ECONOMIC ANALYSIS OF PRODUCTION ANDPROCESSING OF CLUSTER BEAN IN SOUTHERN HARYANA: A MICRO REVIEW

ABSTRACT

The present study was carried out with the objectives to work out costs and returns in cultivation of cluster bean, to study the economics of cluster bean processing units and to identify various constraints faced by farmers and processers in production and processing of cluster bean in Southern Haryana. The study was based on primary data. A total of 80 farmers were interviewed to gather all the desired information. The per hectare cost of cluster bean cultivation was found to be ₹ 40241 and ₹ 44553 in Bhiwani andMahendargarh district, respectively. On an average, the per hectare gross and net returns obtained from the cultivation of cluster bean in Bhiwani district were ₹ 49002 and ₹ 8758. The corresponding figures for Mahendargarh district were worked out to be ₹ 52732 and ₹ 8178, respectively. The B:C ratio for cluster beancultivation was worked out to be 1.21 for Bhiwani & 1.18 for Mahendargarh district. On an average total cost of processing guar into guar gum was worked out to be ₹ 6408.78 per quintal of output. Cluster bean processing plants incurred a profit of ₹ 204 per quintalon average basis during the year 2020-21 with gross and net returns of ₹ 6484.42 lakh and ₹ 200.35 lakh, respectively. The B:C ratio was worked out to be 1.03 for processing units of cluster bean in Southern Haryana. Results of survey undertaken to know the problem faced by the farmers in production and by processors in processing of cluster bean revealed that the problem of weed, high cost of labour, high cost of plant protection chemicals, problem of disease, problem of aphids in the crop, scarcity of labour and non-availability of quality seeds and improved varieties were the serious constraints faced by farmers in the production cluster bean in the study area and insufficient supply of raw material, High cost of fuel, high losses during transport from farm to factory, Shortage of power, Under-utilization of installed capacity and high sales tax and lack of government price polices were the serious constraints faced by the processers in the processing of cluster bean seeds in the study area.

Keywords: Cost of cultivation, Returns, B-C Ratio, B-C Ratio over variable cost, Constraints

Introduction

Cluster bean, (*Cyamopsis tetragonoloba* (L.) Taub) is popularly known as Guar in India. It is multipurpose summer annual leguminous crop with high social and economic importance. It has been cultivated for grain as well as for green vegetable purpose since ancient times in India. Cluster bean is an environment friendly crop as it can be used as a soil fertility restorer, hardy crop and requires low external input. The crop has experienced a remarkable journey from a traditional crop grown on marginal lands mainly for food, animal feed and fodder to a crop with various industrial usages ranging from food, cosmetics, printing, textile, paper, cosmetics, mining (petroleum, natural gas, well drilling and oil industries) and pharmaceutical industry. Green pods are nutritionally rich and are routinely consumed as vegetable especially in northern and

western parts of India. Cluster bean seed (endosperm) is a source of a natural hydrocolloid (galactomannan/'guar gum'). The United States of America is the largest importer of guar and its derivatives from India (Singh, 2015, Bhatt *et al*., 2016).

The potential countries in present time for its production are India, Africa, Peru, Brazil, Java, Australia, Pakistan and the United States. Among these countries, India produces over 6 lakh tons of cluster bean annually and is the largest producer of cluster bean in the world with a contribution of nearly 75 to 80 per cent of the world's total production of cluster bean.

In India, cluster bean crop is cultivated mainly during Kharif season, i.e., sowing in July and harvesting during October-November. It occupied an area of 31.40 lakh hectare with a total production of 15.19 lakh tons of guar seed during 2019-20 in the

country (Directorate of Economics and Statistics, DAC&FW). The country exports over 1.17 lakh tons of guar and its derivatives annually, which is comprised by 0.33 lakh tons of refined split guar gum and 0.84 lakh tons of treated and pulverized guar gum. The net worth of the Indian exports is estimated over ₹ 500 crores. India is the major exporter of guar gum to the world; it exports various forms of Guar products to a large number of countries. The country has exported 234,872 MT of guar gum to the world for the worth of ₹ 1949 Crores during the year 2020-21. U S A, Norway, Germany, Russia, China were the major guar gum export destinations of the country during 2020-21 with a total contribution of 61 per cent to total guar gum export of the country with export quantity of 142978 MT of guar gum [APEDA (Ministry of Commerce and Industry, Govt. of India), Indian stock market].

It is an important leguminous crop which is mostly cultivated on marginal and sub marginal lands of arid and semi-arid regions. In Haryana it occupied an area of 84.40 thousand hectare with a total production of 511.88 thousand tonnes in 2017-18 (Department of Economics and Statistical Analysis, Haryana and Director, Land Records, Haryana). Owing to its demand in the international market, it has been introduced in the non-traditional growing areas like Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Chhattisgarh.

There are number of cluster bean processing units in Bhiwani and Sirsa districts of Haryana state, in Jodhpur, Bikaner, Ganganagar, Alwar and Jaipur districts of Rajasthan state, and Ahmadabad district of Gujarat state. There are more than 150 cluster bean split manufacturers units in India with the total installed capacity of more than 6 lakh tonnes per annum (Singh, 2015).

From the processing of cluster bean seeds mainly three products are obtained viz. guar splits, Churi and Korma. Guar split is used as main product with various industrial uses while Churi and Korma are used as cattle feed. By-products or meals obtained after gum extraction are a rich source of proteins, nutrients and fibers with high digestibility and have high importance in animal and fish feed industry. Seed coat (husk) and the germ material are the by-products of guar gum industry which collectively called as guar meal. After the Extraction of gum, the potential source of protein is guar meal and contains about 42% crude protein, which is one and a half times more than the level of protein in guar seed.

The crop has gained a great significance due to its use in the oil drilling industry for hydraulic fracturing of oil shale, mainly by United States for its concern for the environment and Water contamination. The use of fast hydrated gum as a key ingredient in the process of fracking or drilling has helped in increasing the demand of crop in the international market. Increasing demand of Guar gum due to its growth in shale gas industry along with other factors has made guar a golden crop.

Commercially guar gum is extracted from seeds by a mechanical process of roasting, differential attrition, sieving and polishing. Firstly, seeds are broken into two halves and the germ is separated from the endosperm. From each seed two halves of the endosperm are obtained and are known as undehusked guar split. When the fine layer of fibrous material that forms the husk is removed and separated from the halves of endosperm by polishing, refined guar splits are obtained. The hull (husk) and germ portion of guar seed are known as guar meal, which is a major byproduct of guar seed processing and is used as cattle feed. The refined guar splits are then treated and converted into powders (known as guar gum) by a variety of routes and processing procedures depending on the end product desired. The pre-hydrated guar splits are crushed in a flacker mill and then uniformly transported to an ultrafine grinder, which grinds the splits without producing too much heat. The grinded material is dried and passed through screens for grading of the material according to the particle

size. Various grades are available depending upon color, mesh size, viscosity potential and rate of hydration (Chudzikowski, 1971).

Guar gum shows cholesterol and glucose lowering effects because of its gel forming properties. It also helps in weight loss and obesity prevention. Diet supplemented with guar gum decreased the appetite, hunger and desire for eating (Butt *et al*., 2007). Adequate intake of guar gum as dietary fiber helps in the maintenance of bowel regularity, significant reductions in cholesterol, control of diabetes, enhancement of mineral absorption and prevention of digestive problems like constipation (Yoon *et al*., 2008).

Hence, keeping the above facts into consideration, an attempt has been made to undertake a detailed study entitled "Economic analysis of production and processing of clusterbean (*Cyamopsis tetragonoloba* L. Taub.) in southern Haryana" with the following objectives:

1. To examine the cost and returns of cluster bean cultivation.
2. To work out the economics of cluster bean processing units.
3. To identify production and processing constraints of cluster bean.

In order to gain a better understanding of technique, statistical tools employed, results and outcomes produced by past researchers on the same research subject, the researcher reviewed numerous literature and empirical evidences. The review of literature has been divided into three areas for ease of use:

Studies on cost and returns of cluster bean cultivation:

Bosale *et al*. (2005) under their study named "Economics of guar cultivation in Rajasthan" assessed per hectare cost of cultivation and the returns in cluster bean production in the Jaipur district of Rajasthan during 2003-2004. The overall per hectare cost of cultivation of cluster bean was calculated to be ₹ 7958. The gross and net returns of cluster bean production were estimated to be ₹ 15,200 and ₹ 9242/ha, respectively. The input-output ratio for cluster bean cultivation was 1: 1.97, which indicated that cluster bean production is economically viable.

Chethana and Singh (2005) examined the costs and returns of both Desi (*G. arboreum*) and American (*Gossypium hirsutum*) cotton in Hisar and Sirsa district of Haryana. Primary data was collected from 80 cotton growers. During 1996-97 to 1998-99, the average per hectare costof cultivation for Desi and American cotton were worked out to be ₹ 17157 and ₹ 17203, respectively. However, the variable cost constituted about 56 per cent of the total cost for both desi and American cotton. For both the cotton species the rental value of land, expenditure on plant protection chemicals and human labour charges were the main items of total cost. The average gross returns per hectare were ₹ 16648 and ₹ 17801 for desi and American cotton, respectively. The returns over variable costs were highest on medium farms, followed by largeand small farms, the positive value of gross returns over variable costs reveals the economic viability of cotton cultivation on all the three categories of farms.

Singh (2006) under his study named "Economics of production of cluster bean in Punjab" inferred that total cost incurred in cultivation of cluster bean has been higher for large farmers compared to small and medium farmers due to higher use of inputs. The gross and net returns from cluster bean production have been found higher for large farmers compared to small and medium ones due to realization of higher prices by them and due to their exposure toother markets because of their higher marketable surpluses.

Choudhary (2007) researched on "Economic study of Gaur Production in Rajasthan" and concluded that growth rates for Cluster bean in terms of area, production and productivity were recorded as 1.81, 1.36 and 0.20 per cent per annum, respectively in the state of Rajasthan during 1995-96 to 2005-06. It was reported that the production

of gaur increased at the rate of
1.36 per cent per annum in the state of Rajasthan during the same period. This increase in gaurproduction was resulted mainly due to increase in area under the crop. The area and yield of cluster bean shows a growth rate of 8.85 and 2.8 per cent per annum respectively in the state during 1995-96 to 2005-06.

Singh (2007) conducted the study in Sikar during the year 2005-06 on "Economics of production and marketing of Cluster bean" and analyzed that the cost of cultivation per hectareof cluster bean was found to be ₹ 5916 and ₹ 6274 in the upper and lower project areas in Sikar. In the lower project area, profitable net return obtained was ₹ 4125/ha. It was also analyzed from the study that if the disease resistant and high yielding varieties are developed for cluster bean, we can obtain potentially higher yield from the crop.

Karwasra (2008) examined "Growth Pattern of Production Cost and Profitability of Cluster bean in Haryana" and revealed that the cost of cultivation and cost of production for cluster bean increased over the years. It was found that the cost of production for cluster bean was higher due to decrease in the productivity of the crop over the period.

Pal *et al*. (2015) conducted the study in Karnataka during the year 2013-14 in Gulbarga district and observed that the total cost of cultivation in seed production of pigeon pea was 23 per cent higher than grain production. The variable cost for production of pigeon pea seed (₹ 26936 per hectare) was higher than grain production (₹ 20698/ha). The gross return from seedproduction was approximately 32 per cent greater than the gross return from grain production, and the net return from seed production of pigeon pea was 44 per cent higher than the net returnfrom grain production. The discriminant analysis revealed that gross return (55.88 per cent), seed (18.52 per cent), human labor (8.35 per cent), manures and fertilizers (7.01 per cent), bullock and machine labor (5.99 per cent), and plant protection chemicals (4.26 per cent) all helped to differentiate between pigeon pea seed and grain output. Because the net return from pigeon pea seed production was positive, the area under seed production may be expanded forgreater profitability and timely supply of quality seeds to the farmers.

Meena *et al*. (2016) studied the cost of cultivation and returns in onion on the basis of different cost concepts basis in Jodhpur and Nagaur districts of Rajasthan. The study revealed that on an average, per hectare ₹ 77850 was spent on onion. It was observed that the Highestcost of cultivation was from large farm category which was estimated to be ₹ 91595, followedby medium farms (₹ 83689) and small farms (72258). Human labor accounted for the largestshare (28.45 per cent) of the cost of cultivation among different components, followed by seed (17.43 per cent). The rental value of land (12.85 per cent), irrigation costs (11.92 per cent), FYM (9.52 per cent), PP chemical (5.87 per cent), fertilizers (5.20 per cent), and machinery (3.22 per cent) were the other important components of cost of cultivation. Because onion production requires greater labor for harvesting, watering, and transplanting/sowing, human labor accounted for the largest share of ₹ 22456/ha (28.85 per cent). Large farmers spent ₹ 12835 on manures and fertilizers, compared to ₹ 12134 and ₹ 10853 for medium and smallfarmers, respectively.

Kumar and Dey (2017) conducted the study during 2014-15 in four development blocks of Lalitpur district of Uttar Pradesh. Analysis of the data showed that the per hectare cost of black gram was highest on the farm with semi-medium size and lowest on large sized farms. Irrespective of size of farm i.e., for all farms the average per hectare cost of cultivation was found to be ₹ 27779.31 and the gross return for all farms was observed to be ₹ 41535.04/ha.The Benefit Cost Ratio (BCR) was highest in case of marginal farms and it was found to be 1.54, followed by 1.52 in medium, 1.51

in large, 1.48 in small, and 1.45 in semi-medium farms. This progressive decline in BCR could be explained by diminishing gross returns across the larger farm size groups. The BCR for all farms, however, was 1.49. ‘

Kumar *et al*. (2017) studied the economics of rajmash in Bhaderwah and Bhalla blocks of Doda district of Jammu & Kashmir during 2015–16. A sample of 100 farmers comprised of 78 marginal farmers, 14 small farmers and 8 medium farmers was interviewed for collection of data. Analysis of data revealed that total cost of cultivation per hectare for rajmash was found to be ₹ 33176, ₹ 36301 and ₹ 37931 on marginal, small farms and medium farms, respectively with an overall average of ₹ 35354. On overall, cost A1, A2, B1, B2, C1, C2 and C3 were worked out to be ₹ 15043, ₹ 15816, ₹ 15885, ₹ 28489, ₹ 22749, ₹ 35354 and ₹ 38889, respectively. On an average, the return per rupee investment over cost A1, A2, B1, B2, C1, C2 and C3 was 4.72, 4.49, 4.47, 2.49, 3.12, 2.01 and 1.83, respectively. Net return obtained from rajmash cultivation was ₹ 37761 on marginal farms and ₹ 32533 on medium farms with an overall average of ₹ 35634. The benefit cost ratio was calculated as 1.86, 1.94 and 2.12 on medium, small and marginal farms, respectively. A benefit cost ratio of 2.01 was worked out on overall farm.

Mohinder and Batra (2017) conducted the study during 2015-16 to examine the cost of production of guar in three districts of Haryana i.e., Bhiwani, Hisar and Sirsa and a sample of 225 farmers were selected for the study. The total cost of production of guar was estimated at ₹ 41806.82/ha. The total yield was 9.89 q/ha. The gross returns were ₹ 36790.41 and net returns were negative with loss of ₹ 5016.41/ha.

Bhukar *et al.* (2018) examined the cost of cultivation in cluster bean for seed and grain production during 2016. The survey for grain production was conducted on 125 farmers of major cluster bean growing districts of Haryana viz., Hisar, Bhiwani, Fatehabad, Mohindergarhand Gurgaon. Results of the study showed that total cost of seed production was ₹ 17125/-

which was estimated 11 % higher than grain production and gross return from the seed production was ₹ 28950/- which was 52.4 % higher than grain production. Net return estimated from seed production of cluster bean was ₹ 11825/- while in case of grain production it was ₹ 1444/- per acre. For seed production the benefit cost ratio was calculated 1:1.69. So, it was concluded that the seed production is more beneficial than the crop productionfor the farmers.

Jyani *et al.* (2018) studied the economics of cluster bean crop in Bikaner district of Rajasthan. The Study revealed that the cost of cultivation was highest on large farms (₹ 15676.58), followed by medium (₹ 14837.42) and small (₹ 14117.08) farms. The major component of cost incurred was utilized in sowing of seed including the cost of seed which contributed 20.26 per cent of total cost. It was found that on an average the total cost (Cost C2)per hectare of cluster bean was ₹ 14877.03 for the sample farms of the study area. The cost C2 was highest on large, farms followed by medium and small farms. On an overall basis, the cost of production per quintal was ₹ 3206.76 on sample farms. It was highest on small farms, followed by medium and large farms. On an average, gross income per hectare of cluster bean cultivation was ₹ 2 7368. This was higher on large farms as compared to the medium and small farms. On an overall basis, the net income per hectare of cluster bean cultivation was ₹ 11460.45. It was more on the large farms as compared to the medium and small farms. The return to management per hectare of cluster bean cultivation was ₹ 9869.70. The returns per rupee of investment was highest on large farms (₹ 1.75) followed by medium (₹ 1.70) and small (₹ 1.69) farms.

Singh *et al*. (2018) conducted his study in Hisar during 2015-16 to analyze the cost of cultivation of guar and constraints faced by the farmers in the production of guar. A

total of 75 farmers were selected for the study from three villages with 25 farmers per village. Results of the study revealed that the total cost of cultivation of guar was calculated to be ₹ 44246.42/ha with the total yield of 9.85 q/ha. The net returns from production of guar were estimated negative with loss of ₹ 7421.22/ha with the gross returns of ₹ 36825.20. The variable cost incurred in the production of guar was found to be ₹ 20551.74/ha and the net returns over variable costs were ₹ 16273.46/ha.

Choudhri *et al*. (2018) conducted the study in Bahraich district of U. P. with a sample of 100 respondents chosen through random sampling and were categorized into three categories as marginal, small and medium size group according to the size of their farm holding. Data was collected by personal interview method with use of pre-tested interview schedule. Results of the study revealed that cultivation of maize was found profitable for all categories of farm. The gross income per hectare and the total costs of cultivation of maize were found to be positively related with size of farms, whereas negative relation was observed between net income and farm size which showed that in the cultivation of maize resources are not efficiently used at larger farm size group and the major constraints faced by the farmers in the cultivation of maize noticed were technical, managerial and financial problem.

Bhupender (2019) analyzed the economic aspects related to production and marketing of cluster bean in Hanumangarh district of Rajasthan and observed that total cost, gross income, net income of cluster bean production per farm household found increasing with increasing size of farm holding. However, cost of Production per quintal of cluster bean, found to be ₹ 2056.90, ₹ 2085.16, ₹ 1932.30, ₹ 2022.30 in case of marginal farm, small farm, medium farm and large farm categories respectively. Total cost, gross income, net income of cluster bean production per farm household were found to be higher in case of large farm categories i.e., ₹ 16057.09, ₹ 64386.99 and ₹ 48329.90 respectively. The farmers earn net income of ₹ 2312.49 per quintal by spending ₹ 2026.01 on the production cost and selling the produce at ₹ 4423.40. The major player's i.e., farmers, traders, millers, wholesalers, and retailer earn a profit of ₹ 2890.02, ₹ 171.77, ₹ 454.76, ₹ 192.54 and ₹ 225.62, respectively. The highest value addition per quintal was done by the miller which helped him to income ₹ 454.76 which is significantly higher than the other players.

Deokate et *al*. (2020) studied the economics of soyabean seed and grain production in Washim district of Maharashtra during the agricultural year 2018-2019. From the analysis of the data the per hectare cost of cultivation for soybean seed and grain production was estimated to be ₹ 57901.09 and ₹ 50747.7 which is higher for soybean seed production than grain production, while per quintal cost for soybean grain was found to be ₹ 3288.03 and ₹ 3206.04 for seed production, it shows that grain production has a higher per quintal cost than seed production. The income received per hectare from soybean seed production (₹ 77056.750) was higher, indicating that it was more economically viable than grain production (₹ 56788.37).

Rathore (2020) studied the economics of Isabgol production in Barmer district of Rajasthan. The analysis of the data revealed that total cost of cultivation for isabgol was higher (₹ 38407.69/ha) on large farm, followed by medium farms (₹ 34132.15) and small farm (₹ 31281.96). The different per hectare costs of Isabgol cultivation were computed using the cost concept (Cost A1, A2, B1, B2, C1, C2 and C3). The cost of production was found to be lower on large farms, with a cost of ₹ 5053.64 per quintal,' followed by ₹ 5094.35 per quintal for medium farms, ₹ 5128.19 per quintal for small farms, and ₹ 5092.06 per quintal for overall farm size. Large farms have the highest farm business income, family labour income, and farm investment income from Isabgol. For overall farm size, the benefit cost ratio was determined to be 1.63, with 1.68 for large farms, 1.64 for medium farms, and 1.63 for small farms.

Ashoka et *al*. (2021) conducted his study in Karnataka on cluster bean to work out the economics of cluster bean production. The total cost of cultivation per acre was calculated to be ₹ 35,176. According to the research, this enterprise generates greater gross and net returns of ₹ 70,851 and 35,675 per acre, respectively, with a benefit-cost ratio of 2.01, indicating its profitability.

Pal et *al*. (2021) studied the "Economics of mung bean seed and grain production" in Mau district of Uttar Pradesh during 2017–18 and concluded that the ratio of fixed and variable cost in Mung bean seed production was 18:82. ₹ 38547/ha was estimated to be the total cost in seed production of Mung bean. The gross and net return was calculated to be ₹ 56175 and ₹ 17628/ha with the BC ratio of 1.46. For certified seed production the total cost of cultivationin Mung bean was found to be around 31.29 per cent higher than grain production while, in seed production was about 49.80 per cent higher than gross return in grain production and the net return from seed production of Mung bean was 116.56 per cent higher than that from grainproduction. Mung bean grain and seed production costs are predicted to be ₹ 3915 and ₹ 4591 per quintal, respectively, according to cost C2. The return to farmers on cost C2 was 27.71 and 45.72 per cent above cost of production for Mung bean grain and seed, respectively. Similarly, according to cost A2 and FL (Family Labor) the cost of Mung bean production for grain and seed was calculated to be ₹ 3089 and ₹ 3852 per quintal. For Mung bean grain and seed, the return to farmers on cost A2 & FL was 61.86 and 73.68 percent over cost of production, respectively. Mung bean seed production has resulted in a higher profit prospect for farmers.

Sharma and Deshmukh (2021) studied the "Economics of seed production of chickpea in Kawardha and Lohara blocks in Kabirdham district of Chhattisgarh". The average croppingintensity and size of holding of chickpea seed growers were 189.82 per cent and 6.78 ha. The per hectare total cost of cultivation of chickpea was ₹ 36331.71. On an average rental value of owned land 23.39 per cent of the total cost. The Cost A1 was estimated to be ₹ 25331.59 because of absence of leased in case in sample household. Cost B1 and B2 were registered to be ₹ 26331.83 and ₹ 36331.71. Cost C1, C2 and C3 were amounted to ₹ 27931.83, ₹ 37931.71 and ₹ 37969.64 respectively. The family business income, gross income and net income was found to be ₹ 100923.41, ₹ 126255, ₹ 89923.29 respectively. Yield of main product was 18.5 quintal and of by-product was 11.5 quintal. Return over different costs, like A1, A2, B1, B2, C1, C2 and cost C3 were ₹ 100923.41, ₹ 100923.41, ₹ 100023.29, ₹ 91523.29, ₹ 98323.17, ₹ 98423.29, ₹ 89923.29 and ₹ 89886.96 respectively.

Kumar and Malik (2022) studied the economics of chickpea cultivation in Haryana for different periods from 2004-05 to 2016-17. The total cost of cultivation computed for India andHaryana was ₹ .12163/- and ₹ 9241/ha for the period (2004-05 to 2007-08) and it increased to ₹ 36036/- and ₹ 39207/ha for the period (2014-15 to 2016-17). For India and Haryana, the share of fixed and variable cost to the total cost of cultivation was found to be 59:41 and 44:56 per cent. During the study period, the net profit of chickpea in India increased by three times and in Haryana a seven times increase was observed in the net profit of chickpea. In India and Haryana, the value of B-C ratio was found to be greater than one which indicates that the cultivation of chickpea is profitable.

Studies on economics of cluster bean processing units:

Reddy (2002) analyzed the "Economics of Cotton Ginning Mills in Adilabad district of Andhra Pradesh" with the objective to study the costs and returns, recovery performance, efficiency and profitability of the sampled cotton ginning mills. The study revealed that the raw material was the major cost component amounting to ₹ 5606.25 and ₹ 5683.20 per quintal for Pool-A and Pool-B, respectively and their net

returns per quintal of cotton lint were ₹ 395.28 and ₹ 322.25. A margin of safety of 15,576.23 and 8290.90 quintals was observed in Pool-A and Pool-B. The business ratio revealed that the return on assets, capital turnover, returns on ₹ 1000 of working costs, benefit-cost ratio, net profit margin, capital turnover, return on total capital employed and return on ₹ 1000 of investment were higher in cotton ginning mills.

Narayan Lal (2002) under their study named "Processing and Marketing of Guar in Bikaner District of Rajasthan" with the objective to estimate the economics of processing of guar seed into guar gum revealed that the total processing costs of guar into guar gum (excluding the cost of raw material) for medium and large size industry was worked out to be ₹ 193.17 and ₹ 232.39 per quintal. During the year 2014-15, both medium and large size plants earned a profit of ₹ 38.83 and ₹ 58.61 per quintal of output, respectively.

Meena *et al.* (2006) carried his study in Jodhpur District, Rajasthan and examined the economic viability of chilli processing units of different sizes. The data was collected from 12 processing units during 2000-01 in the district. Results of the study revealed that the per quintal cost of processing of chilli was ₹ 180.06, ₹ 167.30 and ₹ 234.42 for small, medium and large processing units, respectively. With an increase in processing unit size, processor margin also increases. However, the recovery of chilli powder was unaffected by the different sizes of processing units. With an increase in size of processing unit, the value addition by investment rupee also increases as processing costs and returns to per rupee investment increased. Although all of the processing units were working above the break-even point, their installed capacity was not being fully utilized.

Kumar and Chinnappa (2010) researched on processing aspects of cashew nut in Karnataka. Primary data was collected from 30 processing units of cashew in Dakshina Kannada and Udupi Districts of Karnataka. The data was analyzed using descriptive statistics, investment measures and break-even analysis. According to the study, the variable cost of processing of cashew nuts came to ₹ 48,844 per tonne, with the cost of raw materials accounting for 81.01 percent. The marketing and fixed costs per tonne were at ₹ 3862 and ₹ 2289 per tonne, respectively. The overall processing cost of cashew per tonne, including variable, marketing, and fixed costs, was observed to be ₹ 54,433. In large, medium, and small processing units, net returns realized were ₹ 3,880, ₹ 3,537, and ₹ 3,009 per tonne, respectively. The medium and large size units were more efficient than the small size units, according to business ratios.

Manjunath et *al*. (2018) studied the economics of processing of gum guar seeds into guar gum split in the Jodhpur district of Rajasthan and revealed capacity utilization of gum guarpowder manufacturing units was found to be 69.69 per cent of their installed capacity, according to the study. The overall cost of processing of 16 tonnes per day per line was 19, 78, 348 dollars, with the major expenditure (94.65 per cent) spent on gum guar seeds. The revenue obtained from the sale of gum guar splits was 14, 40, 000 (62.36per cent), and the return per rupee of expenditure realized was 1.16 including the sale of churi and korma. The total investment of ₹ 5, 41, 666 was estimated for the requirement of building and equipments for processing capacity of 16 tonnes of gum guar splits per day per line. The study examined that by charging higher sales prices to processed products, the guar gum split processing units are earning more profit. Therefore, by taking into accounts the benefits of guar gum split processing units, study revealed that there is a great need for research and development to improve the quality of the processed products.

Choudhary *et al*. (2019) studied the economics of processing of barley into malt. The study reveals that all the malt processing plants under study were operating at

significantly lower capacity than their intake potential. The fixed, variable and raw materials costs accounted for 11.95, 8.11 and 79.94 per cent of the total operating expenses for small size plants. Whereas, 11.30, 6.30 and 82.40 per cent for a medium sized plant and 8.60, 6.46, and 84.94 per cent for the large size plant. For small, medium, and large-scale plants, the overall processing costs (including the cost of raw materials) were ₹ 2001.32, 1942.02, and 1883.51 per quintal of barley grains, respectively. During the 2017–18, the small, medium, and large barley processing units earned profits of ₹ 264.27, 225.17, and 283.68 per quintal of barley malt. The key elements of the overall fixed cost for all the plants were interest on term loans, taxes, and insurance costs. Salary for permanent employees and plant depreciation were other significant fixed cost elements. Electricity costs, fuel costs, packing costs, repair and maintenance costs, and temporary labour costs were significant variable cost components.

Studies about Constraints in the production and processing of cluster bean:

Narayan Lal (2002) under their study named "Processing and Marketing of Guar in Bikaner District of Rajasthan" with the objective to identify the problems faced by the guar gum processors. Results of the study revealed that, lack of transport facility for processed product from processing point to port of export and lack of high viscosity containing varieties were the major problems faced by the processers in processing of guar.

Reddy (2002) analyzed the "Economics of Cotton Ginning Mills in Adilabad district of Andhra Pradesh" with the objective to identify the major problems faced by the sampled cotton ginning mills and reported that shortage of quality raw material, high tax rate and power shortage were the major constraints faced by millers in the cotton ginning mills.

Graham *et al*. (2003) observed major constraints in the bean production in most areas where this crop is grown are factors related to edaphic conditions include nutrient shortages, particularly N and P deficiency, acidity of the soil, including manganese and aluminum toxicity, and drought.

Sharma and Gummagolmath (2012) analyzed that there is a high year-to-year variation in production of guar, and consequently, in exports of guar and its derivatives. The food safety concerns are becoming important for the guar processing industry as guar gum is mainly used in the food and bakery industry. The preparedness of guar split and guar gum manufacturing industries for these food safety concerns, high fluctuations in area, production and productivity of guar seed, high volatile prices of guar seed and gum splits, are crucial limitations to the growth of guar industry. These problems and solutions in the guar value chain and guar gum processing industry have been covered in the study. The main challenges facing the guar sector include a lack of professional expertise and processing technologies for industry-specific value-added products, as well as poor market connections with farmers and uncertain trade policies.

Purushottam *et al*. (2013) studied about the significant reasons placing the major restrictions on the growth of the cluster bean industry, which were, high fluctuations in area, production and productivity of cluster bean seed ,the preparedness of cluster bean split and gum manufacturing industries for these food safety concerns, high volatile prices of cluster bean seed and gum splits, Lack of technical knowledge and processing technology for industry specific value-added products, poor market linkages with farmers, unstable trade policies etc.

Narayan and Kumar (2015) analyzed the constraints of technology inadequacy as well as policy reform and the status of pulses growth, and also focuses on the constraints in the production of pulses due to the non-availability of essential inputs i.e., quality

seed, fertilizers and nutrients, life-saving irrigation, price policy implication.

Singh (2015) carried out his study in Churu district of Rajasthan state with the objective to identify the major constraints in production and marketing of guar in Churu district. A sampleof 50 farmers was drawn by probability proportional to area under guar. The farmers were divided into small, medium and large with help of cumulative total method. The major constraints in production of guar were shortage of hired human labour for sowing and harvesting, poor quality of seed and uneven rainfall. Lack of storage facilities, high cost of transportation, malpractices by middleman, lack of market intelligence, high price fluctuation, delay in cash payment and high cost of labour and were the major constraints in the marketingof cluster bean.

Saras *et al*. (2016) conducted a field experiment at DWSR-Anand Centre, Anand Agricultural University, Anand (Gujarat) during kharif 2013-2014 to overcome the major constraint of weed occurance in the production of cluster bean crop where four herbicides either as sole or in combination with hand weeding were applied and evaluated for their efficacies on controlling weeds, their influences on yield and production economics on Gujarat Gaur 1 (GG-1) variety of cluster bean. *Echinochola crusgalli*, *Commelina benghalensis*, *Cynodon dactylon* and *Cyperus rotundus*, were the dominant weed species among monocot weeds however amongdicot weed species like *Phyllanthus niruri*, *Amaranthus viridis*, *Euphorbia hirta*, *Digera arvensis* and *Spergula arvensis* were found to be the dominant weeds. Maximum efficiency of weed control was observed at 20 and 40 days after sowing when the inter-cultering followed by hand weeding.

Choudhri *et al*. (2018) conducted the study in Bahraich district of U. P. with a sample of 100 respondents chosen through random sampling and were categorized into three categories as marginal, small and medium size group according to the size of their farm holding. To find out the result, Simple tabular analysis was done. Results showed that the major constraints faced by the farmers in the cultivation of maize were technical, managerial and financial problem.

Singh *et al*. (2018) conducted his study in Hisar during 2015-16 to identify the constraints faced by the farmers in the production of guar. A total of 75 farmers were selected for the study from three villages with 25 farmers per village. The estimated percentage score for the constraints faced by the farmers revealed that for guar production the improved package of practices like use of certified seed was done by 21.33 per cent of farmers, 25.33 per cent of farmers followed the seed treatment, insect management was done by 45.33 per cent of farmers, 56.00 per cent of farmers adopted the line method of sowing, 69.33 per cent of farmers adopted the weed management practices and proper disease management was done by 53.33 per cent of farmers in Hisar.

Agarwal *et al.* (2019) examined the major constraints faced by the farmers in the production of cluster bean in Hisar district. Study revealed that the major constraints observed in the production of cluster bean were lack awareness of weather forecasting/ variability in weather (90.91%) and labour scarcity during peak season of sowing (81.82%) along with cropprotection, viz., problem of weeds (79.55%), insect-pests (45.45%) and diseases (22.73). Lack of farmer-industry linkage and Minimum Support Price (MSP) were the major constraints reported by all the sample farmers.

Rathore (2020) researched on isabgol and identified the major constraints faced by farmers in the production of isabgol in Barmer district of Rajasthan. 80 farmers were selected for the collection of primary data. From the analysis of the data, it was found that the most important restraints faced by the farmers in the production of isabgol production are insect anddisease damage to crops.

Ashoka *et al*. (2021) researched on cluster beans in Karnataka and concluded that the

production of cluster beans is subject to a number of limitations and is not a financially viable alternative for producers, which discourages farmers from choosing this crop. The main obstacles found in the cluster bean sector were the high wage rate and the unavailability of high yielding varieties or hybrid seeds.

Patil *et al*. (2021) stated that, Indian agriculture can be defined as a "confrontation with weeds" because of the quotation A year's seeding is seven year's weeding". Therefore, the removal of weeds and off type plants needs to be more focused than any other activity which aids in increasing the agricultural production. In cluster bean, weed competition throughout the season causes severe yield reductions ranging from 29 to 48 per cent, with severity varying from 70 to 98 per cent depending on the weed infestation. For weed control hand weeding is a classic and effective method, but due to untimely rains, labour shortages during peak season and higher labour costs this method cannot be utilized effectively. Herbicides like pendimethalin and Imazthapyr, when used with or without weeding, have been found to be efficient in controlling weeds.

CONCLUSION

It was concluded from the study that total cost, gross income, net income in cultivation of cluster bean per farm showed a positive relation with the size of farm holding *i.e.,* total cost, gross income, net income increases with increasing size of farm holding.

In cluster bean processing units, there was an excess installed capacity in every mill and they were not operating as per their actual potential. On an average the per quintal cost of processing of cluster bean seed was found to be ₹ 6409. While the gross return obtained from processing of 1 quintal of cluster bean seed was observed to be ₹ 6617 with a net return of ₹ 204 per quintal of guar seed. The B:C ratio was found to be 1.03. The break-even output worked out for the cluster bean processing plant was 6527 quintal which was around 7% of the total amount of raw material processed during the study period.

Among all the constraints faced in the cultivation of cluster bean problem of weed, high cost of labour, high cost of plant protection chemicals, problem of bacterial leaf blight disease, problem of infestation of aphids in the crop were the serious constraints faced in the protection of cluster bean in the study area. Major constraints faced by the processers in the processing of cluster bean seeds were inconsistent and insufficient supply of raw material, High cost of fuel, high losses during transport from farm to factory, Inappropriate packaging materials and high packaging cost, Weak or non-existent market development, Shortage of power, Under-utilization of installed capacity, high sales tax and lack of government price polices *etc*.

Author contribution: A. B.: data collection, investigation, resources, methodology, formal analysis, visualization and writing of the manuscript; G. S.: visualization, supervision, review and editing; I.W.: data collection, review and editing; D.B.: review and editing.

Conflict of interest: Authors declare that there is no conflict of interest among them.

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