Volume - 5, Issue- 9,September 2017 IC Value : 56.46 e-ISSN : 2347 - 9671| p- ISSN : 2349 - 0187
EPRA International Journal of Economic and Business Review SJIF Impact Factor(2016) : 6.484
ISI Impact Factor (2013): 1.259(Dubai)

Research Paper

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FACTORS AFFECTING ADOPTION OF PULSE TECHNOLOGY: A CASE STUDY IN MAYURBHANJ DISTRICT OF ODISHA

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ABSTRACT

Pulses are an important commodity group of crops that provide high quality protein complementing cereal proteins for pre-dominantly substantial vegetarian population of the country. Although, being the largest pulse crop cultivating country in the World, pulses share to total food grain is production is only 6-7% in the country. The cultivation of pulses builds- up a mechanism to fix atmospheric nitrogen in their root nodules and thus meet their nitrogen requirements to a great extent.

In India, pulses can be produced with a minimum use of resources and hence, it becomes less costly even than animal protein. In comparison to other vegetables, pulses are rich in protein which are less expensive and can be cultivated as an inter-crop and also as mixed crop. Pulses are mostly cultivated under rainfed conditions and do not require intensive irrigation facility and this is the reason why pulses are grown in areas left after satisfying the demand for cereals/cash crops. Even in such conditions, pulses give better returns. Apart from this, pulses possess several other qualities such as they are rich in protein, improve soil fertility and physical structure, fit in mixed/ inter-cropping system, crop rotations and dry farming and provide green pods for vegetable and nutritious fodder for cattle as well.

KEYWORDS: *pulses, vegetables, soil fertility, food grains, water efficient*

INTRODUCTION

Although this crop group is more important from the nutritional point of view, there has not any significant increase in area and production during 1950-51 to 2009-10, however, significant growth in area and production has been recorded during the last five years (i.e. 2010-2011 to 2014-15). With the increase in infrastructural and irrigation facilities/ resources, the pulses get the marginalized treatment pushing them to another poor and marginal land piece. The productivity of pulses has increased about 68% at 764 kg/ha during 2013-14 from the level of 441 kg/ha during 1950-51. It is imperative to mention that the New Agriculture Technology (NAT) introduced during mid-sixties has increased the production of food-grains from 50.82 million tonnes during 1950-51 to 265.64 million tonnes during 2013-14 with the increase in area from 97.32 million hectares to 125 million hectares. The productivity of food grains has also sharply increased to 2120 kg/ha during 2013-14 from the level of only 522 kg/ha during 1950-51.

The potential of pulses to help address future global food security, nutrition and environmental sustainability needs has been acknowledged through the UN declaration of the 2016 International Year of Pulses. Pulses are a Smart Food as these are critical for food basket (dal-roti, dal-chawal), important source of plant protein and help address obesity, diabetes etc. In addition pulses are highly water efficient, can grow in drought prone areas and help improve soil fertility by fixing soil nitrogen.

PULSES IN INDIAN AGRICULTURE

The pulse is an important ingredient in our food composition. In eastern part of India, pulse is a common food item for all families and more so of poor people. Our population is predominately vegetarian. The protein requirement for growth and development are mostly met from pulses. Pulses are also good green fodders for cattle. Pulses being leguminous take very little from soil and give much more to soil to maintain its fertility level. Being deep rooted plants pulses are highly adaptive to dry land condition.

Multiple agricultural programs like, green revolution, multiple cropping, insensitive area programs, high yielding varieties program and multi objective crop improvements etc have helped in a real breakthrough in our cereal production. These attempts solved our food problem but due to short supply of pulses and poor human nutrition still remain unsolved. The average yield level of pulses remained stagnant within 500 to 600 kg/hectare over a long time but population has increased. The situation resulted in heavy reduction of per capita availability of pulses which came down to 34.9grams per day from 68.5 grams in the fifth five year plan.

India is a major pulse producing country in the world which accounts for 33% of total world area under pulses and 25% of total world production. The pulses are grown over an area of 23 million hectares with production of 13 to 14 million tonnes which account for 18% of total area under food grain and 8% of total food production in India.

Major Constraint in pulse productions is Agro-Climatic factor as (a) 92% area under pulses are rain fed, (b) rainfall erratic, uncertain, unevenly distributed (c) grown in eroded soil, marginal and sub-marginal soil and (d) pulses are sensitive to alkali, acidic, high water table

The second important constraint in pulse production is Lack of high yielding varieties and third important constraint is Improper agronomic management which includes (a) poor management condition (b) Non-availability of suitable rhizobium culture (c) Improper sowing of pulses (d) Delayed sowing (e) Selection of wrong varieties (f) Inadequate seed rate (g) Unscientific method of sowing (h) Heavy infestation of weed (crop loss 50-79%) in different pulses, (chickpeas 30-50%, green ram 50-70%, pigeon pea 50%) (i) Sever attack of diseases and insects and (j) Inadequate research focus .The fourth constraint in pulse production is the Socio-economic factors associated with pulse growers. The Post-harvest technology is stated to be one of the constraints that inhibit production and productivity of pulses.

The importance of pulse in our food items as well as in farming system has been realized greatly by the farming communities. The reasons are,

1. Pulses are the richest source of protein in our diet: The protein contents of pulses like gram, Arhar, Urd, Green gram and Lentil is 21.0, 22.3, 24.0, 24.0 and 25.5 grams respectively where as protein contents of wheat and paddy is 12.8 and 8.5 grams. Form nutritional point of view; pulses are unmatched for Indian population. Pulses contain many amino acids than cereals. Pulses are good source of Vitamin A. It contains Vitamin B-1 in much higher quantity and vitamin C at sprouting of seeds. Besides pulses are good sources of minerals, Calcium which enrich our diets.

Besides, the pulses are also very much useful in farming with respects of increasing soil fertility, conservation of soil water, as fodder for cattle and controlling weeds.

Keeping these considerations in view the study was conducted to expand pulse cultivation in rice fellow (1.74 lakh hectares) with the following specific objectives.

OBJECTIVES

1. To analyze adoption of pulse technology by the sample farmers and the methods of transfer of technology adopted by the extension agencies to increase production and productivity of pulses.
2. To Study the socio economic status of the pulse growers for better understanding about them in our farming system.

REVIEW OF LITERATURE

Sathe and Agarwal (2004) examined some issues related to trade liberalization in the Indian pulses sector. The paper examined the world pulse market and how Indian production, imports and exports of pulses had moved since 1985 (the year the Indian economy started having a more open import regime). Also examined are the prices of pulses and the relationship between production, prices and imports. It was shown that the world market for pulses was fairly narrow and non-buoyant. Both the world and India's production had been fairly stagnant since 1985-86. India is one of the major importers and its major import partners were Myanmar, Canada, Australia and Turkey. While the price index of pulses had always been higher than that for food articles, the rate of growth of prices and the volatility in prices in both categories had been comparable. In volume terms, pulse imports had increased at a rate of 1.29 per cent while domestic production had increased at 0.33 per cent for the period 1985/86-2001/02. The share of imports in domestic production had been, at times, quite high. There was a fairly strong and negative relationship between domestic production and imports (with one year lag). Imports, with or without lag, did not seem to be affecting the price index in any substantial way.

Mathur and Henry (2004) analyzed the production of different pulses in India for two periods: period 1- from 1971 to 1990, producing chickpea, pigeon pea, lentil and total pulses; and period 2- from 1991 to 2002, producing black gram, mung bean, pea/bean and other pulses. It was found that the total production of pulses increased significantly during period 1. However, in period 2, the production of pulses revealed low negative compound growth rate (CGR). The mean import of pulses during the period 1992-2002 was 9.0 lakh tonnes with value of Rs. 1164.58 crores. The value of import of pulses showed a significant increase. During the same period, India exported pulses of worth Rs. 254.85 crores and CGR revealed that both quantities of pulses exported and value earned significantly increased. The mean import of pulses (1991-99) was 5.73 lakh tonnes of which the major share was that of peas, chickpeas, other pulses and pigeon peas. Countries like Myanmar, Australia and the UK were important for import of pulses.

Reddy (2004) used data mainly from the 1990s analyzed regional patterns in the production and consumption of pulses in India and the potential for expansion of output. It found that the large differences in both production and consumption of pulses across regions, as well as the increase in imports in recent years. It argued that an improved package of practices, including technological interventions, and a region-specific approach were needed to improve productivity and thereby alleviate the problem of short supply of pulses and chronic malnutrition among the people.

Moe *et al.* (2008) studied that before 1990, international trade of pulses was not well develop because of trade restrictions in major export and import countries. India and Myanmar were major trade partners of pulses because Myanmar pulses favour consumer preference, low freight charge and fast delivery. There were still major trade restrictions of pulses such as minimum support price

programme, high levy of import tax and export banning policy in India, and high levy of export tax and misalignment exchange rate system in Myanmar. In Johansen co-integration test, all prices of international markets were weakly integrated in the long run. In VECM test, India had negative equilibrium condition in all pulses while Myanmar had positive equilibrium conditions. India could correct the deviation of price in long run equilibrium with 19 per cent in black gram, 16 per cent in green gram, and 35 per cent in pigeon pea, within a month. In Granger causality test, all prices of Myanmar Granger caused India except in black gram. India Granger caused Myanmar black gram price. Myanmar was a leading country for international price formation. However, there was a unidirectional causality in international price of pulse. It indicated the monopolistic behaviour and asymmetry price transmission in the international markets of pulses. This imperfect and asymmetry price transmission might be the results of quantitative restrictions of trade, misalignment exchange rate system and high levy of export and import taxes in pulses trade.

Rao *et al.* (2010) assessed consumption, production and marketing of pulses in Asia, and explored future prospects for the pulses sector by focusing on chickpea and pigeon pea, the two most important pulse crops grown in the continent. Chickpea and pigeon pea were important grain legumes and play a significant role in the food and nutrition security of the poor in developing countries of Asia. Together, these crops accounted for 41 per cent of Asia's pulses production. Asia accounted for 88 per cent of global chickpea production and 90 per cent of global pigeon pea production. Within Asia, India was the largest producer of both crops, accounting for 75 per cent of Asia's chickpea as well as pigeon pea production. Global yields of both chickpea and pigeon pea were low, and had been relatively stagnant for much of the last two decades. India had a dominating influence on these trends owing to its large share in the global production of these crops. A number of biotic and abiotic factors limited realization of yield potential. The sluggish growth in chickpea and pigeon pea yields in India attributed to: (i) the shift in crop area from favorable to marginal environments; (ii) the slow uptake of improved varieties and other production technologies; and (iii) its cultivation on poor soils under erratic rainfall conditions. On the demand side, however, buoyed by increasing incomes in both Asia and Africa, demand for both the crops was set to increase in the medium term, doubling in Asia and Africa over the period 2000 to 2020. Trade in chickpea was relatively robust and had been growing over time. Close to 10% of the total chickpea produced in 2003-05 entered the international market. For pigeon pea, Myanmar was a major exporter followed by Malawi, Kenya, Uganda and the Dominican Republic. International prices of both chickpea and pigeon pea declined in real terms until 2006. Since then, prices for both crops had increased in line with the general rise in prices of all agricultural commodities. The scope of raising chickpea and pigeon pea production in Asia through area expansion alone was limited. Therefore, the main challenges for research and development are to bridge the gap between actual and attainable yield by enhancing farmers' access to quality inputs, improved technologies and information; and improve the competitiveness of pulse crops through domestic incentives related to production, marketing, processing, and prices in line with cereals and competing crops.

Akibode and Maredia (2012) analyzed the global and regional trend analysis and sheds light on the pulse crop production, price, trade, and consumption patterns observed in the developing world, developed countries and globally from mid-1990s to 2008. Globally, the harvested area under pulse crops was about one-tenth the harvested area under all cereal crops and a high proportion of pulse area harvested was under rainfed-low input systems compared to cereal crops. Thus, in 2008, the average global yields of pulse crops (0.86 t/ha) was only about one-fourth the average yields of cereal crops (3.54 t/ha). On the bright side, over the past 14 years, the overall pulse production had increased at a rate higher than the growth rate in population both in developing and developed countries. Over this time period, SSA had led the developing world in terms of contribution to production growth through growth in yield (but with a low base). A major share of the pulse production growth rate in developed countries had been area expansion, especially in countries like Canada. In terms of production growth rate among major pulse crops, cowpeas and soyabean in West Africa had shown the biggest increase, which were followed by pigeon peas and dry beans. However the overall picture for faba beans, chickpeas and lentils over the last 14 years had not been so favorable with small positive growth rate for faba beans and an overall negative growth rate for lentils due to decline in area. Farm-gate prices for pulses had fluctuated during the past 14 years due to supply and demand mismatch, and had experienced an upward pressure recently. This pressure was expected to continue in the near future but may be reversed in the medium and long term. Over the past 14 years, developing countries on aggregate had increasingly met their growing pulse requirements through increased imports and had now become net importers of pulses. Trade in pulses grew more rapidly between 1994 and 2008 than output. The expansion in international trade of pulses had provided a good opportunity for several developing and developed countries to expand their exports. China, Myanmar and Argentina, among developing countries, and Canada, U.S. and Australia among developed countries had emerged as major exporters of pulses. However, despite this rapid growth in exports and imports, pulse trade remained a relatively thin market, especially when compared to other food commodities, such as cereals and oil crops. On the demand side, over the past 14 years, a stable and modest positive trend in per capita consumption was observed within the context of a declining overall historical trend. This declining historical trend in per capita consumption of pulses was expected to continue into the future. Dietary patterns are changing all over the world and the share of non-cereal foods in the total calorie and protein consumption is increasing. However, at least over the past 14 years, pulses had not seen a dramatic decline in the total calorie and protein contribution as seen by the cereal crops. Household level survey data from India showed the continuing importance of pulses as a source of protein in poor people's diet, despite the overall changing dietary pattern, rising income and declining per capita consumption of pulses.

Gamanagatti *et al.* (2013) noticed during 2010-11, the country produced 18.09 Mt of pulses from 26.28 M ha area, with an average yield of 689 kg/ha. These figures made India the largest producer of pulses in the world. With the large population dependent on pulses for protein requirements, India is also the largest consumer and importer of pulses.

Ironically, the country's pulse production had been hovering around 14-15 Mt, coming from a near-stagnated area of 22-23 M ha. The states *viz.,* Madhya Pradesh, Maharashtra, Uttar Pradesh, Andhra Pradesh and Karnataka were the leading pulse producing states. The share of these states in the total pulse area of the nation was 65.58 per cent contributing 75.86 per cent to the total production of pulse in the country. UAE, USA, Sri Lanka and Pakistan are the major buyers for Indian pulses. India's pulses imports were increasing drastically with the growth rate of 6.06 per cent per annum to cut down this and move towards exports there should be increase in production in the country. The favourable weather conditions and change in economic environment are found to be the important factors in increasing the production to meet the domestic as well as external demand.

METHODOLOGY

Selection of District: The study "Factors Affecting Adoption of Pulse Technology: A case study in Mayurbhanj District of Odisha" was designed to investigate into transfer of pulse technology to increase production and productivity. The measure concern of study is to find out mechanism through which pulse technologies are transferred to growers. Based on rice fallow in the district the selection was made accordingly.

Selection of Block: The district Mayurbhanj constitute 26 blocks out of which three blocks namely Samakhunta, Joshipur and Rasagobindapur were selected because of area under pulses and thrust of the Govt. compared to other blocks in the district. In these three blocks area under pulses is reported to be higher for which the blocks were selected.

Selection of village: Out of three blocks 14 villages were selected on random recognizing cultivation of pulses mostly arhar, Black gram and Bengal gram. The selection of blocks, villages and respondents are given in following table.

Selection of sample: It was decided to select only small and marginal farmers growing pulses either of three namely arhar, green gram and Bengal gram of equal number. A total of 240 farmers were selected consisting of 120 small and 120 marginal farmers are per crop 80 farmers constituting both small and marginal farmers of equal proportion, i.e. 40 small and 40 marginal farmers. The table given below indicates selection of village, block and sample.

Table 1 Block, Village and Farmers under study

Sl. No.	Block	Village	Farmers selected	Marginal Farmer	Small Farmer
1.	Joshipur	Basol	20	10	10
		Bidhakudor	20	10	10
		Itamundi	20	10	10
		Sarjanposh	20	10	10
2.	Rasagobindapur	Tikayatpur	20	10	10
		Haripur	20	10	10
		Barhampur	20	10	10
		Tambakhdi	20	10	10
3.	Shamakhunta	Ambadubi	20	10	10
		Sindurgour	20	10	10
		Mudrajodi	20	10	10
		Baunsatila	8	4	4
		Bahadurpur	6	3	3
		Bajratundi	6	3	3
	Total	**14**	**240**	**120**	**120**

Selection of crop and technology: Out of 12 pulses grown in Odisha three major crops namely Arhar, Breen gram and Bengal gram were selected for the study because of their spread index. The names of the pulses are

1. Arhar (Red Gram/ Pigeon Pe) Cajanus cajan
2. Green Gram (Moong) Phaseolus Gureus
3. Bengal gram (Gram)

After selection of crop the technology relating to pulse crops were finalized.

(I) ADOPTION OF PULSE TECHNOLOGY:

The adoption is a process through which individual's passes through stages like awareness, interest, trial, evaluation and adoption. The study determined rate of adoption of packages of practices of pulse cultivation advocated for adoption by the farmers. These practices are prepared by the scientists of Agricultural University and research satiations based of research and experimental data. . These are available with State Department of Agriculture which are in turn reaches the pulse growers. An attempt has been made to present adoption rate of three selected pulse technology namely, Arhar, Green Gram and Bengal Gram.

(i) Arhar and adoption of recommended packages: The crop archer is grown in all the states of India. In Odisha it is grown in kharif season. The area production and productivity of pulse in the state is 138.88 (000ha), 124.44 (000 MT) and 8.96 q/hectare respectively. The adoption of recommended packages of Arhar by sample farmers is presented in table given below.

Table 2 Adoption of package of practices of Arhar (N=80)

Sl. No.	Technological Practices	Adoption			Score
		Full	Partial	Not at all	
1.	Approved varieties like UPAS-120, T-21, PUSA AGETI	60	15	5	1.68
2.	Seed rate @ 30 kg./ hect.	40	20	20	1.25
3.	Seed Treatment with chemical	18	21	41	0.71
4.	Right showing time (June-July)	80	-	-	2.00
5.	Land Preparation with @ 5 tones compost/hect.	12	12	56	0.45
6.	Showing Practices				
(i)	Distance between plant and row (60x20 cm, 10 plants/sq. mt.)	40	30	10	1.37
7.	Fertilizer Use				
(i)	NPK @ 20:40:20/ hect.	28	32	20	1.10
(ii)	Use of zinc phosphate	12	15	53	0.48
(iii)	Use of bio-fertilizer	10	12	58	0.40
8.	Irrigation at critical phase of growth (Flowering & seed formation	42	18	20	1.27
9.	Plant protection measures	20	10	50	0.62
10.	Post harvest care	15	20	45	0.62

The facts contained in the table reveal that adoption of recommended practices of Arhar has been studied over 10 important practices. These practices directly contribute to yield level of crops. Out of the 10 practices, highest adoption rate is observed in case of right sowing time followed by recommended varieties, maintaining distance between plant to plant and row to row and providing irrigation at critical stage of crop growth. The adoption rates of seed treatment, Zinc phosphate and bio fertilizer, plant protection and post harvest care has been found to be very low. In case of fertilizer use in terms of N P and K per hectare is found in fifth position but not as per recommendation. In short, the major practices the recommendations is not followed as required specifically land preparation for sowing of seeds although is done but not with compost @ 5 tonnes per hectare. There is variation in use of compost in pulse crops which is not the case with cereals.

(ii) Green Gram and adoption ofrecommended packages: The crop green gram is most popular pulse in Odisha. The crop is grown both in Kharif and Rabi season. The state grows green gram 857.07 thousand hectares producing 407.99 thousand MT with yield level of 4.76Q/ hectare (2013-14). The study examined adoption rate of recommended practices of green gram taking 10 important parameters which contribute to productivity of the crop.

Table 3 Adoption of Packages of Practices of Green Gram (N=80)

Sl. No.	Technological Practices	Adoption			Score value
		Full	Partial	Not at all	
1.	Approved varieties like Jyoti, Sujata, P.D.M-54, K.851	34	20	26	1.05
2.	Seed rate @ 30 kg./ hect.	38	30	12	1.63
3.	Seed Treatment with chemical	18	22	40	0.72
4.	Right showing time (Feb-March)	80	-	-	2.00
5.	Land Preparation with @ 5 tones compost/hect.	8	48	24	0.80
6.	Showing Practices				
(i)	Distance between plant and row (25x5, 80 plants/sq. mt.)				0.00
(ii)	Behind the Plough				0.00
(iii)	Broadcasting	80	0	0	1.00
7.	Fertilizer Use				
(i)	NPK @ 20:40:20/ hect.	28	22	30	0.97
(ii)	Use of zinc phosphate	12	8	60	0.65
(iii)	Use of bio-fertilizer	18	12	50	0.60
8.	Irrigation at critical phase of growth (Flowering & seed formation	16	21	43	0.66
9.	Plant protection measures	20	10	50	0.62
10.	Post harvest care	35	28	17	1.22

A look at the table reveals that 10 important packages of practices have been considered in a scale of full, partial and not at all of adoption. The results reveal that sowing time of green gram is followed as per recommendation because the crop is grown with moisture content of the soil normally after harvest of paddy. The rate of adoption of approved variety and seed rate is up to satisfaction. The adoption rates of other important packages like fertilizer use, use of Zinc Phosphate, bio fertilizer and application of compost at the time of sowing and irrigation at the time of flowering of the crop are not so much encouraging. However, post harvest cares like keeping of seeds, sun drying and control of store grain pest is comparatively better. On the whole it can be inferred that major recommended practices are not followed as desired. In case of green gram, the availability quality seed variety has been the constant problem in the state since a very long time.

(iii) Bengal Gram and adoption of recommended packages: Bengal Gram popularly known gram is grown in the state during Rabi season after harvest of paddy. The area, production and productivity of Bengal gram is reported to be 47.15 thousand hectare, 36.21 thousand M and 7.69Q/hectare respectively. The study attempted to analyze adoption rate of package of practices Bengal gram as recommended by the scientists.

Table 4 Adoption of pulse technology Bengal Gram (N=80)

Sl. No.	Technological Practices	Adoption			Score
		Full	Partial	Not at all	
1.	Approved varieties like Radhey, moti, Anegiri 1, K-850	42	20	18	1.30
2.	Seed rate @ 50 kg./ hect.	35	25	20	1.18
3.	Seed Treatment with chemical	22	14	44	0.72
4.	Right showing time (Oct-Nov)	80	-	-	2.00
5.	Land Preparation with @ 5 tones compost/hect	21	18	41	0.75
6.	Showing Practices	80	-	-	2.00
(i)	Distance between plant and row (33 plants/sq. mt.)	0	0	0	0.00
(ii)	Behind the Plough	80	-	-	1.00
(iii)	Broadcasting	40	-	-	1.00
7.	Fertilizer Use				
(i)	NPK @ 20:40:0/ hect.	16	28	36	0.75
(ii)	Use of zinc phosphate	8	12	60	0.35
(iii)	Use of bio-fertilizer	15	12	53	0.52
8.	Irrigation at critical phase of growth (Flowering & seed formation	22	28	30	0.90
9.	Plant protection measures	11	21	48	0.53
10.	Post harvest care	16	12	52	0.55

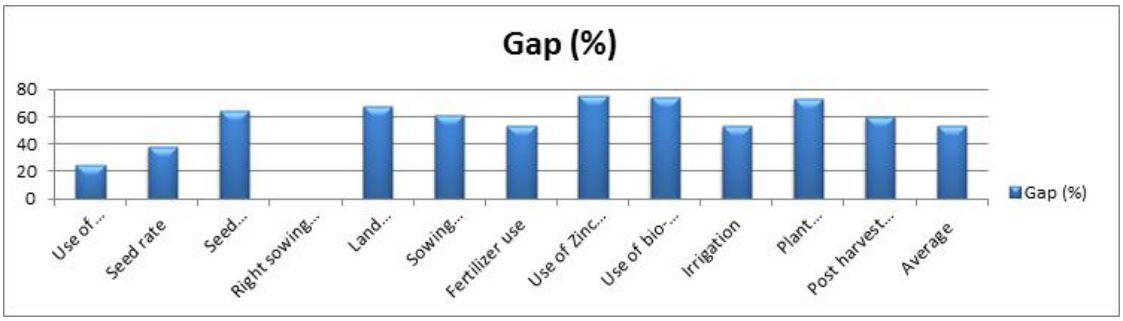
The analysis reveals that 10 important practices of Bengal gram have been studied in relation to adoption rates. The adoption rates have been measured in a scale of full, partial and not at all. The results reveal that sowing time and sowing practices, i.e. behind plough have been fully adopted as per recommendation. The adoption of recommended varieties and seed rate per hectare have been adopted to a level of satisfaction while irrigation at critical stage of growth, application of fertilizers (NPK) and seed treatment have not been adopted as per recommendation which directly influence the level of yield. The adoption rates of Zinc phosphate, bio fertilizer and use of compost at the time of sowing of seeds are much below than expectation. The practices like plant protection and post harvest care have not received attention of the growers. In short, the adoption rates of important package of practices of Bengal gram are much discouraging.

(iv) Gap in adoption of recommended practices: The growing of pulses like arhar, green gram and gram add to the total production of pulses of the state. In analyzing the gap in adoption rates of important recommended practices the following results were obtained.

Table 5 Composite Analysis of three pulses

Sl. No	Practices	Bengal gram	Green Gram	Red gram	Average	Gap (%)
1.	Use of recommended varieties	1.30	1.05	1.68	1.51	24.50
2.	Seed rate	1.18	1.63	1.25	1.25	37.50
3.	Seed treatment	0.72	0.72	0.71	0.72	64.00
4.	Right sowing time	2.00	2.00	2.00	2.00	0.00
5.	Land preparation with compost	0.75	0.80	0.45	0.66	67.00
6.	Sowing practices	0.66	0.33	1.37	0.78	61.00
7.	Fertilizer use	0.75	0.77	1.10	0.94	53.00
8.	Use of Zinc Phosphate	0.35	0.65	0.48	0.49	75.50
9.	Use of bio-fertilizers	0.52	0.60	0.40	0.51	74.50
10.	Irrigation	0.90	0.66	1.27	0.94	53.00
11.	Plant Protection Measures	0.53	0.62	0.62	0.54	73.00
12.	Post harvest care	0.55	1.22	0.62	0,80	60.00
	Average	0.86	0.92	0.99	0.94	53.58
	Gap (%)	**60.00**	**54.00**	**50.50**	**80.00**	**-**

The gap analysis in adoption of important practices reveals that on average the gap is 53.58% of all the practices of three crops taken together. Maximum gap is observed in case of use of Zinc phosphate (75.50%) followed by use of bio fertilizer (74.50%) and plant protection measures (73.00%). The gap in adoption rates is found to be within 60-70% in case of seed treatment, land preparation with compost, sowing practices like keeping distance between rows and plants and post harvest care. The gap up to 50% is found in adoption rate of practices like use of recommended varieties, seed rate per hectare, fertilizer use, critical irrigation at the time of flowering and post harvest care. Crop wise highest gap is found with Bengal gram (60%), followed by Green gram (54%) and Arhar (50.5%) in order. With such extent of gap in adoption of recommended practices, we cannot expect higher level of production and productivity of pulses in the state.



(II) SOCIO-ECONOMIC PROFILE AND STATUS OF THE PULSE GROWERS UNDER STUDY:

The study was conducted taking 240 pulse growers consisting of equal number of small and marginal farmers from three blocks namely, Joshipur, Rasagobindapur and Shamakhunta block of Mayurbhanj district. Again growers of arhar, green gram and Bengal gram were selected at the rate of 80 each.

The details of pulse growers included in the study are given in table below.

(1) Age of the sample farmers. Age is an indicator of activeness of an individual. The decision making, experience and behaviour of a person is related to his age. The distribution of sample on age category is presented below.

Table 6 Distribution of sample on age category

Age	MF	SF	Total	Percentage
(i) 30 Years	50	52	102	42.50
(ii) 31-50	40	42	82	34.17
(iii) 51 & above	30	26	56	23.33
Total	**120**	**120**	**240**	**100.00**

As contained in table, 42.50% are in age group of up to 30 years, 34.17% are within age group of 31 to 50 years and rest 23.33% above the age of 51 years. It shows that sample farmers were drawn from all age groups. Therefore responses of the sample represent all categories of farmers of age groups for drawing valid conclusions.

(2) Educational status: The research findings have invariably proved that educational attainment of individuals significantly influences their adoption behaviour. The farmers who are educated look farming from scientific as well as business point of view. They adopt technology better than others. Keeping this hypothesis in view the educational attainment of sample farmers was determined as presented in table given below.

Table 7 Educational attainment of the sample

Educational level	MF	SF	Total	Percentage
(i) Illiterate	22	18	40	16.67
(ii) Primary	44	38	82	34.17
(iii) Middle School	36	31	67	27.92
(iv) High School	10	18	28	11.66
(v) Above High School	8	15	23	9.58
Total	**120**	**120**	**240**	**100.00**

As seen in table, of the total sample, 16.67% are illiterates, 34.17% have primary education, 27.92% middle school, 11.66% high school and 9.58% have gone to college education. It infers that college educated persons are also in farming. The table implies that sample represents all educational categories and hence the views of sample represent cross section of the society in the area under study.

(3) Training in Agriculture: The agricultural programs of today are composed of technology as well as capacity building. The training in agriculture is offered by different agencies like Department of Agriculture, KVK, State Agricultural Universities, ICAL institutes and NGOs. The information regarding availing of training by the sample farmers was determined as sta5ed in table below.

Table 8 Training in Agriculture

Training in Agriculture	MF	SF	Total	Percentage
(i) Yes	12	18	30	12.50
(ii) No	108	102	210	87.50
Total	**120**	**120**	**240**	**100.00**

The results reveal that out of total sample only 12.50 have received training in agriculture while rest 87.50 have yet to undergo training program. The finding is disappointing. The output in farming is not significant because of lack of technical knowledge and to strengthen the knowledge level of farmers training is essential which is missing at large.

(4) Social Category: In a society like ours, the role of social category and caste structure has good degree of impact. The distribution of sample of social categories was ascertained as presented in table.

Table 9 Social Category

Social Category	MF	SF	Total	Percentage
1. SC	58	15	73	30.42
2. ST	32	24	56	23.33
3. Other category	30	81	111	46.25
Total	**120**	**120**	**240**	**100.00**

The analysis indicates that sample represent all social categories. The representation of SC is 30.42% in the sample followed by ST up to 23.33% and other category 46.25%. The sample thus represents all social categories and cross section of the population in the area under study.

(5) Membership in formal organization: At present the Government and Non-Government agencies have opened different organizations for the benefits of the farmers. The farmers are expected to take advantages of these socially valued organizations. The hypothesis is that more the exposure and membership of farmers with different organizations better is their knowledge level and outputs. The information regarding membership of sample farmers in different organization was determine as shown in table below.

Table 10 Membership in formal organization

Membership	MF	SF	Total	Percentage
1. No membership	90	80	170	70.83
2. Membership	27	28	55	22.92
3. Office Bearer	3	12	15	6.25
Total	**120**	**120**	**240**	**100.00**

It is surprising to find that as much as 70.83% have no membership in any formal organizations while 22.92% have membership and 6.25% are found to be office bearers. This part of the study implies that farmers in rural areas should become members of different organizations and take advantages of these to strengthen their socio-economic status.

(6) Social Contact: Social contact and social interaction are necessary to enrich a person with knowledge. In social science, we emphasize for more of social contact and social interaction with a view to make people cosmopolite. The social contact of sample pulse growers with different organization and institution was measured on a three point scale consisting of, very much, much and little with assigned score of 3,2 and 1 respectively which yielded the following results.

Table 11 Social Contact

Social Contact	MF	SF	Difference (%)
1. Co-operative Society	1.46	2.55	42.74
2. Panchayat	1.65	1.95	15.38
3. Social organisation	1.32	2.00	34.00
4. Religion	1.37	1.12	18.24
5. Cultural	1.72	1.43	16.86
6. Educational	1.55	1.43	7.74
Average	**1.62**	**1.74**	**6.87**

Analysis reveals that social contact of small farmers is more than marginal farmers. Out of six organizations, the social contact of marginal farmers is highest with cultural bodies, followed by panchayt, cooperatives, religious and social organizations. In case of small farmers the contact is highest in case of cooperative societies followed by social organizations, panchayat, educational, cultural and religious organizations. The small and marginal farmers differ significantly with respect of all organization except educational organizations. The educational institutions at present need cooperation of all households in village especially families having school going children.

(7) Media Contact: In this era of mass media, the people remain in contact with media every day. Our interest is to examine whether pulse growers derive information about pulse technology in the area of study. The distribution of sample with regard to mass media contact is given in table below. The response of sample were secured on a three point scale consisting of, very much, much and little with assigned score of 3,2 and 1 respectively

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Table 12 Media Contact

Media Contact	MF	SF	Difference (%)
1. TV	2.15	1.92	10.70
2. Newspaper	1.21	1.53	20.92
3. Radio	1.37	2.17	36.87
4. Farm Journal and Magazine	0.35	0.56	37.50
5. Exposure Visit	0.55	0.76	27.63
6. Training	0.75	0.87	13.79
7. Exhibition	0.31	0.51	39.22
8. Demonstration	0.32	0.47	31.91
Average	**0.87**	**1.09**	**27.31**

The mass media contact of small farmers is higher than marginal farmers. In case of marginal farmers T.V, newspaper, radio are more in use than training, demonstration and farm general is minimum. However training and exposure visit are found to be more in contact over other extension methods. In case of small farmers trend remains same as T.V, newspaper, radio remain same in diffusing pulse technology. The exposure visit and training is more in case of small farmers compared to marginal farmers. However, there is significant difference between small and marginal farmers in using mass media as source of information for pulse technology as the overall average difference is 27.31%.

(8) Extension Contact: The farmers in general need extension support for their enterprises. The extension support stems from different organizations from where farmers receive guidance, technology and provide feedback for improvement. For farmers of Odisha the extension sources are, extension officers of Agriculture Department, State Agriculture University (OUAT), KVK, private firm, research centre of state Govt. and ICAR and NGOs. The contact of sample farmer with extension agencies was measured in three point scale consisting of, frequently, sometimes and never with assigned score 2,1 and 0 respectively.

Table 13 Extension Contact (Score)

Extension Contact	MF	SF	Average	Rank
1. Extension Officer	1.92	2.12	2.02	I
2. OUAT/ KVK Scientist	1.39	1.86	1.62	II
3. Private Firm	0.63	0.77	0.56	III
4. Research Station	0.37	0.27	0.32	IV

A look at the table reveals that extension officers of Agriculture Department are found to be at top in providing pulse technology followed by OUAT/KVK, private firm and research stations. It seems that research stations have very little contribution towards transfer of pulse technology to the farmers.

(9) Use of electricity: There have been good attempts to provide electricity to the households in rural areas. But the situation has not changed as planned as evidenced from data in table below.

Table 14 Use of electricity

Use of electricity	MF	SF	Total	Percentage
1. Yes	32	62	94	39.17
2. No	88	58	146	60.83
Total	**120**	**120**	**240**	**100.00**

As revealed in table about 39.17% of the samples have electricity provision against 60.83% those have yet to receive such basic facilities. Thus it is inferred that majority households in the area under survey are not provided with electricity and what to talk of use of electricity in agriculture.

(10) Irrigation facility: Agriculture goes with irrigation. The pulse crops are mostly rain fed crop but at critical stage like flowering and pod formation there is need for irrigation. The moisture stress at this stage causes heavy flower drop leading to low production and productivity. The irrigation facilities of the ample farmers are given in table.

Table 15 Land under irrigation of the sample farmers

Land under irrigation	MF	SF	Total	Percentage
1. Nil	28	22	50	20.83
2. 25%	54	48	102	42.51
3. 50%	38	42	80	33.33
4. 75%	0	8	8	3.33
5. 100%	0	0	0	0.00
Total	**120**	**120**	**240**	**100.00**

The results reveal that about 20.83% of the sample has no irrigation facilities while 42.51% have only up to 25% of their cultivated land. Likewise, 33.33% have irrigation up to 50% of their land and only 3.33% up to 75% of their cultivated land. The farmers when get irrigation facilities they opt for other remunerative crops. Therefore it is observed that with expansion of irrigation facilities mostly canal irrigation the land under pulse cultivation is reduced and replaced by other remunerative crops.

(11) Major occupation. The occupational status of the sample farmers is presented in table below.

Table 16 Major Occupation

Major Occupation	MF	SF	Total	Percentage
1. Farming	83	76	159	66.25
2. Service	12	17	29	12.08
3. Business	3	13	16	6.67
4. Wage earning	22	14	36	15.00
Total	**120**	**120**	**240**	**100.00**

Farming is the major occupation of the majority of sample (66.25) while 12.08% have service as major occupation to maintain livelihood. The business as major occupation is found with only 6.67% of the sample and about 15% depend on wage earning to earn their livelihood.

(12) Possession of Farming Equipments: The study attempted to find out possession of worth materials related to farming which yielded the following result.

Table 17 Possession of farming equipment

Possession of following	MF	SF	Total	Percentage
1. Bullock	47	34	81	33.75
2. Iron MB Plough	58	78	136	56.67
3. Sprayer	37	73	110	45.83
4. Duster	3	18	21	8.75
5. Weeder	10	21	31	12.92
6. Seed Drill	0	0	0	0.00
7. Tractor/ power tiller	6	26	32	13.33
8. Pump set	8	27	35	14.58

As seen in table 56.67% of the sample has MB iron plough, 33.75% bullock, 45.83% sprayers, 13.33% tractor/ power tiller, 12.92% weeders while 14.58% water pump. None of them possessed seed drill for sowing of seeds. The table on the whole reveals that farmers under study have agricultural equipment as per their requirement but no equipment with regard to pulse cultivation.

(21) Correlation between socio-personal variables and adoption response of pulse growers:

An attempt was made to find out relationship between socio-personal variables and adoption response of the pulse growers. As stated earlier as much as 10 practices of pulse cultivation identified as crucial like variety, seed rate, seed treatment, sowing time. Land preparation, sowing method, fertilizer use, use of Zinc phosphate, irrigation plant protection and post harvest care were selected for analysis. With selected socio-personal variables like education, training in agriculture, social category, family size, earning member per family, membership in formal organization, social contact, media contact, extension contact, major occupation, farming equipment, source of pulse seeds and possession of soil health card for adoption response, the scoring was made assigning 3,2 and 1 for the adoption response of very much, much and little. The scoring method for socio-personal variable has been discussed earlier and for adoption response. The results are presented below.

Table 18 Correlation between socio-personal variables adoption response of pulse growers ('r 'value)

Sl. No	Variable	Marginal farmer (N=120)	Small farmer(N=120)
1	Education	0.543*	0.752*
2	Training in Agriculture	0.358*	0.452*
3	Social category	0.152	0.315*
4	Membership in formal organization	0.128	0.261
5	Social contact	0.371 *	0.384*
6	Media Contact	0.486*	0.412*
7	Extension contact	0.681 *	0.582 *
8	Major Occupation	0.182	0.163
9	Farming equipment	0.238	0.351 *

- Significant at 5% level

As contained in table the relationship between socio-personal variables and adoption response is found to be closely associated with. In case of marginal farmers the variable like social category, family size, membership in formal organization, major occupation an farming equipment are independent of adoption of recommended practices of pulse crop. In case of small farmers membership and occupation are not related while all other factors are significantly

associated with adoption response. The variables like extension contact and sources of seeds are highly significant in case of small farmers. On other hand education, sources of seeds, extension contact and earning members per family contribute much towards adoption response of small farmers.

CONCLUSION

The study" Factors Affecting Adoption of Pulse Technology: A case study in Mayurbhanj District of Odisha" was Conducted with a sample size of 240 pulse growers belonging to three blocks and eight villages of Mayurbhanj District lead to arrive at the following conclusions.

1. Out of 10 important practices of cultivation of arhar ,seed treatment, land preparation, use of zinc phosphate, bio-fertilizer, plant protection and post harvest care are adopted to very limited extent, while right time of sowing, seed rate, varieties are adopted to an appreciable extent.
2. In case of green gram and Bengal gram the practices like, land preparation. Seed rate, seed treatment, distance between plant and row, use of required doses of fertilizers are not adopted as per recommendation.
3. 3. The findings reveal that there is wide gap in adoption of recommended practices in all three pulse crops. The high gap is observed in case of practices like, use of Zinc phosphate, bio-fertilizers, seed treatment, land preparation with compost application and use of plant protection measures. The overall gap in adoption of recommended practices is about 54%. With such wider gap, we cannot expect increase in production and productivity of pulses.
4. The results reveal that pulse growers are found in all age groups, most of them have primary education with illiterates up to 16.67%, are devoid of capacity building training, belong to all social classes and are not members of any formal organizations. There is difference between marginal and small farmers with regard to social contact higher being with small farmers, limited farmers have irrigation facilities, about 40% use electricity and few have modern agricultural equipments.
5. Many of socio-economic variables like education, training in agriculture, caste category, media contact, extension contact and possession of farm equipment are directly associated with level of adoption of pulse technology

In short, the pulse crops have not been remunerative because of non-adoption of recommended practices as required. There exist vast potentiality for increasing production and productivity of pulses. We have enough pulse technology at our hand. Only requirement is to plan and execute efficient technology transfer strategy.

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