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Analysing the farming system diversity of farmers following integrated farming system in Cooch Behar district of West Bengal

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Abstract

The important reason behind conducting this research in this particular area is, West Bengal is known for its small land holding size of the farmers especially Cooch Behar district. So it is very much important for them to increase their income from the small land holdings. Analyzing the diversity of their farms will help them increase the income levels. The present study was taken place in Cooch Behar-I, Cooch Behar-II & Dinhata-II blocks of Cooch Behar district and 175 farmers following IFS were selected using multi stage random cum purposive method. Data were collected through personal interviews using a well-structured interview schedule specifically designed for the research objectives. In this study, the level of the farming system diversity was considered as one of the dependent variable, while twenty-one independent variables were selected to examine their relationship with the dependent variable. The findings revealed that the majority of the farmers (44.00%) belonged to the medium level category of farming system diversity, followed by 36.57 per cent in the high level category and 19.43 per cent in the low level category. Further analysis indicated that several independent variables, namely family education, annual family income, annual family expenditure, landholding, irrigation status, animal possession, material possession, credit seeking behaviour, information seeking behaviour, scientific orientation, economic orientation and management efficiency showed positive and significant relationship and the variables age showed negative and significant relationship with the farming system diversity.

Keywords: Farming system diversity, integrated farming system

Introduction

Agriculture continues to be the backbone of rural livelihoods in many developing countries, including India, where a majority of farmers operate under small and marginal landholdings. However, conventional monocropping systems often result in declining soil fertility, inefficient resource utilization, and unstable farm incomes due to climatic variability and market fluctuations. In this context, Integrated Farming Systems (IFS) have emerged as an important strategy for sustainable agricultural development by integrating crops with enterprises such as livestock, poultry, fishery, horticulture, and agroforestry. Such integration enhances farm productivity, reduces risk, and improves nutrient recycling within the farm ecosystem (Yadav *et al.*, 2024) ^[1].

Integrated farming systems promote efficient utilization of available resources by linking complementary farm enterprises in a mutually supportive manner. The recycling of crop residues and animal wastes within the farm enhances soil fertility while reducing dependence on external inputs. Research findings indicate that IFS models significantly improve farm profitability, employment generation, and sustainability compared to single-enterprise farming systems (Bhati *et al.*, 2024) ^[2].

In addition to improving farm income, integrated farming systems contribute to environmental sustainability by conserving natural resources and enhancing biodiversity. Diversified farming enterprises increase ecological resilience and reduce the negative impacts associated with intensive monocropping systems. Studies have demonstrated that diversified agricultural systems improve soil health, reduce land degradation, and enhance plant diversity within farm landscapes (Raveloaritiana & Wanger, 2024) ^[8].

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The diversity of farming systems adopted by farmers plays a crucial role in determining farm productivity, livelihood security, and sustainability. Farming system diversity refers to the combination of multiple enterprises and management practices that farmers adopt based on their resources, socio-economic conditions, and agro-ecological environment. Studies have emphasized that integrating enterprises such as crop production, dairy, poultry, horticulture, and aquaculture improves employment opportunities, resource recycling, and economic stability for farm households (Rawat *et al.*, 2025) [9].

The Cooch Behar district of West Bengal, located in the Terai agro-ecological zone of eastern India, possesses favourable climatic conditions, fertile alluvial soils, and abundant water resources that support diversified farming activities. Farmers in this region commonly integrate crop cultivation with livestock, fishery, and other allied enterprises, forming diverse integrated farming system models. Such diversified systems help farmers optimize resource use, generate multiple income sources, and improve livelihood security. Furthermore, diversified cropping and intercropping systems in alluvial regions of eastern India have shown potential for improving productivity and sustainability through efficient land use and nutrient management. (Ankita, B. *et al.*, 2024).

Understanding the diversity of farming systems followed by farmers is essential for designing effective agricultural development strategies and extension interventions. Analysing the different enterprise combinations within integrated farming systems provides valuable insights into resource use efficiency, income generation, and sustainability of farm households. Therefore, the present study aims to analyse the farming system diversity of farmers following Integrated Farming Systems in Cooch Behar district of West Bengal, which will help policymakers, researchers, and extension agencies promote location-specific sustainable farming models for improving farmers' livelihoods.

Methodology

A multi stage, purposive and random sampling procedures were followed in selecting the study area and the respondents for this present study. The present study was conducted in Cooch Behar district of West Bengal which was purposively selected. Three blocks namely Cooch Behar-I, Cooch Behar-II, Dinhata-II were randomly selected from twelve blocks of Cooch Behar district.

From these selected blocks, two villages from each block were selected randomly. From Cooch Behar-I block, Bhogdabri Kesaribari and Elajaner Kuthi were selected. The villages namely Basantapur and Dakshin Kalarayer Kuthi were selected from Cooch Behar-II block. From Dinhata-II block, the villages namely Durganagar and Joygopalganj were selected. The respondents were selected with the help of proportionate random sampling procedure. The total number of respondents was 175 who were adopted integrated farming system from all selected six villages of three blocks. The data were collected with the help of structured interview schedule through personal interview method. The collected data were processed into the statistical tools like frequency, per centage, mean, standard deviation, coefficient of variation, correlation coefficient and regression. For the present study twenty-one independent variables and one dependent variable namely Extent of Farming System Diversity was selected. In measuring farming system diversity we take into account a number of enterprises that we under take in one piece of land or by a single farmer. That means enterprises diversification will be the criteria for measuring the farming system diversity. These enterprise can be agriculture, horticulture, dairy farming, poultry farming, pisci culture, goat farming, vermi-composting, mushroom cultivation or a combination of any of these. There are several measures to calculate the diversity of farming systems like Composite entropy index, Herfindal Index, Modified Entropy index, Ogive Index, Simpson Index of Diversification (SID) and Entropy Index. Keeping the objective of the study in mind, here, a slightly modified Simpson's Diversity Index was used to measure the diversity of farming systems. It is a measure of diversity that considers both richness and evenness. The value of a diversity index rises as the number of enterprises rises and as evenness rises. When all enterprises are equally abundant for a given number of enterprises, the value of a diversity index is maximized. It has the benefits of computational simplicity, robustness, and applicability in a broader range. Simpson's diversity index ranges from zero to one. If there is no diversity or complete specialization exists, the score will be zero and if there is no specialization or complete diversity exists, the score will be one. If there is moderate diversity or specialization exists, the score will be between 0 to 1.

Results and Discussion

Table 1: Profile Characteristics of Respondents (N = 175)

Variable	Category	Frequency	%	Statistics
Socio-personal variables				
Age (X ₁)	Young	84	48.00	Mean = 41.31
	Middle aged	47	26.86	S.D. = 16.09
	Old	44	25.14	C.V. = 38.96
Education (X ₂)	Illiterate	0	0.00	Mean = 2.17
	Primary	43	24.60	S.D. = 0.79
	Higher secondary	59	33.70	C.V. = 36.75
	College and above	73	41.70	
Family size (X ₃)	Small	85	51.43	Mean = 4.77
	Medium	90	48.57	S.D. = 1.78
	Big	0	0.00	C.V. = 37.42
Dependency ratio (X ₄)	Low	78	44.60	Mean = 1.97
	Medium	25	14.30	S.D. = 0.92
	High	72	41.10	C.V. = 47.20
Family education status (X ₅)	Low	34	19.42	Mean = 2.74
	Medium	113	64.57	S.D. = 1.08
	High	28	16.01	C.V. = 39.71
Farming experience (X ₆)	Low	60	34.30	Mean = 2.02
	Medium	52	29.70	S.D. = 0.84

	High	63	36.00	C.V. = 41.67
Occupation (X ₇)	Farming + AH	31	17.10	Mean = 4.38
	Farming + AH + Service	82	46.90	S.D. = 1.41
	Farming + AH + Business	62	36.00	C.V. = 32.26
Socio-economic variables				
Annual family income (X ₈)	Low	20	11.40	Mean = 2.51
	Medium	45	25.70	S.D. = 0.69
	High	110	62.90	C.V. = 27.58
Annual expenditure (X ₉)	Low	25	14.28	Mean = 0.96
	Medium	69	39.42	S.D. = 0.32
	High	81	46.30	C.V. = 33.51
Land holding (X ₁₀)	Low	28	16.00	Mean = 4.15
	Medium	106	60.57	S.D. = 1.59
	High	41	23.43	C.V. = 38.42
Irrigation facilities (X ₁₁)	Low	24	13.70	Mean = 2.86
	Medium	90	61.40	S.D. = 1.13
	High	61	34.90	C.V. = 39.66
Material possession (X ₁₂)	Low	30	17.14	Mean = 19.02
	Medium	109	62.28	S.D. = 7.11
	High	36	20.57	C.V. = 37.43
Animal possession (X ₁₃)	Low	29	16.57	Mean = 5.78
	Medium	92	52.57	S.D. = 1.96
	High	54	30.85	C.V. = 33.97
Socio-psychological variables				
Credit seeking behaviour (X ₁₄)	Low	29	16.60	Mean = 7.18
	Medium	97	61.10	S.D. = 2.41
	High	39	22.30	C.V. = 33.69
Social participation (X ₁₅)	One organization	38	21.70	Mean = 2.21
	More than one organization	62	35.40	S.D. = 0.77
	Membership with position	75	42.90	C.V. = 35.15
Information seeking behaviour (X ₁₆)	Low	33	18.86	Mean = 18.84
	Medium	94	53.71	S.D. = 5.93
	High	48	27.43	C.V. = 31.49
Scientific orientation (X ₁₇)	Low	35	20.00	Mean = 28.85
	Medium	91	52.00	S.D. = 10.47
	High	49	28.00	C.V. = 36.31
Risk orientation (X ₁₈)	Low	41	23.43	Mean = 28.91
	Medium	98	56.00	S.D. = 8.71
	High	36	20.57	C.V. = 30.12
Economic orientation (X ₁₉)	Low	33	18.86	Mean = 29.52
	Medium	107	61.14	S.D. = 10.72
	High	35	20.00	C.V. = 36.32
Innovativeness (X ₂₀)	Low	56	32.00	Mean = 1.99
	Medium	65	37.10	S.D. = 0.79
	High	54	30.90	C.V. = 39.97
Management efficiency (X ₂₁)	Low	36	20.57	Mean = 60.87
	Medium	99	56.57	S.D. = 17.44
	High	40	22.86	C.V. = 28.65

Table 1 shows the details about the profile characteristics of the respondents. In case of socio personal variables, there are variables like age, education, family size, dependency ratio, family education status and farming experience, occupation. Majority of the farmers are young, followed by middle aged and old aged with a mean of 41.31. In case of education with a mean score of 2.17, most of the respondents had an education level of college and above followed by higher secondary education and primary education. All the farmers were almost equally divided into small and medium sized families and no farmer were in the category of big family size and the mean score of the family size is 4.77. When it comes to dependency ratio, the mean score is 1.97 with most of them were in low dependency level category followed by high and medium. In case of family education status, majority of them belongs to medium level of family education status followed by low and high with a mean score of 2.74. Most of the farmers are having high farming experience followed by low and medium farming experiences with a mean

score of 2.02. The variable occupation is distributed with a mean score of 4.38 and it is found that the farmers with the occupation of farming along with animal husbandry and service are more in number, followed by farming along with animal husbandry and business and farming with animal husbandry.

Under the socio-economic variables the variables annual family income, annual family expenditure, land holding, irrigation facilities, material possession and animal possession are considered. In case of annual family income, the mean score is 2.51 and majority of the farmers having high income level followed by medium and low levels. In case of land holding, the average land holding size is 4.15 and out of all the respondents, there are a greater number of small farmers followed by medium and marginal farmers. When it comes to annual expenditure, majority of the respondents belong to high level of annual expenditure category followed by medium and low categories with a mean score of 0.96. As per material possession, most of the respondents have medium level of material possession

followed by high and low levels and the mean score is 19.02. Farmers with medium level of animal possession are more than fifty per cent followed by high and low level of animal possessions. Irrigation status with a mean score of 2.86, has the majority farmers under medium level of irrigation status followed by high and low.

In the category of socio-psychological variables credit seeking behaviour, social participation, information seeking behaviour, scientific orientation, risk orientation, economic orientation, innovativeness, and management efficiency are there. In case of credit seeking behaviour, majority of the farmers are under medium credit seeking behaviour followed by high and low levels with a mean score of 7.18. Information seeking behaviours mean score is 18.84 with majority of the farmers belonging to medium level of information seeking behaviour followed by high and low levels. In case of social participation

with a mean score of 2.21, majority of the respondents were having membership with position in organization followed by next majority were having membership in more than one organization and few of them have membership in one organization. Majority of the respondents have medium level of scientific orientation followed by high and low levels with a mean score of 28.85. Risk orientation with a mean score of 28.91, is having the majority of candidates under medium level followed by low and high levels. In case of economic orientation, most of the farmers belongs to medium level followed by high and low with a mean of 29.52. When it comes to innovativeness, the mean score is 1.99 with majority of the farmers in medium level category, followed by low and high. Management efficiency with a mean score of 60.87, has the majority respondents under medium level followed by high and low.

Table 2: Distribution of the IFS farmers according to their extent of farming system diversity

Sl. No.	Category	Frequency	Percentage	Statistics
1.	Low (<56)	34	19.43%	Range = 10-100 Mean = 77.88 S.D. = 24.50 C.V. = 31.46%
2.	Medium (56-98)	77	44.00%	
3.	High (>98)	64	36.57%	

Table 2 represents the distribution of the IFS farmers according to their extent of farming system diversity. The data were grouped into three categories like low extent of farming system diversity, medium extent of farming system diversity and high extent of farming system diversity. It is apparent from the results that majority of the respondents (44.00%) were having medium level of extent of farming system diversity, followed by high (36.57%) and low (19.43%) levels of extent of farming system diversity. The mean score of the extent of farming system diversity of the respondents is 77.88, standard deviation 24.50 and coefficient of variation is 31.46 percent. From the above results, we can say that majority of the farmers had medium and high extent of farming system diversity. The possible reason behind it might be that the farmers who adopted IFS, might want to diversify their fields to avoid the risk of crop failure, which is very common in depending solely on agriculture.

Table 3: Correlation co-efficient (r) of IFS farmers' profile characteristics with extent of farming System Diversity

Sl. No.	Variables	Correlation
1.	Age (X1)	-0.260**
2.	Family size (X3)	-0.79
3.	Family education (X5)	0.347**
4.	Farming experience (X6)	-0.269**
5.	Annual family income (X8)	0.637**
6.	Annual family expenditure (X9)	0.499**
7.	Land holding (X10)	0.383**
8.	Irrigation status (X11)	0.535**
9.	Material possession (X12)	0.369**
10.	Animal possession (X13)	0.628**
11.	Credit seeking behavior (X14)	0.516**
12.	Information seeking behavior (X16)	0.285**
13.	Scientific orientation (X17)	0.299**
14.	Risk orientation (X18)	0.039
15.	Economic orientation (X19)	0.304**
16.	Management efficiency (X21)	0.549**

Table 3. reflects the correlation between IFS farmers' extent of farming system diversity with their profile characteristics. The

variables such as family education, annual family income, annual family expenditure, landholding, irrigation status, animal possession, material possession, credit seeking behaviour, information seeking behaviour, scientific orientation, economic orientation and management efficiency showed a positive and significant relationship with the extent of farming system diversity, indicating that better socio-economic status, resource availability and behavioural orientation of farmers encourage diversification and integration of multiple farm enterprises (Patel *et al.*, 2022; Chaudhary & Patel, 2021; Meena *et al.*, 2023) [7, 3, 5]. The variable age showed a negative and significant relationship, suggesting that younger farmers tend to adopt diversified farming enterprises more actively compared to older farmers (Singh *et al.*, 2022) [10]. The variable family size showed a negative but non-significant relationship, implying that family size alone may not have a strong influence on the diversification of farming systems (Kumar & Sharma, 2021) [4]. Further, risk orientation showed a positive but non-significant relationship with the extent of farming system diversity, indicating that although farmers with higher risk orientation may be inclined towards diversification, the relationship was not statistically significant (Patel & Desai, 2023) [6].

Table 4: Chi-square test between IFS farmers' extent of farming system diversity and five independent categorical variables

Sl. NO.	Variable	Degrees of freedom	Chi-Square value
1.	Education (X2)	4	68.526**
2.	Dependency ratio (X4)	4	15.194**
3.	Occupation (X7)	4	104.291**
4.	Social Participation (X15)	4	28.283 **
5.	Innovativeness (X20)	4	91.568**

Table 4. reflects the non-parametric chi-square analysis between IFS farmers' extent of farming system diversity with their categorical variables. The variables education, dependency ratio, occupation, social participation and innovativeness showed significant relationship with the dependent variable extent of farming system diversity at 1 percent level of significance.

Table 5: Regression analysis of IFS farmers' profile characteristics with their farming system diversity

Sl. No	Variable	Unstandardized coefficients		Standardized coefficients Beta	't' value
		B	Std. Err.		
1	Age (X1)	-.105	.113	-.069	-.926
2	Family size (X3)	-.602	.594	-.044	-1.014
3	Family education (X5)	1.959	1.040	.087	1.883
4	Farming experience (X6)	-.226	.207	-.083	-1.094
5	Annual family income (X8)	-.864	2.111	-.033	-.409
6	Annual family expenditure (X9)	17.889	5.213	.237	3.432**
7	Land holding (X10)	-.680	1.368	-.044	-.497
8	Irrigation status (X11)	4.184	1.101	.193	3.801**
9	Material possession (X12)	.150	.166	.044	.904
10	Animal possession (X13)	3.742	.636	.300	5.885**
11	Credit seeking behavior (X14)	1.161	.513	.115	2.266*
12	Information seeking behavior (X16)	.205	.187	.050	1.097
13	Scientific orientation (X17)	.229	.109	.098	2.108*
14	Risk orientation (X18)	-.100	.125	-.036	-.801
15	Economic orientation (X19)	.388	.100	.170	3.875**
16	Management efficiency (X21)	.228	.071	.163	3.216**

(R² = 0.718)

Table 5. reflects regression analysis between extent of farming system diversity and other twenty one independent variables of IFS farmers. The variables annual family expenditure, irrigation status, animal possession, credit seeking behavior, scientific orientation, economic orientation and management efficiency are positively and significantly contributing towards characterizing the dependent variable extent of farming system diversity. Irrigation status plays a major role in rain fed areas to take three crops in a year, which contributes to his higher income. The farmers with higher earning capacity can diversify their farms easily. Having a high animal possession can provide the farmers an extra income so that he can integrate more number of enterprises at his farm. The farmers with high credit seeking behavior can able to invest in something through which his income will be increased and integrated farming system is one of them. A farmer following IFS and with high scientific approach will tries to follow the IFS, which is developed at the research station. The enterprises will be compatible with each other and the diversity will be more. Farmers with high economic orientation always looks to maximize the profits, through seeking the information from different sources regarding profit earning activities and the farms' diversity will be increased. A farmer with high management efficiency can manage more enterprise combinations at their farms which means the diversity will be more in their farms. These might be the plausible reasons for the positive and significant contribution of these variables in case of characterizing the extent of farming system diversity.

The R² value being 0.718 it is to infer that twenty one independent variables put together have explained 71.80 percent variation embedded with the extent of farming system diversity. But still 28.20 percent variation embedded with predicted one remains unexplained. So, there is a scope to incorporate more contextual variables for better explicability. These findings are unique and not supported by any of the previous studies.

Conclusion

The present study entitled "Analysing the farming system diversity of farmers following Integrated Farming System in Cooch Behar district of West Bengal" reveals that Integrated Farming System (IFS) plays a significant role in enhancing the diversification and sustainability of farm enterprises in the study area. The findings indicate that a considerable proportion of the farmers have adopted multiple farm components such as crop

production, livestock, fisheries, and other allied enterprises, which together contribute to improved resource utilization and livelihood security. The integration of various enterprises within the farming system has enabled farmers to efficiently recycle farm resources, reduce production risks, and generate regular income throughout the year.

The analysis of the extent of farming system diversity shows that the majority of the respondents fall under the medium level of farming system diversity, followed by those with high and low levels of diversity. This suggests that while many farmers have adopted diversified farming practices, there is still scope for further integration of additional enterprises to enhance the overall productivity and sustainability of the farming system. The presence of a smaller proportion of farmers with low diversity indicates the need for increased awareness, training, and institutional support to encourage broader adoption of integrated enterprises.

Overall, the study highlights that Integrated Farming System is an effective approach for improving farm income, optimizing resource use, and ensuring environmental sustainability in the region. Strengthening extension services, promoting farmer capacity building, and facilitating access to inputs, credit, and markets can further enhance the adoption and diversification of IFS components among farmers. Therefore, policy interventions and extension efforts should focus on promoting diversified integrated farming models suitable to the local agro-ecological conditions of Cooch Behar district to ensure sustainable agricultural development and improved livelihoods for farming communities.

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