

**AN ECONOMIC ANALYSIS OF ADOPTION OF IMPROVED
PULSES PRODUCTION TECHNOLOGY IN SEHORE DISTRICT
OF MADHYA PRADESH**



THESIS

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CERTIFICATE-I

This is to certify that the thesis entitled “**An economic analysis of adoption of improved pulses production technology in Sehore district of Madhya Pradesh**” submitted in partial fulfillment of the requirements for the degree of Master of Science/Doctor of Philosophy in Agriculture/Horticulture of the Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior is a record of the bonafide research work carried out by **Mr. Nageen Verma, ID No. RA/SH/11 /2009** under my guidance and supervision. The subject of the thesis has been approved by the student’s Advisory Committee and the Director of Instruction.

No part of the thesis has been submitted for any other degree of diploma (Certificate awarded etc) or has been published/ published part has fully acknowledged. All the assistance and help received during the course the course of the investigation has been acknowledged by him/her.

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CHAPTER I

INTRODUCTION

Pulses constitute an important component in Indian agriculture since centuries or long ago. The pulse crops are also called as grain legumes and have been valued as nutritious and protein rich food, fodder and feed. They have a pivotal role in agricultural economy of India. It has ability to fix atmospheric nitrogen by symbiotic association with rhizobium. The pulse crops are popularly considered as mini fertilizer factory, which contribute to the enrichment of soil substantially. Deep penetrating root system enables the pulse crops to utilize the limited available moisture more efficiently and maintain soil structure for sustainable productivity over years. Therefore, farmers have chosen pulse crop with diversified condition in India. Pulse crop also have a greater drought resistance than any cereal crops. As per Indian Council of Medical Research, per day per capita requirement of pulses is 80gms. But at present hardly 36gms requirement of pulses is fulfilled.

India is the largest producer of pulses in the world accounting for 33 per cent of the total area and 22 per cent of the total production in few years. But the productivity of pulses in India is low which is around 35 per cent, 55 per cent and 65 per cent of that in the United State, China and the world respectively. During the second decades after independence the production of pulses decreased significantly due to stagnant productivity and grown under rainfed condition with non adoption of improved pulse production technology. After the green revolution, with the introduction of pulse production technology and its adoption on farm level has substantially increased the pulse production in India.

In post independence era, India has made significant advances in agricultural development. Food grain production has specially increased after the green revolution that is about three-fold up to tenth plan period. But with all the advances made through sustained research, pulses production has remained stagnant around 11 to 12 million tonnes over past 30 years. In total, there are more than a dozen pulse crops grown in India, but chickpea (gram), pigeonpea (tur) and lentil remain the major pulses accounting for 55 per cent of the area under pulses and 75 per cent of the total pulse production. The productivity of all these crops remains less than one tonnes per hectare

even after adoption of new pulse production technology.

Madhya Pradesh is one of the leading pulses producing state (having first position among other states) contributing about 20.00 and 25.00 per cent pulse area and production of the country. Area, production and productivity of total pulses were 4502.8 thousand hectares with 3508.2 thousands tonnes and 775.0 Kg per hectare in the year 2007-08 respectively, against 3023.00 thousand hectare area, 1446.60 thousand tonnes production and 479 Kg per hectare productivity in the year 1969-70. These figures show that substantial change in area, production and productivity under pulses during these periods of time.

Pulses being a commercial crop required judicious decision in the investment in production process. Because, maximization of profit with changing improved technology and resources are the main aim of the farmers. To achieve the goals of maximization of profit with different level of technology and resources requires scientific and intelligent decision making concerning to the status of technology. Therefore, farmers are generally confronted with the problems of determining the profitability and productivity with increasing levels of variable inputs as recommended in improved technology in the production process. Specially, it is important in the context of changing input –output prices because stable equilibrium of cost and return is liable to change due to change in price parity between input and output. Hence, it is necessary to examine the cost structure and profitability of pulses cultivation at different level of technology used at farm level.

There is also saying that research efforts are to be concentrated on identifying the farmers who are left behind, providing explanation for their lagging behind and setting forth what should be done to help them. Any attempt to understand the basic problems in the adoption of recommended technology package assumes special significance this step needs a scientific evaluation of the extent of yield gap, the causes and constraints thereof. Hence, there is no need to emphasize the importance of present study to assess yield gaps of pulse production at farm level in study area.

Several studies earlier reported that productivity of pulses in India, in Madhya Pradesh as well as in study area also found to very low. The low productivity could be due to various reasons. Such constraints are required to be analysed and removed

through research and developmental efforts, so that not only area under pulses can be enhanced rapidly, but also to generate good income to the growers through increase productivity.

Keeping the view as above statements, the present investigation is concentrated around level of adoption of improved pulse production technology and their economics of production in Sehore district of Madhya Pradesh with the following specific objectives.

Objectives of the study: -

1. To study the extent of adoption of technology.
2. To study the economics of different levels of adoption of technology by the farmers.
3. To examine the yield gaps due to adoption of technology.
4. To study the problem faced by farmers in adoption of technology.
5. To examine the scope for increasing area under pulses during ensuing years.

Assumption of the study:-

The results of the study are based on following assumptions.

1. The samples represent the homogeneous area of the study.
2. It is assumed that the objective of the farmers is to maximize profits.
3. The farmers are free to take any decisions for maximization of profit.
4. The market for resources and products are assumed to be competitive.

Limitation of the study:-

1. The study is limited to agricultural year 2010-11 and as such, results can not be generalized.
2. The data for the study is based on farmer's memory and hence, results of the study will be individual.
3. The study is conducted on limited number of farmer, hence, the findings can not be generalized and the results may be applicable to the study area only.
4. The study is limited to factors which are within the control of farmers and are contributing in increasing return.

CHAPTER II

REVIEW OF LITERATURE

In this chapter, an attempt is being made to assimilate the works within the framework in interpretation of results obtained during the analysis of an economic analysis, adoption of improved production technology in Sehore district of Madhya Pradesh in different areas of the state as well as in country. The detail review of literature was subdivided into three subheads as per the stated objectives of the study.

1. General information:

Dhondyal (1968), in a study found that the result respected in the study show how the levels of production and net income per hectare have been pushed up by high yielding varieties in relation with increased complementary input of water and fertilizer. The input output ratio is also crucial to the justification of the overall effectiveness of the improved strains.

Singh (1983), studied 300 adopter and 150 non-adopter farms of Sehore district in the year of 1987-88 with the object to find out “the impact of modern technology on production, employment and income in agriculture”. His study revealed that gross income per hectare for the farm business as a whole is 98 percent more on adopter farms than the non-adopters, similarly, the intensity of cropping is higher (164.34) among adopter farms than the non-adopter farms (132.59).

Patel,V.G. (1999), study examines the economics of pulse cultivation vis-a-vis competing other crops in Baroda district (for tur) and Panchmahal district (for gram), Gujarat, India, and identifies the constraints in raising their production. For the study 100 pulse growers (50 from each district) were selected and primary data were collected for the agricultural year 1995-96. The constraints identified in the cultivation of pulses are that most of farmers lacked modern farm inputs with marginal variations in land owned and operated. Poor irrigation and the cultivation of a long duration cotton crop led to low cropping intensity, and a change in cropping pattern in favour of food crops. The productivity of pulses was low and its cost of cultivation was high as compared to other crops. The study provides several suggestions to increase pulse production in the state.

Usha Tuteja (1999), study aims to: examine the economics of pulses production vis-a-vis competing crops in Ambala and Bhiwani districts, Haryana, India; identify the constraints on the adoption of improved production technology; and suggest relevant policy measures. Primary data were collected through a survey of 100 pulse crop growers from 10 villages, and secondary data were collected from different sources. The study relates to the year 1997-98. Results show that: the area under pulses got shifted to a large extent to wheat; improved variety of pulses did not cover more than 33% of the area; and in spite of the low adoption of improved technology, yield of pulses increased substantially (from 13 to 19%). Lack of information about improved technology (including rhizobium culture), scant availability of improved seeds, and lower profits in production of pulses vis-a-vis competing crops resulted in high variability in yield. Measures suggested are: the intensification of research on adaptive and disease resistant varieties of pulses; vigorous and wider dissemination of improved technology; marketing of improved seeds; and procurement of pulses at minimum support prices. It is suggested that major efforts should be made to increase productivity per unit of area by adopting a package of well planned production and protective technologies coupled with protective irrigation.

Daniel, R.R. (2000), study that the overall performance in food grain production in post-independent India, spurred by the Green Revolution, is worthy of the highest administration. Notwithstanding, the trends in grain (rice, wheat, coarse cereals and pulses) production over the last decade portend a wide variety of major challenges and compulsions to meet the accelerating demands in about 20-30 years. Yet there is no clear expression of government action for a long-term strategy and integrated action plan to match the severity of the unprecedented challenges and the exploitation of emerging technologies. The purpose of the paper is to bring together these challenges to highlight how important it is to understand and surmount them in order to increase the future grain production.

Usha Tuteja (2000), the study analyses the economics of production of pulses vis-a-vis competing crops; identifies the constraints in the adoption of improved production technology; and suggests policy measures for increasing production and productivity of pulses in 2 districts (Firozpur and Ludhiana) of Punjab, India. The primary data

(pertaining to the years 1996-97 and 1986-87) were collected through a survey of 100 pulses growers in 10 selected villages; secondary data were also collected. Yields of pulses declined by 219 kg/ha and increased by 422 kg/ha in Ludhiana and Firozpur, respectively. The adoption of modern cultivars was much higher (about 75%) in Ludhiana than in Firozpur (about 25%). The adoption of other inputs relating to improved production technology for pulses was low due to its lower profitability compared with competing crops like wheat and cotton. The major factors contributing the increase in the productivity of pulses are: lack of information about improved technology; lower adoption of rhizobium culture; low availability of improved seeds; high variability in yield levels; and lower profits in production of pulses vis-a-vis competing crops. It is concluded that the strategy for increasing the production of pulses would be a multi-pronged coordinated effort in which research, extension and input supply agencies (particularly improved seeds) collaborate with the farmers in an extensive scale.

Gupta, S.K. (2001), stated the main objectives of this study are: to calculate the economics of production of pulses vis-a-vis other competing crops; and to identify the constraints in the production including the adoption of improved technology. 13 states under the 10 Agro-Economic Research Centres of India were covered, and the study pertained to the agricultural year 1996-97. Unlike other food grains like rice and wheat, pulses are still relegated to the status of an inferior crop. Despite prices having risen, area under pulses is found to have nearly stagnated. The major constraints inhibiting an increase in productivity of pulses are: lack of information about improved technology; lower adoption of rhizobium culture; scant availability of high-yielding, disease resistant and drought resistant improved variety of seeds suitable for different climatic conditions; lower profits in production of pulses vis-a-vis competing crops; and high variability in yields. The farmers fail to benefit from enhanced market prices of pulses due to lack of direct access to processing and marketing facilities. Disease and drought resistant varieties of seeds suitable for different climates, input subsidy, price support, improvement in the harvest and post harvest technology, and modern storage facilities, are the main requirements to boost pulses production.

Sikandar Kumar and Sandeep Kumar (2004), reported that the main aim of the

production unit in study was to coordinate and utilize resources or factors of production in such a manner that together they yield the highest net returns. In study it is suggested that farmers should use more of high yielding variety seeds, insecticide and pesticide, bullock labour and tractorization, improved implements to turn out negative return into positive. Again consolidation of land holding and a redistribution of land in favor of marginal and small farmers will undoubtedly help in increasing the agricultural production, productivity and rural employment.

Singh, Nirmal and Singh, Rachhpal (2004), stated that in terms of area contribution of pulses, Madhya Pradesh, Rajasthan, Uttar Pradesh and Maharashtra were conspicuous states. The state-wise area and production of pulses contribution showed a consistent behaviour during all the time of study.

2. Cost and returns:

Kashive (1974), worked out economics of production of soybean and competitive crops in M.P. The study observed that the returns from soybean are more in Sagar, Seoni and Hoshangbad districts. He reported that net returns from soybean were Rs.288, as against Rs.36 from Jowar in Sehore district, Rs.104, as against Rs.12 from soybean were equal (Rs.21) to that from Jowar.

Mruthyanjaya and Kumar (1989), found that the cost of cultivation of crops has increased in all the crops over the years owing to inflationary pressure. The increases in the cost mainly come from the rise in cost of machine power. Fertilizer, human and bullock labour etc. the cost of production has shown an upward trend, the yield levels in general have shown little improvement. Declining profitability and terms of trade were observed in all the crops except sugarcane and cotton on account of little improvement in yield coupled with rising cost of production. The cost of production at constant input prices indicated a generally declining trend in all the crops except maize, gram and jute. The share of operational cost and purchased input was increased in the total cost.

Raghuwanshi, R.S. (1999), reported that costs and returns from gram [*Cicer arietinum*] crop grown in small, medium and large sized holdings in Tikamgarh district of Madhya Pradesh during 1994/95 are analysed. The results indicated that the per hectare cost of gram cultivation was Rs. 6064 with the little variation between the holding size. The net income, family labour income and farm business income were

highest in small farms and lowest in large farms. The return on investment of per rupees was Rs.1.84, indicating that it is a profitable crop.

3. Adoption and Yield gap:

Hazarim,R.P. *et. al.* (1985), reported on the constraints analysis of soybean production in Parua nala rainfed watershed area of Sehore district of M.P. They analyse the variety-wise yield gap and observed that the gap becomes narrow as the size of holding increasing in J.S. 72-44 variety of soybean, while no specific trend was observed in other varieties. They also reported that the lack of technical knowledge was the most important constraints found followed by low price of farm product, lack of communication, high price of fertilizer, lack of irrigation and less marketing facilities. The extension agencies are not serving marginal and small farmers. There was positive relationship between gap in field production and size of holding. The gap in actual ad recommended operation of field preparation increased as the size of holding increased.

Karanjkar and Pandya (1985), estimated the gap in resource use and crop management practices in Indore region and observed that a larger proportion (53 per cent) of farmers were not applying adequate doses of fertilizers and also were not using proper seed rate. They also estimated the yield gap between reliable potential yield in Indore region at different size of farm and observed that 54 per cent of the realizable potential yield has been obtained by the sample farmers of the region: 46 per cent yield gap in realizable potential yield and actual farm yield was present. Gap in yield was found to decrease with the increase in the size of farm.

Sunandini,G.P. *et.al.* (1988), reported that the reasons attributed by the farmers for the yield gaps, are incidence of pests and diseases, lack of own funds, high cost of inputs, lack of timely supply of these input and rainfall. It is suggested that more demonstrations, subsidized supply of inputs, timely supply of inputs, credit facilities, technical know how and marketing facilities help in reducing the gap.

Rajeswaran,R. and Varadarajan,S. (1992), estimated yield gap II, as the difference between maximum yield realized on farms in a region and the actual yield of average farmer. The study covered 100 low land rice farms and 100 upland (Semi-dry) rice farms in Madursi and Ramanathapuram districts of Tamil Nadu. Functional analysis with linear and log forms for low land and bridging the gap in input use through

additional use of N on low land farms and application of N and protection measure on upland farms. In both the cases educational status of the farmers had a significant impact on yield gap. Therefore, education of farmers to promote their conviction about the potential benefit of the recommended agro-techniques and supporting them with adequate and timely supply of inputs are policies suggested, strict quality control in seeds and supply of adequate quantity of quality seeds in time are found to be the urgent felt needs of the farmers in study area.

Shivaramu *et.al.* (1997), revealed that the over all technology recommended (TR) and technology adopted (TA) ratio were worked out to be 23.4 per cent. This indicated that only 23.4 per cent of the technologies develop and recommended by the institute have sown for adoption by the users. This was the extent of diffusion of dry land technologies in Yernal watershed.

Gaddi,G.M. *et al.* (2002) conducted a study based on the primary data collected from 80 samples farmers spread over in eight village of four Talukas from two leading districts, viz., Dharwad and in eight villages of four Talukas from two leading districts, viz., Dharwad and Bellary with respect to cotton area. They observed that with the advent of new technology in agriculture, significant improvement in the crop productivity was noticed. However, proper resource mix and appropriate culture practices become a pre-requisite for the adoption and success of new farm technology, which are often beyond the reach of majority of the farmers.

Soni,S.N. (2002), reported the perceptions of improved technologies users need to be under-stood and ensure viable potential of modern technology use on their own end. In other side, it is very essential both for the farmers and to programme personnel before execution of programme designed to raise agricultural production. They should also know whether investment in modern inputs like high yielding variety, fertilizer, plant protection, chemicals and irrigation etc. are to be remunerated. The present study is examining the comparative economics of gram production of the existing and improved technology adopted by the farmers and adoption gap influence the productivity. The result indicated that with the adoption of modern technology the yield of gram increased on an average 3.35 quintal per hectare. This we can say that there exist a vast yield potential in the area. In economics point of view the improved technology was found to

be highly remunerative also. It is resulting in encouraging additional net returns Rs. 910.50/hectare.

Sharma, M.L. *et.al.* (2002), observed the yield gap and constraints responsible for the yield gap in Finger millets and Ban yard millet, the two most important small millet crops and suggest, suitable measure for minimizing the yield gap. In the constraints analysis, it was found that the most important constraint was about the use of high yielding variety (HYV) seed which none of the farmer used. Another important constraints was seed rate and the result revealed that in the case of both these millets all the farmers at all the both these millets all the farmer at all the three attitudes used higher seed rate at compared to recommended rate. The other constraints, which affected the yield significantly, were method of sowing. None of the farmers of the study area adopted line sowing. In addition to these, the other constraints that affected the yield was about non-application of chemical fertilizer, through most of the farms have done weeding as per the recommended schedule. The study of suggested that to increase the productivity of crops and to reduce the yield gap, HYV seed should be popularized among the farmers and for this suitable improved varieties of these crop adopted to rainfed conditions should be developed secondly, the line sowing method should be popularized among the farmers in place of broad casting method for which emphasis for development of pasture and community land should be given because farmers were adopting broad casting method of sowing to obtain more fodder.

Sharma *et.al.* (2002), the studied to analyzed the adoption and yield gap of chickpea production in Sehore developments block of Madhya Pradesh and studied the various constraints associated with its adoption and yield gap. They noted the reasons for attributed to various constraints, viz. crop management labour management and the constraints related to institutional organization. Low availability of high yielding varieties seed, lack of knowledge about soil testing facilities, high cost of fertilizers, irregular power supply, lack of capital for purchase of weedicide and insecticides are the main constraints related to crop management. As regards the constraints related to labour management the leading constraints is the shortage of power supply of peak operation time. Among the institutional constraints the lack of knowledge about warehouse and the non-availability of quality inputs through co-operative society are some of the main

constraints in the study area.

4. Constraint in production:

Dubey (1986), conducted a study as constraints of production of soybean crop in Damoh district of Madhya Pradesh. He found that high cost and non-availability of desired fertilizer was the principle constraints followed by lack of irrigation, desired seed not available and lack of technical know how etc. There was a wide gap between the adoption of practices and recommended practices. He suggested that technological know-how be transfers properly b the extension agencies so that the farmer are aware about the use of scientific application of the yield increasing input and practices.

Marothia,D.K. (1986), stated the study reports on the second phase of the constraint analysis project which was sponsored by Madhya Pradesh Council of Science and Technology. It assesses the constraints to high wheat and gram yields in three villages (Barbanda, Nowardi and Tor) of Dharsiwa Block where these two crops are grown under a tank irrigation system. Basic data were obtained from a survey of 82 randomly selected farmers. The results show a positive association between adoption rates of improved inputs and profitability of the new wheat and gram technology. The yield and income gaps between the survey farms and experimental farms for the wheat crop were greater than those for gram. The results indicate the positive correlation between irrigation facilities and use of growth promoting inputs and quality seeds.

Alshi Bhole and Bidwal (1988) conducted a study on the constraints of crop production. They observed that the constraints in the adoption of new technology such as hybrid seed, fertilizer and pesticides for increasing production in Akola, Yavatmal, Amravati and Buldhana district of Vidharbha in Maharashtra for the year 1987-88 and found that the extent of adoption of recommended practices was more in preparatory tillage and sowing operations and less in manuring, fertilizers and plant protection operations, non availability of farm yard manure in the village lack of money to purchase the manure, risk due and inadequate amount of loan to purchase fertilizers were the main constraint faced by most of the respondents. The use of pesticides failure to understand the importance of preventive measures and non-availability of plant production equipment were the major constraints in the use of pesticides.

Singh,M. *et al.*(1989), in post independence era, India's food grain production has

increased three fold but pulses production has remained almost stagnant. The constraint for stagnant yield of pulses are unavailability of input seed, low genetic potential of local cultivars, limitation of soil moisture, poor agronomic management, low fertilizer use and inadequate plant protection measures. An integrated technology package is required to boost pulses production which includes growing of suitable improved varieties on well drained land at proper time by line sowing along with fertilizer dose of one quintal diammonium phosphate per hectare. The other factors package are seed inoculation with rhizobium culture, weed control at early growth stage, irrigation and need based plant protection measures. Productivity of pulses per unit area can be raised by inter cropping systems having cereals and pulse and pulse combination.

Sharma, H. *et.al.* (1996), reported soybean yields in Madhya Pradesh state, India, are 77% and 244% lower than recommended technology and potential yields, respectively. This study was undertaken to investigate the factors responsible for these differences. The analyses indicated that lack of knowledge of soybean production technology, lack of capital for purchasing inputs, lack of skilled labour at peak periods, and non-availability of timely inputs and labour are the major constraints which resulted in low production and income.

Agarwal, G.P. and Gautam, D.S. (1999), conducted a survey of constraints analysis of Kharif and Rabi crop production in Kundam Tribal block of Kaymore and Satpura hills Region was conducted in the year of yield of paddy, wheat, sesamum, mustard, pigeon pea and gram in farmers field was lower than state average, viz; 41.47%, 57.48%, 12.4%, 62.3%, 58.7% and 57.74% respectively. This indicates lower per hectare crop production in tribal farms due to various, social, economical and technical constraints which are effectively create lower level of adjustment to boost up productivity of Kharif and Rabi crops. The study reveals that constraints in Kharif and Rabi, crops production were lack of knowledge about improved seed tribal development programme, agriculture extension programme etc. Lack of irrigation facilities, capital for purchase of inputs improve methods of sowing and improve implement of sowing in existing resources were more predominant constraints with tribal community. Beside these, suggestions for improvement in existing tribal condition to increase crop productivity has also prescribed to state administration and extension authority of Madhya Pradesh.

Rajput,A.M.; Rajesh, Porwal and Deshpande,S.L. (2000), a study was conducted during 1993-94 to investigate crop productivity and constraints on tribal farms in Dhar block, Dhar district, Madhya Pradesh, India (n=75). Average yield of soybean (11.5 q/ha), wheat (19.5 q/ha) and chickpeas (9.75 q/ha) was highest on large farms (above 6 ha) followed by small (up to 2 ha) and medium farms (2.1 to 6 ha). Cost benefit ratio for soybean (1:1.61), wheat (1:1.68) and chickpeas (1:1.41) was also highest on large farms. Cost benefit ratio of wheat was 1:1.56, 1:1.55 and 1:1.68 on small, medium and large farms, respectively. The major constraints were low price of farm produce, labour shortage and high transportation charges. These three constraints were experienced by more than 70 per cent of the sample farmers.

Sharma *et.al.* (2003), reported that data were collected from 100 chickpea growers from six villages of the Sehore Development Block, Madhya Pradesh, India, to explore the constraints in the adoption of improved chickpea production technology in the state. Results revealed a wide adoption gap, which was highest in use of micronutrients (99%) and lowest in proper field preparation (10%). A wide gap was also observed between the potential and actual yield, which may be attributed to various constraints, viz., crop management, labour management, and infrastructural constraints.

CHAPTER III

MATERIAL AND METHODS

In this chapter, the material and methods used in the present study along with the research procedure, the study design, the nature of sample and the data collection techniques was mentioned. This research study is split into following four sections.

1. The study area
2. Sampling procedure
3. Nature, collection of data and method of enquiry
4. Analytical procedure

3.1 Study area:

The study was conducted in Sehore district of Madhya Pradesh. This district is situated in the Vindhyan plateau suitable for pulse production in Madhya Pradesh. The average rainfall received during the period from 23rd to 43rd standard meteorological week (i.e. from June 4 to October 28) was 872mm (2009-10). Early withdrawal of monsoon affected adversely the crop yield. The area presents the common toposequence of the Plateau, viz. hilly rock, shallow soil, medium and deep soil. The soil is typical vertisol derived from basalt and has clay loam mixture. The heavy black soil and suitable agro-climatic condition for cash crop like soybean and pulses in kharif and wheat and gram etc giving opportunity to improve the economic condition of the farmers. The existing cropping pattern showed that kharif and rabi pulses namely pigeonpea, urad-bean, gram and lentil are the popular pulse crops in the district. The details of area and production of major pulses in the districts are presented in table 3.1:

Table: 3.1: Area and production of major pulse crops in the districts. (2008-09)

S.No	Crop	Area "000"hectare	Production "000" tonnes	% to total area
1.	Tur	4.60	3.10	4.13
2.	Uradbean	0.40	0.20	0.36
3.	Gram	102.7	82.3	92.19
4.	Pea	0.50	0.20	0.45
5.	Lentil	3.20	2.30	2.87
6.	Total	111.4	88.1	100.00

The above table shows that gram is the only pulse crop accounting for more than 92 per cent of the total pulses area in the district, hence, selected for the study.

Sampling Procedure:

For the study, three stage sampling technique was used for drawing the sample. At the first stage, Sehore block in Sehore district was selected purposively due to highest area under pulse crops among the other blocks of the district and well known for researcher. At the second stage, a list of villages in selected block was prepared in ascending order of area under pulse crops. Among these villages, 3 villages were selected randomly namely Kakerkheda, Bhaukhedi and Mogarram. At the third stage for the selection of respondents, a list of pulse growing cultivators of each village was prepared in ascending order of their pulse area. From this list 75 farmers was selected randomly for the study.

3.3 Nature, collection of data and method of enquiry:

For the present study, primary data was collected.

Primary data:

Primary data was collected from sample pulse growers. The primary data was recorded on socio economic characteristics of farmers, farm resource structure and resource use pattern in pulse cultivation. The specific and detail information on cost incurred and returns obtained in the cultivation of selected pulses was also collected from the sample respondents. The information also collected regarding yields obtained in the field of full adoption of recommended pulse production practices and actual yields

in general farmer's fields. The constraints confronted by the farmers in pulse production also recorded.

Period of the study:

All the collected primary data were related to the agricultural year 2010-11.

Collection of data:

The data were collected using survey method. The data on different aspects were collected through pre-tested interview schedule. Each of the selected sample pulses growers was approached personally for recording relevant data (Appendix-1).

3.4 Analytical procedure:

Collected data were edited and checked for their adequacy and accuracy. Keeping in view the objectives of the study, the data were classified and tabulated. The classified and tabulated data were further processed in terms of average and percentage to arrive at conclusive figures for interpretation of data. In present study following statistical and econometrics tools were used.

(1) Adoption pattern of improved production technology:

To find out the level of improved pulse production technology, technologies recommended (TR) and technologies adopted (TA) ratio will be calculated as formula suggested by Sabarathnam *et.al.* (1991).

$$\text{TR \& TA ratio} = \frac{\sum_{t=1}^n t_n}{TN} \times 100$$

Where,

t = number of technologies adopted

n = number of farmers who reported adoption

T = total number of technologies recommended

N = Total number of respondents.

(2) Recommendation of gram production technology:

To know the adoption pattern of selected gram production technology, the

recommended packages of practices of gram production are present in table 3.2

Table:3.2: Recommended package of practices for gram production.

S.NO.	Package of practices
1.	Field preparation
2.	High yielding variety seed
3.	Sowing method
4.	Seed treatment
5.	Fertilizer and manures application
6.	Use of Bio-fertilizer
7.	Use of micro nutrient
8.	Interculture operation
9.	Insect-pest control
10.	Irrigation
11.	Harvesting process

(3) Estimation of profitability:

The estimates of profitability were based on different cost and return incurred in pulses cultivation.

(a) Cost concepts:

The cost of cultivation classified as recommended, “Special expert committee on cost estimates, GOI, New Delhi”, was used in this study. The cost concepts are given below:

Cost A₁: It includes: -

- i. Value of hired human labour,
- ii. Value of hired and owned bullock labour,
- iii. Value of hired and owned machinery labour,
- iv. Value of owned and purchased seed,
- v. Value of fertilizers, manures and chemical,

- vi. Value of insecticide and pesticides,
- vii. Expenditure on irrigation,
- viii. Land revenue and taxes,
- ix. Interest paid on crop loan if taken,
- x. Depreciation on farm assets excluding land,
- xi. Interest on working capital,
- xii. Miscellaneous expenses.

Cost A₂: It includes-

Cost A₁ + rent paid for leased in land

Cost B₁: It includes-

Cost A₂ + interest on value of owned fixed capital assets.(excluding land)

Cost B₂: It includes-

Cost B₁ + rental value of owned land

Cost C₁: It includes-

Cost B₁+ imputed value of family labour

Cost C₂: It includes-

Cost B₂ +imputed value of family labour

Cost C₃: Cost C₂ + 10 percent of cost C₂ to account for managerial input of the farmer.

Evaluation of farm inputs:

Methods followed in evaluating different farm input for the present study are described in the following paragraphs.

i. Hired human labour:

The farmers normally engage permanent farm labour on the basis yearly wages and casual labour on daily wages basis, for performing farm operations. The casual labour was evaluated on the basis of actual wages prevailed in the locality. The wages of male and female labour included payment given both in cash and /or kind. The value of kind components given to the labour was calculated at their prevailing market prices.

ii. Family labour:

The family labour cost was evaluated at the rate of prevailing wages in the locality for casual hired labour at various stages of operations.

iii. Bullock and machinery labour:

Estimation of bullock and machine labour charges on actual wage prevailed in the locality were considered.

For estimation of depreciation, interest on working capital, interest on fixed capital and rental value of owned land, following standard norms were used.

iv. Depreciation on farm assets:

The straight-line method is used for calculating rate of depreciation. The depreciation rates for different farm assets are taken @ of 10 per cent.

v. Interest on working capital:

It is worked out @ 12.50 percent for half of the duration of the crop.

vi. Interest on fixed capital:

Interest is charged @ 10 percent per annum on the value of implements, machineries, farm building, irrigation structure and drought animals. It excludes interest

on land input, because rental value of owned land is calculated separately.

vii. Rental value of owned land:

It is calculated on the basis of 1/6th of the gross income or prevalent rate in the area for the same.

(b) Value of farm produce:

This includes the value of main product and the by – product of the crop. The harvest price of the crop was considered for calculating the value of main produce. The value of by – produce was calculated at the prevailing price in the locality.

Profitability concepts:

For the estimation of profitability from, the following efficiency measures were used in this study:

- (i) Gross income,
- (ii) Net farm income,
- (iii) Input- output ratio,

These are defined as under: -

- (i) **Gross income:** It is defined as: total value of main product +by product.
- (ii) **Net farm income:** It is defined as: gross income – cost ‘C₃’
- (iii) **Input – output ratio**

$$\text{Input- output ratio} = \frac{\text{Gross income}}{\text{Cost of cultivation}}$$

4) Farm level yield gap:

The definition and conceptualization of potential yield and yield gap model is

considered in study. "Potential farm yield is one which is obtainable on a farmer's field with the adoption of modern technology. The difference between the potential farm yield and actual average farm yield is termed as yield gap". In present study following yield gap is studies:

Economics of Yield gap:

The yield gap was studied earlier by employing three gap model (Swaminathan 1977) and four gap model (Venkateswarlu 1978 and Suryanarayana 1980). The present study employs three gap models as follows:

Gap I : The difference between the yields obtained in on Research Station that obtained on progressive farms.

Gap II : The difference between yield obtained by the progressive farms and average yield realized by sample farms.

Gap III : The difference in the yield on Research Station and the average yield realized by the farms.

5) The constraint operating in pulses production:

The constraint of pulse production operating could be physical or biological, technological and socio-economic. The actual constraint on farmer field analysis was based on the opinion survey of the farmers under study.

CHAPTER IV

RESULTS

The present chapter is the most important of present study which consists the analysis of empirical data collected and inferences drawn from the data with cause and effect relationship to find out final results and thus, conclusion drawn of the study. The inferences were based on the economics and statistical tools applied for the study. As per the stated objectives the micro level analysis of general information of sampled farmers were revealed with their land use pattern and fixed assets investment for production purpose. As per objective an attempt also has been made to analyze the comprehensive study of economics of adoption level of improved pulse production technology to show the profitability of technology level adopted by farmers. In this way, the study represents the picture of possible costs of production and return from per unit area with adoption level of technology used in pulse production. The extent of yield gap with the use of different level of technology was also calculated. To provide feed back of the constraints confronting by the farmers in adoption of pulse production technology in the study area and their suggestions were also made for expansion of pulse production in future and to remove constraints at farm level.

Socio-economic characteristics of sample farmers:

This part of the study is primarily concerned with micro level analyses of general information of sample farmers regarding farm family and their farm structure.

Since, socio-economics characteristics of farmers and farm resource structure reflect the operational, organizational and managerial constraints of the farm business activity. These are the characteristics of the farmers which directly and indirectly affecting the efficiency of farm, level of resource use, income and level of profitability from farm enterprise. Hence, it is very important to study these characteristics of the sample farmers.

The data on distribution of sample farmers according to age and education level is presented in Table 4.1.

Table: 4.1: Socio-economic characteristics of sample farmers. (Per farm)

S.No.	Particular	Number/Characters	Percentage to total
1.	Total Farmers	75	100
2.	Average age of respondents (years)	45.16	--
3.	Education of farmers		
	a. Illiterate	23	30.66
	b. Primary	28	37.34
	c. Up to H.S.S.C	13	17.34
	d. College	11	14.66
4.	Percentage literate to total	--	69.34
5.	Percentage illiterate to total	--	30.66
6.	Strengths of family		
	a. Male	1.87	24.60
	b. Female	1.71	22.50
	c. Children	4.03	52.90
	Total persons (size of family)	7.61	100
7.	Work force		
	a. Male	1.52	53.52
	b. Female	1.32	46.48
	c. Size of worker	2.84	100

The data in table shows that the average sample farmers found to about 45.16 years of age old. Regarding literacy position, the illiterate respondents found to on an average 30.66 per cent of total respondents. The result shows that the maximum respondents 69.34 per cent were found to literate. Among the literate, the maximum number of respondents were found to pass out up to primary school level 37.34 per cent followed by up to H.S.S.C 17.34 per cent and remaining 14.66 per cent was passed out up to college level of education.

Table 4.1 also shows the distribution of the size of farm family and work force (labour) in their family. The data revealed that 7.61 persons were found in a family. Among them the male person was found to 24.60 per cent followed by 22.50 per cent female and 52.90 per cent children respectively. Work force (labour) in a family is important parameter for family income. The data revealed that there was 2.84 people in a family active as a workforce and among them 53.52 per cent was male worker. The female worker was 46.48 per cent to total worker in a family.

Structure of farm resources:

As operational holdings of the farmers is the basic unit of study. The physical and financial resources available with the farmers determine farm business activities and adoption of suitable cropping systems on their farms amongst the prevailing cropping systems in area. Opportunities for utilization of these resources and other factors that affect the crops production should know prior to decision making process. Farmers own resource comprise mainly of land, family labour, machinery and the other available assets and inputs. The distribution of these resources has been studied as follows:

Land utilization and irrigation pattern:

Land is probably the most important measure in classifying the farms, because it is a primary and fixed input constituting the major portion of the fixed cost. It is also free from the substantial annual fluctuations. The land use pattern of sample farmer's holdings is presented in table 4.2

Table: 4.2: Land utilization and irrigation pattern of sample farmers.

(Per farm)

S.No.	Particulars	Hectare	Percentage to total
1.	Average size of holding	4.88	100.00
2.	Area under other use	0.22	4.51
3.	Cultivated area	4.66	95.49
4.	Area under Kharif crops	4.62	94.67
5.	Area under Rabi crops	3.42	70.08
6.	Gross cropped area	8.04	164.75
7.	Total irrigated area	3.41	69.88
8.	Percentage irrigated area to cultivated area	--	73.17
9.	Area under gram	1.28	26.23
10.	Gram area percentage to rabi area	--	37.43

As observed from the table 4.2, the average size of farm holding found to be 4.88

hectares per farm among which 0.22 hectare was under other uses and remaining 4.66 hectares per farm area was under cultivation. Hence, the cultivated area was found on an average 95.46 per cent to total size of holding.

Irrigation is compulsory for higher production of crops particularly in rabi season. The irrigated area as a percentage of cultivated area was found to on an average 73.17 per cent which shows very satisfactory as per the irrigation availability in the district and state also. The total average irrigated area through all sources was 3.41 hectare i.e. on an average 69.88 per cent of average size of holding per farm.

The study also shows that kharif crops in area were dominated and it was growing in 94.67 per cent area of total holding. On the other hand, the rabi area was found to 70.08 per cent of total holding per farm. Gram is a very popular and common pulse crops growing in the area in rainfed or semi irrigated condition. The area under gram was found to 1.28 hectare i.e. 26.23 per cent of total holding and 37.43 per cent of total rabi area.

Fixed assets on the sample farm:

Fixed assets comprises the value of the fixed capital like land, farm building, implements and machinery and the value of miscellaneous assets which is shown in the table 4.3.

Table: 4.3: Fixed assets of sample farmers.

(Per farm)

S.No.	Particulars	Rupees	% to total fixed assets
1.	Value of land	1732000	82.18
2.	Farm building	198973	9.44
3.	Irrigation structure	109138	5.18
4.	Implements and machinery	55724	2.64
5.	Minor implements and miscellaneous	8487	0.40
6.	Other fixed assets	3293	0.16
7.	Total Fixed assets	2107617	(100)
8.	Total assets value excluding land value	375617	17.82

The values of fixed farm assets in general determine the absolute farm production unit, which is invested during the past years. Among the total value of fixed capital, land is the costly assets out of all the farm assets. On an average percentage value of land to the total value of assets on the sample farm found to about 82.18 per cent followed by total value of farm assets excluding land value found to 17.82 per cent respectively.

Technological level adopted by farmers in pulse production:

In general, the aim of agricultural economist is, to reduce the marginal cost of output for getting the maximum profit with the use of improved agricultural technology. This can occur either by employing (adoption) the existing inputs but in different composition (a change in technology and package of practices as per the recommendation) or by introducing new factors of production either for replacing old ones or simply as additional inputs (technological innovation). With regards to above fact, application of adequate quantities of farm power with other yield attributing inputs like high yielding variety (better seeds), fertilizer and nutrients application, plant protection measures, irrigation etc. with improved agronomical practices are the important necessary condition for optimum output in agriculture, hence considered for study.

Table 4.4 give the major recommended package of practices for selected pulse production technology; these are indicators of technological process or technological status for improved level of pulse production in study area.

Fig:1: Distribution of the respondents according to their education.

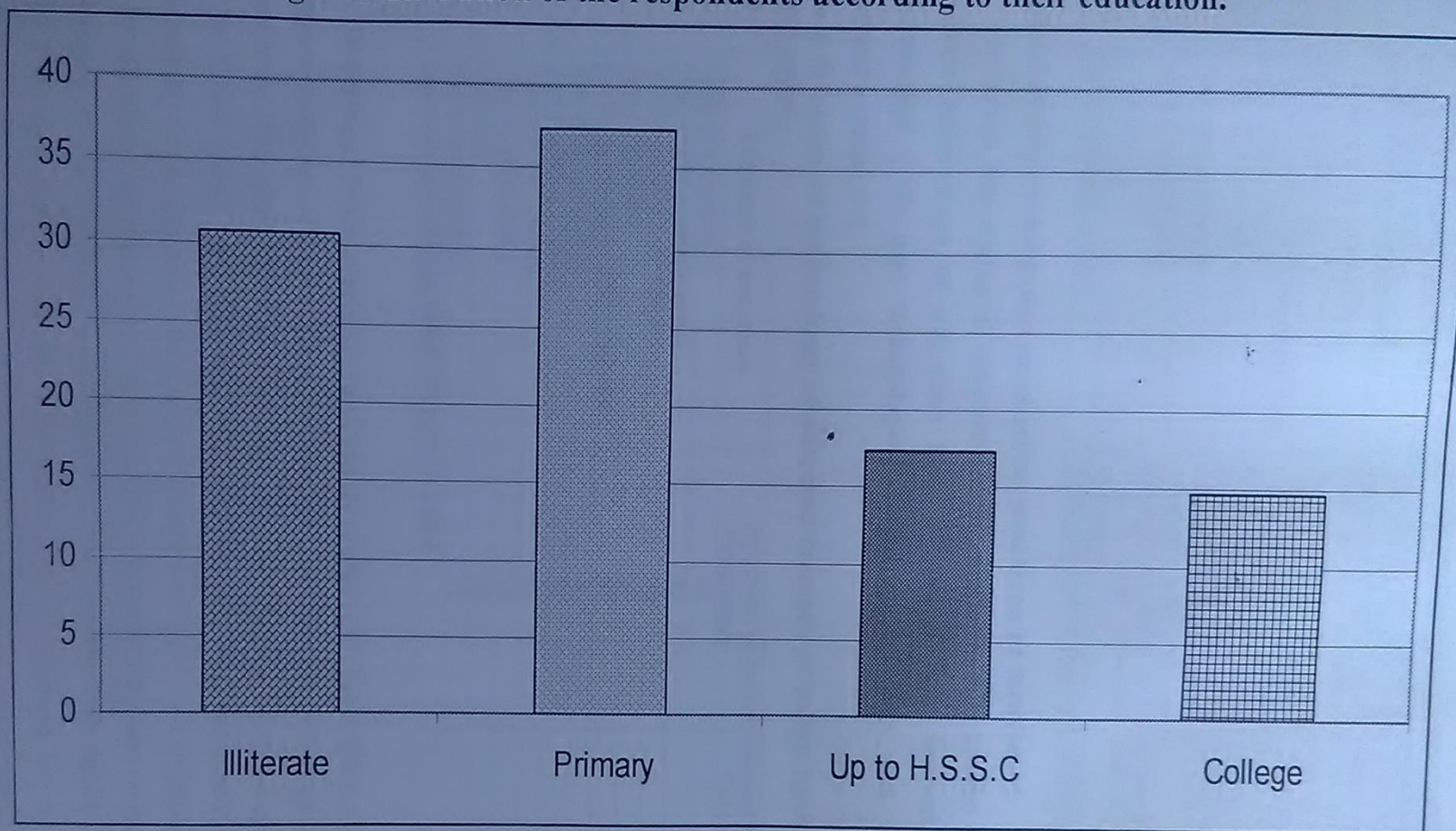


Table 4.4: Recommended technological for pulse (gram) production.

S.NO.	Package of practices	Recommendations
1.	Field preparation	Pre sowing irrigation + 2 or 3 shallow ploughing
2.	High yielding variety seed	Improved varieties as per recommended for area
3.	Sowing method and time	Row to row distance 30cm and plant to plant distance 10cm, (15 October to 15 November)
4.	Seed treatment	Thiram + Corbandizum 2:1 @ 3gram per Kg of seed
5.	Fertilizer and manures application	DAP@100Kg per hectare(N=15-20 kg+P= 40-50Kg)
6.	Use of Bio-fertilizer	Rhizobium + PSB culture @ 5gram per Kg of seed
7.	Use of micro nutrient	Zinc sulphet + Gypsum@ 30+20kg per hectare
8.	Interculture operation	After 20-25 days of sowing 1 or 2 manual weeding or 1 weeding with hand howar
9.	Insect-pest control	Indosulphan 35EC @ 1.5liter per hectare 2 times
10.	Irrigation	1 or 2 times (flowering and at the time of seed formation)
11.	Harvesting process	At the time when pod was matured upto 90%

Adoption of improved pulse production practices at farm level:

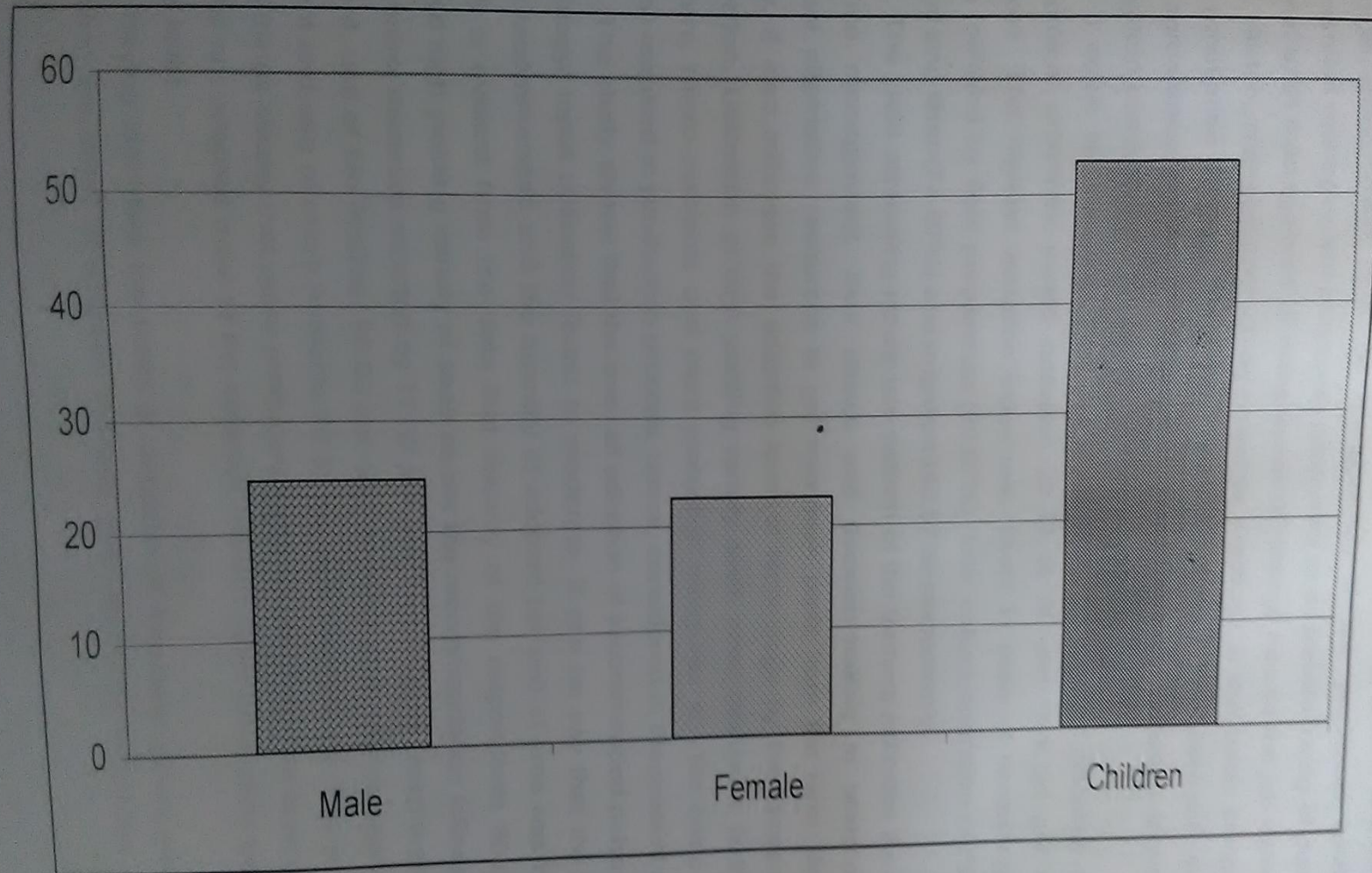
To know the status of adoption of recommended improved selected pulse production technology at the farm level by the sample farmers, technologies recommended (TR) and technologies adopted (TA) ratio was calculated and presented in table 4.5:

Table 4.5: Level of technology of selected farmers of pulse (gram) production at farm level.

S.NO.	Package of practices	Adoption of recommended technology	
		Frequency	Percentage to total
1.	Field preparation	68	90.67
2.	High yielding variety seed	60	80.00
3.	Sowing method and time	56	74.67
4.	Seed treatment	50	66.67
5.	Fertilizer and manures application	42	56.00
6.	Use of Bio-fertilizer	45	60.00
7.	Use of micro nutrient	22	29.33
8.	Interculture operation	62	82.67
9.	Insect-pest control	58	77.33
10.	Irrigation	32	42.67
11.	Harvesting process	72	96.00
12.	Level of technology used (TR and TA ratio)		68.73

The above table presents the findings relating to information about statuses of package of practice wise recommended pulse production technology adopted by the respondents. The study revealed that the over all TR and TA ratio were worked out to be 68.73 per cent. This indicated that only about 69 per cent of the technologies developed by pulse scientists and recommended for optimum production level have gone for adoption by the users. This was the extent of diffusion of pulse production technologies in the study area as well as in the district. The figure may still come forward if the extension and research personnel concerned for pulse production motivated to farmers through various extension and farm trial activities in the area.

Fig:2: Distribution of the respondents according to their strength of the family.



Raising the pulse crops is a biological activity. Plant growth is a function of ecological environment and its management if the ecological environment (agronomical management practices) conducive to successful rising of pulse crops dose not exist management of components of ecology can do the job within certain limits. Hence, management of agronomical practices is the basic component of pulse production ecology. To get the optimum yields from pulses soil, water and other agronomical practices management is all most always possible to promote an eco-system conducive for the growth of desired plants.

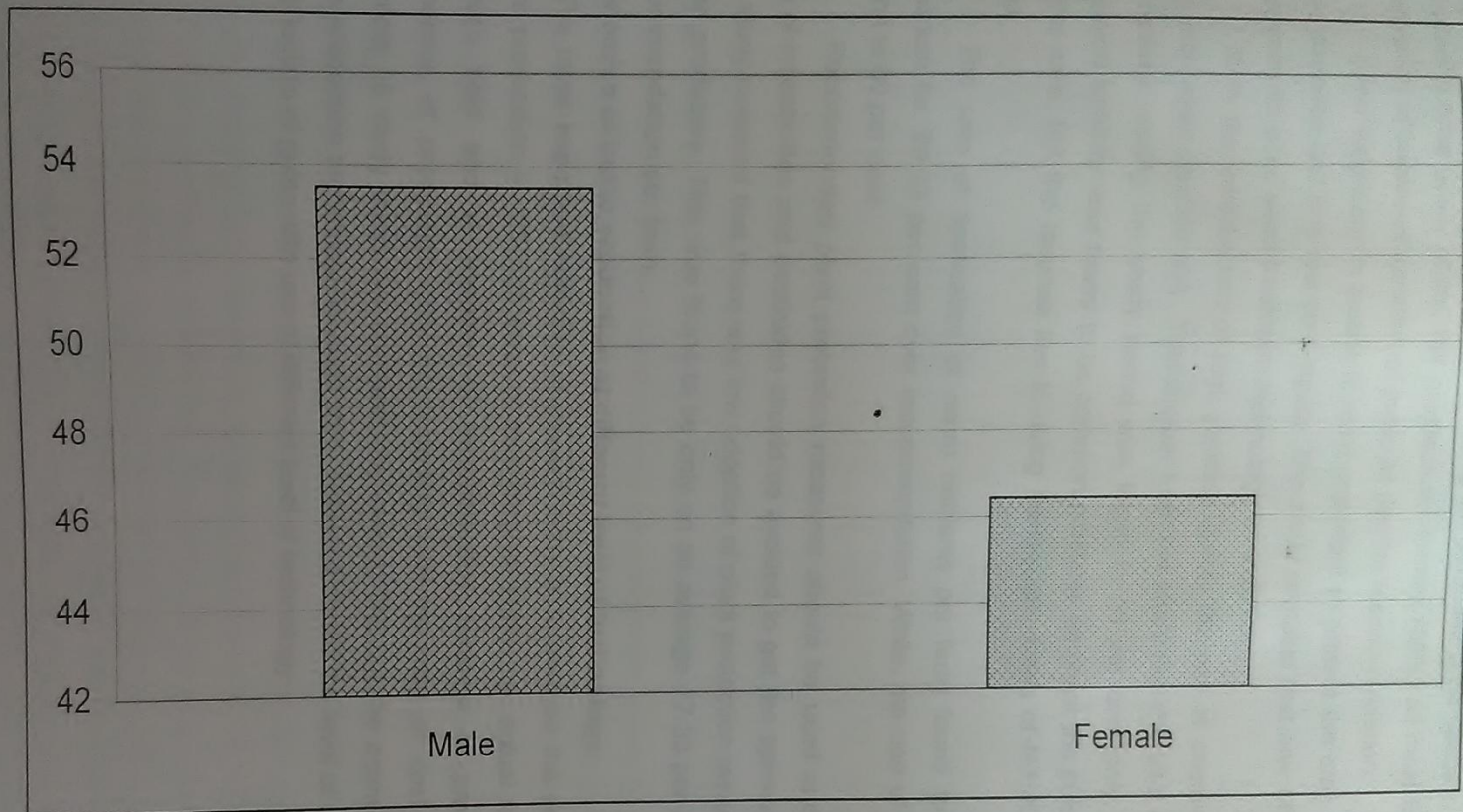
It could be observed from the study that the index of adoption regarding agronomical practices varied between 29.33 to 96 per cent as per individual practices. The highest adoption index was found in case of harvesting process (96%) followed by field preparation (90.67%), inter culture operation (82%), sowing method and time (74.67%) and irrigation (42.67%) respectively.

The yield attributing inputs use pattern of the farmers indicates the degree of resource management, their choice and decision-making in selection among different alternative resources to get maximum profit from the farm. Besides the above, it also indicates the adoption level of technology by the farmers in pulse production. Utilization of high yielding variety seed, seed treatment, fertilizers, bio-fertilizers, micro nutrients and plant protection measures are the basic resources (inputs) required in production process, hence, considered in the present study.

The study shows that the over all adoption of recommended pulse production technology/ input utilization found to moderate. It can be say that the quantity of inputs recommended and the quantity of adopted per unit of area was having wide gap. It is evident from the data that majority of the respondents 80.00 per cent adopted high yielding variety of seed as per the recommendation followed by insect pest control measure adopted by 77.33 per cent respondents, seed treatment 66.67 per cent, use of bio fertilizer 60.00 per cent, fertilizer and manure application 56.00 per cent and use of micro nutrients 29.33 per cent respectively. This point bring out to one things clearly that pulse producers were still practicing low level of technology and had not adopted most of the selected modern pulse production technologies at judicial level.

Having identified the index of adoption of improved inputs utilized in pulse production the detail of adoption of these yield attributing inputs are discussed as below:

Fig:3: Distribution of the respondents according to their work force.



For higher production it is essential that seeds used should be of proven quality and recommended as high yielding for particular area specific. In the pulse producing area under study, the progressive farmers (80%) all most have adopted cultivation of improved varieties of pulse as per the recommendation.

Seed treatment in pulses is most important to protect the crop against pest and diseases and it is low cost inputs. The study revealed that only 66.67 per cent respondents used seed treatment technology on their farm.

With the introduction of high yielding variety the use of chemical fertilizers has increased considerably. This is clear from the study that the total consumption of fertilizer during the study period was found to 56 per cent only. The use of chemical fertilizer was found to be common practices amongst the pulse producers in the area, but the lacunae lies in using inadequate doses of N.P.K. per unit of area.

The rate of application of micro nutrients per farm found to be varying minimum i.e. 29.33 per cent over recommendation. While, the use of bio fertilizer found to 60 per cent.

Recommended plant protection measures should be used and haphazard use of insecticides and pesticides should be avoided to get the optimum yield. But the study revealed that there was low adoption of plant protection measures by the pulse producers. This was found to be only on an average 77.33 per cent over to recommendation per farm.

Economics of pulse production at different level of technology:

The most important objective of present study is to analyse the economics of pulse production in different level of technological status i.e. actual farm level at farmer's field and at adoption of recommended package of practices. The economics of production may be analysing with the help of cost and return concepts. In study these two concepts are used to find out the economic level of pulse production technology in study area. Table 4.6 stated the level of cost incurred in production of pulse with use of different level of technology.

Table 4.6: Cost of cultivation of pulse (gram) in different level of technology.
(Rs/ha)

S.No.	Cost particulars	Level of technology	
		Farmers practices	<i>Recommended practices</i>
1.	Hired human labour	1003	1578
2.	Bullock labour	1202	1325
3.	Machine power	1003	2314
4.	Seed +Seed treatment	2500	3501
5.	Fertilizer + Micro nutrient	1050	1769
6.	Bio fertilizer	40	80
7.	Plant protection	573	932
9.	Irrigation + other charges	452	714
10.	Interest on working capital	131	220
11.	Depreciation	1199	1199
12.	Land revenue	164	164
	Cost-A₁	9327	14796
13.	Interest on fixed capital	119	119
	Cost-B₁	9446	14915
14.	Rental value of land	2000	2000
	Cost-B₂	11446	16915
15.	Imputed value of family labour	3027	4789
	Cost-C₁	12473	19704
	Cost-C₂	14473	21704
	Cost-C₃	15920	23874

The cost of pulse cultivation for different level of technology used and on the basis of different cost concepts. The data on cost of cultivation per hectare on sample holding farmers practices revealed that the average cost A₁ comes to Rs.9327. This cost found to higher in the farm of recommended level of adoption i.e. Rs.14796. The reason for higher cost in recommended technological adoption status of pulse production was due to judicious and higher use of inputs and their respective cost involved in production process.

In case of cost B₁ and B₂, the cost of cultivation found to higher in recommended technological adoption farm respectively. The corresponding costs B₁ were found to Rs.14915 and Rs.16915 per hectare respectively. On the other hand, the

average cost of B₁ and B₂ in farmer's practices level were found to Rs.9446 and Rs.11446 per hectare respectively.

In case of cost C₁, C₂ and C₃, the average cost of cultivation per hectare was higher in recommended practices i.e. on an average found to Rs.19704, Rs.21704 and Rs.23874 per hectare respectively. The cost C₁, C₂ and C₃ were found lower than recommended practices when considered on farmer's practices. In farmers technological status it was found to Rs.12473, Rs.14473 and Rs.15920 respectively.

It is concluded from the study that the total expenditure on pulse cultivation per hectare on recommended technological status (C₃) found to higher over farmers practices i.e. 49.96 per cent. The study revealed that the higher technological status showed higher cost of cultivation only might be the higher value involved in adoption of package of practices.

Aggregate profitability of pulse (gram) production: -

The profitability of pulse production with using different level of technology in rupees per hectare at different profitability measures is presented in table 4.7.

Table 4.7: Aggregate profitability of pulse (gram) production in different level of technology. (Rs/ha)

S.No.	Level of technology	Cost C ₃	Yield quintal per heater	Gross Income	Net farm income	B.C. Ratio
1.	Farmers practices	15920	11.58	25121	9201	1.57
2.	Recommended practices	23874	20.00	43380	19506	1.81

The productivity of pulse crop was highest (20.00 qt/ha) with the recommended technology followed by (11.58 qt/ha) on farmers' technology respectively.

The gross income was found to be directly related with the productivity and the market price of the product. The overall average gross income per hectare of pulse crop was Rs.43380 on the farm of recommended practices. The net farm income also shows direct relationship with the different level of technology on sample holdings. The overall net farm income was found to on an average Rs.19506 per hectare on the farm of recommended practices. On the other hand, on an average gross income and net

income per hectare of pulse production on farmer's practices was Rs.25121 and Rs.9201 respectively. The increase in the investment in the form of inputs used, resulted increase in productivity corresponding higher and subsequently produced more profit. Since pulse is a commercial crop its profit is mainly affected by cost and productivity structure. The result showed that due to use of higher technological status the cost of cultivation found higher. But the higher technological status caused also higher productivity and ultimately, caused higher net profit. The cost benefit ratio also found higher in recommended practices i.e. 1.31, while it was only 1.57 in case of farmers practices.

It is concluded that, as discussed above the improved technology found to more input (capital) intensive and require higher initial investment, but it prove to be more profitable on per hectare basis. That is the reason that the profit is found to higher as increasing trend with the used level of technology. On the other hand, with the use of higher technology the return over per rupees expenditure found to profitable incase of recommended practices level.

Economics of pulse (gram) production technology:

The detail of economics of recommended pulse (gram) production practices and actual farmers production practices are presented in table 4.8.

Table: 4.8: Profitability of pulse (gram) production with recommended practices over farmers practices.

S.No	Component	Technological option		Gap index (%)	
		Farmers practices	Recommended practices	Farmers practices	Recommended practices
1.	Cost of cultivation (C ₃) Rs./hect	15920	23874	--	49.96
2.	Cost of production Rs./qt.	1375	1194	--	-13.16
3.	Yield qt./hectare	11.58	20.00	--	72.71
4.	Gross return Rs./hect	25121	43380	--	72.68
5.	Net return Rs./hect	9201	19506	--	112.00
6.	B.C.Ratio	1.57	1.81	--	15.28

Study shows that if consider the recommended level of pulse production technology, there exists a wide commercially untapped yield reservoir. Table 4.8 shows that the productivity potentials of the currently available recommended technology that could be exploited under real farm situations are considerable higher than that of the corresponding actual farm average by 72.71 percent.

It is also general believe that improve technologies are capital intensive. Table 4.8 revealed a sharp rise (49.96%) in the cost of cultivation in recommended technology over average cost of farmer's prevailing practices.

It is true that favorable yield increments due to adoption of technology may be caused incremental incomes. The mean additional net profit of recommended technology incurred 112 per cent over average farmer's practices. The mean incremental net income incurred due to successive use of technology. The study also shows that the additional net return incurred over per rupee expenditure due to the adoption of recommended technology found to increase by 15.28 per cent.

Estimation of yield gap:

The actual farm yield on farmer's practices to be compared under different situations to be of more use for decision making. The most widely used term 'potential' yield is defined as the yield of the crop which is obtainable on farmers fields under farmers environments with the improved production inputs and techniques giving maximum yield. The difference between the potential farm yield and the average farm yield on farmer practices as well as yield from recommended technological adoption level and technological adoption level of farmer's field's yield may be called as the yield gaps which are considered in the present study. The table 4.9 revealed quantification of yield gap between potential (progressive farm) and actual farm situation (average farm) as well as recommended technological adoption level and farmer's technological adoption or actual conditions yield gap respectively.

Table 4.9: Yield of pulse under different situations.

S.No.	Situation	Yield (Q./Ha.)	Termed as	Remarks
1.	Recommended practices	20.00	Possible potential	Small size plots, agronomic and management practices as schedule. No resources restriction.
2.	Progressive farm (Assured input supply)	14.10	Attainable	Supply of recommended inputs assured. Improved practices explained, but not supervised and farmers own management.
3.	Real farm situation (average existing farm practices)	11.58	Actual	Farmers' own resources and management skill with normal practices followed in the study area.

The quantification of yield gap was studied as follows:

Gap I : The difference between the yields obtained in on recommended practices (Research Station) that obtained on progressive farms.

Gap II : The difference between yield obtained by the progressive farms and average yield realized by sample farms.

Gap III: The difference in the yield on recommended practices (Research Station) and the average yield realized by the farms.

Yield gap (I): Recommended practices v/s progressive farm:

Recommended practices (possible potential yield) i.e. improved technological adoption level on small piece of land with full command under expert regarding practices, management and inputs with best supervision. This yield is actual due to technological adoption and management practices as seduced on the farm.

Yield gap (II): Progressive farms v/s Actual average farms:

The progressive farmers in study area reaped higher potential yield against average actual yield obtained in the area. The widely used term potential yield (yield on progressive farms) is may be called as the yield of a crop which is obtainable on farmers field under farmers environment with the modern production techniques or inputs level given maximum yield.

Yield gap (III): Recommended practices v/s Actual average farms:

The yield gap between the recommended practices and the actual average of farmers' field practices shows very higher gap due to low adoption of recommended practices in general. This is the situation on account of environmental differences, non transference of some part of technology on farmer's field and other management factors relating to soil fertility and physical condition. The different yield gap is presented in table 4.10.

Table 4.10: Magnitude of yield gap in pulse production.

S.No	Situation	Extant of gap		Contributing factors
		Qt./Ha	%	
1.	Recommended practices v/s progressive farm	5.90	41.84	Research multiplicative effect.
2.	Progressive farms v/s Actual average farms	2.52	21.76	Judgment, management, resources and knowledge effect.
3.	Recommended practices v/s Actual average farms	3.42	29.53	Research multiplicative, resources management and extension effect.

The above table indicated that there exists a reservoir of untapped yield potential of pulse in study area. The contributing factors as derived in the study shows that about

21.76 per cent yield of the farmers can be increased merely by improved management practices and with adoption of improved inputs and practices which shows the extension gap or technological adoption gap. The study also revealed that with the increase of improved production practices and inputs; the high technological adopter farmers can increase their yield upto 41.84 per cent.

It is concluded that, the potential yield on progressive farms was found to 14.10 quintal per hectare which shows on an average farm reaped to quite low yield i.e. 11.58 quintal per hectare i.e. 21.76 per cent less than potential yield of the area which can be achieved with the use of improved management practices and yield attributing inputs.

Constraints confronted by farmers in pulse production:

The various constraints present in the study area regarding adoption of improved pulse production technology are presented in table 4.11 and classified into three groups that is:

1. Pertaining to technology
2. Pertaining to labour management
3. Pertaining to institutional infrastructure

Pertaining to technology:-

Pertaining to technological constraints are mainly considered the use of improved seed, application of fertilizer and nutrients management, weed control and diseases control measures respectively. Among the all fertilizer and nutrients management constraints reported by highest (46.87%) of total respondents got first rank followed by weed control constraint faced by (38.10%) of total respondents got second rank. The third rank was obtained by diseases and pest control measures, faced by (33.29%) of total respondents. In last (31.25%) of total respondents faced the problem regarding use of improved seed got the rank fourth.

Pertaining to labour management:-

Constraint pertaining to labour management was got the highest rank amongst the all. Due to industrial development near by city, mostly migration of labour was found from study area towards industrial city. This is caused shortage of labour at the time of peak period. The most serious problem regarding labour was high wages of labour at peak period faced by maximum (66.07%) of total respondent and next serious problem

was shortage of skilled labour for the purpose of improved practices, problem faced by (28.57%) of total respondents.

Table:4.10: Constraints confronted by farmers in pulse production.

S.No.	Particulars	Number of respondents	Percentage to total	Average percent	Rank
1.	Pertaining to technology			37.73	III
a.	Regarding use of improved seed			31.25	IV
i.	Unavailability of seed in time	20	35.71		
ii.	Lack of knowledge about improved seed	15	26.78		
b.	Fertilizer and nutrients management			46.87	I
i.	Thinking of high doses of fertilizer spoils the soil	30	53.57		
ii.	High cost of fertilizer	40	71.43		
iii.	Non availability of F.Y.M	15	26.78		
iv.	Lack of timely supply of fertilizer	20	35.71		
c.	Weed control			38.10	II
i.	Chemical application not effective as hand weeding	28	50.00		
ii.	Difficulty in weeding in irrigated field	14	25.00		
iii.	Lack of knowledge about proper weedicide	22	39.29		
d.	Disease and pest control			33.29	III
i.	Lack of effective plant protection material	24	42.85		
ii.	Lack of knowledge about proper plant protection measure	17	30.358		
iii.	Lack of local supply of plant protection appliances	10	17.86		
iv.	Indigenous method of pest control is most useful	25	44.64		
2.	Pertaining to labour management			39.88	I
i.	Shortage of labour at peak period	14	25.00		
ii.	High wages of labour at peak period	37	66.07		
iii.	Skilled labour shortage for the purpose of improve practices	16	28.57		
3.	Pertaining to institutional infrastructure			34.91	II
a.	Credit			38.88	II
i.	Not available in time	22	39.29		
ii.	Rate of interest is not only high but varies from agency to agency	11	19.64		
iii.	Complicated loaning procedure	27	48.21		
b.	Marketing			22.02	III
i.	Monopoly and forced sale marketing system	7	12.50		
ii.	Regulated market located at a distant place	21	37.50		
iii.	More transportation charges	9	16.07		
c.	Extension			58.92	I
i.	Farmer training conducted at distant place	27	48.21		
ii.	Improved production techniques are not demonstrated in the field	47	83.93		
iii.	Mass media exposures are inadequate and not understandable	25	44.64		

Pertaining to institutional infrastructure:-

The constraints regarding to institutional infrastructure consist of problems regarding credit, problems regarding marketing and problems regarding extension activities. Among these constraint extension activities is the serious problem facing by (58.92%) of total respondents followed by credit problem faced by (38.88%) of total respondents and marketing problem facing by (22.02%) of total respondents respectively.

Suggestions and prospects for expansion of pulses in coming years:

To attain high pulse production can be achieved by strategies mentioned below:

- 1. Area expansion:** Additional area can be brought under pulse production by diversifying low value crops in planned way. Moong-bean, urad-bean and other bean crops can also be grown in summer season with assured irrigation condition. Inter-cropping system of pulses with cereals and by replacing less remunerative crops in particular area can certainly help in increasing the area and production of pulses.
- 2. Availability of quality seeds at subsidized rate:** Most of the farmers suffering with not availability of quality seed at the time of sowing. Non availability of quality seeds of pulses is a important constraints in enhancing area and production of pulses. Hence effort should be made to distribution of seeds through mine kit in sufficient quantity at subsidize rate. The farmers should be also trained in seed production technology of pulse crops.
- 3. Integrated nutrient management:** Pulses are grown mainly on marginal lands which are deficient in essential nutrients resulting into very low yields. Study revealed that poor farmers do not apply fertilizers and other micro nutrients at balanced combinations. It is also observed that rhyzobium can increase productivity in sum extant. Therefore, to achieve higher yield farmers should be encouraged to promote the use of balance fertilizer, sulphur, zinc and seed inoculation by suitable strains of rhyzobium bacteria.
- 4. Disease and pest management:** At present effective IPM modules are available for management of pulses pest and disease. To protect the crops from different

diseases, seed treatment with suitable fungicide and trichoderma etc should be encouraged.

- 5. Life saving irrigation:** Pulses have capabilities to tolerate drought to great extent and are adapted to moisture stress conditions. Some times particularly in rabi season crops suffer due to moisture stress. Yield losses are heavy if the moisture stress is during the critical stages of growth like flowering, podding and grain filling. There fore to get a bumper harvest life saving irrigation and irrigation at critical stages is essential.
- 6. Transfer of technology:** Now a day's improved pulses production technology is available. There is urgent need to make the farmers aware about the improved pulse production technology. It will also be highly desirable to conduct the frontline demonstrations at farmers field to make farmers acquaint with the improved pulse production technology active participation at every stage.

CHAPTER V

DISCUSSION

In the chapter of result, the data were analyzed, processed, prescribed and presented in the form of the objectives of the study. In this chapter the inference was drawn to make the research's result in purposeful and to draw broad conclusions of the study. It is also called the presentation of the findings which have got in the chapter of result. Therefore, it is important that the results of the study are presented clearly and meaningful as per the objectives of the study.

In post independence era, India has made significant advances in agricultural development. Food grain production has increased three-fold up to tenth plan period. However, this increase in food production can not be attributed to increase in wheat and rice production. With all the advances made through sustained research, pulses production has remained stagnant around 11 to 12 million tonnes over past 30 years and it yet significant impact has to be made on the production of pulses using various technological options keeping in view that pulses are mainly grown in dry farming areas. In total, there are more than a dozen pulse crops grown in India, but chickpea (gram), pigeonpea (tur) and lentil remain the major pulses accounting for 55 per cent of the area under pulses and 75 per cent of the total pulse production. The productivity of all these crops is less than even one tonnes per hectare.

It is important view that after our success on house hold food security, we should strive for household nutritional security. Pulses are one of the richest source of protein for vegetarians. But their per capita availability has reduced to almost half from 60 grams per day in 1950-51 to 26 grams in the 2000-01 as against the recommended level of 43 grams by the Indian Council of Medical Research. Besides, their nutritional value, pulses are endowed with unique property of maintaining and resorting soil health through biological nitrogen fixation. The pulse crops added more nitrogen to our soils than total nitrogen fertilizers produced in our country.

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rice production. With all the advances made through sustained research, pulses production has remained stagnant around 11 to 12 million tonnes over past 30 years and it yet significant impact has to be made on the production of pulses using various technological options keeping in view that pulses are mainly grown in dry farming areas. In total, there are more than a dozen pulse crops grown in India, but chickpea (gram), pigeonpea (tur) and lentil remain the major pulses accounting for 55 per cent of the area under pulses and 75 per cent of the total pulse production. The productivity of all these crops is less than even one tonnes per hectare.

It has been observed by several studies that the productivity per unit of area and total production may be increase by the application of improved agricultural technologies. It has been also found that mostly improved technology found to capital intensive and farmers suffer with scarcity of capital with abundant of family labour. On the other hand, the traditional farming needs more labour and less of capital. This is beyond doubt that the improved agricultural technologies have established their superiorities over traditional system. It is, therefore, believed that the adoption of improved technologies will lead to socio economic development of the country.

In general, the aim of agricultural economist is, to reduce the marginal cost of output for getting the maximum profit with the use of improved agricultural technology. This can occur either by employing (adoption) the existing inputs but in different composition (a change in technology and package of practices as per the recommendation) or by introducing new factors of production either for replacing old ones or simply as additional inputs (technological innovation). With regards to above fact, application of adequate quantities of farm power with other yield attributing inputs like high yielding variety (better seeds), fertilizer and nutrients application, plant protection measures, irrigation etc. with improved agronomical practices are the important necessary condition for optimum output in agriculture, hence considered for study. To know the status of adoption of recommended improved selected pulse production technology at the farm level by the sample farmers, technologies recommended (TR) and technologies adopted (TA) ratio was calculated.

The study presents the findings relating to information about statues of package

of practice wise recommended pulse production technology adopted by the respondents. The study revealed that the over all TR and TA ratio were worked out to be 68.73 per cent. This indicated that only about 69 per cent of the technologies developed by pulse scientists and recommended for optimum production level have gone for adoption by the users. This was the extent of diffusion of pulse production technologies in the study area as well as in the district. The figure may still come forward if the extension and research personnel concerned for pulse production motivated to farmers through various extension and farm trial activities in the area.

The study shows that the over all adoption of recommended pulse production technology/ input utilization found to moderate. It can be say that the quantity of inputs recommended and the quantity of adopted per unit of area was having wide gap. It is evident from the data that majority of the respondents 80.00 per cent adopted high yielding variety of seed as per the recommendation followed by insect pest control measure adopted by 77.33 per cent respondents, seed treatment 66.67 per cent, use of bio fertilizer 60.00 per cent, fertilizer and manure application 56.00 per cent and use of micro nutrients 29.33 per cent respectively. This point bring out to one things clearly that pulse producers were still practicing low level of technology and had not adopted most of the selected modern pulse production technologies at judicial level.

The most important objective of present study is to analyse the economics of pulse production in different level of technological status i.e. actual farm level at farmer's field and at adoption of recommended package of practices. The economics of production may be analyzing with the help of cost and return concepts. In study these two concepts are used to find out the economic level of pulse production technology in study area. It is concluded from the study that the total expenditure on pulse cultivation per hectare on recommended technological status (C_3) found to higher over farmers practices i.e. Rs.23874. On the other hand, farmers' technological status was found lower cost C_3 i.e. Rs.15920. The study revealed that the higher technological status showed higher cost of cultivation only might be the higher value involved in adoption of package of practices.

It is concluded that, as discussed above the improved technology found to more input (capital) intensive and require higher initial investment but it prove to more

profitable on per hectare basis. That is the reason that the profit is found to more as increasing trend with the used level of technology. On the other hand, with the use of higher technology the return over per rupees expenditure found to profitable in case of recommended practices level. It is true that favorable yield increments due to adoption of technology may be caused incremental incomes. The mean additional net profit of recommended technology incurred 112.00 per cent over average farmer's practices. The mean incremental net income incurred due to successive use of technology. The study also shows that the additional net return incurred over per rupee expenditure due to the adoption of recommended technology found to increase by 15.28 per cent.

The actual farm yield on farmer's practices needs to be compared under different situations to be of more use for decision making. The most widely used term 'potential' yield is defined as the yield of the crop which is obtainable on farmers fields under farmers environments with the improved production inputs and techniques giving maximum yield. The difference between the potential farm yield and the average farm yield on farmer practices as well as yield from recommended technological adoption level and technological adoption level of farmer's field's yield may be called as the yield gaps which are considered in the present study. The quantification of yield gap was studied as follows:

Gap I : The difference between the yields obtained in on recommended practices (Research Station) that obtained on progressive farms.

Gap II : The difference between yield obtained by the progressive farms and average yield realized by sample farms.

Gap III : The difference in the yield on recommended practices (Research Station) and the average yield realized by the farms.

It is concluded that, the potential yield on progressive farms was found to 14.10 quintal per hectare which shows on an average farm reaped to quite low yield i.e. 11.58 quintal per hectare i.e. 21.76 per cent less than potential yield of the area which can be achieved with the use of improved management practices and yield attributing inputs.

There is a saying that research efforts are to be concentrated on identifying the farmers who are left behind, providing explanation for their lagging behind and setting fourth what should be done to help them. Any attempt to understand the basic problems

in the adoption of recommended technology package assumes special significance. This step needs a scientific evaluation of the extent of yield gap, the causes and constraints thereof. The various constraints present in study area regarding adoption of improved pulse production technology which are classified into three groups that is, pertaining to technology confronted by 37.73 per cent farmers followed by pertaining to labour management 39.88 per cent and pertaining to institutional infrastructure 34.91 per cent respectively.

CHAPTER VI

SUMMARY, CONCLUSION AND SUGGESTIONS

Summary:

Pulse crops are one of the most important groups under food crops in our country. Pulse accounts for roughly one fifth of the total area under food grain crops and contribute about one twelfth of the total food grain production in the country. The area under pulse crops at present is around 23 million hectares; and 15 million tonnes production with productivity about 650 kg/hectare in India (2007-08). The history of growth is not identical for all crops where as the area and yield of cereals, especially wheat and soybean have improved over time. While, the production of pulses has been stagnant for last four decades, as a result, the per capita availability of pulses has declined from 64 gm/capita/day to less than 40gm/capita/day as against the FAO/WHO's recommendation of 80gm/capita/day in recent time.

At present in technological era the improved pulse production technologies are available for recommendation which have shown consistent yield improvement at farm level. Further, the spread of these technologies among the farmers and the feed back are important. Hence, perception analysis of adoption of improved pulse production technologies generated by agricultural scientist which consist of level of adoption, yield gaps, constraints in adoption an prospects of pulse production in future was under taken with following specific objectives:

SPECIFIC OBJECTIVE:

6. To study the extent of adoption of technology.
7. To study the economics of different levels of adoption of technology by the farmers.
8. To examine the yield gaps due to adoption of technology.
9. To study the problem faced by farmers in adoption of technology.
10. To examine the scope for increasing area under pulses during ensuing years.

Sehore district of Madhya Pradesh has been selected for the purpose of this study because this district is one of the important district for pulses production in the state. For the study, three stage sampling technique was used for drawing the sample.

At the first stage, Sehore block in Sehore district was selected purposively due to highest area under pulse crops among the other blocks of the district and well known for researcher. At the second stage, a list of villages in selected block was prepared as per ascending order of area under pulse crops. Among these villages, 3 villages were selected randomly. At the third stage for the selection of respondents, a list of pulse growing cultivators of each village was prepared in ascending order of their size of holding under pulse crop and 75 farmers were selected randomly for the study.

Depending upon the objectives of the study both primary and secondary data were used. The primary data was collected from selected respondents using pre-tested questionnaire schedule through survey method. Each selected respondents was approached personally for recording relevant data. Secondary data regarding production, area, and yield etc was collected from the Dept. of Agriculture and Dept. of Statistics. The data was collected for the Agricultural year 2009-10.

Analytical tools: -

(1) Economics of Adoption pattern in improved production technology:

To find out the level of improved pulse production technology, technologies recommended (TR) and technologies adopted (TA) ratio was calculated as formula suggested by Sabarathnam *et.al.* (1991).

$$\text{TR \& TA ratio} = \frac{\sum_{t=1}^n t_n}{TN} \times 100$$

Where,

t = number of technologies adopted

n = number of farmers who reported adoption

T = total number of technologies recommended

N = Total number of respondents.

(2) Economics of Yield gap:

The potential farm yield which is obtainable on a farmer's fields with the adoption of modern technology. The difference between the potential farm yield and actual farm

yield is termed as a yield gap.

The yield gap where studied earlier by employing three gap model (Swaminathan 1977) and four gap model (Venkateswarlu 1978 and Suryanarayana 1980). The present study employs three gap models as follows:

Gap I : The difference between the yields obtained in on Research Station that obtained on progressive farms.

Gap II : The difference between yield obtained by the progressive farms and average yield realized by sample farms.

Gap III : The difference in the yield on Research Station and the average yield realized by the farms.

(3) Constraints analysis and prospects of pulse production:

The constraints analysis and prospects of pulse production in future under study area was based on the opinion survey of the farmers under study.

Conclusion: -

From the foregoing results it could be concluded as under:

- The study shows that the average sample farmers found to about 45.16 years of age old. Regarding literacy position, the illiterate respondents found to on an average 30.66 per cent of total respondents. The study shows that the maximum respondents 69.34 per cent were found to literate. Among the literate, it was obvious that maximum number of respondents were found to pass out up to primary school level 37.34 per cent followed by up to H.S.S.C 17.34 per cent and remaining 14.66 per cent was passed out up to college level of education.
- The distribution of strength in farm family and work force in their family. The data revealed that 7.61 persons were found in a family. Among them the male person was found to 24.60 per cent followed by 22.50 per cent female and 52.90 per cent children respectively.
- Work force in a family is important parameter for family income. The study revealed that there was 2.84 people in a family active as a workforce and among them 53.52 per cent was male worker. The female worker was 46.48 per cent to total worker in a family.

- The physical and financial resources available to the farmers determine farm business activities and adoption of suitable cropping systems on their farms amongst the prevailing cropping systems in area. Opportunities for utilization of these resources and other factors that affect the crops production should know prior to decision making process. Farmers own resource comprise chiefly of land, family labour, machinery and the other available assets and inputs.
- Study show that the average size of farm holding found to 4.88 hectares per farm among which 0.22 hectare was under other use and remaining 4.66 hectares per farm area was under cultivation. Hence, the cultivated area was found on an average 95.46per cent to total size of holding per farm.
- Irrigation is compulsory for higher production of crops particularly in rabi season. The irrigated area as a percentage of cultivated area was found to on an average 73.17 per cent which shows very satisfactory as per the irrigation availability in the district and state also. The total average irrigated area through all sources was 3.41 hectare i.e. on an average 69.88 per cent of average size of holding per farm.
- The study shows that kharif crops in area were dominated and it was growing in 94.67 per cent area of total holding. On the other hand, the rabi area was found to 70.08 per cent of total holding per farm. Gram is a very popular and common pulse crops growing in the area in rainfed or semi irrigated condition. The area under gram was found to 1.28 hectare i.e. 26.23 per cent of total holding and 37.43 per cent of total rabi area.
- The on an average percentage value of land to the total value of assets on the sample farm found to about 66.09 per cent followed by total value of farm assets excluding land found to 33.91 per cent respectively.
- The study revealed that the over all TR and TA ratio were worked out to be 68.73 per cent. This indicated that only about 69 per cent of the technologies developed by pulse scientists and recommended for optimum production level have gone for adoption by the users. This was the extant of diffusion of pulse production technologies in the study area as well as in the district.

- Study shows that the index of adoption regarding agronomical practices varied between 42.66 to 96 per cent as per individual practices. The highest adoption index was found in case of harvesting process (96%) followed by field preparation (90.67%), inter culture operation (82%), Swing method and time (74.67%) and irrigation (42.67%) respectively.
- It is evident from the study that majority of the respondents 80.00 per cent adopted high yielding variety of seed as per the recommendation followed by insect pest control measure adopted by 77.33 per cent respondents, seed treatment 66.67 per cent, use of bio fertilizer 60.00 per cent, fertilizer and manure application 56.00 per cent and use of micro nutrients 29.33 per cent respectively. This point bring out to one things clearly that pulse producers were still practicing low level of technology and had not adopted most of the selected modern pulse production technologies at judicial level.
- Study show that cost C_1 , C_2 and C_3 , the average cost of cultivation per hectare was higher in recommended practices i.e. on an average found to Rs.19704, Rs.21704 and Rs.23874 per hectare respectively. The cost C_1 , C_2 and C_3 were found lower than recommended practices when considered on farmer's practices. In farmers technological status it was found to Rs.12473, Rs.14473 and Rs.15920 respectively.
- Study concluded that the improved technology found to more input (capital) intensive and requires higher initial investment but it prove to more profitable on per hectare basis. That is the reason that the profit is found to more as increasing trend with the used level of technology. On the other hand, with the use of higher technology the return over per rupees expenditure found to profitable in case of recommended practices level.
- It is true that favorable yield increments due to adoption of technology may be caused incremental incomes. The mean additional net profit of recommended technology incurred 112.00 per cent over average farmer's practices. The mean incremental net income incurred due to successive use of technology. The study also shows that the additional net return incurred over per rupee expenditure due to the adoption of recommended technology found to increase by 15.28 per cent.

- It is concluded that, the potential yield on progressive farms was found to 14.10 quintal per hectare which shows on an average farm reaped to quite low yield i.e. 11.58 quintal per hectare i.e. 21.76 per cent less than potential yield of the area which can be achieved with the use of improved management practices and yield attributing inputs.

Suggestion: -

For further development of pulse production in the area and to obtain higher remuneration per unit of area and production following suggestions may be considered.

1. Study revealed a wide gap in adoption of pulse production technology on farmers' field over recommendation. This, requires vigorous efforts to educate the farmers on production technology and effort should also make to insured input supply. More demonstration regarding improved pulse production technology also suggested. If more demonstrations are organized on improved production practices lines than more farmers will be convinced to adopt the improved pulse production technology which is a pre-requisite for higher productivity.
2. In present study it was observed a wide gap between the existing and potential yield levels of pulse crop. In view of this difference between the potential and existing productivity and the existing market prices and the minimum support prices of pulse is calling us for filling these gaps as an immediate major for increasing the production. The produce must be marketed to assure a remunerative price to farmers. There is a need to eradicate the present irregularities in marketing system.
3. The pulse productivity on general farm found to low because of the allocation of poor quality lands to pulse crop and lack of suitable varieties for varied situations. Thus, the intensive efforts on improvement and dissemination of local specific improved varieties to expected situations should available at farm level.
4. The inputs like improved seed variety, fertilizers and pesticide etc in essential for pulse production which are not adequately available. Besides, the prices are high

in input market. Thus, many farmers are not applying these yield attributing inputs to the crop. Hence, it is suggested that short term credit is very essential especially to poor farmers to adopt the improved pulse production technology.

5. It is suggested that strengthening and streamlining the existing extension services helps in achieving higher productivity. The extension gap may be contributing to the existing gap. Adequate extension staff at field level to make farmers more aware of improved pulse production technology. The adoptive research programme on improved pulse production technology is also pre-requisite for local specific problems in pulse production.

CHAPTER VII

BIBLIOGRAPHY

- Agarwal,G.P. and Gautam,D.S. (1999). Constraint study of Kharif and Rabi crop production in Kundam Tribal block of Madhya Pradesh- Kaymore & Satpura hills Region. *Bhartiya Krishi Anusandhan Patrika*. **14**(1&2): 23-32.
- Alshi,M.R; Bhole,B.D; and Bidwal,P.N. (1988). Constraints in adoption of improved technology for commercial crop. A case study of crops in vidharbha. *Indian. J. Agril. Economics*. **43**(3): 525-526.
- Daniel,R.R. (2000). Future challenges in food grain production in India. *Current Science*. **79**(8):1051-1053.
- Dhondayal,S.P. (1968). Cost and effectiveness of modern technology on farm production and farm income. *Indian Journal Agricultural Economic*. **123**(2):58-62.
- Dubey,A.K.(1986). Study of constraints of production of soybean crop in Damoh block Madhya Pradesh. *Unpublished M.Sc.(Ag.)Thesis J.N.K.V.V. Jabalpur*.
- Gaddi,G.M. Mundinamani and Patil,S.A. (2002). Yield gaps constraints and Potential in cotton production in north Karnataka an Econometric analysis. *Indian J. Agril. Econ*. **57**(4): 722-723.
- Gupta,S.K. (2001). Economics of pulses production and identification of constraints in raising their production (a consolidated report of AERC studies). Study Agro Economic Research Centre for Madhya Pradesh .*Jawaharlal Nehru Krishi Vishwa Vidyalyaya*. **79**:177.
- Hazarim,R.P.; Singh,T.B.; Jain,B.L. and Singh,P.P. (1985). Constraint Analysis of soybean production in Purana Nala rainfed watershed development project in Sehore district of Madhya Pradesh. *M.Sc. (Ag.) Thesis submitted by, R.A.K. College of Agriculture Sehore*.
- Karanjkar,S.C. and Pandya,S.C. (1985). Constraints to higher yield of soybean in Indore Region of M.P. *Zonal Agriculture Research Station Indore*. pp:16.
- Kashive,R.C. (1974). Economic of production soybean and competitive crops. All Indian

soybean work shop U.P. *Agri, University, Pant Nagar, May 1974.*

- Marothia, D.K. (1986). Farm level constraints to high yields of wheat and gram in Dharsiwa Block of Raipur District, Madhya Pradesh (mimeo). ISAE. Raipur, Madhya Pradesh, India; *Jawaharlal Nehru Krishi Vishwa Vidyalaya*. pp 41.
- Mrathyunjaya and Kumar, P. (1989). Trend and structural changes in the cost of production and profitability of crops in India. *Agril. Situ. in India*. **44**(6): 451-457.
- Patel, V.G. (1999). Economics of pulses production and identification of constraints in raising their production in Gujarat. *Research Study Agro Economics Research Centre, Sardar Patel University*. (110):58.
- Raghuwanshi, R.S. (1999). Economic analysis of gram cultivation in Tikamgarh district of Madhya Pradesh. *Legume Research*. **22**(2): 130-132.
- Rajeswaran, R. and Varadarajan, S. (1992). An economic analysis of yield gap in rice. *Indian Jn. of Agri. Econ*. **47**(3): 535.
- Rajput, A.M.; Rajesh Porwal; Deshpande, S.L. (2000). Crop productivity and its constraints on tribal farms of Dhar district of Madhya Pradesh. *Crop Research Hisar*. **19**(2): 350-352.
- Sharma, H.; Nahatkar, S. and Patel, M.M. (1996). Constraints to soybean production in Madhya Pradesh: an analysis. *Bhartiya Krishi Anusandhan Patrika*. **11**(2):79-84.
- Sharma, H.O.; Gupta, H.C. and Singh, R.P. (2002). Constraints in adoption of Chickpea production Technology in Madhya Pradesh. *Indian J. Agril. Econ*. **57**(3):403-404.
- Sharma, H.O.; Singh, R.P. and Mahesh Patidar (2003). Production constraints in adoption of improved chickpea technology in Madhya Pradesh. *Indian Journal of Pulses Research*. **16**(2): 125-127.
- Sharma, M.L. , Hussain, N. , Kabdwal, B.C. and Dev Chandra (2002). Study of yield gap and constraints in Small Millets in Uttaranchal. *Indian J. Agril. Econ*. **57**(3) : 407.
- Shivaramu, H.S.; Ramesh, S.C. Kumar; Chary, G.R. and Yadav, S.C. (1997). Adoption of dry farming technologies – a case study of yernal watershed of Bijapur district, Karnataka. *Soil and crops*. **7**(1):107-110.

- Sikandar Kumar and Sandeep Kumar (2004). Resource use efficiency and returns from selected food grain crops of Himachal Pradesh. *Agricultural Situation in India*. pp: 475-785.
- Singh, Mahatim and Singh, Y. (1989). Strategy for increasing pulse production. *Journal of Agricultural Issues*. 1(0):117-123.
- Singh, Nrimal and Singh, Rachhpal (2004). Production of pulses in India – possibilities and constraints. *Agricultural situation in India*. pp: 141-147.
- Singh, T.B. (1983). Impact of modern technology on production, employment and income in agriculture (A case study in Sehore District). *Unpublished Ph.D. Thesis*.
- Soni, S.N. (2002). Perception analysis of adoption of improved gram production technologies. *Madhya Journal of extension education*. 3 (4 & 5):62.
- Sunandini, G.P; Nagabhushanam, T.D.J. and Krishnaiah, J. (1988). Yield gaps and constraints analysis in groundnut production in Waragal district of Andhra Pradesh. *Journal of oil seed research*. 5(2):107-118.
- Usha Tuteja (1999). Economics of pulses production and identification of constraints in raising production in Haryana. *Research Study Agricultural Economics Research Centre, University of Delhi*. (99&3): 89.
- Usha Tuteja (2000). Economics of pulses production and identification of constraints in raising production in Punjab. *Research Study Agricultural Economics Research Centre, University of Delhi*. (1):99.

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