2021

Report

Impact Evaluation: Bridging Yield Gaps in Lentil Through Technology Interventions and Capacity Development for Enhanced Production and Rural Livelihood of Madhya Pradesh

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Abbreviations

OBC	Other Backward Classes
SC	Scheduled Caste
ST	Scheduled Tribe
GEN	General
PSB	Phosphate Solubilizing Bacteria
DAP	Di Ammonium Phosphate
ICARDA	The International Center for Agriculture Research in the Dry Areas
RKVY	Rashtriya Krishi Vikas Yojana

Executive Summary

Lentil is an important pulse that constitutes high protein content. The crop is beneficial to soil health also. In India, Madhya Pradesh produces the highest amount of lentil. Despite this fact, the average productivity of lentil in Madhya Pradesh has remained unstable and low.

The major constraints include climate variability, wilt disease, non-availability of improved variety seed, scientific inputs, etc., Thus the interventions have been done to overcome some of these challenges under the project name "Bridging yield gaps in lentil through technological intervention and capacity development for enhanced production and rural livelihood in Madhya Pradesh". The major aim of the project is to attain the maximum potential of lentil production through participatory technological interventions and capacity development. The project was sanctioned by the department of Farmer's welfare and Agriculture department, Ministry of Agriculture, Govt. of Madhya Pradesh to the Food Legume Research Platform-International Center for Agricultural Research in the Dry Areas (FLRP-ICARDA), Amlaha for three years 2017-18 to 2019-20. The project was implemented in the year 2017-18 in eight districts of Madhya Pradesh. Four districts namely, Tikamgarh, Narsinghpur, Sagar, and Sehore were taken as sample districts for the study.

This impact assessment study is done to assess the program "Bridging yield gaps in lentil through technological intervention and capacity development for enhanced production and rural livelihood in Madhya Pradesh". The study was conducted across **33** villages and a total of **284** beneficiaries were contacted for the purpose. The following objectives were proposed for the study

- To assess the impact of the project in terms of enhancing the overall farm productivity and profitability through technology interventions
- To assess the quality seed production and delivery system at the village level
- To assess the impact of the project in terms of knowledge empowerment of the beneficiary farmers through capacity building programs
- To study the bottlenecks and gaps in the effective implementation of the project
- Make recommendations to improve the effectiveness of the program design and its delivery

Key Findings

Profile of the Respondents:

Data collection and analysis across sample locations have revealed that about **45%** of the respondents are female and the remaining **55%** are males. Participation of such a large proportion of females is a good sign and also sheds some light on the beneficiary selection process of the implementing agency. Caste wise distribution of the respondents across locations is slightly skewed towards the backward classes as around **68%** of the respondents are from the OBC category. The second-largest proportion in terms of caste is of the ST's, they are **20%** of the respondents and in the remaining general category is third and lastly the SC with the lowest representation.

About **three-fifths** of the respondents are from the **APL** category and the remaining **two-fifths** fall into the **BPL** category. Slightly less than half of the respondents are small and marginal farmers and about 13% are large farmers. The primary level of education is attained by at least

56% of the respondents across sample districts and **23%** are illiterate. 36–55 years of age bracket is the one in which more than half, about **55%**, of the respondents fall and most of the respondents, **96%**, are married.

Major Kharif Crops:

Major Kharif crops cultivated in the sample districts are as follows; Soyabean, sesame, and urad in Tikamgarh. Soyabean, sugarcane, and maize in Narsinghpur. Soybean is the major Kharif crop in Sagar and Sehore districts.

Lentil Production:

As far as lentil production is considered about **73%** of the respondents said that they did not use to grow lentil before the intervention and **27%** said otherwise. The total area under lentil production, for the respondents, in 2016-17 was **185.25** acres which increased to **405.20** acres in 2017-18 and went down in 2019-20 to **157** acres. This variation may be due to the unavailability of quality seeds to the farmer. Following the change in the area under lentil, the production of lentil also varied, the manner of variation is as follows; **417** quintals in 2016-17 to **6780** quintals in 2017-18 to **819** quintals in 2019-20.

The training and the quality of seeds impacted the cost of cultivation, the cost of cultivation in 2016-17 was **₹ 7137** for an acre which went down to **₹ 4705** in 2017-18 and again rose to **₹ 6459** in 2019-20. Post-intervention the lentil fetched a price of **₹ 4208** per quintal in 2017-18 which was lesser in 2016-17 as the selling price in the same year was **₹ 3818**. The selling price again dipped in the year 2019-20 to **₹ 4034**. The majority of the produce was sold into the market and a very small proportion of the respondents did sell the produce to the fellow farmers. The positive impacts on the respondents can be easily attributed to the intervention.

A few more positive impacts have been such as the seed rate utilized during the cultivation of lentil have approached near the optimal value of **50 kg/ha** and the use of traditional seeds in lentil production has gone down drastically from **98%** in the year 2016-17 to a mere **1%** in 2017-18. The use of traditional seeds has however increased a bit from its previous value of 1% to **14%** in 2019-20. RVL-31 has emerged as the best quality seed for lentil production, it is disease-resistant, wilt resistant, and a higher productivity per acre as compared to the traditional seeds.

Access to New Improved Quality Seeds:

Seed distribution was a major task and a large portion of it across the sample districts was done by ICARDA. In, Tikamgarh, Narsinghpur, and Sehore districts all the seed distribution was done by ICARDA whereas in the Sagar district Jawahar Lal Nehru Krishi Vishwa Vidyalaya, Sagar played a crucial role in the same.

The majority of the respondents got the right quantity of new variety seeds for cultivation, at the district level almost all the respondents of Tikamgarh and Sagar said that they got the right amount and more than **60%** in Narsinghpur and about **78%** in Sehore reported the same. All the respondents across the four locations got the new variety seeds well within the time of sowing. The majority was in favour that the disease resistance of new variety seed was better than the traditional seeds with a marginal proportion in Sagar **(14%)** and Narsinghpur **(10%)** who did not agree to the same. Respondents of Tikamgarh district did not see any kind of

disease in their fields whereas, in Sehore **(85%)**, Sagar **(51%)** and Narsinghpur **(65%)** said that their plants did develop diseases. Using a new variety of seeds was advantageous for a majority of the respondents across the locations except for about **30%** in Narsinghpur,**12%** and **9%** in Sehore and Sagar respectively.

The beneficiaries were provided with quality seeds, Rhizobium, PSB, DAP, manure, etc., free of cost, and much before the start of sowing. At the district level, a major portion of the respondents, about **98%** in Tikamgarh, **93%** in Sagar, **87%** in Sehore agreed that they got the inputs on time but **55%** of the respondents reported that they got the agricultural inputs late.

Training and Capacity Building:

Training before sowing was provided to about **98%** of respondents in Tikamgarh and **79%** of the respondents in Sagar. According to the respondents, **55%** in Narsinghpur and **60%** of respondents were not provided with any training. A proportion of about **77%** of total respondents was trained in their respective villages, **19%** at the ICARDA centre, and a marginal **4%** at the KVK's. ICARDA was the agency that provided the training to about **81%** of the respondents.

As far as training after sowing is considered the majority of the candidates were not trained. Drilling down to the district level it is revealed that **95%** in Tikamgarh, **80%** in Narsinghpur, **60%** in Sehore, and **60%** in Sagar were not trained after sowing was over. Except for Sagar, where **75%** of the respondents were trained by the Agriculture Department, all the respondents were trained by ICARDA. Training at the villages was organized for all the respondents in Tikamgarh and Sagar districts. ICARDA provided training to all the respondents of Sehore at their centre, while in Narsinghpur **33%** of respondents were trained at their villages and the remaining **67%** at the KVK's. The majority of the respondents across the sample districts said that they did not have any problems during the training and **80%** had no problem in lentil production. The training was beneficial for **100%, 70%, 88%, and 64%** of the respondents of Tikamgarh, Sehore, Sagar, and Narsinghpur respectively.

Conclusion and Recommendations:

Overall, the project was beneficial for the beneficiaries. Increased productivity, lesser use of herbicide and fungicides, and lower instances of diseases lowered the expenses from the farmer's pocket and increasing his gains. There were some shortcomings in the program too, as no baseline study was done the beneficiary identification was not proper. Monitoring is a major task for the success of any program ad it also helps in course correction, this was not proper in the implementation of the program. During field visits, it was revealed that monitoring was missing during the implementation phase.

A baseline study must be conducted before the implementation of such programs so that the right beneficiaries may be selected. Monitoring must be foolproof and very strong as it is vital for the success of any program. Value chain studies should be done to increase the value of the lentil which in turn will increase the incomes of the farmer. The number of days and duration of training could have been more for proper dissemination of knowledge among the trainees. Seed procurement from M.P. Beej Nigam Limited is a good option as it will ensure that the seeds procured will be of prime quality. Steps to reduce temporal and spatial variation in price, and provide a competitive market price of pulses will help in enhancing as well as sustaining the farmer's interest in pulses.

Chapter 1: Introduction

1.1 Status of lentil Production: An Overview (India and Madhya Pradesh)

Lentil (Lens culinaris) is a self-pollinating, cool-season pulse crop. It is cultivated in subtropical and warm temperate regions, and at high altitudes in the tropics. The legume has an impressive nutritional profile; the high protein content is one of its main traits. It is a powerhouse and can be a good source of food for the poor. The high values of various nutrients can fulfill the nutritional needs of an individual to a large extent. Consumption of lentil has various health benefits as well, it can improve heart health, may decrease cholesterol, improves glycemic control, prevents obesity and cancer.

The crop is not only beneficial for human health but can improve soil health too. It is a legume and legumes are well known for their nitrogen fixation property; it fulfills most of its N requirement through atmospheric N_2 fixation with the symbiotic help of rhizobia living in its root nodules. This is very beneficial for the soil and also for the crop that will be grown after harvesting lentil or any other legume. This nitrogen fixation increases the amount of nitrogen in the soil and thus the amount of nitrogen that is required is decreased hence decreasing the amount of NPK to be administered on the land. Economic benefits are only part of the reason for growing lentil. Lentil offers rotational benefits as well:

- Decreased need for nitrogen inputs to the following crop
- Decreased costs for herbicides and fungicides in the following crop
- Increased yields of the following crop
- Increased quality of the crop grown the year after lentil (for example, protein premium on wheat)

Canada is the largest producer of lentil in the world followed by India as shown in figure 1. The difference is majorly due to the difference in productivity per unit of land in the two countries.

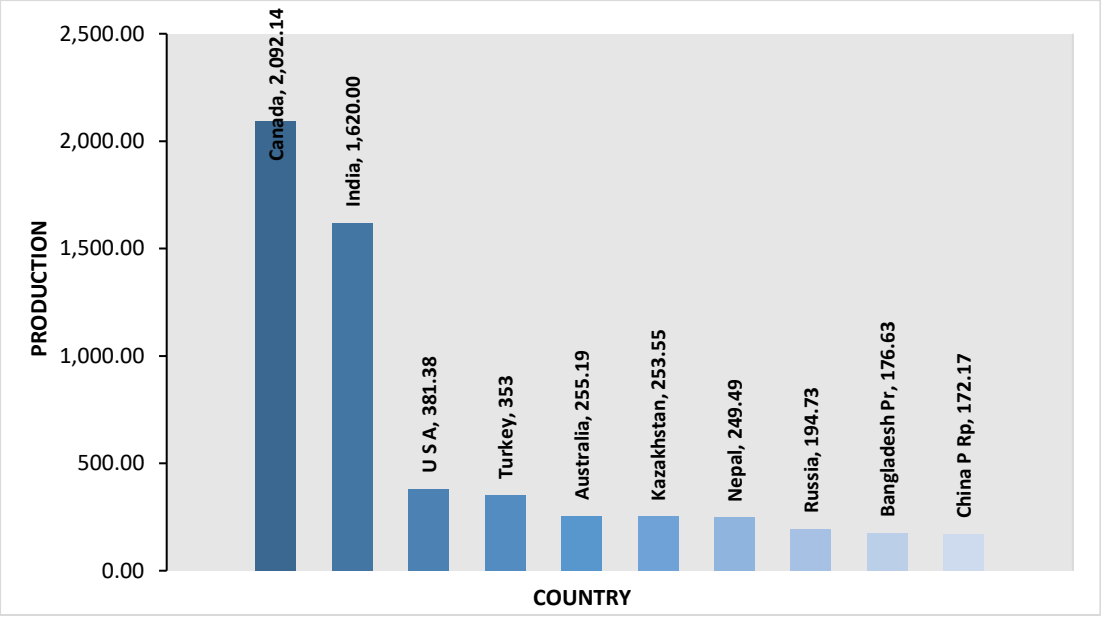

Figure 1: International Production of lentil in 2018.
Source:https://agriexchange.apeda.gov.in/International_Productions/International_Production.aspx?ProductCode=0201

India stands at the second position in the world in terms of the production of lentil. In India, lentil is grown in an area of 1.55 million hectares and producing 1.61 million tonnes production with 1034 kg/ha productivity.

As depicted in figure 2 there is a gradual increase year after in the area under the crop the production has also increased as a result. The yield of the crop has also increased, as shown in figure 3, but the increase has not been impressive. The reasons are mainly the deficiency of quality seeds, climate change, package of practices of the farmers. The farmers are unaware of the advanced technologies in the areas of agriculture and most of them are practicing the rice-wheat systems. There is an urgent need for the extension of information about new technologies and new varieties of seeds to the farmers.

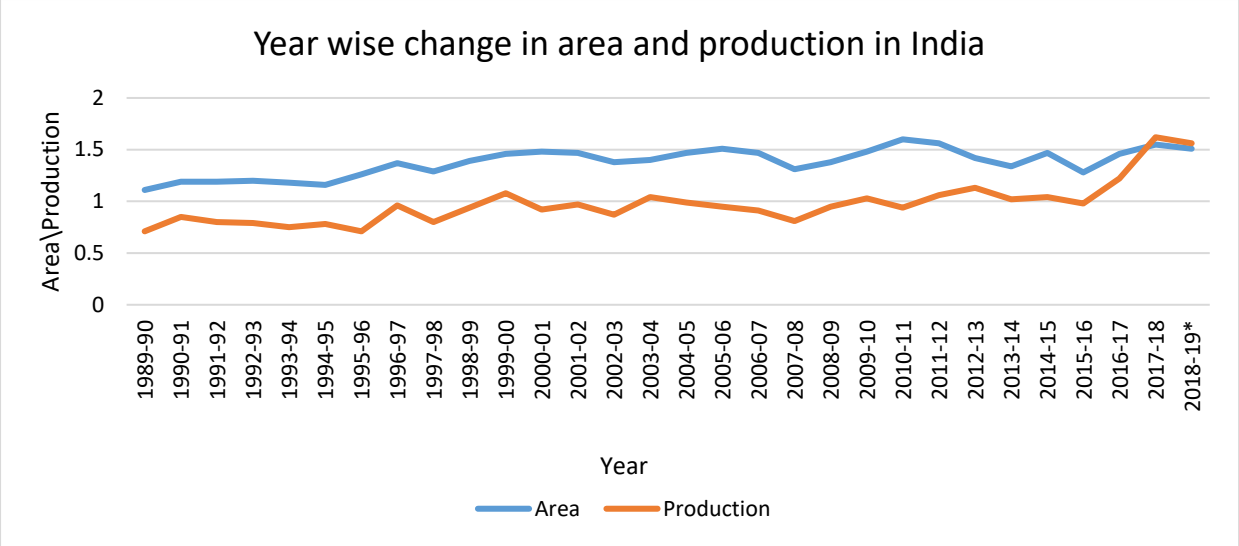

Figure 2: Year-wise change in the area (Million Hectares) under lentil and production (Million Tonnes) of lentil in India from 1989-90 to 2018-19

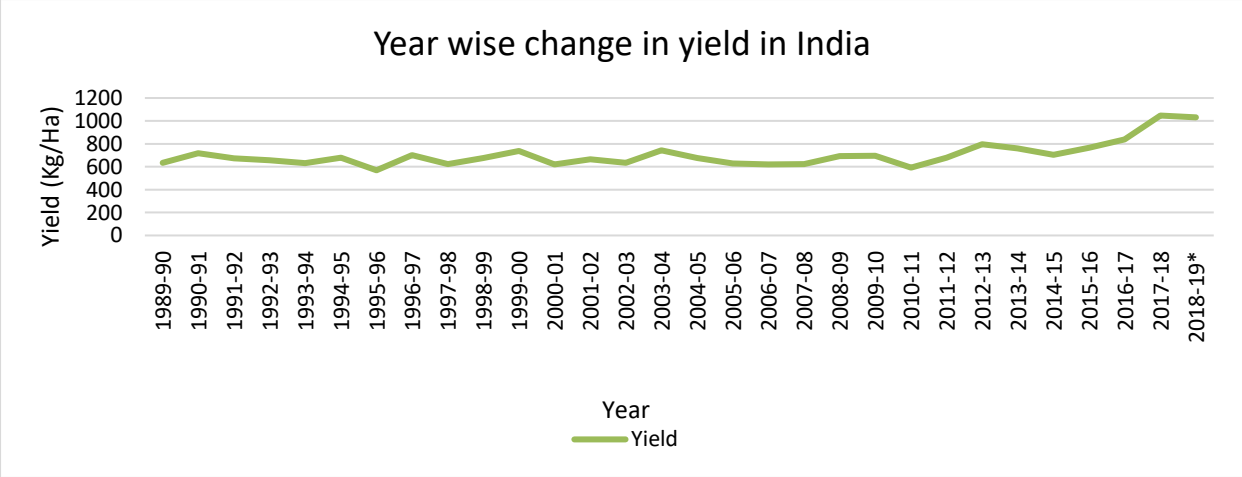

Figure 3: Year-wise change in the yield (Kg/Hectare) of lentil in India from 1989-90 to 2018-19

In India, Madhya Pradesh produces the highest amount of lentil followed by Uttar Pradesh, as can be seen from figure 4. Madhya Pradesh produces around 42.5% of the total lentil produced in India.

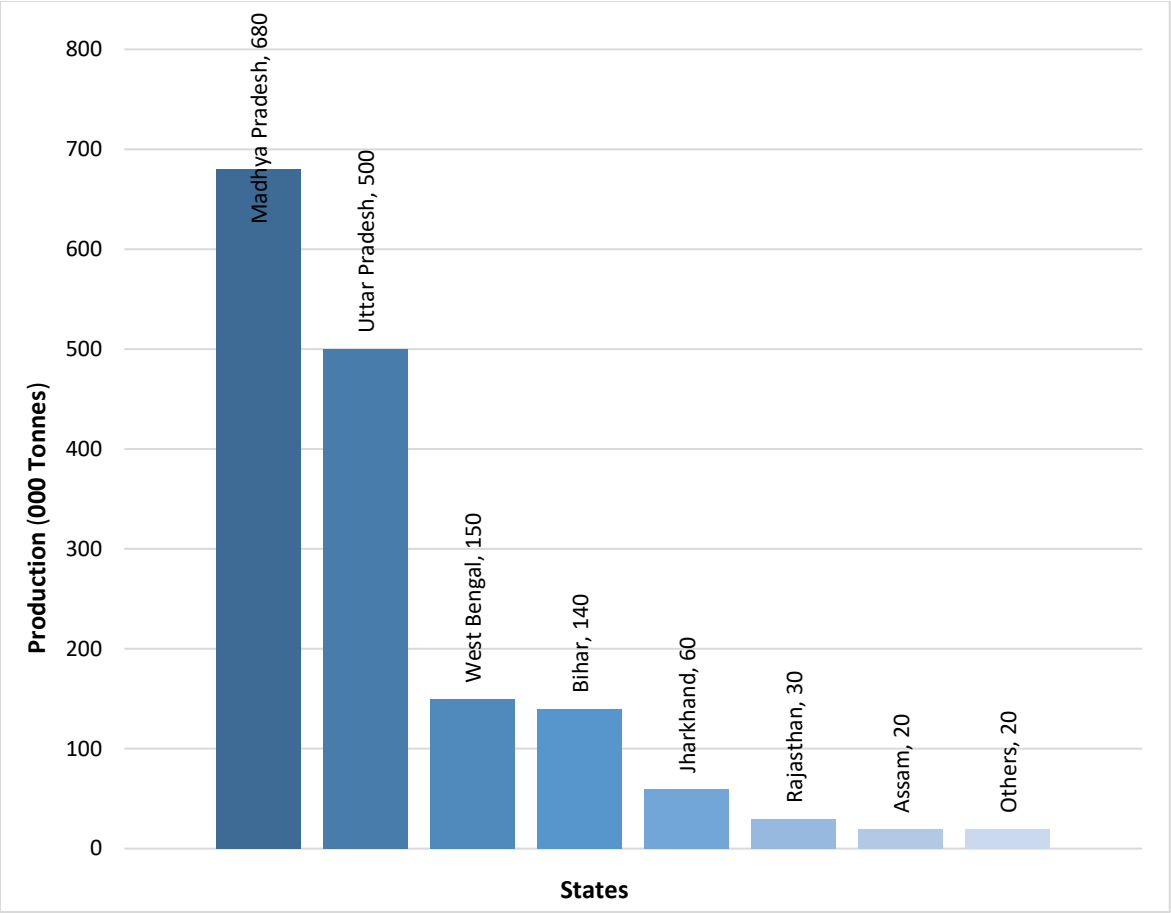

Figure 4: Top 10 lentil producing states of India in 2018.
Source: https://agriexchange.apeda.gov.in/India%20Production/AgriIndia_Productions.aspx?productcode=1008

Madhya Pradesh is the largest producer contributing about 42.26 percent of India lentil production. The lentil crop occupied 6.12 lakh hectare areas and contributed 4.16 lakh tone production with 678kg/ha yield during 2014-15.[1] The situation has improved in 2017-18 by covering an area of 0.60 million hectares with production and productivity of 0.68 million tonnes and 1139 kg/ha respectively. (Agricultural Statistics at a Glance, 2018). The production varied from 110.3 (1976-80) to 416(2014-15) thousand tonnes. The productivity has increased from 301 in 2010-11 to 678 Kg/Ha in 2014-15.

Lentil is mainly cultivated in Dindori, Rewa, Narsinghpur, Sagar, Vidisha, Satna, Mandla, Panna, Jabalpur, Anuppur, Seoni, Ashiknagar, Raisen, Rajgarh, Damoh, Katni, and Shajapur.

The state has shown a steady increase in lentil production, the average productivity of the lentil in the state against the national average (758 KG/Ha) has remained low and unstable. Lentil crop is prone to diseases like rust, wilt, and root rot. This indicates its vulnerability to climate variability and various biotic stresses, mostly drought and heat. Studies have reported that various biotic stress reduces the productivity of lentil crops by 20-25%.

[1] http://mpkrishi.mp.gov.in/hindisite_New/compendium2005-06_new.aspx

Changes in the area and production from the year 1997-98 to 2015-16 have been shown in figure 5, the area and the production levels did not change too much until 2010-11 but from the subsequent year i.e., 2011-12, here is an increase which is maintained till the end of the period being shown in figure 5.

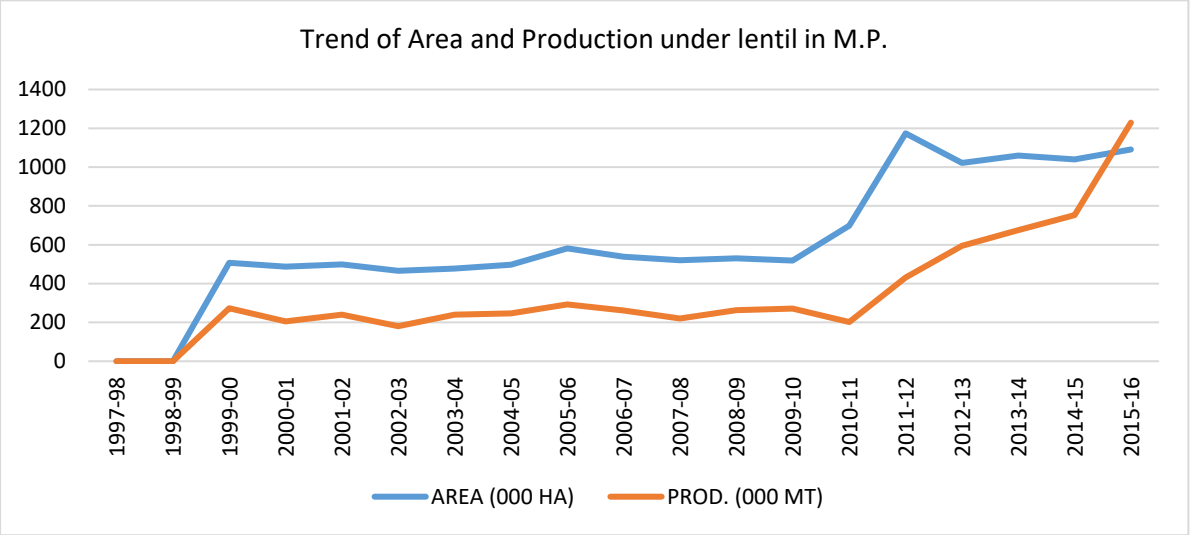

Figure 5: Trends in area and production of lentil from 1997-98 to 2015-16

The yield of lentil in M.P. has also been varying per year, until 2012-13 the yield was a little variable but as the area and productivity levels increased during the same year the productivity also shot up and the same has been shown in figure 6.

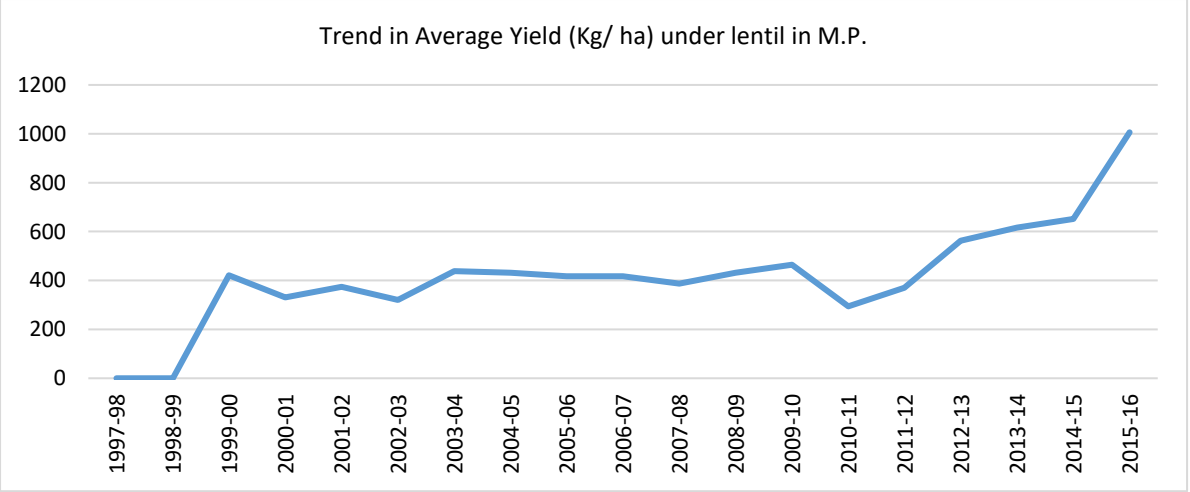

Figure 6: Trend in yield of lentil from 1997-98 to 2015-16

1.2 Project Interventions

The project "Bridging yield gaps in lentil through technological intervention and capacity development for enhanced production and rural livelihoods in Madhya Pradesh" was sanctioned by the Department of Farmer's Welfare & Agricultural Development, Ministry of Agriculture, Govt. of Madhya Pradesh to Food Legume Research Platform-International Center for Agricultural Research in the Dry Areas (FLRP-ICARDA), Amlaha for three years 2017-18 to 2019-20 to scale-up the existing best-bet lentil technologies to bridge the yield gaps through the adoption of improved varieties and production technologies.

The project funding was provided under Rashtriya Krishi Vikas Kalyan Yojna.[2] Seventeen districts, namely Sagar, Dindori, Rewa, Satna, Vidisha, Panna, Narsinghpur, Jabalpur, Mandla, Anuppur, Seoni, Damoh, Raisen, Katni, Ashoknagar, Shajapur, and Chhatarpur account for 90% of the total area under lentil in the state and thus the focus of the project. A total budget of Rs 7.57 cores (tentative) is proposed for the project.

Five potential villages in each district were proposed to select as the pilot village for technology interventions during 2016-17 years post rainy season. In each village, 100 farmers were proposed to form a cluster to involve in establishing demonstrations for testing and transfer of technologies. In 2017-18 total number of 39 blocks and 241 villages covering eight districts of the project area. A total of 944 farmers has been benefited in these eight districts through project interventions.

Table 1 is used to exhibit the number of blocks and number of villages per district and it also gives information about the variety of seeds that were distributed in the villages under the project.

Name of District	No of blocks	No of villages	Lentil Variety
Sehore	4	29	IPL-316, RVL-31, DPL- 62, Pusa Agiti, L4076
Sagar	6	37	IPL-316, RVL-31
Damoh	6	31	IPL-316, RVL-32
Vidisha	4	14	IPL-316, RVL-33
Shajapur	2	5	IPL-316, RVL-34
Raisen	6	49	IPL-316, RVL-35
Narsinghpur	5	14	IPL-316, RVL-36
Tikamgarh	6	62	IPL-316, RVL-31, L4076
Total	39	241	

Table 1: Varietal distribution of lentil in the project locations.

[2] Rashtriya Krishi Vikas Yojana (RKVY) scheme was initiated in 2007 as an umbrella scheme for ensuring holistic development of agriculture and allied sectors by allowing states to choose their own agriculture and allied sector development activities as per the district/state agriculture plan. The scheme has come a long way since its inception and has been implemented across two plan periods (11th and 12th).

Aims and Objectives of the Project:

The main objectives of the project were as follows

- To scale-up the existing best-bet varieties to bridge the yield gaps through farmer's participatory seed production and delivery system.
- To increase awareness of improved production technologies.
- To integrate low-cost agro-technologies to lentil production systems through increased access to production inputs for reaping the desired yield advantages and enhanced profitability
- To generate sufficient motivation among farmers and participating institutions through capacity building.
- To generate and evaluate improved varieties of lentil and production technologies for maintaining a continuum in the research-product delivery chain.

Expected Outcome of the Proposed Work:

- Through this intervention farmers of the participating district will be benefitted. Farmers who were not having recent varieties to meet the demand of production will get new high yielding, disease-resistant varieties and the scientific input which will give expected yield from their field.
- Farmer's Training program will teach them to adopt new scientific technology like; seed priming, a seed treatment for saving the crop from biotic & abiotic stresses, Rhizobium & PSB culture to get 15-20% higher yield, harvesting & storing the crop.
- This intervention will increase lentil productivity in Madhya Pradesh & India because India comes in the second rank in the terms of production but first in the area. To meet the challenge of the yield gap and improve rural livelihood in Madhya Pradesh this intervention will be the key point.

1.2 Need and Objectives of the impact Evaluation

The program "Bridging yield gaps in lentil through technological intervention and capacity development for enhanced production and rural livelihood in Madhya Pradesh" has ended in the year 2019-20. The broad aim of the present study is to conduct a third-party ex-post impact evaluation of the project interventions. The study would help to know the impacts it has made on the farmer's income, the levels of productivity, changes in their package of practices concerning lentil. The study will also try to find out the gaps and lacunae in the program and its implementation and suggest recommendations for the same. The department of Agriculture had expressed an interest in an ex-post impact evaluation study to AIGGPA of this project for the year 2017-18.

The following objectives were proposed for the study

- To assess the impact of the project in terms of enhancing the overall farm productivity and profitability through technology interventions
- To assess the quality seed production and delivery system at the village level
- To assess the impact of the project in terms of knowledge empowerment of the beneficiary farmers through capacity building programs
- To study the bottlenecks and gaps in the effective implementation of the project
- Make recommendations to improve the effectiveness of the program design and its delivery

1.3 Research Methodology

The study was conducted through quantitative and qualitative data and the concept of pre-and post-intervention analysis was utilized. The primary data is based on structured surveys, semi-structured interviews with concerned stakeholders, and observations. Case studies have also been developed across the four sample locations.

The study in the initial stages started from doing available literature surveys on the subject matter. Before the collection of primary data from the field, pilot testing was done in Sehore to get more clarity about the implementation of the project and check the validity of the survey tool. After the pilot phase, the inputs were also taken from all the stakeholders on the relevant issues and changes in the research tools were made accordingly.

Sampling Design:

A random stratified sampling method has used to collect samples from the identified districts. The project has been implemented in 8 districts namely Sehore, Sagar, Damoh, Vidisha, Shajapur, Raisen, Narsinghpur, Tikamgarh in the year 2017-18. A total of 944 farmers has been benefited in these eight districts. The study has evaluated the project in four districts Tikamgarh, Sagar, Narsinghpur, and Sehore which covers three divisions namely Jabalpur, Bhopal, and Sagar. Using Sloven's method we determine the sample size of the farmers to be 283, as shown in table 2. A total of four case studies had prepared to cover the qualitative aspect of the study. The sample size for four districts is proportionally varied (according to the number of farmers benefited in the respective districts) as depicted in table 1.

District	Sample Size	Case Studies
Tikamgarh	120	1
Sagar	43	1
Narsinghpur	20	1
Sehore	100	1
Total	**283**	**4**

Table 2: Sample design

Four districts, Sagar, Sehore, Tikamgarh, and Narsinghpur were selected for the study and are highlighted in figure 7.

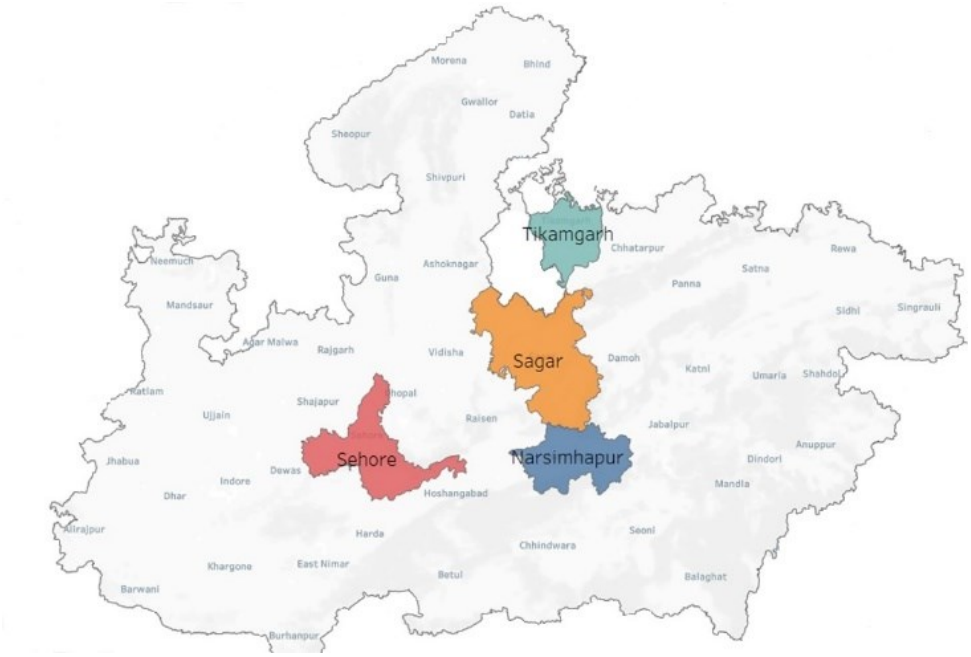

Figure 7: Geographical coverage

Chapter 2: Study Results and Findings

2.1 Area, Production, and Yield of Lentil in the project areas

2.1.1 Change in the area under lentil for the 5 years (2015-16 to 2019-20):

The secondary data has been collected from the Agriculture Department of Madhya Pradesh to analysis the status of lentil in project areas. The variation in the area under lentil in the project districts for a period of years from 2015-16 to 2019-20 has been reflected in figure 8. During the initial two-year period, the area under lentil increased for all the districts. In the third year, i.e. 2017-18 the area decreased in Damoh, Narsinghpur, Sagar, and Tikamgarh and increased for the remaining four districts.

The area under lentil production further decreased in the year 2018-19 in all the locations except for Sagar which saw an increase in the area under lentil production. For the following year, 2019-20, when compared to the year before the area under lentil production again went down for all the locations.

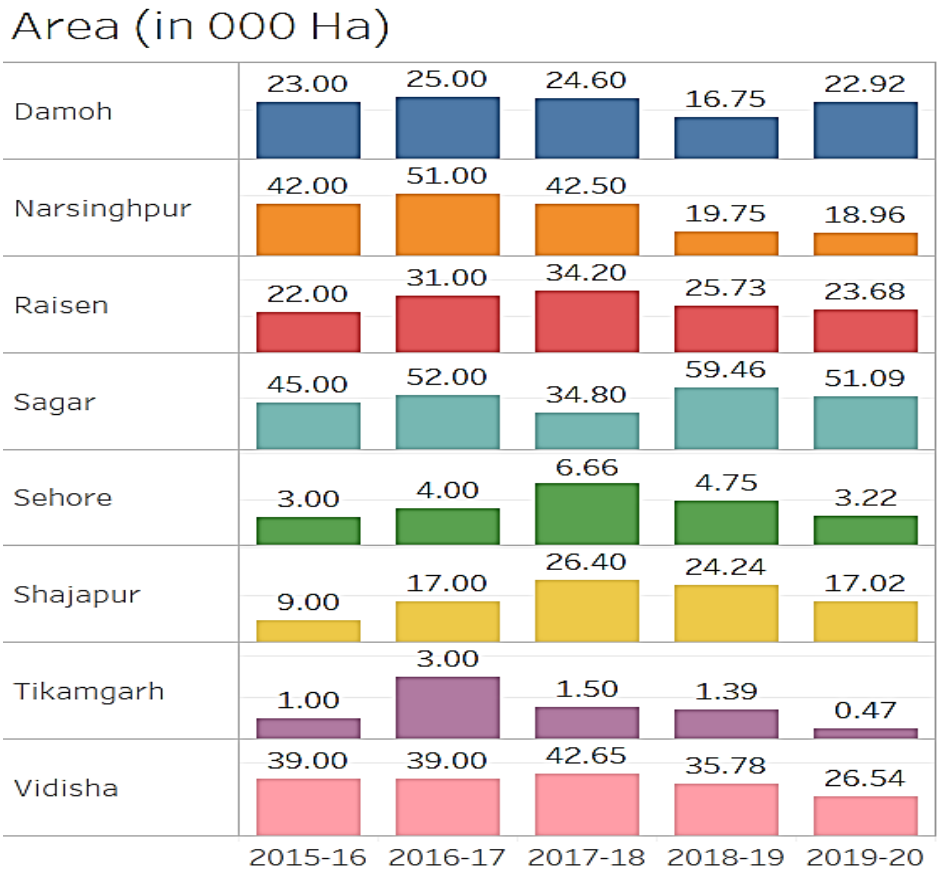

Figure 8: Variation in area under lentil from 2015-16 to 2019-20

2.1.2 Change in production of lentil for a 5-year period (2015-16 to 2019-20):

The levels of production, as expected, have varied in tandem with the area under lentil production. The variation among the project districts for the 5 years, 2015-16 to 2019-20 has been shown in figure 9 alongside. The ups and downs correspond to the variation in the area during the same year. The levels of production although changed but are not very impressive and not exactly reciprocate to the corresponding change in the area under the crop.

Vidisha and Tikamgarh clearly show a decreasing trend for the period under consideration. Other locations show an increase then a decrease during the end of the period.

If the last two years of the total time period is taken, i.e., 2018-19 to 2019-20 then only Damoh and Narsinghpur show an increase in the levels of production.

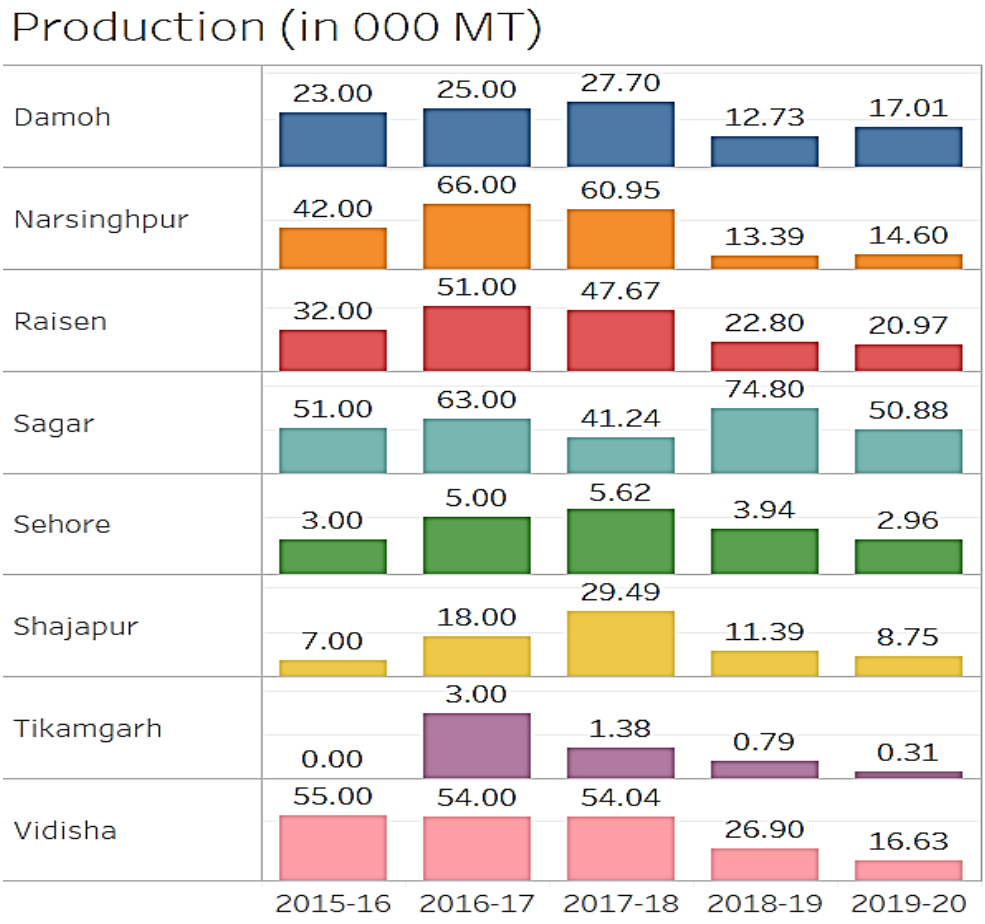

Figure 9: Variation in production of lentil from 2015-16 to 2019-

2.1.3 Change in yield of lentil for the 5 years (2015-16 to 2019-20):

The levels of yield have improved for all the locations except Damoh and Vidisha for the first two years of the period under consideration. Shajapur has shown an impressive increase during this time as shown in figure 10.

Except in Shajapur, Damoh, and Narsinghpur the levels of yield have decreased in 2017-18 for all the locations. The yield further goes on decreasing and Shajapur shows a steep fall. The yield goes down to 470 Kg/Ha from 1117 Kg/Ha.

In general, the trend of yield is negative as during some point of time the yield across all the project districts was in four digits but the last year under consideration i.e. 2019-20 the yield is in three digits.

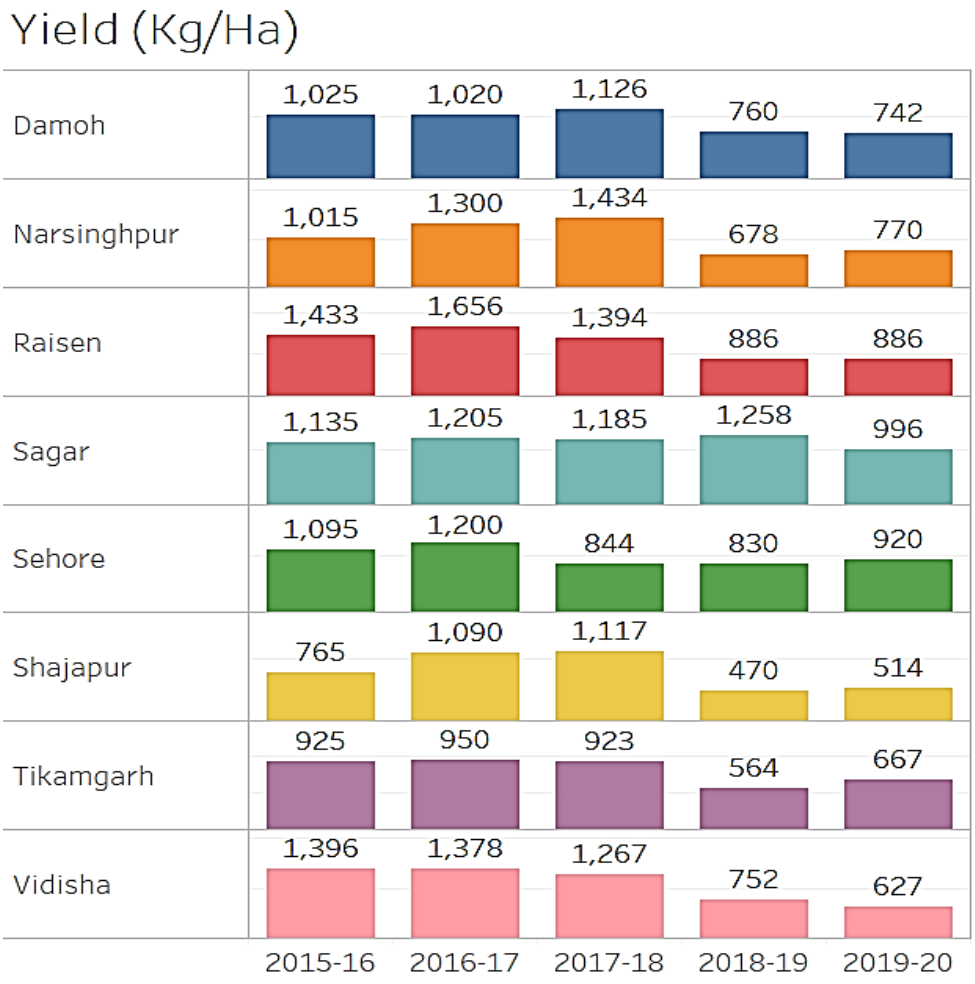

Figure 10: Variation in the yield of lentil from 2015-16 to 2019-10

2.2 Demographic Characteristics of the respondents

2.2.1 Gender

The number of males and females covered under the study is 155 and 129 respectively, i.e., 55% of males and 45% of females as shown in figure 11. The majority of the respondents covered during the fieldwork in Tikamgarh district were females whereas the situation in Sehore and Narsinghpur districts is the exact opposite. The same information at the granularity of the districts has been shown in table3.

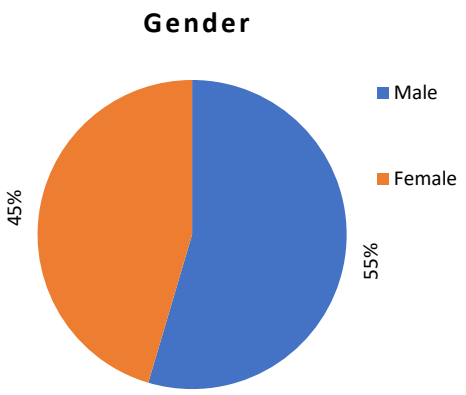

Figure 11: Gender distribution of beneficiaries

Gender Distribution District Wise		
Tikamgarh	3%	97%
Narsinghpur	100%	0%
Sagar	74%	26%
Sehore	99%	1%

Table 3: Gender distribution

2.2.2 Caste

Across the districts, the majority of the beneficiaries belong to the backward class i.e., OBC. Overall, 68% of the respondents belong to this caste followed by the scheduled caste, general, and the scheduled tribe caste the same is shown in figure 12 which shows a further drill-down of the caste dynamics. The reason for this skew in the data may be due to the majority of a caste in the study area.

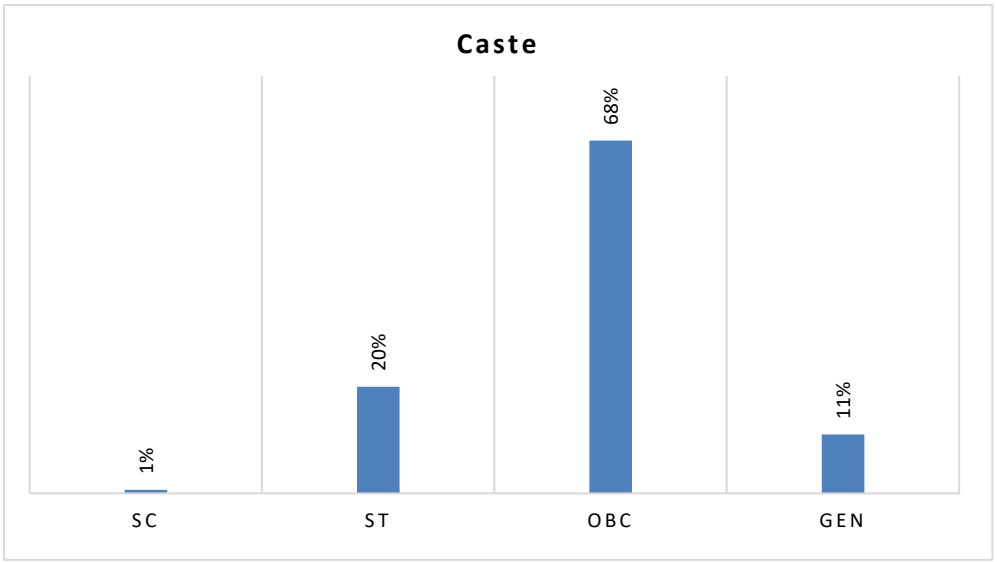

Figure 12: Caste distribution

2.2.3 Economic Status

Analysis of data suggests that 62% of the respondents are in the APL category while the remaining fall into the BPL category, the same is shown in figure 13 alongside. Here once again it is evident that the beneficiary selection could have been better. The lowest percentage of beneficiaries in the BPL category is in Narsinghpur and the highest is in Tikamgarh. About 60% of the respondents from Tikamgarh are from the BPL category. Except for Tikamgarh, the other districts have a higher proportion of beneficiaries in the APL category.

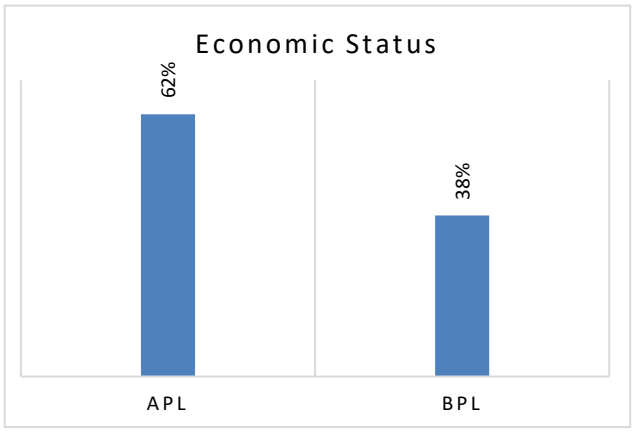

Figure 13: Economic status

2.2.4 Landholding Pattern

About half of the beneficiaries have a landholding size between 0 to 2.5 acres, 25% have 2.5 to 5 acres of land, and the remaining 25% have more than 5 acres of land, depicted in figure 14. At the district level, the majority of the beneficiaries of Narsinghpur are big farmers, Sagar and Sehore have a mix of all the four categories, i.e., 0 to 2.5 to more than 10 acres, as beneficiaries. In Tikamgarh none of the beneficiaries has a landholding size of more than 5 acres, the reason could be that only marginal and small farmers have been selected as beneficiaries for the project.

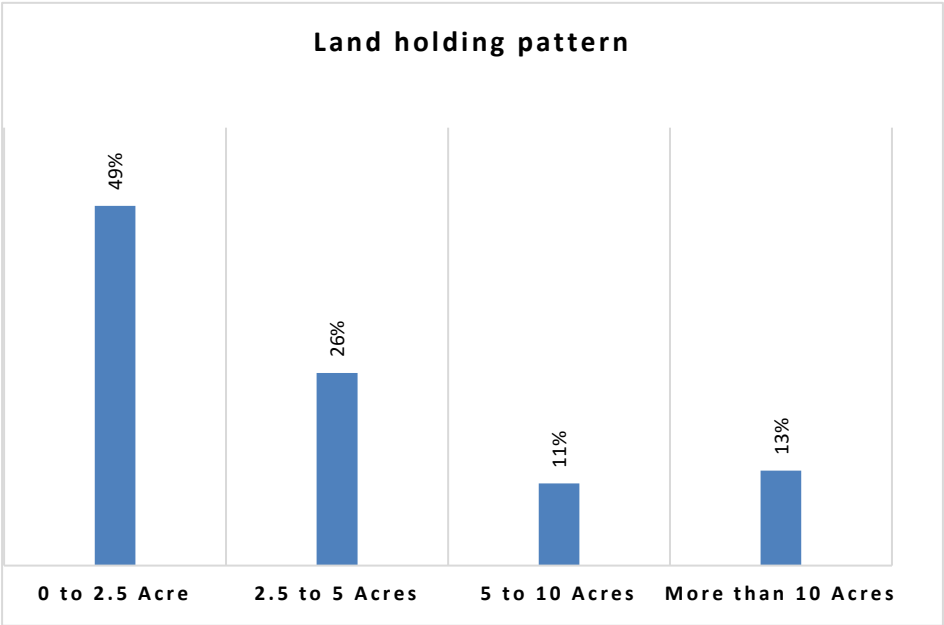

Figure 14: Land holding pattern

2.2.5 Marital Status

The majority of the beneficiaries of the sample districts are married i.e., about 97%. Marginal proportion have lost their life partner, 0.35% and 0.70% were found widower and widow respectively and the remaining about 2% were unmarried. The same has been shown in table 3 alongside.

Marital Status of Respondents	
Unmarried	2.11%
Widower	0.35%
Widow	0.70%
Married	96.83%

Table 4: Marital status of the respondents

2.2.6 Educational Status

Figure 15 suggests that about one-fourth of the beneficiaries are illiterate, one-fifth is literate and a similar ratio has passed their higher secondary. Tikamgarh has the highest percentage of illiterate beneficiaries. In Narsinghpur, about half of the beneficiaries have passed their college and about 40% have passed 12th standard. Sehore and Sagar have 21% and 28% beneficiaries who are educated up to college level respectively.

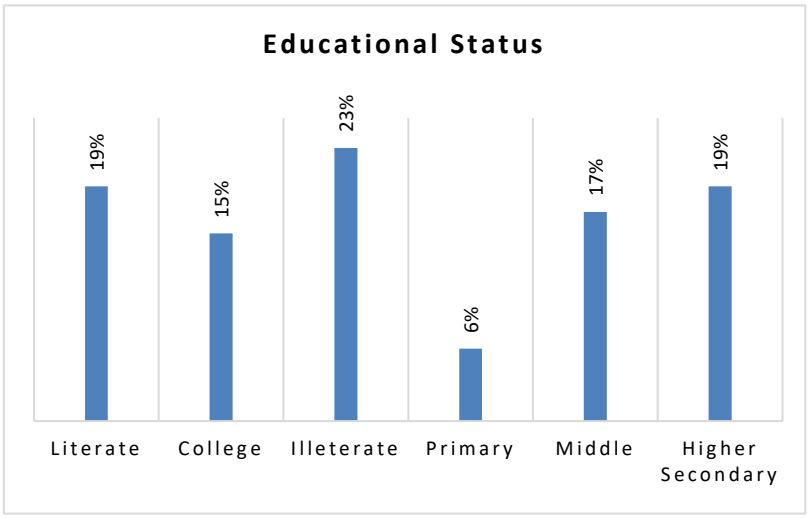

Figure 15: Educational Status

2.2.7 Age Group

As far as the distribution of age group is considered, shown in figure 16, the proportion of female beneficiaries is slightly younger as compared to the males across the sample locations.

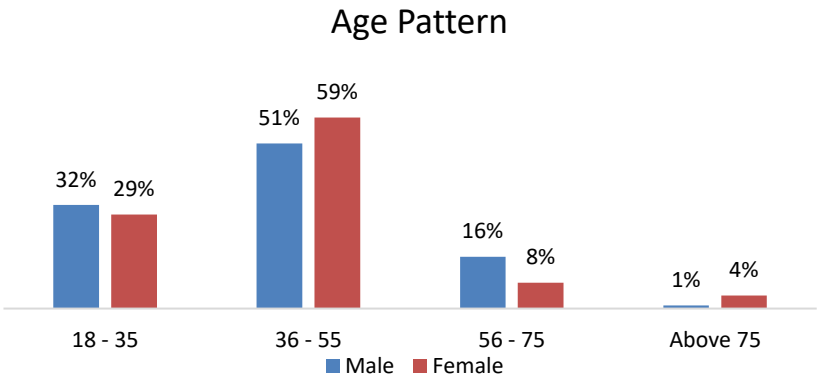

Figure 16: Age pattern

2.3 Description of Crops

2.3.1 Description of Kharif crops (except lentil)

A. Major Kharif Crops District wise

Major crops in Tikamgarh for the Kharif season have been listed in table 5, these are Urad followed by sesame and soybean. During the last five years, the cropping pattern of the beneficiaries of the district has almost remained the same. One interesting inference is that the other districts have more dependence on Soyabean as compared to Tikamgarh.

Tikamgarh					
Crop	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Urad	71%	70%	73%	74%	77%
Sesame	19%	18%	15%	14%	7%
Soyabean	10%	12%	12%	12%	16%

Table 5: Major Kharif crops in Tikamgarh

Soybean is the major crop that is being cultivated in Narsinghpur, Sugarcane and paddy are at the second place while urad and maize are also important crops of the region. The region has a wider spectrum of crops being cultivated in the region as table 6 below suggests.

Narsinghpur					
Crop	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Urad	10%	10%	6%	0%	0%
Sugarcane	35%	20%	6%	15%	18%
Paddy	10%	5%	31%	15%	18%
Maize	5%	5%	16%	20%	13%
Soyabean	40%	60%	41%	50%	51%

Table 6: Major Kharif crops in Narsinghpur

Table 7 provided below is for Sagar district, soybean is the major crop of the Kharif season, all the beneficiaries have reported that they cultivate soybean in the season.

Sagar					
Crop	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Soyabean	100%	100%	100%	100%	100%

Table 7: Major Kharif crops in Sagar

Sehore also has a similar story as Sagar, as depicted in table 8, the majority of the beneficiaries are cultivating soybean with a marginal proportion growing wheat, gram, moong, and vegetables.

Sehore					
Crop	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Wheat	2%	2%	1%	1%	1%
Gram	1%	1%	1%	1%	1%
Moong	1%	0%	0%	0%	0%
Vegetables	1%	1%	1%	1%	1%
Soyabean	95%	96%	97%	97%	97%

Table 8: Major Kharif crops in Sehore

B. Economic Aspect of Kharif Crops

Table 9 below provides details about various aspects of crop production during the Kharif season for five years. The data is an average of all the sample locations of all the respondents. The average area under farming and average area under irrigation have almost, as expected, remained the same during the period.

Year	Average area under irrigation Kharif (Acre)	Average area under farming Kharif (Acre)	The average cost of production (₹)
2015 -16	5.15	4.36	15926.47
2016 - 17	5.16	4.51	15233.09
2017 - 18	5.18	4.38	16273.29
2018 - 19	5.07	4.67	17320.29
2019 - 20	5.04	4.53	18717.22

Table 9: Area and Input Cost of Kharif crops

Table 10 The cost of production has seen a slight increase year after year which is again in line with the increasing cost of agricultural inputs and other allied activities. The production although has been haphazard during the two-time stamps. Firstly, there has been a dip from 2015-16 to 2017-18 and then a sign of recovery can be seen, although the initial level of production as it was in 2015-16 is still higher than the present levels of crop production. The average amount sold and the average selling price has also varied in tandem with the varying levels of production.

Year	Average Production (Q)	Average Amount Sold (Q)	Average selling price (₹)	Productivity (Q/Acre)
2015 -16	23.62	22.07	6509.38	**5**
2016 - 17	15.21	13.75	5600.73	**3**
2017 - 18	9.51	8.50	4453.07	**2**
2018 - 19	12.88	12.52	5285.04	**3**
2019 - 20	13.48	13.20	5528.61	**3**

Table 10: Year-wise production, amount sold, selling price and productivity

2.3.2 Description of Lentil Crop

Since when growing lentil: As far as lentil production is considered about three-fourths of the respondents across the sample districts started lentil production after the intervention. Narsinghpur is the only district where lentil production was prevalent among 65% of the beneficiaries before the intervention. An overall picture is presented in table 11 below.

Since when growing Lentil	Before demonstrations	After demonstrations
Tikamgarh	20%	80%
Narsinghpur	65%	35%
Sagar	19%	81%
Sehore	34%	66%
Overall	28%	72%

Table 11: Cultivation of lentil

The area under lentil production: Response to the above questions gets more strength when we see the change in the area under lentil production among the sample districts depicted in table 12. The sudden increase in the year 2017-18 is because this was the year of intervention. Beneficiaries have received free seeds from the project and used the same in their fields. The drop in the area under lentil among the beneficiaries after the year 2017-18 maybe because they did not receive any seeds and many beneficiaries did not save the seeds from their harvest to use them the following year.

Area Under Lentil (in Acres)	Tikamgarh	Narsinghpur	Sagar	Sehore
2015-16	18.5	107	10.25	72
2016-17	6	113	7.75	58.5
2017-18	94.95	133.5	83.5	93.3
2018-19	30.5	106.25	23.5	85.25
2019-20	3.5	38	23.75	91.75

Table 12: Area under lentil production

Seed Rate: The variation in the seed rate per year is visible in table 13 below, this variation is the result of the training because of which the farmers became aware that there is an optimum quantity of seed that should be used. Increasing the seed rate will not always increase productivity.

Seeds Sown (Kg/Acre)	Tikamgarh	Narsinghpur	Sagar	Sehore
2015-16	16	3	16	25
2016-17	14	8	15	26
2017-18	15	4	19	17
2018-19	21	7	16	25
2019-20	27	4	19	25

Table 13: Seed rate

Gestation period: The gestation period for the crop has almost remained the same as it was before the intervention, the majority of the beneficiaries have reported that the same was from 90 to 110 days.

Varieties used in production: A mix of new varieties of lentil are being used by the farmers now such as RVL-31, JLS-3, IPL 316 and 317, and DPL 62. Among these, RVL-31 was the best performer and a clear winner. This variety has provided maximum productivity and in turn maximum benefits to the farmer.

Use of traditional seeds: A drop in the use of traditional seeds is evident from table 14. Before the intervention i.e., before 2017-18 majority of the beneficiaries used traditional seeds for lentil production. The number of beneficiaries who are using the traditional seeds for lentil production has again started increasing. This increase from 1% in 2017-18 to 14% in 2018-19 to again 18% in 2019-20 can be attributed to the fact that no free seed distribution has been done after 2017.

Use of Traditional Seeds				
2015 - 16	**2016 - 17**	**2017 - 18**	**2018 - 19**	**2019 - 20**
96%	95%	1%	14%	18%

Table 14: Use of traditional seeds

Status of seed germination: Seeds germination rate also increased during the intervention period, during pre-intervention about half of the seeds did not germinate. After training the beneficiaries were aware of the seed rates and by keeping the seed rate optimal the seed germination rate also increased. Moreover, the seed germination rate has also increased because quality seeds in place of traditional seeds were used. The germination rates have gone down year after year after 2017-18 the reason is again the non-availability of quality seeds after the intervention year, the same is shown in table 15.

Did not germinate	**Pre-Intervention 2015-16**	**2016-17**	**Intervention 2017-18**	**Post-Intervention 2018-19**	**2019-20**
0% to 10%	47%	48%	74%	64%	37%
11% to 20%	43%	42%	20%	29%	41%
21% to 30%	9%	9%	3%	6%	10%
Greater than 30%	1%	1%	3%	1%	12%

Table 15: Status of seed germination

Trends of levels of production of lentil: Changes in the levels of production are also positive, overall, the productivity has increased because of two factors, firstly because of the increase in the area under lentil production and secondly, because of the high yielding variety provided to the beneficiaries. The sudden increase in the year of intervention is visible easily in table 16 below.

Production of Lentil (in Q)	Tikamgarh	Narsinghpur	Sagar	Sehore
2015-16	32.3	79	31.5	341
2016-17	9.4	115	19.4	273.5
2017-18	5315.1	161	443	861.25
2018-19	1597.6	120.75	115	461
2019-20	59.9	73.5	183	503

Table 16: Production of lentil

Economics of lentil production: Table 17 depicts the changes that are visible in other aspects too; the cost of cultivation has seen a decline as compared to it was before the intervention. The average selling price has surged a bit. The slight increase in the selling price is because of the better quantity of the harvest. The major portion of the produce was sold at APMC before the intervention but after it, a small proportion of the farmers started selling their produce to other farmers which the buyers used as seeds on their fields in the next season.

Year	Average cost of cultivation (per Acre)	Average selling price (per Q)	Sold at
2015-16	5497	3785	APMC
2016-17	7137	3818	APMC
2017-18	4705	4208	APMC, Local market
2018-19	5747	4094	APMC, Other farmers
2019-20	6459	4034	APMC

Table 17: Economics of lentil

2.4 Income Trends

The respondents were questioned about their earnings from the various sources of income such as animal husbandry, milk production, self-employment and any other source of income. The data was collated for 5 years, and the median of incomes from all the sources has been taken for an explanation, from 2015-16 to 2019-20 and the same is depicted in figure 17 above. The annual income of the respondents from agriculture except lentil has shown a steady increase year after year for all the sample locations.

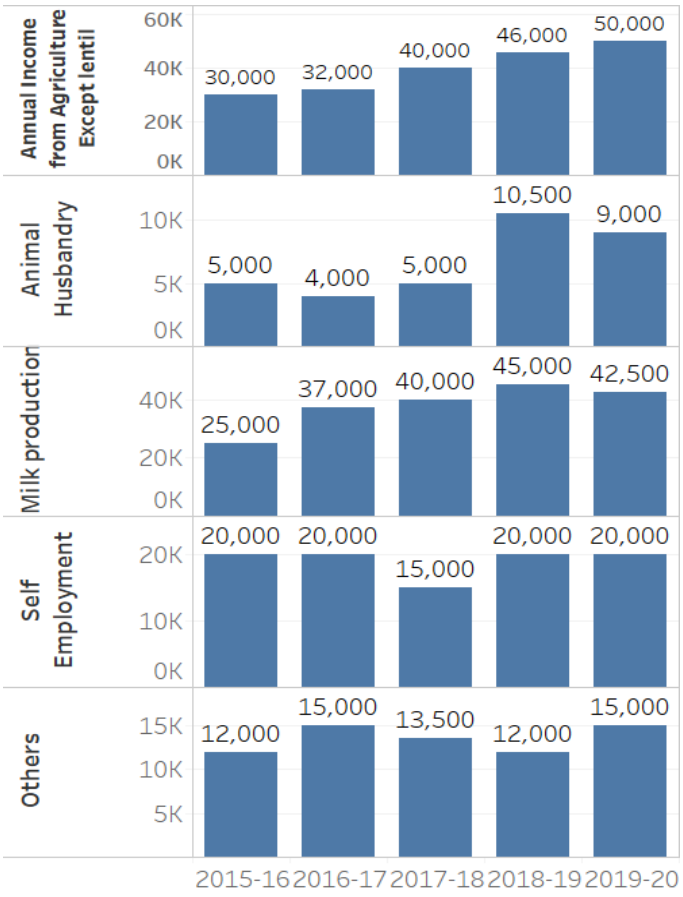

Figure 17: Income trends

The activity of animal husbandry has become profitable during the last 5 years for those who are engaged in the activity, and the same is clear from figure 13 where the income has increased from ₹ 5000 in 2015-16 to ₹ 10,500 in 2018-19 although it dipped in the following year the data suggests that overall, the trend is positive. Similarly, income from milk production has also increased steadily from 2015-16 to 2018-19 but dipped in the year 2019-2020 although the decrease is not substantial but is significant when we are talking about farmers who are below the poverty line.

Income from other sources of income is variable and swings between ₹ 12,000 to ₹ 15,000 during the five-year tenure. The self-employment income has remained constant for about four years and was ₹ 20,000, except for the year 2017-18 when it was about ₹ 15,000.

Overall, the income trends are positive and the respondents and the signs of increased incomes in agriculture and allied activities are visible from the data.

About 11% of the total respondents cultivated lentil for all the five years, i.e., 2015 to 2019. The income of the farmers who were cultivating lentil before as well as after the intervention has been shown below in table 18. It is clear that due to an increase in productivity and a slight increase in the average selling price the income in 2017-18 was very high as compared to all the years under consideration.

	Average Quantity Sold (Q)	*Average Selling Price/Q*	*Average Income*
2015-16	4	3798	13830
2016-17	5	3853	18908
2017-18	16	4154	65846
2018-19	7	4116	28809
2019-20	7	4059	30324

Table 18: Income from lentil

2.5 Access to Quality Seeds

2.5.1 Seed Distribution

Seed distribution was one of the major tasks of the program and keeping in mind the large geography it could not be achieved from a single agency. ICARDA with the help of the Agriculture Department, KVK's, and other farmers, did the seed disbursal. In the sample districts of Tikamgarh and Sehore, all of the seed distribution was done by ICARDA itself. In Sagar district, the seed distribution was majorly done by the agricultural university and the KVK, ICARDA has done only 12% seed disbursal there. Seed hub is only operational in Sagar district and around 9% of beneficiaries from the district got the quality lentil seeds from the same, the situation has been shown in figure 18.

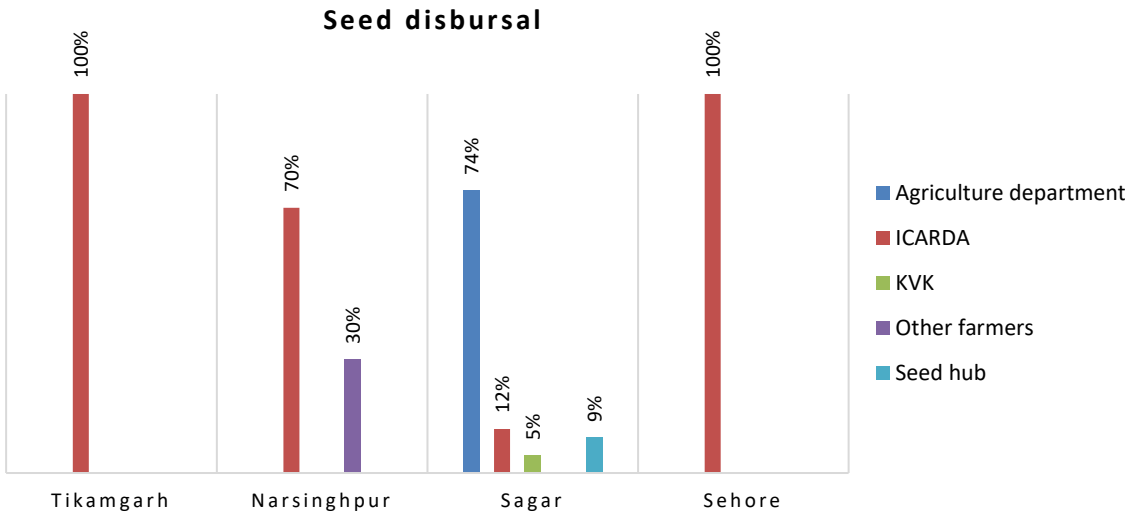

Figure 18: Seed disbursal

2.5.2 Quantity of Seeds

As far as the optimum quantity of seeds according to the landholding size is considered more than 85% of the beneficiaries across the locations received the right quantity of quality seeds for sowing it in their fields. At the district level, almost all the beneficiaries of Sagar and Tikamgarh answered yes. Three fifths and four-fifths of beneficiaries from Narsinghpur and Sehore respectively reported having received an optimal quantity of seeds as per their landholding size, the same has been depicted in figure 19.

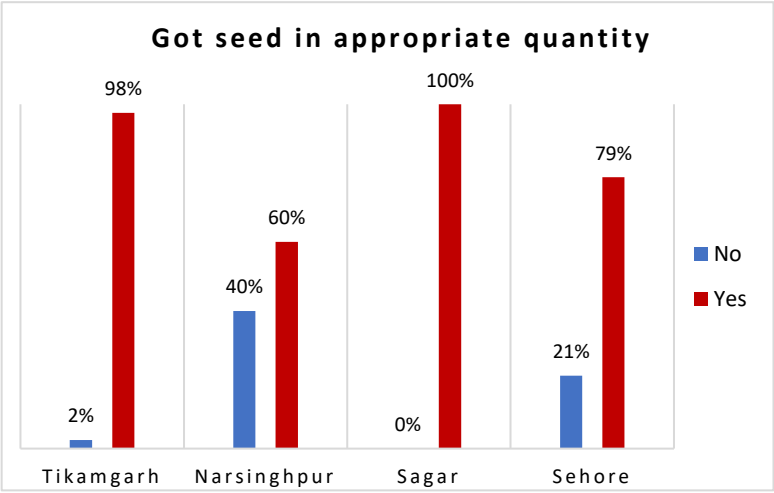

Figure 19: Quantity of seeds received

2.5.3 Received the seeds within time

Figure 20 suggests that the seed distribution was well within the time for all the sample locations. As depicted in the figure above the answer to the question was one-sided and all the beneficiaries opined that they did receive the seeds on time.

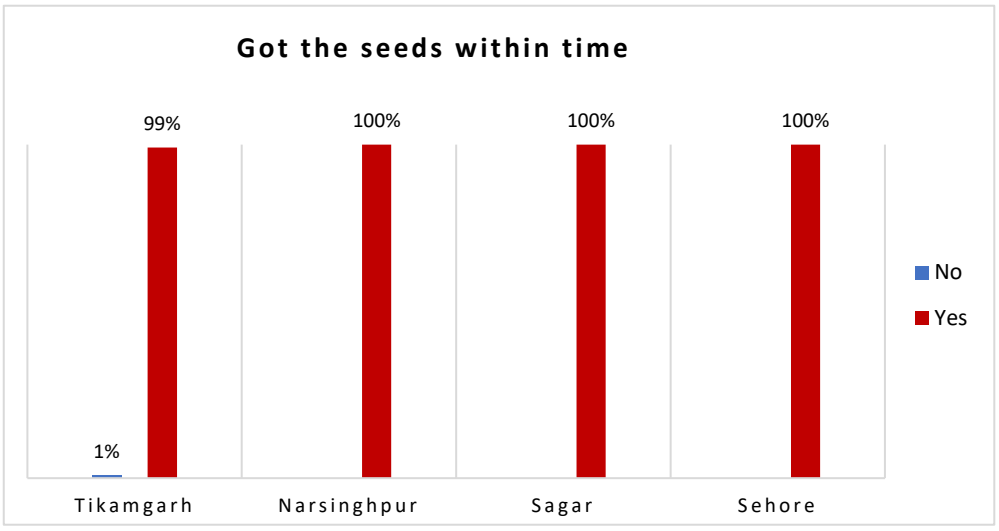

Figure 20: Timing of seed distribution

2.5.4 Disease resistance of quality seeds

As far as disease resistance of the lentil seeds provided was considered, the majority of the beneficiaries across locations agreed that the quality seeds have more resistance than the traditional ones and the same is shown in figure 21. In Sagar and Narsinghpur about 14% and 10% of respondents respectively found the new seeds to be lesser disease resistant than the traditional seeds.

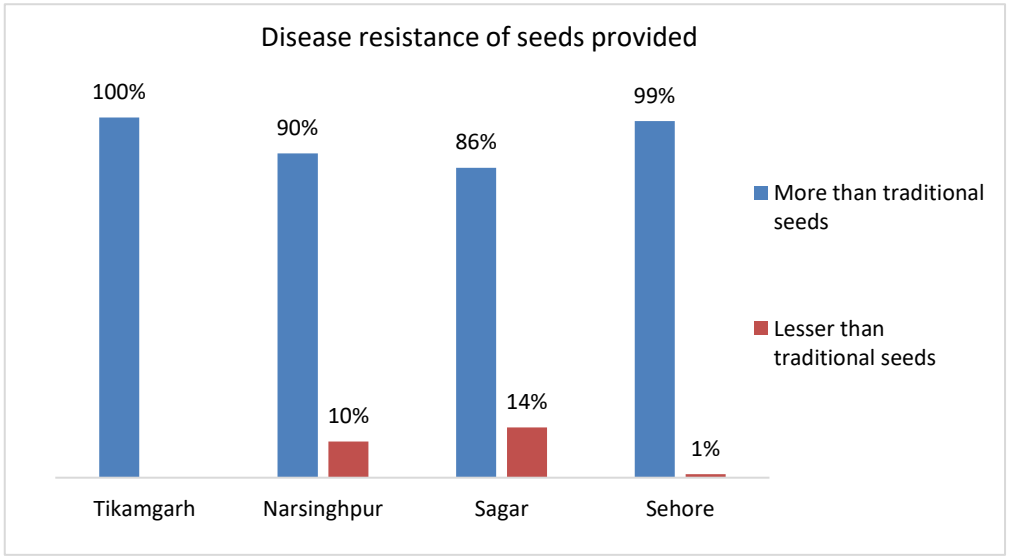

Figure 21: Disease resistance of seeds provided

2.5.5 The occurrence of diseases post-intervention

Diseases are always a part of the crops, as already seen that the seeds were more disease resistant than the traditional ones but still the lentil crop was affected by diseases. Sehore district had the highest proportion of diseases followed by Narsinghpur and then Sagar. Tiakmgarh has the lowest proportion of instances of disease in the lentil crop, the above explanations are supported by figure 22. The instances of diseases that have occurred at the sample locations, from 2015-16 to 2019-20 ugta, mahua and miriya were the major diseases that have occurred.

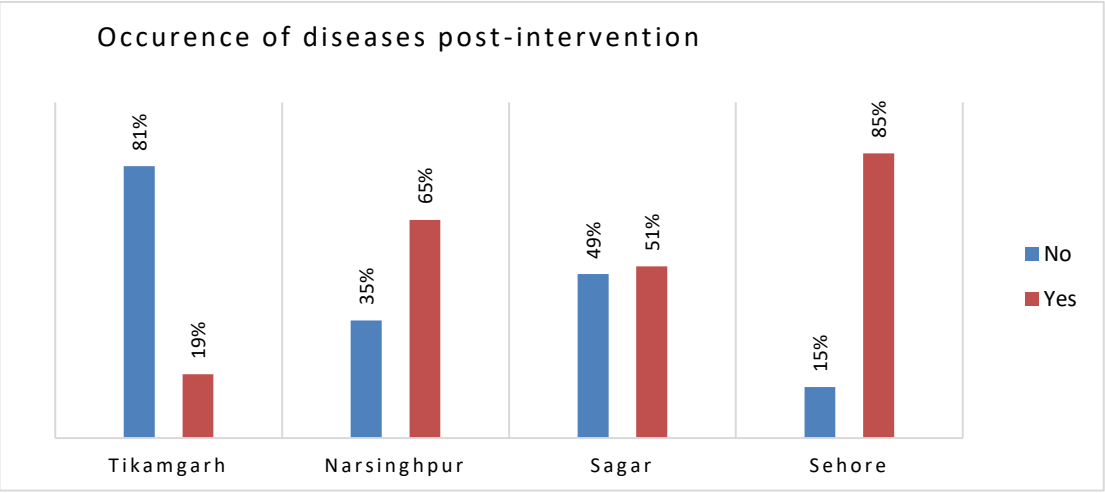

Figure 22: Occurrence of diseases

2.5.6 Reasons for adopting the seeds of new variety seeds

Five main reasons for the adoption of a new improved variety of seeds were given by the farmers, as depicted in table 19. The maximum proportion of the beneficiaries gave higher productivity as the main reason for adopting the seeds. The higher market price was the second reason for adoption in Sagar and lesser diseases in Narsinghpur and Tikamgarh.

Reasons for adopting a new variety of seeds	Sagar	Sehore	Narsinhpur	Tikamgarh
Higher productivity	39%	37%	26%	24%
Lesser diseases	18%	5%	26%	23%
Higher market price	33%	4%	21%	24%
Require less irrigation	8%	7%	18%	13%
Other farmers were doing so did I	2%	48%	9%	17%

Table 19: Reasons for the adoption of the new variety of seeds

2.5.7 The new variety, advantageous or not?

Figure 23 suggests that all the beneficiaries of Tikamgarh and the majority in Sagar and Sehore agreed that the new variety has its advantages. Maximum proportion, 30% from Narsinghpur followed by 12% in Sehore did not agree that using the improved variety seeds was advantageous.

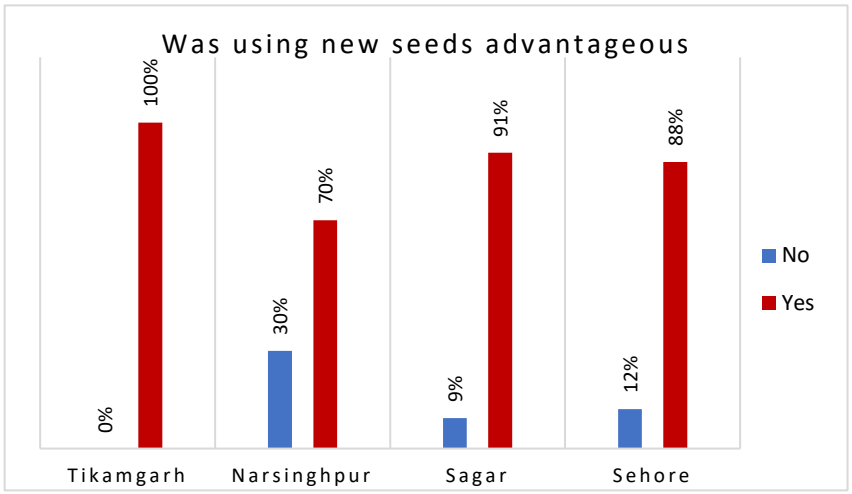

Figure 23: New seeds advantageous or not

An increase in productivity was the most common advantage among the beneficiaries, followed by a decrease in the number of instances of diseases. A third most important advantage to the beneficiaries was that the produce was easily sold and fetched a better price than earlier when they used traditional seeds. Lastly, a lesser number of weeds were developed resulting in lower spending on weed management, the same has been shown in table 20.

S.No.	Advantages	%Age of Respondents
1	Increased productivity	32%
2	Crop developed lesser diseases	15%
3	Lesser irrigation was done	9%
4	Crop was ready in a shorter period	12%
5	Sold easily and fetched a better price	17%
6	Lesser weeds developed in the fields	15%

Table 20: Advantages of using quality seeds

A marginal number of beneficiaries did not have the benefits and the major reasons, shown in table 21. The most common reason was lower productivity followed by the occurrence of diseases in the crop and the requirement of more cycles of irrigation. A few beneficiaries have also reported that the gestation period was longer for the new seeds as compared to the traditional seeds, while some said that they could not get good prices for the produce.

Reasons for getting no advantages	
Lesser productivity	42%
More diseases than traditional seeds	21%
More cycles of irrigation	11%
Longer gestation time	16%
Did not fetch better prices	8%
Weed growth was too much	3%

Table 21: Reasons for getting no advantages

2.6 Training & Capacity Building

2.6.1 Agriculture inputs

As far as agriculture inputs are considered, 14 % of the beneficiaries reported that they have not received any other inputs except seeds. The remaining 86 % have reported one or more than one agriculture inputs being received by them, the inputs provided are rhizobium, medicines, DAP, manure, PSB.

2.6.2 Timely distribution of agricultural inputs

Majority of the beneficiaries across the locations agreed that the agricultural inputs provided to them were well within the time when they require it the most, the same is shown in figure 24. The only exception being Narsinghpur district, where, slightly less than half of the beneficiaries said that they did not get the inputs when they needed them. Tikamgarh has the highest proportion of beneficiaries who were satisfied with the timing of the distribution of the agriculture inputs.

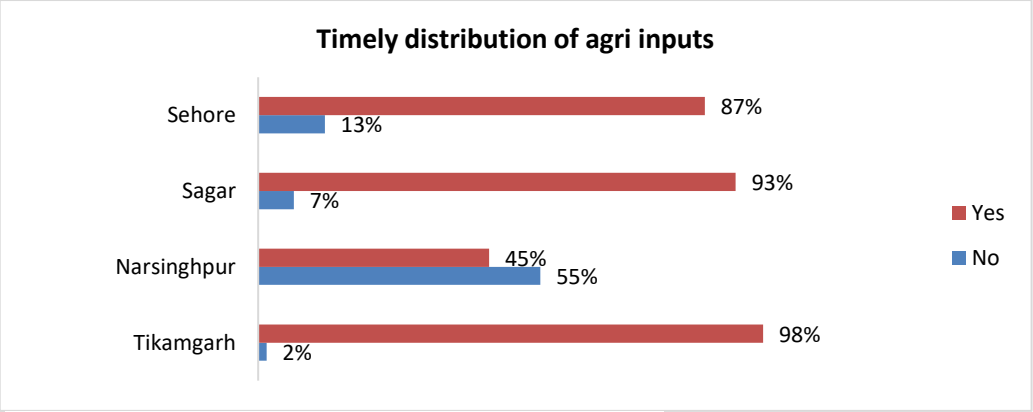

Figure 24: Timing of distribution of agricultural inputs

2.6.3 Training received before sowing

As shown in figure 25, before the start of the sowing season a training session was organized for about 85% of the total beneficiaries as reported during the data collection. Further drill down reveals that almost all of the beneficiaries of Tikamgarh district said that training was organized before the sowing season, followed by Sagar where about four-fifths of the beneficiaries reported that training was conducted before the start of the sowing season. In Sehore, only two-fifths of the beneficiaries reported the same. The beneficiaries who reported that they have received the training said that the same was organized in August and September and the majority of them said that the training session was for one day.

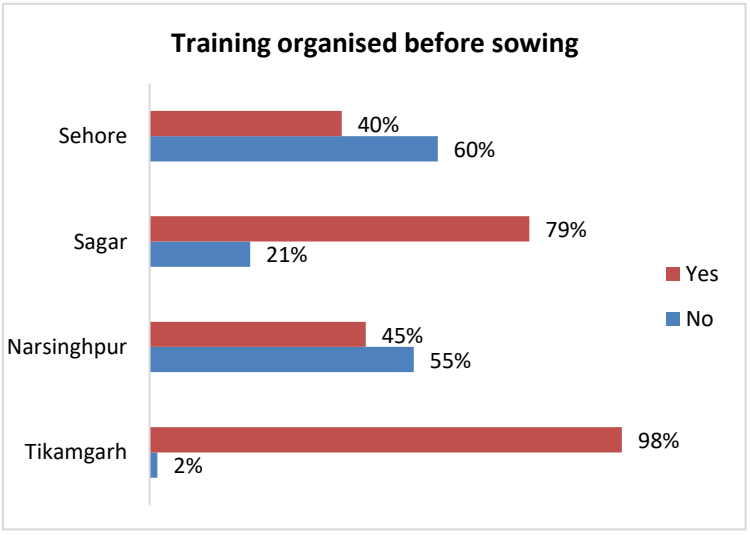

Figure 25: Training organized or not before sowing

A. Learnings from training

An overall picture of the learnings from the training is presented below in figure 26, more than half of the respondents, of those who have been trained, said that they have learned about seed treatment, methods of sowing and irrigation management. About half of the trained beneficiaries have learned about disease management, tillage methods, and manure & fertilizer management.

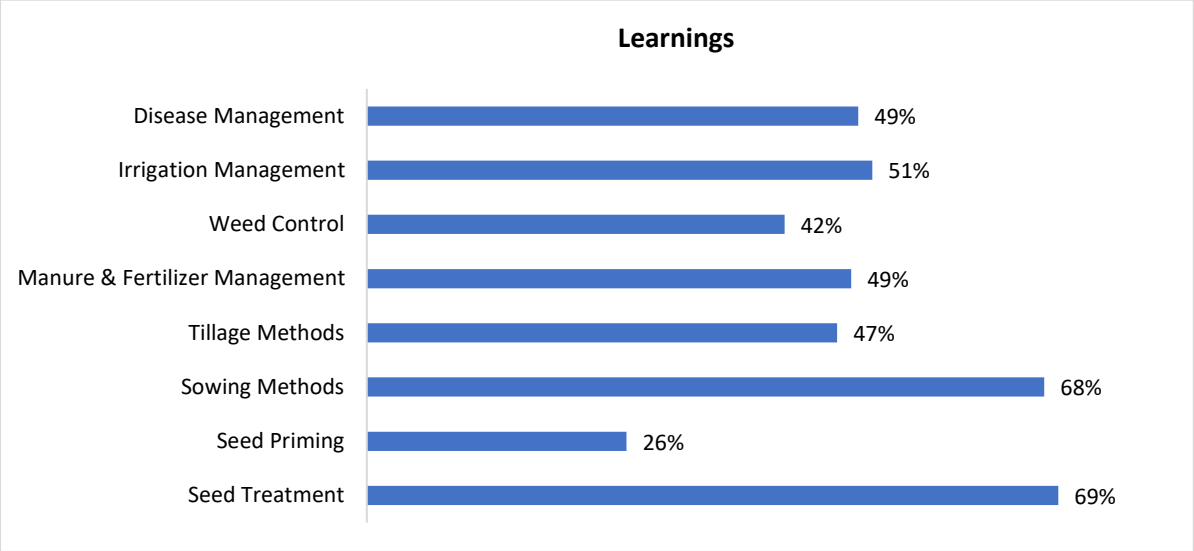

Figure 26: Learnings from the training

B. Place of training:

A major chunk of beneficiaries, 77% of those who were trained, reported that they were trained in their villages themselves. About one fifth said that they received the training at the centre of ICARDA and the remaining did the same at KVK. Majority of the candidates from Tikamgarh (98%) and Sagar (79%) districts were trained in their villages. Sehore has the largest proportion who were trained at the ICARDA centre, as depicted in figure 27.

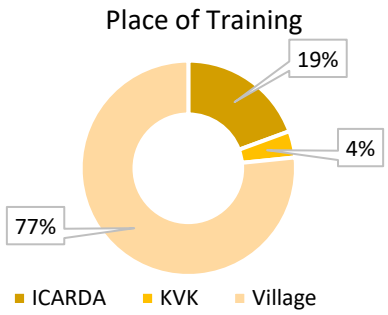

Figure 27: Place of training

C. Training provider:

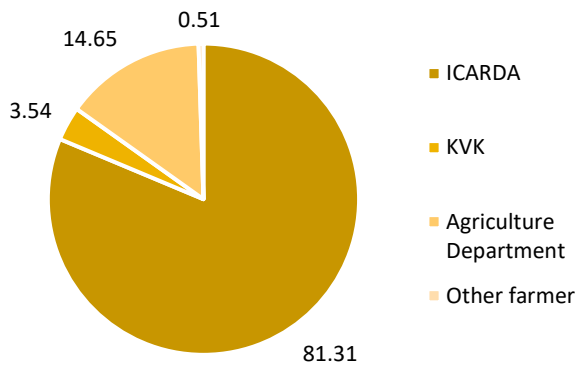

Figure 28: Training provider

Out of the beneficiaries who were trained 81% said that they were trained by ICARDA followed by the Agriculture department and then KVK's, a marginal 0.51% reported that they received information regarding the lentil seeds from the other farmers of the village, the same is shown in figure 28. Majority of the beneficiaries from Tikamgarh and Sehore were trained by ICARDA and about half from Tikamgarh got the information from ICARDA itself. In Sagar majority of the beneficiaries were trained by the Agriculture University.

2.6.4 Training after sowing

Answer to the question that whether training was provided after sowing or not saw a one-sided response, overall, 78% of the beneficiaries answered no and 22% said yes. About 95% of the beneficiaries from Tikamgarh, four-fifths from Narsinghpur, three fifths from Sagar, and slightly more than three fifths from Sehore said that they did not receive any training after sowing, as shown in figure 29. Nearly all of those who said that they have received training after the sowing season said that the training was conducted for a day in January.

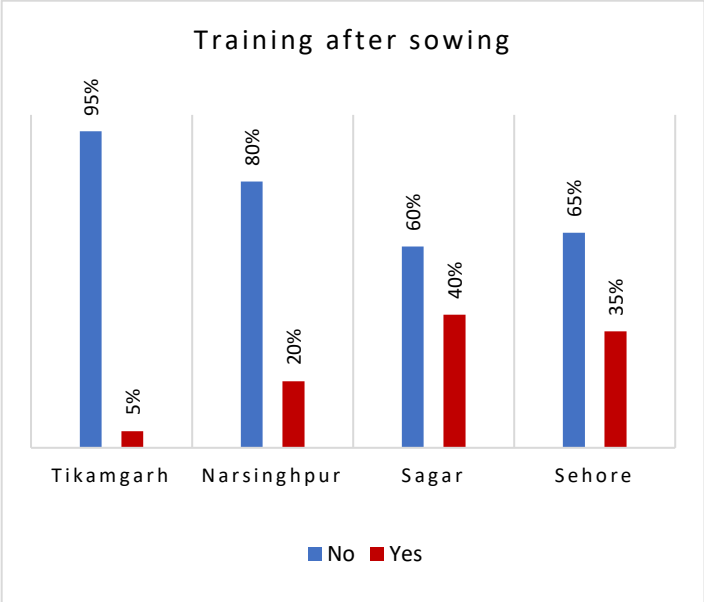

Figure 29: Training after sowing

A. Learnings from second training

Around 85% of those who attended the training after the sowing season said that they learned about harvesting methods. Other topics that the trainees learned are storage and seed treatment.

B. Training provider

The second round of training was conducted after the sowing season, ICARDA provided training to about 85% of the beneficiaries across the sample locations. As shown in figure 30, Tikamgarh, Narsinghpur and Sehore ICARDA provided the training for all the beneficiaries. Sagar is the only exception, where beneficiaries reported that the training was either provided by the KVK (25%) and the Agriculture department (75%).

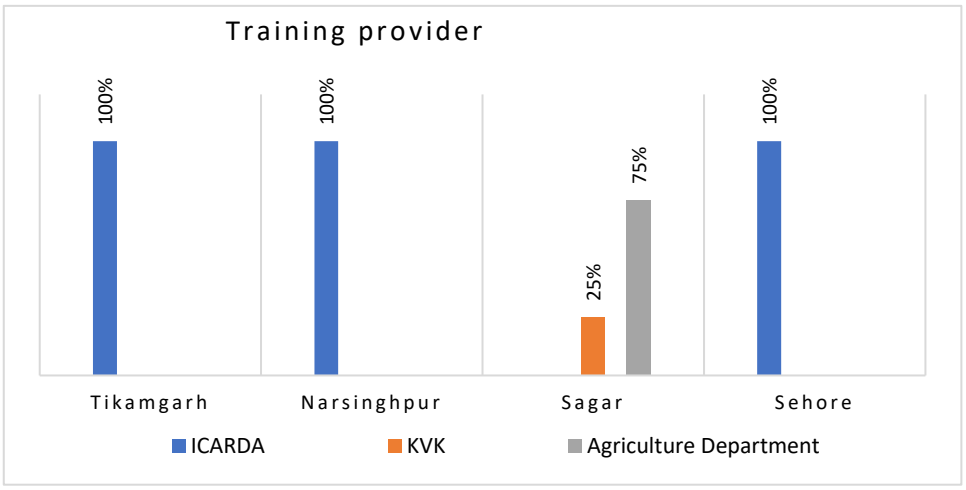

Figure 30: Training provider

C. Place of training

The second round of training was provided at the centre of ICARDA, KVK's and the villages in which the project was operational. In Sehore, all the beneficiaries who attended the training said that the same was organized at the centre of ICARDA. In Tikamgarh and Sagar districts, all the beneficiaries reported that the training was provided in their villages and 67% of the beneficiaries of Narsinghpur district, who attended the training, said it was organized in KVK and the rest said it was done at the village level, the same has been shown in figure 31.

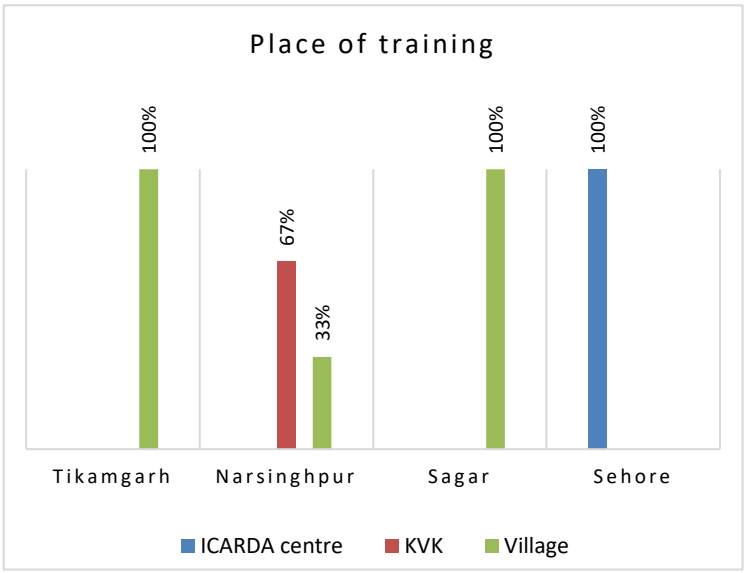

Figure 31: Location of training

2.7 Problems and Benefits of Training

2.7.1 Problems faced during training

As depicted in figure 32 except 33% from Narsinghpur all the beneficiaries across all the sample locations reported that they did not face any difficulties during the training sessions. The two major problems faced by the trainees during the training sessions were that they could not easily understand the dialect of the trainers and secondly, some farmers said that they could not understand the things that were explained to them during the session.

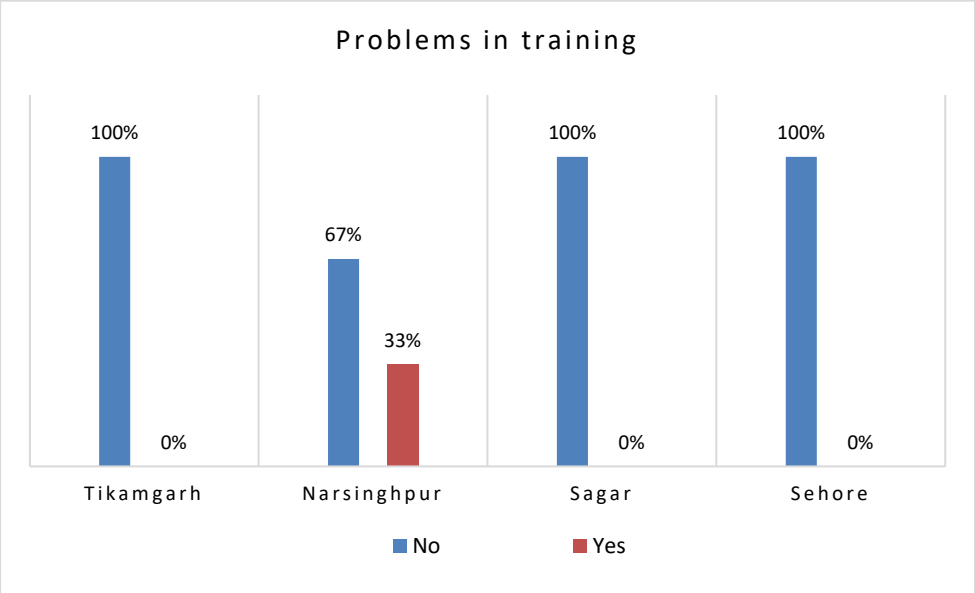

Figure 32: Problems during training

2.7.2 Benefits of training

About 85% of the total beneficiaries, who attended the training, said that the training was beneficial. Further breakup at the district level has been depicted in figure 33 and it suggests that Tikamgarh has the highest proportion of satisfied beneficiaries, followed by Sagar and Sehore. The training was not very fruitful for the attendees of the Narsinghpur district as about two-fifths of the beneficiaries said that they did not benefit from the training session.

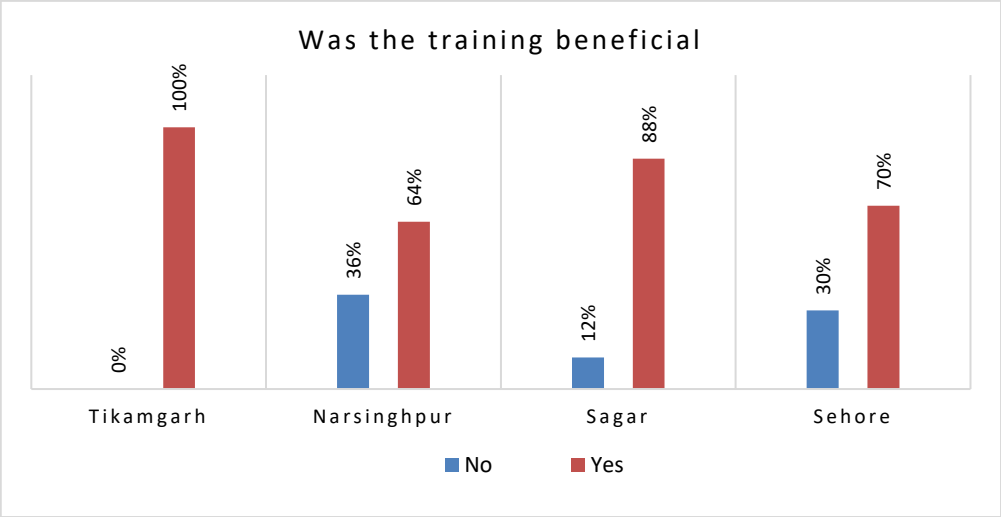

Figure 33: Was training beneficial

In terms of benefits the maximum proportion, about 29% opined that because of the training they had increased productivity. New techniques of lentil production were also a benefit for about 28% of beneficiaries, one fourth said that they had increased incomes and around one fifth said that as an outcome of the training they have a lesser amount of fertilizer in their agricultural field, the same has been depicted in figure 22.

Benefits of training	
Increased productivity	29%
Increased incomes	25%
New techniques regarding lentil production	28%
Used less fertilizer	18%

Table 22: Benefits of training

Lower productivity, lower prices in the market, longer gestation period, diseases, more cycles of irrigation, got lesser quantity of seeds than required, no exposure visits and information not provided on time were some of the reasons because of which the training was not beneficial for some of the beneficiaries of Sagar, Sehore and Narsinghpur districts.

2.8 Challenges Faced in Lentil Production

A major portion of the respondents (86%) said that they did not face any challenges in lentil production as they have been doing it previously too. The only change this time was the quality of seeds and some changes in the package of practices.
The maximum proportion of beneficiaries who said they did not face any problems was from Sagar (98%) district, followed by Narsinghpur then Tikamgarh and Sehore as shown in figure 34.

For those who said that they did face problems in lentil production timely procurement of seeds was the major problem for around 36% of them. Production was an issue for 33%, followed by disease-related problems for 22%, while a marginal proportion of 6% said that they did not get prices in the market for their produce.

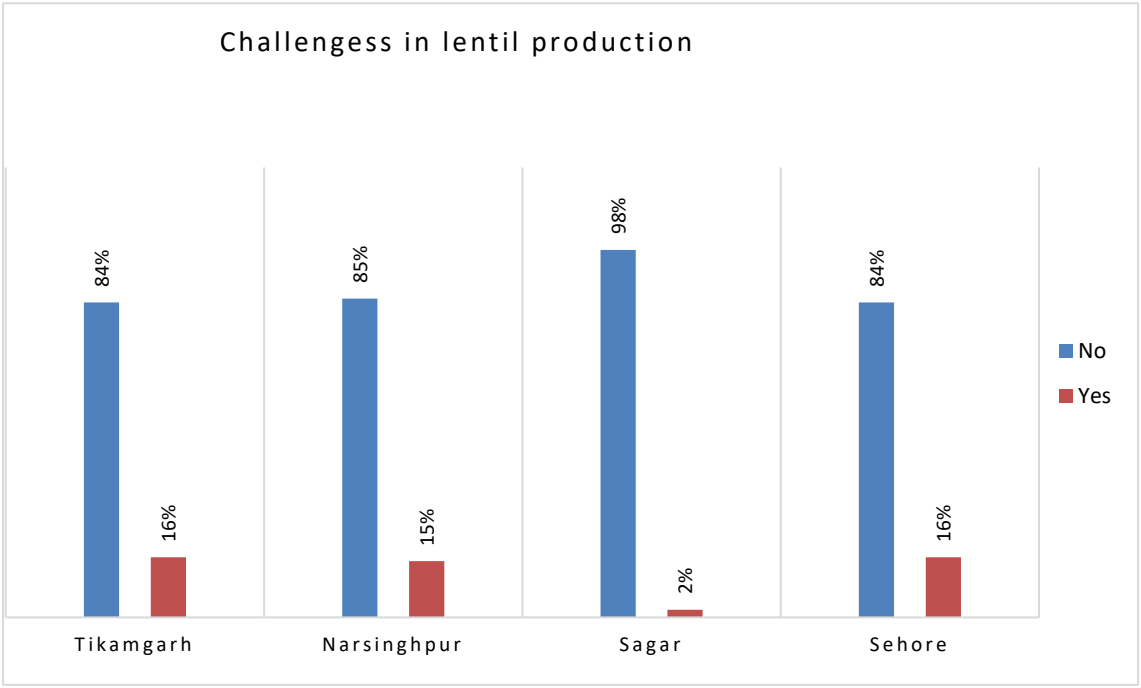

Figure 34: Did face any problem during lentil production

2.8 Trend of Lentil

As part of the impact evaluation study, an attempt was made to understand the changes in lentil crop farming for all the beneficiaries who have grown lentil from 2015 to 2019 continuously.

2.8.1 Details of Area, Production and Quantity sold of lentil crop

The average area under lentil crop and average quantity produced from 2015-16 to 2019-2020 has been shown in figure 35. Pre-intervention period the production was much lower as compared to post-intervention, the quantity per acre has almost doubled during the year 2017-18. In the year 2018-19 the average quantity per acre dipped from 9Q per acre to about 4.5Q per acre i.e., it was reduced to half and the levels remained the same in 2019-2020 too.

Figure 36 has been used to show that during the five years major portion of the produce was sold and a very small quantity was either preserved for future use or self-consumption.

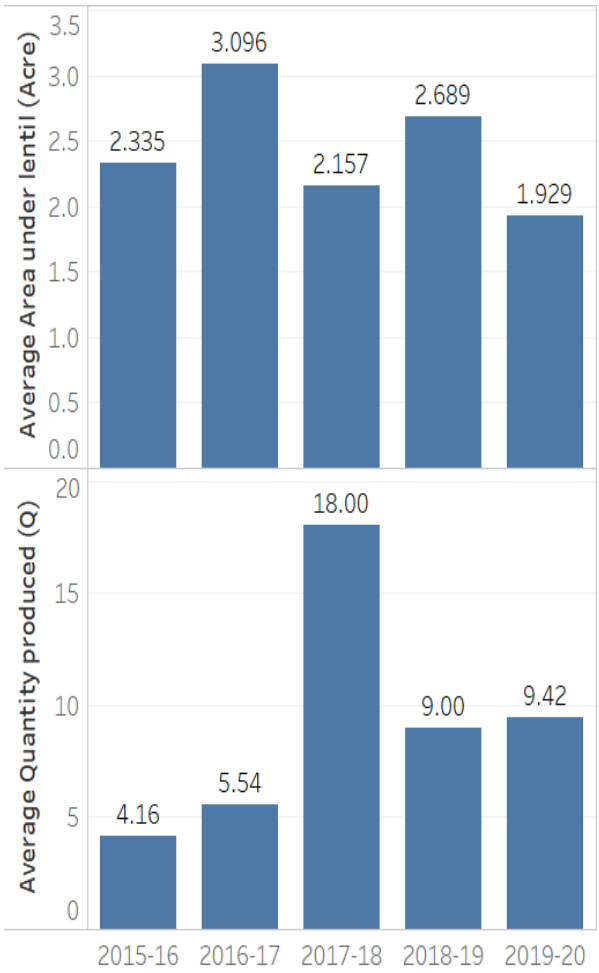

Figure 36: Average area under lentil and Average production of lentil

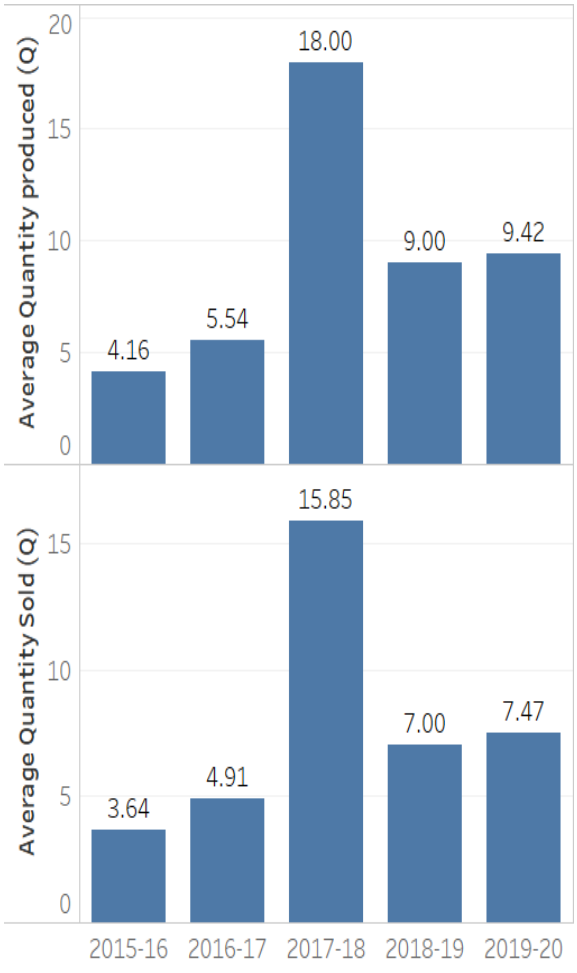

Figure 35: Average quantity produced and Average quantity sold

2.8.2 Seed Germination and Gestation period

The seed germination rate has been decreasing as evident from figure 38, the quantity of seeds that did not germinate is increasing per year and in 2019-2020 it has almost increased by about 10% as compared to the year 2018-19. The gestation period has been variable too as shown in figure 37.

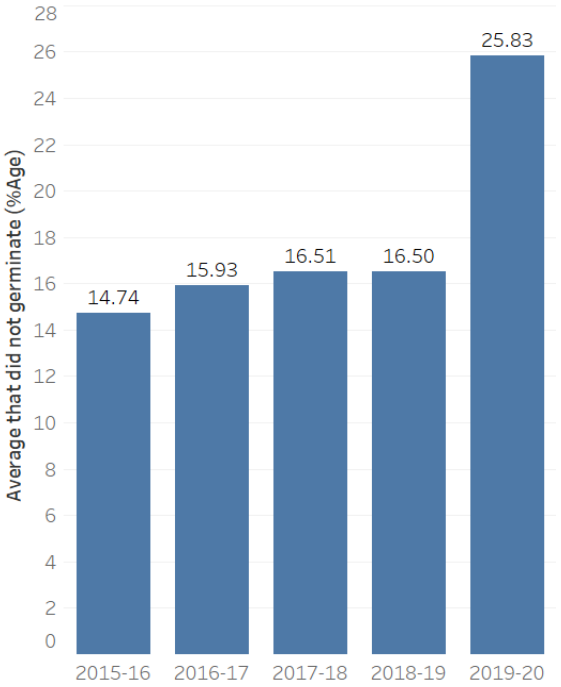

Figure 387: Seed that did no germinate

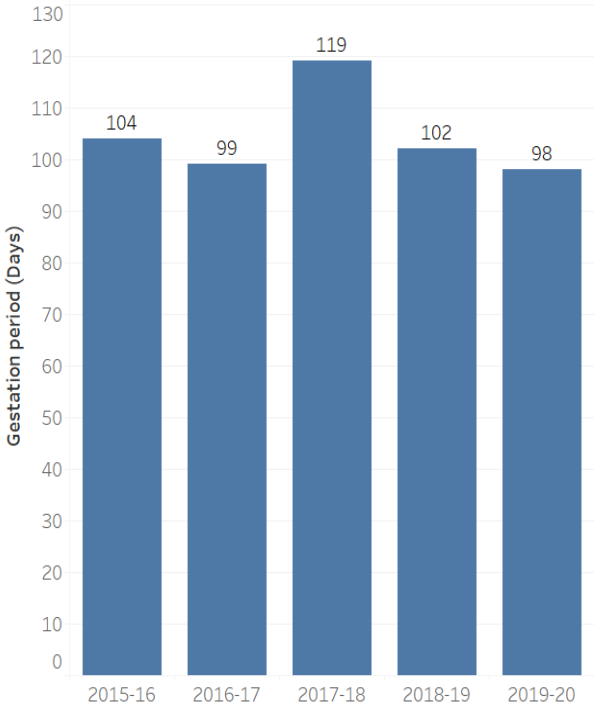

Figure 378: Gestation period of lentil seeds

2.8.3 Seeds Rate

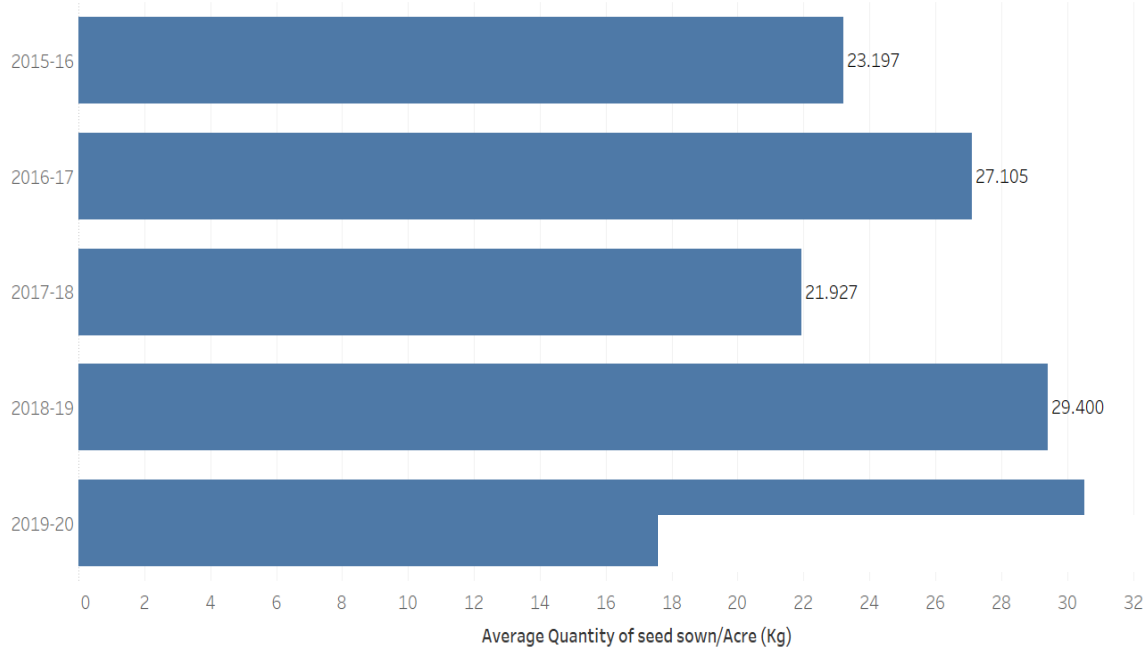

Figure 39: Average quantity of seeds sown per acre.

Figure 39 below is used to show the variation in the average quantity of seed in Kg per acre year after year, sown by the beneficiaries in their fields. The amount utilized by the beneficiaries was minimum in the year 2017-18 about 22 Kg per acre, which has increased to about 30.5 Kg per acre in 2019-2020. The dip in the seed rate during the year of intervention maybe because the beneficiaries, as a result of training, used an optimal quantity of improved variety seeds in their fields.

2.8.4 The average cost of cultivation and average selling price

The cost of cultivation increased in the year 2016-17, went down during 2017-18 and again went up for the two consecutive years i.e., 2018-19 to 2019-2020. The dip in the cost of cultivation during the intervention year maybe because free seeds were provided to the beneficiaries and the lower fertilizer and the use of other inputs were lower as compared to before.

The selling price per quintal saw a steady increase from 2015-16 to 2017-18 but it slightly dipped in the consecutive years, figure 40 is used to explain the situation explained above.

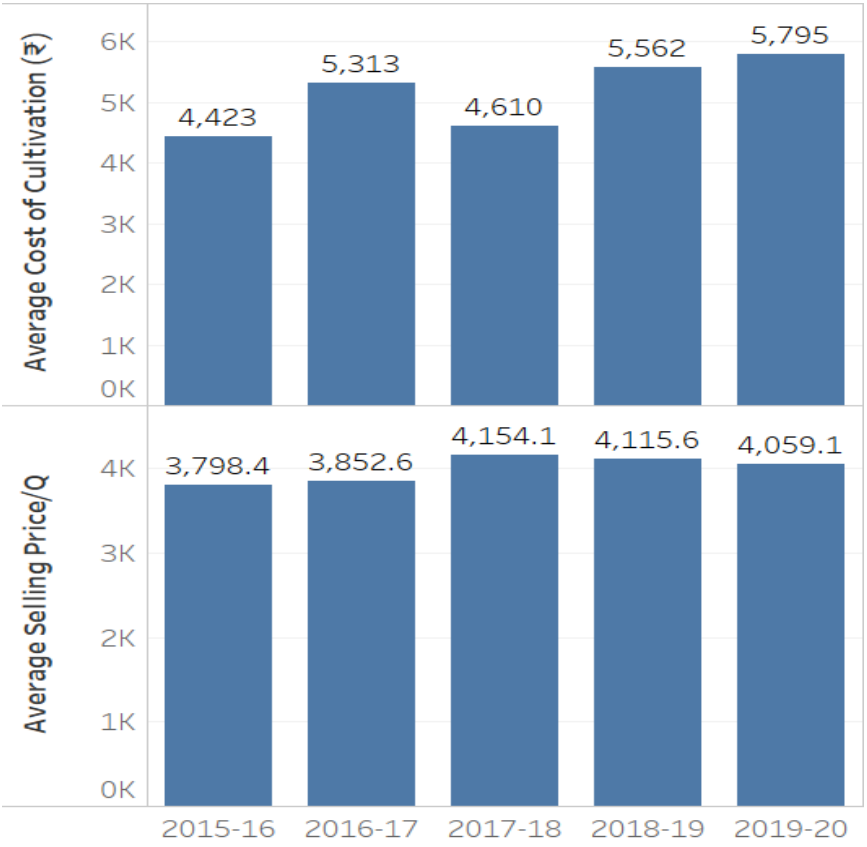

Figure 40: Average cost of cultivation and Average selling price

Case Study

Case Study 1:

Ram Saur is a farmer having about 4 acres of land in Ahaar village of Tikamgarh district. He belongs to the scheduled caste category and is in the below poverty line category. The farmer has no other source of income except agriculture and reported that his annual income is lower than ₹ 1 lakh. He said that he came to know about the project through ICARDA and he also said he did not use to grow lentil before the intervention and was doing urad and other crops.

The reason for being a part of the project is only that he could get better productivity and hence increased incomes. The farmer reported that he has received seeds, Rhizobium and PSB from the implementing agency which was a great help and saved a lot of money for him and the quality of every item provided was also very good.

He received the training in his village and said that he did not face any problems in the same. He has two suggestions regarding the training component, firstly, the training should be for at least two to three days and Secondly, the seeds should be distributed in the village itself.

Ram said that he had increased productivity and the instances of diseases were also less. He sold most of the produce in the market. He says that programs like these should be continued and the availability of quality seeds will make life easier for the farmers like him.

Case Study 2:

Rao Gulab Singh Lodhi is a resident of village Nanhegaon in Goteygaon block in Narsinghpur district. He belongs to the backward community and has a family size of 9. All the members of the family are into agriculture and allied activities. This is a family where everyone has a progressive mindset concerning farming techniques. The family is also involved in rearing animals for indulging in the business of dairy. The family has about 75 acres of land and an annual income of around ₹ 4 lakh from agriculture, moreover, they make earnings of around ₹ 2 lakhs per annum from animal husbandry activities.

The beneficiary came to know about the project through KVK. According to him the training that was provided to the farmers was not sufficient as the time duration was very less, the training should be at least 2 to 3 days long for developing a better understanding. Although, he did not face any problems during the training. Gulab Singh sowed improved quality lentil seeds on 20 Acres of his land and the varieties used by him were JLS - 3 and RLV – 31. He said that the implementing agency only provided them with the demonstrations and seeds and no other support of any kind was provided to them.

As far as the performance of the new seeds was considered Singh was not very optimistic about it. He said that the cost of cultivation is almost same and lesser irrigation was required as compared to traditional seeds. He did not see any large improvements in the quantity of production per acre and since the productivity was the same as the traditional seed so eventually there was no increase in the earnings.

Singh said that it was more of an experiment for him and he learned new techniques of lentil production and is optimistic that he will get desired benefits from it in the future.

Case Study 3:

Farmer Details:

Rameshwar Nema is a farmer of Bhadauna village, in Rahatgarh block of Sagar district and is the only earning member of the family and owns 70 acres of land.

He is a regular visitor of the Krishi Vigyan Kendra in Sagar. Rameshwar is the kind of person who is always in a learning mode and is always curious to know the new technologies and better agricultural inputs.

Rameshwar came to know about the lentil seed intervention program of ICARDA from the Krishi Vigyan Kendra. Quality seeds and other agricultural inputs were provided to him with the help of ICARDA and KVK played a pivotal role in facilitating the distribution of the material.

After using the seeds and inputs as time passed on, he observed that the instances of diseases were negligible. After the harvest, it was clear that the yield on using the quality seeds was significantly higher than the yield obtained earlier by using the traditional variety of seeds. The data below, in table 23, is provided by Rameshwar, the change in productivity is visible.

Before the intervention		**After the intervention**		**Difference in productivity (Q)**
Area (Acre)	**Productivity (Q)**	**Area (Acre)**	**Productivity (Q)**	
4	16	4	30	14

Table 23: Production details of the respondent

Cost of cultivation with traditional seeds	
Heads	**Cost (₹)**
Seeds + Seed treatment	2000
Irrigation (1 cycle)	1000
Sowing	1000
Harvesting	2000
Threshing	1000
Others	1000
Total	**8000**

Table 24: Cost of cultivation of the respondent

Nema said that for the only difference in the cost is of irrigation cycle, in traditional seed system they did one cycle of irrigation. For the quality seeds, they do 2 cycles of irrigation so the difference in the cost of cultivation is somewhere around ₹ 1000 to ₹ 1500 but the change in productivity is so much that this change in the cost of cultivation is negligible when compared to it, the same is depicted in table 24.

A portion of the produce was used for self-consumption and the major chunk was sold to the other farmers of the same block i.e. Rahatgarh. The rate at which he sold the seeds to other farmers was from ₹ 3800 to ₹ 4200 per quintal.

Overall, Rameshwar is very happy with the program as it has increased his earnings.

The farmer gave special mention of Dr. Devendra Kumar Payasi, Scientist, Plant Breeding & Genetics, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Regional Agricultural Research Station, Sagar, for his support.

Case Study 4:

Farmer Details:

Dev Narain Eatudey is a farmer in Dhaamanda village in Sehore district of Madhya Pradesh. He belongs to the khati community which is the traditional farming community of the state. He has about 8.5 acres of land equipped with tube well for irrigation. Dev used to work with a chemical factory as a supervisor in the lab and is a retired person now. After his retirement, he has now become a full-time farmer with only one source of income i.e., farming, the current annual income of the family from agriculture is around 3 lakh rupees.

Regarding Intervention:

The farmer came to know about the quality seed intervention through other farmers of the village. Since ICARDA Amlaha centre is about 3 kilometers from the village he decided to go to the centre himself to get complete information regarding the project. During his visit to the centre, he was given relevant information regarding the quality seed, it's potential productivity, and resistance to diseases. He decided to give it a try by using the seeds on a portion of his land. Dev Narain usually likes the other farmers replaces the seeds after using them for 3 years so he was very sure that this is the right time to do so that too with high-quality seeds.

He decided that he will sow these seeds on 1 acre of his land on which he used to sow Kala masoor earlier. He wanted to sow the seeds on one acre but could not do so as he did not receive the required quantity of seeds that were needed for an acre. The farmer was given directions by ICARDA regarding how to use the seeds and was even told that the seeds would be bought back from him. As time passed by the farmer became more convinced that the productivity will increase and this was confirmed during the harvest season. Usually, the productivity of lentil was around 4 quintals to 5 quintals per acre but this season he got a yield of more than 8 quintals per acre. He also reported that there were almost negligible instances of diseases on the crop which allowed him to earn more due to increased productivity from the same area of land, as shown in table 25.

Before the intervention		**After the intervention**		**Difference in productivity (Q)**
Area (Acre)	**Productivity (Q)**	**Area (Acre)**	**Productivity (Q)**	
0.5	2.5	0.5	4	1.5

Table 25: Production details of the respondent

Dev Narain sold the major portion of his produce to the other farmers of the village so that more and more farmers could reap the benefits of the new improved variety of seeds. He also gave a piece of strange information that no one in the village ate the older variety of lentil but he did so after using the quality seeds.

Perception of farmer

The farmer believed that training and monitoring which plays a major role in success for such interventions was missing which has impacted the productivity otherwise he could have achieved better productivity. He also reported that he was assured that seeds would be bought back from him but this did not happen. Overall, the farmer is happy with the intervention as it has increased his income marginally and is eager and ready for using the seeds again with an improved package of practices to further increase the productivity and in turn his levels of income.

Chapter 3: Gaps in Package of Practices

Certain best practices have to be followed to get maximum productivity. The beneficiaries were provided training by the implementing agency so that the beneficiaries can get maximum benefits from the project.

One of the aspects of the training was soil testing, post-intervention about 81% of the respondents said that they did not get the soil testing done. Thus, there is a large gap that exists in this segment and needs attention.

Seed priming is an important aspect, the process involves soaking seeds overnight and then spreading them on a jute sack the next morning. The process is very beneficial in case of the low moisture in the soil at the time of sowing. About 92% of the respondents said that they did not do seed priming post-intervention.

Germination of seeds depends on seed rate, the seed rate in the case of lentil should be 50kg/hectare. The respondents at sample districts reported either a lower or a higher seed rate being utilized. Post-intervention the seed rate is marginally higher than the optimal seed rate. The average seed rate across locations is 52kg/ha.

More than half of the respondents said that they irrigate their fields only once and two-fifths said that they do so two times, and a marginal proportion said that they did so more than two times during lentil production. The optimal number of irrigation cycles that should be done is two and post-intervention about half of the respondents are following the correct procedures.

The above analysis depicts that there are large gaps in terms of soil testing, seed priming and the number of irrigation cycles that have to be filled. This will enhance productivity and hence the incomes of the farmers.

Chapter 4: Problems and Challenges faced by the implementing agency

During the implementation of the program, various problems and challenges surfaced before the agency. The agency observed that being a private agency they have a limited number of resources in terms of finances and field staff. According to them, if they had better funding, they could have engaged farm facilitators. These farm facilitators would, in turn, helped them in the identification of the right beneficiary, as the beneficiary selection was not proper in the program. These facilitators would also have increased the geographical reach of the project and in turn, a larger number of farmers might have reaped the advantages of the same.

The Agriculture Department, KVK's, and Agriculture Universities were involved as facilitators at various districts as ICARDA's workforce was not available everywhere. Taking follow up from them and getting their responses always was not easy as they are already overburdened with their departmental work.

The duration of the project was not appropriate, it must be longer. Implementing agency has an opinion that implementing such seed improvement programs require a longer time. The duration of the program should be increased or a Second phase should be started. They feel that did not have enough time to develop demonstration fields and sensitize farmers and other grass-root stakeholders regarding the importance of the program.

The absence of farmer collectives also posed a problem for proper implementation of the program at certain locations as such institutions help in strengthening such programs. The concept of seed hub could be more successful if a strong farmers collective was in place at the time of the start of the project.

Research support is also what was lacking, supporting research in the area will prove beneficial for the policymakers as well as the stakeholders.

Chapter 5: Conclusions and Recommendations

5.1 Conclusions

The evaluation reveals that the project has provided benefits to the individuals associated with the project. An improvement in the income was evident during the intervention because of the enhanced productivity and lower instances of diseases. Since the seeds provided to the farmers were disease resistant therefore the application of fungicides, herbicides, etc. automatically decreased which lowered the spending to an extent. The farmers became aware of new tools and techniques regarding lentil production. The difference in the cost of cultivation per acre between quality seeds and traditional seeds is around ₹ 1500 to ₹ 2000 but his amount is marginal in terms of the increase in productivity. Yield is about 1.5 to 2 times higher when the respondents used a new improved variety of seeds.

There are certain shortcomings too, such as training and monitoring which are very critical for the success of any project were not up to the mark. In some sample districts, the beneficiaries have reported that they could have achieved better productivity if training could have been provided to them. ICARDA, which was the implementing agency has its limitations like they need a large number of farm facilitators, need a longer time duration for implementing such a program, etc. The beneficiary selection was also random and no planning was done in doing so.

The current status makes it very clear that the project is overall not sustainable. The project was running well until the beneficiaries received the free seeds and other agricultural inputs but because of the lack of sensitization during the training sessions, most of the farmers did not save the seeds for the future. They were also told to sell the seeds produced to other farmers and not in the market but no mechanism was devised to facilitate such buying or selling.

5.2 Recommendations

After intense field work, primary data collection and analysis, various rounds of discussions with the different stakeholders a list of recommendations have been developed.

Strategies for production enhancement: Increase in income of the farmers can be achieved by increasing the production, below are a few recommendations for achieving the same.

1. The development and distribution of disease-resistant quality lentil variety are vital for the enhancement of lentil production. This requires strengthening the research institutions focusing on pulses research and maintaining a continuum in the research product delivery chain.

2. The present study shows that the market price for traditional seed and improved variety seed is similar. Better price for improved variety seed would encourage farmers to adopt new variety seed as well as scientific techniques to increase the production. Steps to reduce temporal and spatial variation in price, and provide a competitive market price of pulses will help in enhancing as well as sustaining the farmer's interest in pulses.

3. Seed procurement should be done by the M.P. Beej Nigam Limited as this would help in getting better quality seeds and competitive prices and the harvest could also be bought back from the Nigam.

4. Policy level interventions are required for the establishment of strong linkages among producers, suppliers, consumers, processors, whole-sellers, and retailers to begin the value chain. Interventions in the marketing of pulses are also required.

Strategies for effective implementation of the Project: To provide the maximum benefit of a program to its beneficiaries, effective implementation of the intervention is the most critical point. A few strategies have been provided below for an effective implementation design of the intervention.

1. Baseline Study: A baseline study should be done before the start of the project to develop a clear understanding of the region and develop a resource map. This would help in developing tailored interventions in different districts instead of one fit for all approach. This exercise could help in better utilization of available resources.

2. Beneficiary selection process: The most important part of any project or intervention are the direct beneficiaries. These should be selected with utmost care. The needy ones should be selected first in such programs. Small and marginal farmers should be the ones getting most of the benefits rather than the large farmers who are already self-sufficient.

3. Training and exposure visit: Optimal number and duration of training sessions should be calculated. Training plays a pivotal role in the success of such programs; it not only gives knowledge but also a sense regarding the same. Proper training and its feedback will help the program to be successful and this will be a win-win situation for all. Conducting exposure visits will help the trainees develop a better understanding and such interactions will also clear their doubts.

4. Farm monitoring: Monitoring helps in course correction; it gives us invaluable information that can prove beneficial in the present and at later stages too. Regular farm visits by the representatives of the implementing agency are necessary as they develop a sense of confidence among the beneficiaries and also chances of error are minimized.

5. Sensitizing the beneficiaries: The farmers should be sensitized that they must sell some portion of the produce, which could be used as seeds by the buyers, to other farmers in the village so that everyone can benefit from such programs. Since such programs have a limited reach this could prove beneficial and the last man could also reap the benefits.

6. The monitoring part may be given to the Agriculture Universities and their role should not be limited only to that of a facilitator.

7. The mechanism to ensure the sustainability of this kind of intervention should be included in the design of the project or program.

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