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A Participatory Approach to Identify and Address Key Constraints in Odisha Agriculture Sector

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ABSTRACT

India is predominantly an agrarian country where the agriculture sector contributes around 18.3% of the total GDP. However, India's agricultural productivity is lagging the developed countries. This is mainly attributed to the occurrence of several biotic and abiotic stresses and policy-related problems. Prioritisation of these problems helps to minimise these problems through research and government intervention. The present study was conducted in Khordha district of Odisha to understand the factual and current needs of the farmers. A total of nine major problems were identified in the village based on a transect walk, focused group discussions and key informants' interviews. All the identified constraints were categorised using Rank-Based Quotient (RBQ) and Value-Based Index (VBI). The RBQ and VBI results showed the prevalence of brown plant hopper and low profitability from betel vines as the top two challenges faced by the respondents. Pest infestation caused a loss of 60 per cent in the paddy crop with a monetary loss of about 5000 per respondent per season. Similarly, there was a monetary loss of about 4000 because of low returns to the betel vine crop. Therefore, this study necessitates a comprehensive and collective action plan involving the farmers, Government institutions and agricultural research and extension wings for the overall development of the region.

Keywords: Focused group discussion, Key informants, Problem identification and prioritization, Rank based quotient, Value-based index, Problem-solution tree

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INTRODUCTION

Globalization has resulted in appreciable economic growth in India during the recent past in the industry and service sectors. However, agriculture remains the most promising sector of the Indian economy representing 18.3% of GDP in 2022-23 (Anonymous, 2023). Moreover, it ensures the production of raw materials for the industries, earning through export, and providing maximum employment, especially in rural areas. Moreover, during the pandemic of COVID-19, the growth of almost all industries dipped except agriculture, which showed growth, proving itself as the backbone of the Indian economy (Varshney et al., 2020). Though India has emerged as the most populated country in the world, it has emerged as the second largest producer of food grains, achieved food sufficiency, and has emerged as the largest exporter of rice and wheat in the world (Kumar and Ahmed, 2025). However, production in India is still challenged by low productivity, monsoon dependency and fragmented land holdings. Developing and disseminating improved varieties, agro-techniques, and plant protection measures can effectively improve the former two. However, across the states, the variable agroclimatic conditions, soil types, and farmers' inclination towards specific crops often limit the adoption of a recommendation agro-techniques or a variety. Under such circumstances, understanding the farmers' lifestyle, their crop preferences, the prevailing cropping sequence in a particular area, its marketing facilities, and the problems faced by the farmers become crucial for developing or recommending a developed agro-technology to reduce the drudgery of the farmers.

The Participatory Rural Appraisal (PRA) is an approach and set of methods used to understand the complex realities of rural life (Karuppasamy et al., 2020). PRA is the need of the hour as the agricultural context in India is dynamic and becoming challenging over time. The process becomes more effective as it provides a platform for the farmers to express their needs, challenges, and aspirations, and there is a flow of knowledge and experiences from either side, making it sustainable. The interaction between the scientific and/or extension workers and the farmers helps identify the actual problems the farmers face rather than relying on secondary data or assumptions. Thus, effective communication from the extension workers helps in effective prioritization to bring out solutions for such problems. Moreover, the impact of technology or agrotechnique can be effectively done through the PRA tool. Thus, by empowering farmers, gathering accurate data, and fostering collaboration, PRA can emerge as

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an effective tool for building more resilient, equitable and sustainable agricultural systems (Gaur et al., 2024). Therefore, a detailed understanding of the agricultural landscape of India in terms of the varying agro-climatic zones, soil parameters, land use patterns and diverse cropping systems is inevitable for Indian agricultural researchers to conduct nationwide targeted research for suggesting comprehensive policy measures.

Keeping these facts in mind, the present study was undertaken to study the socioeconomic implications and consequences of technologies, processes and products; to gain detailed insights into the problems, prospects and formulate approaches for futuristic research and to provide comprehensive guidelines to the farmers to minimize their drudgery and improve their livelihood.

MATERIALS AND METHODS

Selection of study area

The Experimental village is Srirampur village, Nariso Gram Panchayet, Balipatna Development Block of Khordha District of the Indian State of Odisha. The village was selected by coordinating with the Paschimeswar FPO under the guidance of ICAR-Central Institute for Women in Agriculture, Bhubaneswar, Odisha. The village was selected purposively based on the involvement of a maximum number of farmers belonging to the small and marginal group (84.27%) and the involvement of a maximum number of women in the agriculture and allied sectors.

Data Collection and PRA Tools Used

The primary and secondary data collection was done by interacting with the progressive farmers of the village and state Agriculture Department Officials. Different PRA tools namely transect walk for preparation, agroecological, social resource map, and technology maps, seasonal problem analysis, trend analysis, technology adoption scenario, problem identification and prioritization, problem and solution tree and comprehensive action plan.

Identification of Problems and its Prioritization

During the focused group discussion with the 40 progressive farmers of the Srirampur village, the major problems of agriculture and allied sectors were identified and were subsequently prioritized using the Rank Based Quotient (RBQ) formula (Kaleeswaran et al. 2024).

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

Where, i=concerned rank, N=Number of farmers, n=number of ranks, f=frequency of farmers for i^{th} rank of technological need.

Calculation of Value-Based Index (VBI)

The VBI is a tool that uses the witnessed economic loss resulting from a particular problem to prioritize the prevailing problems. It is calculated by following the formula:

VBI = RBQ × Percentage of total economic loss experienced at the field level per annum due to the problem

Therefore, in the present study, the VBI was calculated for the problems identified by the key informants of the village. To choose the key informants wisely for prioritizing the most important problems, Spearman's rank correlation (Hauke and Kossowski, 2011) was also determined based on RBQ and VBI.

RESULTS AND DISCUSSION

Selection of the study area and socio-economic profile of the respondents

Brief information about the socio-economic and demographic profile of the village is presented in Table 1. Primary data were collected from 400 respondents (*i.e.* about 20 percent of the residents of the village) and secondary data were also compiled from the state agricultural, horticultural, and animal husbandry departments. 40 key informants (KI) from the village were also identified and primary data about the village were collected by conducting focused group discussions.

Table 1: Socio-economic and demographic profile of the village

Basic information about the village			
Village Name	Srirampur		
Block	Balipatna	**District**	Khordha
State	Odisha		
Geographical Locators	Latitude (in Decimals): 86.02920 N	Longitude (in Decimals): 20.13879 E	
Demographic and social profile			
• Number of Households • Population (No) • Literacy Rate (%) • Social Group (No. of households) • Religion (No. of households)	• 426 • 1908 (Male: 961, Female: 947) • 71.3 % (1361) • OBC: 164, General: 57, SC: 205 • Hindu: 301, Muslim: 125		
Households with major occupation (Number)	Farming: 204	Dairying: 156	
	Goatery-53	Sheep Farming-34	
	Poultry: 87	Fisheries: 12	
	Daily wages: 162		
Category of households by land holding (Number)	Large (>4 ha): 4	Medium (2-4 ha):12	
	Small (1-2 ha): 257	Marginal (<1 ha): 102	
	Landless (0 ha):51		
Total Geographical Area	254 ha		
Total Cultivated Land	213 Ha		
Source of Irrigation	Canal, Bore well		

Trends in resource use and developmental patterns

Srirampur village has various land patterns that include upland, medium and lowland regions scattered throughout the village. Residents of the village are majorly involved in farming activities including field crops and vegetable production, livestock rearing as well as fishing. The most unique feature of the village was the betel vines which were the major source of income for the farmers in past decades. The intersections of natural, physical, social and human resources are being able to make the village prosper in both agriculture and allied activities.

The trends in the status of major agricultural and livestock activities are presented in Figure 1 (a), (b) and (c). The variations in area, yield and prices of different crop and livestock products over the years can be understood from these figures. The betel vine farming has been the backbone and traditional enterprise of farmers of Srirampur village since decades. In 2005, the farmers were getting on an average 1000/- per 1000 betel leaves; however, after 2020, it faced severe challenges due to a decrease in demand and export restrictions from Bangladesh for mitha paan. Sugarcane farming has been considered as a profitable enterprise during last decade due to the increase in price of sugar and increase in number of cooperatives in the area. The livestock sector is the second major source of livelihood in the village. However, the population of livestock such as cattle, sheep and goats has witnessed a cyclical pattern over the last decade subject to frequent natural calamities and disease outbreaks. A gradual increase in the milk yield due to the adoption of improved management practices and high-yielding clones has been noticed. The price of Indigenous cow milk was Rs. 10 per liter in 2005, which has been raised to Rs. 60 per litre in 2023. Similarly, the price of buffalo and crossbred cow milk has also shown an increasing trend from Rs. 20 in 2005 to Rs. 45 per litre in 2023

Fig. 1 (a): Trends in area and prices of betel leaves

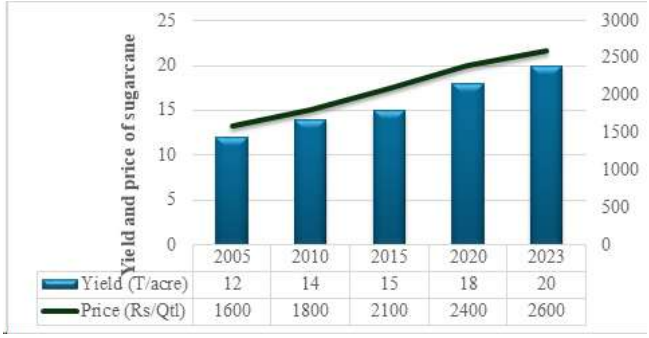

Fig. 1 (a): Trends in yield and prices of sugarcane

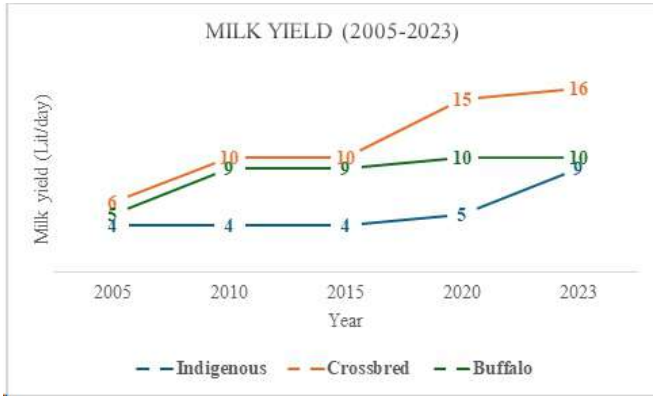

Fig. 1 (c): Trend in milk yield

Seasonal problems encountered by the farmers in agriculture and livestock activities

Various diseases and pest infestations in crops and livestock encountered in different seasons are presented in Table 2. Paddy, being the major crop of the village faces severe losses due to infestation of brown plant hoppers (BPH) in both kharif and rabi seasons. Apart from BPH, paddy stem borer and sheath blight also incur heavy losses to the paddy crops in the village. Among the vegetable crops, okra suffers the most due to white fly, yellow mosaic virus, fruit & shoot borer and damping off. Brinjal fruit and shoot borer and leaf curl in chilli also cause significant losses to respective crops in kharif season. The cattle suffer from both Foot and Mouth Disease and Trypanosomiasis (Surra) diseases when there is a prevalence of high temperature coupled with high humidity i.e. during July, August and September. The goats suffer from Contagious Caprine Pleuropneumonia during the rainy season i.e. from July to September.

Table 2: Seasonal analysis of problems in agricultural and livestock sectors

Crops/Livestock	Feb	Mar	Apr	May
Paddy	Sheath blight	BPH		
Sugarcane				Red rot
Okra	Whitefly	YMV, fruit borer		Fusarium wilt
Pumpkin	GSB			
Brinjal		Fusarium wilt, BFSB, flower and fruit drop		
Chilli		Mites, flower and fruit drop, leaf-curl disease complex		
Tomato	Fruit borer, late blight, leaf curl			
Cattles				
Goats				

Crops/Livestock	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Paddy		Sheath blight, Stem borer		BPH	False smut			
Sugarcane	Red rot							
Okra		Fruit borer, *Cercospora* leaf spot						Damping off
Pumpkin	Fruit fly							GSB
Brinjal			BFSB, bacterial wilt					
Chilli			Leaf-curl, mosaic virus, bacterial wilt , thrips					
Tomato						Damping off		Leaf miner, Whitefly
Cattles		Foot and Mouth Disease Trypanosomiasis (Surra)						
Goats		CCPP						

Notes: BPH: Brown Plant Hopper; GSB: Gummy Stem Blight; BFSB: Brinjal Fruit and Shoot Borer; YMV: Yellow Mosaic Virus, CCPP: Contagious Caprine Pleuropneumonia

Problem identification and prioritization

The problem identification technique was used to identify the major agricultural sector-related problems prevailing in the village, followed by prioritization based on the perceived ranks given by the key informants (KIs) for this technique. Nine major problems about researchable, developmental and extension issues were identified based on the information obtained from the focused group discussions with the selected 40 KIs (Table 3).

Table 3: Major problems identified in the region

Sl. No.	Problems	Type
1	Rice Brown Plant Hopper	Research and extension
2	Brinjal fruit and shoot borer	Research and extension
3	Nutrient deficiency in soil	Research and development
4	Trypanosomiasis in cattle	Extension
5	Limited access to Govt. facilities	Developmental and extension
6	Low yield of vegetables	Research and extension
7	Adoption of alternate professions than agriculture	Extension
8	Lack of processing unit	Extension and development
9	Low economic returns in betel vines	Research and extension

All the KIs were asked to rank the identified problems following a 9-point scale based on their severity, yield and economic losses and losses to the resources of the village (Reddy et al., 2016). The lists of problems along with the corresponding frequency for each rank are presented in Table 4.

Table 4: Ranking of the problems by the Kis

Sl. No	Problems	Ranking of problems									Total (N=30)
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	
1	Rice Brown Plant Hopper	9	4	10	6	1	0	0	0	0	**30**
2	Brinjal fruit and shoot borer	3	5	2	3	6	4	4	2	1	**30**
3	Nutrient deficiency in soil	2	3	1	0	3	11	10	0	0	**30**
4	*Trypanosomiasis* in cattle	4	2	0	5	4	8	2	0	5	**30**

Sl. No	Problems	Ranking of problems									Total (N=30)
		1	2	3	4	5	6	7	8	9	
5	Limited access to Govt. facilities	3	1	2	6	1	0	9	0	8	30
6	Low yield of vegetables	1	2	3	2	4	5	0	10	3	30
7	Adoption of alternate professions than agriculture	2	3	3	3	3	1	1	6	8	30
8	Lack of processing unit	1	3	1	3	1	1	4	11	5	30
9	Low economic returns in betel vines	5	7	8	2	7	0	0	1	0	30
Total	30	30	30	30	30	30	30	30	30	30	

To normalize the subjective perceptions and effect of biased rankings in the RBQ technique, the farmers were asked to state the average annual percentage of loss they faced by each of the problems (Amarawat et al., 2023). Then the Value Based Index (VBI) was estimated by multiplying the RBQ value with the corresponding average annual percentage of loss and a final ranking of the problems was framed (Jeet et al., 2020). The identified problems with their corresponding RBQ and VBI values are presented in Table 5. The problem with maximum VBI value was identified as the topmost researchable problem. It can be inferred from the table that Rice Brown Plant Hopper and Low economic returns from betel vines are the top two problems with the highest VBI values and, hence, identified as the most important issues in the study area.

Table 5: RBQ and VBI values corresponding to the identified problems

Sl. No	Problems	RBQ (%)	Rank	Avg eco. Loss/annum (%)	VBI value	Rank
1	Rice Brown Plant Hopper	82.96	1	60	4977.60	1
2	Low economic returns in betel vines	76.30	2	50	3815	2
3	Brinjal fruit and shoot borer	60.00	3	35	2100	6
4	Limited access to Govt. facilities	53.70	4	40	2148	5
5	Trypanosomiasis in cattle	51.11	5	45	2300	4
6	Low yield of vegetables	46.30	6	45	2083.50	7
7	Adoption of alternate professions than agriculture	45.56	7	30	1366.80	9
8	Nutrient deficiency in soil	44.81	8	55	2464.60	3
9	Lack of processing unit	39.26	9	50	1963	8

Cause and solution analysis of the identified problems

It is a short dendrogram analysis of the problem faced by the farmers in the study region. It is one of the most important PRA tools that uses a bottom-up approach to identify the root causes of the problems and provides possible solutions in a top-down manner.

Brown Plant Hopper (BPH) infestation in paddy

BPH infestation in paddy was the most serious problem with significant yield reduction and the highest economic loss of almost 60 percent for the farmers per annum. BPH attack in paddy fields compels the farmer for a significant amount of expenses in the pest control measures which even worsens the condition of the farmers. The causal diagram of BPH infestation in the paddy field is depicted in Figure 2. The most important signs of BPH attack recorded from the field were the browning of leaves in patches and the lodging of plants. Some of the causes of BPH infestation in the paddy field include the growing of susceptible varieties, high humidity condition of the locality, excess nitrogen application in the field, resurgence and development of resistance to some insecticides.

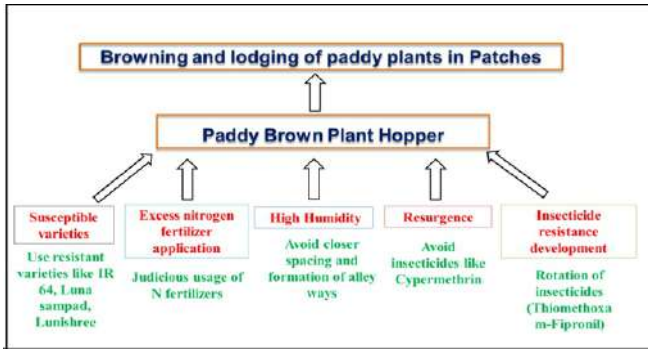

Fig. 2: Causal diagram of BPH infestation in paddy field

The problem of BPH infestation can be ruled out by taking the following measures:

- Adoption of BPH-tolerant varieties like IR 64, PTB 33, ADT 37, and some of the varieties developed by the ICAR-National Rice Research Institute (NRRI), such as Lunishree and Luna Sampad.
- Quantity of nitrogen content can be analyzed by Leaf Colour Chart (LCC) and based on that the farmer can use a judicious dose of fertilizer.
- BPH infestation is more common in highly humid climate conditions; therefore, closer spacing should be avoided and alleyways can be formed.
- Cypermethrin-like insecticides must be avoided for controlling resurgence.
- Insecticides should be applied on a rotation basis to avoid the resistant development by the BPH.

Low economic returns from betel vines

The village was famous to produce premium quality betel vines, which had a special position in national and international markets. But after cyclone *Fani* in 2019 and COVID-19 in 2020, the supply chain of betel leaves has been completely disrupted, which ultimately resulted in a low profit from *Paan* cultivation. Hence, another important problem in the village was identified as low economic returns from betel vines, which is attributed to various causes like the occurrence of natural calamities (mostly cyclones), marketing-related problems and adoption of alternative crops by the farmers & shifting away from betel vine cultivation. Marketing-related problems include a lack of storage & processing units in the village, a high no. of intermediaries in the supply chain, and high price fluctuation of *Paan*. Similarly, farmers are reluctant for betel cultivation due to low wages for labor, disease and pest attacks and lack of trading & export opportunities in the current scenario. The causal diagram of low economic returns from betel vines is depicted in Figure 3.

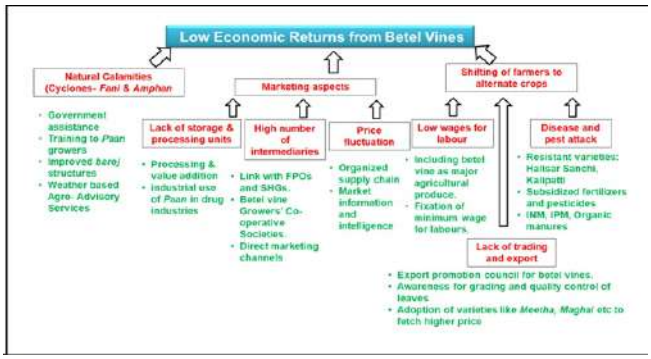

Fig. 3: Causal diagram of low economic returns from betel vines

The following practices can be carried out to overcome the problems related to betel vine cultivation:

- Govt. assurance can be provided in the forms of insurance and compensation after cyclones to re-establish the *Paan Baroj* structures.
- Farmers must be trained in terms of disaster management and coping strategies.
- Weather-based agro-advisory services for that village should be available to the farmers like the status of rainfall, temperature and related humidity information *etc.*
- Multipurpose cold storage, as well as processing unit, can be established in the village for value addition of *Paan* into aromatic oil, candy, flavored ice creams and various medicinal drugs.
- Farmers can be directly linked with SHGs, FPOs as well as betel vine growers' cooperative society to increase the efficiency of the supply chain and prompt marketing practices.
- Direct marketing channels like weekly/fortnightly *haats* can be established in the village coinciding with the picking period.
- Supply chains can be strengthened for channelizing their products directly to the market as well as market information network can be promoted by displaying the market price daily.
- Betel vine can be provided the status of major agricultural produce so that the minimum wage of labor can be fixed.
- Bacterial leaf blight and root rot tolerant varieties like Halisar sanchi, and Kalipatti can be promoted among the farmers along with the integrated disease and pest management practices.
- One Betel Vine Export Promotion Council can be established to stabilize the price and quality control of betel leaves.
- Varieties like Meetha, and Maghai can be promoted to fetch higher prices in both national and international markets due to their taste and consumer preferences.

CONCLUSION

The agriculture and livestock sector served as the main source of income for the villagers. Despite several Governmental initiatives, schemes, and subsidies, the farmers could not get incentives under any kind of accidental situation. Infestation of BPH in paddy, low economic return from betel vines, lack of processing units, Surra disease in cattle, low nutrient content of the soil and disease & pest attacks on horticulture crops were some of the worrisome problems of the region, causing the farmers to adopt alternate professions. After identification and prioritisation of the problems, two topmost issues *i.e.* BPH infestation in paddy and low returns from betel vines were shortlisted and detailed action plans have been suggested to the line departments and village administration to tackle these problems. However, a suitable coordinated approach by farmers, Govt. line departments, and agricultural research & extension institutes can bring out the overall development of the village.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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