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Participatory Rural Appraisal Techniques for Problem Identification and Formulation of Village Agricultural Development Plan of Chosla Village

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Authors' contributions

This work was carried out in collaboration among all the authors. Author RB designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SS and SK managed the analyses of the study and prepared the charts and the tables. Author RS performed the RBQ analysis. Authors VGD and MKS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Participatory Rural Appraisal (PRA) paves a way to understand the grass root level problems faced by farmers following which successful research programs can be proposed. The present study was carried out at Chosla Village of Tonk District in Rajasthan. The PRA tools such as transect walk, agro-ecological mapping, social mapping, time trend, seasonal calendar, gender analysis, timeline, livelihood analysis, technology mapping, consequence diagram and SWOT analysis. Around 20

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major problems were identified; in which aphid in mustard, fragmented lands, non-availability of irrigation water were the top three agricultural problems whereas among the non-agricultural problems: sanitation, lack of higher Education facility and lack of awareness about govt. schemes occupied the top three positions. The action plans for these various problems were formulated by the researchers which would eventually serve as the solutions to improve the socio and economic status of the peoples of the Chosla village.

Keywords: Agro ecosystem analysis; participatory rural appraisal; problem identification; field experience training.

1. INTRODUCTION

Despite the miraculous economic growth in the recent past with respect to industrial and services output, agriculture remains the most prevailing sector of the Indian economy. Agriculture represents 17% of GDP (2015) and 35% of employment in India, making it vital in the general economy of the country. The 49% of population in nation is involved in agriculture and related activities (Census 2011) and it contributes 17.4% to the nation's Gross Value Added for the year 2016-17 (at current costs). One of the fundamental reasons behind the fact that major Indian population is primarily dependent on agriculture as their source of livelihood is that the climatic conditions in India is perfectly suitable for farming activities. However, in the recent past changes in the climate paradigm has made farming activities quite a challenging task. There are other reasons as well like the impact of trade liberalization, globalization, degrading natural resources etc. has created a disinterest among the rural youth in agricultural activities [1]. The agriculture segment is encountering auxiliary changes which are opening new difficulties and challenges. In this view, the Hon'ble Prime Minister has set an objective before the nation to double the farmer's income by 2022. Thus, the Indian council of Agricultural Research is striving efficiently to reach the goal. To make this dream come true we shall know what kind of technological interventions can be introduced in rural areas to uplift the rural economy to enhance their standard of living. The National commission of farmers has presented a report that is a reason for trepidation which states that "given a chance, 40 percent of the Indian farmers wanted to quit agriculture and moved to secondary and tertiary sector for their livelihood", implied in this statement are the facts that valuable agriculture lands are being converted for attractive business enterprises [2].

A knowledge of the present scenario of Indian villages will be beneficial for all the agricultural scientists across the country to carry out a need-based research. PRA is intended to enable local communities to conduct their own analysis and to plan and act [3]. PRA involves project staff learning together with villagers about the village. The aim of PRA is to help strengthen the capacity of villagers to plan, make decisions, and to act towards improving their own situation. The basic concept of PRA is to learn from rural people. Chambers [3] has defined PRA as an approach and methods for learning about rural life and conditions from, with and by rural people. He further stated that PRA extends into analysis, planning and action. PRA closely involve villagers and local officials in the process. PRA is a methodology of learning rural life and their environment from the rural people. It requires researchers / field workers to act as facilitators to help local people conduct their own analysis, plan and act accordingly. It is based on the principle that local people are creative and capable and can do their own investigations, analysis, and planning.

As a part of training of the newly recruited scientists of the Agriculture Research Service (ARS) undergoing Field Experience Training (FET) is mandatory to be aware of the real problems faced by farmers at field level.

The present study was carried out with the following objectives:

1. To provide an opportunity to Scientist-trainees to interact with the farming community and gain insight into their livelihood.
2. To inculcate culture of teamwork and multi-disciplinary perspective among scientist- trainees.
3. To study socio-economic implications and consequences of technologies, products and processes

4. To generate a detailed account of technology products and processes, used by producers with respect to production scenario, problems, opportunities, and futuristic approaches.
5. To provide comprehensive insight in to the role of private industry and other stakeholders in value chain.

2. METHODOLOGY

The ARS Scientist Probationers had undergone a 21 days FET programme in coordination with Central Sheep & Wool Research Institute (CSWRI), Avikanagar, at Chosla village under Chaipura Gram Panchayat, Malpura Tehsil, Tonk District in the Indian State of Rajasthan during February-March, 2020. Initially a good rapport was built with the villagers and other stake holders, Focused group discussion was performed with the progressive farmers, CSWRI Extension officials, State Agriculture department Officials at the village.

2.1 Data Collection

The study was conducted in Chosla village that has a geographical coordinate of (26°26'33" N, 75°28'56" E) and is bounded by the villages of Motipura on the east, Srirampura Dhani towards West, Chainpura on the North and Ramjipura on the South respectively. The village has an average annual precipitation of 523.75 mm; the mean annual temperature being 26°C, the warmest month being May (average 34.7°C); the coldest month is January (average 16.2°C) and the wettest month is August (average 241 mm). The major soil type of the village is light textured aridisol with pH ranges between 8.00-9.20 and electrical conductivity varies between 0.05-0.59 (dS/m). The nutrition profile of soils in the village ranges is as organic carbon varies between 0.20 to 0.40%, available phosphorous from 28 to 45.51 Kg/ha, and available potassium is between 145 to 320 Kg/ha. Both primary as well as secondary data were collected to gain an insight about the village resources and the facilities present in the village so that a sound workable plan can be formulated for the development of the agriculture in the village. Different PRA tools and a semi structured questionnaire were used to collect both primary as well as secondary data of the village from Assistant Director of Agriculture, Assistant Director of Horticulture and other agricultural officials.

2.2 PRA Tools Used

The different PRA tools used include transect walk for transect map and transect analysis, Agro-ecology map, Resource map, Social map, Mobility Map, Indigenous Technology knowledge (ITK), Technology map, Bio-resource flow diagram, Seasonal analysis (activities, problems and gender disaggregation), Time line, Time trends, Livelihood analysis, Venn diagram, Consequence diagram, Matrix ranking, Problem identification and prioritization.

2.3 Problem Identification

The major problems identified in the village Chosla were found out during focused group discussions and with the help of 30 progressive farmers from the village. These problems were prioritized using a method called Rank Based Quotient (RBQ) given by Sabarathnam [4]. The formula is as follows;

$$RBQ = \sum_{i=1}^{n} \frac{f_i(n+1-i) \times 100}{N \times n}$$

Where, i= concerned ranks, N= Number of farmers, n=Number of ranks, f_i= Frequency of farmers for i^{th} rank of the technological need

3. RESULTS AND DISCUSSION

The transect walk was done from north to south direction in the village along with the Key Informants. The walk was started from the main road (Diggi-Madhojahpura Road) of the village to the southern end of the village. This area is having flat lands with light textured sandy loam soil. Wheat and Mustard were the major crops in low land area. This area is followed by the residential areas which have most of the livestock population of the village. Within the village mustard and wheat fields were there. There are two ponds near the village at opposite ends. Moving forward there are more fields, mainly of mustard, barley, Lucerne, fenugreek and wheat in medium land with clay loam soil. Wells and Ponds are the major source of irrigation in village. The various aspects/characters of the village are covered in the Table 1.

The village boundary and infrastructure are depicted in the Fig. 1a & b. Chosla is bestowed with natural flora and fauna with good climatic conditions and ample water availability which

provides a favorable condition for growing different crops such as Wheat, Mustard, Sorghum, Pearl Millet, Barley, Green Gram, Black Gram, Fenugreek, Chickpea, Garlic, Carrot, Radish, Onion, Cucurbits and Apple Gourd (Tinda).

Besides these, almost all households have their own Cows, Buffaloes and a few Goat, Sheep, Horse, Poultry and Pig. The wide diversity in crops and livestock resources makes the village suitable for different farming practices such as integrated farming system, organic farming etc. However, lack of awareness among the farmers and their reluctance in adopting new practices along with alkalinity in soil causes difficulty in cultivation of crops resulting into lower productivity and hence lower net income to the farmers. There were 150 families all completely engaged in agricultural as the main source of livelihood. These types of conditions are like the experiences with tropical agricultural producers such as Olivares and Hernández [5]; Olivares [6]; Camacho et al. [7].

3.1 Agro Ecological Map

Agro-ecology map indicates the relationship between agriculture and environmental factors. The meteorological parameters like rainfall,

Table 1. General transect of Chosla Village

Criteria	Residential area	Field area
Soil type	Light textured aridisol	Light textured aridisol
Topography	Upland and Middle land	Plains
Crops	Garlic, Carrot, Radish, Onion and Cucurbits, Apple Gourd (Tinda)	Kharif: Green Gram, Pearl millet, Sorghum, Black Gram Rabi: Wheat, Mustard, Fenugreek, Chickpea
Livestock/Fish	Cow, Buffalos, Goats, Sheep, Horse, Poultry and Pigs	Cow, Buffalos, Goats, Sheep, Horse, Poultry and Pigs
Fruits & Other trees	Citrus, Papaya, Ber, Neem, Henna	Citrus, Ber, Neem, Peepal, Banyan, Aloe vera, Aonla, Pomegranate and Henna
Water resources	Water supply from dam, Hand pumps and Shallow Tube wells	Ponds, Shallow Tube wells
Disease and pest	-	Black and yellow rust in wheat, White rust in mustard, Painted bug in mustard, Mustard Aphid.
Weeds	*Cynodon dactylon, Cyperus rotundus, Parthenium sp.*	*Parthenium spp., Cynodon dactylon, Cyperus rotundus, Chenopodium album, Phalaris minor* and *Sorghum halepense*
Problems	1. Open defecation 2. Poor sanitation 3. Fluoride contamination in ground water 4. Child marriage 5. Unemployment 6. No facility for higher education	1. Poor Water Management 2. No Value addition of commodities 3. Fragmentation of land 4. Black and yellow rust in wheat 5. White rust in mustard 6. Painted bug in mustard 7. Mustard Aphid 8. Weed menace in wheat 9. Foot and mouth Disease 10. Mastitis 11. Peste despetits ruminants (PPR) 12. Enterotoxemia (ET) 13. Haemorrhagic septicaemia (HS) 14. Sheep pox (SP)
Opportunities	1. Poultry 2. Dairy Cooperatives	1. Sprinkle irrigation 2. Crop Diversification 3. Vermicomosting 4.Solar panel for bore well 5.Use of organic fertilizers

temperature, relative humidity, flora and fauna of the village and the basic land use pattern such as agro-forestry, forest cover and wasteland are depicted in the map. The environmental factors which affect agricultural production include temperature, rainfall, relative humidity and wind velocity. Besides these factors, topography, fragmentation of holdings, soil type and irrigation sources are also the major factors in deciding the cropping patterns. Agro-ecological map includes main system (village), village boundaries, cropping system, fruit crops, animals, tree crops, common land, forest area, weeds, natural resources etc. The village is located between latitude 26°26'33" N and longitude 75°28'56" E and altitude of 326 m above mean sea level. Villagers basically grow season specific vegetables such as carrot, radish, onion, coriander, cucurbits and garlic throughout the year. In kharif season pearl millet is the major crop with popular varieties such as Pioneer, Rohini and Balwan. Apart from this green gram is also grown in kharif. In rabi season wheat (Raj-306, Raj-3077 and Raj-4238) and mustard (Giriraj, Pioneer and Bio 902) are preferred crops. Major trees found in the village are Neem (*Azadirachta indica*), Khejari, Sheesam, Gooseberry, Banyan and Peepal. The major weeds are Parthenium, *Cynodon dactylon, Cyperus rotundus, Chenopodium album, Phalaris minor* and *Sorghum halepense.*

3.2 Resources in the Village

The resource map of the village shows the presence of five types of resources *viz*: natural, physical, social, human and financial resources. They were observed during the transect walk inside the village and on the village boundary and during discussion with the key informants and personal observations. Natural resources of any area can be defined as the stock of natural assets which include geology, soil, air, water and all living forms of life. Light textured sandy loam soils were observed in the region. The annual rainfall in the village is about 523.75 mm of which mostly occurs during the kharif season. The temperature of the village ranges in between 5-45°C. During the kharif season, due to more precipitation, moong is the major crop which is grown on about 95 per cent area and vegetables are also grown on the remaining land. In rabi season wheat, chickpea and mustard are grown in the village. Cow, buffalo and goat are the main livestock in the village. In addition to cultivation of agricultural crops, the villagers also rear different livestock for business and household usage. The important trees present in the village were Ber, Aonla, Neem, Peepal, Banyan etc. a pond was found adjacent to the boundary of the village. The village is well connected to Malpura, Tonk, Diggi, Soda, Sanganer and Jaipur by pucca roads. Proper roadside drainage system was not there in the village which poses connectivity problems from one region to other. This problem increases many folds during rainy season. For public transport in the village, there are various types of vehicles such as bicycle, motor bike, car etc. Government and private bus facility were available in the village. For the transportation of the agricultural produce and inputs in retail, villagers are using either their own motorbikes. However, for the bulk transport of the agricultural produce, they use simply tractors.

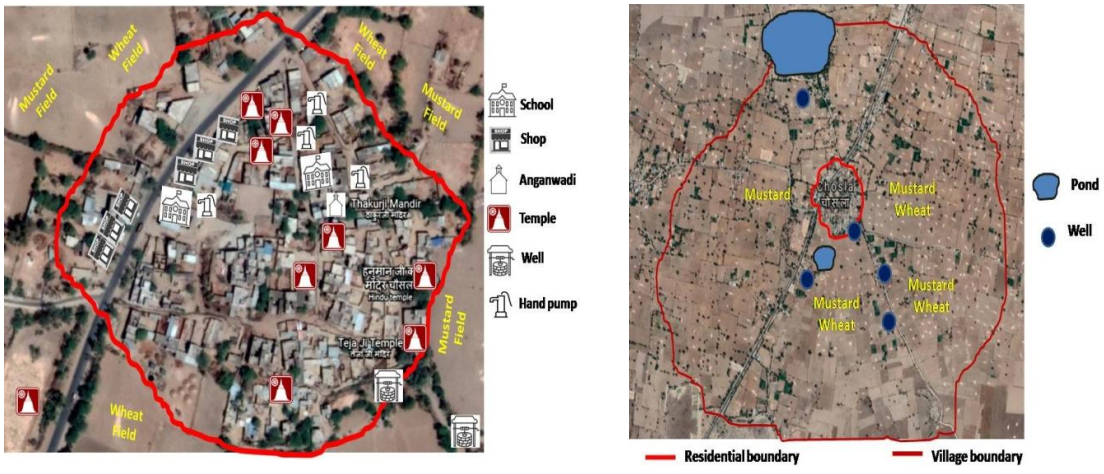


Fig. 1(a and b). Boundary and resources within the village

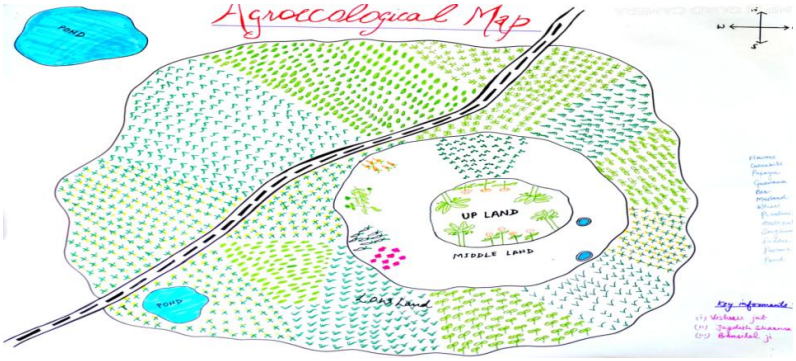


Fig. 2. Agro ecological map of Chosla Village

3.3 Social System of Chosla Village

The total number of households in Chosla village is 179 with the population of 1204 people in which 608 are male and 596 are females. There are fifteen communities representing different cultural customs in the village *viz* Jaat, Jangir, Gurjar, Khati, Vaishnav, Dadi and Kumawat which belongs to OBC category forms the majority of the population accounting for approximately 77.24% followed by Regan, Balai, Harijan and Bairwa which belongs to SC category accounting for approximately 9.55% of the total population. Around 9.13% populations belong to general category (Brahmin, Rajpoot, Jain) and 4.08% of the total population belongs to ST (Meena) community. There is both joint (60%) and nuclear (40%) family pattern in Chosla. The rate of change of joint families into nuclear families has been growing since past 10 years.

All the people in the village follow Hinduism except two families one of which follows Islam and other follow Jainism. There are 12 temples present in the village. However, no mosque was found in the village. All the communities were showing social harmony. For marriages only arranged marriage system exists in this village. There has been no love and inter cast marriage till date. The age of marriage for both men and women was mostly before 18 years. Thus, child marriage is being practiced in this village without any restriction. Most of the houses found in Chosla village are in the village while few are in the farm area as well. Approximately, 60% houses are pucca while 40% are kutcha houses. Most of the pucca houses had been built through Pradhan Mantri Awash Yojana. Moreover, all communities live together in the villages without any residential restriction to any communities or casts. There are four education institutions in the village i.e., Rajakiya Madhyamik Vidyalaya (till X^{th} Standard), Rajkiya Ucch Prathamik Sanskrit Vidyalaya (till V^{th} Standard), Maharishi Vidya Niketan (till XII^{th} Standard) and Anganwadi Kendra. For availing higher education, villagers mostly travel to Malpura and Jaipur. As there is a primary school in the village so most of the male members in the village have studied at least up to 10th class. The average literacy rate in the village is around 70%. In which the literacy rate for men is 55%, the rate for women is 45%. Most of the youth prefer to work in village agriculture and privet sectors. Only 5 people from village work as government employees who were serving as soldier in arm forces, policeman, state medical doctor and Patwari. One government ayurvedic center, veterinary sub center, post office and agriculture supervisor office was present in the village. Primary health center was in Chainpura village which was 1.5 km far from the village. Banking facility for villagers was at Diggi which was 10 km far from the Chosla. These characteristics are similar to those reported by Olivares and Franco [8]; Olivares and Cortez [9] which report the importance of this type of participation techniques in rural settings.

The village is well connected with the nearby villages as well as district headquarter by pucca roads. However, roads inside the village were not of concrete. Village is well connected to the cities as it is situated at Jaipur-Malpura main road. The main mode of transport for the villagers to travel to other villages is either personal vehicles or Rajasthan Roadways. They use tractor trolley to carry agricultural products from one place to the other. Villagers often travel to nearby villages and district headquarters to access different facilities like higher education, sale of vegetables, milk, procurement of different farm implements, fertilizers, seeds, pesticides etc. Despite the availability of LPG in all households,

approximately 80% of the households in the village use firewood and cow dung cake for cooking purpose. Only 20% of household use cooking gas (LPG) for cooking. LPG connection is available in all households through PM Ujjwala Yojana. About 80% of drinking water in village is supplied though Bisalpur PayJal Yojna, 10% through tube wells and remaining 10% through hand pumps. No households use RO purifier for water purification.

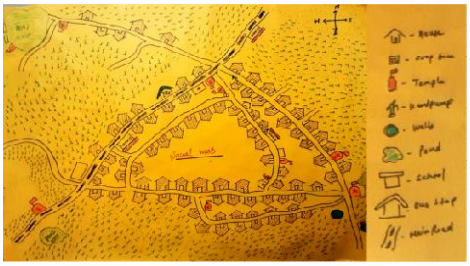
3.4 Timeline of the Village

Timeline is a tool of PRA technique used to know the history of major remembered events in community and their significance. It indicates the causal link between past and present. The purpose of this tool is to obtain historical account of changes in demography, socio-economic condition, communication, social relationship and interaction, technology diffusion and adoption etc. Information regarding the important events like the development in agriculture, animal husbandry is collected from the key informants, preferably elderly people of the village and presented in the Tables 2 and 3.

From the timeline of agriculture in Chosla village, it is evident that most of the farmers in the village are optimistic to adopt new technologies for their overall development. This result being comparable with studies related to the typification of tropical agricultural production systems such as Olivares et al. [10,11,12].

3.5 Time Trend

Time trend is a simple PRA technique, usually depicted in the form of graph (bar/line) to show the trend of crop/animal production, commodity prices, productivity etc. The specific objectives of this tool are to identify the changes/fluctuations that have occurred over a period in the variables influencing village life. For the purpose of the



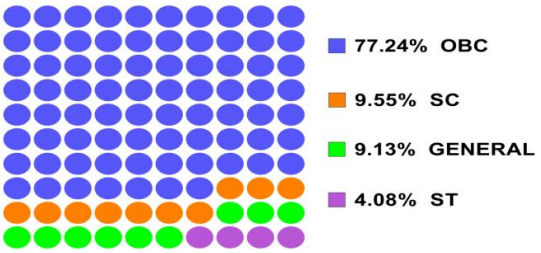


Fig. 3(a and b). Social Map and Category wise population distribution of Chosla village

Table 2. Timeline for major events in Chosla Village

Year	Events
1920	First Bicycle
1954	Govt. Secondary School
1965	Chainpura Panchayat Office
1970	Public Bus Transport
1975	Radio
1980	Pucca House
1985	Hand Pump
1990	Electricity
1992	First Motorcycle
1998	Electric Borewell
2000	First Television Introduced
2001	Anganwadi
2002	People were sensitized about using Pesticide and Herbicide
2003	Landline Telephone Connections
2005	First Car
2009	Smartphone
2010	LPG Connection
2012	Internet
2017	Solar Panels

Table 3. Timeline for major agricultural events in Chosla Village

Year	Events
Age old	Use of bullock cart
1978	Hindustan Tractor (Rs. 11,000) by Rameshwar Ji
1990	Manual Sprayer
1995	People started using Pesticide
2002	Power Operated Chaff Cutter
2004	Artificial Insemination
2005	Urea
2006	Thresher
2007	DAP, MOP
2010	HYV
2014	Power Operated Sprayer
2016	Soil Health Card
2016	Farm Pond Prepared under Mukhyamantri Jal Swabhalamban Yojana
2017	Giriraj (Mustard) Seed Introduced
2018	Vermicomposting
2018	Green House

present PRA study, the data were collected for crop productivity and price of Bajra, Wheat, Moong, Mustard and Milk of more than 10 years and are presented graphically in the appendix.

3.6 Seasonal Calendar for Gender Disaggregated- Farm Operations

The gender disaggregated seasonal calendars indicate the differential involvement of men/women/children in agriculturally based enterprises. Agricultural aspects include activities related to crop production, crop management, harvesting and selling of the farm produce. Most of the farm related activities are carried out by men. Weeding is solely done by women. With respect to livestock, that comprises of livestock rearing activities including grazing, feeding, milking and selling of milk and castles in nearby market. Most of the livestock related activities are performed by both male and female. Besides this, all the household activities are also done by female. The seasonal calendar for gender disaggregated farm operations obtained from key informants is presented in Table 4.

3.7 Seasonal Analysis for Agricultural and Livestock Problems of Village Chosla (Raj)

It represents the deviation from normal farm-based activities. This is a calendar, which indicates month wise abnormalities, specialties, threats, problems, abundance, and shortage about agriculture in a comprehensive way. The items to be included in seasonal analysis must be of those items, which really affect the agriculture and livestock productivity. The pests and diseases prevalence in crops and animals, the fodder availability, the cash inflows/out flows, the labor requirements and migration, on farm, off farm and non- farm employment etc., can be shown in the Seasonal Analysis.

This explores seasonal constraints and opportunities by diagramming changes, month by month throughout the year. The main constraints which affect the crop productivity and livestock health are collected from the key informants. These constraints are illustrated in Table 5.

3.8 Technology Map

The pictographic depiction of social patterns of respondents in the direction of technology adoption is known as technology map. The social pattern may be an active adoption, over adoption, discontinuance or rejection of the technology based upon the usefulness of the technology. Technology map consists of type and frequency of adoption behavior of respondents towards latest technology involving various agencies related to agricultural research and development. The given map displays the nature of technology adopted, discontinued or rejected in Chosla village, Block Malpura, Rajasthan.

The village farmers have adopted several varieties of wheat, chickpea, mustard, pearl millet, sorghum, clusterbean, mung and vegetables mainly for house purpose like tomato, brinjal, chilly, cauliflower, cabbage, ash guard and cucurbits etc. Groundnut cultivation has

been discontinued in the village due to less rainfall and stony soil. For wheat cultivation Raj-306, Raj-3077 and Raj-4238 varieties have been adopted by the villagers due to their good yield and better disease resistance. Raj-306 was grown mainly due to its good cooking quality and more fodder production. For pearl millet, Pioneer is the ruling variety in this village, for more than a decade, a case of over adoption. Many farmers have recently started from last 2-3 years, growing of Giriraj variety of mustard which is superior to other varieties in terms of yield, disease resistance. Its adoption is increased due to low price of seed and good yield.

Other adopted varieties of mustard Pioneer, Bio-902 and Jammu were also good in yield. For chickpea, JNG-2144 and JNG-1581 were cultivated among those farmers prefer JNG-2144 as it shows resistance to fusarium wilt.

Under horticulture schemes plants like Guava, Ber, Papaya, Citrus were grown by few villagers. But horticultural crops adoption has been discontinued due to non-suitability of fruit plants in village climate and cankery soil conditions.

Both conventional and modern farm implements were used for agricultural practices in the village. A rapid progress towards mechanization regarding farm implements was noticed in Chosla village. Many farm implements were used in different farm operations from land preparation to thrashing. Both conventional and modern farm implements were used for agricultural practices in the village. Bullock carts have been discontinued in the village long back. The number of tractor and bore wells were 55 and 110 respectively. Beside this, the villagers also possessed 60 cultivator, 45 ferti-seed drill, 25 power thrashers and 30 leveller as they help to enhance the work efficiency of the farm operations. Hand sprayer, chaff cutter was extensively adopted in the village. From last 3-4 year power operated sprayer is also adopted in village. Three solar panels were found in the village. Sprinkler irrigation system has been adopted by a few farmers under Pradhan mantra Krishi Sinchai Yojana but adoption is at stack due to scattered land patterns of most of the farmers. A combined harvester was available in the Custom hiring centre.

When livestock farming was taken into consideration, the farmers reared buffalo, cow mainly and a few farmers reared goat and sheep. Two- three family reared hens, mare and ducks also. The Gir breed of cow was found to be largely adopted, since it was adaptable to climatic conditions, disease resistant as well as less rearing cost of the animal. Crossbreds were rejected due to high susceptibility to heat stress. Most of the farmers have adopted the “Murrah” breed of buffalo due to higher milking ability yield and high fat percentage (7%) in the milk. Badavari breed buffaloes were also adopted by few farmers due to low rearing cost and disease resistance. In the context of goat rearing, the villagers mostly adopt Sirohi breed with the intervention of CSWRI, Avikanagar under ‘Farmer First’ project for the purpose of milk production as the rearing cost of goat is much lower than cows or buffaloes. Beside this the reproductive rate of goats is also higher. Non-descript goats were also adopted due to high disease resistance. Sheep breed Malpura and patanvari have also been reared by a farmer with the efforts of CSWRI, Avikanagar. In 5-6 families, nondescript breed of mare was also reared for economic purposes to use in marriage functions.

Table 4. Seasonal calendar for gender disaggregated-farm operations

S. no.	Operations	Male	Female
1	Land preparation	✓	
2	FYM application	✓	
3	Sowing	✓	
4	Weeding		✓
5	Fertilizer application	✓	
6	Irrigation	✓	
7	Herbicides/ Pesticides application	✓	
8	Harvesting	✓	✓
9	Cattle feeding		✓
10	Milking	✓	✓
11	Milk and farm produce selling	✓	
12	Fodder collection	✓	✓
13	Goat and sheep rearing		✓

Table 5. Seasonal analysis for agricultural & livestock problems

Crops	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Wheat	BR	L									W+T	BR
Chickpea	FW+AB+PB	PB										FW+AB
Mustard											A	A + WR
Tomato	FB+ YMV											FB+YMV
Chilli	LCV											
Brinjal							SFB					
Cauliflower	DBM											DBM
Tinda							FD					
Cattle	MF				FMD+HS				FMD			
Goat/Sheep	ET+PPR											PPR

Acronyms: W: Weeds, L: Lodging, BR: Black Rust, FW: Fusarium wilt, AB: Ascochyta Blight, PB: Pod borer, A: Aphid, WR: White rust, SFB: Shoot and Fruit Borer; FD: Flower Dropping, LCV: Leaf curl virus; FB: Fruit borer; YMV: Yellow mosaic virus; DBM: Diamond black moth; FMD: Foot and mouth disease; HS: Haemorrhage Septicemia; PPR: Peste des petits ruminants; ET: Enterotoxemia, MF: Mastitis and fever

3.9 Problem Identification and Prioritization

The problem identification technique was used to identify and prioritize the problems related to agricultural sector prevailing in the village. For this purpose, 15 farmers were identified from the village representing all sections of the village using snowball technique. From the three key informants (progressive farmers), 15 agriculture related problems (in different crops/ animal husbandry sectors) (Table 9) and 5 non-agricultural problems were listed down (Table 10). One by one all 15 farmers were asked to rank the problems based upon the severity and average annual percentage of loss they were personally facing by the problem. Frequencies of each rank for a problem were calculated and tabulated in rank frequency Table Rank Based Quotient (RBQ) and Value Based Index (VBI) were then calculated using following formulae.

Rank Based Quotient (RBQ):

$$RBQ = \frac{\sum_{i=1}^{N} (f_i (n + i - 1) \times 100)}{N \times n}$$

Where,

f_i = Frequency of farmers for the ith rank of the attribute.
N = Number of farmers contacted for factor identification.
n = the maximum number of ranks given for various factors.
i = Rank of the attributes.
Value Based Index (VBI):
VBI = RBQ x Total Economic Loss Percentage/Annum

The problem with the maximum value based index is identified as the top most researchable problem (Table 11). The table given above shows that non availability of irrigation water problem is having the maximum VBI and hence identified as the most important researchable issue of this village with other on-par problems like fragmented lands, lack of farm mechanization and labour shortage which are having equal weightage for research. Understanding all the persisting problems and their casual factors, suggestions were suggested to farmers to overcome their issues by taking help from nearby research organizations and administration.

3.10 SWOT Analysis of Chosla Village

SWOT (strengths, weaknesses, opportunities, and threats) analysis is a framework used to evaluate a village and to develop strategic planning. SWOT analysis assesses internal and external factors, as well as current and future potential.

A SWOT analysis is designed to facilitate a realistic, fact-based, data-driven look at the strengths and weaknesses of a village, its initiatives [8,13]. The SWOT analysis of the Chosla Village is mentioned below (Table 14).

Table 6. Technology table for crops

S. no.	Crop	Technology	Status	Reason
1	Wheat	Raj-306	Over adopted	High yield, good for chapatti making and more fodder
		Raj-3077	Adopted	High yield and short duration
		Raj-4238	Adopted	Good yield and rust resistance
2	Mustard	Giriraj	Adopted	High yield and low price seed
		Pioneer 45S42	Adopted	High production and diseases resistance
		Bio-902	Discontinued	Low yield and
3	Pearl millet	Pioneer	Adopted	More production
		Rohini	Adopted	Good production and less price seed
4	Chickpea	GNG-2144	Adopted	More yield, good for rainfed conditions and resistance to Fusarium wilt
		GNG-1581	Rejected	More water required
5	Sorghum	Raj Chari 1	Adopted	More production and quality of fodder
6	Clusterbean	RGC-936	Adopted	Good production under rainfed conditions
7	Fenugreek		Adopted	Good production and market price
7	Round gourd/tinda	Arka tinda NRB-10	Adopted	Good production in kharif season and market price
8	Cucurbits	Pusa Barkha	Adopted	Good yield, tolerant to high temperature and downy mildew
9	Napier grass	Pusa giant	Adopted	Got 4-5 cutting per year

Table 7. Technology table for agricultural implements

S. no.	Technology	Status	Reason
1	Manual sowing	Rejected	Low efficient and time taking
2	Mechanical sowing	Adopted	Increased effective field efficiency and reduced labour and time
3	Manual harvesting	Adopted	Based on the nature of crop to be harvested and needs of farmers
4	Mechanical harvesting	Adopted	Require less time and unavailability of labour
5	Mechanical threshing	Adopted	Require less time and more efficient
6	Soil testing	Discontinued	Lack of awareness about the advantages of soil testing
7	Flood irrigation	Adopted	Small land holdings
8	Sprinkler irrigation	Adopted	Saves water and money
9	Zero tillage	Rejected	Lack of awareness
10	Gypsum application	Adopted	Good for saline soil conditions
11	Fertilizers application	Adopted	Better growth and higher crop yield
12	Herbicides and pesticides	Adopted	Easy control of weeds
13	Vermicompost unit	Adopted	Good manure obtained replaces the chemical fertilizers

Table 8. Technology table for Livestock's

S. no.	Technology	Status	Reason
1	Buffalo (Murrah)	Adopted	High milk yield and quality
2	Buffalo (Badavari)	Adopted	Well adapted to local environment, good quality milk
3	Gir Cow	Adopted	Good milk production and less rearing cost
4	Jersi Cow	Adopted	Adapted to local conditions
5	Holstein Friesian Cow	Rejected	Non-adapted to local conditions
6	Sirohi Goat	Adopted	High and good quality milk and adopted to local conditions
7	Nondescript Goat	Adopted	adopted to local conditions and disease resistance
8	Malpura sheep	Adopted	Adopted to local conditions and high meat production
9	Nondescript mare	Adopted	Used for economic profit in marriage function

Table 9. Agricultural related problems & their frequencies of ranking given by villagers

Problems	Ranks				
	1	2	3	4	5
Non availability of irrigation water	19	8	1	1	1
APHID in mustard	21	6	1	1	1
Low milk production	5	6	9	8	2
Non-adoption of soil health card	10	7	5	5	3
Foot and mouth disease	9	10	3	5	3
Stray and wild animal attack in crop	20	5	2	2	1
Lack of marketing facility	14	8	2	3	3
Fragmented lands	22	4	1	2	1
Termite in wheat	4	6	7	8	5
White rust in mustard	6	9	8	4	3
Black rust in wheat	9	6	7	6	2
No crop insurance	7	6	8	4	5
Lack of storage facility	6	4	5	8	7
Labour shortage	15	7	4	2	2
Lack of farm mechanization	16	7	3	3	1
Exterotoxins in cattle's	9	9	7	3	2

Table 10. Non-agricultural related problems & their frequencies of ranking given by villagers

Problems	Ranks				
	1	2	3	4	5
Sanitation	22	5	1	1	1
Lack of higher education facility	21	4	2	2	1
Lack of awareness about govt. schemes	16	7	5	1	1
Lack of any SHG & co-operative society	11	8	5	4	2
No concrete road in village	13	9	5	1	2

Table 11. Ranking of agricultural problems

Problems	RBQ	Rank	Avg. % economic loss per annum	VBI	Rank
Non availability of irrigation water	88.68	III	52.36	4642.59	I
APHID in mustard	90.00	I	33.21	2988.90	V
Low milk production	62.71	XIV	22.68	1421.28	XII
Non-adoption of soil health card	70.67	X	12.31	869.91	XVI
Foot and mouth disease	71.53	IX	28.67	2045.13	VI
Stray and wild animal attack in crop	87.48	IV	18.56	1620.91	X
Lack of marketing facility	78.00	VII	15.87	1237.86	XIV
Fragmented lands	89.33	II	49.74	4443.44	II
Termite in wheat	57.82	XV	31.58	1810.59	IX
White rust in mustard	67.33	XII	28.37	1910.25	VII
Black rust in wheat	69.46	XI	26.71	1851.89	VIII
No crop insurance	64.00	XIII	18.74	1199.36	XV
Lack of storage facility	56.00	XVI	23.91	1338.96	XIII
Labor shortage	80.67	VI	38.52	3107.28	IV
Lack of farm mechanization	82.34	V	42.64	3524.91	III
Exterotoxins in cattle's	73.81	VIII	19.75	1448.33	XI

Table 12. Ranking of non-agricultural problems

Problems	RBQ	Rank
Sanitation	90.67	I
Lack of higher education facility	88.34	II
Lack of awareness about govt. schemes	84.00	III
Lack of any SHG & co-operative society	74.83	V
No concrete road in village	80.25	IV

Table 13. Categorization of problems

Sl. no.	Problem	Category
1.	Non availability of irrigation water	Extension gap/Researchable
2.	APHID in mustard	Extension gap/Researchable
3.	Low milk production	Extension gap
4.	Non-adoption of soil health card	Extension gap/Researchable
5.	Foot and mouth disease	Knowledge gap/Researchable
6.	Stray and wild animal attack in crop	Extension gap/Researchable
7.	Lack of marketing facility	Infrastructure
8.	Termite in wheat	Knowledge gap/Researchable
9.	White rust in mustard	Extension gap/Researchable
10.	Black rust in wheat	Extension gap/Researchable
11.	No crop insurance	Policy problems/ Extension gap
12.	Lack of storage facility	Infrastructure
13.	Labour shortage	Extension gap/ Researchable
14.	Lack of farm mechanization	Extension gap/Researchable
15.	Exterotoxins in cattle's	Knowledge gap/Researchable
16.	Sanitation	Infrastructure
17.	Lack of higher education facility	Infrastructure
18.	Lack if awareness about govt. schemes	Extension gap
19.	Lack of any SHG & co-operative society	Extension gap
20.	No concrete road in village	Infrastructure

Table 14. SWOT analysis

Strength	Weakness	Opportunities	Threats
Good Road Connectivity to nearby cities.	Laggard Farmers	Introduction of Horticulture	Youths losing interest in farming due to low returns.
Land Availability	Lack of Higher Education Institutes	Incorporation of Organic farming	Scarcity of Irrigation water
Animal Wealth	Poor Sanitation	Incorporation of Zero Tillage	Heavy losses due to Mustard aphid and white rust
Human Capital	Low Standard of Living	Milk Cooperative Dairy	Land fragmentation
Farmer First Program	Child Marriage	Adoption of IFS model for better income	Increase in Soil Alkalinity
Good Transport Facility	Kutcha roads inside villages	Soil Health Cards	
Technical Assistance from ICAR-CSWRI, Avikanagar		Apiculture	
Availability of Solar Panels		Training on Artificial Insemination, Good Dairy Practices and Poor Sanitation	
Availability of Electricity			

Analyzing the overall scenario of village, based on current survey, an action can be purposed to implement new policies, tools and techniques to overcome the shortcomings of the village. The purposed action Plan for the Village is as:

Action Plan for the Village

S. no.	Action Plan	Who	What	Where	When	Outcome
1	Low productivity of mixed Murrah buffaloes	Animal gynaecologist, Animal Medicine, Veterinary Assistant Surgeon	1. Genetic improvement of Mixed Murrah breed Rajasthan, India for higher milk yield	State livestock Dept., Rajasthan Central Institute for Research on Buffaloes, Hisar, Haryana	2020-2024	• Improved breed • Enhanced milk production • Technology transfer
2	Aphid in Mustard	Agricultural entomologist, Extension scientist	1. Development of IPDM modules and viable pest and disease control practices. 2. Dissemination of technology developed.	DRMR, Bharatpur, Rajsathan KVK, Tonk, CSWRI, Avikanagr	2020-21	• IPDM module • Viable pest control practices • Technology transfer
3	White rust in mustard	Plant pathologist, Plant breeder, Extension scientist	1. Screening of multiple diseases resistant varieties. 2. Development of viable diseases control practices.	IARI, New Delhi ,DRMR, Bharatpur, Rajsathan KVK, Tonk, CSWRI, Avikanagr	2020-2022	• Area specific disease resistant variety. • Viable diseases control practices. • Technology transfer.
4	Non adoption of soil health cards	Extension scientist	Creating awareness about soil health and soil health cards and its benefits	Agricultural officer, Chosla, Assistant directorate of agriculture, Malpura	2020-2021	Awareness about soil health and
5	Wild animal attack problem	Vertebrate Pest Management Division. Extension Scientist	1. Development and validation of effective control measures for wild animal attack 2. Development of repellents 3. Technology transfer	NIPHM, Hyderabad. ICAR-NIBSM, Baronda	2020-2022	• Effective control measures • Effective repellents Technology transfer.
6	Alkaline soil	Extension Scientist and Agriculture	1. Soil testing 2. Creating awareness about	State Agril. Dept., Rajasthan	2020-2021	• Awareness about soil health and soil

S. no.	Action Plan	Who	What	Where	When	Outcome
		officer	soil health its benefits 3.Recommendation for Gypsum application	CSWRI, Avikanagar KVK, Tonk		health cards. • Utilization of facilities provided by scheme. • Reduced input cost. Improved soil health.
7	Irrigation water availability	Sarpanch, BDO officer	1.Deepening of farm pond 2.Water harvesting structures	Panchayat under NAREGA, Block development office	2020-2021	Sufficient water availability to use underutilized land
8	Lack of awareness of govt. schemes	Extension scientist and agriculture officer	Training, door to door pamphlet distribution Awareness about schemes like PMFBY, PKVY, Pusa krishi mobile app launched by MoA&FW, GOI.	Panchayat, BDO, CSWRI, Avikanagar	2020-2021	Awareness and implementation of schemes

4. CONCLUSION

The information collected in the village Chosla through various PRA techniques were helpful in bringing out various plans for the development of the village. The social scenario evidently pinpoints that the village needs development and improvement in many sectors. The villagers are still lagging to adopt new technologies which if adopted can be a boon to their socio economic status. This clearly highlights the fact that it's not just the dumping of technologies or information on farmers' field but also the proper institutional policy and support in the form of better input & output market and infrastructure that has to be considered in order to make farming a profitable venture. Considering the increasing risk involved in agriculture, holistic efforts should be made to diversify the farm enterprises of small and marginal farmers to have a sustainable farming system thereby to double the farmer's income.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

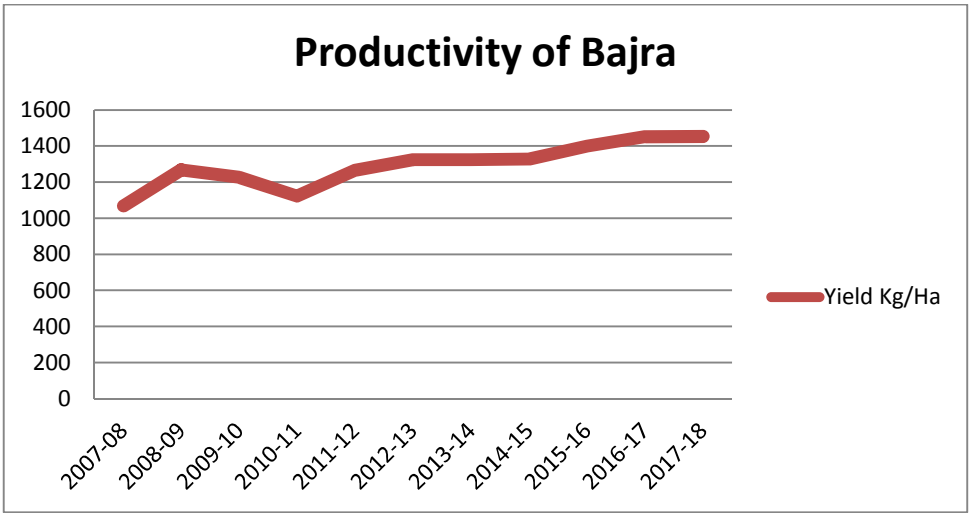

Fig. 1. Time trend of bajra productivity

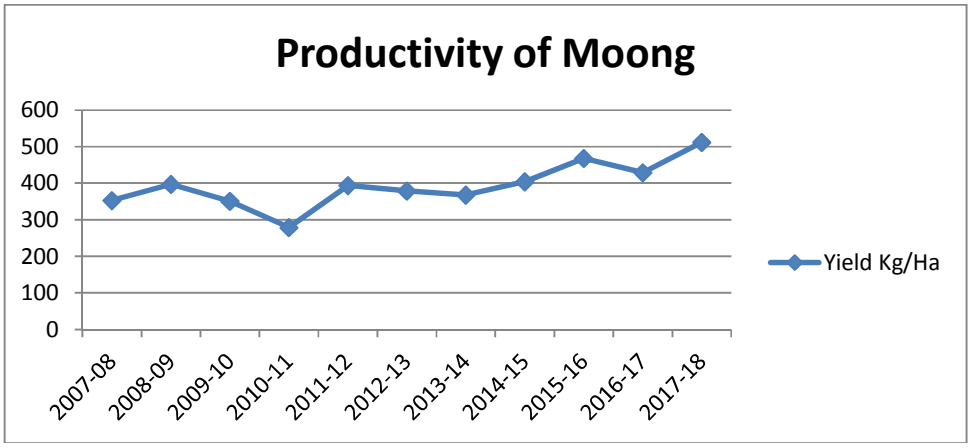

Fig. 2. Time trend of moong productivity

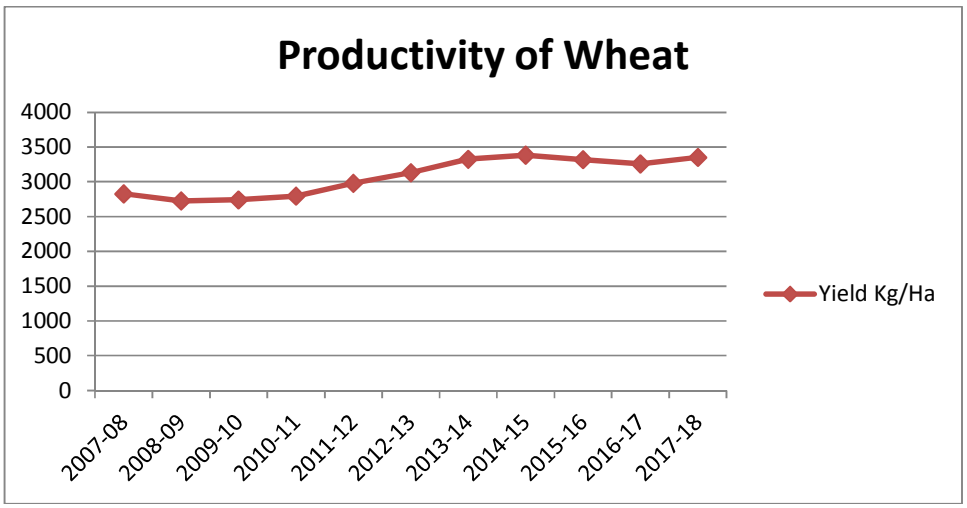

Fig. 3. Time trend of wheat productivity

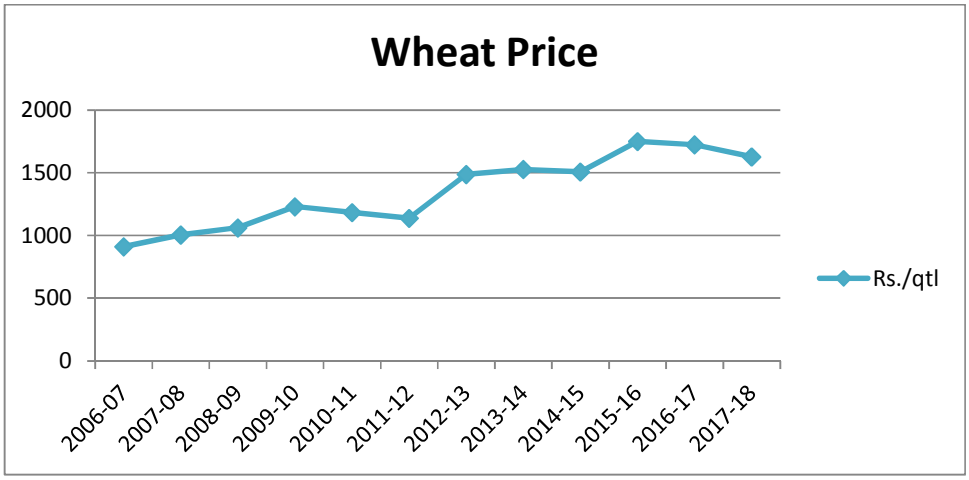

Fig. 4. Time trend of wheat price

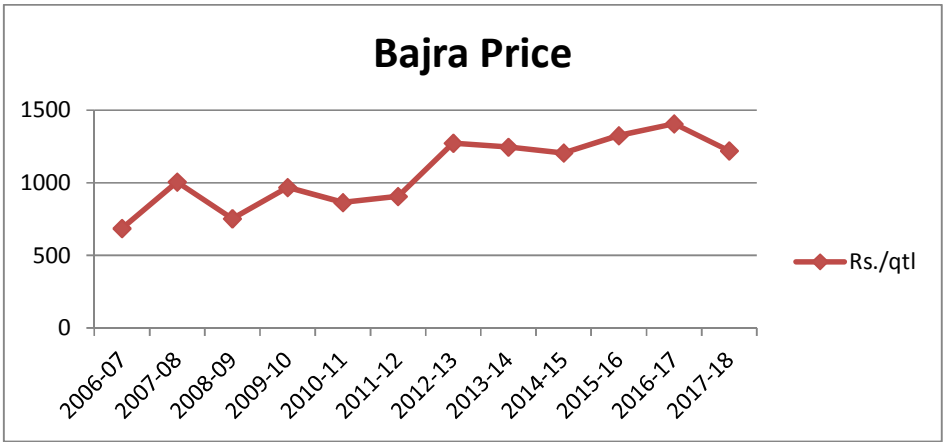

Fig. 5. Time trend of bajra price

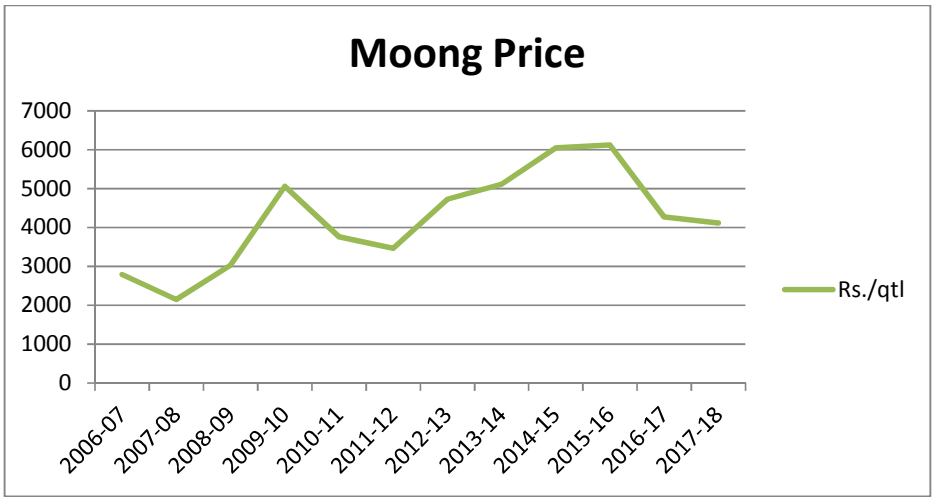

Fig. 6. Time trend of moong price

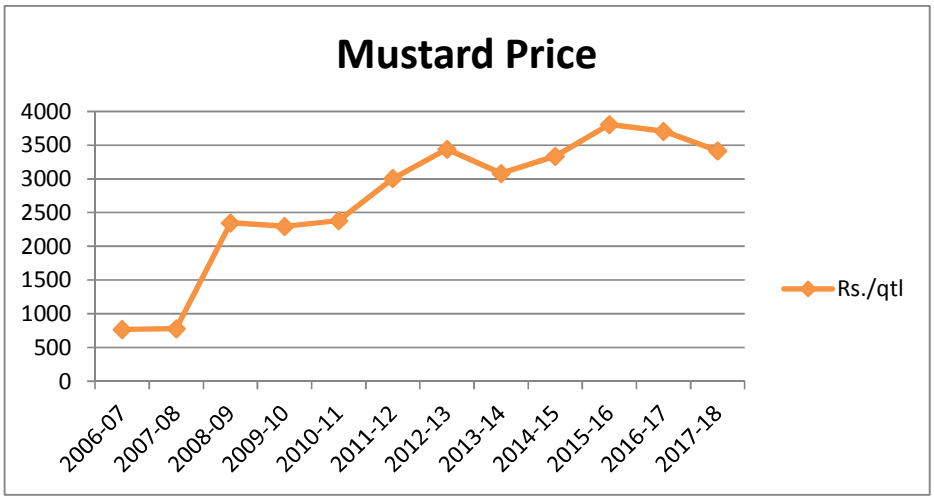

Fig. 7. Time trend of mustard price

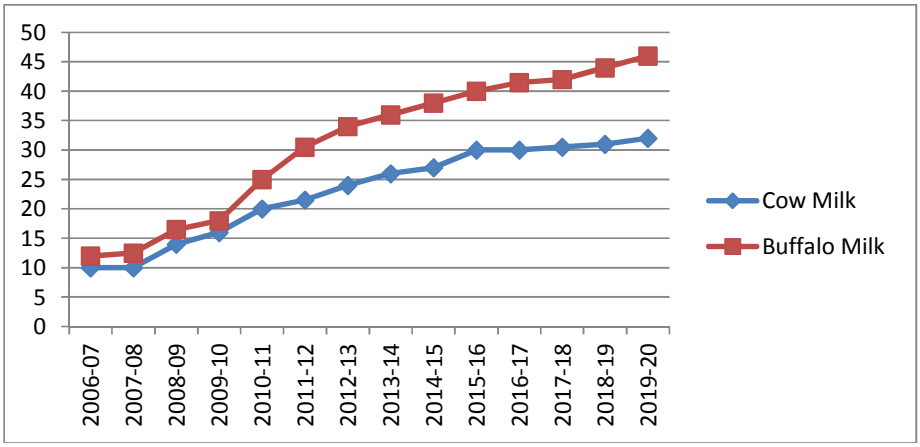

Fig. 8. Time trend of milk price

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