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Impact assessment of 'Potash for life' project: Accelerating adoption of balanced use of fertilizers and enhancing farm income of farmers' in Chhattisgarh, India

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Abstract
Rice is the major crop and the central plains of Chhattisgarh are known as Rice bowl of central India. Under present study four districts have been selected, namely Bilaspur, Durg, Raipur and Rajnandgaon. In Rajnandgaon two blocks Rajnandgaon and were selected. In Rajnandgaon block two villages Haldi and Surgee and, Arjunda village from Gonderdal block was selected to conduct survey. Two villages namely: Malud and Mahamara were selected from Nakpura and Durg blocks in district Durg. Similarly, three villages Janjra, Devri and Kopra from Fingeswer block of Raipur district was selected to conduct socioeconomic survey. In district Bilaspur Bilha block was identified in which Sendari, Kechar and Dhabipara villages were selected for the above cited purpose. From each district cooperator-farmers were selected, as in Rajnandgaon 29 farmers, in Durg 18 farmers, in Raipur 29 farmers and in Bilaspur 30 farmers. A total of 106 cooperator farmers were surveyed. 85% of area is comes under irrigated land out of total aerable portion and the major sources of irrigation are electric operated shallow tube wells and canals. The area under tube well and canal irrigated lands are 204 ha and 96 ha, respectively. It occupies about 90% (274 ha) and 92% (283 ha) area to total cropped area in *kharif* season and 50.6% (155.2 ha) and 49.9% (153.10 ha) area in *rabi* season in 2012-13 and 2014-15, respectively. Another important crop is tomato which occupies 3.3% (10.1 ha) and 3.9% (12.1 ha) in the year 2012-13 and 2014-15, respectively on sample farms. In *kharif* rice, use of potash increased significantly by 262.42% while the doses of nitrogen and phosphorus is reduced by 23% and 19%, respectively in assessment year over the base year. However, total nutrient use has been increased by 16% in the referred period. In *rabi* rice the use of potash fertilizer increased by 170.2% in the corresponding period and the doses of nitrogen and phosphoric nutrients have decreased by 30% and 24.46%, respectively. It shows that the farmers are using higher doses of potash after they have gained knowledge and education about its significances from the PFL project activity.
The impact of potassic fertilizers have also been studied over crop tolerance to various stresses such as adverse weather conditions, water stress, severity of diseases and effect of natural enemies. Application of potash, protect crop from many adversaries which happened during cropping season. Many communication as well as extension techniques and tools are being used under PFL project for creating awareness regarding balanced use of fertilizers and benefits of using potash in soils. Demonstration plots are ranked first in creating awareness among cooperator farmers. Besides it, field days, publicity material, digital media, TV publicity and crop seminars were found to be most effective in communication techniques. Therefore, suitable technological interventions and policy option need to be design to encourage farmers for use of balanced inorganic fertilizers.

Keywords: potash for life, accelerating adoption, fertilizers, enhancing farm

Introduction
The population of world is growing at alarming rate and the cultivable area is being converted into residential area. With no scope in expansion of cultivable area in future, increase in productivity has become an urgent need to meet the food requirement of increasing population. The productivity can be realized by efficient and timely use of all resources including inputs like HYV seeds, fertilizer, pesticides, irrigation water, agriculture machinery etc. It is a well-known fact that mechanization of agricultural operation is beneficial for reducing cost of production. Energy requirement of agricultural operations like seed bed preparation, harvesting, threshing and seed processing is very high and it is not possible to perform these jobs efficiently and timely by traditional methods. Introduction of farm machineries enables timely operations resulting in increased production besides the reduced drudgery.

Indiscriminate and imbalance use of fertilizers is becoming a matter of more concern as it has greatly affected soil health and its micro environment leading to deterioration in productivity and profitability of crops in India as well as their sustainability. Fertilizer consumption in India has increased significantly for last four decades due to subsidy based fertilizer rising in the past. The NPK consumption increased from 11 kg/hectare in 1970 to 128.34 kg /hectare in year 2012-13. As a result of the decentralization of the fertilizer prices and the introduction of nutrient based subsidy potassic fertilizer prices increased in domestic market. This reduced potash consumption in India. It is apprehended that the decrease in potash consumption would adversely affect crop productivity, farm profitability, soil health and sustainability. To respond to recent negative development in potash use in India and to support farm sector for profitable agriculture. Indian Potash Limited (IPL) in collaboration with Indian Chemical Limited (ICL) Fertilizers has launched a project "Potash for life (PFL)". This is a three year project starting from late 2013 to continue up to 2017. It is expected that information generated from the project would provide to the farmers with science based evidence of the profitable use of potassic fertilizers with the help of advanced and best proven extension methods.

Potassium has multi-functional role on different levels as its reaction to soil, plants and in efficient crop production are indiscriminate. Potassium stimulates early growth, increases protein production, improves the efficiency of water use and is vital for stand persistence, longevity and hardiness of stem and more importantly improves resistance to disease and insects. Potassium provides better quality of grains/fruits which fetch premium price in the market. As a result of the introduction of the nutrient-based subsidy in April 2010 and the subsequent increase in potash prices in the international market (and its cascading effect in the domestic market) potash consumption drastically reduced in India. The decrease in potash will, in the long run adversely affect crop productivity, soil health and farm profitability.

Rice, wheat, maize and sugarcane are major crops as they occupy relatively more area and use collectively major proportion of inorganic fertilizers in the country. However, consumption of inorganic fertilizers in other crops which are included in the program is relatively low.

Method and Materials

In Chhattisgarh state data have been collected from selected villages of four districts namely: Bilaspur, Durg, Raipur and Rajnandgaon. Bilaspur district is famous for its unique characteristics like rice quality, kosa industry and its cultural background. Bilaspur district is known as rice bowl (dhan ka katora) for the Chhattisgarh region. Topographically, Bilaspur district falls under the "Plains of Chhattisgarh" and provide suitable rice growing environment in *kharif* as well as in *rabi* season. In Bilaspur district, Bilha block have been selected in which socioeconomic survey have been conducted in three villages namely: Sendari, Kechar and Dhabipara, where 'Potash for Life' project activity is being continued since 2013. Durg district is one of the densely populated districts of Chhattisgarh. It lies between 20'54 and 21'32 N latitude, and 81'10 and 81'36 East Longitude. The district is bounded by Rajnandgaon district in the west and Raipur district in the East. In Durg district Nakpura and Durg development blocks were selected for assessment study. One village from each block, Malud village from Nakpura and Mahamara village from Durg have been selected and conducted socioeconomic survey. Raipur district is situated in the fertile plains of Chhattisgarh region (Singh HN *et al.* 2017) [3]. In Raipur district one block namely Fingeswar have been selected in which Janjara, Deoari and Kopra villages have been selected. Finally fourth district Rajnandgaon have been selected in which Arjinda, Haldi and Surgi villages were visited and data were collected from cooperator farmers.

Sampling design for selection of state, districts and crops

States	Districts	Crops
Jammu & Kashmir	Budgam, Pulwama, Jammu, Sambha and Kathua	Apple, cole vegetables, rice and wheat
Uttar Pradesh	Muzaffarnagar, Bijnor, Kushinagar and Maharjganj	Sugarcane, rice and wheat.
Bihar	Sitamarhi, Madhubani, Begusarai and Hajipur	Rice, maize and wheat
Madhya Pradesh	Mandsaur, Ratlam, Vidisha, Harda and Hosangabad	Soybean, wheat and moong bean
Chhattisgarh	Durg, Rajnandgaon, Raipur and Bilaspur	Rice (*kharif & rabi*) and Tomato*
Maharashtra	Nasik and Solapur	Pomegranates, vegetables (tomato, cole crops, onion) and maize
West Bengal	24 Paraganas and Nadia	Rice and potato

*Detailed analysis of rice and tomato crops from Chhattisgarh is analyzed and presented in this paper only.

Results and Discussion

Family structure of sample farms

The total number of cooper-farmers of surveyed area including their family structure, years of schooling and farming experiences are given in table 1. A total of 106 cooperator farmers have been selected for assessing impact of use of discriminate doses of potassic fertilizers in crop production. Analysis revealed that 46% of population is male adult and 33% of population is female adult whereas male and female children populations are 13 and 8%, respectively. The average family size comprises of 5 members in which 3 are males and 2 are female in selected households' sample. The average age of male adult on overall basis is 40 years and of females it is recorded to be 41 years. Average age of household head is recorded to be 50 years on overall basis and average years of schooling is found to be 7 years that shows there is lack of educational exposure. Farming experiences of household head is to be recorded as 29 years on overall basis which shows that they have been indulged in Agricultural activities since long. (Table-1)

Table 1: Family description of cooperator-farmers in study area

Particulars	Districts									
	Rajnandgaon		Durg		Raipur		Bilaspur			
Villages	Haldi, Surgi, Arjunda	%	Malud, Mahamara	%	Janjra, Deori, Kopra	%	Sindri, Kechar, Dhabipara	%	overall	%
Households (nos)	29		18		29		30		106	
Male(Adult)	80	49	42	48	64	43	71	44	257	46
Female(Adult)	52	32	32	37	52	35	50	31	186	33
Children (Male)	12	7	11	13	21	14	29	18	73	13
Children (Female)	20	12	2	2	11	7	10	6	43	8
Total no.	164	100	87	100	148	100	160	100	559	100
Avg. family size (no.)	6	-	5	-	5	-	5	-	5	-
Avg. male/family	3	-	3	-	3	-	3	-	3	-
Avg. female/family.	3	-	2	-	2	-	2	-	2	-
Average age (years)										
Male(Adult)	39	-	38	-	42	-	40	-	40	-
Female(Adult)	40	-	37	-	42	-	42	-	41	-
Children (Male)	13	-	12	-	13	-	12	-	13	-
Children (Female)	14	-	8	-	15	-	12	-	13	-
Avg. age of household head	51	-	51	-	36	-	47	-	50	-
Schooling (in yrs) of household head	5	-	7	-	8	-	8	-	7	-
Farming experiences of households' head	29	-	30	-	15	-	27	-	29	-

(Cooperator-farmers or households)

Description of employment pattern of farmers

In India despite recent progress in industrialization, the strength of economy is significantly dependent upon the gross production of agricultural commodities and agriculture is the mainstay of millions of teeming population. In Chhattisgarh state, 69% households are dependent solely on agriculture besides 8% population which is involved in government sector jobs and 14% households head have opted private services as major source of their family income. For private business firms or government corporations, the major objective is to maximize net income, yet both have significant objectives other than simply making the highest profit possible. A farmer will certainly want to diversify his agricultural activities in relation to income generation to reduce risk and lead a secure livelihood (Table-2).

Table 2: Employment pattern of cooperator-farmers

Name of occupation	Rajnandgaon		Durg		Raipur		Bilaspur		Chhattisgarh	
	No.	%	No.	%	No.	%	No.	%	Overall	%
Farming	19	66	14	78	21	72	20	67	74	69
Govt. services	3	10	1	6	2	7	2	7	8	8
Pvt. Services	5	17	1	6	2	7	7	23	15	14
Farm labor	2	7	1	6	2	7	0	0	5	5
Business	0	0	1	6	2	7	1	3	4	4
Total	29	100	18	100	29	100	30	100	106	100

(Cooperator-farmers or households)

Description of land holding, land & soil types and irrigation sources in study area

In Chhattisgarh, the soils are mainly classified as Bhata (Entisols), Matasi (Inceptisols), Dorsa (Alfisols) and Kanhar (Vertisols) according to depth and topography. On higher elevation the topography of soil situation called Bhata, lower to it called Matasi, and Dorsa and at lowest elevation and highest deep Kanhar soils are widely situated.

Table 3: Description of operational holdings, land & soil types and sources of irrigation

Particulars	Rajnandgaon	%	Durg	%	Raipur	%	Bilaspur	%	overall	%
Total households (no)	29		18		29		30		106	
Land holdings (ha)	57.8	100.0	25.7	100.0	84.1	100.0	81.0	100.0	248.9	100.0
Irrigated (ha)	40.3	69.7	17.7	68.8	77.7	92.4	77.0	95.1	212.72	85.5
Unirrigated (ha)	17.5	30.3	8.3	32.3	6.4	7.6	4.0	4.9	36.16	14.5
Leased-in area (irrigated) (ha)	23.4	78.5	51.3	88.9	10.4	100.0	11.1	100.0	51.34	88.9
Leased-in area (unirrigated) (ha)	6.4	21.47	6.4	11.1	0	0.0	0.0	0.0	6.4	11.1
Total leased-in area (ha)	29.8	100.0	57.7	100.0	10.4	100.0	11.1	100.0	57.74	100.0
Area under different land types (ha)										
Upland	10.2	11.8	5.6	6.2	0	0.0	1.4	3.7	17.2	5.6
Medium land	52.8	61.2	64.1	70.9	28.5	30.8	26.8	71.4	172.12	56.1
Low land	23.2	27.0	20.7	22.9	64.0	69.2	9.4	24.9	117.3	38.3
Total	86.2	100.0	90.4	100.0	92.5	100.0	37.6	100.0	306.7	100.0
Area under different soil types (ha)										
Clay	8.8	62.5	8.2	9.1	6.7	7.2	1.4	3.7	25.1	8.2
Heavy clay	53.8	62.5	42.1	46.5	55.2	59.7	21.8	57.9	172.86	56.4

Loam	14.5	16.8	13.9	15.4	4.2	4.5	1.4	3.7	33.96	11.1
Sandy loam	9.1	10.6	26.2	29.0	26.4	28.5	13.0	34.6	74.7	24.4
Total	86.2	100.0	90.4	100.0	92.5	100.0	37.6	100.0	306.7	100.0
Area under varied sources of irrigation(ha)										
Electric tube well	31.0	36.0	72.3	80.0	64.2	69.4	36.6	97.4	**204.1**	66.5
Canals	51.2	59.4	16.3	18.0	28.3	30.6	0.2	0.4	95.92	31.3
Others	4.0	0.5	1.8	2.0	0.0	0.0	0.8	2.1	6.6	2.2
Total	86.2	100.0	90.36	100.0	92.5	100.0	37.56	100.0	306.7	100.0

These classifications are based on farmers' perceptions. Due to variation in texture, structure and topography, bulk density, water holding capacity, soil productivity and other biological and chemical properties of the soils also differ accordingly.

The major sources of irrigation are electric operated shallow tube wells and canals.

The total irrigated area by tube well and canal are 204 and 96 ha, respectively (Table-3).

Assets acquisition on sample farms

Table 4 shows the various assets acquisition on sample farms after 2012 year. The farmers of selected areas are using many agricultural and household tools and implements according to their need.

Table 4: Common assets acquired after 2012 on sample farm

Particulars	Units	Purchase value (Rs)	Per unit cost (Rs)	Present value (Rs)	Per unit cost (Rs)
Cattle shed	5	120500/-	24100/-	156000/-	31200/-
Farm building	1	125000/-	125000/-	100000/-	100000/-
Storage structure	2	375000/-	187500/-	310000/-	155000/-
Others	1	25000/-	25000/-	21000/-	21000/-
Tractor	14	7935000/-	566786/-	5495000/-	392500/-
Iron plough	4	140000/-	35000/-	90000/-	22500/-
Deshi plough	7	11050/-	1579/-	8550/-	1221/-
Irrigation pump	2	50000/-	25000/-	38000/-	19000/-
Sprayer	25	56500/-	2260/-	44800/-	1792/-
Duster	1	1200/-	1200/-	800/-	800/-
Thresher	5	575000/-	115000/-	385000/-	77000/-
Radio/Tape recorder	3	2700/-	900/-	1703/-	568/-
T.V.	14	106100/-	7579/-	51800/-	3700/-
Fan	17	17600/-	1035/-	10700/-	629/-
Sofa set	4	83000/-	20750/-	55000/-	13750/-
Refrigerator	5	57000/-	11400/-	31000/-	6200/-
Gas cylinder	10	37000/-	3700/-	27700/-	2770/-
Stove(kerosene)	2	1100/-	550/-	600/-	300/-
Washing machine	4	64000/-	16000/-	39003/-	9751/-
Bicycle	19	58100/-	3058/-	32900/-	1732/-
Motor cycle	24	1119200/-	46633/-	620000/-	25833/-
Tullu pump	1	20000/-	20000/-	15000/-	15000/-

Different types of assets were found in selected villages during survey period. All essential agricultural assets were available with farmers and major portion of assets have been acquired in last three years 2013-15. Many cattle shades have been made by them to provide their cattle's a conducive environment. Some storage structures also have been made by them to store their agricultural produce safely so that it can be protected by adverse weather conditions and natural enemies; viz birds and rodents. Tractor is an important implement as it is being used for multiple purposes as land preparation, harrowing, threshing, water lifting, transportation of commodities etc. The cost of a tractor is calculated to be Rs. 566786/unit in purchased year. Besides, sprayer is also being used as a major implement by farmer as it is being considered necessary to protect their crops from pest and diseases since early stages of their life cycle. Farmers are adopting timely application of plant protection chemicals so that crop can be protected properly. A total of 25 units of sprayer have been purchased on overall basis having Rs 2260/unit cost. Thresher is also purchased by some farmers and the unit cost is Rs 115000. Custom of hiring system is prevalent in the locality for using machinery on their farms. Radio, Tape recorder, T.V, fan, sofa sets and washing machines have also been purchased by farmers. (Table-4)

Cropping pattern on sample farms

Table 5 depicts the cropping pattern followed by the cooperator-farmers in surveyed area in all four selected districts of the state. Rice is the major cereal in all the districts Bilaspur, Durg, Rajnandgaon and Raipur. It is been grown in *kharif* as well as in rabi season. Rice crop is major inorganic nutrient consuming crop in the study area. It occupied about 90% (274 ha) and 92% (283 ha) area to total cropped area in *kharif* season across all the four districts in the 2013-14 and 2014-15, respectively. Addition to rice, tomato is also considered as one of the important crops in surveyed area in *kharif* season which covers about 2.2% (7 ha) of total cropped area. In *kharif* season many other crops are taken under cultivation as spinach, cowpea, okra, brinjal, onion, french bean, soybean, carrot, broad bean, banana but acreage are minor. It shows the multi cropping systems in sample area across the years are followed by the farmers. In *kharif* season about 2.3% (7 ha) land comes under fallow due to water logging situation in both the period. There are 33 different modern and traditional rice varieties grown by the farmers in surveyed area. The characteristics of these varieties are of short-long maturity duration, coarse- fine, long-small grain types and suitable to various hydrological condition of the land/soil types. There are several crops being grown on

sample farms (Appendix-I).

In *rabi* season rice crop is also taken as main crop and covers maximum area, which accounted 50% of total cropped area across the years. There are 15 modern and traditional rice varieties are grown on sample farms. Most of the rice varieties are common in both the seasons. Wheat is the next important crop after rabi rice which covered 12 and 6% area in 2012-13 and 2014-15, respectively. This indicates relatively lower acreage of wheat than the rice, hence rice is considered to be most important crop of selected districts owing to its maximum acreage in both the seasons equally. Besides these many other crops are taken into cropping pattern under different rotations by the farmers and these crops are primarily tomato, potato, gram, masoor, cowpea, okra, brinjal, onion, soybean, lathyrus etc. The acreage under these crops are minor but they are also helping farmers in maintaining round the year availability of vegetables, pulses and fruits and also maintaining soil health. Analysis revealed that farmers are still growing a number of local/or traditional varieties of cereal, pulses, vegetables crops etc. on their farms. However, these farmers are also growing improved varieties of same crops simultaneously. In *rabi* season the fallow land is comparatively higher than *kharif* season as it covers about 29.8% of total cropped area in both the years (Appendix-II).

In *zaid* season, limited numbers of crops are taken for cultivation as tomato and okra are the major vegetables, lobia as pulses and banana as fruit crops. Maximum area 99% (303.6 ha) remained fallow in both the study periods in *zaid* season. This happens because of acute dry summer coupled with hot wind and high temperature (Appendix-III).

Although, surveyed area is entirely irrigated by shallow tube wells and canal but diversification of crops is very high. Farmers are growing a number of crops on their farm for their various requirement and purposes. Rice is the main crop and it is produced on large area for home consumption as well as for market to earn cash to meet out different needs. Vegetables and pulses are being usually grown for home consumption round the year. These crops are not only helping to meet out nutritional security of family members but also maintain soil health and environment in surveyed area. Growing of banana served dual purpose of the farmers because it can use as fruit and as vegetable too. As per farmers' perception, banana crop is a very high inorganic fertilizer consuming especially potash. Banana consumes about 600-800 kg /ha potash from the soil as reported by the cooperator farmers. In the surveyed area, farmers applied potassic fertilizer in vegetable and pulse crops for better production and to avoid stresses, if any.

Extent of acreage of various crops and varieties-wise information by districts and seasons of sample farms are given in appendix I, II and III. The popular rice varieties are Swarna followed by MTU 1010 and Mahamaya which accounted for 31.7, 18.7 and 5.5% area to total rice area in *kharif* season on sample farms, respectively. The area allocation in different crops and share of varieties is almost similar across the years on sample farms. However, the pattern of rice varieties in terms of their acreage has somehow deviated little bit in *rabi* season and MTU 1010 became most popular variety followed by MTU 1008 and Swarna which accounted 31.9, 4.6 and 3.6% to total rice area season on sample farms, respectively, due to suitability of rice growing environment. Grain quality and other purpose of rice cultivation seem major determinant of varietal diversification in *kharif and rabi* seasons on sample farm. The topographical situation of land located in surveyed area, soil type, hydrological condition of plots, stagger labor demand and different requirement of rice product are encouraging farmers for high degree of varietal diversification on sample farms.

Although, PFL project activity also targeted to conduct on-farm trials on important vegetables of state. But due to extreme flooding and unfavorable weather conditions prevailing across the year, they could not succeed in expanding much area under vegetables. However, due to effort of PFL project, only four farmers of district Durg and Rajnandgaon were convinced to grow tomato on their farms to judge the performance of crop for their profitability in the year 2014-15. The cooperator-farmers planted himsona, 5005 and T 405 hybrids of tomato on their farms.

Table 5: Cropping pattern on sample farms by season and district

Particulars	2012-13										2014-15									
	Bilaspur		Durg		Raipur		Rajnandgaon		Overall		Bilaspur		Durg		Raipur		Rajnandgaon		Overall	
	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%	A	%
Kharif season																				
Rice	90.2	94.5	26.8	83.2	90.6	97.9	66.8	77.1	274.3	89.5	90.2	94.5	28.0	86.9	91.7	99.1	73.2	84.5	283.0	92.3
Tomato	-	-	0.6	1.9	-	-	6.0	6.9	6.6	2.2	-	-	0.6	1.9	-	-	6.0	6.9	6.6	2.2
Spinach	-	-	2.4	7.5	0.4	0.4	7.6	8.8	10.4	3.4	-	-	-	-	-	-	-	-	-	-
Cowpea	-	-	0.1	0.3	-	-	-	-	0.1	-	-	-	0.1	0.3	-	-	-	-	0.1	-
Okra	0.2	0.2	0.6	1.9	-	-	0.2	0.2	1.0	0.3	0.2	0.2	0.6	1.9	-	-	0.2	0.2	1.0	0.3
Brinjal	0.2	0.2	-	-	-	-	-	-	0.2	0.1	0.2	0.2	-	0.0	-	-	-	-	0.2	0.1
Onion	-	-	1.0	3.1	-	-	-	-	1.0	0.3		0.0	1.0	3.1	-	-	-	-	1.0	0.3
French bean	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2	1.4	1.2	0.4
Soybean	-	-	-	-	-	-	3.2	3.7	3.2	1.0	-	-	-	-	-	-	3.2	3.7	3.2	1.0
Carrot	-	-	-	-	-	-	-	-	-	-	-	-	0.8	2.5	-	-	-	-	0.8	0.3
Broad bean	-	-	0.1	0.3	-	-	-	-	0.1	-	-	-	0.1	0.3	-	-	-	-	0.1	-
Banana	2.4	2.5	-	-	-	-	-	-	2.4	0.8	2.4	2.5	-	-	-	-	-	-	2.4	0.8
Fallow	2.4	2.5	0.6	1.9	1.5	1.6	2.8	3.2	7.3	2.4	2.4	2.5	1.0	3.1	0.8	0.9	2.8	3.2	7.0	2.3
Kharif Total	95.4	100	32.2	100	92.5	100	86.6	100	306.6	100	95.4	100	32.2	100	92.5	100	86.6	100	306.6	100
Rabi Season																				
Rice	61.6	64.6	5.0	15.5	84.0	90.8	4.7	5.4	155.2	50.6	61.2	64.1	5.0	15.5	82.3	89.0	4.7	5.4	153.1	49.9
Wheat	10.6	11.1	2.5	7.7	0.4	0.4	3.3	3.8	16.8	5.5	11.8	12.4	2.1	6.5	0.4	0.4	4.3	5.0	18.6	6.1
Tomato		-	0.9	2.8	-	-	9.2	10.6	10.1	3.3	-	-	0.9	2.8	-	-	11.2	12.9	12.1	3.9
Potato	2.2	2.3	-	-	-	-	-	-	2.2	0.7	1.4	1.5	-	-	-	-	-	-	1.4	0.5

Raddish	-	-	-	-	-	-	3.2	3.7	3.2	1.0	-	-	-	-	-	-	3.2	3.7	3.2	1.0
Gram	1.0	1.0	3.0	9.3	2.4	2.6	8.2	9.5	14.6	4.8	1.0	1.0	3.0	9.3	4.8	5.2	8.2	9.5	17.0	5.5
Cowpea	-	-	1.2	3.7	-	-	3.4	3.9	4.6	1.5	-	-	1.2	3.7	-	-	3.4	3.9	4.6	1.5
Brinjal	-	-	0.4	1.2	-	-	-	-	0.4	0.1	-	-	-	-	-	-	-	-	-	-
Soybean	-	-	-	-	-	-	0.4	0.5	0.4	0.1	-	-	-	-	-	-	0.4	0.5	0.4	0.1
Okra	-	-	-	-	-	-	4.0	4.6	4.0	1.3	-	-	-	-	-	-	2.0	2.3	2.0	0.7
Kukumber	0.4	0.4	-	-	-	-	-	-	0.4	0.1	0.4	0.4	-	-	-	-	-	-	0.4	0.1
Onion	-	-	-	-	-	-	-	-	-	-	-	-	0.4	1.2	-	-	-	-	0.4	0.1
Lathyrus	-	-	-	-	-	-	0.8	0.9	0.8	0.3	-	-	-	-	-	-	1.2	1.4	1.2	0.4
Banana	2.4	2.5	-	-	-	-	-	-	2.4	0.8	2.4	2.5	-	-	-	-	-	-	2.4	0.8
Pulse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6	0.7	0.6	0.2
Fallow	17.2	18.0	19.2	59.6	5.7	6.2	49.4	57.1	91.5	29.8	17.2	18.0	19.6	60.9	5.0	5.4	47.4	54.8	89.2	29.1
Rabi Total	95.4	100	32.2	100	92.5	10	86.6	100	306.6	100	95.4	100	32.2	100	92.5	100	86.6	100	306.6	100
Zaid Season																				
Tomato	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0.6	-	-	-	-	0.2	0.1
Okra	-	-	-	-	-	-	-	-	-	-	-	-	0.4	1.2	-	-	-	-	0.4	0.1
Lobia	-	-	0.4	1.2	-	-	-	-	0.4	0.1	-	-	-	-	-	-	-	-	-	-
Banana	2.4	2.5	-	-	-	-	-	-	2.4	0.8	2.4	2.5	-	-	-	-	-	-	2.4	0.8
Fallow	93.0	97.5	31.8	98.8	92.5	100	86.6	100	303.8	99.1	93.0	97.5	31.6	98.1	92.5	100	86.6	100	303.6	99.0
Zaid Total	95.4	100	32.2	100	92.5	100	86.6	100	306.6	100	95.4	100	32.2	100	92.5	100	86.6	100	306.6	100

Productivity of different crops grown by season, district and years

Table 6 represents the extent of allocation of different crops and its farm-level productivity in all four selected district in the year 2012-13. A total of 306 ha area is covered by the selected cooperator farmers under cultivation of different crops in which 95.4 ha in Bilaspur, 32.2 ha in Durg, 92.5 ha in Raipur and 86.6 ha in Rajnandgaon districts in both the study periods 2012-13 and 2014-15. In *kharif* season rice is major crop covering 89.5% (274.3ha) in 2012-13 and 92.3% (283 ha) followed by spinach (palak) covering about 3.4% (10 ha) area to total cropped area in the year 2012-13 and this crop disappeared in succeeding year from the cropping pattern. Besides these, a number of other crops under cultivation in *kharif* season such as tomato, cowpea, okra, soybean, banana, broad bean etc. In *rabi* season, again rice is a major crop covering about 50% area to total cropped area followed by wheat, pulses, oilseed and vegetables in both the years. However, in zaid season vegetables such as tomato, okra and banana are under cultivation but on very meager area. Due to problem of irrigation water and stray animals land left remained fallow in this season.

In *kharif* season rice is main crop as it occupies more than 92% area to total cropped area on sample farm. The average rice productivity is 48.9 qtls/ha in base year where as in assessment year the corresponding figure is 54.6 qtls/ha. Analysis revealed that the net gain in productivity of rice is 12% have been realized in assessment year. Similarly productivity of *rabi* rice have also been increased by about 6 qtls/ha (12%) shows that a substantial amount of increment added in the productivity that may be the outcome of judicious use of fertilizers (NPK) especially use of Potash. Another important crop is tomato which gives yield 148 qtls/ha in base year and it became 187qtls/ha in 2014-15 that shows a significant increment of 26% in yield (39qtls/ha). In addition to these crops many other vegetable and pulses crops are also included in cropping pattern *viz.*, brinjal, onion, cowpea, soybean, broad bean etc. and these crops are also showing enhanced productivity in assessment year over the base year. The productivity of all crops happened to increase in assessment year somehow due to balanced use of fertilizers and increased application of potash in crops.

Training and other means of extension approaches to educate farmers to strengthen their knowledge and skill for nutrient management imparted by the researchers of PFL project became instrumental in enhancing production and productivity of crops in surveyed area of Chhattisgarh. It is also important to note that no changes occurred in the cropping pattern which indicates that increase is more important rather shifting in area of crops.

Table 6: Season-wise acreage and productivity of different crops in the year 2012-13 and 2014-15

	2012-13										**2014-15**									
	Bilaspur		**Durg**		**Raipur**		**Rajnandgaon**		**Overall**		**Bilaspur**		**Durg**		**Raipur**		**Rajnandgaon**		**Overall**	
Crops	**Area**	**Pvty (qtls)**	**Area**	**Pvty (qtls)**	**Area**	**Pvty (qtls)**	**Area**	**Pvty (qtls)**	**Area**	**Pvty (qtls)**	**Area**	**Pvty (qtls)**	**Area**	**Pvty (qtls)**	**Area**	**Pvty (qtls)**	**Area**	**Pvty (qtls)**	**Area**	**Pvty (qtls)**
Kharif season																				
Rice	90.2	49.5	26.8	47.8	90.6	52.9	66.8	45.5	274.3	48.9	90.2	54.7	28.0	54.7	91.7	56.1	73.2	53.1	283.0	54.6
Tomato	-	-	0.6	366.7	0.4	45.0	6.0	33.3	7.0	148.3	-	-	0.6	333.3	-	-	6.0	41.7	6.6	187.5
Brinjal	0.2	50.0	-	-	-	-	-	-	0.2	50.0	0.2	60.0	-	-	-	-	-	-	0.2	60.0
Okra	0.2	60.0	0.6	92.5	-	-	0.2	50.0	1.0	67.5	0.2	70.0	0.6	112.5	-	-	0.2	55.0	1.0	79.2
Spinach	-	-	2.4	45.8	-	-	7.6	50.0	10.0	47.9	-	-	-	-	-	-	-	-	-	-
Cowpea	-	-	0.1	15.0	-	-	-	-	0.1	15.0	-	-	-	-	-	-	-	-	-	-
Onion	-	-	1.0	85.0	-	-	-	-	1.0	85.0	-	-	1.0	60.0	-	-	-	-	1.0	60.0
Broadbean	-	-	0.1	17.5	-	-	-	-	0.1	17.5	-	-	0.1	20.0	-	-	-	-	0.1	20.0
Soybean	-	-	-	-	-	-	3.2	9.4	3.2	9.4	-	-	-	-	-	-	3.2	10.9	3.2	10.9
Banana	2.4	41.7	-	-	-	-	-	-	2.4	41.7	2.4	45.0	-	-	-	-	-	-	2.4	45.0
Carrot	-	-	-	-	-	-	-	-	-	-	-	-	0.8	40.0	-	-	-	-	0.8	40.0
Frenchbean	-	-	-	-	-	-	-	-		-	-	-	-	-	-	1.2	32.5	1.2	8.1	-
Fallow	2.4	0.0	0.6	0.0	1.5	0.0	2.8	0.0	7.3	0.0	2.4	0.0	1.1	0.0	0.8	0.0	2.8	0.0	7.1	0.0
Kharif total	95.4	48.7	32.2	56.3	92.5	50.8	86.6	43.4	306.6	49.8	95.4	54.0	32.2	65.9	92.5	55.4	86.6	50.2	306.6	56.4

Rabi season																				
Rice	61.6	50.5	5.0	43.2	84.0	54.3	4.7	48.2	155.2	49.1	61.2	54.9	5.0	55.3	82.3	58.6	4.7	51.7	153.1	55.1
Wheat	10.6	16.8	2.5	18.0	0.4	17.5	3.3	20.2	16.8	18.1	11.8	26.5	2.1	18.1	0.4	20.0	4.3	11.8	18.6	19.1
Gram	1.0	6.7	3.0	7.6	2.4	11.9	8.2	11.1	14.6	9.3	1.0	18.3	3.0	25.7	4.8	22.5	8.2	21.4	17.0	22.0
Potato	2.2	99.4	-	-	-	-	-	-	2.2	99.4	1.4	116.7	-	-	-	-			1.4	116.7
Banana	2.4	0.0	-	-	-	-	-	-	2.4	0.0	2.4	0.0	-	-	-	-	-	-	2.4	0.0
Cucumber	0.4	50.0	-	-	-	-	-	-	0.4	50.0	0.4	37.5	-	-	-	-	-	-	0.4	37.5
Tomato	-	-	0.9	203.3	-	-	9.2	49.6	10.1	126.5	-	-	0.9	182.8	-	-	11.2	134.9	12.1	158.9
Okra	-	-	-	-	-	-	4.0	25.0	4.0	25.0	-	-	-	-	-	-	2.0	27.5	2.0	27.5
Radish	-	-	-	-	-	-	3.2	21.9	3.2	21.9	-	-	-	-	-	-	3.2	46.9	3.2	46.9
Soybean	-	-	-	-	-	-	0.4	5.0	0.4	5.0	-	-	-	-	-	-	0.4	5.0	0.4	5.0
Cowpea	-	-	1.2	20.8	-	-	3.4	24.1	4.6	22.5	-	-	1.2	25.0	-	-	3.4	23.1	4.6	24.1
Lathyrus	-	-	-	-	-	-	0.8	7.5	0.8	7.5	-	-	-	-	-	-	1.2	5.6	1.2	5.6
Onion	-	-	0.4	125.0	-	-	-	-	0.4	125.0	-	-	0.4	100.0	-	-	-	-	0.4	100.0
Pulse											-	-	-	-	-	-	0.6	16.7	0.6	16.7
Fallow	17.2	0.0	19.2	0.0	5.7	0.0	49.4	0.0	91.5	0.0	17.2	-	19.6	-	5.0	-	47.4	-	89.2	-
Rabi total	95.4	38.5	32.2	34.9	92.5	47.1	86.6	12.3	306.6	-	95.4	42.9	32.2	37.2	92.5	51.3	86.6	17.8	306.6	37.3
Zaid season																				
Banana	2.4	0.0	-	-	-	-	-	-	2.4	0.0	2.4	-	-	-	-	-	-	-	2.4	0.0
Okra											-	-	0.4	50.0	-	-	-	-	0.4	50.0
Tomato											-	-	0.2	150.0	-	-	-	-	0.2	150.0
Fallow	93.0	0.0	32.2	0.0		92.5	86.6	0.0	211.7	23.1	93.0	-	31.6	0.0	92.5	-	86.6	-	303.6	0.0
Zaid total	95.4	0.0	32.2	2.2	92.5	0.0	86.6	0.0	306.6	-	95.4	-	32.2	8.7	92.5	-	86.6	-	306.6	2.2

Input used in rice production (*kharif*)

Table 7 indicates the total material input used in kharif rice production in surveyed area during base and assessment years. Rice crop solely covered around 90.60, 26.80, 90.60, and 66.80 ha area in Bilaspur, Durg, Raipur and Rajnandgaon districts, respectively. The average seed rate ranges from 46.7 to 57.8kg/ha in all four districts. However, transplanting and direct seeding, both the rice establishment techniques are followed by the farmers in sampled area. Usually farmers used 90 kg/ha seed in direct seeding and 42kg/ha seed in transplanting methods.

Table 7: Input used in kharif rice (2012-13 and 2014-15)

District/particulars	Units	Bilaspur		Durg		Raipur		Rajnandgaon		Grand Total	
		2012-13	2014-15	2012-13	2014-15	2012-13	2014-15	2012-13	2014-15	2012-13	2014-15
No. of plots		30	30	18	18	29	29	29	29	106	106
Seed	kg	50.0	50.6	52.4	46.7	57.8	55.9	55.9	50.5	54.1	51.4
FYM	q/ha	14.6	10.2	26.9	22.5	0.0	0.0	30.3	23.0	17.0	13.0
Fertilizers											
N	Kg/ha	133.5	105.9	117.9	103.9	128.0	97.22	125.7	93.04	127.2	97.9
P	Kg/ha	83.7	70.6	77.3	63.11	84.9	63.4	82.6	68.6	82.66	66.8
K	Kg/ha	30.2	82.5	25.9	85.0	25.6	124.3	44.8	102.12	32.2	116.7
Zinc	Kg/hat	7.4	7.3	5.3	5.3	7.5	6.6	6.2	7.3	6.7	6.8
Herbicide	Lit/ha	1.4	1.3	1.2	0.5	1.1	1.0	1.1	1.2	1.2	1.1
Insecticides	Lit/ha	1.8	0.6	1.1	0.4	1.6	1.0	1.6	2.0	1.6	1.0

The recommended dose of NPK in Chhattisgarh is 120:60:60 in ratio of 2:1:1, total of 240 kg nutrients per hectare is required for rice crops. Half amount of nitrogen, full amount of phosphorous and potash are recommended to apply as basal dose and remaining amount of nitrogen applied in two split doses at different stages of rice crop growth.

However, in farmers' practice the fertilizer application in rice is somehow different and they applied the full dose of phosphorus and half dose of potash before transplanting as basal dose, i.e., after land preparation in rice. After one week of transplanting, first dose (half amount) of nitrogen is being applied in the crop as top dressing.

Fig 1: NPK use in Kharif rice

In the second dose remaining half amount of nitrogen and potash usually top dressed at panicle initiation stage in rice crop. The split doses of fertilizers application in rice crop is the common practice followed by the farmers which is beyond the recommendation but farmers are widely doing this practice. In Bilaspur district the N:P:K doses of fertilizers in 2013-14 was applied to be 133.5kg, 83.7 kg and 30.2 kg, respectively, which is in ratio of 4.4:2.7:1(247.4 kg) much deviating from standard ratio and indicating imbalanced use as fertilizers practiced by the farmers. Likewise in other three districts Durg, Raipur and Rajnandgaon, the ratio of N:P:K fertilizers were used in the ratio of 4.5:2.9:1 (221.1kg), 5.0:3.3:1(238.5kg), 2.8:1.8:1(378.8kg), which are also not up to the standard doses. The amount of nitrogenous fertilizers is found to be so increased in the surveyed area and potassium was utilized in very low amount. In assessment year, the amount of N:P:K being applied in all four districts were in the ratio of 1.28:0.85:1(259 kg), 1.2:0.74:1(252.0 kg), 0.78:0.51:1(284.9 kg) and 0.91:0.51:1(263.7kg), respectively, which shows a reduction in doses of nitrogen and phosphorus and steep rise in the doses of potash over base year and ratio are found near to the recommended dose. The use of total nutrients in the rice crop has increased 16% than the base year (fig 1). It is interesting to note from the analysis that use of potash increased significantly which is about 262% in assessment year over base year and the doses of nitrogen and phosphorus is being cut short significantly by 23% and 19%, respectively, over base year in assessment year 2014-15. Result revealed that the farmers are using higher doses of potash after they have gained knowledge about significance of potash in the crop but on the other side they are not using optimum doses of nitrogenous and phosphoric fertilizers in the surveyed area. These imbalanced uses of fertilizers also need to be taken care by farmers for long-term soil health management. The other nutrient such as zinc is also being used by farmers but in small doses. Plant protection measures to control insects and diseases were also been used by the farmers in both the study periods in surveyed area. (Table-7).

The activity-wise labor used in kharif rice production in surveyed area of state is given in table 8. The total labor days used in rice cultivation in the Bilaspur distric is 47 /ha and 49/ha in base and assessment years, respectively. However, the corresponding figures for Durg were 45 and 43, Raipur 41 and 41 and in Rajnandgaon 67 and 71/ ha in the referred period, respectively. It has been found that there is a slight increase in labor use in Bilaspur and Rajnandgaon districts in assessment year over base year.

Table 8: Labor use in *khari*f rice (2012-13 and 2014-15) (per ha)

	Bilaspur		Durg		Raipur		Rajnandgaon		Overall	
Particulars	**2012-13**	**2014-15**	**2012-13**	**2014-15**	**2012-13**	**2014-15**	**2 2012-13**	**2014-15**	**2012-13**	**2014-15**
Land preparation										
Family labor	2	2	1	1	2	2	2	2	2	2
FYM applications										
Family labor	0	0	0	0	1	1	2	2	1	1
Hired labor	1	1	0	0	0	0	1	1	1	1
Transplanting										
Family labor	2	2	1	1	2	2	2	2	2	2
Hired labor	18	20	18	16	16	16	15	20	17	18
Fertilizer application										
Family labor	1	1	1	1	2	2	2	2	1	1
Weeding										
Family labor	2	2	1	1	2	2	5	5	3	3
Hired labor	11	11	8	8	8	8	9	9	9	9
Herbicide application										
Family labor	1	1	1	1	0	0	1	1	1	1
Hired labor	0	0	0	0	0	0	0	0	0	0
Pesticide application										
Family labor	1	1	0	0	1	1	1	1	1	1
Hired labor	0	0	0	0	0	0	0	0	0	0
Irrigation										
Family labor	1	1	1	1	1	1	1	1	1	1
Harvesting										
Family labor	1	1	0	0	1	1	2	2	1	1
Hired labor	6	6	11	11	4	4	17	17	9	9
Threshing										
Family labor	1	1	0	0	0	0	2	2	1	1
Hired labor	0	0	1	1	0	0	5	5	1	1
Transportation & storage										
Family labor	0	0	0	0	0	0	0	0	0	0
Total	47	49	45	43	41	41	67	71	50	52

Transplanting, weeding and harvesting happened to be most labor intensive operations amongst all and it required 17- 18 labor/ha on overall basis which accounts for 34% in former operation and 17% for weeding and harvesting to total labor use. In Rajnandgaon the total number of labor is used to be highest amongst all districts as farmers of that particular area is using in harvesting and threshing (Table 8).

Costs and return analysis of rice production *(kharif)*

Table 9 represent analysis of costs and return of kharif rice production in Bilaspur, Durg, Raipur and Rajnandgaon districts of Chhattisgarh state where PFL project activities are continued from 2013.The average cost of cultivation of kharif rice crop of surveyed area in both the periods: base and assessment years were Rs.19985 and Rs.22602, respectively.

The material cost involved in rice cultivation such as costs of seed, fertilizer and plant protection chemicals. In materials cost, cost of seed is relatively high as the farmers use high quality seed owing to their better quality and resistance to many stresses conditions of crop (fig 2).

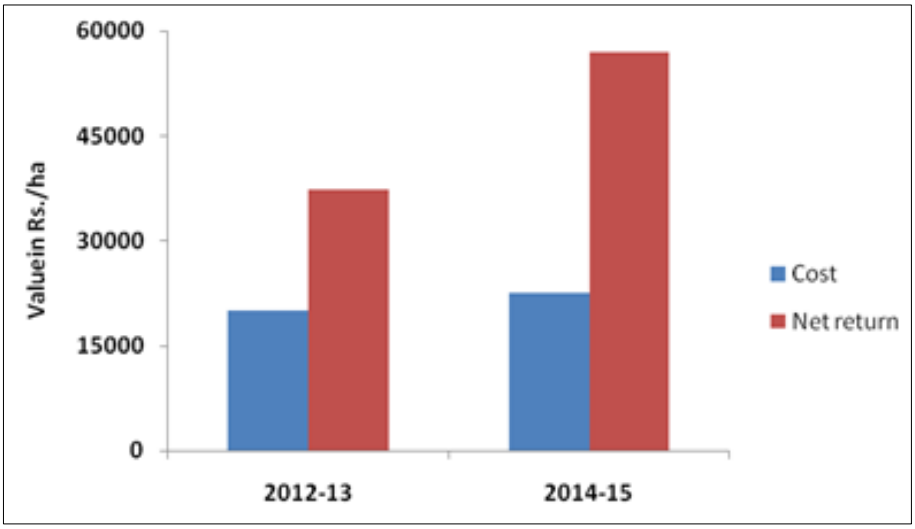

Fig 2: Cost and return in Kharif rice

In labor cost transplanting and harvesting happen to be most cost intensive as it covers 12 and 6% of total cost. In power operations mainly tractor is being used for land preparations that make proportion of 10-11% out of total cost of cultivation the both study periods. It is to be mentioned that the cost of cultivation is relatively high in Rajnandgaon district as compared to other selected district due to higher wage rate in particular district. The cost of cultivation is relatively increased in assessment year by 13% owing to increment in material cost and labor cost according to price hikes in the market. However, fewer fluctuations have been recorded in cost involved in power operations across the years. The net income is found to have been increased in assessment year as owing to better quality of their produce the cooperator farmers have been able to fetch attractive price in market as well as increased in the production. On an average, about 53% net return hike have been gained by cooperator farmers in assessment year over base year due to balance use of inorganic fertilizer especially potash (Table-9).

Table 9: Cost and returns of *kharif* rice production on sample farms by districts

Districts/Particulars	Bilaspur		Durg		Raipur		Rajnandgaon		Overall			
	2012-13	2014-15	2012-13	2014-15	2012-13	2014-15	2012-13	2014-15	2012-13	%	2014-15	%
Material cost												
Seed	657	754	1730	1701	899	794	1512	1348	1140	6	1088	5
FYM	447	358	807	787	0	0	909	806	512	3	455	2
Urea	1314	1106	1144	978	1237	1023	1218	935	1238	6	1015	4
DAP	4347	3837	4034	3430	4415	3448	4295	3731	4298	22	3632	16
MOP	687	2132	606	2199	597	1883	1044	2517	746	4	2181	10
Zink	191	210	108	131	282	284	156	226	192	1	221	1
Sub total	7644	8397	8430	9227	7430	7433	9133	9562	8126	41	8593	38
Plant protection cost												
Herbicide	593	571	443	193	450	417	470	566	495	2	464	2
Insecticide	1465	460	912	349	1456	886	902	1367	1214	6	806	4
Sub total	2057	1031	1355	543	1907	1303	1372	1933	1709	9	1269	6
Labour cost												
Land preparation	90	103	118	157	72	80	71	80	85	0	100	0
FYM application	97	130	43	57	58	78	109	145	80	0	107	0
Transplanting	2167	2940	1987	2306	1892	2410	1728	2648	1941	10	2608	12
Fertilizer application	46	67	7	9	11	15	6	9	19	0	27	0
Weeding	1274	1593	946	1182	969	1211	1121	1402	1093	5	1366	6
Herbicide application	13	20	22	33	16	21	10	14	14	0	21	0
Irrigation	6	6	0	0	0	0	0	0	2	0	2	0
Pesticide application	56	75	0	0	52	69	39	52	41	0	54	0
Harvesting	707	884	1300	1625	481	601	1855	2319	1060	5	1325	6
Threshing	0	0	83	111	26	34	708	944	215	1	287	1
Sub Total	4457	5817	4506	5482	3577	4520	5649	7614	4551	23	5897	26
Cost involved in power operations												
Tractor owned	303	347	0	0	236	264	216	243	209	1	237	1
Tractor hired	1873	2278	2685	3371	2238	2686	1826	2341	2098	10	2592	11
Irrigation tube well	0	0	0	0	0	0	86	86	24	0	24	0

Irrigation tube well	220	248	90	117	15	61	212	259	140	1	177	1
owned diesel engines	60	60	14	14	74	83	32	32	48	0	51	0
Harvesting combine	1969	2500	1731	2164	2153	2719	1237	1513	1779	9	2233	10
Harvesting tractor	539	610	1139	1050	450	502	1486	1761	875	4	970	4
Threshing tractor	296	354	479	628	263	403	690	884	426	2	559	2
Sub total	5260	6397	6139	7344	5429	6717	5783	7119	5599	28	6843	30
Total cost	19418	21642	20430	22596	18343	19973	21937	26228	19985	100	22602	100
Gross Income (Per ha)												
Main product	52370	72554	48103	74054	56540	74737	51406	70477	52105	-	72956	-
By product	4541	6393	6528	6661	4685	6777	4629	6589	5096	-	6605	-
Gross return	56911	78847	54631	80716	61225	81113	56035	77066	57201	-	79436	-
Net return	37457	57376	34653	58508	42894	61185	33977	51162	37253	-	57049	-
B:C Ratio	1.9	2.6	1.7	2.6	2.3	3.0	1.5	2.0	1.9	-	2.5	-

Input used in rice production *(rabi)*

Table 10 shows the various quantity of material input used in rabi rice production in surveyed area during base and assessment years.

Table 10: Input used in rabi rice (2012-13 & 2014-15)

Districts/Particulars	Units	Bilaspur		Durg		Raipur		Rajnandgaon		Overall	
		2012-13	2014-15	2012-13	2014-15	2012-13	2014-15	2012-13	2014-15	2012-13	2014-15
No. of plots		30	30	18	18	29	29	29	29	106	106
Seed	kg	82.2	75.6	30.0	27.5	53.2	54.1	24.4	25.4	49.6	47.8
FYM	qtl	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N	Kg	146.8	89.3	54.7	28.7	126.2	92.1	25.9	15.1	84.8	59.5
P	Kg	78.0	63.9	37.8	21.5	83.3	65.0	17.3	10.0	56.0	42.3
K	kg	27.8	58.8	9.3	26.5	21.8	64.4	5.0	10.6	16.8	45.4
Zink	Kg	4.9	4.9	1.0	1.0	6.6	6.6	1.6	1.6	3.8	3.8
Herbicide	lit/ha	1.4	1.4	0.8	0.6	1.9	1.9	0.3	0.3	1.1	1.1
Insecticide	lit/ha	1.7	0.9	0.6	0.0	2.0	0.5	0.2	0.0	1.2	0.4

In Chhattisgarh state rice is a major crop in rabi season too. The farmers of all selected four districts *viz*., Bilaspur, Durg, Raipur and Rajnandgaon are growing rice in rabi season also. Rabi season rice is considered to be good option for round the year availability of rice grain. The rabi rice is measured to be less input intensive as soil is considered to be rich in nutrients by application of judicious amount of nutrients in preceding season and considered to be less labor intensive due to less labor required for weeding operations. Usually farmers mostly sell their produce of rabi rice in the market. They used to consume kharif rice due to their culinary preferences and taste. The average seed rate of rice ranges between 48- 50 kg/ha on in both the study periods.

Fig 3: NPK use in rabi rice

In Bilaspur district the N:P:K doses were found in the ratio of 5.3:2.8:1 (252.6 kg) in base year and 1.5:1.1:1 (212.2 kg) in assessment year. Like-wise in other districts of surveyed area the corresponding figures were found to be 5.9:4.1:1 (101.8kg/ha) and 1.1:0.8:1(76.7kg/ha) in Durg, 5.8:3.8:1 (213.3kg/ha) and 1.4:0.94:1 (35.5kg/ha) in Raipur and in Rajnandgaon they have been found in the ratios of 5.2:5.8:1(48.5kg/ha) and 1.4:0.94:1 (35.5kg/ha), respectively. In assessment year the doses of nitrogen nutrient have been found to be decrease by 30% on overall basis and there is also decrease in phosphoric nutrients have been noticed by 24.46% (fig 3). However, the amount of potash fertilizer has been increased by 170.2% in assessment year over the base year. Although ratio of N:P:K are not judicious and balanced in both the study periods but there is steep rise in doses of potassic fertilizers have been found in succeeding year. It may be impact of rigorous social and technical awareness created through PFL project to withstand the benefits of potash fertilizers application in the soil. Application of zink is also followed by the farmers to prevent the effect of khaira disease in sample area. Plant protection chemicals are also being utilized by cooperator farmers to maintain crop health and reduced yield losses from various kind of insect and diseases infestation.

Table 11 represent the operation-wise labor use in rabi rice production in base and assessment years in all four selected districts of the Chhattisgarh state where PFL project activity is being continued since 2013. Rice is considered to be labor

intensive crop owing to its cultivation methodology and it required more number of labors for transplanting and weeding which are done manually and timely to maintain health and vigor. Labors are required through entire cropping season in all operations as land preparation, nursery establishment, transplanting, fertilizer application, harvesting, threshing etc. Analysis revealed that the total requirement of labor in rabi rice in Bilaspur district is 47 and 46/ha base and assessment years respectively, In Durg district 71 labors were utilized in base year and 67/ha labors in the assessment year. Like-wise in district Raipur, 41 and 40/ha labors were needed in rice cultivation. The corresponding figures for Rajnandgaon district it is found to be 56 and 49 labors/ha, respectively.

Total cost of cultivation comprised of different costs involved as material and labor costs which included costs of seed, fertilizers, plant protection, labor, machinery etc. In these costs, the share of material cost is about 35% in both the years (base and assessment) on overall basis in Chhattisgarh state. Cost involved in power operations shows second highest share of 27% and 31% in both study periods, respectively. Labor cost also found to be 25% and 28% in both, base year and assessment year accordingly.

Table 11: Labor used in *rabi* rice (2012-13 & 2014-15)

Districts/ Particulars	Bilaspur		Durg		Raipur		Rajnandgaon		Overall	
	2012-13	2014-15	2012-13	2014-15	2012-13	2014-15	2012-13	2014-15	2012-13	2014-15
Land preparation										
Family labor	2	2	2	2	2	2	3	3	2	2
Hired labor	1	1	2	2	0	0	1	1	1	1
FYM application										
Family labor	0	0	0	0	1	0	0	0	0	0
Hired labor	0	0	1	0	0	0	0	0	0	0
Transplanting										
Family labor	3	3	1	1	2	2	1	1	2	1
Hired labor	20	18	24	20	15	16	21	20	20	18
Fertilizer application										
Family labor	1	1	2	2	2	2	2	1	2	2
Hired labor	0	0	0	1	0	0	0	0	0	0
Weeding										
Family labor	3	3	6	6	2	2	3	2	4	3
Hired labor	10	10	15	15	9	8	9	6	11	10
Herbicide application										
Family labor	1	1	1	1	1	1	0	0	0	0
Hired labor	0	0	0	0	0	0	0	0	0	0
Irrigation										
Family labor	1	1	1	1	1	1	2	1	1	1
Hired labor	0	0	0	0	0	0	0	0	0	0
Pesticides application										
Family labor	1	1	1	1	1	1	1	1	1	1
Hired labor	0	0	0	0	0	0	1	1	0	0
Harvesting										
Family labor	2	2	1	1	1	2	1	1	1	1
Hired labor	4	4	15	15	4	4	8	8	8	8
Threshing										
Family labor	0	0	0	0	0	0	1	1	1	1
Hired labor	0	0	0	0	0	0	2	2	1	1
Harvesting										
Harvesting & threshing	0	0	0	0	0	0	0	0	0	0
Total	47	46	71	67	41	40	56	49	54	51

Table 12: Costs and return analysis of *rabi* rice cultivation on sample farms (Rs./ha)

Districts/Particulars	Bilaspur		Durg		Raipur		Rajnandgaon		Overall			
Years	2012-13	2014-15	2012-13	2014-15	2012-13	2014-15	2012-13	2014-15	2012-13	%	2014-15	%
Material cost												
Seed	593	697	595	617	638	726	539	604	614	3	700	3
Fertilizers												
Urea	1184	938	1275	785	1221	942	1148	904	1209	6	925	5
DAP	4166	3578	4700	2625	4329	3536	4070	3030	4293	22	3442	17
MOP	723	1653	496	1417	509	1826	309	2049	570	3	1743	9
Zink	207	207	75	83	250	252	304	334	223	1	226	1
Sub total	6873	7073	7140	5526	6947	7282	6370	6922	6908	35	7035	35
Plant protection cost												
Herbicide	649	649	825	694	802	802	0	0	709	4	697	3
Insecticide	1577	866	1300	0	1814	470	612	0	1624	8	537	3
Sub total	2226	1514	2125	694	2616	1272	612	0	2332	12	1234	6
Cost involved in machinery												
Tractor owned (diesel)	353	353	0	0	216	220	524	612	260	1	267	1

Tractor hired	1617	2038	2350	2633	2255	2624	1194	1444	1990	10	2363	12
Tube well (diesel)	137	137	325	225	18	17	0	0	85	0	76	0
Canal irrigation	107	107	0	0	147	169	56	22	115	1	125	1
Combine harvesting	2111	2622	1533	1917	2181	2820	1453	1816	2061	11	2618	13
Harvesting (reaper)	145	145	1375	1500	460	601	917	1250	459	2	561	3
Threshing	105	105	975	800	289	328	1167	1333	335	2	348	2
Sub total	4575	5507	6558	7075	5566	6779	5310	6478	5305	27	6358	31
Labour cost												
Land preparation	73	80	225	450	54	75	83	111	109	1	179	1
FYM	0	0	100	0	56	0	0	0	39	0	0	0
Transplanting	2341	2739	2850	2963	1787	2422	2572	2770	2388	12	2723	13
Fertilizer application	30	40	38	100	10	13	0	0	19	0	38	0
Weeding	1194	1493	1853	2300	1034	1170	1202	971	1321	7	1483	7
Herbicide application	8	11	24	40	16	21	0	0	12	0	18	0
Irrigation	0	0	0	0	0	0	0	0	0	0	0	0
Pesticides application	63	84	0	0	53	71	0	0	29	0	39	0
Harvesting	382	478	1800	2250	481	601	1000	1250	916	5	1145	6
Threshing	0	0	0	0	26	34	333	444	90	0	120	1
Sub total	4092	4924	6890	8103	3516	4407	5191	5546	4922	25	5745	28
Total cost	17766	19018	22713	21398	18645	19740	17483	18946	19467	100	20372	100
Main product	53486	69453	52617	65120	55849	70787	49607	62879	52890	-	67060	-
By-product	4980	6901	5487	6617	7329	7329	4732	6368	5632	-	6804	-
Gross return	58466	76354	58104	71737	63178	78116	54339	69247	58522	-	73864	-
Net return	40700	57336	35391	50339	44533	58376	36856	50301	39055	-	53492	-
B:C Ratio	2.3	3.0	1.6	2.4	2.4	3.0	2.1	2.7	2.0	-	2.6	-

Total cost of cultivation found to be Rs. 19467.00 and Rs. 20372.00/ha in base and assessment year, respectively. In assessment year the cost of cultivation is likely to be increased by 4.64% than the base year. The net return in base year and in assessment year are found to be Rs. 39055.00/ha and Rs. 53492.00/ha, respectively, which shows an increment of 37% in assessment year than the base year (fig 4). This profit may be outcome of judicious allocation of inorganic fertilizer and other associated crop production technology in surveyed area.

Fig 4: Cost and return in rabi rice

Input used in tomato cultivation:

The recommended dose of N:P:K nutrients for tomato cultivation are N 150 kg, P 100 kg, K 50 kg (300 kg). This shows the ratio of N;P;K is 3:2:1. The half dose of nitrogen (75 kg), full phosphorus(100 kg) and full potash (50kg) should be applied as basal dose and 75 kg N/ha on 30th days after planting and at the time of earthling up and intercultural operation. In sampled area tomato is considered to be an important vegetable crop and is grown by cooperators in Durg and Rajnandgaon districts (Table 14).

Table 13: Input used in tomato crop (2012-13 and 2014-15)

Districts/Particulars	Units	Durg		Rajnandgaon		Overall	
		2012-13	2014-15	2012-13	2014-15	2012-13	2014-15
No. of plots		2	2	2	2	4	4
Seed	gms/ha	229.2	229.2	250.0	250.0	239.6	239.6
FYM	qtls/ha	6.3	7.5	7.5	6.7	6.9	7.1
N	kg/ha	152.5	89.5	126.7	102.5	139.6	96.0
P	kg/ha	95.8	67.1	59.4	48.9	77.64	57.96
K	kg/ha	37.9	77.52	30.0	67.5	30.0	72.5
Herbicides	lit/ha	1.8	1.0	2.1	1.3	2.0	1.2
Insecticide	lit/ha	2.9	1.7	2.5	1.1	2.7	1.4

The seed rate of tomato is 229 g/ha in Durg and 250 g/ha in Rajnandgaon across the years for nursery establishment followed by planting. In Durg district the NPK doses used in base year were 152.5 kg, 95.8 kg and 37.9 kg, respectively, which shows the ratio of 4:2.5:1 (286.2) and in Rajnandgaon the corresponding figures was, 126.7 kg, 59.4 kg and 30 kg, in ratio of 4.22:1.98:1 (216 kg). These both set of figures indicated that the doses of nitrogenous fertilizers were higher than the recommended doses and quantity of potash being used is relatively lower. In assessment year the ratio of N:P:K nutrients in Durg and Rajnandgaon districts were found to be 1.33:0.86:1(234.12) and 1.51:0.72:1 (218.9 kg) indicating great reduction in doses of nitrogenous and phosphoric nutrients and shows an increment in potassic fertilizers.

Table 14: Labor used in tomato cultivation

Districts/Particulars	Durg		Rajnandgaon		Overall	
	2012-13	2014-15	2012-13	2014-15	2012-13	2014-15
Land preparation						
Family	10	10	5	5	8	8
Hired	0	0	3	3	1	1
FYM application						
Family	5	5	3	3	4	4
Planting of seedlings						
Family	9	9	6	6	8	8
Hired	0	0	6	6	3	3
Fertilizer application						
Family	4	4	3	3	4	4
Hired	0	0	1	1	0	0
Intercultural operations						
Family	8	8	10	10	9	9
Hired	0	0	5	5	3	3
Herbicide application						
Family	3	3	1	1	2	2
Irrigation						
Family	6	6	4	3	5	5
Hired	0	0	1	2	1	1
Pesticide application						
Family	3	3	1	1	2	2
Hired	0	0	0	0	0	0
Harvesting						
Family	14	14	13	13	14	14
Hired	0	6	10	11	5	8
Grading & packaging						
Family	6	6	8	8	7	7
Hired	0	0	5	5	2	2
Transportation & loading						
Family	4	4	8	8	6	6
Total	73	78	94	94	83	86

Tomato crop is also one of labor intensive crop as it requires tender handling and care. Mainly family labor is involved in all cultural operations of crop including land preparation, FYM application, plant protection & chemicals application, grading and packaging etc. However, hired labor is also needed in planting of seedlings and picking of tomato. Picking of tomato (harvesting) is considered to be most labor intensive operation amongst all cultural operation and its share is about 25% of total labor use. Picking, collection and packaging are totally done manually due to softness of product which requires extra care during these operations. The total number of labors requirement are 73 and 78/ha in Durg district in base and assessment years, respectively. Where in Rajnandgaon district the total requirement of labor is 94 across the study period.

Costs and return analysis of tomato cultivation on sample farms

Table 15 represents the costs and return analysis of tomato cultivation in Durg and Rajnandgaon district of state. Cooperator farmers considered that tomato is the important vegetable crops which provide better income and employment to the family members in the selected areas. The seed cost is found to be as high as farmers are using best quality high yielding varieties seeds (hybrid) in their fields. Seed cost alone comprise 35% cost to total cost involved in tomato cultivation. Cost in power operations is also high for land preparation which needs to be done more efficiently as tomato crop requires well pulverized seedbed to grow nursery and main crop as well. Labor cost is also higher in this crop because it is a labor intensive crop. The tomato crop is considered to give higher returns as analysis revealed that Rs.106646 and Rs. 145846/ha net return were realized in base and assessment year, respectively. The cooperator farmers are able to fetch good prices for their crops by using balanced fertilization in successive year. (Table-15)

Table 15: Costs & return of tomato cultivation on sample farms (Rs./ha)

Districts/ Particulars	Durg		Rajnandgaon		Overall			
	2012-13	2014-15	2012-13	2014-15	2012-13	%	2014-15	%
No. of plots	2	2	2	2	4	-	4	-
Material Cost								
Seed	8021	9167	8750	10000	8385	30	9583	35
Fertilizers								
FYM	44	60	53	53	48	0	57	0
Urea	1500	963	1350	1269	1425	5	1116	4
DAP	5000	3646	3100	2656	4050	15	3151	11
NPK	750	0	0	0	375	1	0	0
MOP	887	2196	700	1913	793	3	2054	7
Sub total	14565	13835	13253	13978	13909	51	13907	51
Plant protection cost								
Herbicide	854	490	1010	615	932	3	552	2
Insecticide	3625	2229	3625	1694	3625	13	1961	7
Sub total	4479	2719	4635	2308	4557	16	2514	9
Cost involved in Power operations								
Land preparation (tractor)	2000	2500	0	0	1000	4	1250	5
Land preparation (bullock)	3000	3188	7240	7650	5120	18	5419	20
Tube well	521	521	568	568	544	2	544	2
Sub total	5521	6208	7808	8218	6664	24	7213	26
Labor cost								
Land preparation	0	0	438	583	219	1	292	1
Establishment of nursery & planting	0	0	969	1292	484	2	646	2
Fertilizer application	0	0	125	167	63	0	83	0
Weeding	0	0	813	1083	406	1	542	2
Herbicide application	0	0	0	0	0	0	0	0
Irrigation	0	0	188	333	94	0	167	1
Harvesting & picking	0	1167	1563	2167	781	3	1667	6
Grading and packaging	0	0	688	917	344	1	458	2
Sub total	0	1167	4781	6542	2391	9	3854	14
Total Cost	24565	23929	30477	31046	27521	100	27487	100
Yield	175	215	188	217	181.5	-	216	-
Gross Return	123333	162917	145000	183750	134166.5	-	173333.5	-
Net Return	98768	138988	114523	152704	106646	-	145846	-
B:C Ratio	4.0	5.8	3.7	4.9	3.8	-	5.4	-

Perception of farmers' on effect of potash application on crop growth and productivity

The impact of potassic fertilizers have also been studied over crop tolerance to various stresses such as adverse weather conditions, water stress, severity of diseases and effect of natural enemies. In personal interviews from cooperator farmers it has been discovered that in Bilaspur district 93% farmers perceived that there is no impact of frost in crops after using potash. However, from above statement 94%, 97% and 90% cooperator farmers are remained agreed in Durg, Raipur and Rajnandgaon districts, respectively. Regarding water stress their views are same of having no water stress impact on their crops. Crop can also withstand well after water logging conditions for 2-3 weeks.

Severity of diseases and incidences of insects is also noticed less than previous year in assessment year in rice crop (Table-16). The major diseases of rice in the surveyed area are blast and bacterial leaf blight (BLB) in *kharif* season. The incidence of these diseases usually occurs in *kharif* season due to unbalanced use of fertilizers/ or use of excessive nitrogenous fertilizer in rice crop (high humidity and temp.). The problem of diseases incidence can be reduced/controlled by the use of potash in *kharif* rice as reported by the farmers. Tomato crop is also less affected from frost and adverse weather conditions in winter season when potassic fertilizer is used in the early stage of crop growth. Similarly incidence of insect and diseases also declined after application of potassic fertilizer with other inorganic nutrients (urea and phosphorus).

Evaluation of extension strategies to popularize potassic fertilizer

Many communication tools as well as extension strategies are being used by PFL project activity to creating awareness among the farmers for use of potash in crop production. Popularization of balance used of fertilizers and their benefits to enhance productivity, production and profitability of crops is a targeted agenda of PFL project in surveyed area. Analysis revealed that many benefits have been realized by the cooperator farmers by use of balanced fertilizer in crop cultivation.

Demonstration plots located in on-farm conditions are considered to be highly effecting in creating desired awareness amongst farmers on overall basis in all selected districts. In this method some plots being selected by scientists and balanced doses of fertilizers is being applied in the demonstration plots so that the impact of fertilization is clearly visible to other farmers of locality in quality and quantity parameters (fig 5).

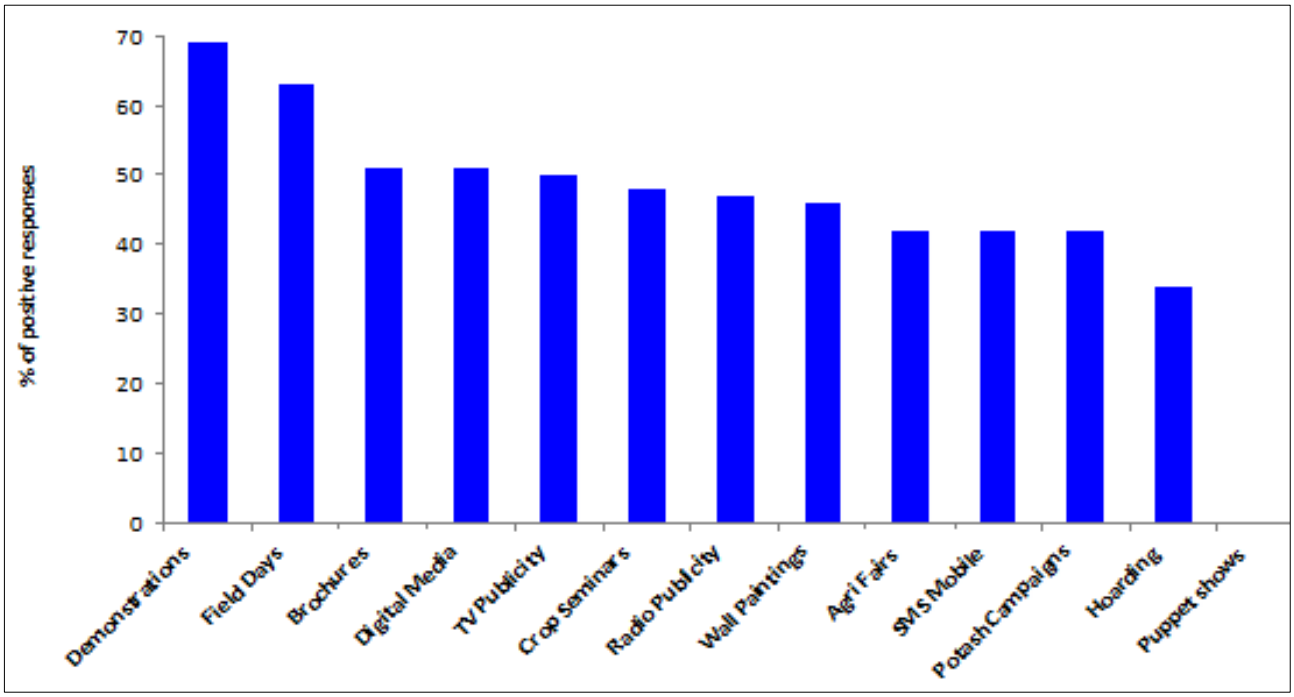

Fig 5: Extension strategies

The extension strategies such as demonstration on farmers' field, field days, brochures, digital media etc. seem most effective in creating awareness among cooperator farmers for use of potash in crop production. All the extension and communication strategies followed under PFL project activity are useful, efficient and effective in skill development; strengthen knowledge and understanding of farmers' for nutrient management in various crops in target area.

Table 16: Perception of farmers' on effect of potash application in crop growth and production

Districts/Particulars	Bilaspur					Durg					Raipur					Rajnandgaon				
	Y	N	%	D	%	Y	N	%	D	%	Y	N	%	D	%	Yes	No	%	D	%
Effect of frost	0	28	93	2	7	0	17	94	1	6	0	28	97	1	3	0	26	90	3	10
Water stress	0	28	93	2	7	0	18	100	0	0	0	27	93	2	7	0	27	93	2	7
Water logging	0	29	97	1	3	0	16	89	2	11	0	28	97	1	3	0	29	100	0	0
Severity of diseases	0	29	97	1	3	0	18	100	0	0	0	28	97	1	3	0	26	90	3	10
Incidence of insects	0	28	93	2	7	0	18	100	0	0	0	28	97	1	3	0	28	97	1	3
Other if any	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Farmers	30	30	100	30	100	18	18	100	18	100	29	29	100	29	100	29	29	100	29	100

Besides it, the other useful strategies are TV publicity, crop seminars, radio publicity, wall painting, agri. fairs, potash campaigns and hoarding are also found effective in strengthening the knowledge of farmers for use of potash with other inorganic fertilizers (Table-17). It is obvious from the above analysis that the extension strategies followed by the PFL project activity are quite effective and instrumental in creating awareness among the farmers for balanced use of inorganic fertilizer especially potash in the crop production practices.

Table 17: Responses of different extension strategies and communication techniques

Districts/ particulars	Bilaspur				Durg				Raipur				Rajnandgaon				Overall				Rank
	Y	%	N	%	Y	%	N	%	Y	%	N	%	Y	%	N	%	Y	%	N	%	
Demonstration plots	20	67	10	33	13	72	5	28	19	66	10	34	21	72	8	28	73	69	33	31	I
Field Days	22	73	8	27	10	56	8	44	19	66	10	34	16	55	13	45	67	63	39	37	II
Printed Publicity Material- Brochures	17	57	13	43	9	50	9	50	13	45	16	55	15	52	14	48	54	51	52	49	III
Digital Media-www.potash4life.com	14	47	16	53	8	44	10	56	16	55	13	45	16	55	13	45	54	51	52	49	III
TV Publicity	19	63	11	37	7	39	11	61	16	55	13	45	11	38	18	62	53	50	53	50	IV
Crop Seminars & Farmers Meeting	16	53	14	47	6	33	12	67	14	48	15	52	15	52	14	48	51	48	55	52	V
Radio Publicity	17	57	13	43	9	50	9	50	11	38	18	62	13	45	16	55	50	47	56	53	VI
Wall Paintings	13	43	17	57	9	50	9	50	15	52	14	48	12	41	17	59	49	46	57	54	VII
Agri Fairs	13	43	17	57	6	33	12	67	14	48	15	52	12	41	17	59	45	42	61	58	VIII
SMS Mobile voice	16	53	14	47	10	56	8	44	15	52	14	48	4	14	15	52	45	42	51	48	VIII
Potash Campaigns	14	47	16	53	6	33	12	67	12	41	17	59	12	41	17	59	44	42	62	58	IX
Hoarding	10	33	20	67	5	28	11	61	9	31	20	69	12	41	17	59	36	34	68	64	X
Puppet Shows	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	XI
Total Farmers	30	30	30	30	18	18	18	18	29	29	29	29	29	29	29	29	106	106	106	106	-

Synthesis of survey results

Attempt is made to correlate different indicators which are invariably related to impact assessment of project activity on crop production practices in selected district of Chhattisgarh state. These variables are widely used in tabular analysis and indicate improvement in the yield, production, cost and returns (Table 18), if any. Table depicts that the average yield of rice grown in both season, increased 6qtls/ha (12%) in assessment year over the base year. The production of rice also increases 15% and 10% in kharif and rabi season in referred period, respectively. The total quantity of NPK used also increased 16% in assessment year than the base year while it was decreased by 7% in rabi season after maintaining nutrient based ratio. Similarly, expenses incurred on NPK use (9% and 1%) and total cost of cultivation (14% and 5%) too increased in kharif and rabi season rice in surveyed area. Analysis indicate that the balanced use of fertilizer (changed ratio of NPK by reducing quantity of N and P and increase quantity of K) in assessment year is quite attractive and encouraging to the farmers in increasing net return of crops accounted 53% (Rs.19796/ha) and 37% (Rs.14437/ha) in *kharif* and *rabi* rice, respectively in assessment year than the base year.

Table 18 shows that project beneficiaries are enjoying a lot of benefits in terms of profit to a great extent after compensating increased cost of rice cultivation in both the seasons. Table 18 also indicates that an increased in total returns of Rs.5602268/- and Rs.2210304/- realized on sample farms in *kharif* and *rabi* season, respectively in surveyed area in assessment years than the base year. Farmers cooperating in project activity are happy to have huge amount of net return which increases 59% (Rs.56261) and 35% (Rs.20078) on per farm basis in kharif and rabi rice, respectively in assessment year than the base year.

Moreover, similar results have also been reported in case of tomato cultivation in which net return is increased Rs. 474332/- in surveyed area as a whole, as well as Rs. 118583/- per farm. However, due to limited number of growers available in surveyed area, the sample size is too small (only four observation) and result couldn't be generalized. But this result may be an indicative to the application of potash in vegetable crops are beneficial for the growers as it enhances weight and shining of product, protect from biotic and abiotic stresses etc. The developed nutrient management technology under PFL project can be followed on larger scale (by increasing number of farmers as well as area under cultivation), so that huge amount of benefit can be realized by the farming community in surveyed area. The derived benefit may be used to strengthen the economic activity on household-level in the target area.

Developed technology of nutrient management under PFL project seems to be effective on various parameters of impact assessment and judging on farmers' field through its adoption since 2013 continuously. The cost-benefit ratio which is good indicator of profitability of crops is usually higher in assessment year than the base year.

Table 18: Comparison of different impact indicators of sample farms.

Particulars	*Kharif* rice				*Rabi* rice				Tomato			
	2012-13	2014-15	Δ	%Δ	2012-13	2014-15	Δ	% Δ	2012-13	2014-15	Δ	%Δ
Yield (qtls/ha)	49	55	6	12	49	55	6	12	127	159	32	26
Production (qtls)	13413	15452	2039	15	7620	8436	815	10	1278	1923	645	51
NPK (kg /ha)	242	281	39	16	158	147	-11	-7	247	227	-21	-8
NPK ratio	3.95:2.56:1	0.83:0.57:1	-	-	1.51:3.33:1	1.31:0.92:1			4.65:2.58:1	1.32:0.79:1	-	-
Cost of NPK (Rs/ha)	6282	6828	546	9	6072	6110	38	1	6268	6321	53	1
Total cost of cultivation(Rs/ha)	19985	22602	2617	14	19467	20372	905	5	27521	27487	-34	-0.1
Net return(Rs/ha)	37253	57049	19796	53	39055	53492	14437	37	106646	145846	39201	37
Net return (Rs./farm)	96049	152310	56261	59	57182	77261	20078	35	269280	441184	171904	64
B:C Ratio	1.86	2.52	-	-	2.00	2.62	-	-	3.87	5.30	-	-

Δ indicates increases in respective variable.

Conclusion and policy recommendations

Preliminary findings of the study indicates that on-going 'Potash for Life' project has several implications in strengthening skill, education and knowledge of farmers in various aspects of crop management practices including nutrient management. The project has multi-dimensional effects on productivity, production, cost and returns and restoration of soil health and environment. Broadly following points has been emerged from above findings.

- 'Potash For Life' project activities seems effective in creating awareness to the cooperator-farmers for crop production management practices by using various tools of extension and communication. Results of survey indicate that the production and net return of crops increased significantly by incorporating potash with urea and phosphoric fertilizers. Therefore, this intervention needs to be popularize among the farming community on larger area in the country. Agriculture extension department of state/central Govt/or NGOs should take lesson from the PFL project activity to popularize importance of use of potash among the farming community.
- Project activities have strengthened and enriched the knowledge and skill of farmers in study area for nutrient management in general and use of potash particular in different crops. The area of operation of PFL project activity should be expand in more villages/district/states so that the unprivileged farmers could be benefited. Also there is need to project activity should be continued for longer period and until to developed confidence of perceived benefits of use of potash among the farming community.
- Develop skill to the cooperator farmers to reduce the effect of stresses by application of potash in the crop on larger scale. The designed extension strategies seem to be more effective in increasing production of crops and minimize yield losses due to several abiotic and biotic stresses by use of potash. The whole package of these extension approaches/strategies should be strongly followed and expanded in new areas where farmers could be benefited.
- Government should ensure the timely availability of Potash in the market on reasonable price. For popularization of potash among the farming community,

Govt. should must increased amount of subsidy on potash fertilizer to benefiting farmers for time being.

- In the present days, input supplier centers become major source of information of agri-technologies in the rural area. Therefore, there is need to impart training and develop skill of the shopkeepers effectively and efficiently so that they can disseminate information among the farmers successfully.
- Farmers are well exposed to apply inorganic fertilizers in required ratio and use micro-nutrient like zinc which ultimately enhances not only crop productivity, but also income at a great extent. Therefore, it can be concluded that 'Potash for Life' project or alike project activity should be continued to increase production and productivity of crops. Since land is limited and no scope to expand area under cultivation of crop, we have only option to increase production by increasing productivity per unit land to feed growing population. In this backdrop, PFL project activity seems instrumental to arrive on this objective.

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Appendix 1: Acreage of different crops by varieties and district in *kharif* season on sample farm.

Crops	2012-13										2014-15									
	Bilaspur		Durg		Raipur		Rajnandgaon		Overall		Bilaspur		Durg		Raipur		Rajnandgaon		Overall	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
Rice																				
PA-6444	-	-	7.0	21.8	2.0	2.2	14.9	17.2	23.9	7.8	-	-	4.5	14.0	-	-	17.7	20.4	22.2	7.2
MTU 7029	21.0	22.0	-	-	-	-	-	-	21.0	6.8	-	-	-	-	-	-	-	-	-	-
Rajshree	5.4	5.7	0.4	1.2	-	-	-	-	5.8	1.9	6.4	6.7	-	-	-	-	2.0	2.3	8.4	2.7
Swarna	17.4	18.2	10.7	33.3	53.7	58.1	27.5	31.7	109.3	35.6	11.2	11.7	5.2	16.2	61.0	65.9	19.7	22.7	97.1	31.7
Swarna Sub1	12.0	12.6	-	-	-	-	-	-	12.0	3.9	23.2	24.3	-	-	-	-	-	-	23.2	7.6
Sonamasuri	16.8	17.6	-	-	1.6	1.7	-	-	18.4	6.0	13.4	14.1	-	-	1.6	1.7	-	-	15.0	4.9
Dubraj	0.4	0.4	-	-		0.0	-	-	0.4	0.1	0.4	0.4	-	-	-	-	-	-	0.4	0.1
MTU 1010	-	-	2.7	8.4	7.2	7.8	4.6	5.3	14.5	4.7	19.6	20.5	8.5	26.4	6.0	6.5	23.4	27.0	57.5	18.7
Mohanbhog	-	-	-	-	5.4	5.8	-	-	5.4	1.8	-	-	-	-	3.4	3.7	-	-	3.4	1.1
MTU 1008	5.6	5.9	-	-	-	-	-	-	5.6	1.8	5.6	5.9	-	-	-	-	-	-	5.6	1.8
Mahamaya	2.2	2.3	5.2	16.0	3.0	3.2	10.0	11.6	20.4	6.7	0.8	0.8	7.2	22.3	3.8	4.1	5.0	5.8	16.8	5.5
Tulsi	0.6	0.6	-	-	-	-	-	-	0.6	0.2	0.6	0.6	-	-	-	-	-	-	0.6	0.2
Swaraj	0.6	0.6	-	-	-	-	-	-	0.6	0.2	0.6	0.6	-	-	-	-	-	-	0.6	0.2
MTU 1001	7.0	7.3	0.8	2.5	1.6	1.7	1.2	1.4	10.6	3.5	5.2	5.5	1.8	5.6	1.2	1.3	1.2	1.4	9.4	3.1
HMT	-	-	-	-	-	-	-	-	-	-	1.2	1.3	-	-	-	-	-	-	1.2	0.4
Vishnubhog	0.8	0.8	-	-	8.3	9.0	-	-	9.1	3.0	0.8	0.8	-	-	-	-	-	-	0.8	0.3

Lohdi	-	-	-	-	-	-	-	-	-	-	0.8	0.8	-	-	-	-	-	-	0.8	0.3
Shankarbhog	0.4	0.4	-	-	-	-	-	-	0.4	0.1	0.4	0.4	-	-	-	-	-	-	0.4	0.1
Sabhamasuri	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.1	3.4	-	-	3.1	1.0
ChandanGold	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2	1.3	-	-	1.2	0.4
Kaveri	-	-	-	-	1.2	1.3	-	-	1.2	0.4	-	-	-	-	1.2	1.3	-	-	1.2	0.4
Sonam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2	1.3	-	-	1.2	0.4
Sarthi	-	-	-	-	0.8	0.9	-	-	0.8	0.3	-	-	-	-	0.8	0.9	-	-	0.8	0.3
Chandan	-	-	-	-	0.4	0.4	-	-	0.4	0.1	-	-	-	-	-	-	-	-	-	-
VNR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.6	2.8	-	-	2.6	0.8
Om-3	-	-	-	-	-	-	2.0	2.3	2.0	0.7	-	-	-	-	-	-	-	-	-	-
Sobhna	-	-	-	-	2.0	2.2	-	-	2.0	0.7	-	-	-	-	1.2	1.3	1.6	1.8	2.8	0.9
Balwan	-	-	-	-	2.0	2.2	-	-	2.0	0.7	-	-	-	-	2.0	2.2	-	-	2.0	0.7
Bamleswari	-	-	-	-	1.4	1.5	-	-	1.4	0.5	-	-	-	-	1.4	1.5	-	-	1.4	0.5
Karma Masori	-	-	-	-	-	-	-	-	-	-	-	-	0.8	2.5	-	-	-	-	0.8	0.3
US-382	-	-	-	-	-	-	4.0	4.6	4.0	1.3	-	-	-	-	-	-	-	-	-	-
MTU-1011	-	-	-	-	-	-	2.6	3.0	2.6	0.8	-	-	-	-	-	-	2.6	3.0	2.6	0.8
Rice total	90.2	94.5	26.8	83.2	90.6	97.9	66.8	77.1	274.3	89.5	90.2	94.5	28.0	86.9	91.7	99.1	73.2	84.5	283.0	92.3
Tomato																				
5005	-	-	0.6	1.9	-	-	-	-	0.6	0.2	-	-	0.6	1.9	-	-	-	-	0.6	0.2
Himsona	-	-	-	-	-	-	6.0	6.9	6.0	2.0	-	-	-	0.0	-	-	6.0	6.9	6.0	2.0
Tomato total	-	-	0.6	1.9	-	-	6.0	6.9	**6.6**	**2.2**	-	-	0.6	1.9	-	-	6.0	6.9	6.6	2.2
Spinach																				
Local	-	-	2.4	7.5	0.4	0.4	7.6	8.8	10.4	3.4	-	-	-	-	-	-	-	-	-	-
Spinach total	-	-	2.4	7.5	0.4	0.4	7.6	8.8	10.4	3.4	-	-	-	-	-	-	-	-	-	-
Cowpea																				
Lali	-	-	0.1	0.3	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
Cowpea total	-	-	0.1	0.3	-	-	-	-	0.1	-	-	-	0.1	0.3	-	-	-	-	0.1	-
Okra																				
Sakti	-	-	0.6	1.9	-	-	-	-	0.6	0.2	-	-	0.1	0.3	-	-	-	-	0.1	-
Kranti	0.2	0.2	-	-	-	-	-	-	0.2	0.1	-	-	-	-	-	-	-	-	-	-
Chiaya	-	-	-	-	-	-	0.2	0.2	0.2	0.1	-	-	0.6	1.9		0.0	0.2	0.2	0.8	0.3
Local	-	-	-	-	-	-	-	-	-	-	0.2	0.2	-	-	-	-	-	-	0.2	0.1
Okra total	0.2	0.2	0.6	1.9	-	-	0.2	0.2	1.0	0.3	0.2	0.2	0.6	1.9	-	-	0.2	0.2	1.0	0.3
Brinjal																				
Local	0.2	0.2	-	-	-	-	-	-	0.2	0.1	-	-	-	-	-	-	-	-	-	-
Kranti	-	0.0	-	-	-	-	-	-	-	-	0.2	0.2	-	-	-	-	-	-	0.2	0.1
Brinjal total	0.2	0.2	-	-	-	-	-	-	0.2	0.1	0.2	0.2	-	-	-	-	-	-	0.2	0.1
Onion																				
Pusa red	-	-	1.0	3.1	-	-	-	-	1.0	0.3	-	-	-	-	-	-	-	-	-	-
Nasik	-	-	-	-	-	-	-	-	-	-	-	-	1.0	3.1	-	-	-	-	1.0	0.3
Onion total	-	-	1.0	3.1	-	-	-	-	1.0	0.3	-	-	1.0	3.1	-	-	-	-	1.0	0.3
French bean																				
Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2	1.4	1.2	0.4
French bean total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2	1.4	1.2	0.4
Soybean																				
Local	-	-	-	-	-	-	3.2	3.7	3.2	1.0	-	-	-	-	-	-	3.2	3.7	3.2	1.0
Soyabean Total	-	-	-	-	-	-	3.2	3.7	3.2	1.0	-	-	-	-	-	-	3.2	3.7	3.2	1.0
Carrot																				
Local	-	-	-	-	-	-	-	-	-	-	-	-	0.8	2.5	-	-	-	-	0.8	0.3
Carrot total	-	-	-	-	-	-	-	-	-	-	-	-	0.8	2.5	-	-	-	-	0.8	0.3
Broadbean																				
Local	-	-	0.1	0.3	-	-	-	-	0.1	-	-	-	0.1	0.3	-	-	-	-	0.1	-
Broadbean total	-	-	0.1	0.3	-	-	-	-	0.1	-	-	-	0.1	0.3	-	-	-	-	0.1	-
Banana	-	-	-	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	-	0.0	-
Local	2.4	2.5	-	-	-	-	-	-	2.4	0.8	2.4	2.5	-	-	-	-	-	-	2.4	0.8
Banana Total	2.4	2.5	-	-	-	-	-	-	2.4	0.8	2.4	2.5	-	-	-	-	-	-	2.4	0.8
Fallow total	2.4	2.5	0.6	1.9	1.5	1.6	2.8	3.2	7.3	2.4	2.4	2.5	1.0	3.1	0.8	0.9	2.8	3.2	7.0	2.3
Kharif Total	95.4	100	32.2	100	92.5	100	86.6	100	306.6	100	95.4	100	32.2	100	92.5	100	86.6	100	306.6	100

Appendix 2: Acreage of different crops by varieties and district in *rabi* season on sample farm

Particulars	2012-13											2014-15								
	Bilaspur		Durg		Raipur		Rajnandgaon		Overall			Bilaspur		Durg		Raipur		Rajnandgaon		Overall	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
Rice																				
PA-6444	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Swarna	4	4.2	1.2	3.7	3	3.2	2.9	3.3	11.1	3.6	4.0	4.2	1.2	3.7	3.0	3.2	2.9	3.3	11.1	3.6
Swarna Sub 1	-	-	-	-	-	-	-	-	-	-	2.4	2.5	-	-	-	-	-	-	2.4	0.8
Sonamasuri	6	6.3	-	-	-	-	-	-	6.0	2.0	6.0	6.3	-	-	-	-	-	-	6.0	2.0
MTU-1010	32.36	33.9	2.4	7.5	63	68.1	1.8	2.1	99.6	32.5	30.0	31.4	2.4	7.5	63.8	69.0	1.8	2.1	98.0	31.9
Mohanbhog	4	4.2	-	-	0.8	0.9	-	-	4.8	1.6	4.0	4.2	-	-	0.8	0.9	-	-	4.8	1.6
MTU-1008	7	7.3	-	-	7.6	8.2	-	-	14.6	4.8	7.0	7.3	-	-	7.2	7.8	-	-	14.2	4.6
Mahamaya	8.2	8.6	0.6	1.9	-	-	-	-	8.8	2.9	7.8	8.2	0.6	1.9	-	-	-	-	8.4	2.7
MTU-1001	-	-	-	-	6.4	6.9	-	-	6.4	2.1	-	-	-	-	3.2	3.5	-	-	3.2	1.0
HMT	-	-	-	-	1.2	1.3	-	-	1.2	0.4	-	-	-	-	1.2	1.3	-	-	1.2	0.4
Sonal	-	-	-	-	2	2.2	-	-	2.0	0.7	-	-	-	-	-	-	-	-	-	-
Karma Masuri	-	-	0.8	2.5	-	-	-	-	0.8	0.3	-	-	0.8	2.5	-	-	-	-	0.8	0.3
Om-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0	2.2	-	-	2.0	0.7
Aruna	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	0.8	-	-	0.7	0.2
Pant-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4	0.4	-	-	0.4	0.1
Rice Total	61.56	64.6	5	15.5	84	90.8	4.7	5.4	155.2	50.6	61.2	64.1	5.0	15.5	82.3	89.0	4.7	5.4	153.1	49.9
Wheat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PBW-226	-	-	-	-	-	-	1.8	2.1	1.8	0.6	0.8	0.8	-	-	-	-	1.2	1.4	2.0	0.7
Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.6	1.8	1.6	0.5
GJ-2+3	1	1.0	1.6	5.0	-	-	-	-	2.6	0.8	1.4	1.5	1.2	3.7	-	-	-	-	2.6	0.8
Sujata	0.6	0.6	0.88	2.7	-	-	-	-	1.5	0.5	0.6	0.6	0.9	2.7	-	-	0.8	0.9	2.3	0.7
Sarbati	0.4	0.4	-	-	-	-	0.8	0.9	1.2	0.4	0.4	0.4	-	-	-	-	-	-	0.4	0.1
GW-273	0.8	0.8	-	-	-	-	-	-	0.8	0.3	0.8	0.8	-	-	-	-	-	-	0.8	0.3
Sonalika	3.6	3.8	-	-	0.4	0.4	-	-	4.0	1.3	3.6	3.8	-	-	0.4	0.4	-	-	4.0	1.3
Syngenta	-	-	-	-	-	0.0	0.2	0.2	0.2	0.1	-	-	-	-	-	-	0.2	0.2	0.2	0.1
Lok-1	4.2	4.4	-	-	-	0.0	0.5	0.6	4.7	1.5	4.2	4.4	-	-	-	-	0.5	0.6	4.7	1.5
Wheat Total	10.6	11.1	2.5	7.7	0.4	0.4	3.3	3.8	16.8	5.5	11.8	12.4	2.1	6.5	0.4	0.4	4.3	5.0	18.6	6.1
Tomato																				
Himsona	-	-	0.2	0.6	-	-	-	-	0.2	0.1	-	-	0.2	0.6	-	-	-	-	0.2	0.1
5005	-	-	0.3	0.9	-	-	9.2	10.6	9.5	3.1	-	-	0.3	0.9	-	-	11.2	12.9	11.5	3.8
T-405	-	-	0.4	1.2	-	-	-	-	0.4	0.1	-	-	0.4	1.2	-	-	-	-	0.4	0.1
Tomato total	-	-	0.9	2.8	-	-	9.2	10.6	10.1	3.3	-	-	0.9	2.8	-	-	11.2	12.9	12.1	3.9
Potato																				
Potato Lalima	2.2	2.3	-	-	-	-	-	-	2.2	0.7	1.4	1.5	-	-	-	-	-	-	1.4	0.5
Potato total	2.2	2.3	-	-	-	-	-	-	2.2	0.7	1.4	1.5	-	-	-	-	-	-	1.4	0.5
Raddish																				
Local	-	-	-	-	-	-	3.2	3.7	3.2	1.0	-	-	-	-	-	-	3.2	3.7	3.2	1.0
Radish total	-	-	-	-	-	-	3.2	3.7	3.2	1.0	-	-	-	-	-	-	3.2	3.7	3.2	1.0
Gram																				
Local	0.4	0.4	2	6.2	2.4	2.6	5	5.8	9.8	3.2	0.4	0.4	-	-	2.8	3.0	5.0	5.8	8.2	2.7
G-1	0.6	0.6	1	3.1	-	-	0.8	0.9	2.4	0.8	0.6	0.6	-	-	-	-	0.8	0.9	1.4	0.5
JG-11	-	-	-	-	-	-	2.4	2.8	2.4	0.8	-	-	2.0	6.2	1.6	1.7	2.4	2.8	6.0	2.0
Namdhari	-	-	-	-	-	-	-	-	-	-	-	-	1.0	3.1	-	-	-	-	1.0	0.3
Radhey	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4	0.4	-	-	0.4	0.1
Gram Total	1	1.0	3	9.3	2.4	2.6	8.2	9.5	14.6	4.8	1.0	1.0	3.0	9.3	4.8	5.2	8.2	9.5	17.0	5.5
Cowpea																				
Ankur	-	-	1.2	3.7	-	-	-	-	1.2	0.4	-	-	1.2	3.7	-	-		0.0	1.2	0.4
Lakhadi	-	-	-	-	-	-	3.4	3.9	3.4	1.1	-	-	-	-	-	-	3.4	3.9	3.4	1.1
Cowpea total	-	-	1.2	3.7	-	-	3.4	3.9	4.6	1.5	-	-	1.2	3.7	-	-	3.4	3.9	4.6	1.5
Brinjal																				
MV	-	-	0.4	1.2	-	-	-	-	0.4	0.1	-	-	-	-	-	-	-	-	-	-
Brinjal total	-	-	0.4	1.2	-	-	-	-	0.4	0.1	-	-	-	-	-	-	-	-	-	-
Soybean																				
Local	-	-	-	-	-	-	0.4	0.5	0.4	0.1	-	-	-	-	-	-	0.4	0.5	0.4	0.1
Soybeen total	-	-	-	-	-	-	0.4	0.5	0.4	0.1	-	-	-	-	-	-	-	0.5	0.4	0.1
Okra																				
Chiraya	-	-	-	-	-	-	4	4.6	4.0	1.3	-	-	-	-	-	-	2.0	2.3	2.0	0.7
Okra total	-	-	-	-	-	-	4	4.6	4.0	1.3	-	-	-	-	-	-	2.0	2.3	2.0	0.7
Kukumber 2	0.4	0.4	-	-	-	-	-	-	0.4	0.1	0.4	0.4	-	-	-	-	-	-	0.4	0.1
Kukumber Total	0.4	0.4	-	-	-	-	-	-	0.4	0.1	0.4	0.4	-	-	-	-	-	-	0.4	0.1
Onion																				
Pusa red	-	-	-	-	-	-	-	-	-	-	-	-	0.4	1.2	-	-	-	-	0.4	0.1
Onion Total	-	-	-	-	-	-	-	-	-	-	-	-	0.4	1.2	-	-	-	-	0.4	0.1

Lathyrus																				
Local	-	-	-	-	-	-	0.8	0.9	0.8	0.3	-	-	-	-	-	-	1.2	1.4	1.2	0.4
Lathyrus total	-	-	-	-	-	-	0.8	0.9	0.8	0.3	-	-	-	-	-	-	-	1.4	1.2	0.4
Banana																				
Local	2.4	2.5	-	-	-	-	-	-	2.4	0.8	2.4	2.5	-	-	-	-	-	-	2.4	0.8
Banana total	2.4	2.5	-	-	-	-	-	-	2.4	0.8	2.4	2.5	-	-	-	-	-	-	2.4	0.8
Pulses																				
Local	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6	0.7	0.6	0.2
Pulses Total	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6	0.7	0.6	0.2
Fallow	17.20	18.0	19.18	59.6	5.70	6.2	49.4	57.1	91.5	29.8	17.2	18.0	19.6	60.9	5.0	5.4	47.4	54.8	89.2	29.1
Rabi Total	95.4	100	32.2	100	92.5	100	86.6	100	306.6	100	95.4	100	32.2	100	92.5	100	86.6	100	306.6	100

Appendix 3: Acreage of different crops by varieties and district in *zaid* season on sample farm

Crops	**2012-13**									**2014-15**										
	Bilaspur		**Durg**		**Raipur**		**Rajnandgaon**		**Overall**	**Bilaspur**			**Durg**		**Raipur**		**Rajnandgaon**		**Overall**	
	Area	**%**	**Area**	**%**	**Area**	**%**	**Area**	**%**	**Area**	**%**	**Area**	**%**	**Area**	**%**	**Area**	**%**	**Area**	**%**	**Area**	**%**
Tomato																				
N-5	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0.6	-	-	-	-	0.2	0.1
Tomato Total	-	-	-	-	-	-	-	-	-	-	-	-	0.2	0.6	-	-	-	-	0.2	0.1
Okra																				
Sakti	-	-	-	-	-	-	-	-	-	-	-	-	0.4	1.2	-	-	-	-	0.4	0.1
Okra Total	-	-	-	-	-	-	-	-	-	-	-	-	0.4	1.2	-	-	-	-	0.4	0.1
Banana																				
Local	2.4	2.5	-	-	-	-	-	-	2.4	0.8	2.4	2.5	-	-	-	-	-	-	2.4	0.8
Banana Total	2.4	2.5	-	-	-	-	-	-	2.4	0.8	2.4	2.5	-	-	-	-	-	-	2.4	0.8
Fallow Total	93.0	97.5	32.2	98.8	92.5	100	86.6	100	303.8	99.1	93.0	97.5	31.6	98.1	92.5	100	86.6	100	303.6	99.0
Zaid Total	95.4	100	32.2	100	92.5	100	86.6	100	306.6	100	95.4	100	32.2	100	92.5	100	86.6	100	306.6	100