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Case study on farming practices and constraints faced by farmers of lateritic belt of Birbhum district, West Bengal, India

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Abstract

Farmers in the lateritic belt of Birbhum district, West Bengal, India face significant agricultural constraints due to agro-climatic, infrastructural, technological, and socio-economic factors. This study conducted in three villages of lateritic belt of Birbhum district, aimed to analyse their farming practices, technologies adopted by them since green revolution, challenges faced and to identify potential solutions. Both qualitative and quantitative approach was adopted, using well-structured interviews with 90 farmers, 30 each from each 3 villages. The findings revealed that small and fragmented landholdings, dependence on erratic monsoon rainfall, poor soil nutrient status were major agro-climatic constraints. Infrastructural constraints included insufficient irrigation facilities and high costs of essential inputs. Among technological constraints, pest infestations causing the most significant yield losses and lack of proper technical assistance were the critical issues. Socio-economic constraints, such as low investment capacity and lower benefit-cost ratio, restricted the risk bearing ability of farmers for adopting new profitable practices. Farmers suggested several measures to mitigate these constraints, including employment guarantee during off-season, subsidy on inputs, short term credits, more crop insurance coverage, and targeted training programs for tackling increasing disease-pest problems. Strengthening irrigation infrastructure, promoting stress-tolerant and high-yielding varieties, promoting cooperative purchasing models for inputs were also suggested by the respondents. This study emphasizes the need for an integrated approach, combining financial support, technological interventions, and knowledge dissemination, to enhance agricultural productivity and profitability in the region.

Keywords: Lateritic soil, constraints, semi-structured interview, pest infestations, employment guarantee, financial support

1. Introduction

The red and lateritic belt of West Bengal, India, mainly comprises the districts of Purulia, Bankura, and parts of Birbhum, is situated between 22º 38' N to 24º 35' N latitude and 85º 75' E to 88º 1' E longitude (Duary *et al*., 2015) [1]. In case of Birbhum district, laterite soils are mainly found in the Mayureswar, Nalhati-1, Bolpur-Sriniketan, Md Bazar and Rajnagar blocks (Sahu *et al*., 2022) [2]. Sahu *et al*. (2022) [2], characterized the lateritic soils of Birbhum district, revealing sandy loam to sandy clay loam texture, acidic pH, low organic carbon, deficiencies in available nitrogen, phosphorus, and sulfur, and significant correlations between soil physico-chemical properties and nutrient availability. The unconsolidated laterite layer of this region experiences severe gully erosion due to a combination of natural and human-induced factors, including fluvial erosion, tropical climate, quaternary geology, and seasonal vegetation changes. "Khoai" or badland are found as a consequence of these events (Samanta and Sarkar, 2014) [3]. Present study was carried out to address several key constraints faced by farmers of lateritic belt of Birbhum district in their agricultural practices, categorized under agro-climatic, infrastructural, technological, and socio-economic challenges.

2. Materials and Methods

The present investigation was carried out during agricultural year 2022-23 (including Kharif, Rabi, summer) in 3 villages i.e., Ruppur, Bahadurpur, Mala of Bolpur-Sriniketan block of Birbhum district. Total 90 farmers, 30 each from each village, were the respondents. Both qualitative and quantitative approach was chosen through well-structured interview to gather information from the respondents. This method gave in-depth insights of major agricultural technologies adoption in the villages, cropping pattern of lateritic belt of the district, experiences of the respondents regarding their farming practices. The aim of the interview was to find key constraints faced by the farmers and suggestions from them for the improvement of their socio-economic status. Suggestions from the sides of farmers were taken for improvising their farming practices and livelihood, and listed according to the frequency of the respondents and numbers of solutions. The collected data of major constraints was analysed using Rank Based Quotient (RBQ)

(Sabarathnam,1988) [4] and presented in tabular format.

Rank Based Quotient (RBQ) = [{Σ(F_i (n+1)-i)}/ (N x n)] x 100

Where, F_i = Frequency of respondents for the concerned rank, n = Total ranks, i= i^{th} rank number, N = Total respondents

3. Results

3.1. Timeline of adoption of different farming technologies and systemic analysis of sequence of crops grown throughout the year

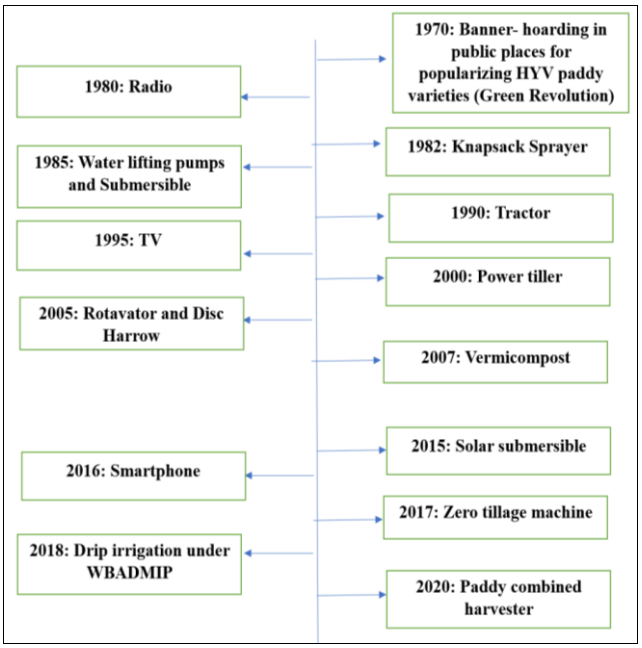

Fig 1: Timeline of agricultural technologies introduced in the villages (Based on cumulative responses of farmers from 3 villages)

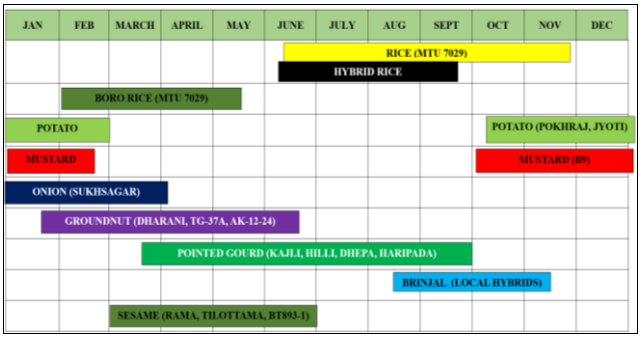

Fig 2: A seasonality diagram depicts the crop grown throughout the season Kharif, Rabi and Pre-Kharif

The major cropping pattern found in the villages were: Rice-Rice, Rice-Mustard, Rice-Potato-Sesame, Rice-Vegetables, Rice-Fallow-Summer Groundnut. Major pulses were not a favourable choice for the respondents due to grazing problems of livestock. Solar pump set, submersible, ponds, Binuria canal water, wells were found as major sources of irrigation water.

3.2. Various constraints of the farmers of lateritic belt of Birbhum district

Among the agro-climatic constraints, the most significant issue was small and fragmented plot sizes, according to the respondents (85.65%). This fragmentation creates difficulties in mechanization and efficient land use, ultimately leading to lower productivity. The heavy dependence on monsoon rainfall reported by the farmers (76.76%), further creates uncertainty in crop production. With unreliable rainfall patterns, farmers struggle to maintain consistent yields and crop cycle for each season. The poor nutrient status of the soil was noted by the farmers (72.41%), suggests that while soil fertility is a concerning issue, which needs to be managed through balanced fertilizer application. Additionally, respondents reported that undulated topography (57.41%) created problems in farming, limiting the effectiveness of irrigation and mechanized farming techniques.

Poor irrigation facilities (77.31%) with gradually decreasing groundwater reserves also creates significant problem, making farmers heavily reliant on erratic rainfall. Limited access to reliable water sources prevents them from adopting water-efficient irrigation techniques, further reducing their productivity. However, recently implemented schemes, e.g., Bagla Krishi Sinchai Yojana or West Bengal Accelerated Development of Minor Irrigation Project are supplying infrastructures for micro-irrigation to the farmers. Also, Infrastructural constraints can further limit agricultural success. One of the concerns is the availability and affordability of necessary inputs (72.31%), which respondents highlighted as a major issue. The high cost of fertilizers, pesticides, and quality seeds makes it difficult for farmers to invest in improved agricultural practices.

Technological constraints are another major challenge in agricultural advancement. The most critical challenge, faced by the farmers, is losses due to pest attacks (97.5%). Pests and diseases significantly reduce yield potential, leading to economic losses. Despite the availability of pest control technologies, their adoption remains limited due to high costs and lack of awareness. Insufficient technical assistance was reported by farmers (78.79%), pointing to a major gap in the extension system. Additionally, respondents indicated that their crops do not respond well to existing chemicals they apply (76.85%), which may be due to suboptimal soil conditions, improper farming methods, or a mismatch between recommended practices and local conditions.

Socio-economic challenges further complicate these difficulties. The most prominent issue, affecting farmers, is their low investment capacity (91.85%). Limited financial resources prevent them from adopting improved farming techniques, purchasing high-quality seeds, and investing in better irrigation systems. The poor benefit-cost ratio (87.77%), reported by farmers, indicates that farming is not highly profitable under current conditions. This discourages investment in agriculture and limits overall productivity. Moreover, respondents highlighted a lack of knowledge about improved technologies (80.83%), further emphasizing the need for targeted training and awareness programs.

Table 1: Degree of different constraints faced by the respondent farmers regarding farming practices

Constraints	Sl. No.	Constraints	RBQ Calculation (Based on 1 to 12 scale)	Percentage	Rank
A. Agro-climatic constraints	1.	Crop depends on monsoon	[{(22×12)+ (16×11) +(12×10) +(12×9) + (6×8)+ (7×7)+ (3×6)+ (6×5)+ (2×4)+ (1×3)+ (2×2)+ (1×1)}/(90×12)] ×100	76.76	IX
	2.	Poor nutrient status of soil	[{(12×12)+ (16×11)+ (14×10)+ (7×9)+ (14×8)+ (7×7)+ (12×6)+ (1×5)+ (3×4)+ (2×3)+ (1×2)+ (1×1)}/(90×12)] ×100	72.41	X
	3.	Small fragmented plot size	[{(44×12)+ (8×11)+ (8×10)+ (8×9)+ (11×8)+ (5×7)+ (4×6)+ (2×5)+ (0×4)+ (0×3)+ (0×2)+ (0×1)}/ (90×12)] ×100	85.65	IV
	4.	Undulated topography creates problem	[{(7×12)+ (4×11)+ (8×10)+ (11×9)+ (10×8)+ (12×7)+ (8×6)+ (7×5)+ (11×4)+ (4×3)+ (2×2)+ (6×1)}/ (90×12)} ×100]	57.41	XII
B. Infrastructure Constraints	5.	Poor irrigation facility	[{(18×12)+ (18×11)+ (12×10)+ (18×9)+ (7×8)+ (6×7)+ (2×6)+ (3×5)+ (0×4)+ (3×3)+ (2×2)+ (1×1)}/ (90×12)} ×100]	77.31	VII
	6.	Required inputs are not available/ costly	[{(20×12)+ (17×11)+ (10×10)+ (8×9)+ (7×8)+ (6×7)+ (5×6)+ (4×5)+ (3×4)+ (5×3)+ (2×2)+ (3×1)}/ (90×12)} ×100]	72.31	XI
C. Technological constraints	7.	Crop doesn't get response to technologies	[{(20×12)+ (18×11)+ (11×10)+ (12×9)+ (10×8)+ (5×7)+ (4×6)+ (2×5)+ (3×4)+ (4×3)+ (0×2)+ (1×1)}/ (90×12)} ×100]	76.85	VIII
	8.	Loss due to pest attack	[{(74×12)+ (7×11)+ (7×10)+ (2×9)+ (0×8)+ (0×7)+ (0×6)+ (0×5)+ (0×4)+ (0×3)+ (0×2)+ (0×1)}/ (90×12)} ×100]	97.50	I
	9.	Insufficient technical help	[{(28×12)+ (11×11)+ (12×10)+ (12×9)+ (7×8)+ (5×7)+ (8×6)+ (2×5)+ (3×4)+ (1×3)+ (1×2)+ (0×1)}/ (90×12)} ×100]	78.79	VI
D. Socio-economic constraints	10.	Low investment capacity	[{(55×12)+ (12×11)+ (6×10)+ (8×9)+ (6×8)+ (2×7)+ (1×6)+ (0×5)+ (0×4)+ (0×3)+ (0×2)+ (0×1)}/ (90×12)} ×100]	91.85	II
	11.	Poor benefit-cost ratio	[{(47×12)+ (8×11)+ (8×10)+ (9×9)+ (10×8)+ (7×7)+ (1×6)+ (0×5)+ (0×4)+ (0×3)+ (0×2)+ (0×1)}/ (90×12)} ×100]	87.77	III
	12.	Poor knowledge about improved technologies	[{(38×12)+ (12×11)+ (6×10)+ (7×9)+ (8×8)+ (10×7)+ (1×6)+ (0×5)+ (2×4)+ (2×3)+ (4×2)+ (0×1)}/ (90×12)} ×100]	80.83	V

It was found that yellow stem borer in rice, late blight in potato, aphid and club root in mustard, wilting and fruit & shoot borer in brinjal were the major diseases-pests prevalent in the area. These were the key issues faced by the farmers as most of the chemicals gave no response to control the damage. With the increase in use of chemicals and decrease in output yield, farmers are hardly getting good returns. Paddy farmers get an average of Rs. 1500 benefit from their crop in 1 bigha. Due to good marketing chain, Government procurement facilities, low investment capacities, farmers don't have alternative option for replacing rice in kharif season.

Table 2: Distribution of suggestions from the respondents

Sl. No.	Suggestions	Frequency (N= 90)	Percentage	Rank
1.	Introduce subsidized loans and microfinance options to address low investment capacity.	67	74.44	III
2.	Strengthen crop insurance coverage to reduce financial risk	77	85.55	II
3.	Conduct village-level training on improved practices by experts	56	62.22	V
4.	Demonstrate pest control techniques to address high losses due to infestations	65	72.22	IV
5.	Develop small-scale irrigation solutions, like community ponds and rainwater harvesting	26	28.89	IX
6.	Promote farmer cooperatives/ farmers producer organization for bulk input purchases at lower costs	30	33.33	VIII
7.	Ensure timely and affordable access to fertilizers, pesticides, and quality seeds	53	58.89	VI
8.	Promote stress-tolerant and high-yielding varieties	47	52.22	VII
9.	Enhance the adoption of organic soil improvement methods to mitigate poor soil nutrient status	17	18.88	X
10.	Employment guarantee for poor, marginal farmers through MNREGA during off-season	80	88.88	I

4. Discussion

Encouraging the adoption of cost-effective, high-yielding, and stress-tolerant crop varieties would be effective strategy for this region. Farmers need high yielding quality seeds suited to small plots and unpredictable climatic conditions. Additionally, promoting organic and bio-fertilizer options could help improve soil nutrient status without imposing excessive financial burdens. Recommendation of more liming, nitrogen, phosphorus, and zinc, organic manure, potassium, boron may be done accordingly. Farmers can benefit from GPS-based fertilizer recommendations without soil testing (Mandal *et al*., 2020) [5]. One of the major promising nutri-cereal in this region can be finger millet which can be grown with limited nutrient and water requirements (Chakroborty, 2024) [6]. Also, farmers can be encouraged to follow conservation agricultural practices in rice-mustard/yellow sarson-pulse (black gram/green gram) based cropping system which can be more profitable (Teja and Duary, 2018) [7]. Modern practices e.g., zero tillage, mulching in rabi crops like wheat, chickepea (Chatterjee *et al*., 2016; Das *et al*., 2022) [8, 9], Paira cropping with toria, lathyrus or other pulses in rice fallow areas (Mandal *et al*., 2022; Duary and Ghosh, 2013) [10, 11] can fetch better returns.

5. Conclusion

Addressing these constraints requires multiple approaches. Improving financial support for farmers is crucial, as many of them don't have sufficient capital to invest in better technologies and inputs. Providing access to affordable

credit, along with government subsidies for seeds and fertilizers, could reduce some of these financial burdens. Additionally, enhancing extension services is necessary to bridge the knowledge gap. Regular field visits by agricultural experts, along with community-based training programs, can help farmers understand and adopt improved techniques suited to this region. Demonstrations of pest control methods and micro-irrigation techniques could mitigate key challenges such as pest infestations and decreasing groundwater reserves. Efforts should also focus on making inputs more accessible and affordable. Cooperative purchasing models through FPOs could enable farmers to buy seeds, fertilizers, and pesticides at lower costs. Ensuring the timely availability of these resources before each cropping season is essential to improving adoption rates. Moreover, investment in infrastructure development, such as small-scale micro-irrigation systems and land consolidation initiatives through community-based farming, can address challenges related to fragmented plots for the small and marginal farmers of this region.

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