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Knowledge and adoption of crop rotation practices among farmers in Badagaon block of Jhansi district, Uttar Pradesh

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Abstract

Crop rotation is one of the important sustainable agricultural practices for maintaining soil fertility, improving crop productivity, reducing pest and disease incidence, and enhancing resource use efficiency. The present study was conducted to assess the knowledge and extent of adoption of crop rotation practices among farmers in Badagaon Block of Jhansi District, Uttar Pradesh. An exploratory research design was employed for the study. Ten villages were selected randomly from Badagaon Block, and 120 farmers were selected, with 12 respondents from each selected village. Data were collected through personal interviews using a pre-tested structured schedule. The findings revealed that the majority of respondents (64.16%) belonged to the middle age group and 89.17 per cent were literate. More than half of the respondents (52.50%) possessed a medium level of knowledge regarding crop rotation, while 17.50 per cent had a high level of knowledge. Similarly, 49.17 per cent of the respondents exhibited a medium level of adoption of crop rotation practices. Correlation analysis showed that education, extension contact and scientific orientation had a positive and highly significant relationship with knowledge level. Adoption of crop rotation was positively and significantly associated with caste, family type, land holding, family size, material possession and annual income. The major constraints perceived by farmers were damage caused by stray animals, lack of resources, inadequate irrigation facilities and small land holdings. The study suggests strengthening extension services, training programmes, and access to agricultural resources to enhance farmers' knowledge and adoption of crop rotation practices.

Keywords: Crop rotation, knowledge, adoption, farmers, extension contact, sustainable agriculture

Introduction

Agriculture is the backbone of the Indian economy and plays a significant role in ensuring food security, employment generation and rural development. Sustainable agricultural production is essential for maintaining soil health, increasing crop productivity and ensuring environmental sustainability. However, continuous cultivation of the same crop often leads to depletion of soil nutrients, increased incidence of pests and diseases, deterioration of soil structure and reduction in crop yields.

Crop rotation is one of the oldest and most effective agronomic practices used to maintain soil fertility and improve crop productivity. It refers to the systematic cultivation of different crops on the same piece of land in a definite sequence over time. Common crop rotations in India include cereal-legume and cereal-oilseed combinations. Crop rotation improves nutrient cycling, enhances soil physical properties, reduces weed infestation, interrupts pest and disease cycles and increases the efficiency of resource

utilization ^[1].

The inclusion of leguminous crops in crop rotations contributes to biological nitrogen fixation, thereby reducing dependence on chemical fertilizers. Crop rotation also promotes soil organic matter accumulation, improves water infiltration, reduces soil erosion and enhances the biological activity of soil microorganisms. Consequently, it serves as an important strategy for sustainable agricultural development and climate-resilient farming systems ^[1, 2].

Despite its numerous benefits, the adoption of crop rotation practices among farmers is influenced by several socio-economic, technological and institutional factors. Limited awareness, inadequate extension support, small land holdings, lack of irrigation facilities, market uncertainties and financial constraints often restrict farmers from adopting diversified cropping systems. Previous studies have examined farmers' decisions and the factors influencing crop rotation and diversification, including economic conditions, resource availability and farm characteristics ^[3, 5].

Farmers' knowledge regarding the benefits and scientific principles of crop rotation plays a crucial role in determining its adoption. Adequate knowledge helps farmers make informed decisions and encourages them to implement improved agricultural practices effectively. Studies on farmers' adoption behaviour have also reported associations between educational attainment, literacy and adoption of crop-rotation-related practices [6].

Adoption is a dynamic process that involves awareness, evaluation, trial and continued use of an innovation. The level of adoption of crop rotation practices varies among farmers depending upon their education, extension contact, economic status, resource availability and risk-bearing ability. Crop diversification and improved cropping plans can contribute to livelihood resilience and sustainable resource management [7, 8]. Understanding farmers' knowledge and adoption behaviour is therefore essential for developing effective extension strategies and policy interventions.

The Bundelkhand region of Uttar Pradesh is characterized by variable rainfall, limited irrigation facilities and predominance of small and medium farmers. Under such conditions, crop rotation can play an important role in improving farm productivity, soil fertility and sustainability. However, information regarding farmers' knowledge and adoption of crop rotation practices in the region is limited. Therefore, the present study entitled "Knowledge and Adoption of Crop Rotation Practices among Farmers in Badagaon Block of Jhansi District, Uttar Pradesh" was undertaken with the following objectives:

1. To study the socio-economic profile of the respondents.
2. To assess the knowledge level of respondents regarding crop rotation practices.
3. To assess the extent of adoption of recommended crop rotation practices among the respondents.
4. To determine the relationship between selected socio-economic variables and the knowledge and adoption levels of respondents regarding crop rotation practices.
5. To identify the constraints faced by farmers in adopting crop rotation practices and to obtain their suggestions for improving adoption.

Materials and Methods

The study was conducted in Badagaon Block of Jhansi District, Uttar Pradesh during 2023–24. An exploratory research design was adopted for the investigation. Badagaon Block was selected purposively from the eight development blocks of Jhansi District. The block consists of 74 villages, out of which ten villages, namely Barata, Ambabai, Bhojla, Garhmau, Digara, Meri, Mawaigird, Simraha, Takori and Palar, were selected randomly. A total of 120 respondents were selected, with 12 respondents from each selected village.

Sampling Procedure

The sampling procedure consisted of purposive selection of Badagaon Block followed by random selection of ten

villages. Twelve respondents were selected from each selected village, giving a total sample size of 120 farmers. The original manuscript describes the respondents as selected through proportionate random sampling in the Abstract; however, the Methods section specifies equal allocation of 12 respondents per village. The present version follows the explicit village-wise allocation reported in the Methods section and removes the unsupported "proportionate" description from the Abstract. This point should be checked against the original sampling records before submission.

Data Collection

Primary data were collected from the selected respondents through a pre-tested structured interview schedule. The investigator personally collected information regarding socio-economic characteristics, knowledge and adoption of crop rotation practices, constraints faced by respondents, and suggestions provided by them. The collected data were carefully tabulated and organized for analysis.

Measurement of Knowledge

Knowledge regarding crop rotation was assessed using a modified knowledge test based on Ernest (1973), as reported in the original manuscript. Each response was scored as 1 for correct and 0 for incorrect answers. Respondents were categorized into low, medium and high knowledge levels on the basis of the mean and standard deviation.

Measurement of Adoption

The extent of adoption of crop rotation practices was measured using an Adoption Intensity Index following Narayan Swamy (1995), with slight modification, as reported in the original manuscript. Adoption statements were scored on a four-point scale: 3 for most adoption, 2 for somewhat adoption, 1 for least adoption and 0 for nil adoption. Respondents were subsequently categorized into low, medium and high adoption levels using the mean and standard deviation.

Analytical Tools

The collected data were analyzed using frequency, percentage, mean, standard deviation and correlation coefficient. The relationship between selected socio-economic variables and knowledge and adoption of crop rotation was examined using the correlation coefficient (r). Constraints faced by respondents were recorded according to their perceptions, tabulated by frequency and ranked in descending order.

Note: The complete bibliographic details for Ernest (1973) and Narayan Swamy (1995), which are cited as methodological sources in the original manuscript, were not provided in the supplied reference list. These details must be verified from the thesis/original sources and added to the final reference list before submission.

Study Area

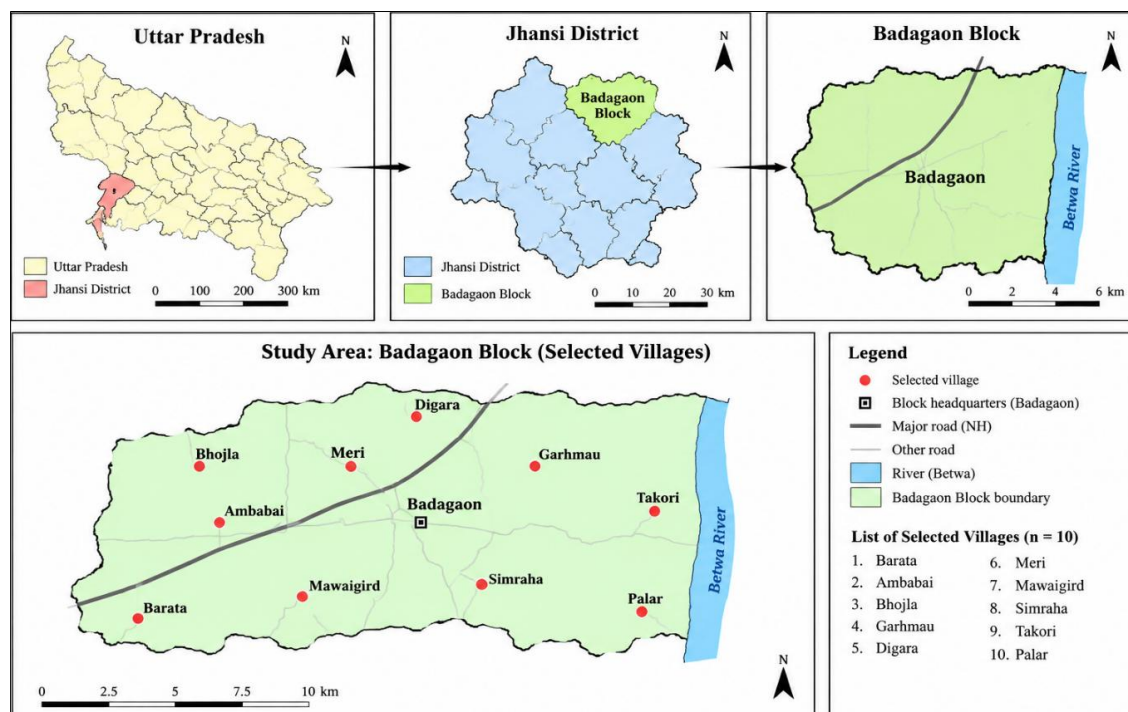


Fig 1: Location map of the study area in Badagaon Block of Jhansi District, Uttar Pradesh

Results and Discussion

Socio-economic Profile of Respondents

Table 1 presents the socio-economic characteristics of the respondents. The majority of respondents (64.16%) belonged to the middle age group (40–60 years), while 21.67 per cent were in the old age group and 14.17 per cent were young. About 89.17 per cent of respondents were literate. The largest educational category was intermediate (30.83%), followed by

graduate and above (24.17%) and high school (23.33%). More than half of the respondents belonged to the backward caste category (55.00%). Most respondents (66.67%) had 7–15 family members, while 30.00 per cent possessed marginal land holdings. Agriculture and animal husbandry was the main occupation for 96.67 per cent of respondents. Annual income was concentrated mainly in the ₹1–2 lakh and ₹2–3 lakh categories.

Table 1: Socio-economic characteristics of respondents (n = 120)

S. No.	Variable	Category	No.	%
1	Age	Young (up to 39 years)	17	14.17
		Middle (40–60 years)	77	64.16
		Old (above 61 years)	26	21.67
2	Education	Illiterate	13	10.83
		Primary school	5	4.17
		Junior high school	8	6.67
		High school	28	23.33
		Intermediate	37	30.83
3	Caste	Graduate and above	29	24.17
		General caste	46	38.33
		Backward caste	66	55.00
		Scheduled caste	8	6.67
4	Family size	Up to 6 members	23	19.17
		7–15 members	80	66.67
		16 and above	17	14.16
5	Land holding	Marginal (<1.0 ha)	36	30.00
		Small (1.0–2.0 ha)	29	24.17
		Medium (2.0–4.0 ha)	31	25.83
		Large (≥4.0 ha)	24	20.00
6	Main occupation	Agriculture & animal husbandry	116	96.67
		Service	2	1.67
		Agriculture labour	1	0.83
		Caste-based occupation	1	0.83
7	Annual income	Up to ₹1 lakh	5	4.17
		₹1–2 lakh	49	40.83
		₹2–3 lakh	47	39.17
		Above ₹3 lakh	19	15.83

Knowledge and Adoption of Crop Rotation Practices

Table 2 presents the mean scores and ranks of knowledge statements and adoption practices. Farmers had the highest knowledge scores for the statements that crop rotation increases crop yield and helps maintain soil health, followed by maintenance of soil fertility. Lower knowledge scores were observed for the concept of crop rotation, alternating

crops with high and low nutrient uptake, and maintaining nutrient levels in grain through crop rotations. On the adoption side, growing crops in rotation ranked first, followed by use of variety and crop mixtures and intercropping legumes with non-legumes. Adoption was comparatively low for weed-management sequences, disease-break sequences and green manuring.

Table 2: Mean score and rank of knowledge statements and adoption practices

Knowledge statement	Mean	Rank	Adoption practice	Mean	Rank
Crop rotation increases the yield of crop	0.975	I	Grown crops in rotation	1.29	I
Crop rotations help in maintaining soil health	0.975	II	Use variety and crop mixtures	0.96	II
Crop rotation maintains soil fertility	0.967	III	Intercrop legumes with non-legumes	0.92	III
Grow deep-rooted crops followed by shallow-rooted crops	0.917	IV	Rotation includes marketed crops	0.91	IV
Rotate the crops	0.852	V	Crop rotation considered in field	0.86	V
Crop rotation helpful in weed control	0.692	VI	Grow legume crop in crop rotation	0.83	VI
Crop rotation helpful in disease control	0.6833	VII	Use crop sequences to aid in controlling weeds	0.13	VII
Benefits of crop rotations	0.675	VIII	Break crop to interrupt disease cycles of oilseeds and pulses	0.09	VIII
Use nitrogen-demanding crops followed by nitrogen-fixing crops	0.608	IX	Grow green manuring crop	0.083	IX
Give importance to previous crop in respect to succeeding crop	0.582	X	Follow one crop with another closely related species	0.075	X
Grow the same type of cereal crop year after year	0.516	XI			
Crop rotation concept	0.275	XII			
Cultivate crops with high and low nutrient uptake alternately	0.18	XIII			
Maintain the nutrients level in the grain by crop rotations	0.067	XIV			

Overall, 52.50 per cent of respondents had a medium level of knowledge, while 30.00 per cent had a low level and 17.50 per cent had a high level of knowledge. The overall mean knowledge score was 0.64. The results indicate that farmers were relatively well aware of the general benefits of crop rotation, whereas knowledge related to nutrient management and scientific crop sequencing was comparatively limited. These observations are consistent with earlier work emphasizing the importance of knowledge, education and information access in farmers' adoption decisions [3, 6].

Relationship between Socio-economic Variables and Knowledge and Adoption

Table 3: Relationship between selected socio-economic variables and knowledge and adoption of crop rotation

S. No.	Socio-economic variable	Knowledge (r)	Adoption (r)
1	Age	-0.0630	0.0380
2	Education	0.3569**	0.0247
3	Marital status	0.1498	-0.0010
4	Caste	0.2095*	0.2869**
5	Type of family	-0.1128	0.3072**
6	Family size	-0.0867	0.2236*
7	Land holding	0.1579	0.3011**
8	Occupation	0.0620	0.0331
9	Material possession	0.1954	0.2240*
10	Housing pattern	-0.0793	-0.0989
11	Social participation	0.2151*	0.1741
12	Annual income	0.2374*	0.1980*
13	Extension contacts	0.4279**	0.1261
14	Scientific orientation	0.3561**	-0.1051
15	Economic motivation	-0.0051	0.1243
16	Risk orientation	0.0724	-0.1387

* Significant at 5% level; ** Significant at 1% level. Critical values reported in the original manuscript: $r = 0.197$ (5%) and 0.257 (1%).

Education ($r = 0.3569$), extension contact ($r = 0.4279$) and scientific orientation ($r = 0.3561$) exhibited positive and highly significant relationships with knowledge. Caste and annual income also showed significant positive relationships with knowledge. The positive association of education and extension contact with knowledge is in line with previous research on farmer adoption and knowledge behaviour [6, 9].

Adoption of Crop Rotation Practices

Nearly half of the respondents (49.17%) were categorized under the medium level of adoption, followed by 25.83 per cent under low adoption and 25.00 per cent under high adoption. The overall mean adoption score was 0.614. Farmers commonly practiced crop rotation involving cereals, pulses and oilseed crops. Adoption was relatively higher for general crop rotation practices but lower for green manuring and disease-break crop sequences. Similar studies have highlighted the role of farm resources, socio-economic conditions and diversification decisions in shaping adoption behaviour [3, 5, 7].

Relationship Between Socio-economic Variables and Adoption

Caste, family type and land holding showed positive and highly significant relationships with adoption. Family size, material possession and annual income also showed significant positive relationships with adoption. These findings indicate that resource availability and socio-economic status influence farmers' willingness and ability to adopt crop rotation practices. Earlier research has likewise identified farm characteristics and economic considerations as important determinants of crop-rotation decisions [3, 5].

Constraints Faced by Farmers

1. Damage caused by stray animals (87.49%)
2. Lack of resources such as improved seed, machinery and

- markets (62.50%)
- 3. Inadequate irrigation facilities (50.00%)
- 4. Small land holdings (46.66%)
- 5. Difficulty in managing multiple crop rotation activities (45.83%)
- 6. Labour shortages (45.00%)
- 7. Traditional farming practices (43.33%)

Suggestions Offered by Farmers

1. Proper fencing to protect crops from stray animals.
2. Promotion of drip and sprinkler irrigation systems.
3. Timely technical guidance through KVKs and extension agencies.
4. Motivation of rural youth towards agriculture.
5. Improved access to institutional credit and government schemes.
6. Increased subsidy support for farm machinery and inputs.
7. Adoption of modern agricultural technologies.

Conclusion

The study concluded that the majority of respondents possessed a medium level of knowledge (52.50%) and adoption (49.17%) regarding crop rotation practices. The predominance of respondents in the medium category may be attributed to their moderate educational status, medium level of extension contacts, average annual income and limited exposure to scientific agricultural information. Although most farmers were aware of the general benefits of crop rotation, their knowledge regarding scientific crop sequencing, nutrient management and advanced crop rotation practices was comparatively limited.

Similarly, the medium level of adoption observed among respondents may be due to inadequate irrigation facilities, small land holdings, lack of resources and the prevalence of traditional farming practices. Farmers generally adopted basic crop rotation practices involving cereals, pulses and oilseeds, but adoption of improved and scientifically recommended crop rotation systems remained limited.

Education, extension contact and scientific orientation significantly influenced farmers' knowledge levels, while caste, family type, land holding, family size, material possession and annual income significantly influenced adoption behaviour. The major constraints faced by respondents included damage caused by stray animals, lack of resources and inadequate irrigation facilities.

Therefore, strengthening agricultural extension services, organizing regular training programmes, improving irrigation infrastructure, promoting scientific crop planning and ensuring timely technical guidance can enhance farmers' knowledge and adoption of crop rotation practices. Increased adoption of crop rotation will contribute to improved soil fertility, higher crop productivity and sustainable agricultural development in the Bundelkhand region.

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