COMPARATIVE ECONOMICS OF SEED PRODUCTION VS. GRAIN PRODUCTION OF SOYBEAN IN WASHIM DISTRICT OF MAHARASHTRA

by

Ade Pawan Prakash
(Reg. No.018/207)

MASTER OF SCIENCE (AGRICULTURE)

DEPARTMENT OF AGRICULTURAL ECONOMICS

POST GRADUATE INSTITUTE
MAHATMA PHULE KRISHI VIDYAPEETH
RAHURI-413722, DIST-AHMEDNAGAR
MAHARASHTRA, INDIA

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APPROVED BY

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MAHARASHTRA, INDIA

2021

CANDIDATE'S DECLARATION

I hereby declare that this thesis or part
there of has not been submitted
by me or other person to any
other University or Institute
for a Degree or
Diploma

Place: MPKV, Rahuri (Pawan P. Ade)

Date : / /2021

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Maharashtra (State) India.

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This is to certify that the thesis entitled. **"COMPARATIVE ECONOMICS OF SEED PRODUCTION VS. GRAIN PRODUCTION OF SOYBEAN IN WASHIM DISTRICT OF MAHARASHTRA "** submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) in partial fulfilment of the requirements for the award of the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **AGRICULTURAL ECONOMICS,** embodies the result of piece of bonafide research work carried out by **Mr. ADE PAWAN PRAKASH** under my guidance and supervision and that no part of the thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of this investigation have been duly acknowledged.

Place: MPKV, Rahuri
Date : / /2021

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Place: MPKV, Rahuri (Dr. P. N. Rasal)

Date : / /2021

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Place : M.P.K.V., Rahuri ***(Pawan P. Ade)***
Date : / / 2021

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ABBREVITIONS

/	-	Per
Agril.	-	Agriculture
e.g.	-	Exampli gratia (For example)
USDA	-	United States Department of Agriculture
et. al.	-	et alia (others)
etc.	-	Etcetera
Fig.	-	Figure
ha.	-	Hectare
Lit.	-	Literature
No.	-	Number
i.e.	-	That is
SOPA	-	The soybean Processors Association of India
Kg.	-	Kilogram
q.	-	Quintal
Qty.	-	Quantity
MT	-	Metric tons
₹	-	Rupees
MRTP	-	Monopoly Restrictive Trade Practices
Viz.	-	Videlicet (namely)
FERA	-	Foreign Exchange Regulation Act
Govt.	-	Government
FL	-	Family labour
@	-	At the rate
N	-	Nitrogen
P	-	Phosphorus
K	-	Potash
%	-	Per cent
M	-	Meter

hrs	-	Hours
MVP		Marginal Value of Product
MFC		Marginal Factor Cost
FYM		Farm Yard Manure
PP		Plant Protection
CDZ		Central Dry Zone
TPS		True Potato Seed
CDC		Cameroon Development Corporation
CIG		Common Initiative Groups
NGO		Non-Government Organization
MMT		Million metric tonnes

ABSTRACT

COMPARATIVE ECONOMICS OF SEED PRODUCTION VS GRAIN PRODUCTION OF SOYBEAN IN WASHIM DISTRICT OF MAHARASHTRA

by

Mr. Ade Pawan Prakash
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2021

Research Guide	**:**	**Dr. T. B. Deokate**
Department	**:**	**Agricultural Economics**

The present study was undertaken to examine comparative economics of seed and grain production of soybean, per hectare resource use structure and identifying the problems Faced by soybean grain and seed growers. The investigation was based on the primary data collected from 90 soybean grain and seed growers (45 grain and 45 seed growers) from three tahsil *viz.*, Risod, Washim and Malegaon. These above three tehsils were the major soybean grain and seed growing. Therefore, these three tehsils were selected purposively for the present study. From each tahsil three villages were selected. From each villages 10 soybean grain and seed growers (5 grain and 5 seed growers) were selected. Data pertaining 2018-19 were selected by personal interviews by survey method with the help of specially designed schedule.

The study revealed that the per hectare cost of cultivation was ₹ 50747.7 and ₹ 57901.09 for soybean grain and seed production. The per hectare cost of cultivation was higher in soybean seed production than grain production but per quintal cost were ₹ 3288.03 and ₹ 3206.04 for soybean grain and seed production

respectively. Per quintal cost was lower in seed production than grain production mainly because of its higher productivity.

The per hectare income received from soybean seed production (₹ 77056.75/ha.) was higher showing more economic viability than that of grain production (₹ 56788.37/ha). The B:C ratio at cost C was 1.33 in case of soybean seed production as compared to 1.12 in grain production. The B:C ratio of more than unity indicated that the seed production in the study area is a economically viable proposition.

The functional analysis was also carried out by using Cobb-Douglas type of production function and significance of the parameters of the function was tested by using student't' test. The appropriateness of estimated model and the variable incorporated in model were tested by estimating R^2 values. The results of Cobb-Douglas production function indicated that there is scope for increasing the use of human labour, bullock labour, machine power, nitrogen and potassium for soybean grain production and bullock labour, manure power and plant protection charges for soybean seed production to obtain higher gross return.

The findings of the investigation further showed that problems faced by soybean grain growers in production were unavailability of labours in time, high wages rates, high cost of seed, insufficient institutional credit etc. whereas, problems faced by soybean seed growers were unavailability of labours in time, risk of rejection of soybean seed at the time of grading, processing and testing, high wages rates, high cost of foundation seed etc.

Therefore, study suggested the net return from soybean seed production is encouraging, therefore the area under seed production may be increased for higher profitability. Therefore, to increase their income, more and more number of farmers can take up seed production in areas where soybean is grown predominantly, provided the procedures and other formalities in registering the seed farms are simplified. Simultaneously, seed and grain growers of soybean shall take the benefit custom hiring services would help in addressing labour problem.

1. INTRODUCTION

Soybean is legume crop but cultivated as oilseed crop. In India, it is introduced in 1970-71 onwards. Soybean is one of the fastest growing as well as short durational crop in India. Oilseeds are an important sector of Indian agricultural economy as they contribute to one tenth of total output of crop sector in the country. India is the lucky in having a wide range of oilseed crops grown in its different agro-climatic zones. India is the third largest producer of oilseeds in the world. The oilseed crops grown by adopting new technology in India are groundnut, soybean, safflower, sunflower, mustard, linseed, etc. Among the oilseed crops, soybean occupies an important position next only to groundnut. The oilseed crops occupy an important place in Indian farming as they provide vegetable fat to the Indian diet, they provide raw material for many industries. They can be grown in all kinds of soils and are important constituents of crop rotation with millet and pulses.

Soybean has an important place in world's oilseed cultivation scenario, due to its high productivity, profitability and vital contribution towards maintaining soil fertility. The crop also has a prominent place as the world's most important seed legume, which contributes 25% to the global vegetable oil production, about two thirds of the world's protein concentrate for livestock feeding and is a valuable ingredient in formulated feeds for poultry and fish. About 85% of the world's soybeans are processed annually into soybean meal and oil. Approximately 98% of the soybean meal is crushed and further processed into animal feed with the balance used to make soy flour and proteins. Of the oil fraction, 95% is consumed as edible oil; the rest is used for industrial products such as fatty acids, soaps and biodiesel.

1.1 Importance of soybean

Soybean (*Glycine max*-Linn.) is a leguminous and self-pollinated crop belongs to family leguminaceae and subfamily papilionoidae (fabaceae). Soybean also term as miracle crop as well as “GOLDEN BEAN” of 21st century because of its unique qualities. Though, soybean is legume crop, yet it is broadly used as oilseed. Due to very poor cook ability on account of inherent presence of trypsin inhibitor it can’t be used as pulse. It is now second largest oilseed in India after groundnut. It is grows in different agro-climatic zones. It is beneficiary crop which contain 18-20% edible oil, 42-45% high quality protein, 30% carbohydrates and 4% minerals. A large number of Indian and Western dishes such as chapatti, milk, sweets, pastries etc. can be prepared by soybean. Fortified soybean flour makes good quality and more nutritious chapatti. Soybean oil is used for manufacturing Vanaspati ghee and several other industrial products. Soybean is used for making high protein used for children. It is mainly used in the industrial production of different antibiotics. Soybean builds up the soil fertility by fixing large amount of atmospheric nitrogen through the root nodules and also through leaf fall on the ground at

maturity which increases soil fertility. It can be used as fodder, forage can be made into hay, silages etc. Its forage and cake are excellent nutritive feed for livestock and poultry.

India has the fifth largest vegetable oil economy in the world. After cereals, oilseeds are the second largest agricultural commodity, accounting for the 14% of the gross cropped area in the country. However, country meets its edible oil demand through imports, which accounts for almost 50% of requirement. The per capita consumption of the vegetable oil is increasing very rapidly due to increase in population and improved economic status of the population. The demand has increased to about 12.6 kg/year compared to 4 kg/year in 1961 and the projected demand for the year 2020 and 2050 is 16.44 and 19.16 kg/year respectively. To meet this demand, the country will require nearly 25.26 and 35.90 million tons of edible oil. In this scenario, soybean has played and will play a pivotal role in the future. Production of soybean in India is dominated by Maharashtra and Madhya Pradesh which contribute 89 per cent of the total production. Rajasthan, Andhra Pradesh, Karnataka, Chhattisgarh and Gujarat contribute the remaining 11 per cent production.

1.2 Soybean production in the World

Although a native of China, soybean for all practical reason is an American crop today. USA is the major producer of soybean and ranks first in production. Its share in the world production was almost 34.64 per cent (2018-2019). Brazil, Argentina and China ranked second, third and fourth position in terms of production, respectively. India occupies fifth place in the production of soybean with 3.05 per cent of world production. (Source - World Markets and Trade, a USDA Publication)

1.3 Soybean production in India

In India, the total area under soybean crop had increased from 6.11 million hectare in 2002 to 10.83 million hectares in the year 2018-2019 and production from 4.65 million metric tonnes to 10.93 million metric tonnes in the year 2018-2019.

Table 1.1 Area, production and productivity of soybean in India (2010 to 2018)

Year	Area (M. ha)	Production (MMT)	Productivity (kg/ha)
2010-2011	9.60	12.74	1327
2011-2012	10.28	12.28	1207
2012-2013	10.84	14.66	1353
2013-2014	11.71	11.86	1012
2014-2015	10.91	10.37	951
2015-2016	11.60	8.56	738
2016-2017	11.18	13.58	1177
2017-2018	10.15	8.350	822
2018-2019	10.83	10.93	1009

(Source: www.agricoop.nic.in and SOPA Databank)

The major soybean growing states in India are Madhya Pradesh, Maharashtra, Karnataka Andhra Pradesh and Gujarat. Madhya Pradesh rank first in area (54.10 lakh hectares) followed by Maharashtra (36.39 lakh hectares), Rajasthan (9.21 lakh hectares), Karnataka (3.19 lakh hectares), Andhra Pradesh (1.79) and Gujarat (1.34 lakh hectares). Also, in production of soybean, Madhya Pradesh rank first (58.18 lakh MT) and second Maharashtra (34.34 lakh MT) followed by Rajasthan (8.94 lakh MT), Karnataka (2.90 lakh MT) and Andhra Pradesh (1.57 lakh MT) during the year 2018-2019.

Table 1.2 State wise area, production and productivity of soybean (2018-2019)

Sr. No.	States	Area (Lakh ha.)	Production (Lakh MT)	Productivity (kg/ha)
1	Madhya Pradesh	54.10	58.18	1075
2	Maharashtra	36.39	34.34	944
3	Rajasthan	9.21	8.94	971
4	Karnataka	3.19	2.90	911
5	Andhra Pradesh	1.79	1.57	877
6	Gujarat	1.34	1.24	925
7	Chhattisgarh	1.28	1.10	865
8	Others	1.09	1.04	955
Grand total		108.395	109.336	1009

(Source: SOPA Databank)

1.4 Soybean production in Maharashtra

Soybean was introduced in Maharashtra during nineties (1984-85). Soybean became popular due to its short durational nature (90-115 days) with higher productivity as compared to other oilseed both under rainfed and irrigated condition. The area and production of soybean had shown a continuously increasing trend during the last two decades. The average yield for soybean realized in Maharashtra was around 12.43 q/ha as against the productivity potential of about 20-25 q/ha. This indicated that though the area under soybean was increasing, there is a wide gap between the potential yield and the actual yield on farmer's field. Maharashtra has second rank in soybean area and production in India. Area under soybean was 36.39 lakh hectares with production of 34.34 lakh metric tonnes and productivity of 944 kg/ha in *kharif* season of 2018-2019 (Source: www.krishi.maharashtra.in).

The major soybean growing districts in Maharashtra are Nanded, Buldhana, Latur, washim, Amravati, Yavatmal, Akola and Hingoli. In Maharashtra Nanded district rank first in production (3.85 lakh MT) and second in area (3.41 lakh hectare) while Latur rank first in area (3.72 lakh hectares) and third in production (3.26 lakh MT) , Buldhana rank second in area (3.614 lakh ha.) as well as second in production (3.28 lakh MT) during the year 2018-19.

(Source: SOPA Databank)

1.5 Soybean production in Washim district of Maharashtra

Major soybean growing area in Maharashtra is Vidarbha region. The area under soybean in Amravati region of Vidarbha was 12.67 lakh hectares with the production of 12.38 lakh MT and average productivity of 977 kg/ha in the year 2018-2019. The major soybean growing districts in Vidarbha region are Buldhana, Washim, Amravati, Akola, and Yavatmal. Soybean shown increasing trend in respect of area during the last decade. Though Soybean is recently introduced in Maharashtra, soybean farmers are now attracted towards soybean cultivation. In Maharashtra, Washim district stand first in productivity (1185 kg/ha.), fourth in production (3.09 lakh MT) and fifth in Area (2.61 lakh hectares). (Source: SOPA Databank)

1.6 Seed

Seeds are first and foremost, the source of most food, at least of plant origin, and therefore have the greatest socio-economic benefit to human welfare of any known biological device. The development and use of high yielding varieties of seed have been the technological forces behind the successful green revolution, the availability of food at prices profitable for farmers and affordable by the populace and a reduction in rural poverty. Thus, seed provision both in normal and disaster years, is a prerequisite for increasing food production, improving farmer's income, alleviating poverty, and ensuring food security.

Good quality Seed is the most important input in increasing production in agriculture. Inputs such as fertilizer, water etc. help to realize the potential imbibed in seed viewed in the context of limited possibility expansion of area for cultivation in most developing countries such as India the role of seed to increase agricultural production in the future becomes all the more essential. It is believed that genetically good quality seed alone can increase production up to 18-20 per cent.

Recognizing the importance of a vibrant seed industry to increase agricultural production to meet the challenges posed by the burgeoning population the Government of India initiated various policy measures which helped the growth of the nascent seed industry. The launching of All India Co-ordinated Maize project(1957),establishment of National seed Corporation(1963) enacting seed act (1966), launching of National Seed Project(1975)with World Bank assistance are some of the important milestones in the development of the seed industry in India. Further, in a major departure from its protectionist policy towards the sector the Government allowed Monopoly Restrictive Trade Practices (MRTP) and Foreign Exchange Regulation Act (FERA) companies to participate in the seed activity in 1987. In October 1988, the govt. announced a New Policy on Seed Development which allowed the import of seed and other planting materials with some conditions. The New Industrial Policy of 1991 identified seed production as high priority industry and foreign collaboration with Indian Seed Companies were encouraged.

Seed corporations in India can not own large tract of land to produce seed due to land ceiling legislation. Land ceiling laws permit owning a maximum 7.28 hectare of irrigated land

and 21.85 hectare of dry land for a family. Industry is not one of them. Therefore seed corporations have to rely on individual farmers for producing seed for them. The corporation identify through some local people, mostly agricultural inputs dealers and the farmers who are willing to take up seed production. Then the corporations enters into an agreement with the farmer with regard to area committed by farmers for growing a particular seed crop, price at which seed would be taken delivery by the corporation, terms of payment, cultural practices to be followed etc. The corporation supplies the foundation seed to farmer and makes periodic visits to his field to ensure that the farmer is strictly following the recommended practices. The corporation is keen to ensure the quality of seed produced by farmers so that it meets the certification standards as laid down by central seed certification. The farmers deliver the seed at the processing plant company where it is processed and after successful board of the completion of all tests, are packed and dispatched to different marketing centers.

1 .7 Topic of the study

The farmers are attracted towards soybean cultivation due to its suitability and profitability. Therefore, Washim is purposively selected for the study. The study has been planned to explore various aspects of soybean with respect to grain and seed production. There are no studies conducted on comparative economics of grain and seed production in Washim district of Maharashtra. Therefore, the main objective of the present investigation was to inquiry into comparative economics of seed productions vs grain productions of soybean in Washim district. The study would provide guidelines and direction for proper utilization of resources for maximization of profits. The study would also be useful in selecting suitable cropping system for study area. When soybean crop had entered into existing cropping pattern of producers in study area by replacing some other kharif crops, claiming that it is relatively profitable However, there are other advantages like short duration of the crop as well as less reduction in the fertility status of the soil. In case of cotton crop, it is of long durational crop, the soils comparatively get exhausted more than that from soybean.

The other advantage is the profitability. It was seen from various studies one of that comparative study on grain and seed production of groundnut in Karnataka (Pal 2016) observed that the variable cost was comparatively higher in seed production (₹25745.0 per ha) over grain production (₹20752.0 per ha). The total cost of cultivation in groundnut seed production was around 18% higher than grain production. The gross return was about 27% higher in seed production than grain production and net return from seed production of groundnut was 44% higher than grain production. The B: C ratio was 1.73 in case of groundnut seed production as compared to 1.60 in grain production. Above study indicate that seed production has greater profitable than grain production. There is scope for seed production of every crop. However, in due course of time the prices of soybean or other alternative crops undergo a change in either direction i.e. increase or decrease. Therefore, it would have effect on change in acreages under

these crops. But it was seen that there is a stability of soybean crop in recent years in Washim district. Therefore, it was important to study that, at present what is the picture of profitability, returns, etc. The present study would be helpful for framing suitable price policies and for planning and implementing different development programmes for soybean seed and grain production programmes in future, if required. Therefore, present study involving comparative economics of seed production vs. grain production of soybean in Washim district was taken up with following specific objectives.

1.8 Objectives of the study

1) To study comparative economics of seed production vs. grain production of soybean
2) To study the resource use efficiency of seed production and grain production of soybean
3) To study the problems faced by the farmers in seed production and grain production of soybean

1.9 Hypothesis of the study

The following hypotheses were set forth for testing:

A. **Null (H_0)**: Resource use levels are not higher in seed production than the grain Production.

Alt. (H_1): Resource use levels are higher in seed production than the grain production.

B. Null (H_0): Soybean seed production is not more profitable than grain production.

Alt. (H_1): Soybean seed production is more profitable than grain production.

1.10 Scope and utility of the study

Scope of this investigation limits itself to study the aspects mentioned in the objectives. Now-a-days there is an increased demand for edible oils due to increased population. Especially in case of soybean, the tastes, preferences, family consumption and speed of life are being forced to use processed products and healthy food as it is a high protein and low-calorie food. The Government is trying to encourage grain as well as seed production and marketing activities of oilseed crops especially for soybean. Incentives and quick services have been given to producers and farmers of soybean. The study entitled, "Comparative Economics of Seed Production vs Grain Production of Soybean In Washim District of Maharashtra" will show the extent of profitability of the soybean crop. The findings of the present study would be relevant and applicable to similar situations existing elsewhere. The study of resource use efficiency for grain and seed production is useful. The findings would be of great help to convince the farmers for proper utilization of resource incise of grain and seed production of soybean. As compare to grain production of soybean, seed production has greater profit so there is scope to increase the area under seed production of soybean. The findings will also depict the comparative profitability between grain and seed production of soybean. The study would be definitely useful to the farmers in planning their marketing process of this oilseed crop in the area under study and also give guidelines to the extension workers and policy makers to evolve a better production.

The findings of the study would help the planners and decision makers to adopt effective strategies for development and expansion of soybean seed production in other regions with similar conditions. The conclusion drawn from this study would provide an indicative guideline for accelerating the soybean seed and grain production. The present study covers Washim district, but it is hoped that the findings may be applicable to other soybean grain and seed growing districts in Maharashtra, in general. The research findings would be highly useful to the farmers, agricultural economists and planning authorities of the state.

1.11 Limitations of the study

During course of study several difficulties were faced in the collection of data from soybean grain and seed grower. Due to limitation of time and resources, the study was restricted to the analysis of data collected from 90 soybean grain and seed grower from 9 villages of 3 tahsils from Washim district of Maharashtra. The results of study are based on data collected for only one agriculture year that is 2018-19. Data collected by survey method. Farmers of the villages do not maintain farm records so responses of farmers regarding area sown, quantity of seed used, manures and fertilizers used, output produced, information and other related question were mainly based on memory which may not be very correct. Findings though may not be generalized; it could become applicable in the areas where similar conditions exist.

2. REVIEW OF LITERATURE

While carrying out systematic research it is necessary to have knowledge of the previous research works carried out by other researchers. It gives an insight in respect of manner in which the problems have been tackled, the nature of results obtained and the conclusions derived. The review of past literature, therefore, forms an integral part of any systematic research work. So, the literature closely related to the present study was reviewed in this chapter. The literature is grouped into following categories.

1) Costs and returns
2) Resource use efficiency
3) Problems in grain and seed production

2.1 Costs and returns

Mallikarjunaiah *et al.* (1974) studied the economics of hybrid jowar seed production and estimated the average cost of hybrid jowar seed production at ₹1,722.5 per acre with an average yield of 7.74 quintals of quality seeds. The net returns were ₹3,686.58 per acre, while net return per rupee of investment was ₹2.14. The average cost of production per kg of seeds was ₹1.53.

Radha and Chowdry (2005) studied the Comparative economics of seed production vis-a-vas commercial production of cotton in Andhra Pradesh. The result reveal that human labour occupied major share (53.86 and 19.03 present) of total cost of ₹74412 per Acre and ₹ 26461 per Acre of seed production and commercial production of cotton, respectively. The operational costs of all items were comparatively higher in seed production (₹68101/Acre) over commercial production (₹16166/Acre).This was due to additional operations like gap filling, roughing, emasculation, pollination, etc., involved in cotton seed production. Thus the operational cost took major share of 91 percent in seed production as compared to 61 percent in commercial production. It reveals that all cost were higher in seed production than commercial production. It was found that, seed production gives positive returns with the cost-benefit ratio of (0.29:1.00) when compared to commercial production (1.00:-0.35).

Kakade (2006) studied the economics of soybean in Nagpur district of Maharashtra state. The result revealed that average per hectare cost i.e. cost “c” was worked to ₹ 16172.72. The input output ratio for soybean production at cost “c” was 1:1.20 which indicated that soybean production was profitable business.

Pouchepparadjou *et al*. (2009) studied the comparative economics of seed production vis-a-vas commercial grain production of paddy in Puducherry. The results revealed that the cost of cultivation is higher in seed production as compare to commercial production of paddy. But the total return is higher in seed production than commercial crop production of paddy.

Patil (2011) conducted the study to examine the cost and returns of production of pigeon pea under transplanted and conventional methods. The study revealed that the cultivation of

pigeon pea in transplanted method was found to be more profitable compared to conventional method. Total cost of cultivation in transplanted method and conventional method were ₹39,382.31 per hectare and ₹30,819.53 per hectare respectively. Net returns were found to be higher in the case of Transplanted system (₹54,103.25/ha) than in conventional method (₹. 25,562.78/ha).

Sofijanova *et al*. (2012) studied the comparative economic analysis of wheat production using certified and uncertified seed: the case of Ovcepole region in republic of Macedonia. They concluded that the average productivity in wheat farming using certified seeds is 22.5% higher than production with uncertified seeds. The total production costs in wheat production using certified seeds are 11.3% higher compared to the wheat production using uncertified seeds. Gross margin in wheat production using certified seeds is 36 % higher compared to wheat production using uncertified seeds. Net profit per hectare in wheat farming using certified seeds is 26.5% higher compared to wheat production using uncertified seeds.

Dudhat *et al. (*2013) studied the growth pattern and instability in seed production, future of demand and supply, economics and processing of groundnut seeds and problems of seed industry in Gujarat. A sample of 51 farmers was selected purposively from the five talukas of Junagadh district. The study revealed that the compound growth rates found positive for area and production of quality seeds for the state as a whole but for yield it was found negative.

Sannamani (2014) studied the economic analysis of tomato hybrid seed production under contract farming in haveri district. The results revealed that the returns structure in tomato hybrid seed production was found to be profitable and beneficial to the farmers in relation to the total cost incurred by them. The gross returns and net returns were found to be much higher than their cost structure. The gross return was found to be ₹8, 97,554 per acre. The net returns over variable cost were worked out to be ₹5, 15,023.25. The net returns over total cost were worked out to be ₹5, 09,845.66. The returns were worked out per kg basis; farmers realized net returns of ₹12,200 per kg. Then the returns were worked out per each rupee of expenditure, it was found that farmers obtained ₹ 2.31 which was much higher than the expenditure.

Shoaib *et al. (*2015) studied the comparative economic analysis of hybrid rice v/s conventional rice production in district Badin Sindh Province Pakistan. The study revealed that the total costs per acre of Hybrid Rice were 62010.87 ₹/Acre which were more than Conventional Rice was 56972.09 ₹/Acre. It was found that average higher yield (79.41mounds per acre) was obtained from Hybrid Rice while Conventional Rice yield (59.74 Mounds per acre) was less then Hybrid Rice. There was 14.14% increase in Hybrid Rice yield comparing with conventional Rice which gives additional income to poor farmers, Price gained per mounds was almost the same in both activities. High profit was observed in Hybrid Rice and low profit was obtained in conventional Rice. Most of the farmers focused to grow Hybrid Rice due to high yield.

Pal *et al.* (2016) studied the economic analysis of pigeon pea seed production in Gulbarga district of Karnataka. The study revealed that the total cost of cultivation in pigeon pea seed production was around 23 percent higher than grain production, while gross return was about 32 percent higher in seed production (₹73300/ha) than grain production (₹55700/ha). It is observed that a net return from seed production of pigeon pea was 44 percent (₹33864/ha) higher than grain production (₹23502/ha). They concluded that the production of certified seed has resulted in a win-win situation for the farmers with higher yield and increased returns.

Pal *et al.* (2016) study the comparative of grain and seed production of groundnut in Karnataka. The result reveals that human labour occupied the major share (27.07%) of total cost in seed production and bullock and machine labour occupied the major share (29.38%) of total cost in grain production of groundnut. The higher human labour requirement in seed production was mainly due to activities like rouging, gap filling etc. The variable cost was comparatively higher in seed production (₹25745.0 per ha) over grain production (₹ 20752.0 per ha). The total cost of cultivation in groundnut seed production was around 18% higher than grain production. The gross return was about 27% higher in seed production than grain production and net return from seed production of groundnut was 44% higher than grain production.

Vikaskumar *et al*. (2017) carried out an Economic analysis of Maize Seed Production on farmer's fields. The study revealed that the per hectare basis, the average quality seed production was 1402.68 kilogram. The average rate of quality seed was ₹25 per kilogram (the rate at which farmers have sold). The total dry fodder produced was 8256.92 kg and the imputed value of it was taken as ₹300 per quintal. The total return was found as ₹56632.95 per hectare. The average net return was ₹28203.74 per hectare. The average benefit cost ratio was 1.99. The cost of production of seed when only main product as quality seed only was considered was ₹20.30 per kilogram of seed. The cost of production of seed when both main product (quality seed) and other by-products (dry fodder, rejected seed etc.) were considered was ₹ 4.90 per kilogram of seed.

Pal *et al.* (2019) studied an economic analysis of mung bean seed production technology in Mau District of eastern Uttar Pradesh. The result reveals that the ratio of fixed and variable cost in mung bean seed production was 18:82. Human labour was the major component of cost (39.63 per cent of total cost) followed by machine labour (15.31 per cent), manures and fertilizers (7.54 per cent), irrigation (6.23 per cent) seed (4.77 per cent), plant protection chemicals (4.54 per cent) and seed certification charges (1.53 per cent). The total cost in seed production was of mung bean was ₹38547 per hectare. The gross return and net return was ₹ 56175 and ₹ 17628 per hectare respectively. The BC ratio was 1.46. The total cost of cultivation in mung bean certified seed production was around 31.29 per cent higher in than grain production while gross return was about 49.80 per cent higher in seed production than grain

production. Consequently, net return from seed production of mung bean was 116.56 per cent higher than grain production.

Dominic *et al.* (2019) studied Profitability and profit efficiency of certified groundnut seed and conventional groundnut production in Northern Ghana. The study revealed that certified groundnut seed production is more profitable and profit efficient than conventional groundnut production.

Pal *et al.* (2020) studied an economic analysis of paddy seed production in Mau district of eastern Uttar Pradesh, the result reveal that the fixed and variable cost ratio in paddy seed production was 20:80. Human labour was the major cost component (42.21 per cent of total cost) followed by manures and fertilizers (11.85 per cent), bullock & machine labour (11.80 per cent), plant protection chemicals (4.53 per cent), irrigation (3.18 per cent) and seed (1.99 per cent). Total cost incurred in seed production of paddy was ₹ 51882 per hectare, while the net and gross returns were ₹ 28506 and ₹ 80388 per hectare respectively with the B: C ratio 1.55. Total cost pertinent to paddy certified seed production was 11.36 per cent higher than grain production. The gross return was 18.92 per cent higher in seed production (₹ 80388/ha) than grain production (₹ 67600/ha). Net return from seed production of paddy was 35.66 per cent (₹ 28506/ha) higher than grain production (₹ 21012/ha).

Sendhil and Sharma (2020) studied a comparative economics of seed vis-a-vas grain production in wheat in entrepreneurship development in seed production of *rabbi* crops. The difference in returns arises from the main product (grain or seed) value despite same product value (straw). The magnitude of the difference between seed production and grain production owing to the main product alone was around ₹94750 per hectare (116.62%). Ultimately the differences in net returns or profit was to the tune of ₹76060 per hectare (167.93%). It indicate that the farmer has made a profit of ₹ 121352 per hectare through seed production which is higher than the grain production by 168 per cent.

Dulal and Marahatta (2020) conducted a study on comparative economics of maize grain and seed production in Okhaldhunga, Nepal. The study revealed that the total return for maize grain producers is ₹90,451 and that for maize seed producers is ₹145,224 on hectare basis. The benefit cost ratio (B: C) was computed as the ratio of gross returns to the total cost involved in maize production. The B: C ratio for grain producers was 1.13 and that of seed producers was 1.52 however the difference was statistically non-significant. The higher B: C ratio indicates that the seed producers were more benefited than grain producers and this could encourage the grain producers to shift toward seed production.

Thejashree and Umesh (2020) studied an economic analysis of Redgram seed production in Chikkaballapura district of Karnataka, India. The study revealed that the per hectare cost of cultivation (₹ 58,989), gross return (₹ 92,935) and net return (₹ 33,946) with yield of 15.4 quintals in BRG-1 variety seed production was higher than BRG-2 variety in which the cost of

cultivation, gross returns and net returns were ₹ 51,768, ₹ 80,890 and ₹ 29,122, respectively, with a yield of 13.7 quintals . Hence, production of BRG-1 variety certified seed has resulted in a win-win situation for the farmers with higher yield and increased returns.

Most of the above studies related to the comparative economics of seed vs grain production of groundnut, cotton, mung bean, paddy and pigeon pea among the different states in India. It is quite understandable from the above reviews that the seed production is more profitable and profit efficient than grain production. Hence the present aspect has been considered for the present study.

2.2 Resource use efficiency of soybean grain and seed production

Pawar and Vijaykumar (2012) studied the resource productivity and resource use efficiency in soybean production in latur district of Maharashtra. The results revealed that, regression co-efficient of human labour was (0.129) followed by machine labour (0.024) which were positive and highly significant at 1 per cent level. Regression co-efficient of bullock labour (0.067) and plant protection (0.011) were positive and significant at 5 per cent level. Regression co-efficient of seed, manure, nitrogen and phosphorus were also positive but non-significant. Marginal product of area under soybean was 10.803 q followed by machine labour (0.274 q), bullock labour (0.231 q) and so on. MVP to price ratio with respect to phosphorus was 3.01 followed by that of nitrogen (2.98). Hence, preference might be given to increase the use of phosphorus on priority basis in soybean production.

Sannamani (2014) studied the economic analysis of tomato hybrid seed production under contract farming in haveri district revealed that the Cobb-Douglas production function for tomato hybrid seed production under contract farming in haveri district furnished that coefficient of multiple determinations (R^2) was 0.94 showing that the production function model was a good fit. The coefficients of seedlings (0.540) and FYM (0.305) were significant at one per cent, the output elasticities of PPC (0.197) was significant at ten per cent. The output elasticities of human labour (0.312), bullock labour and machine hour (0.102) was positive, but found to be non-significant. While stacking materials (-0.065) and fertilizer (-0.085) had non-significant negative elasticities. This indicates that the variables included in the function explained 94 per cent of the variation in the production of tomato hybrid seeds.

Josaphat *et al.* (2014) studied the resource use efficiency in Soybean production in Rwanda. They used the Cobb-Douglas production function and indicated that the elasticity of 0.46 (plot size) was the most important factor of soybean production. It was closely followed by intermediate inputs (fertilizers, pesticides and seeds), with a coefficient of 0.44. When intermediate inputs were decomposed, fertilizers with an elasticity of 0.062 appears to contribute more to soybean production than pesticides (0.057) and seeds (0.034).

Srivastava *et al.* (2015) studied economics of production and resource use efficiency of soybean production in India, the results of the study revealed that, human labour, machine

labour, were over utilized and seed, manure, chemical fertilizer, bullock labour and plant protection chemicals were underutilized by the farmers. The MVP to MFC ratio for human labour (-3.13), machine labour (-0.007), were less than 1 hence, these resources in study area were over utilized and seed (3.83), FYM (1.57), chemical fertilizer (8.90) and bullock labour (2.55) and PP chemicals (3.80) were showing more than one. They further concluded that these resources were underutilized hence there is scope for increasing these resources.

Bellundagi *et al*. (2015) studied resource use efficiency and profitability of *Bt* cotton seed production in Karnataka .The study focused on the resource use efficiency in *Bt* cotton seed production and profitability under different companies. Primary data collected entirely based on a multistage random sampling technique from 200 *Bt* cotton seed producing growers who have contracted with the different seed companies. Study revealed that more returns to scale was observed by the farmers who have contracted with Monsanto Seeds Company (4.29) and Bayer Seeds Company (3.43), however less returns to scale was indicated in Seed Work International Pvt. Ltd. Company (1.29) and JK Seeds Company (1.33) famers. Thus, profit could be improved by using more of seed input and human labour. The ratio of Marginal Value Product (MVP) to Marginal Factor Cost (MFC) indicated that allocative efficiency was positive and greater than unity in case of seeds, manures, human labour, machine hour and PPC that still there is scope for more use of these inputs and increase the gross returns of *Bt* cotton seed production.

Upev *et al*. (2016) analyzed the resource use efficiency among soybean farmers in Gboko local Government area of Benue state, Nigeria. The study revealed that the production function analysis indicated that, 87.21per cent of the variation in the output of soybean is explained for by the independent variables. Resource-use efficiency revealed that, quantity of seed; farm size, herbicide and inorganic fertilizer were underutilized while labour was over utilized. Provision of adequate and timely farming inputs, making loans accessible to farmers and reasonable market price of soybean are essential to boost production.

Hasma *et al*. (2017) studied resource use efficiency in cultivation of major food (ragi, maize and groundnut) crops under rainfed condition in central dry zone of Karnataka. They concluded that the inputs used are human labour, bullock labour, machine labour, seed, fertilizer and farm yard manure (FYM). In rainfed ragi, the regression coefficients for bullock pair (1.27) and FYM (0.94) were positive and statistically significant. In rainfed maize, the elasticity of production for human labour was highest (1.18) followed by production co-efficient of seed (0.98) and fertilizers (0.63). The elasticity co-efficient in rainfed groundnut with respect to seeds was 0.41, while that of fertilizers was 0.71 indicating the scope for higher use of these inputs from the present level to optimize returns. The ratio of MVP to MFC was differed from unity in all major crops, indicating scope for reallocation of expenditure among various resources.

Paled and Guledgudda (2017) Studied costs, return and resource use efficiency in brinjal hybrid seed production under contract farming in Haveri district of Karnataka. Results revealed

that total of 604.48 man days were employed which include 176.38 man days of male and 428.10 man days of female labour. About 423.31 man days of labour employed only for pollen collection and pollination. The output elasticities of human labour (1.71), seedlings (0.26) and irrigation (0.10) were significant. The coefficient of multiple determination (R^2) was 0.88. An increasing return to scale was observed (Hbi=2.26). The MVP to MFC ratio was found to be highest in seedlings (61.05), followed by irrigation (24.40), FYM (9.99), human labour (5.64) and mulching (2.18).

Naik *et al.* (2018) studied the resource use efficiency of soybean in Belagavi district of Karnataka. A Cobb-Douglas production analysis technique was used to analyses the data. The study revealed that the seed, FYM, human labour, bullock labour, and fertilizer were over utilized and machine labour and plant protection chemicals were underutilized by the farmers. The MVP to MFC ratio for Seed (-0.59), FYM (0.27), Human labour (0.13), Bullock labour (-0.23), Fertilizer (- 0.05) were less than 1 hence the resources in study area was over utilized and machine labour (3.60) and PP chemicals (2.21) were showing more than one. Hence these resources are underutilized hence there is scope for increasing these resources.

Thejashree and Umesh (2020) studied an economic analysis of Redgram seed production in Chikkaballapura district of Karnataka, India. A Cobb-Douglas production analysis technique was used to analyses the data. The study revealed that the cost of fertilizers applied in BRG-1 (₹4,123) and in BRG-2 (₹ 3,601) variety was non-significant. The difference in cost of FYM, plant protection chemical cost, machine labour cost, seeds and bullock labour costs were significant . The co-efficient of multiple determination (R^2) was 0.94 and 0.91 for BRG-1 variety and BRG-2 variety, respectively, indicating that independent variables included in the production function explained 94 per cent and 91 per cent of the variation in the production of BRG-1 and BRG-2 varieties of redgram seed production.

In BRG-1 variety, the ratio of MVP to MFC in case of FYM, human labour and area were 0.44, 1.06 and 0.54, indicating that the FYM and area were over utilised and human labour is underutilised, hence there is still scope to increase the human labour in production to get more returns . In case of BRG-2 variety, the ratio of MVP to MFC of fertilizer and human labour were 1.49 and 1.58, respectively indicating on invest of one rupee on fertilizer and human labour would give additional gross returns of ₹ 1.49 and ₹ 1.58.

To conclude, the above reviews indicated that the resources such as human labour, bullock labour, manures, fertilizers and seed were the major determinants of production efficiency of grain and seed production, but it was varied across the regions, locality and over the period which needs to be verified for the study area. Therefore, the present objective has been considered for the present study.

2.3 Problems faced by farmers in soybean grain and seed production

Chulaki (2001) identified the problems faced by seed growers in production and marketing of hybrid cotton seeds in Northern Karnataka. The problems faced by the farmers were classified into production and marketing problems. Among production problems, non-availability of skilled labour and non-availability of financial assistance were common.

Khan (2007) studied the problems in production of soybean .The study was conducted on 50 farmers of Narsing kheda village of Sihore district with the objective to know major constraints. Severe constraints like unavailability of electricity, higher input cost, limited resource of information and unavailability of insecticides, pesticides and fertilizers increases the cost of cultivation and check their income. Socio-personal attributes like age, land holding and economic motivation had positive and significant correlation, while education, scientific orientation and risk preferences had negative and non-significant correlation.

Dupare *et al.* (2010) studied the farmers problems associated with cultivation of soybean in Madhya Pradesh, India An investigation to identify the felt needs and problems of soybean growers of Madhya Pradesh. The study revealed that the non-availability of quality seed of improved varieties of soybean is the major problem experienced by the farmers. The problems associated with management of insect-pests and disease complex followed the suit. Among the pests, girdle beetle, tobacco caterpillar and the green semi-looper were found to be more responsible for the yield erosion in farmer's field. Resorting to imbalanced fertilization and timely unavailability of needed fertilizers ranked third while the delayed and erratic monsoon causing moisture stress, poor infrastructural facilities including lacunae in input supply system are observed to be the major problems identified in this study.

Tawale and Pawar (2011) conducted study on constraints and suggestions of soybean production in Maharashtra. The result revealed that, constraints like attack of insect pests and diseases was expressed by 74.45 per cent of soybean growers. In next order, shortage of labour at time of harvesting (62.78 per cent), and low price of soybean at the time of harvesting (61.11 per cent) were major constraints by the soybean growers. In regard to suggestions, provision of training in regard to pest and disease controls was suggested by 61.11 per cent, followed by provision of high rate for soybean was suggested by 53.89 per cent farmers.

Singh *et al.* (2012) examined the constraints in adoption of soybean production technology and the study revealed that, the constraints related with personal matter, farmers reported that lack of education (67.72%) and lacks of knowledge (54.05%) were the major constraint. Problem of non-availability of credit at proper time and non-availability of proper amount in credit were important socio-economic constraints. The study also indicated that, the lack of social participation and lack of risk bearing capacity were major socio-psychological constraint. As far as the communicational constraints were concerned, lack of information at proper amount was found a major constraint followed lack of information in proper time and

non-availability of information media. The study also showed the technological constraints due to which the rate of adoption was low. It was observed about 91.72 per cent respondents reported the lack of irrigation facility as the major constraints. Following suggestions could be considered to overcome these constraints- to provide the irrigation facility.

Ahikwar *et al.* (2014) conducted study on economics of soybean cultivation and analysis of production constraints in central Narmada valley of Madhya Pradesh. The study revealed that the lack of hired human labour during peak operational periods was the main constraint in the study area in cultivation of soybean as reported by 74 per cent of farmers, missing soil testing facilities 18 (72%), high cost of inputs (70%), lack of knowledge on plant protection measures (63%), inadequate capital (54%), timely non-availability of quality seed of improved variety (53%), missing awareness on intercropping techniques (51%) and deficit in knowledge on recommended production practices (49%) were the other major constraints reported by the soybean Farmers in the study area.

Sannamani (2014) studied the economic analysis of tomato hybrid seed production under contract farming in haveri district. Garrett's ranking method was used for the quantification of constraints expressed by the farmers. They observed that about non-availability of skilled labour was given utmost priority by the farmers (78.83). The second importance was given to high wage rate (78.10). The third and fourth ranks were high pest and disease attack (74.10) and lack of technical guidance (68.87). Non availability of high yielding varieties, climatic factors and non-availability of seedlings on time occupied next three positions with score of 64.73, 54.80 and 35.65 respectively. In this ranking method, non-availability of skilled labour has got first rank (78.83) and non-availability of seedlings on time (35.65) got the least rank among the different attributes.

Medat *et al.* (2016) study the constraints in soybean production and marketing faced by the farmers in south Gujarat. The result revealed that problem of higher incidence of non-availability of labour in time, difficulties in pest and disease control and non-availability of fertilizer in time were the major constraints faced by farmers in production of soybean. In economics level constraints were high cost of pesticides, high cost of seed and high cost of fertilizer and the major constraints related to technical were lack of knowledge about identifying the disease, lack of knowledge about identifying the pests and lack of technical knowledge about soybean cultivation.

Jaybhaye *et al.* (2016) conducted study on the soybean cultivation by farmers of Maharashtra: Identification and analysis of the problems. A study was conducted in the 20 villages of five districts of western Maharashtra. The Study found that labour problems, irrigation facilities, weed management, marketing of produce, pest and disease management were the top five constraints faced by the farmers in soybean cultivation. Shortage of labour and higher wages during peak period (95%) was major labour related constraints faced by farmers. In

irrigation, farmers reported lack of irrigation facilities (81%) as major constraints in soybean cultivation. Proper farm mechanization, water conservation measures, short duration drought resistant varieties of soybean, timely supply of institutional credits and training to farmers on improved cultivation practices are important suggested measures to overcome the constraints faced by these farmers, for sustainable and profitable soybean production.

Koundinya and Kumar (2018) Studied the Indian Vegetable Seeds Industry: Status and challenges Seed is the first and foremost important commodity for successful vegetable cultivation. Expanding areas under vegetable cultivation, varied agro-climatic conditions, availability of huge and cheap human resource are creating titanic scope for development of vegetable seed industry in India. Vegetable seed industry has positive influence on Indian economy in terms of income and employment generation and earning foreign exchange in international market. There are few constraints like high cost of seed production, technical problems and stringent laws set break to the vegetable seed industry in India.

Patel *et al.* (2018) conducted study on constraints faced by the groundnut growers in adoption of recommended *kharif* groundnut production technology. The study was conducted in Banaskantha district. They observed that the major constraints faced by the groundnut growers in adoption of recommended *kharif* groundnut production technology were; high cost of input (96.67%), high wages of labour (92.00%), high cost of seed (85.33%), lack of pure and good quality seed/certified seed (80.00%), non-availability of sufficient labour in time (72.00%) and lack of improved implements (70.00%).

Dulal and Marahatta (2020) while carrying out the comparative economics of maize grain and seed production in Okhaldhunga, Nepal and examined that major problems as production problems were scarce farm labor followed by lack of infrastructures, while low seasonal price followed by low volume of production ranked the first and second most important marketing related problems.

Thejashree and Umesh (2020) conducted study on constraints faced by Redgram Seed Production in Chikkaballapura district of Karnataka, India. Garrett ranking analysis technique was used to analyses the constraints.. The study revealed that the farmers are requested to rank the factors due to which they take seed production over grain production,both BRG-1 and BRG-2 varietal seed producing firms awarded first rank to assured market by giving score 62 and 63 respectively, which shows farmers take seed production majorly because of assurance of market they get from Karnataka State Seeds Corporation Limited. Next factor due to which farmers take seed production under Karnataka State Seeds Corporation Limited is Seed Subsidy, farmers opined that they get seeds at subsidized rate which is another favorable factor to take seed production. Third rank is awarded to technical guidance, KSSC officials regular visits at different stages of crop and guidance regarding transplanting, crop protection, harvesting and storage made a impact on them to continue the seed production. Remunerative price was ranked

third followed by dividend as all seed growing farmers are not the members or shareholders of KSSC not everyone get the dividend every year hence it is ranked as last factor due to which they take seed production over grain production.

Constraints analysis indicated that labour scarcity at peak season was the major constraint as seed production is labour intensive, hence farm mechanization must be encouraged, particularly during the peak seasons to ward off labour supply demand gap, further extending custom hiring services would help in addressing labour problem. This study reveals that adoption of certified seed production of red gram in farmers fields is helpful in providing a profitable enterprise for increasing the net farm income.

To summarize, the above reviews indicated that the constraints such as high wage rate, high pest and disease attack, lack of technical guidance, Non availability of high yielding varieties, climatic factors and non-availability of seedlings on time, non-availability of skilled labour got the least rank among the different attributes. High costs of input were the major constraints faced by the farmers in grain and seed production. But it was varied across the regions, locality and over the time period which needs to be identified for the study area. Therefore, the specific objective has been considered for the present investigation.

3. METHODOLOGY

The present study was undertaken with the aim to study the comparative economics of seed and grain production of soybean in Washim district of Maharashtra. The objective of any scientific investigation is to draw the some useful conclusions. In order to arrive at the meaningful conclusions, it is essential for the investigator to adopt appropriate methods, procedure and analytical approach for the data during the course of research work. Keeping this in view, this chapter has been devoted to explain the methodology adopted, to fulfil the objectives of the study.

3.1 Sampling design

Since the study was aimed at finding out the comparative economics of seed and grain production of soybean, the sampling design adopted for the investigation was simple randomization.

3. 2 Selection of district and tahsils

Washim district was purposively selected for the study, as it is one of the important and major soybean grain as well as seed growing districts in Maharashtra. Out of six tahsils in the district Risod , Washim and Malegaon tahsils were selected for the study because maximum area under soybean seed production in these three tahsils.

3.3 Selection of villages

From each of the three selected tahsil three villages were selected where the maximum soybean seed growing area was concentrated. Totally nine villages were selected for the study.

Table 3.1 Distribution of selected Soybean Grain and Seed Growers

Sr. No.	Tahsils	Villages	Grain growers	Seed growers	Total
1	**Risod**	Koyali	5	5	10
		Vyad	5	5	10
		Asegaon	5	5	10
2	**Washim**	Hiwara	5	5	10
		Tamashi	5	5	10
		Mohaja	5	5	10
3	**Malegaon**	Ekamba	5	5	10
		Taktoda	5	5	10
		Kotha	5	5	10

3.4 Selection seed and grain growers of soybean

The list of certified seed growers of soybean in Washim district have been obtained from Maharashtra State Seed Corporation Lmt., Akola. From the list 45 certified seed growers of soybean have been selected randomly from six villages. For comparison study with grain production of soybean again 45 grain producers of soybean selected randomly from the above

selected six villages Thus, the total number of selected farmers (grain and certified seed producer of soybean) was 90.

From each selected village 5 sample of soybean seed grower and 5 sample of soybean grain grower was selected randomly. Total 90 samples (45 sample of seed grower and 45 sample of grain grower) were selected for the study.

3.5 Collection of data

Primary data were collected by personnel interview with the respondents using a well structured and pre-tested interview schedule. Data on socio-economic parameters, various inputs used in the grain and seed production of soybean and their costs and returns were collected for the agricultural year 2018-2019. The schedules used for data collection are given in Appendix-I.

3.6 Analysis of Data

For estimating the cost of cultivation of soybean seed and grain production following standard cost concept *viz.,* Cost "A", Cost "B" and Cost "C" were used.

Cost 'A'

Includes the costs on account of hired human labour, bullock labour, machinery charges, value of manures, value of fertilizers, value of seed, plant protection charges, land revenue, depreciation and repairs, interest on working capital etc.

A. Human labour

It includes both hired and family labour. Most of the labour force engaged in soybean grain and seed production was hired. However, the farmers have to engage his own family members from time to time for certain operations like spraying, weeding, etc. throughout the year. Human labour cost comprises of

a. Wages actually paid to hired labour

b. Imputed value of labour put in by the family members

c. Wages paid to attach farm labours for different operations have been included in the hired labour. The actual wages paid to the casual labour were considered and wages of male and female members of the family were calculated on the basis of existing wage rates of the hired casual labours in force from time to time for different operations.

B. Bullock pair charges

Bullock pair cost was calculated by considering the actual hired charges paid by the farmers or the prevailing rates for bullock pairs for different operations were taken it to consideration.

C. Machine power

In case of owned machines, cost was evaluated on the basis of hired charges prevailed in the village and in the case of hired machines as per the actual amount paid.

D. Seed

In case of the seed purchased from the other farmers or from shop, the actual price paid was ascertained and charged.

E. Manure

The cost of farm yard manure (FYM) or compost produced on the farm was evaluated at the rates prevailed in the village. The cost on account of manures purchased was accounted as the actual price paid by the farmers

F. Fertilizers

The fertilizer was evaluated at the actual price paid by farmers.

G. Insecticides and pesticides

The insecticides and pesticides expenses were considered at the actual price paid by the farmers.

H. Land revenues, cesses and taxes

This cost included land revenue and other relevant taxes and cesses which were actually paid by the farmers.

I. Depreciation on implements, machinery and farm buildings

Farm assets like implements and farm buildings were evaluated at the prevailing market prices taking into consideration the condition of the assets. Depreciation of these assets for the current year was calculated using straight line method for which the present value and the remaining useful life of asset was considered.

$$\text{Annual depreciation} = \frac{\text{Present value} - 10 \text{ per cent of present value}}{\text{Expected remaining life of assets}}$$

J. Interest on working capital

Interest on working capital was charged at the rate of 6 per cent per annum. Working capital includes cash or kind expenses incurred during the period of cultivation.

K. Interest on fixed capital

Interest on present value of fixed assets such as farm building, implements and machinery, irrigation structure and equipment's and livestock was charged at the rate of 10 per cent.

L. Rental value of land

This cost includes the estimated rental value of owned land. It was evaluated at the rate of 1/6 of the value of gross output minus the land revenue.

Cost 'B'

Rental value of land and interest on fixed capital represent imputed cost which is added to the Cost 'A'.

Cost 'B' = Cost 'A' + rental value of land + interest on fixed capital.

Cost 'C'

It is the total cost of production, which included all the costs items, actual as well as imputed. The value of owned labours is imputed and added to cost 'B' to work out cost 'C'.

Cost 'C' = Cost 'B' + imputed value of family labour.

3.7 Functional analysis

The Cobb-Douglas type of production function was used to study the effect of various inputs on soybean seed and grain production. It being a homogenous function provided a scale factor enabling to measure the returns to scale. The estimated regression coefficients represented the production elasticities. The form of Cobb-Douglas production function used in the present study was as follows.

$$\mathbf{Y = a x_1^{b1} x_2^{b2} x_3^{b3} x_4^{b4} x_5^{b5} x_6^{b6} x_7^{b7} x_8^{b8} x_9^{b9} e^{u}}$$

Where,

Y = Output of main produce (q/ha)

X_1 = Human labour (man days/ha)

X_2 =bullock labour (pair days/ha)

X_3 = Machinery (hr. /ha)

X_4 = Manures (q/ha)

X_5= N quantity in (kg/ha)

X_6 = P quantity in (kg/ha)

X_7= K quantity in (kg/ha)

X_8= plant protection charges (₹)

X_9= seed (kg/ha)

a= Constant / intercept

b^i= Regression coefficient of respective resource variable

e^u = Error term

3.8 Estimation of marginal value products

The marginal value products (MVPs) of individual resources were estimated and compared with the marginal cost (MC). The MVP of individual resources were estimated by using following formula,

$$\mathbf{MVP = bi \frac{\bar{Y}}{\bar{X}i} Py}$$

Where,

MVP = Marginal Value Product

b_i = Production elasticity corresponding to the i^{th} input

$\bar{Y}$ = Geometric mean of output

$\bar{X}$ = Geometric mean of i^{th} input

P_y = Price per unit of output

If the ratio of MVP/MC is more than one then the resource is used more efficiently and if the ratio is less than one then resource is used less efficiently.

3.9 Problems in grain and seed production of soybean.

To find out the most significant factors which influences the respondents, Garrett's ranking technique was used. As per this method, respondent have been asked to assign the rank for all problems and the outcome of such ranking have been converted into score value with the help of following formula:

Percent position= 100- (Rij - 0.5) / Nj

Where,

Rij = Rank given for the ith variable by jth respondent

Nj = No of variables ranked by jth respondent

4. RESULTS AND DISCUSSION

The present chapter has been devoted to put the results of the data under analysis in order to explain the linkage of facts, thus to derive meaningful inferences.

The success of any enterprise in agriculture can be judged on the basis of economic benefits to be accured by the entrepreneur from that enterprise. In the present world of competition, the farmers have to look upon his farm production activities from the business point of view. Therefore, present investigation is intended to study the comparative economics of grain and seed production of soybean in Washim district of Maharashtra. Data regarding cost of production of soybean grain and seed have been collected by special interview method. The data collected have processed, tabulated, analyzed and discussed to draw valid conclusion, it also gives implications for future policy and research. In accordance with the specified objective, the chapter is arranged in four sections.

In this chapter, an attempt has been made to study the socio-economic aspects, land holding and cropping pattern of soybean farmers, the cost of cultivation, gross income, net profits, production and problems in production soybean seed and grain.

4.1 Family size and its composition

The information on family size and its composition is presented in table 4.1. The average family size for soybean grain grower was 4.70 person in which proportion of males was 41.06 per cent and proportion of females and children were 32.55 and 26.39 per cent respectively.

Table 4.1 Family size and its composition of selected soybean grain and seed growers

(Numbers)

Sr. No.	Particulars	Grain Growers	Seed Growers
1	Male	1.93 (41.06)	1.91 (42.73)
2	Female	1.53 (32.55)	1.73 (38.70)
3	Child	1.24 (26.39)	0.83 (18.57)
4	Total	4.70 (100)	4.47 (100)

(Figures in parentheses are the percentages to the respective total)

The average family size for soybean seed grower was 4.47 person in which proportion of males was 42.73 per cent and proportion of females and children were 38.7 and 18.57 per cent respectively of family size.

From the Table 4.1, it was revealed that the average family sizes in case of soybean seed growers are quite high with respect to soybean grain growers.

4.2 Education status

Table 4.2 represents the information on educational status of soybean grain and seed growers.

Education is another important factor influencing managerial ability and technical knowledge of the farmers. It was noticed that, in soybean grain grower, only 15.53 per cent family members were having education up to degree level. 24.69 per cent family members were having higher secondary education, 22.76 per cent were having up to secondary education, 18.51 per cent family members were having up to primary education and 18.51 per cent family members were illiterate.

Table 4.2 Education status of selected soybean grain and seed growers

(Numbers)

Sr. No.	Particulars	Grain Growers	Seed Growers
1	Primary	0.87 (18.51)	0.80 (17.90)
2	Secondary	1.07 (22.76)	1.11 (24.83)
3	Higher secondary	1.16 (24.69)	1.07 (23.93)
4	Degree	0.73 (15.53)	0.87 (19.46)
5	Illiterate	0.87 (18.51)	0.62 (13.88)
6	Total	4.70 (100)	4.47 (100)

(Figures in parentheses are the percentages to the respective total)

In case soybean seed grower, only 19.46 per cent family members were having education up to degree level. 23.93 per cent family members were having higher secondary education, 24.83 per cent were having up to secondary education, 17.90 per cent family members were having up to primary education and 13.88 per cent family members were illiterate.

4.3 Land use pattern

Information presented in Table 4.3 depicted that, the average size of land holding was 5.21 and 3.13 hectares for soybean grain and seed grower, respectively. The percentage of irrigated area is substantially higher in case of grain grower as compared to seed grower of soybean. The net cropping area of soybean grain and seed grower was 5.00 and 3.00 hectares, respectively.

Table 4.3 Land use pattern of selected soybean grain and seed growers

(Area in ha)

Sr. No.	Particulars	Grain growers	Seed growers
1.	Total land holding	5.21 (100)	3.13 (100)
2.	Permanent fallow	0.18 (3.46)	0.12 (3.83)
3.	Operational holding	5.03 (96.54)	3.01 (96.16)
	a) Irrigated	3.62 (69.48)	1.68 (53.67)
	b) Unirrigated	1.41 (27.06)	1.33 (42.49)
4.	Current fallow	0.03 (0.57)	0.01 (0.32)
5.	Net cropping Area	5.00 (95.97)	3.00 (95.84)
6.	Gross cropped area	6.60	4.71
7.	Cropping intensity %	132.00	158.05

(Figures in parentheses are the percentages to the total holding)

From the above table it was seen that, the percentage of operational holding was more in case of soybean grain growers than seed growers, also the area under irrigated land followed same pattern. The cropping intensity was observed as 132.00 and 158.05 per cent of soybean grain and seed grower respectively.

4.4 Cropping pattern

Cropping pattern refers to proportion of the area under different crops. The Table 4.4 presented the information on area under different crops during the year 2018-2019, on the farms of sample soybean grain and seed growers.

In case of soybean grain growers, cotton occupied 4.55 per cent of the gross cropped area. Pigeon pea and green gram occupied 7.12 and 1.82 per cent area to the gross cropped area, respectively. In *rabi* season, major crops were wheat, gram and jowar which accounted 18.94, 11.21 and 3.18 per cent, respectively. The total area under soybean was 48.49 per cent in case of soybean grain grower, to the gross cropped area of the sample farmers.

In case of soybean seed growers, cotton occupied 4.25 per cent of the gross cropped area. Pigeon pea and green gram occupied 7.00 and 2.76 per cent area to the gross cropped area, respectively. In *rabi* season, major crops were wheat and gram and jowar which accounted 18.05,8.06 and 2.76 per cent, respectively. The total area under soybean seed was 47.56 per cent in case of soybean seed grower, to the gross cropped area of the sample farmers.

It is clear from the table that, the cropping pattern of selected farmers in *kharif* is dominated by soybean, pigeon pea and cotton the area under cotton has decreased and area under soybean has increased.

Table 4.4 Cropping pattern of selected soybean grain and seed growers

(ha)

Sr. No	Particulars	Grain growers	Seed growers
1	***Kharif* Crops**		
	a) Cotton	0.30 (4.55)	0.20 (4.25)
	b) Soybean	3.20 (48.49)	2.24 (47.56)
	c) Pigeon pea	0.47 (7.12)	0.33 (7.00)
	d) Green gram	0.12 (1.82)	0.13 (2.76)
	e) Kharif jowar	0.07 (1.06)	0.04 (0.85)
	f) Bajra	0.01 (0.15)	0.03 (0.64)
	g) Black gram	0.03 (0.45)	0.02 (0.42)
	Sub Total	**4.20** **(63.64)**	**2.99** **(63.48)**
2	***Rabi* Crops**		
	a) Wheat	1.25 (18.94)	0.85 (18.05)
	b) Gram	0.74 (11.21)	0.38 (8.06)
	c) Jowar	0.21 (3.18)	0.13 (2.76)
	Sub Total	**2.20** **(33.33)**	**1.36** **(28.87)**
3	Vegetables	0.14 (2.12)	0.28 (5.95)
4	Perennials	0.05 (0.76)	0.07 (1.49)
5	Summer crops	0.01 (0.15)	0.01 (0.21)
	Gross cropped area	**6.60** **(100)**	**4.71** **(100)**

(Figures in parentheses are the percentages to the gross cropped area)

4.5 Farm assets and investment

Investment in farm assets is presented in Table 4.5. It can be observed that, per farm total value of investment in farm assets excluding land was worked out to ₹ 692049.33 and ₹ 752941.50 for soybean grain growers and seed growers respectively.

In case soybean grain growers, per farm investment on irrigation structure was 5.20 per cent, bullock drawn implements 0.45 per cent, livestock 2.47 per cent.

In case soybean seed growers, per farm investment on irrigation structure was 6.34 per cent, bullock drawn implements 0.51 per cent, livestock 3.78 per cent.

From the above table it is also concluded that, the major contribution in farm assets was of land followed by the houses and cattle shed. Soybean seed growers have invested more in tractor and its implements compared to soybean grain growers.

Table 4.5 Per Farm Value assets and investment of soybean grain and seed growers

(₹)

Sr. No	Particulars	Grain growers	Seed growers
1	Land	2165833.3 (75.78)	1900000 (71.62)
2	Houses and Cattle Shed	345766.67 (12.10)	358966.67 (13.53)
3	Irrigation Structure	148616.67 (5.20)	168233.33 (6.34)
4	Bullock Drawn Implements	12843.33 (0.45)	13591.67 (0.51)
5	Tractor and its Implements	111500 (3.90)	108833.33 (4.11)
6	Livestock	70520 (2.47)	100360 (3.78)
7	Hand Tools and Implements	2802.67 (0.10)	2956.50 (0.11)
8	Total assets including land	2857882.67 (100.00)	2652941.5 (100.00)
9	Total assets excluding land	692049.33 (24.21)	752941.50 (28.38)

4.6 Livestock position

Livestock plays an important role in soybean production. Table 4.6 showed that, In case of soybean grain growers, per farm value of bullock pair, cow and buffalo were ₹45288.89, ₹ 21933.33 and ₹15311.11 which accounted for 47.48 per cent, 22.99 per cent and 16.05 per cent, respectively In case of soybean seed growers, per farm value of bullock pair, cow and buffalo were ₹ 44022.22, ₹14177.78 and ₹18533.33 which accounted for 50.50 per cent, 16.26 per cent and 21.26 per cent, respectively.

It is concluded from above table that; soybean grain growers have invested more in bullock pair (47.48 per cent) and soybean seed growers have invested more in bullock pair (50.50 per cent). In case of soybean grain grower's major contribution in livestock was of bullock pair, followed by cows and in case of soybean seed grower's major contribution in livestock was of bullock pair, followed by buffalo

Table 4.6 Per Farm Livestock position of Selected Soybean grain and seed growers

(Value in ₹/Farm)

Sr.No.	Particulars	Grain growers		Seed growers	
		Number	Value (₹)	Number	Value (₹)
1	Bullock pair	0.66 (11.00)	45288.89 (47.48)	0.64 (12.50)	44022.22 (50.50)
2	Cow	1.27 (21.17)	21933.33 (22.99)	0.82 (16.01)	14177.78 (16.26)
3	Cow calf	0.84 (14.00)	4644.44 (4.87)	0.51 (9.96)	3566.67 (4.09)
4	Buffalo	0.49 (8.16)	15311.11 (16.05)	0.51 (9.96)	18533.33 (21.26)
5	Buffalo calf	0.36 (6.00)	4222.22 (4.43)	0.44 (8.60)	3355.56 (3.85)
6	Goat / sheep	0.67 (11.17)	3288.89 (3.45)	0.62 (12.11)	2877.78 (3.30)
7	Poultry	1.71 (28.50)	695.56 (0.73)	1.58 (30.86)	647.78 (0.74)
	Total	6.00 (100)	95384.44 (100)	5.12 (100)	87181.12 (100)

(Figures in parentheses are the percentages to the respective total)

4.7 Resource Use Levels

The inputs such as human, bullock and machine labour, seed, manures, fertilizers, and plant protection charges used in cultivation of soybean grain and seed production were estimated on per hectare basis and presented in Table 4.7.

It was revealed that per hectare human labour used for soybean grain production was 47.69 mandays which was relatively less than that of soybean seed production which has 53.52 mandays. The higher human labour requirement in seed production was mainly due to activities like rouging, gap filling etc. The bullock power use was also found to be lower in case of soybean grain production (1.64 pair days) as compare to soybean seed production (2.75 pair days). However per hectare utilization of machine power (7.93 hrs.) for soybean grain production which was lower than that of soybean seed production (8.28 hrs.).

The seed rate per hectare was found to be 77.67 kg and 81.91 kg for soybean grain and seed production respectively. Soybean seed grower used more seed rate as compared to soybean grain grower because soybean seed grower follows roughing practices for maintaining plant to plant distance. Per hectare use of manures were found to be more in case of soybean seed growers (31.07 q) as compare to soybean grain growers (23.34 q).

Per hectare fertilizer use for soybean grain production 28.53 kg N, 69.14 kg P and 11.03 kg of K. however for soybean seed production per hectare fertilizer use were 31.94 kg N, 71.44

kg P and 14.37 kg K. Per hectare Plant protection charges for soybean grain and seed production was ₹921.25 and ₹ 950.4 respectively.

Table 4.7 Resource use levels of Soybean grain growers and seed growers

(Per ha)

Sr. No.	Particulars	Grain Growers	Seed Growers
1	Total human labour (days)	47.69	53.52
A	Male	18.96	22.84
B	Female	28.73	30.68
2	Bullock power (pair days)	1.64	2.75
3	Machine power (hrs.)	7.93	8.28
4	Manures (q)	23.34	31.07
5	Seed (kg)	77.67	81.91
6	Fertilizers (kg)		
A	Nitrogen	28.53	31.94
B	Phosphorus	69.14	71.44
C	Pottasium	11.03	14.37
7	Plant protection charges (₹)	921.25	950.4

From the above discussion it is clear that all the resources *viz*, human, bullock and machine labour, seed, manures, fertilizers, and plant protection charges were higher used in seed production over grain production in soybean. The seed grower has to strictly adhere to the recommended cultural practices to ensure genetic purity as laid down by the seed certification agency. Seed production plot must be weed free and off-type plants need to be removed manually to maintain genetic purity. Proper drying of seeds and preliminary processing is another special operation in seed production. All these operations required additional labour. Pal *et al.* (2016) also observed that there is resources were used in higher dose on seed production as compared to grain production.

Thus, from the above discussion the proposed alternative hypothesis put forth as the resource use levels are higher in seed production than the grain production is proved.

4.8 Cost of cultivation

Economic comparison is essential to test the profitability and viability of any activity. Therefore, economics of grain production vis-a-vis seed production has been calculated and compared, so as to analyze the feasibility of seed production over grain production. The present analysis on cost of cultivation was worked out on per hectare basis separately for seed and grain production of soybean. The item-wise cost of cultivation of grain and seed production of soyabean has been presented in Table 4.8. The table reveals that human labour occupied the major share (12.84 %) of total cost of ₹57901.09 per hectare in seed production and (12.59 %) of total cost of ₹ 50747.70 per hectare in grain production of soybean respectively .The higher human labour requirement in seed production was mainly due to activities like rouging, gap filling etc. It was reported in a study Reddy *et al*. (2013) that due to knowledge and adoption gap, its results in lower yield and higher cost of cultivation. The other items involved in production of soybean seed were bullock and machine labour (10.36 % of total cost) and cost of seed (9.90%). The higher share of bullock and machine labour was due to less mechanization at field level and this can be reduced by increasing mechanization in cultivation operation. The total cost of cultivation in soybean seed production was higher than grain production. Pal *et al.* (2020) and Sendhil and Sharma (2020) in their study also observed that there is total cost cultivation for Seed production was more than grain production.

Table 4.8 Cost of cultivation for Soybean grain and seed production

Sr. No.	Cost Item	Grain production			Seed production		
1	Hired Human Labour (Man days)	**Qty**	**Value (₹)**	**Percent**	**Qty**	**Value (₹)**	**Percent**
	A)Male	14.94	2988.89	5.89	18.69	3738.87	6.46
	B)Female	22.67	3401.9	6.70	24.64	3697.3	6.38
	Total Human Labour	37.62	6390.79	12.59	43.34	7436.2	12.84
2	Bullock Power(pair days)	1.64	821.03	1.62	2.75	1378.33	2.38
3	Machine (hrs.)	7.93	4364.26	8.60	8.28	4558.85	7.88
4	Manures (q)	23.34	3502.2	6.90	31.07	4661.72	8.05
5	Seed (kg)	77.67	5825.30	11.48	81.91	5734.32	9.90
6	Fertilizers (kg)		4678.63	9.22		4767.06	8.23
	Nitrogen	28.53			31.94		
	Phosphorus	69.14			71.44		
	Pottasium	11.03			14.37		
7	Plant protection charges (₹)		921.25	1.82		950.4	1.64
8	Weedicide (₹)		1496.39	2.95		1610.08	2.78
9	Incidental charges(₹)		548.76	1.08		655.34	1.31
10	Repairs (₹)		410.73	0.81		417.35	0.72
	Working capital		28959.44	57.07		32169.34	55.55
11	Int. on working capital @ 6% (₹)		1737.57	3.42		1930.16	3.33
12	Depreciation on farm implements		3950.14	7.78		3921.69	6.78
13	Land revenue and taxes		110.35	0.22		114.8	0.20
	Cost "A"		**34757.5**	**68.49**		**38136**	**65.86**
14	Rental value of land		9072.37	17.88		12755.79	22.03
15	Interest on fixed capital @ 10 % (₹)		4800	9.46		4856.47	8.39
	Cost "B'		**48629.87**	**95.83**		**55748.27**	**96.28**
16	Family labour						
	A)Male	4.02	1207.59	2.38	4.15	1246.29	2.15
	B)Female	6.06	910.24	1.79	6.04	906.52	1.56
	Cost "C"		**50747.7**	**100**		**57901.09**	**100**
	Gross income (₹)		56788.37			77056.75	
	A) Main produce (q)	15.47	55692		18.06	75852	
	B) By produce (q)	10.91	1096.37		12.04	1204.75	
17	Per quintal cost (₹)		3288.03			3206.04	

4.9 Profitability of Soybean grain and seed production

An attempt has been made to compare the per hectare gross income, different cost and profit at different costs with the net returns and the benefit cost ratio for soybean grain and seed production the details are given in the table 4.9.

Table 4.9 Costs, Returns, Gross income and B:C ratio for Soybean grain and seed production (Per ha)

Sr. No.	Particulars	Unit	Grain production	Seed production
1	Total Cost			
	Cost “A”	₹	34757.5	38136
	Cost “B”	₹	48629.87	55748.27
	Cost “C	₹	50747.7	57901.09
2	Profit At			
	Cost “A”	₹	22030.87	38920.75
	Cost “B”	₹	8158.5	21308.48
	Cost “C”	₹	6040.67	19155.66
3	Production	q	15.47	18.06
4	Gross Income	₹	56788.37	77056.75
5	B:C Ratio			
	Cost “A”		1.63	2.02
	Cost “B”		1.17	1.38
	Cost “C”		1.12	1.33

It reveals that all the costs were higher in seed production over grain production in soybean. The seed grower has to strictly adhere to the recommended cultural practices to ensure genetic purity as laid down by the seed certification agency. Seed production plot must be weed free and off-type plants need to be removed manually to maintain genetic purity. Proper drying of seeds and preliminary processing is another special operation in seed production. All these operations required additional labour. Hence, cost of cultivation was higher in seed production as compared to the grain production. The cost A, B and C were higher in soybean seed production in comparison to grain production respectively.

The Per hectare gross income received by soybean seed grower was ₹ 77056.75 and it was ₹ 56788.37 in case of soybean grain grower therefore, soybean seed grower obtain more gross income than soybean grain grower. Higher gross income was mainly due to higher productivity (18.06 q./ ha.) in case of soybean seed production as compare to soybean grain production(15.47 q./ ha.).Seed production gives higher returns with higher B:C ratio compared to grain production. The B:C ratio at cost “C” was 1.33 in case of soyabean seed production as compared to 1.12 in grain production. The B:C ratio of more than unity indicated that the seed production in the study area is a economically viable proportion. Hence the hypotheses Soybean seed production is more profitable than grain production has been accepted. These results are in

conformity with the findings of Shoaib *et al.(*2015),Pal *et al*.(2016), Akshatha (2017), Pal *et al.*(2019) and Dulal and Marahatta (2020).

4.10 Functional Analysis

The empirical evidences from previous studies suggests that amongst three mathematical functions tried, Cobb-Douglas type of production function is found appropriate for the studying resource use productivity, because it specifies diminishing productivity and diminishing marginal rate of substitution among the different factors and gives specific diminishing, increasing or constant returns. The data were therefore, subjected to functional analysis by using the following type of Cobb-Douglas production function.

$Y = a\ X_1^{b1}\ X_2^{b2}$---------- $Xn + e^u$

In this functional formula 'Y' is dependent variable, Xi's are independent resource variables, 'a' is constant representing intercept of the production function and bi's are the regression coefficients. In logarithmic terms, this function transforms into a linear form of the following type.

$\text{Log } Y = \log a + b_1 \log X_1 + b_2 \log X_2 +$ -------- $+ bn \log Xn + u \log e$

For fitting the production function, nine inputs *viz.*, human labour, bullock labour, machine power, manures, nitrogen, phosphorus and potassium fertilizers, plant protection and seed have been considered as important factors influencing the production of seed and grain production of soybean.

The output of seed and grain production of soybean has been used as dependant variable. The equation fitted was of the following from

$$\mathbf{Y = a x_1^{b1} x_2^{b2} x_3^{b3}\ x_4^{b4} x_5^{b5} x_6^{b6} x_7^{b7} x_8^{b8} x_9^{b9}\ _{eu}}$$

Where,

Y = Output of main produce (q/ha)

X_1 = Human labour (man days/ha)

X_2 =bullock labour (pair days/ha)

X_3 = Machinery (hr. /ha)

X_4 = Manures (q/ha)

X_5= N quantity in (kg/ha)

X_6 = P quantity in (kg/ha)

X_7= K quantity in (kg/ha)

X_8= plant protection charges (₹)

X_9= seed (kg/ha)

a= Constant / intercept

b^i= Regression coefficient of respective resource variable

e^u = Error term

The results of the Cobb- Douglas production function are presented in Table 4.10. The Cobb-Douglas type of production function was used to study the effect of various inputs on soybean seed and grain production.

From table 4.10 , it was observed that, in case of soybean grain production, the value of R^2 was 0.79 and for seed production it was 0.71, it indicated that the factor under consideration *viz.*, Human labour (X_1) ,bullock labour (X_2),Machinery (X_3),Manures (X_4), N quantity in (X_5), P quantity in (X_6), K quantity in (X_7), plant protection charges (X_8) and seed (X_9) explained 79 per cent and 71 per cent variation in output of soybean grain and seed production, respectively. Similar trend was reported by Rangnath (2004).

It was further observed that in case of grain production of soybean the variables such as human labour (X_1), bullock labour, (X_2). machine power (X_3), nitrogen (X_5) and potassium (X_7) were positive and significant at 1 per cent level of significance. It implies that, one per cent increase in the human labour, bullock labour, machine power , nitrogen and potassium would increase the output of grain production by 0.16, 0.15, 0.29, 0.63 and 0.20 per cent, respectively. However manures (X_4) and seed (X_9) were positive but not significant, it indicates that they have positive impact on output. Phosphorous (X_6) and Plant protection charges were negative and non-significance.

Table 4.10 Results of estimated Cobb-douglas production function for soybean grain and seed production.

Sr. No.	Particulars	Unit	Grain production	Seed production
1	Intercept		6.10	1.968
2	Human labour (X_1)	days	0.159* (0.082)	0.085 (0.189)
3	Bullock labour (X_2)	days	0.151* (0.085)	0.221*** (0.052)
4	Machine power (X_3)	hrs.	0.298*** (0.102)	0.215* (0.112)
5	Manures (X_4)	q	0.0005 (0.0008)	0.0001 (0.001)
6	N (X_5)	kg	0.636* (0.182)	-0.161* (0.008)
7	P(X_6)	kg	-0.357 (0.325)	-0.325* (0.190)
8	K (X_7)	kg	0.202** (0.083)	-0.250* (0.142)
9	Plant protection charges (X_8)	₹	-2.036 (1.568)	0.072** (0.029)
10	Seed (X_9)	kg	0.037 (0.058)	-0.122 (0.164)
11	R^2		0.79	0.71

***,**,* Indicate significant at 1, 5 and 10 per cent level respectively.

(Figures in the parentheses are the standard errors of the respective regression coefficient)

In case of soybean seed production the value of coefficient of multiple determination (R^2) was found to be 0.71, that means 71 per cent variation in output was jointly explained by the nine independent resource variables under consideration table (4.10).The regression coefficient of bullock labour (X_2) was positive and significant at 1 per cent level of significance, plant protection charges (X_8) was positive and significant at 5 per cent level of significance. The regression coefficient of machine power (X_3) was positive and significant at 10 per cent level of significance. This indicates that there is scope to increases the use of these resources to increase to production. However, human labour (X_1) and manures (X_4) was positive but not significant.

These significant variables indicated that, the increase in use of these resource variables would increase the output of grain and seed production of soybean. Similar results were found by Rangnath (2004) in Kurnool district of Andhra Pradesh.

4.11 Resources use efficiency for soybean grain production.

An efficiency of resources used in soybean grain production on the sample farms was judged with the help of MVP / MC ratio and the results are presented in table 4.11 . It was revealed that the ratio of marginal value of product to factor cost ratio (MVP / MC) ratio was greater than unity (*i. e.* under utilization), in case of resources like human labour (X_1), bullock labour (X_2), machine power (X_3), nitrogen (X_5) and potassium (X_7) of soybean grain production, implying the achievement of higher resource use efficiency in case of above mentioned variables, were as MVP / MC ratio of manures (X_4), potassium (X_6), plant protection charges (X_8) and seed (X_9) were found to be less than unity *i. e.* over utilization for these resources in case of soybean grain production manures (X_4), potassium (X_6), plant protection charges (X_8) and seed (X_9) were over utilized, that means there is no need to increase these inputs for increasing the output.

Table 4.11 Resource use efficiency in Soybean grain production

Sr. No.	Particulars	Units	GM	GM of Y	Unit price output	bi value	MP	MVP	MC	MVP/MC
1	Human labour (X_1)	days	126.66	58.07	3600	0.1599	0.07331	263.915	200	1.32
2	Bullock labour(X_2)	days	6.42	58.07	3600	0.1518	1.37306	4943.01	500	9.89
3	Machine (X_3)	hrs.	31.19	58.07	3600	0.2981	0.55501	1998.03	600	3.33
4	Manures (X_4)	q	3.13	58.07	3600	0.0005	0.00928	33.3949	150	0.22
5	N (X_5)	kg	108.15	58.07	3600	0.6362	0.3416	1229.76	42.6	28.87
6	P (X_6)	kg	261.81	58.07	3600	-0.0525	-0.0116	-41.921	46.9	-0.89
7	K (X_7)	kg	41.86	58.07	3600	0.2029	0.28147	1013.3	19.3	52.50
8	Plant protection charges (X_8)	₹	3488.76	58.07	3600	-0.009	-0.0001	-0.5393	1	-0.54
9	Seed (X_9)	kg	293.69	58.07	3600	0.0375	0.00741	26.6929	75	0.36

4.12 Resources use efficiency for soybean seed production

An efficiency of resources used in soybean seed production on the sample farms was judged with the help of MVP / MC ratio and the results are presented in table 4.12

It was revealed that the ratio of marginal value of product to factor cost ratio (MVP / MC) was greater than unity (*i. e.* under utilization), in case of resources like bullock labour (X_2), machine power (X_3) and plant protection charges (X_8) of soybean seed production implying the achievement of higher resource use efficiency in case of above mentioned variables, whereas MVP / MC ratio of human labour (X_1), manures (X_4), were found to be less than unity *i. e.* over utilization for these resources. In case of soybean seed production human labour (X_1), manures (X_4) were over utilized, that means there is no need to increase these inputs for increasing the outputs.

The MVP / MC ratio of nitrogen (X5), phosphorous (X6) and potassium (X7) were found to be negatively greater than unity which indicates that there is need to decrease these inputs for increasing the outputs. Similar results were found by Thejashree and Umesh, (2020) An Economic Analysis of Redgram Seed Production in Chikkaballapura District of Karnataka.

Table 4.12 Resource use efficiency in Soybean seed Production

Sr. No.	Particulars	Units	GM	GM of Y	Unit price output	bi value	MP	MVP	MC	MVP/MC
1	Human labour (X_1)	days	75.78	40.04	4200	0.0855	0.04518	189.76	200	0.6733
2	Bullock labour(X_2)	days	5.44	40.04	4200	0.2211	1.62736	6834.92	500	12.1972
3	Machine (X_3)	hrs	16.78	40.04	4200	0.2154	0.51398	2158.72	600	3.5893
4	Manures (X_4)	q	5.39	40.04	4200	0.0001	0.00074	3.12	150	0.0028
5	N (X_5)	kg	65.38	40.04	4200	-0.161	-0.099	-415.66	42.6	-9.0106
6	P (X_6)	kg	146.207	40.04	4200	-0.325	-0.0892	-374.62	46.9	-7.3740
7	K (X_7)	kg	29.36	40.04	4200	-0.250	-0.3413	-1433.7	19.3	-68.4722
8	Plant protection charges (X_8)	₹	1906.67	40.04	4200	0.072	0.00151	6.36009	1	5.7558
9	Seed (X_9)	kg	198.25	40.04	4200	-0.015	-0.003	-12.724	80	-0.1590

4.13.1 Problems in Soybean grain production

The information regarding problems in soybean grain production was presented in table 4.13. Out of 45 soybean grain grower's labour scarcity at peak season ranked as first by 20 respondent, second rank by 16 respondents, third rank by 7 respondents, fourth and sixth rank by 1 respondents each. Similarly high wages rates ranked as first by 18 respondents, second ranked by 14 respondents, third ranked by 10 respondents.

Table 4.13 Preference and ranking of problems faced by Soybean grain growers

Sr. No.	Problems	Rank given by the respondent							
		I	II	III	IV	V	VI	VII	VIII
1	High wages rates	18	14	10	1	1	1	0	0
2	High cost of seed	1	10	19	11	1	1	2	0
3	Insufficient institutional credit	1	1	6	20	12	1	3	1
4	Lack of availability of good quality seed	2	0	1	7	19	11	5	0
5	Lack of technical knowledge	1	3	1	2	9	20	5	4
6	labour scarcity at peak season	20	16	7	1	0	1	0	0
7	High cost of fertilizer	0	0	1	2	3	7	17	15
8	High cost of pesticides	2	1	0	1	0	3	13	25

Garret value is calculated by using the garret ranking conversion table. In this table, per cent position is given along with garret score. The nearest value of per cent position is seen from the table and garret score is given to that per cent position.

The above findings are confirmed with results of Akhirwar *et al*. (2014) show that major problems in soybean grain production were labour scarcity at peak season, high cost of inputs, lack of availabiliry of good quality seed etc

Table 4.14 Per cent position and garret value for problems in Soybean grain productions

Sr. No.	100 (Rij-005) / Nj	Percent position	Garret value
1	100*(1-0.5)/8	6.25	80
2	100*(2-0.5)/8	18.75	68
3	100*(3-0.5)/8	31.25	60
4	100*(4-0.5)/8	43.75	53
5	100*(5-0.5)/8	56.25	47
6	100*(6-0.5)/8	68.25	41
7	100*(7-0.5)/8	81.25	32
8	100*(8-0.5)/8	93.75	20

Table 4.15 Garret Score of Soybean grain growers

Sr. No.	Problems	Garret score									%	Rank
		I	II	III	IV	V	VI	VII	VIII	Total		
1	High wages rates	1440	952	600	53	47	41	0	0	3133	69.62	**2**
2	High cost of seed	80	680	1140	583	47	41	64	0	2635	58.56	**3**
3	Insufficient institutional credit	80	68	360	1060	564	41	96	20	2289	50.87	**4**
4	Lack of availability of good quality seed	160	0	60	371	893	451	160	0	2095	46.56	**5**
5	Lack of technical knowledge	80	204	60	106	423	820	160	80	1933	42.96	**6**
6	labour scarcity at peak season	1600	1088	420	53	0	41	0	0	3202	71.16	**1**
7	High cost of fertilizer	0	0	60	106	141	287	544	300	1438	31.96	**7**
8	High cost of pesticides	160	68	0	53	0	123	416	500	1320	29.33	**8**

Problems ranked by soybean grain growers are mentioned in table 4.19. labour scarcity at peak season got the first rank, followed by high wages rates, high cost of seed, insufficient institutional credit, lack of availability of good quality seed, lack of technical knowledge, high cost of fertilizers and high cost of pesticide rank II, III, IV, V, VI, VII, VIII respectively.

4.13.2 Problems in Soybean seed productions

The information regarding problems in soybean seed production were presented in table 4.14. Out of 45 soybean seed growers labour scarcity at peak season ranked as first by 21 respondents, second rank by 19 respondents, third rank by 2 respondents. Similarly risk of rejection of soybean seed at the time of grading, processing and testing ranked as first by 18 respondents, second ranked by 19 respondents, third ranked by 5 respondent

Garret value are calculated by using the garret ranking conversion table. In this table, per cent position is given along with garret score. The nearest value of per cent position is seen from the table and garret score is given to that per cent position.

Table 4.16 Preference and ranking of problems faced by farmers in soybean seed productions

Sr. No.	Problems	Rank given by the respondent							
		I	II	III	IV	V	VI	VII	VIII
1	Risk of rejection of soybean seed at the time of grading, processing and testing	18	19	5	0	0	0	2	1
2	High cost of foundation seed	1	0	8	16	17	1	1	1
3	Lack of availability of good quality seed	1	1	2	4	14	17	5	1
4	High wages rates	2	4	19	11	4	5	0	0
5	Maintenance of seed plot required more labour	0	1	8	12	8	9	7	0
6	Labour scarcity at peak season	21	19	2	1	0	2	0	0
7	Insufficient institutional credit	0	1	0	1	1	7	21	14
8	Lack of technical knowledge	2	0	1	0	1	4	9	28

Problems ranked by soybean seed growers are mentioned in table 4.19. The labour scarcity at peak season got the first rank, followed by risk of rejection of soybean seed at the time of grading, processing and testing, high wages rates, high cost of foundation seed, maintenance of seed plot required more labour, lack of availability of good quality seed, lack of technical knowledge

Table 4. 17 Per cent Position and Garret Value for Problems in Soybean Seed Productions

Sr. No.	100 (Rij-005) / Nj	Percent position	Garret value
1	100*(1-0.5)/8	6.25	80
2	100*(2-0.5)/8	18.75	68
3	100*(3-0.5)/8	31.25	60
4	100*(4-0.5)/8	43.75	53
5	100*(5-0.5)/8	56.25	47
6	100*(6-0.5)/8	68.25	41
7	100*(7-0.5)/8	81.25	32
8	100*(8-0.5)/8	93.75	20

Table 4.18 Garret Score of Soybean seed Growers

Sr. No.	Problems	Garret score								Total	%	Rank
		I	II	III	IV	V	VI	VII	VIII			
1	Risk of rejection of soybean seed at the time of grading, processing and testing	1440	1292	300	0	0	0	64	20	3116	69.24	**2**
2	High cost of foundation seed	80	0	480	848	799	41	32	20	2300	51.11	**4**
3	Lack of availability of good quality seed	80	68	120	212	658	697	160	20	2015	44.78	**6**
4	High wages rates	160	272	1140	583	188	205	0	0	2548	56.62	**3**
5	Maintenance of seed plot required more labour	0	68	480	636	376	369	224	0	2153	47.84	**5**
6	labour scarcity at peak season	1680	1292	120	53	0	82	0	0	3227	71.71	**1**
7	Insuffient institutional credit	0	68	0	53	47	287	672	280	1407	31.27	**7**
8	Lack of technical knowledge	160	0	60	0	47	164	288	560	1279	28.42	**8**

5. SUMMARY AND CONCLUSION

The cultivation of soybean plays an important role in the economy of nation because, most of the edible oil requirement of nation is met through import. It is one of the best sources of vegetable protein and also maintains the soil health with its nitrogen fixation ability and less exhaustive growth habit. As it is well known, that India is blessed with varying agro-climatic conditions and has abundant labour force, produces practically all varieties.

The present investigation entitled, "Comparative Economics of Seed Production vs Grain Production of Soybean in Washim District of Maharashtra", was undertaken with the following specific objectives.

1. To study comparative economics of seed productions vs grain productions of soybean
2. To study the Resource use efficiency of seed productions and grain productions of soybean
3. To study the problem faced by the farmers in seed productions and grain productions of soybean

Data for the study were collected from three tahsils of Washim district *viz.*,Risod, Washim and Malegaon these tahsils were purposively selected. From each tahsils three villages were selected. Totally nine villages were selected from each villages five soybean grain growers and five soybean seed growers were selected means from each villages ten (5 soybean grain and 5 soybean seed growers) were selected. Totally 90 (45 soybean grain growers and 45 soybean seed growers) were selected.

All the relevant data required for study were collected by survey method with the help of schedule specially designed for the purpose. Collection of data was done by personal interviews with the sample growers. Information pertaining to input utilization and constraints were collected for the year 2018-19.The collected data were analyzed with the help of tabular analysis such as averages, percentages, ratios, standard cost concepts and Garret ranking *etc.* besides Cobb-Douglas production functional analysis has been employed. The summary of the results so obtained from the analysis of data is presents as below.

5.1 Summary

1. The average size of land holding was 5.21 and 3.13 hectares for soybean grain and seed grower, respectively. The percentage of irrigated area is substantially higher in case of grain grower as compared to seed grower of soybean. The net cropping area of soybean grain and seed grower was 5.00 and 3.00 hectares, respectively.
2. The cropping intensity was observed as 132.00 and 158.05 per cent of soybean grain and seed grower respectively.
3. The cropping pattern of selected farmers in kharif is dominated by soybean, pigeon pea and cotton the area under cotton has decreased and area under soybean has increased.

4. The major contribution in farm assets was of land followed by the houses and cattle shed. Soybean seed growers have invested more in tractor and its implements compared to soybean grain growers.soybean grain growers have invested more in bullock pair (47.48 per cent) and soybean seed growers have invested more in bullock pair (50.50 per cent). In case of soybean grain grower's major contribution in livestock was of bullock pair, followed by cows and in case of soybean seed grower's major contribution in livestock was of bullock pair, followed by buffalo.
5. All the resources *viz,* human, bullock and machine labour, seed, manures, fertilizers and plant protection charges were higher used in seed production over grain production in soybean. The seed grower has to strictly adhere to the recommended cultural practices to ensure genetic purity as laid down by the seed certification agency. Seed production plot must be weed free and off-type plants need to be removed manually to maintain genetic purity. Proper drying of seeds and preliminary processing is another special operation in seed production. All these operations required additional labour.
6. The total cost of cultivation in soybean seed production was higher than grain production. The Per hectare gross income received by soybean seed grower was ₹ 77056.75 and it was ₹ 56788.37 in case of soybean grain grower therefore, soybean seed grower obtain more gross income than soybean grain grower. Higher gross income was mainly due to higher productivity (18.06 q./ ha.) in case of soybean seed production as compare to soybean grain production(15.47 q./ ha.).
7. The B:C ratio at cost "C" was 1.33 in case of soybean seed production as compared to 1.12 in grain production.The B:C ratio of more than unity indicated that the seed production in the study area is a economically viable proposition.
8. In case of soybean grain production, the value of R^2 was 0.79 and for seed production it was 0.71, it indicated that the factor under consideration *viz,* Human labour (X_1), bullock labour (X_2),Machinery (X_3),Manures (X_4), N quantity in (X_5), P quantity in (X_6), K quantity in (X_7), plant protection charges (X_8) and seed (X_9) explained 79 per cent and 71 per cent variation in output of soybean grain and seed production, respectively.
9. The major problems faced by the soybean grain grower were the labour scarcity at peak season, high wages rates, high cost of seed, insufficient institutional credit, lack of availability of good quality seed, lack of technical knowledge, high cost of fertilizers and high cost of pesticide .
10. Whereas in case of soybean seed production growers reported following problems. Such as labour scarcity at peak season, risk of rejection of soybean seed at the time of grading, processing and testing, high wages rates, high cost of foundation seed, maintenance of

seed plot required more labour, lack of availability of good quality seed, insufficient institutional credit and lack of technical knowledge etc.

5.2 Conclusions

1. The cropping pattern of selected farmers in kharif is dominated by soybean, pigeon pea and cotton the area under cotton has decreased and area under soybean has increased.
2. All the costs were higher in seed production over grain production in soybean. The seed grower has to strictly adhere to the recommended cultural practices to ensure genetic purity as laid down by the seed certification agency. Seed production plot must be weed free and off-type plants need to be removed manually to maintain genetic purity. Proper drying of seeds and preliminary processing is another special operation in seed production. All these operations required additional labour. Hence, cost of cultivation was higher in seed production as compared to the grain production. The cost A, B and C were higher in soybean seed production in comparison to grain production respectively.
3. The per hectare cost of cultivation was ₹50747.7 and ₹57901.09 for soybean grain and seed production. The per hectare cost of cultivation was higher in soybean seed production than grain production but per quintal cost were ₹3288.03 and ₹3206.04 for soybean grain and seed production respectively. Per quintal cost was lower in seed production than grain production mainly because of its higher productivity.
4. The per hectare income received from soybean seed production (₹77056.75) was higher showing more economic viability than that of grain production (₹56788.37). The B:C ratio at cost "C" was 1.33 in case of soyabean seed production as compared to 1.12 in grain production.The B:C ratio of more than unity indicated that the seed production in the study area is a economically viable proportion.
5. The functional analysis was also carried out by using Cobb-Douglas type of production function and significance of the parameters of the function was tested by using student't' test . The appropriateness of estimated model and the variable incorporated in model were tested by estimating R^2 values. The results of cobb-Douglas production function indicated that there is scope for increasing the use of human labour, bullock labour, machine power, nitrogen and potassium for soybean grain production and bullock labour, manure power and plant protection charges for soybean seed production to obtain higher gross return
6. The findings of the investigation further showed that problems faced by soybean grain growers in production Such as labour scarcity at peak season, high wages rates, high cost of seed, insufficient institutional credit etc. whereas, problems faced by soybean seed growers were Such as labour scarcity at peak season, risk of rejection of soybean seed at the time of grading, processing and testing, high wages rates, high cost of foundation seed etc.

5.3 Suggestions

1. Seed production of soybean is more profitable compared to grain production of soybean. Therefore, to increase their income, more and more number of farmers can take up seed production in areas where soybean is grown predominantly, provided the procedures and other formalities in registering the seed farms are simplified.
2. The resource use efficiency analysis revealed that there is scope for increasing the use of resources like bullock labour , machine power and plant protection charges because they are overused in soybean seed production .Hence, there is need to educate the farmers on the optimal use of these resources.
3. Constraints analysis indicated that labour scarcity at peak season was the major constraint as seed and grain production is labour intensive. Hence, there is need to farm mechanization must be encouraged, particularly during the peak seasons to ward off labour supply demand gap, further extending custom hiring services would help in addressing labour problems.

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7. APPENDIX - I

QUESTIONNAIRE (2018-19)

Comparative Economics of Seed Production vs Grain Production of Soybean in Washim district of Maharashtra.

1. Name of Soybean Grain / Seed Grower :

Age: Education: Occupation:

Village: Tal: District:

Mobile No:

2. Family Information

Sr. No.	Name	Relation with head of family	Age (years)	Education	Occupation	Income (₹)

3. Land Use Pattern

Sr. No.	Survey No.	Total holding	Permanent Fallow	Operational Holding		Current fallow	Land Revenue	Present value
				Irrigated	Rainfed			

4. **Buildings**

Sr. No.	Building type	Size	Building year	Present value (₹)	Repairing charges (₹)	Remaining life (years)
1	House					
2	Farm house					
3	Cattle shed					
4	Store house					
5	Shop					
6	Other					

5. Irrigation Structure

Sr. No.	Type	Digging/ Purchasing Year	Present value (₹)	Irrigation capacity (ha)	Remaining life (years)	Repairing Charges (₹)
1	Well					
2	Bore-well					
3	Pipe line(m/f)					
4	Electric motor (hp)					
5	Diesel engine					
6	Drip/sprinkler system					
7	Other					

6. Farm Implements and Machineries

Sr. No.	Particulars	Number	Purchase year	Purchase Cost (₹)	Repairing charges (₹)	Remaining life
A	Implements					
1	Wooden					
2	Plough					
3	Iron plough					
4	Harrow					
5	Seed drill					
6	Hoes					
7	Other					
B	Machineries					
1	Tractor					
2	Trolley					
3	Rotavator					
4	Plough					
5	Harrow					
C	Bullock cart					
D	Spade					
E	Sickle					
F	Axe					
G	Other					

7. Livestock

Sr. No.	Type	Number	Age (years)	Present value (₹)
1	Bullock			
2	Cow			
A	Local			
	Milch			
	Dry			
B	Crossbreed			
	Milch			
	Dry			
C	Calves			
3	Buffalo			
A	Milch			
	Dry			
B	Calves			
C	Goats			
4	Poultry			
5	Other			

8. Cropping Pattern (2018-19)

Sr. No.	Season	Crop	Area (ha)	
			Irrigated	Rainfed
1.	Kharif	1 2 3 4 5 6		
2.	Rabi	1 2 3 4 5		
3.	Summer	1 2 3 4 5		
4.	Annual	1 2 3 4		
5.	Fruit crops	1 2 3 4		
6.	Vegetables	1 2 3 4 5		

9. Cost of Cultivation of Soybean Grain / Seed

Area: Plot No.: I/U: Variety: Date of sowing: Date of Harvesting:

Sr. No.	Operation	Material			Labour								Rate				Total cost
					Family			Hired			Machinery		M	F	B	Machinery	
		Name	Qty.	Value	M	F	B	M	F	B	Family	Hired					
1.	**Preparatory Tillage**																
a.	Ploughing																
b.	Harrowing																
c.	Clod crushing																
d.	Stubble Picking																
e.	Manuring																
2.	Sowing																
2.1	Seed Treatment																
3.	**Intercultural operations**																
3.1	Chemical Fertilizers		Ss														
	i)																
	ii)																
	iii)																
3.2	Weeding																
3.3	Hoeing																
3.4.	**Plant Protection**																
a.	Insecticide																

Table contd…

Sr. No.	Operation	Material			Labour								Cost				Total cost
					Family			Hired			Machinery		M	F	B	Machinery	
		Name	Qty.	Value	M	F	B	M	F	B	Family	Hired					
b.	Fungicides																
c.	Herbicides																
d.	Others																
4	Harvesting																
5	Threshing																
6	Transport																
7	Others																
8	Total Cost																
9	Total Yield																
10	Per quintal price																

10. Problems in Grain Production of Soybean

Sr. No.	Problems	Rank given by the respondent							
		I	II	III	IV	V	VI	VII	VIII
1	High wages rates								
2	High cost of seed								
3	Insufficient institutional credit								
4	Lack of availability of good quality seed								
5	Lack of technical knowledge								
6	labour scarcity at peak season								
7	High cost of fertilizer								
8	High cost of pesticides								

11. Problems in Seed Production of Soybean

Sr. No.	Problems	Rank given by the respondent							
		I	II	III	IV	V	VI	VII	VIII
1	Risk of rejection of soybean seed at the time of grading, processing and testing								
2	High cost of foundation seed								
3	Lack of availability of good quality seed								
4	High wages rates								
5	Maintenance of seed plot required more labour								
6	labour scarcity at peak season								
7	Insuffient institutional credit								
8	Lack of technical knowledge								

7. VITAE

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IN
AGRICULTURAL ECONOMICS

2021

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