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Economics and Extension Support for the Sustenance of Sunflower Production in Karnataka

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Abstract

A study was carried out in Chickballapur, Chitradurga and Chikkamagaluru districts, to assess the economics, yield gap and backward linkage support for sustenance of sunflower crop in Karnataka. The results revealed that sunflower crop was profitable as the profit per acre was ₹ 9541, ₹ 6733 and ₹ 8401 per acre in the three districts. The yield gap was quite high in the case of irrigated areas at 36.27 and 42. 64 per cent between farmers' yield and demonstration yield and between farmers yield and yield from package of practices, respectively. There was adequate backward linkage support through various means including AICRP centre, State Department of Agriculture and others for sustenance of sunflower production at farm level in the state.

Keywords : Sunflower production, yield gap, sustenance of technologies

One of the modes of achieving self-sufficiency in food production in India has been initiatives in agricultural research in the form of All India Coordinated Research Projects (AICRP) for important crops. As per this mandate, the Directorate of Oilseeds Research (DOR) formerly operating as All India Coordinated Research Project on Oilseeds (AICORPO) came into existence on August 1, 1977 with the headquarters at Rajendranagar, Hyderabad. The AICRP on sunflower functioning since 1977 has made concerted efforts to address the regional problems by developing production technologies suitable for different states including Karnataka, which has large area under sunflower cultivation.

Sunflower is an important oil seed crop in Karnataka State. It occupies an area of 356 thousand hectares in 2014-15 which was highest area under sunflower in the country. The aggregate production of sunflower in the state was 206 thousand tons. Nutritionally sunflower is an important oil seed crop as it has a high level of unsaturated fatty acids. The AICRP in Karnataka state has developed a number of sunflower hybrids and production technologies suitable to the state. This has enabled the state to occupy prime place in the production of sunflower oil seed in the country.

The AICRP centre at University of Agricultural Sciences, Bangalore (UASB) is one of the pioneering research centre on sunflower and it has to its credit developing country's first hybrid sunflower BSH-1. It has also developed several varieties, hybrids, production technologies and relevant package of practices for the cultivation of sunflower in the state. The technologies developed and recommended have been transferred to farmers through the frontline demonstration on farmers' fields and extension services from the state departments. Quality seeds are supplied through various government and private agencies. The State Department of Agriculture and Seed Corporation are active in this regard. As a result of these efforts, large scale adoption of sunflower technologies has significantly enhanced the production and yields of sunflower in the state.The study was carried out with the twin objectives of assessing the economics of sunflower production and analysing the backward linkage to support sustenance of technologies transferred to farmers.

Methodology

Karnataka is the major sunflower producing state in the country and the first hybrid sunflower in the country was released by the University of Agricultural Sciences, Bangalore (UASB). The study was confined to jurisdiction of UASB. Based on area and production

of sunflower, three districts *viz.*, Chickballapur, Chitradurga and Chikkamagaluru were selected for the study. The adoption of technologies released from AICRP on sunflower was higher in these districts than in other districts. Taluks of Gauribidanur, Hiriyuru and Kadur were selected from Chickballapur, Chitradurga and Chikkamagaluru districts, respectively as these taluks have highest area under sunflower in their respective districts.

Sampling design

From each selected taluk, a cluster of villages was chosen where sunflower crop was grown in large area and frontline demonstrations on sunflower were conducted by the AICRP. The ultimate sample of farmers numbering 50 from each taluk was chosen randomly from the cluster of villages to form overall sample size of 150 sunflower farmers.

Data base

A structured schedule was prepared and pre-tested before it was administered to the respondent farmers. The schedule covered general information on sunflower farmers, their asset position and details of sunflower crop production in terms of input usage, costs, income etc. For assessing the yield gap, information available with package of practices (PoP) with respect to yield of sunflower was used. To know the backward support to transfer technologies to farmers, secondary data on breeder seed production and related information and extension activities conducted by the AICRP centre were collected.

Analytical tools/techniques

Economics of sunflower crop cultivation

To assess the economics of sunflower crop production, economic measures of costs and tabular analysis was used. The economics of crop production was assessed on per acre basis as it is a common measure of unit of land in the study area.

Input and cost concepts

The total costs were divided into two broad categories:

a. Variable Costs

b. Fixed Costs

a. Variable costs: The variable costs included cost of seeds, manure, fertilizers, wages of human and bullock labour, plant protection chemicals, irrigation, repair and maintenance charges and interest on the variable costs and the inputs were valued at prevailing market prices.

b. Fixed costs: These included depreciation on farm implements and machinery, interest on fixed capital, land revenue and rental value of land. The measurement and definitions of fixed cost components are as below :

i. *Depreciation charges:* Depreciation on each capital equipment and machinery owned by the farmers and used for land cultivation was calculated based on the purchase value using the straight-line method.

$$\text{Annual depreciation} = \frac{\text{Purchase value} - \text{Junk value}}{\text{Useful life of the asset}}$$

The average life of the asset as ascertained through consultation with farmers was used in the computation of the depreciation. The depreciation cost of equipment was apportioned to the crop based on its percentage use.

ii. *Interest on fixed capital:* Interest charge on fixed capital was calculated at the rate of nine per cent, as the fixed deposits in commercial banks at the time of data collection was fetching this rate of interest. The items considered under fixed capital are implements and machinery.

iii. *Land revenue:* Actualland revenue paid by the farmers to the government was considered.

iv. *Rental value of land:* The prevailing rental value of the land in the study area was considered.

Total Cost of cultivation: It is the sum of variable costs and fixed costs and expressed on per acre basis.

Output and returns

i. *Gross returns*: Returns were obtained by multiplying the output of the crop with the value of the output prevailing in the market. It included returns from the main and by-products calculated at actual price or imputed at those prices if the products were used for self-consumption.

ii. *Net returns on variable costs:* It is the gross returns minus variable costs.

iii. *Net returns on cost of cultivation:* It is the gross returns minus total costs.

iv. *Returns per rupee of investment:* It was worked out by taking the ratio of gross return to cost of cultivation.

$$\text{Return per rupee of investment} = \frac{\text{Gross returns}}{\text{Cost of cultivation}}$$

Break-even analysis

Break-even analysis is a technique used to determine the level of production at which farmer realizes neither profit nor loss. It is the minimum level of production required to justify investment or cost of production. At breakeven yield, total returns cover total cost of cultivation of sunflower crop.

Break even output

$TR=TC$

$Y^* P_y=TC$

$Y=TC/P_y$

Where,

Y- Break even output (Quintals),

TC =Total Cost per acre

P=Price per Quintal of sunflower

Assessment of yield gaps between farm yield and yield obtained in front line demonstrations & potential yield according to the package of practices is essential. The yield gap comprises at least two components. The first component of yield gap (I) is the difference between experiment/research station yield and the potential farm yield. This component is not exploitable. The second component of yield gap (II) is the difference between the potential farm yield and the actual average farm yield (Alam, 2006). The yield gap II is exploitable and can be minimized by deploying research and extension approaches and government interventions, especially institutional issues.

Backward linkage support was analyzed in terms of magnitude of breeder seed and certified seed production and outreach activities of AICRP.

Results and Discussion

Economics of Sunflower Production

Assessment of economics of crop production indicates not only its profitability but also resource or input requirement for the production the commodity. The input use pattern and economics of sunflower production are summarised in Tables I and II.

Inputs use in cultivation of sunflower : On an average, farmers used 2.03, 2.48 and 2.5 kg of seed

Table I

Inputs used in cultivation of sunflower (per acre)

Particulars	Units	Chickballapur	Chitradurga	Chikkamagaluru
Seeds	Kgs	2.03	2.48	2.50
Farm yard manure	Tonnes	1.86	1.25	1.71
Fertilizers	Kgs	N:53 P:48 K:25 Gypsum:10 Boron:10 Zinc:10	N:41 P:38 K:28 Gypsum:10 Boron:5 Zinc: 0	N:48 P:36 K:20 Gypsum:10 Boron: 0 Zinc: 0
Plant protection chemicals	Liquid in lts	0.5	0.7	0.8
Machine	hours	5.48	5.86	4.96
Bullock labour	Pairs/day	04	03	06
Labour	Man days	Men:09 Women:28	Men:07 Women:34	Men:13 Women:22

per acre and farm yard manure usage was highest in Chickballapur district at 1.86 followed by Chikkamagaluru (1.71) and Chitradurga (1.25). Since, sunflower is grown mainly as a rainfed crop, application of farm yard manure is important. In respect of fertilise usage, farmers in Chickballapur used higher quantity of fertilisers than the farmers of the other two districts. This could be attributed to proximity of Chickballapur taluk to UASB and easy access to technical information to farmers from the University.

Economics of sunflower production : The total cost of cultivation of sunflower was highest in Chickballapur district at ₹ 15059 per acre, while in Chitradurga district it was lowest at ₹ 13787 per acre (Table II). The higher cost of cultivation in Chickballapur taluk was due to higher cost incurred on farm yard manure and fertilisers by farmers in Chickballapur district. In all the three districts, variable cost was more than 83 per cent of total costs. Among variable costs, labour cost was the major one accounting for more than 25 per cent in all the districts. The next important cost was nutrient costs. It was highest in Chickballapur district at 22.82 per cent (12.38% FYM, 10.44% fertilizers) followed by Chikkamagaluru district with 22.38 per cent of total costs (11.84% FYM, 10.54% fertilizers). It was lowest in Chitradurga district at 18.88 per cent (9.11% FYM, 9.77% fertilizers). Interestingly, machinery hiring

TABLE II

Economics of sunflower production in the three sample districts (₹ */acre)*

Particulars	Chickballapur		Chitradurga		Chikkamagalur	
	₹	% to total	₹	% to total	₹	% to total
Seeds	446	2.96	620	4.49	626	4.31
Farm yard manure	1865	12.38	1256	9.11	1718	11.84
Fertilizers	1573	10.44	1348	9.77	1530	10.54
Plant protection chemicals	69	0.45	93	0.67	114	0.78
Machine charges	2192	14.55	2345	17.00	1984	13.67
Animal labour	1012	6.72	828	6.00	1429	9.84
Family labour charges	2094	13.09	1456	10.56	1573	10.84
Hired labour charges	1912	12.69	2369	17.18	2241	15.44
Irrigation cost	1080	7.17	850	6.16	841	5.79
Interest on working capital@7%	398	2.64	360	2.61	385	2.65
Total variable cost Cost (A)	12641	83.94	11525	83.59	12441	85.74
Land revenue	20	0.13	20	0.15	20	0.14
Depreciation	363	2.41	342	2.48	352	2.42
Rental value of land	1350	8.96	1223	8.87	1011	6.96
Interest on fixed capital@9%	685	4.54	677	4.91	685	4.72
Total fixed cost(B)	2418	16.06	2262	16.41	2068	14.26
Total variable cost Cost (A)	15059	100.00	13787	100.00	14509	100.00
Yield/acre in quintals	8.20		7.5		7.9	
Cost of production/ quintal	1837		1838		1837	
Gross returns	24600		20520		22910	
Net returns over variable cost	11959		8995		10469	
Net returns over all costs	9541		6733		8401	
Net returns per rupee of cost	0.63		0.48		0.57	
Break even yield	5.01		4.83		5.00	

charges was also significant at 14.55, 17 and 13.67 per cent, respectively in Chickballapur, Chitradurga and Chikkamagaluru districts.

Among fixed costs, the rental value of land was the most important one at 8.96, 8.87 and 6.96 per cent in Chickballapur, Chitradurga and Chikkamagaluru districts, respectively. The total fixed cost accounted for 16.06, 16.41 and 19.26 per cent of total cost of ₹ 15059, ₹ 13787 and ₹ 14509 per acre, respectively in the three districts.

The average yield realized by the farmers was higher in Chickballapur district at 8.20 quintals per acre.Whereas, farmers in Chitradurga and Chikkamagaluru districts realized slightly lower yields of 7.5 and 7.9 quintals per acre. The higher yield in Chickballapur district can be attributed to higher degree of adoption of sunflower technologies released by centre at UASB by farmers. The breakeven yield was 5.01, 4.83 and 5.00 quintals per acre in Chickballapur, Chitradurga and Chikkamagaluru districts, respectively. The breakeven yield indicates minimum level of crop yield needed to recover costs. At breakeven yield, farmers just recover their cost by selling the produce at prevailing market prices. The cost of production per quintal of sunflower was almost same in three districts at around ₹ 1837. But gross returns were higher at ₹ 24600 per acre in Chickballapur district. It was ₹ 20520 and ₹ 22910 among farmers in Chitradurga and Chikkamagaluru districts. Net income after meeting all expenditure was highest at ₹ 9541 per acre in Chickballapur district. The net rate of return was 0.63, 0.48 and 0.57 in Chickballapur, Chitradurga and Chikkamagaluru districts, respectively, revealing the profitability of the crop. The results showed that the sunflower production is possible under diverse socio-economic and agro-climatic conditions. Hence, the area under sunflower needs to be expanded.

Yield gap in sunflower

Yield gaps in crops needs to be reduced in interest of increased and sustainable crop production.

The Table III revealed that yield gap was more in irrigated crop than in rainfed crop. The yield gap between farmers' average yield and potential average yield of front line demonstrations was about 17.50 per cent in dryland areas and it was higher in the case of irrigated area at 36.27 per cent. However, the yield gap was large if we consider the potential yield as of Package of Practices. It was 34 and 42.64 per cent in dryland and irrigated areas, respectively. Results of the study strongly point towards scope for enhancing yields of sunflower in Karnataka state, particularly in irrigated areas. If potential yield is achieved, the country can minimise imports of edible oils from outside and this could result in savings of considerable amount of foreign exchange for the country. Socio-economic and institutional/policy constraints can cause yield gaps significantly. It is thus necessary that these issues are addressed seriously and solutions are proposed to increase productivity by minimizing the yield gaps.

TABLE III

Yield gap in sunflower (qtls / ha)

Particulars	Rainfed	Irrigated
Overall average yield in Karnataka	6.60	14.34
Yield observed in front line demonstrations of AICRP	8.00	22.50
Potential yield as of package of practices	10.00	2542.64
Yield gap-1(B-A)	1.40	8.16
Per cent	17.50	36.27
Yield gap-2(C-B)	2.00	2.50
Per cent	20.00	10.00
Yield gap-3(C-A)	3.40	10.66
Per cent	34.00	42.64

Backward linkages to support sustenance of technologies transferred to farmers

It is evident that there is a considerable magnitude of yield gap in sunflower in the state. To bridge this yield gap, there is need for strong backward linkages both at micro and macro levels. In Karnataka state, an adequate backward linkage support is in place for the adoption of sunflower technologies at farm level.

Multiplication of breeder seed : The AICRP Center on Sunflower at UASB is supplying sunflower breeder seeds to National Seeds Corporation (NSC), Karnataka Oil Seeds Grower Federation (KOF) and private players for the production and distribution of foundation and certified seeds to farmers for commercial cultivation. The AICRP Bangalore center is supplying breeder seed to the extent of 14.50 kg for foundation and certified seed production (Table IV) with 1 kg of breeder seed, about 20,000 kg of certified seeds can be produced. This covers an area of 4,000 ha for the commercial sunflower production at farm level. Thus, with the production of 14.50 kg of breeder seed, AICRP could able to meet the requirement of seeds for 58240 ha. However, private seed companies are also into scheme of developing sunflower varieties and supplying the certified seeds to sunflower growers. Thus, there is adequate technology support to farmers by way of supply of certified seeds through continuously evolving sunflower hybrids.

TABLE IV

Multiplication of breeder seed in the chain

1 kg breeder seed	
Foundation seed area production	Foundation seed
0.40 ha	200kg (2qtl.) @5qtl/ha
Certified seed area	Certified seed production
40 ha	20,000 kg (200qtl.)
Commercial area	Commercial production
4000 ha	28000 qtl. @ 7qtl./ha

Source: AICRP centre on sunflower UAS, GKVK, Bangalore

Extension activities : The state department of agriculture is actively engaged in the extension activity besides supplying quality seeds through Raitha Samparka Kendras and mini-kit programmes. AICRP Center in Bengaluru is into extension mode at farm level by conducting frontline demonstrations regularly to educate farmers. As indicated in the Table V, it has conducted 220 Front Line Demonstrations (FLD) during the period 2002-03 to 2009-10. AICRP has also undertaken several field days, training programs, TV / radio programs etc.

TABLE V

Extension activities on sunflower hybrids conducted by AICRP center on sunflower UASB

Outreach activities (2002-03 to 2009-10)	No.
Front Line Demonstrations (FLD's)	220
Field Days organized	11
Training Programmes conducted	10
TV/Radio Programmes	21
Participation in Krishimela/Field days	15

Source: AICRP centre on sunflower UAS, GKVK, Bangalore

Scientist-farmer participatory seed production: Scientist-farmer participatory quality seed production was another backward linkage support. During the period 2007-12, the AICRP center was able to produce more than 3500 quintals of quality sunflower seed in the state (Table VI).

TABLE VI

Scientist-farmer participatory quality hybrid seed production (qtl.)

Name of Hybrid	2007-08	2008-09	2009-10	2010-11	2011-12
KBSH-53, KBSH44, KBSH-41, KBSH-1	520	370	1250	925	506

Source: AICRP centre on sunflower UAS, GKVK. Bangalore

Discipline-wise number of technologies developed and released in sunflower crops by the UASB in Karnataka : The results of Table VII revealed that center was able to develop and release a large number of technologies from different agricultural disciplines relevant to sunflower. The center was able to address needs of farmers in the matters of sunflower cultivation starting from cultivation to disease management. The center has also developed and released a good number of varieties which include both high yielding and hybrid varieties.

Varieties developed and released in sunflower : As depicted in Table VIII, several hybrid varieties

TABLE VII

Discipline-wise number of technologies developed and released in sunflower crops by the UASB in Karnataka

Discipline (from time period)	No. of Technologies released
Crop improvement (1975-2012)	8
Agronomy (1985-2010)	16
Crop physiology (1995-2010)	6
Entomology (1986-2008)	12
Plant Pathology (1983-2010)	12

Source: AICRP centre on sunflower UAS, GKVK, Bengaluru

TABLE VIII

Varieties developed and released in sunflower in Karnataka (1975-76 to 2012-13)

Year	Technology
1975	EC-68415
1978	Morden
1980	BSH-1
1992	KBSH-1
2001	KBSH-41
2001	KBSH-42
2002	KBSH-44
2008	KBSH-53

Source: AICRP centre on sunflower UAS, GKVK, Bengaluru

starting from BSH-1 to KBSH-53 were released by the center during the period 1975-2008. Thus it can be inferred that there is adequate backward linkage support for transfer and sustenance of sunflower technologies in the area operated by AICRP.

Results of the study show that the sunflower production is profitable despite large scale import of cheap edible oils from outside. The yield gap was very large between farmers' yields and potential yields according to the package of practices. There is an adequate system in place to meet the technological requirements of sunflower growers in the form of backward linkages through front line demonstrations, state department of agriculture, scientist-farmer interactions and a large number of sunflower varieties and technologies. There is a need to bridge the yield gap by way of concerted extension efforts to augment the productivity of sunflower in the state.

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