction between changes in mean yield and mean area and interaction between change in the mean area and yield variance contributed negatively to the variance of production in the state. The analysis of variance revealed that production of Chickpea in the state was destabilized mainly due to change in area variance accounted for 58.54 per cent on account of a multitude of factors, among which, its cultivation on marginal and sub-marginal lands with poor management practices and its susceptibility to pests and diseases are the most important ones. Among the major components of change, change in the mean area, change in mean yield an interaction between changes in mean yield and mean area contributed to the stability of Chickpea production in the state.

3.3 Input Use Pattern and Output Obtained in Selected Pulses Cultivation

The pattern of inputs used for per hectare selected pulses cultivation and output obtained by both beneficiaries and non- beneficiaries are presented in Table 4. A perusal of the table revealed that, in the case of Pigeonpea cultivation, about 11.50 kg and 12.43 kg of seeds were used by beneficiaries and non-beneficiaries respectively. The beneficiaries used 80.17 man-days of human labour whereas non-beneficiaries used 75.80 man-days of human labour. Bullock labour used by beneficiaries and non-beneficiaries is 15.10 pair days and 14.65 pair days respectively. About 21.28 hours and 19.70 hours of tractor labour were used by beneficiaries and non- beneficiaries respectively. FYM of 0.80tonne and 0.20 tonne was used by beneficiaries non- beneficiaries respectively.

Beneficiary farmers used about 191.48 kg of chemical fertilizers and whereas non-beneficiary farmers used 215.64 kg of chemical fertilizers. Beneficiaries spent ₹3038.00 on PPC whereas non-beneficiaries spent ₹3723.00. The quantities of inputs utilized were less in case of beneficiaries in some of the major inputs like seeds, chemical fertilizers and plant protection chemicals. This revealed good quality of input utilization among the beneficiaries as against non-beneficiaries. This was mainly because of availability of adequate and timely availability of quality inputs through interventions of NFSM scheme which helped them to use good quality of inputs and also timely guidance by various scientists involved in the scheme. As a result, the output obtained by beneficiaries (13.80 quintals) per hectare of Pigeonpea cultivation was more than that of non-beneficiaries (10.90 quintals).

Similarly in case of Chickpea cultivation, on an average about 52.63 kg and 54.28 kg of seeds were used by beneficiaries and non-beneficiaries respectively for a hectare of area. The beneficiaries used 57.38 man-days of human labour whereas non-beneficiaries used 62.51 man-days of human labour. Bullock labour used by beneficiaries and non-beneficiaries was 8.08 pair days and 8.12 pair days respectively. About 18.32 hours and 17.90 hours of tractor labour were used by beneficiaries and non-beneficiaries respectively. FYM of 0.68 tonnes was used by beneficiaries. Beneficiaries used about 172.38 kg of chemical fertilizers whereas non- beneficiaries used 183.63 kg of chemical fertilizers. Beneficiaries spent ₹ 2850.00 on the usage of PPC whereas non-beneficiaries spent ₹3025.00. The results revealed that less quantity of seeds, chemical fertilizers and plant protection chemicals were used among the beneficiaries as against non-beneficiaries. This was mainly because of the intervention of NFSM scheme. As a result, the output obtained by beneficiaries (11.75 quintals) for per hectare of Chickpea cultivation was more than that of non-beneficiaries (9.89 quintals). The results of the findings are in line with that of [12].

3.4 Costs and Returns in the Cultivation of Pigeonpea

A comparison of cost and returns structure of Pigeonpea between beneficiaries and non-beneficiaries' farms are presented in Table 5. The total variable cost incurred on Pigeonpea was more on the beneficiaries farms (₹ 47623.68) compared to those on the non-beneficiaries farms (₹ 44820.54) as a result of more costs on the application of vital inputs mainly human labour, machine labour, bullock labour, seeds and FYM. The average cost on manures, labour and seeds were more on beneficiaries' farms when compared with non-beneficiaries. This revealed better input utilization and their timely application as opined by beneficiaries during the survey. This was mainly because of the availability of inputs in time whenever they required.

The gross return among beneficiary farms per hectare for Pigeonpea (₹ 77680.20) was significantly more than non-beneficiary farms (₹ 61356.10). It was observed from the table that, the increase in the total cost of cultivation on beneficiary farms was ₹ 2887.17 over non-beneficiary farms. The reason identified was increased cost of seeds, labour and FYM. The net additional returns were ₹13436.93. The profit per rupees was more in beneficiary farms (1.38) as compared to non-beneficiary farms (1.15). It was mainly due to the use of high yielding varieties, proper row spacing of 90 cm which helped in maintaining required moisture and also helped in reducing *Helicoverpa Armigera* (pod borer) infestation and even beneficiaries used recommended plant protection chemicals by the expertise whereas, majority of the non-beneficiaries used the same pesticides which built to resistance in the insect body and thus results in the reduced yield. All these knowledge was obtained by beneficiaries through training and demonstration conducted under NFSM scheme. The findings were in line with [13] who documented that the IPM farmers obtained higher yield in Pigeonpea crop (12.4 q/ha) and net income (19.45%). The B: C in IPM farm was marginally higher than that of non-IPM farm.

3.5 Costs and Returns in the Cultivation of Chickpea Cultivation

It is evident from the results presented in Table 6 that, the total cost of cultivation of Chickpea on beneficiary farms (₹ 46155.67 per hectare) was more when compared to that on non-beneficiaries farms (₹ 45054.72 per hectare). The per hectare variable cost in the cultivation of Chickpea on beneficiary farms (₹ 38787.57) was also higher as compared to that on non-beneficiary farms (₹ 37701.78). The average costs incurred on inputs were more on beneficiaries' farms when compared with non-beneficiaries. This revealed better input utilization and their timely application, which was

mainly because of the availability of inputs in time whenever they required.

The gross return among beneficiary farms per hectare for Chickpea (₹ 56635.00) was more than non-beneficiary farms (₹47669.80). It was observed from the table that, the increase in the total cost of beneficiary farms by ₹1100.95 over non-beneficiary farms. The reason identified was increased cost of seeds, FYM and timely operations (labour). The net additional returns were ₹7864.25. The profit per rupees was more in beneficiary farms (1.23) as compared to non-beneficiary farms (1.06). It was mainly due to the use of high yielding varieties that is Annigeri-I which was better yielding variety in the region than any other, timely sowing of the crop, spraying of urea at the time of flowering and even the beneficiaries followed the timely nipping operation according to the suggestions made by the expertise in the Chickpeacultivation were the possible reasons for getting higher yield in case of beneficiary farms than the non-beneficiary farms. This was in line with the results of [14] who showed a positive impact of NFSM programme in raising various pulses since net returns from these crops are not only higher in NFSM district as against non- NFSM district but net returns have grown sharply in 2008-09 over that of 2007-08, especially in NFSM district of Amravati.

4. CONCLUSION

Substantial growth in production of Pigeonpea and Chickpea was observed both in the study districts as well as at the state level during the entire study period, which was mainly due to area expansion rather than an increase in yield. The major factors contributed to a reduction in yield was the adoption of local varieties by the majority of the farmers, which are prone to high pest and disease incidence. Hence, extension agency should make concerted efforts to educate the farmers regarding use of suitable improved varieties like BRG-1, BRG-2, ICP-7035, ICP-87119, WRP-1 in Pigeonpea and JG-11, ICCV-2 ,ICCV-10 ,ICCV-2 (Kabuli), BGD-103 for Chickpea and also for adoption of improved technologies like proper mix of NPK and use of sulphur and IPM technologies.

Another factor that hindered pulses production in the study area was the cultivation of these crops mainly under the rainfed situation. Due to the erratic behaviour of rainfall in general and during the recent decade in particular in the study area, the crops suffered for want of required moisture during their critical growth stages. Efforts should be made to educate the farmers to provide protective irrigation during critical growth stages of these crops wherever possible and also to grow drought-tolerant varieties for sustainable production of these crops.

It was observed that in the production of major pulses selected for the study showed that the sources of instability between the two periods were the synchronized movements in area and yield. Hence, measures such as support prices, irrigation facilities and yield risk minimizing practices have to be taken up in order to narrow down the fluctuations in area and yield in these crops.

The additional cost incurred by the NFSM beneficiary farmers was relatively higher than their non-beneficiary counterparts in cultivation of Pigeonpea and Chickpea, which was mainly due to timely supply of crucial inputs under the scheme and also use of recommended quantity of these inputs and taking up all operations timely (labour cost) as per the knowledge gained by the beneficiary farmers during field demonstrations and capacity building activities taken up under the scheme. Hence efforts should be made to create awareness among the non-beneficiary farmers about the benefits of the use of critical inputs and adoption of appropriate technologies in the cultivation of pulses to attain sustainable growth over the years in the study districts as well as in the state.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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