

ORIGINAL RESEARCH PAPER

DOI: <https://doi.org/10.64672/IJIFR/25.11.13.03.019>

FACTORS AFFECTING PADDY YIELD: AN ANALYTICAL STUDY OF TRIPURA

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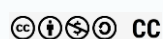
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ABSTRACT: *This study critically explores the dual dimensions of agricultural productivity and Cost-Return integration, focusing on paddy cultivation in the Sepahijala and South Tripura districts of Tripura, India. The region's agricultural economy remains constrained by marginal and small landholdings, low market access, suboptimal input use, and inadequate irrigation. Methodologically, the study is grounded in both production economics and agricultural marketing frameworks. Primary data were collected from 370 paddy producing farm households across eight purposively selected villages using a stratified sampling approach, and supplemented with secondary data from official sources. Two multivariate regression models are employed: the first analyses the factors affecting paddy productivity, while the second examines the determinants of modern technology adoption. To assess cost, revenue, and profitability, the study adopts the cost concepts and accounting framework developed by the Commission for Agricultural Costs and Prices (CACP), incorporating measures such as Cost A1, Cost A2, Cost B, cost C. The study offers context-specific policy insights aimed at strengthening credit systems, promoting market infrastructure, and advancing sustainable agricultural practices among smallholders in Northeastern India.*

KEYWORDS: *Paddy, Productivity, Input Cost, Profit, Tripura.*

PAPER CITATION:

Shil, K., Sen, A.: "Factors Affecting Paddy Yield: An Analytical Study Of Tripura", *International Journal of Informative & Futuristic Research (IJIFR)*, Vol.(13) (3), November 2025, pp. 416 -430.



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1. INTRODUCTION

An economy in its transition from subsistence farming to commercial farming goes through some major stages. Commercial farming silently or covertly assumes the marketing of the product in the best possible way so that the agriculture marketing can be sustainable in one way and it will be amply rewarding on the other. The destiny of the peasantry can be significantly changed when and only when a well built and sustainable agrarian product prevails. Agriculture is the lifeline of rural economies across India, and in the northeastern state of Tripura, it plays a central role in ensuring food security and sustaining livelihoods.

Based on the data of paddy productivity scenario across 8 districts of the state (published by the statistical department, Government of Tripura) it is noticed that Sepahijala and South Tripura districts hold the first and second positions in terms of area brought under the paddy cultivation. This respective positions are held by the two districts long since. The objectives of the study have been fixed 3 with unambiguous description of each. By combining secondary data with primary field-based research, this study will provide a comprehensive analysis of the productivity and cost-return of paddy in Tripura. The findings are expected to yield valuable recommendations for policymakers aimed at enhancing agricultural productivity and improving the marketing systems for paddy, ultimately benefitting farmers and the broader agricultural economy of the state.

2. STATEMENT OF THE ISSUE

The farmers of the Sepahijala district and South Tripura district in particular and the state of Tripura in general have been facing impediments or barriers in marketing of agriculture surplus at reasonable prices in a sustainable way. This study has been primarily based on the relevant agricultural data of the Sepahijala and South Tripura districts. The study is concerned with paddy cultivation which is the chief cereal of the state. The data on paddy cultivation will encompass to Kharif (K) and Rabi (R) crops for making the study meaningful. Sepahijala and South Tripura districts in Tripura have moderate to good fertility for agricultural crops, but with some limitations.

3. SIGNIFICANCE OF THE STUDY

The significance of the study bears at least two important aspects:

Social Aspects:

- Social amity and solidarity will be fortified significantly. Because most of the farmers will get accesses to marketing causing an upward thrust on social interaction.
- Reduction of social tension will also be curtailed as the farmers can raise their income by proper marketability of agriculture surplus.

Economic Aspects:

- With same level of production an agriculture household can increase their family income by getting better price and by boosting the level of sales as well.
- Improvement of agri-marketing system will result in buildup of multiple agricultural storage system. This will render an opportunity to the farmers for realising a better price in the lean season for their harvest.
- It has some positive effects on growth of employability in agriculture.
- The issue of poverty in the agriculture sector can be tackled to a certain extent.
- Standard of living of the agrarian households will improve due to rise in income.

4. OBJECTIVES OF THE STUDY

This study will try to fetch up the following objectives:

- i. To identify and analyse the socio-economic factors influencing paddy productivity
- ii. To assess the impact of factors affecting the adoption of modern technology of paddy.
- iii. To indentify the input cost of paddy cultivation.

5. RESEARCH METHODOLOGY & SURVEY DESIGN

This study examines the socio-economic factors influencing paddy productivity and their impact on yield across eight villages, covering 370 surveyed households. Households are classified into 8 villages separately as well as marginal, small, and medium categories based on landholding size.

The undertaken study is, *prima facie*, based on an ideal mix of Purposive and Random Sampling for the sake of justice to the Work. All districts or villages are not having equal importance to and opportunity for Paddy cultivation. In this stage Purposive Sampling is quite meaningful.

As the average size of districts in Tripura is pretty small, the study is started from districts to villages to paddy growing households (which serve as the smallest unit for statistical investigation). At the initial stage for getting 2 districts (Sepahijala and South Tripura) selected the Purposive Sampling is adopted. Again for selecting 8 villages under 2 districts (4 villages from each district) the Purposive Sampling technique is used. Thus, the data size related to paddy growers will be selected by using probability proportional to size sampling technique from eight selected villages under study.

Table 1: Purpose Sampling for 2 district (Sepahijala and South Tripura)													
Year	State	District	Agri-Sub-Division	Block	Category	Village Name	No. of Households (HHs)	No. of Farming HHs	No. of Paddy Farming	HH %	Sample Size (Overall)	Proportional HH	Actual No. of HH (Rounding Figure)
2022-2023	TRIPURA	South Tripura	Bagafa	Julaibari	Rank-I	West Pilak	980	980	670	13.91	370	51.48	51
					Rank-II	Muhuripur	983	943	630	13.08	370	48.41	48
					Rank-III	Jolaibari	770	728	530	11.01	370	40.73	41
					Rank-IV	Ramraibari	830	810	680	14.12	370	52.25	52
2022-23		Sepahijala	Bishalgarh	Bishalgarh	Rank-I	Gopinagar	789	789	450	9.35	370	34.58	35
					Rank-II	Nabinagar	1259	276	255	5.30	370	19.60	20
					Rank-III	Golaghati	1330	1330	1000	20.77	370	76.84	77
					Rank-IV	KK Nagar	1410	1240	600	12.46	370	46.11	46
						TOTAL	8351	7096	4815	100		370	370

Source: Calculated Primary data

$$n = N/I + N(e^2)$$

Where n = sample size,

N = population size and e = sampling error = 0.05

6. STATISTICAL ANALYSIS

Descriptive Statistics: Mean, percentage distribution, and classification of socio-economic factors.

Regression Analysis: Estimates the impact of independent variables on productivity. Model

Validation: R^2 , Adjusted R^2 , and F-statistics used to evaluate model strength and significance.

6.1 Insight into the Villages

Agriculture in Sepahijala and South Tripura is overwhelmingly dominated by marginal farmers (91% of households, 75% of farmland), while small and medium/large farmers play only a minor role. Marginal farmers face resource disadvantages, with lower irrigation access (57%), smaller labour availability, and weaker educational attainment (over two-thirds below higher secondary), all of which constrain productivity and adoption of modern practices. Farming remains subsistence-oriented, with paddy as the dominant crop, especially in the Kharif season. Market participation is also weak, as 64% of farmers depend on local traders, reflecting low bargaining power and institutional gaps.

6.2 Family Size, Family Workers and Agricultural Workforce

The survey of 370 households in eight villages of Sepahijala and South Tripura highlights the central role of family labour in agriculture. The average family size is 3.79, with 32.83% of members working as family workers. Of these, 91.54% are engaged in agriculture, reflecting heavy dependence on farming. Category-wise, marginal households show the highest share of agricultural family workers (92.33%), while small households record lower agricultural participation (82.5%), and semi-medium & others are fully dependent (100%). Land-labour ratios reveal severe constraints: each agricultural worker cultivates only 0.02 acres, while the land per total family worker averages 0.05 acres (slightly higher for small farmers at 0.07 acres).

6.3 Analysis of Cropping Intensity

Cropping intensity measures land use efficiency by assessing the number of crops grown annually on the same land. In the surveyed villages, paddy is the dominant crop, covering 85.4% of the total cultivated land annually—48.70% in Kharif season and 38.16% in Rabi season. Vegetable cultivation remains minimal at 14.56%, mainly in areas with inadequate irrigation. Across all landholding categories—marginal, small, and medium & large—the land area under paddy is consistently higher in Kharif than in Rabi. The overall cropping intensity is 167.91%, varying by farm size: 170.38% for marginal farmers, 164.07% for small farmers, and 134.69% for medium & large farmers. The higher cropping intensity among marginal farmers suggests a greater dependency on land for livelihood, while larger farms exhibit lower intensity, possibly due to mechanization or crop rotation practices.

6.4 Factors influencing productivity of paddy (per Acre)

In order to determine the determinants of paddy productivity a simple linear multiple regressions analysis will be adopted with the help of OLS method. The equation is as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_{11} X_{11} + u_i$$

Where α stands for intercept and $\beta_1, \dots, \beta_n$ are the partial regression coefficients. u_i is the stochastic disturbance terms.

Y = Productivity of Rice (i.e. production per acre in rupees)

X_1 = Cost of Bullock/Mech. Labour (Rs./Acre)

X_2 = Cost Human Labour (Rs./Acre)

X_3 = Cost of Seeds (Rs./Acre)

X_4 = Cost of Fertilisers (Rs./Acre)

X_5 = Cost on Pesticide (Rs./Acre)

X_6 = Irrigation Charges (Rs./Acre)

X_7 = Gross Cropped Area (in Acre)

X_8 = Ratio of Workers to Family Size

X_9 = Proportion of Area under HYV (%)

X_{10} = Formal Credit (Rs./Acre)

X_{11} = Informal Credit (Rs./Acre)

The study utilizes a straightforward statistical method called Ordinary Least Squares (OLS) multiple regression to analyze the specific factors that influence how much paddy (rice) farmers produce. This method was chosen because it reliably and efficiently calculates the effect of each individual input factor on the final yield, providing a clear and unbiased understanding of which variables drive productivity. The equation:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_{11} X_{11} + u_i$$

Where Y represents paddy productivity (output per acre in monetary terms), and the 11 independent variables (X_1 to X_{11}) represent key inputs and socio-economic factors affecting productivity. Each of these variables has been carefully selected based on its theoretical and empirical significance in agricultural productivity studies.

7. RESULT ANALYSIS

7.1 Input Cost

(i) Cost of Bullock/Mechanical Labour

Significant in many villages (1, 2, 4, 5, 6, 7, 8, pooled, marginal). Signs are mostly negative (e.g., -0.02*, -0.03, -0.01). At 1% and 5% significance, this clearly indicates that higher bullock/mechanised labour cost reduces productivity → due to either inefficiency or diminishing marginal returns from mechanisation.

(ii) Cost of Human Labour

Significant at 5% in Village-2 (negative: -0.01*) and Small farms (-0.01*). Also at 1% in Village-6 (positive: 0.01*). Where labour is scarce/efficient (Village-6), more labour input increases productivity. Where disguised unemployment exists (Village-2, Small), extra labour reduces productivity.

(iii) Cost of Seeds

Highly significant in many villages at 1% and 5% (V-2: 0.08**, V-3: -0.02, V-5: 0.06, V-6: -0.03, V-7: 0.06*). Positive for some (Small farms: 0.08***), negative for others (where seeds are high-quality and optimal, they raise yield; but where seeds are overused or of poor quality, they reduce productivity)

(iv) Cost of Fertilisers

Significant at 1% in V-2 (-0.01**), V-4 (0.04*), V-6 (-0.09), V-7 (0), pooled (-0.02). Mostly negative relationship means excessive fertiliser application beyond optimal level reduces productivity. Positive in Village-4 (0.04***) means balanced fertiliser use helps productivity.

(v) Cost of Pesticides

Strongly significant in V-3 (-0.11**), V-5 (0.09*), V-6 (0.05*), V-8 (0.03*), pooled (0.01), marginal (0.01*). Positive in most means controlled pesticide use boosts productivity. Negative in Village-3 and Small farms means misuse or overuse reduces productivity.

(vi) Irrigation Charges

Highly significant at 1% in Village-1 (0.04**), V-2 (0.17*), V-3 (0.15*), V-5 (0.09*), V-8 (0.08*), Small farms (0.04**). Always positive means better irrigation access consistently increases productivity.

7.2 Farm & Family Characteristics

(i) Gross Cropped Area

Significant in V-1 (4**), V-2 (6.87, no star), V-4 (16.57, no star), Pooled (4**). Strongly positive means larger landholdings are associated with higher productivity. Pooled model shows this at 1% significance, so the result is robust across all villages.

(ii) Ratio of Workers to Family Size

Extremely significant in almost all cases (V-1: 9.27***, V-2: 24.4, V-4: -18.38, V-5: 36.22, V-6: 37.36, V-7: 54.15). Mostly positive and highly significant indicates availability of family labour supports paddy productivity. Exception: Village-4 and Village-8 (negative) means disguised unemployment where too many workers reduce per-head productivity.

(iii) Proportion of Area under HYV

- (iv) Positive in V-1 (0.14*), pooled (0.04), Marginal (0.14*), Small (0.34**) means HYV adoption significantly increases productivity. Negative in V-2 and V-8 (not significant).

7.4 Credit Variables

(i) Formal Credit

Only significant in Village-4 (-6.14*) at 1% means negative impact, meaning credit is either misused or not invested in productivity-enhancing inputs. In other cases, insignificant.

(ii) Informal Credit

Completely insignificant everywhere suggests that credit (formal or informal) has no direct impact on productivity, probably due to diversion of funds.

(iii) Goodness of Fit

R²: ranges 0.15–0.53. Best fit in Village-2 (0.53), Small farms (0.53), weakest in V-5 (0.17).

Adjusted R²: 0.08–0.27 in most villages signifies explanatory power is modest.

(iv) F-value:

Pooled = 7.07*** (significant at 1%) means Model is statistically valid.

Villages with high F (V-2: 16.7, V-1: 7.07, pooled) implies model fit is strong.

Some villages (V-5, V-7) have weaker F-values (<2), meaning poor explanatory strength.

D–W Statistics: Between 1.5–2.6 which means no serious autocorrelation.

So, Highly Significant (1%): Irrigation, Gross Cropped Area, Ratio of Workers to Family Size, HYV adoption, Bullock/Mech Labour cost, Seeds (mixed).

Moderately Significant (5%): Human Labour (some villages), Fertilisers (negative effect), Pesticides.

Weakly Significant (10%): Seeds, Fertilisers, HYV adoption in some villages.

Not Significant: Credit (formal/informal).

7.5 Factors affecting the adoption of modern technology (per Acre)

To analyse the factors affecting or determining the modern technological adoption for the paddy cultivation, the OLS estimate of simple linear multiple regression methodology can be used and a regression equation can be developed for the sample villages or subdivisions. The heterogeneity or variation in the regressions can be shown by computing the value of R².

The multiple regression models can be as follows:

$$Y = \alpha + \beta_1 D_1 + \beta_2 X_1 + \beta_3 X_2 + \dots + \beta_6 X_5 + u_i$$

Where Y is the dependent variable and X₁ to X₅ are independent variables. α is the intercept coefficient and β_i are the partial regression coefficients, u_i is the stochastic disturbance terms.

Y = Intensity of Adoption of HYV Paddy (% of Farm Area under HYV Paddy)

X₁ = Farm Size (Total Operated Land in Acre)

X₂ = Tenancy (Leased in land as a percentage of own land in acres)

X₃ = Credit (Both formal and Informal Credit in Rupees)

X₄ = Ratio of Agricultural Workers to Size of Operated Land (i.e. Labour-Land Ratio)

X₅ = Ratio of Family Workers to Total Family Members (or, subsistence pressure)

X₆ = Education of the Head of the Farm Household.

Worthy to note;

This study analyzes the adoption of High-Yielding Variety (HYV) rice technology in Tripura, a practice essential for regional agriculture but not as widespread as expected. The research assesses adoption using the proportion of farmers cultivating HYV rice and the percentage of land area dedicated to it. A multiple linear regression model (OLS method) was employed to identify the specific factors hindering the intensity of adoption across the sampled villages.

8. RESULT ANALYSIS

The regression analysis of factors affecting adoption of modern technology in paddy production across eight villages reveals both consistent patterns and village-level heterogeneity.

- **Farm Size Effect (X1):** Farm size emerged as the most consistent and positive determinant of technology adoption. This finding was consistent across individual villages (V-1, V-4, V-5, V-6) and in the pooled model, suggesting that larger farms' capacity to bear risks and access credit makes them more inclined to adopt new technologies.
- **Tenancy (Leased Land) (X2):** While generally insignificant at the village level, tenancy showed a negative and significant effect in the pooled model, implying that insecure tenure discourages investment in modern inputs and costly technologies without assured long-term benefits.
- **Credit (Formal & Informal) (X3):** Credit had a surprising negative coefficient in the pooled results and mixed effects across villages. This suggests that available credit is often diverted towards consumption or non-productive purposes rather than technology adoption, meaning access alone is insufficient without proper monitoring and direction.
- **Labour-Land Ratio (X4):** The labour-land ratio had a negative and significant overall impact, indicating that high dependence on agricultural labor reduces the incentive to adopt labor-saving modern technology. However, in some villages (V-3, V-4), the effect was positive, reflecting local variations.
- **Subsistence Pressure (Family Labour Ratio) (X5):** The role of subsistence pressure was village-specific. It had a very strong positive influence in V-8 but was not statistically significant in the overall pooled results.
- **Education of Head of Household (X6):** Education had a strong positive effect in the pooled model and in many villages. This indicates that human capital is an essential driver of technology diffusion, as educated farmers are more likely to understand and accept new farming methods.
- **Model Fit:** The study's regression models demonstrated high variability in explaining technology adoption at the local level, with R^2 values ranging widely from **16% to 61%** across different villages. The combined (pooled) regression model had a relatively low overall explanatory power ($R^2 = 0.161$), indicating that a single aggregate analysis fails to capture the diverse local socio-economic conditions influencing adoption patterns. Despite the low R^2 , the pooled model was statistically significant ($F = 11.597$), confirming that the chosen independent variables jointly have a valid and non-random effect on technology adoption across all villages. Overall, farm size and education were identified as the strongest and most consistent drivers of adoption, while tenancy and credit constraints acted as aggregate-level barriers. The findings underscore the need for flexible, village-specific policies—rather than uniform interventions—to improve land tenure security, enhance credit efficiency, and strengthen farmer education programs.

8.1 Analysis of cost and return of paddy per Acre:

An initiative can be made for the study to evaluate the cost and return in the paddy cultivation across the farm sizes. And later on another attempt can be made to observe the impact of various components on the total cost. Generally in Economics total cost is the aggregation of Total Fixed Cost and Total Variable Cost. This is why to compute the cost function initially we have to determine all the independent variables and their corresponding values. Such cost function can be estimated with the help of OLS estimate of the Cobb-Douglas type of cost function.

To estimate the cost function the following concepts of cost can be incorporated:

Cost- A_1 = Cost of hired human labour
 + Value of owned bullock labour
 + Value of hired bullock labour
 + Value of owned machine charges
 + Hired machine charges
 + Value of manure, fertilisers, pesticides, plant nutrients and insecticides
 + Depreciation repairs and maintenance of implements and farm buildings

- + Value of seeds
- + Irrigation charges (canal water charges and charges from other sources both own & hired)
- + Land revenue, cesses and other taxes
- + Interest on working capital
- + Interest on Crop Loan
- + Miscellaneous expenses

Cost-A₂= Cost A₁ + Rent paid for leased-in land

Cost-B= Cost-A₂+ Imputed rental value of own land (less land revenue paid thereupon) + Imputed interest on owned fixed capital (excluding land)

Cost C= Cost B + Imputed value of family labour.

8.2 Tabular Presentation (Calculated)

Table 2: Villages of Study Area

Category	Marginal	Small	Others	All	% Share of Farms
	(0 to less than 2.5 Acres)	(2.5 to less than 5 Acres)	(Medium & Large) (Above 5 Acres)		by each Village
Village-1	28	7	0	35	9.46
Village-2	14	4	2	20	5.41
Village-3	66	10	1	77	20.81
Village-4	46	0	0	46	12.43
Village-5	50	3	0	53	14.32
Village-6	45	1	0	46	12.43
Village-7	40	1	0	41	11.08
Village-8	50	2	0	52	14.05
TOTAL	339	28	3	370	100
% Share of Farms by Each Category	91.62	7.57	0.81	100	

Source: Calculated Primary Data

Table 3: Family Size, Family Workers and Agricultural Workforce

Villages	Size Group	Total No. of Farms	Average Family Size	Average Family Worker per HH	Average Agri Family Worker per HH	% Share of Family Workers in the Total Family Size	% Share of Agri Family Workers in the Total Family Size	% Share of Agri Family Workers in the Total Family Worker	Average Area Performing per Agri Worker	Average Area Performing per Total Worker
V-1	Marginal	28	4.25	1.46	1.96	34.45	31.09	90.24	0.02	0.06
	Small	7	4.86	1.43	2.14	29.41	29.41	100	0.02	0.07
	Others	0	0	0	0	0	0	0	0.00	0.00
	All	35	4.37	1.46	2	33.33	30.72	92.16	0.02	0.07
V-2	Marginal	14	3.5	1.71	1.5	48.98	38.78	79.17	0.02	0.04

	Small	4	4.25	2	2.5	47.06	35.29	75	0.03	0.07
	Others	2	3	1.5	1.5	50	50	100	0.02	0.03
	All	20	3.7	1.75	1.7	47.3	37.84	80	0.02	0.04
V-3	Marginal	66	4.08	1.09	1.62	26.77	26.02	97.22	0.02	0.06
	Small	10	4.3	1.1	1.3	25.58	23.26	90.91	0.01	0.06
	Others	1	5	1	2	20	20	100	0.02	0.10
	All	77	4.12	1.09	1.58	26.5	25.55	96.43	0.02	0.06
V-4	Marginal	46	3.35	1.2	1.33	35.71	33.12	92.73	0.01	0.04
	Small	0	0	0	0	0	0	0	0.00	0.00
	Others	0	0	0	0	0	0	0	0.00	0.00
	All	46	3.35	1.2	1.33	35.71	33.12	92.73	0.01	0.04
V-5	Marginal	50	3.6	1.24	1.46	34.44	31.67	91.94	0.02	0.05
	Small	3	4.67	1.67	2	35.71	21.43	60	0.03	0.09
	Others	0	0	0	0	0	0	0	0.00	0.00
	All	53	3.66	1.26	1.49	34.54	30.93	89.55	0.02	0.05
V-6	Marginal	45	3.53	1.13	1.64	32.08	30.19	94.12	0.02	0.05
	Small	1	3	1	1	33.33	33.33	100	0.01	0.03
	Others	0	0	0	0	0	0	0	0.00	0.00
	All	46	3.52	1.13	1.63	32.1	30.25	94.23	0.02	0.05
V-7	Marginal	40	3.83	1.28	1.6	33.33	29.41	88.24	0.02	0.05
	Small	1	6	2	3	33.33	16.67	50	0.06	0.18
	Others	0	0	0	0	0	0	0	0.00	0.00
	All	41	3.88	1.29	1.63	33.33	28.93	86.79	0.02	0.06
V-8	Marginal	50	3.66	1.22	1.58	33.33	31.69	95.08	0.02	0.05
	Small	2	4	1.5	2	37.5	25	66.67	0.03	0.08
	Others	0	0	0	0	0	0	0	0.00	0.00
	All	52	3.67	1.23	1.6	33.51	31.41	93.75	0.02	0.05
V-All	Marginal	339	3.73	1.23	1.58	32.94	30.41	92.33	0.02	0.05
	Small	28	4.46	1.43	1.86	32	26.4	82.5	0.02	0.07
	Others	3	3.67	1.33	1.67	36.36	36.36	100	0.02	0.05
	All	370	3.79	1.25	1.6	32.83	30.06	91.54	0.02	0.05

Source: Calculated Primary Data

Table 4: Cropping Intensity

Village	Size Group	Total No. Of farms	Total Area in Acre	Share of Paddy (Kharif)	Share of Paddy (Rabi)	Share of Paddy (Total)	% Share of Vegetables	Colu.7 + Colu.8	Total Operated Land	Cropping Intensity
V-1	Marginal	28	75.4	49.07	41.11	90.19	9.81	100	47	160.43
	Small	7	30	62.67	37.33	100	0	100	23.2	129.31
	Other	0	0	0	0	0	0	0	0	0
	All	35	105.4	52.94	40.04	92.98	7.02	100	70.2	150.14
V-2	Marginal	14	38.44	35.38	35.38	70.76	29.24	100	19.62	195.92
	Small	4	24.8	37.1	37.1	74.19	25.8	10	12.4	200

							1	0		
	Other	2	24.8	35.48	35.48	70.97	29.0 3	10 0	12.4	200
	All	20	88.04	35.89	35.89	71.79	28.2 1	10 0	44.42	198.2
V-3	Marginal	66	150.4	43.35	31.12	81.12	18.8 8	10 0	90.6	166
	Small	10	33.4	56.29	16.17	72.46	27.5 4	10 0	21.6	154.6 3
	Other	1	11.6	51.72	34.48	86.21	13.7 9	10 0	7.2	161.1 1
	All	77	195.4	46.06	28.76	79.94	20.0 6	10 0	119.4	163.6 5
V-4	Marginal	46	86.4	37.43	32.2	69.63	30.3 7	10 0	59.32	145.6 5
	Small	0	0	0	0	0	0	0	0	0
	Other	0	0	0	0	0	0	0	0	0
	All	46	84	36.12	32.64	68.76	31.2 4	10 0	59.32	141.6
V-5	Marginal	50	94.88	59.49	44.31	94.52	5.48	10 0	53.24	178.2 1
	Small	3	20	44	40	84	16	10 0	10.4	192.3 1
	Other	0	0	0	0	0	0	0	0	0
	All	53	114.8 8	56.79	43.56	92.69	7.31	10 0	63.64	180.5 2
V-6	Marginal	45	70.52	51.42	47.45	98.87	1.13	10 0	39.86	176.9 2
	Small	1	7.2	50	50	100	0	10 0	3.6	200
	Other	0	0	0	0	0	0	0	0	0
	All	46	77.72	51.29	47.68	98.97	1.03	10 0	43.46	178.8 3
V-7	Marginal	40	67.6	54.44	44.97	95.27	4.73	10 0	37.4	180.7 5
	Small	1	5.2	53.85	23.08	76.92	23.0 8	10 0	2.8	185.7 1
	Other	0	0	0	0	0	0	0	0	0
	All	41	72.8	54.4	43.41	93.96	6.04	10 0	40.2	181.0 9
V-8	Marginal	50	75.88	50.66	41.43	92.09	7.91	10 0	40.04	189.5 1
	Small	2	10	48	36	84	16	10 0	5.6	178.5 7
	Other	0	0	0	0	0	0	0	0	0
	All	52	85.88	50.35	40.8	91.15	8.85	10 0	45.64	188.1 7
V-All	Marginal	339	659.5 2	47.93	38.9	86.58	13.4 2	10 0	387.08	170.3 8
	Small	28	130.6	51.15	32.31	83.46	16.5 4	10 0	79.6	164.0 7
	Other	3	26.4	56.06	48.48	66.67	33.3 3	10 0	19.6	134.6 9

	All	370	816.5 2	48.7	38.16	85.44	14.5 6	10 0	486.28	167.9 1
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Source: Calculated Primary Data

Table 5: Factors Influencing the Productivity of Paddy

Category	Village-1	Village-2	Village-3	Village-4	Village-5	Village-6	Village-7	Village-8	Village-All	Marginal	Small
Independent Variables	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
Intercept	38.9 2	96.83	-43.367	27.8	51.33	62.59	52.08	131. 16	38.9 2	33.93	96.83
	22.1	93.15	44.04	90.29	76.82	60.81	68.46	57.5	22.1	23.45	93.12
Cost of Bullock/Mech . Labour (Rs./Acre)	0.01 *	0**	0.01**	- 0.03* **	0.01* *	- 0.02* *	- 0.02* *	- 0.01 **	0.01 *	0.01*	0*
	0	0.01	0.01	0.06	0.01	0.01	0.01	0.01	0	0	0.01
Cost Human Labour (Rs./Acre)	0*	- 0.01* *	0*	0*	0*	0.01*	0**	0**	0*	0*	- 0.01* *
	0	0.01	0	0	0	0	0.01	0.01	0	0	0.01
Cost of Seeds (Rs./Acre)	0**	- 0.08* **	-0.02**	- 0.03* *	0.06* *	- 0.03* *	0.06* *	0.03 **	0**	0.01* *	- 0.08* **
	0.01	0.05	0.03	0.04	0.04	0.04	0.04	0.04	0.01	0.01	0.05
Cost of Fertilisers (Rs./Acre)	- 0.02 **	- 0.01* **	-0.06**	- 0.04* **	0**	- 0.09* *	0***	0**	- 0.02 **	- 0.02* *	- 0.01* **
	0.02	0.08	0.03	0.05	0.04	0.04	0.05	0.04	0.02	0.02	0.08
Cost on Pesticide(Rs./ Acre)	0.01 **	-0.09	-0.1***	-0.04	0.09* **	0.05* **	0.08	0.03 ***	0.01 **	0.01* *	-0.09
	0.03	0.14	0.06	0.1	0.09	0.09	0.1	0.09	0.03	0.03	0.14
Irrigation Charges (Rs./Acre)	0.01 **	0.04* **	0.17** *	0.15	- 0.09* **	- 0.04* **	- 0.08* **	- 0.08 ***	0.01 **	0.05* *	0.04* **
	0.03	0.09	0.05	0.1	0.09	0.07	0.09	0.08	0.03	0.03	0.09
Gross Cropped Area (in Acre)	4***	6.87	0.53	16.57	6.03	-0.88	-7.69	- 0.06	4***	6.08	6.89
	0.9	4.68	2.21	4.9	3.93	3.96	6.19	3.43	0.9	1.21	4.68
Ratio of Workers to Family Size	0.85	2.93	40.44	-18.38	19.92	18.79	54.15	- 50.2 2	0.85	-3.98	2.93
	9.27	24.4	20.81	36.22	37.36	31.12	31.3	27.1 3	9.27	10.37	24.4
Proportion of Area under	0.14 **	-0.17	0.66	-0.41	0.09	0.14	0.16	0.06 ***	0.14 **	0.1**	-0.17

HYV (%)	0.04	0.34	0.15	1.03	0.13	0.15	0.14	0.08	0.04	0.04	0.34
Formal Credit (Rs./Acre)	0*	0*	0*	-6.14*	0*	0*	0*	0*	0*	0*	0*
	0	0	0	0	0	0	0	0	0	0	0
Informal Credit (Rs./Acre)	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*
	0	0	0	0	0	0	0	0	0	0	0
R ²	0.18	0.53	0.5	0.31	0.42	0.37	0.28	0.2	0.18	0.19	0.53
Adjusted R ²	0.15	0.21	0.41	0.08	0.27	0.17	0.01	0.03	0.15	0.16	0.21
F	7.07	1.67	5.85	1.38	2.7	1.83	1.04	0.88	7.07	6.87	1.67
No. of Observations	35	20	77	46	53	46	41	52	370	339	28
No. of Variables	12	12	12	12	12	12	12	12	12	12	12
D-W Test	1.59	2.05	1.47	1.54	1.71	1.59	2.2	2.61	1.59	1.58	2.05
Note: Bold colour figures indicate S.E and *, ** and *** represent 1%, 5% and 10% significance level respectively.											

Source: Calculated Primary Data

Table 6: Factors Affecting the Adoption of Modern Technology

Dependent Variable (Y): Adoption of Modern Technology in Paddy Production									
Independent Variables	V-1	V-2	V-3	V-4	V-5	V-6	V-7	V-8	V-All
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	-13.247	-	12.35	-	-35.268	19.414	12.338	59.016**	3.787
	-0.654	-0.929	1.247	-2.325	-1.342	0.94	0.402	2.107	0.472
Farm Size (X1)	9.134*	2.639	2.745	3.399*	25.309*	26.543*	22.784	9.802	7.108*
	2.323	0.829	1.143	2.78	3.987	4.025	1.593	0.929	3.349
Tenancy (Leased in land as a percentage of own land in acres) X2	-0.002		0.006	0.003	-0.356				-
	0.978		0.112	1.204	-0.618				0.044*
Credit (Both formal and Informal Credit in Rupees) X3	0	0.001	4.865	0.000**	0	-0.002*	0.001	-0.002	-0.001*
	-0.924	0.89	0.28	-1.798	0.159	-2.779	0.889	-1.155	-2.916

Ratio of Agricultural Workers to Size of Operated Land i.e. Labour-Land Ratio (X4)	0.087	-11.18	-5.024** *	1.662**	-1.089	-3.618	-15.667** *	-2.221	-4.576* *
	0.012	-0.994	-1.775	2.169	-0.23	-0.908	-1.745	-0.392	-2.477
Ratio of Family Workers to Total Family Members or subsistence pressure (X5)	9.497	22.03 4	9.48	3.748	83.189	-4.767	64.728	-80.853** *	7.98
	0.351	0.702	0.563	0.691	1.602	-0.131	1.303	-1.725	0.575
Education of the Head of the Farm Household (X6)	1.141	12.81 3	-0.924	0.412	0.559	-3.165	0.926	0.736	3.968*
R ²	0.324	0.566	0.161	0.213	0.475	0.607	0.55	0.164	0.161
F	2.237	3.656	2.233	1.76	6.937	12.35	8.72	1.802	11.597
DF	35	20	77	46	53	46	41	52	370
Note: *, ** and *** show the significance level 1%, 5% and 10% respectively and digits in bold colours are 't' values									

Source: Calculated Primary Data

Table 7: Cost and Return of Paddy Production Per Acre

Villages	Land Holding	TR / Acre	Cost A1	Cost A2	Cost B	Cost C	TR-A1	TR-A2	TR-Cost B	TR-Cost C	% Share of A1 in Cost-C	% Share of A2 in Cost-C	% Share of Cost-B in Cost-C
V-ALL	All	40573	15781	18862	29543	38104	24792	21711	11030	2469	41	50	78
	Marginal	39961	15795	19005	29500	38037	24166	20955	10460	1924	42	50	78
	Small	47245	15660	17493	30255	39050	31586	29752	16990	8195	40	45	77
	Medium	47475	15367	15367	27682	36849	32108	32108	19792	10626	42	42	75
V1	All	40939	15763	17367	29211	38104	25176	23572	11727	2834	41	46	77
	Marginal	41444	15841	17846	29601	38395	25603	23598	11844	3049	41	46	77
	Small	38915	15448	15448	27653	36938	23467	23467	11262	1976	42	42	75
V2	All	48750	15788	15788	28467	37654	32962	32962	20283	11096	42	42	76
	Marginal	49342	15805	15805	28618	37725	33537	33537	20723	11616	42	42	76
	Small	47625	16094	16094	28512	37887	31532	31532	19114	9739	42	42	75
	Medium	46857	15063	15063	27317	36692	31794	31794	19540	10165	41	41	74
V3	All	49749	15796	22046	35658	44684	33953	27703	14091	5065	35	49	80

	Marginal	48779	15780	22293	35724	44739	32999	26486	13056	4040	35	50	80
	Small	56254	15886	21019	35950	45075	40368	35235	20304	11179	35	47	80
	Medium	48710	15975	15975	28414	37164	32735	32735	20296	11546	43	43	76
V4	All	36605	15895	28371	38920	47480	20710	8234	-2316	-10875	33	60	82
	Marginal	36605	15895	28371	38920	47480	20710	8234	-2316	-10875	33	60	82
V5	All	38996	15811	16350	25953	34184	23184	22646	13043	4812	46	48	76
	Marginal	38666	15840	16411	25939	34239	22827	22256	12728	4428	46	48	76
	Small	44484	15342	15342	26185	33269	29143	29143	18299	11216	46	46	79
V6	All	34624	15694	15694	24050	32392	18930	18930	10574	2232	48	48	74
	Marginal	34351	15695	15695	23979	32312	18656	18656	10372	2038	49	49	74
	Small	46924	15650	15650	27229	35979	31274	31274	19695	10945	43	43	76
V7	All	37111	15858	15858	24976	33299	21253	21253	12135	3812	48	48	75
	Marginal	37026	15860	15860	24957	33270	21166	21166	12068	3756	48	48	75
	Small	40513	15800	15800	25725	34475	24713	24713	14788	6038	46	46	75
V8	All	36703	15652	15652	24948	33073	21051	21051	11755	3630	47	47	75
	Marginal	36640	15686	15686	24975	33150	20955	20955	11665	3490	47	47	75
	Small	38268	14813	14813	24265	31140	23455	23455	14003	7128	48	48	78

Source: Calculated Primary Data

9. CONCLUSION

Paddy farming is cash-profitable everywhere but economically profitable only in some villages. Village 2 and 3 showed the best performance, Village 4 is severely loss-making while others having around low positive margins. Medium farms perform better than marginal farms, confirming scale economies. The sustainability of paddy depends on raising TR (through yield/price gains) and reducing Cost-C (through tenancy reform, mechanization, and input efficiency). Target interventions in Village 4 (tenancy reform, input/irrigation support) improve yields through technology, water management, and pest control. Reduce costs via mechanization, credit, and collective input use. Diversify livelihoods where paddy remains persistently unviable.

Paddy is profitable over cash costs (A1 & A2) but only marginally profitable over full economic cost (C). The overall margin (TR-C) is very small, making the system fragile. Returns vary sharply across villages. Village 2 performs best, while Village 4 shows losses even over Cost-B and Cost-C due to low TR and high tenancy cost share. Farm size effect: Larger farms (medium > small > marginal) consistently achieve better net returns, suggesting economies of scale. Cost structure: Family labour contributes 20% of Cost-C. High tenancy (A2 share) in some villages, especially V4, erodes profitability.

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