Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(6): 2444-2448
Received: 29-09-2017
Accepted: 30-10-2017

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Resource use efficiency of Greengram in Gadag district of Karnataka

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Abstract
The present study attempted to estimate the cost of cultivation of Greengram in the Gadag district of Karnataka. The multi-stage random sampling procedure was adopted to choose the sample farmers. Thus, the total sample size selected for the present study was totaled to 180. The data pertained to the agricultural year 2014-15. Tabular analysis techniques were used to analyze the data. The results revealed that the variables included in the function explained 79 per cent, 90 per cent and 86 per cent variation in the dependent variable on small, medium and large farmers respectively. Increasing returns to scale were observed for medium (1.05) and large farmers (1.03), whereas decreasing returns to scale was observed for small farmers (0.96). Here large farmers getting more returns to scale compared to other categories of farmers because of operation of economies of scale and proper management of resources in the production process. The ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC), it revealed that allocative efficiency was positive and greater than unity in the case of seeds, manures, human labour, and PPC indicating that still there was scope to use these inputs and increase the gross returns of greengram production in the study area.

Keywords: Categories of farmers, resource use, marginal value product and marginal value cost

Introduction
Greengram (*Vigna radiata L*) is belongs to the family Leguminosae and sub-family Papilionaceae and the earlier name of Greengram was *Phaseolus aureus* that has now been changed to *Vigna radiata*. It falls in the group of Asiatic Species of genus Phaseolus. The Greengram was domesticated in India, where its wild progenitor (*Vigna radiata* subspecies *sublobata*) occurs wild. Archaeological evidence has turned up carbonized Greengram on many sites in India. Areas with early finds include the eastern zone of the Harappan civilization in Punjab and Haryana, which dates back about 4500 years, and in South India modern in state named Karnataka it finds date back more than 4000 years. However in South India there are evidences for evolution of larger-seeded greengram about 3500 to 3000 years ago. And greengram were widely cultivated throughout India, Later cultivated greengram spread from India to neighbouring countries like China and Southeast Asia.

Nutritional and Medicinal value
Greengram contains about 24 per cent protein, this being about two third of the protein content of soybean, twice that of wheat and thrice that of rice. The protein is comparatively rich in lysine, which is deficient in cereal grains. Hence, a diet combining mungbean and cereal grains forms a balanced amino acid diet. Every100 g of mungbean seeds contains 132 mg calcium, 6.74 mg iron, 189 mg magnesium, 367 mg phosphorus and 124 mg potassium and vitamins like 4.8 mg ascorbic acid, 0.621 mg thiamine, 0.233 mg riboflavin, 2.251 mg niacin, 1.910 mg pantothenic acid and 114 IU vitamin A (Haytowitz and Matthews, 1986). Greengram has high digestibility and palatability, its pods are used as green vegetable. Its whole grains and split grains are used as dal and curry. Being highly digestible, its curry is generally recommended for patients. Its flour is used in various preparations like, halwa, savoury dishes, snacks, pakoras and fried dal, to get very delicious and nutritious products. Its green plants, chopped and mixed with other fodders are palatable feed for animals. It is also used as green manuring crop, which adds nitrogen in addition to humus to the soil. It is a soil protecting crop in rainy season.

Cooked dal of green gram is a very digestive food for invalid and sick persons. Its regular use during childhood, pregnancy and lactation helps one to get the required nutrition and promote health. It is an aperients i.e. a laxative. When given in large quantities. The soup made from it is best article of diet after recovery from acute illness. Applying in the form of powder is useful in relieving the heat or burning of the eyes.

A poultice of this powder is useful for checking secretion of milk and reducing distention of the mammary glands. The soaked greengram is an excellent medicine during cholera, measles, chicken-pox, small-pox, typhoid and all types of fevers. It can be given in a small quantity even during acute phase of appendicitis. Flour of the green gram is an excellent detergent and can be used as a substitute for soap. It removes the dirt and does not cause any skin irritation. Its application over the face bleaches the colour and gives good complexion. Black gram flour is also used for washing the hair with green gram paste to lengthen hair and prevent dandruff.

World

Greengram is widely grown in India (31.62 per cent), Nigeria (6.05 per cent), Brazil (5.34 per cent), and China (4.70 per cent). The crop extends to Canada (3.45 per cent), Australia (2.16 per cent), Mexico (1.96 per cent) and USA (1.66 per cent). The crop in India occupied an area of 3.42 million hectares (M.ha) and India produced 1.34 million tonnes grains in 2011-12 (www.faostat).

India

It is grown primarily during rainy (kharif) season almost in entire India and occupies nearly 80 per cent of the total area under crop. The rabi crop amounts for the remaining 20 per cent of the total area. In spring and summer season also it is now cultivated as a short duration catch crop in places where some irrigation water is available and lands remain fallow during summer. The important states in India growing maximum greengram crop are Rajasthan, Karnataka, Maharashtra and Andhra Pradesh and they occupied respectively 1.27, 0.40, 0.39 and 0.25 Mha. The states growing lowest are Himachal Pradesh, Jammu and Kashmir, Assam and West Bengal and they occupied 0.0003, 0.0009, 0.007 and 0.019 Mha in 2011-12. Greengram was practically a kharif crop in Rajasthan, Maharashtra, Gujarat, Madhya Pradesh and Karnataka and predominantly in Andhra Pradesh. Assam grows only Rabi crop and West Bengal grows the crop primarily during the Rabi season. In Bihar also, Greengram is practically a summer crop and the maximum area during summer is found in this state. The state of Uttara Pradesh contributes a considerable area under summer crop and some area under kharif crop.

Karnataka

The major Greengram growing district is Gadag district which stands in first position with the production of 13,944 t and area of 70,316 ha followed by Dharwad district with the production of 8,432 t with an area of 26,350 ha and Bagalkote district with the production of 4,883 t with the area of 51,675 ha (Karnataka State at a Glance, 2011-12).

Gadag

This district has five taluks, covering a geographical area of 4,65,715 ha, out of which forest area is 32,614 ha. It's covering population about 10,64,750, out of which 5,37,147 male population and 5,27,427 female population with the population density 140. The climate of the district is generally dry and in the pre-monsoon it is cool. The average rainfall of the district is 612.7 mm in annual and net irrigated area was 79017 ha. The temperature ranges from 14°C to 42°C. There are two main type of soils *viz.*, black and laterite soil. The average water holding capacity is medium to high. Gadag district is endowed with semi - geographically advantage and contributes good towards agriculture production.The major varieties grown in study area are Selection-4, Pusa Baisakhi and Shining moong. (China moong). The districts namely Dharwad, Belagavi, Vijaypur and Raichur come under Zone-III (www.mofpi.nic.in).

Although India has made significant strides in Greengram production, yet the progress has not been uniform and stable across the states leading to instability in Greengram production. This has affected the low-income people with inadequate diets because shortfall in supplies raises prices and thus reduce the purchasing power of those with small incomes. On the other hand, surpluses in production prove a boon to them in the form of lower prices and thus mitigate upward pressure on prices (Meller, 1981) [5]. However, the fluctuations in Greengram production have not only increased in the wake of rapid diffusion of new production technology, compared to earlier periods but also altered the causal relationship between growth and instability. This causal link between growth and instability and variability of agricultural outputs have been hypothesized by many researchers (Sen, 1967; Rao, 1975; Vyas, 1977 and Mehra, 1981) [10, 9, 14, 4].

Materials and methods

The present study was conducted in Gadag district based on the major greengram producing area in Karnataka, for study purpose primary and secondary data were collected. Primary data relating to costs and returns involved in production of greengram from the selected farmers. Secondary data relating to area, production and productivity of greengram for fifteen years (1998-99 to 2012-13) and other relevant information for the study were collected from the Directorate of Agriculture, Bangalore, District Statistical Office and Joint Director of Agriculture Gadag and Karnataka at a Glance. The multi-stage random sampling procedure was adopted to choose the sample farmers (respondents). In the first stage, Gadag district was selected based on highest greengram area. In second stage, taluks having highest area under greengram ware selected. Later two villages from each taluk having highest area under greengram crop were selected in the third stage. Finally, sample of thirty farmers were chosen from each of these selected villages randomly. Thus, the total sample size selected for the present study was totaled to 180. For this purpose, pre-tested and well-structured schedule were used.

Results and Discussion

Input use management

Inputs used per hectare in greengram cultivation in the study area revealed that the average per hectare utilization of human labour was highest in case of small category farms (33.57 man days) followed by medium farmers (31.50 man days) and large farmers (30.15 man days) because most of the operations such as harvesting, weeding were human labour intensive. Most of the small and medium farmers used bullock labour as against use of machine labour because use of bullock labour worked out to be cheaper than machine labour use, but large farmers used machine for ploughing, sowing and other operations hence the use of machine labour was more on these farms than bullock labour. This might be attributable to accomplishment of quick work and time constraint to cover larger area.

Farmers in the study area used less quantity of farmyard manures, among the various category of farms, the quantity of farmyard manure (FYM) applied per hectare was the highest in the case of small farmers (2.34 tonnes) followed by medium category farms (1.96 t) and small farms (1.25 t). Although small farmers using more FYM compare to other

categories of farmers, but it is less than the recommended level (6 - 8 t/ ha). Because of low availability of FYM. Results presented in previous chapter revealed that there was high amount of application of chemical fertilizers in anticipation of good yield. The large farmers using high amount of fertilizers i.e. 166.50 kg/ha compared to small (153.26 kg/ha) and medium (141.23 kg/ha). Pesticides and other PPC (Plant Protection Chemicals) were used to minimize / control the pests. PPC chemicals used were high on large farms compared to small and medium farms, similar observation expressed by Puram *et al* (2010) [8].

Labour utilization and management

The result presented in Table 2 revealed that around 32 human labour, five pair of bullocks and six hour of machine labour per hectare. Among various operations of greengram cultivation harvesting operations consumed highest mandays of labour because farmers usually go for hand picking instead machine harvesting. In greengram cultivation machine labour was most commonly used than bullock labour for the operations like ploughing, harrowing etc. Apart from machine, the operations like harrowing, loadings and transportation of FYM, were done through bullock pair. However among different farm size categories not much difference observed with regard to human labour utilization but slightly difference observed in case of bullock labour and machine labour.

Estimated Cobb-Douglas Production Function Coefficients

The Cobb- Douglas production function choosing gross income realized from greengram output as dependent variable while expenditure made on seed (₹), fertilizers and FYM (₹), labourers (₹) and PPC (₹) as independent variables were used to study the resource use efficiency. The results presented in the Table 3 revealed that the variables included in the function explained 79 per cent, 90 per cent and 86 per cent variation in the dependent variable on small, medium and large farmers respectively. Increasing returns to scale were observed for medium (1.05) and large farmers (1.03), whereas decreasing returns to scale was observed for small farmers (0.96). Here large farmers getting more returns to scale compared to other categories of farmers because of operation of economies of scale and proper management of resources in the production process.

The estimated production parameter, for FYM (0.26) and machine labour (0.35) coefficients were significant at one per cent, while seed (0.40) was significant at five per cent, bullock labour (-014) was negative and significant at ten per cent for small farmers. In the case of medium farmers, human labour (0.064) was significant at five per cent, while machine labour (0.193) and PPC (0.12) coefficients were significant at 10 per cent. Whereas, in the case of large farmers seed (0.377), human labour (0.721) and bullock labour (0.247) coefficients were significant at one per cent, fertilizer (-0.346) was negative but significant at five per cent.

The overall output elasticities of seed, FYM and human labour were positive and significant at one per cent, which implied the increased usage of these inputs added to the gross income. Since, the greengram crop was labour intensive and the operations such as ploughing, inter cultivation, manures application, hand weeding, spraying of plant protection chemicals, which significantly contributed towards increased yield and thus the income. The other inputs such as bullock labour and fertilizer coefficients were negative but significant and had negative impact on gross income

Plant protection chemicals utilization was seen relatively high in the case of only large farmers because of easy access to funds and in the anxiety to get better yield appeared to spent slightly more on PPC.

MVP to MFC ratios of resources in Greengram Production

The ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC), presented in the Table 4 revealed that allocative efficiency was positive and greater than unity in the case of seeds, manures, human labour, and PPC indicating that still there was scope to use these inputs and increase the gross returns of greengram production in the study area.

In the case of small farmers, the MVP to MFC ratio for seed (6.16), FYM (1.98), machine labour (4.01) and PPC (5.78) were more than one indicating that still there was scope for higher utilization of these inputs and which in turn would increase the gross income. This would help to maximize their profit in greengram production. While, human labour (-0.14), bullock labour (-1.09) and fertilizer (-0.66) were negative, which revealed that excessive use of these inputs will reduces the gross income.

In case of medium farmers, the MVP to MFC ratio for FYM (2.09), human labour (1.23), bullock labour (2.79), machine labour (1.56) and fertilizer (2.49) were more than one indicating that still there was scope for higher utilization of these inputs and which in turn would increase the gross income. This would help to maximize their profit in greengram production. While. Seed (-0.40) was negative, which revealed that excessive use of these inputs will reduces the gross income. The MVP to MFC ratio for PPC was less than unity (0.76) indicated excessive use of this input for the sole reason of increasing the yield

In case of large farmers, the MVP to MFC ratio for seed (9.35), FYM (3.39), human labour (2.79) and bullock labour (5.24) were more than one indicating that still there was scope for higher utilization of these inputs and which in turn would increase the gross income. This would help to maximize their profit in greengram production. While, the ratio of machine labour (-0.03), fertilizer (-3.73) and PPC (-0.18) input suggested that there need to reduce expenditure on these as revealed by ratio its being less than zero (negative).

Table 1: Input use management in Greengram cultivation

Sl. No.	Particulars	Units/ha	Small farmers	Medium farmers	Large farmers	Over all farmers
			(n=75)	(n=57)	(n=48)	(n=180)
1	Seeds	Kgs	12.59	13.72	11.96	12.76
2	Human labour	Man days	33.57	31.50	30.15	31.88
3	Bullock labour	Pair days	6.08	4.62	2.96	4.55
4	Machine labour	Hours	4.61	6.61	7.29	6.17
5	FYM	Tonnes	2.34	1.96	1.25	1.85
6	Fertilizers	Kgs	153.26	141.23	166.50	153.66
7	PPC	₹	412.56	453.78	506.85	457.73

Table 2: Operation wise labour utilization pattern in Greengram cultivation

Sl. No	Particulars	Small Farmers			Medium Farmers			Large Farmers			Over all Farmers		
		(n=75)			(n=57)			(n=48)			(n=180)		
		HL	BL	ML	HL	BL	ML	HL	BL	ML	HL	BL	ML
1	Ploughing	1.62	0.00	3.24	1.67	0.00	3.29	1.52	0.00	3.42	1.60	0.00	3.32
2	Harrowing	1.45	1.82	0.00	1.32	1.29	0.80	1.22	0.61	1.20	1.33	1.24	0.67
3	Loading, transportation and spreading organic manure	3.41	1.23	0.43	2.81	0.92	0.72	3.41	0.00	0.80	3.21	0.72	0.65
4	Sowing	3.23	1.98	0.36	2.96	1.21	1.20	2.45	0.93	1.25	2.88	1.37	0.94
5	Fertilizer Application	1.32	0.00	0.00	1.4	0.00	0.00	1.20	0.00	0.00	1.31	0.00	0.00
6	Weeding	6.45	0.00	0.00	6.62	0.00	0.00	5.40	0.00	0.00	6.09	0.00	0.00
7	Inter cultivation	3.31	1.05	0.00	2.89	1.20	0.00	3.40	1.42	0.00	3.34	1.22	0.00
8	PPC application	2.41	0.00	0.00	2.36	0.00	0.00	2.20	0.00	0.00	2.39	0.00	0.00
9	Harvesting	7.55	0.00	0.00	7.02	0.00	0.00	6.75	0.00	0.00	6.94	0.00	0.00
10	Threshing	2.82	0.00	0.58	2.45	0.00	0.60	2.60	0.00	0.62	2.79	0.00	0.60
	Total	33.57	6.08	4.61	31.0	4.62	6.61	30.15	2.96	7.29	31.88	4.55	6.17

Note: HL- Human Labour BL- Bullock Labour ML- Machine Labour

Table 3: Resource use efficiency of inputs in Greengram (Per ha)

Sl. No.	Explanatory variables	Parameters	Small Farmers (n=75)	Medium Farmers (n=57)	Large Farmers (n=48)	Over all Farmers (n=180)
1.	Intercept	a	3.40 (1.09)	1.80 (1.08)	2.77 (0.23)	2.13 (0.10)
2.	Seeds (₹)	b_1	0.40** (0.17)	-0.009 (0.06)	0.377* (0.12)	0.547* (0.04)
3.	Farmyard manure (₹)	b_2	0.26* (0.09)	0.004 (0.05)	0.032 (0.04)	0.104* (0.01)
4.	Human labour (₹)	b_3	-0.03 (0.10)	0.064** (0.06)	0.721* (0.14)	0.467* (0.04)
5.	Bullock labour (₹)	b_4	-0.14*** (0.07)	0.422 (0.32)	0.247* (0.08)	-0.062*** (0.03)
6.	Machine labour (₹)	b_5	0.35* (0.08)	0.193*** (0.13)	-0.002 (0.01)	-0.004 (0.02)
7.	Fertilizers (₹)	b_6	-0.02 (0.04)	0.361 (0.30)	-0.346** (0.13)	-0.009*** (0.01)
8.	PPC (₹)	b_7	0.12 (0.08)	0.011*** (0.03)	-0.002 (0.01)	0.008 (0.03)
9.	Coefficient of Multiple determination (R^2)		0.79	0.90	0.86	0.82
10.	Returns to Scale (Σb_i)		0.96	1.05	1.03	1.04

Note: Figures in the parentheses indicates their respective standard errors
*- Significant at one per cent probability level
**- Significant at five per cent probability level
***- Significant at ten per cent probability level

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