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A Purposive Study on Village Households at Hydropower Projects in Odisha: The Awareness-practice Gap

Swagat Kishore Mishra[1]*, Bibhunandini Das[2], Pramod Kumar Patjoshi[1]

[1]School of Management, Centurion University of Technology and Management (CUTM), Odisha, India, [2]Department of Economics, Berhampur University, Odisha, India. *Corresponding Author's Email: swagatkishoremishra@gmail.com

Abstract

The public economic system of hydropower plants (HPPs) offers a multifaceted research scope, ranging from technological imperatives and assessments to ethnographic studies and environmental resource allocation. The study is based on purposive sampling of 287 village households in the vicinity of hydropower plants in Odisha, using a structured and validated questionnaire survey to collect data on socioeconomic conditions, agricultural practices, and hydropower-related livelihoods. The sample comprises 10 villages selected under Water Panchayats associated with five large-scale hydroelectric power projects in Odisha. A Logit regression model is applied to estimate the determinants of Climate Resilient Agriculture (CRA) by integrating institutional economics including Transaction Governance, Reduction in Risk and Uncertainties, Collective Action, and Social Norms. Other independent variables include Economic Benefits received from HPP (employment, skill development training, and health camps), family economic status (below Poverty Line), the family entitlement to Public Distribution System (PDS) for Rice and Structure of House (kutcha or others). The study analyses the awareness-practice gap levels in the village communities using the econometric model, reliability, and adequacy. Results show that North principles on uncertainty reduction (0.53, p = 0.04, z = 2.05) and integrated farming system (awareness 0.427659, p = 0.0076; practice 0.392779, p = 0.0083) have positive impact on Climate Smart villages based on the practice and awareness on CRA.

Keywords: Awareness-practice Gap, Climate Resilient Agriculture, Logit Regression, Odisha, Purposive Study.

Introduction

Hydropower Projects in Odisha

Managing resources efficiently is one of the government's primary roles in navigating economic progress. Besides infrastructure outlay, enhancing institutional strength and regulatory systems, studies suggest that effective governance also builds public trust (1), which is essential for attracting investment and expanding infrastructure networks. In addition, studies also ascertain that water governance challenges directly impact the utility and distribution of water, as in the case of Tunisia, where policy decisions and economic incentives interlace significantly, shaping these outcomes (2). Furthermore, studies highlight that national-level analysis significantly masks geographical differences. Besides, institutional support, such as farming subsidies and educational initiatives, has helped rural communities in Mexico mitigate the effects of climate change (3), while governance shortcomings concerning access to credit and technical expertise continue to pose a significant threat to farmers. The case study of Hydropower governance is explained through the Nam Theun-2 2 Hydropower Project. This study asserts that public involvement and detailed economic evaluations have influenced environmental protection and promoted equitable resource distribution (4). Public opinion towards the development of hydropower projects often pivots on consultation practices to efficiently address information related to hydropower development (5). Studies argue that the clarifications of hydropower projects based on long-term economic and social development in developing countries can trigger notable socio-economic shifts, such as community development and employment opportunities. More effective mechanisms for turning local short-term growth into long-term development are imperative (6). Hydropower, a major contributor to renewable energy, supports economic growth but also impacts ecosystems and communities. Studies

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highlight the pricing policies and market dynamics shaping energy systems (7), while others note the benefits of clean energy alongside the risks of displacement and ecological damage (8). Comparisons of small and large projects show that large hydropower projects enhance energy security but cause ecological devastation and inequality (9). Effective governance must align hydropower development with energy security, equity, and sustainability, incorporating life cycle assessments and Levelized Cost of Electricity (10). The coastal economy of Odisha faces recurring challenges from climate extremes such as cyclones and droughts, prompting the State Disaster Management Authority to rehabilitate vulnerable communities. In this context, agriculture and related activities demand Climate Resilient Agriculture (CRA) and Integrated Farming Systems (IFS) to address the awareness–practice gap across three economic dimensions: Institutional Economics, CRA, and IFS, emphasising adaptation strategies for sustainability and capacity-building of local livelihoods. Comparative studies of hydropower in Yunnan highlight that while large projects enhance energy security, they also cause ecological disruption and displacement (11). Resilience strengthening requires integrated approach with sustainability to lead towards economic development (12). These complexities underscore the need for integrated policies balancing growth, conservation, and equity. Institutional Economics, rooted in both traditional and new approaches, draws from scholars such as Myrdal (1978), Coase (1988), Williamson (1988), North (1993), Veblen (1899), Knight (1992), Ayala (2005), Ostrom (2009), and Cairney (2019) (13–21). It distinguishes individual purposes in modern contexts from collective norms (22) and merges economics and sociology (23). Veblen's theory extends to democratic feminism, linking institutional economics to social emancipation (24). American institutionalism, through Veblen, Mitchel, and Commons, advocates transforming pecuniary institutions into industrial practices, improving utilities and labour markets (25, 26). Transactional governance studies estimate the costs and benefits, broadening institutional theory (27). Multi-level governance requires the synthesis of socio-ecological parameters, political clarity, and public trust (28). Classical economic ideals such as perfect competition rarely materialise, necessitating new institutionalist advocacy (29, 30). The Institutional Analysis and Development (IAD) framework offers replicable models for analysing human behaviour under complex market and social conditions (31–34). Socio-economic factors on financial resilience, entrepreneurial and investment decisions are mapped to psychological constructs safeguarded by law (35–37). Institutional quality and governance, deviates from the neoclassical orthodoxy, in determining economic welfare across formal and informal institutions (38–40).

Agriculture in Odisha remains vulnerable to extreme climatic conditions, with food security goals elusive despite interventions (41, 42). Sustainable farm management requires integrated approaches across water, soil, energy, genetic resources, and livestock, fisheries, forestry, and value chains (43). A composite agricultural scenario index (2001–2014) revealed district-level disparities, though households adopted sustainable technologies (44). Odisha's high exposure to cyclones and floods necessitates CRA initiatives (45, 46). The state's climate action plan (2018–2023) emphasises scaling CSA practices (47). Alternate land use in rain-fed agroecology supports resilience (48). CRA adoption has boosted production and farmer earnings through stress-tolerant rice varieties and integrated nutrient management (49). However, CSA programs risk ineffectiveness without sound policies and capacity-building frameworks (50). IFS empowers small and marginal farmers by diversifying income and employment (51). Declining agricultural contributions to national income and shrinking landholdings highlight the need for sustainable alternatives to commercial farming (52). Successful IFS models in Meghalaya and Andhra Pradesh demonstrate participatory approaches yielding economic, nutritional, and environmental benefits (53, 54). Case studies model energy balances and biodiversity conservation under climate scenarios (55). Resource allocation studies in Odisha show increased yields, returns, and employment from IFS adoption (56). IFS reduces dependence on external inputs, encourages waste recycling, and enhances productivity (57).

Table 1: CRA Practice and IFS Adoption by Village Households at Hydropower Sites in Odisha

Name of HPP	Name of the District	Name of Village	GPS Coordinates	CRA Practice	IFS Adoption	Government Support / HPP Support Required
Rengali	Angul	Rengali	21°38′21″ N, 84°02′45″ E	Yes	No	Yes
		Denali	21°15′18″ N, 85°01′56″ E	Yes	Yes	Yes
Burla	Sambalpur	Sadeipalli	20°44′26″ N, 83°28′41″ E	No	Yes	Yes
		Mahatabnagar	21°29′20″ N, 83°53′02″ E	Yes	Yes	Yes
Chiplima	Sambalpur	Senhapalli	21°23′39″ N, 83°57′54″ E	Yes	Yes	Yes
		Champa Pada	21°33′27″ N, 83°58′22″ E	Yes	No	Yes
Indravati	Kalahandi	Mahulpatna	19°25′52″ N, 82°50′31″ E	Yes	Yes	Yes
		Poda Padar	19°23′40″ N, 82°50′27″ E	No	Yes	Yes
Kolab	Koraput	Dighapur	18°49′37″ N, 82°28′07″ E	No	Yes	Yes
		Barniput	18°51′36″ N, 82°36′10″ E	Yes	No	Yes

Note: Climate Smart Agriculture (CRA); Integrated Farming System (IFS).

There are two major research objectives in the study:

a) to empirically examine the influence of institutional economic theories of Commons transaction governance, North uncertainty reduction, Ostrom collective action, and Veblen social norms alongside household economic status variables on the awareness and practice of Climate Resilient Agriculture (CRA) among village households located at hydropower project sites in Odisha, as shown in Table 1.
b) to assess the role of Integrated Farming Systems (IFS) awareness and practice, combined with institutional clarity (secure property rights, compensation mechanisms, and entitlement to public distribution systems), in bridging the awareness–practice gap and fostering household participation in Climate-Smart Village activities.

Methodology

The current operational hydropower projects in the coastal state of Odisha consist of six major hydro-electric stations with a total installed capacity of approximately 2,099.8 MW. Notable among these are the Balimela Power Station, with a capacity of 510 MW, and the Upper Indravati Power Station, which leads with 600 MW. Other hydroelectric utilities include Upper Kolab (320 MW), Rengali (250 MW), and Burla (287.8 MW) stations, each contributing substantially to the region's power generation. The study outlines the economic status of 287 rural households (from 10 selected villages) at the five Hydropower Project sites of Odisha for natural resource management in estimating the awareness-practice gap with respect to the explanatory variables Economic Benefits received from HPP (employment, skill development training, and health camps), family economic status (below Poverty Line), and family entitlement to Public Distribution System (PDS) for Rice and Structure of House (kutcha or others). The research design for the study employs a purposive sampling approach to assess the economic status of village households located in regions with large hydropower plants in Odisha, focusing on four theories of Institutional Economics, Climate Resilient Agriculture (CRA), and Integrated Farming System (IFS) awareness and practices. A total of 10 villages were selected under Water Panchayats associated with hydroelectric power projects, ensuring that the sample is representative of communities affected by water resource governance and agricultural adaptation strategies. The study surveyed 287 village households using a structured questionnaire method, which facilitated data collection on socioeconomic conditions, agricultural practices, and hydropower-related livelihoods. The names of the selected villages are Rengali, Denali, Sadeipalli, Mahatabnagar (Migrants from Basantpur and Talapadar), Senhapalli, Champa Pada, Mahulpatna, Poda Padar, Dighapur (Province Khilaput) and Barniput (Province Maliguda). The period of primary survey reported is 12th April 2025 (Part – I survey at Burla, Chiplima and Rengali HPPs in Northern Odisha) to 22nd November 2025 (Part – II survey at Indravati and Kolab HPPs in Southern Odisha). To analyse the determinants influencing household economic status and the adoption of Climate Resilient Agriculture (CRA) and Integrated Farming System (IFS), a LOGIT regression is applied, allowing for binary outcome predictions of awareness and practice levels in village households. This quantitative method enables an examination of factors influencing decision-making in rural settings, identifying key variables such as education, access to resources, policy support, and climate vulnerability that shape agricultural behaviour.

The research design for selecting 287 households from 10 villages under the water panchayat framework was based on purposive sampling, chosen to ensure representation of communities directly impacted by hydropower projects and water governance. Since no official census data existed for these villages, a quota-based distribution was used, allocating households proportionally across villages to capture socio-economic and environmental diversity. This approach allowed inclusion of households with varying economic status, entitlement to public distribution systems, and exposure to climate risks, thereby strengthening the validity of institutional economics and CRA–IFS analysis. Statistically, purposive sampling is justified here as the study sought context-specific insights rather than general population inference, aligning with accepted thresholds in rural development research. The sample size of 287 households meets methodological robustness for binary logit regression, ensuring sufficient variation across explanatory variables while balancing feasibility under constraints of accessibility, time, and cost. Thus, the design provides a credible empirical base for analysing the awareness–practice gap in climate-smart village activities. The first two villages located nearest to the hydro power plant and under the water panchayat are selected from each of the five HPP sites. A total of 30 households were identified from the selected 10 villages, making a cumulative total of 300 household surveys. However, the 13 questionnaires were rejected during the validation and data analysis. Therefore, the research design effectively integrates economic assessment with sustainability principles, providing insights into how hydropower projects impact local livelihoods and adaptive farming systems in Odisha.

The LOGIT regression model is stated as:

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots + \beta_k X_{ik} + \varepsilon_i = X_i \beta + \varepsilon_i \text{ for } i = 1 \text{ to } n \qquad [1]$$

Where, $X_i = (1, X_{i1}, X_{i2} \ldots X_{ik})$ and $\beta` = (\beta_0, \beta_1 \ldots \beta_k)$.

The Bernoulli distribution having parameter π_i has probability distribution function as:

$$Y_i = 1,\ P(Y_i = 1) = \pi_i \qquad [2]$$

$$Y_i = 0,\ P(Y_i = 0) = 1 - \pi_i \qquad [3]$$

If $E(\varepsilon_i) = 0$, $E(Y_i) = \pi_i$, where E = Expectation Value.

From Equations [1-3],

$$E(Y_i) = X_i \beta = \pi_i = P(Y_i = 1) \qquad [4]$$

Thus, the response function $E(Y_i)$ in Equation [4] is referring to probability of $Y_i = 1$.

And the variance is stated as Equation [5]:

$$Var(Y_i) = \delta^2 Y_j \qquad [5]$$

The cumulative distributive function is given in Equation [6]:

$$E(Y) = \frac{\exp(Y)}{1+\exp(Y)} = \frac{1}{1+\exp(X\beta)} \quad [6]$$

The identity link function for Logistic regression is the log-odds stated as in Equation [7]:

$$\eta = \ln \frac{\pi}{1-\pi} \quad [7]$$

From Equations [4] and [5], the econometric equation is provided in Equation [8]:

CRA (Awareness and Practice) z = $ß_0$ + $ß_1$(Commons Transaction Governance - CTG) + $ß_2$(North Uncertainty Reduction - NUR) + $ß_3$(Ostrom Collective Action - OCA) + $ß_4$(Veblen Social Norms - VSN) + $ß_5$(Economic Benefit from HPP) + $ß_6$(Family Economic Status) + $ß_7$(Family entitlement to Public Distribution System) + $ß_8$(Integrated Farming System – Practice) + $ß_9$(Integrated Farming System – Awareness) + $ß_{10}$(Structure of House) [8]

The research hypotheses undertaken for the purposive study is outlined below.

$\mathbf{H_0}$**:** Institutional Theories and Economic Status of village households located at HPP sites have no significant effect on household participation in Climate-Smart Village activities through CRA.

$\mathbf{H_1}$**:** Households with stronger institutional economic awareness and practice (secure property rights, clear compensation mechanisms, and reduced uncertainty in government policy implementation) are significantly more likely to participate in Climate-Smart Village activities facilitated by CRA, compared to households facing institutional ambiguity.

The forecasting econometric equation is given in Equation [9]:

Z(CRA) = 1-@CLOGISTIC(-(Ć(0) + Ć(1)*CTG + Ć(2)*NUR + Ć(3)*OCA + Ć(4)*VSN + Ć(5)*EB_HPP Ć(6)*IFS_P + Ć(7)*IFS_A + Ć(8)*FES + Ć(9)*FPDS + Ć(10)*SOH)) [9]

where, EB_HPP refer to Economic Benefits derived from HPP, IFS refers to Integrated Farming System (Horticulture/Fishing vs. Livestock/Poultry), CRA is Climate Resilient Agriculture, FES is Family Economic Status (Below Poverty Line vs. Others), FPDS refers to Family Entitlement to Public Distribution System (PDS) Rice and SOH is the Structure of House (*kutcha* or others).

The economic access and social preference to the four institutional economic theories are explored as dimensions of either presence or absence of Commons Transactions Governance (water panchayat irrigation rights and agro-products procurement/timber/fish permits), North Uncertainty Reduction (land records and rights and labour card and HPP employment contracts), Ostrom Collective Action (crop diversification though community development and cleanliness and hygiene conditions in the vicinity) and Veblen Social Norms (solar-pumps for irrigation and solar pumped water overhead tanks).

Results and Discussion

Climate-resilient agriculture (CRA) and integrated farming systems (IFS) are increasingly recognized as essential pathways for sustainable rural development, food security, and ecological preservation like watershed interventions for livestock productivity (58), and resilient farming strategies for long-term sustainability (59). Smart technologies and practices have been developed to strengthen CRA (60), particularly for smallholder farmers (61), while new adaptation and mitigation strategies continue to evolve (62, 63). Integrated approaches enhance farm productivity and resilience (64), with specific relevance to Odisha's agricultural development (65). Sustainable water management (66), biodiversity protection (67), and leveraging millets (68) further reinforce climate-resilient pathways. The variables IFS_P, IFS_A, FES, FPDS, and SOH are statistically significant, meaning they play a key role in determining EB_HPP. The model exhibits strong fit and predictive power, though refining variable selection or testing interaction effects may further enhance it.

Table 2: Binary Logit Model Estimation for Climate-smart Village Engaged in CRA Activity

Variable	Coefficient	Std. Error	Z-Statistic	Prob.
C	0.837421	0.658809	1.271113	0.2037
Commons_Transaction_Governance	-0.070034	0.257943	-0.271511	0.7860
North_Uncertainty_Reduction	0.534575	0.261402	2.045029	0.0409
Ostrom_Collective_Action	0.125250	0.275455	0.454703	0.6493
Veblen___Social_Norms	-0.178266	0.333744	-0.534140	0.5932
Economic Benefit_HPP	-0.020543	0.259336	-0.079216	0.9369
Family Economic Status	-0.166334	0.263903	-0.630283	0.5285
Family access to PDS	-0.347389	0.362943	-0.957144	0.3385
IFS Awareness	0.427659	0.331956	-1.288300	0.0076
IFS Practice	0.392779	0.298545	1.315641	0.0083
Structure of House	0.009658	0.267766	0.036068	0.9712
Observations With Departure=0	108	**Total Observations**		287
Observations With Departure=1	179			

In Table 2, the baseline probability of constant (C = 0.84) is not significant (p=0.204) and the impact of regressors are taken into account. The explanatory variables from institutional economics estimate that North Uncertainty Reduction (0.53, p=0.04, z=2.05) is significant and positive contributor for awareness and practice of climate resilient agriculture (CRA) activities to sustain the climate smart village. On the other hand, Commons transaction governance (-0.07, p=0.79), and Veblen social norms (-0.18, p=0.59) are insignificant to the econometric model and negatively affect CRA activities. Ostrom collective action (0.12, p=0.65) is insignificant though a positive driver for CRA. The awareness (0.43, p = 0.0076) and practice (0.39, p = 0.0083) levels of IFS have positive impact on climate smart village engaged in CRA.

Table 3: Odds Ratio Calculation

Variable	Coefficient (β)	Odds Ratio (e^{β})	Economic Interpretation
C (Constant)	0.837	2.31	Baseline odds multiplier equal to 0. No effect on CRA.
Commons_Transaction_ Governance	-0.070	0.93	Slightly reduces odds, but effect is negligible and not significant. No strategic shift to CRA.
North_Uncertainty_ Reduction	0.535	1.71	Significant (p = 0.041): households with secure property rights/compensation clarity are 71% more likely to adopt CRA activities.
Ostrom_Collective_Action	0.125	1.13	Weak positive effect, not significant. Capacity building initiatives for community development needs more government supervision.
Veblen_Social_Norms	-0.178	0.84	Suggests prestige and/or social signaling reduces odds slightly, but not significant. It breaks the social conduct of activities in CRA.
Economic Benefit_HPP	-0.021	0.98	No measurable effect of hydropower project participation. HPPs must provide skill development trainings more frequently to popularize and demonstrate CRA.
Family Economic Status	-0.166	0.85	Slight reduction in odds, not significant.
Family access to PDS	-0.347	0.71	Households with PDS access are ~29% less likely to adopt CRA, but not significant.

IFS_Awareness	0.428	0.65	Adoption intensity reduces odds by ~35%, and significant.
IFS_Practice	0.393	1.48	Households practicing IFS are ~48% more likely to adopt CRA, though not statistically significant.
Structure of House	0.010	1.01	No effect.

In Table 3, North uncertainty reduction (Odds Ratio = 1.71, p = 0.041) is the only statistically significant predictor. Institutional clarity (secure land rights and government compensation satisfaction) strengthens the capacity building initiatives for CRA engagement. Other institutional dummies (Commons, Ostrom, and Veblen) present weak and insignificant effects. Farming system variables (IFS-Pactice positive, IFS-Awareness negative) show directional trends but lack statistical significance.

Figure 1 below exhibits the trend on actual and fitted residuals (fluctuate around zero without large deviations) based on the binary dummy variable outcomes for institutional economic thoughts embedded with economic status of the village households. The Logit regression model determines the categorical responses with the residuals under minimum stochastics.

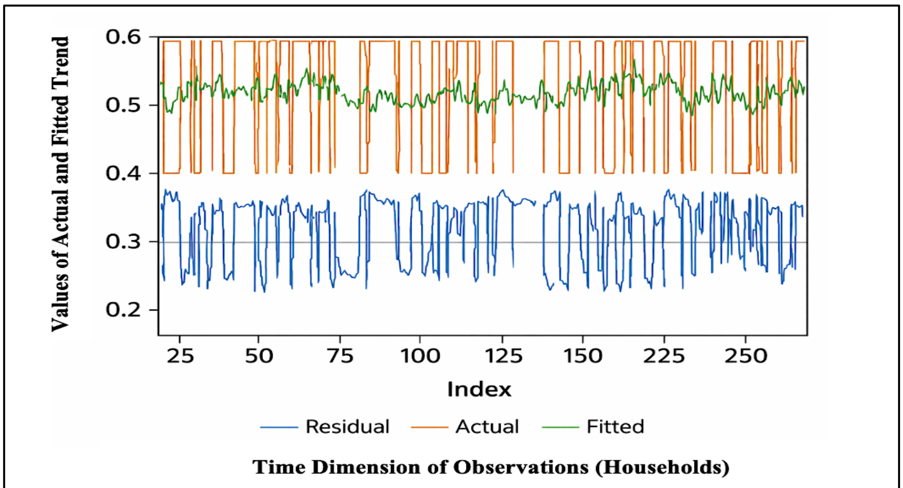

Figure 1: Actual and Fitted Residuals

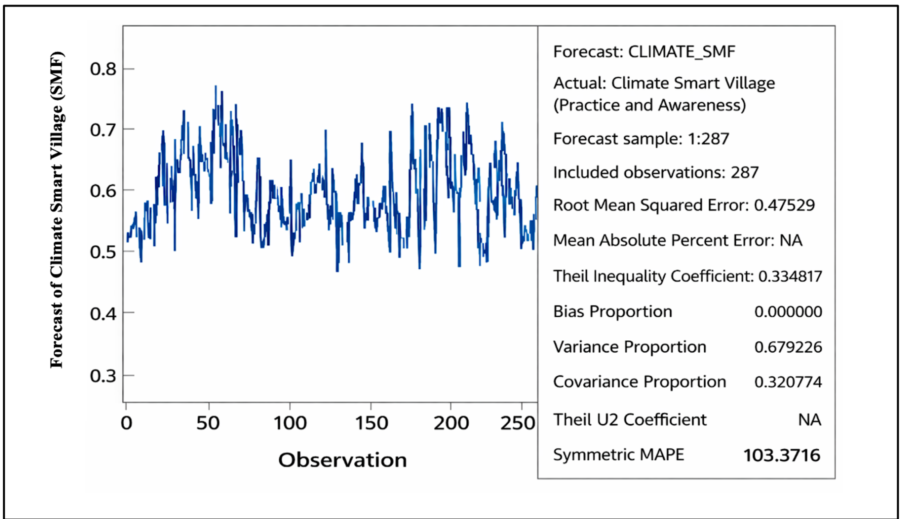

Figure 2: Forecast Graph

In Figure 2, the variance proportion is at 68% reflecting a moderately satisfying forecasting accuracy on CRA with mean absolute error of 48% and Theil inequality coefficient of 0.33. The bias reported for the survey of 287 village households is 0 with covariance of 32%. The value of symmetric mean absolute percentage error (MAPE) is 103.4 accounting for model refit mostly due to a limited sample size of 287 given the time-cost parameters of the survey.

In Table 4, categorical regression is estimated over mean and standard deviation, where variables with clear differences between departure 1 and 0 are North uncertainty reduction (higher in departure 1), IFS awareness (higher in departure 1), IFS Practice (higher in departure 0) and FES (higher in departure 1). Other independent variables offer no change or weak differences.

Table 4: Categorical Regressor Statistics

Explanatory Variables		**Mean**	
Variable	Departure=0	Departure=1	All
Constant	1.000000	1.000000	1.000000
Commons_Transaction_Governance	0.537037	0.536313	0.536585
North_Uncertainty_Reduction	0.407407	0.508380	0.470383
Ostrom_Collective_Action	0.694444	0.698324	0.696864
Veblen__Social_Norms	0.824074	0.810056	0.815331
EB_HPP	0.388889	0.385475	0.386760
FES	0.675926	0.625698	0.644599
FPDS	0.861111	0.832402	0.843206
IFS_A	0.805556	0.692737	0.735192
IFS_P	0.583333	0.681564	0.644599
SOH	0.324074	0.346369	0.337979
Standard Deviation			
Variable	Dep=0	Dep=1	All
Constant	0.000000	0.000000	0.000000
Commons_Transaction_Governance	0.500951	0.500078	0.499531
North_Uncertainty_Reduction	0.493643	0.501332	0.499994
Ostrom_Collective_Action	0.462790	0.460273	0.460416
Veblen__Social_Norms	0.382532	0.393357	0.388707
EB_HPP	0.489771	0.488073	0.487858
FES	0.470210	0.485300	0.479471
FPDS	0.347443	0.374556	0.364242
IFS_A	0.397618	0.462653	0.442002
IFS_P	0.495305	0.467176	0.479471
SOH	0.470210	0.477147	0.473848
Observations	108	179	287

Table 5: Expectation Prediction Evaluation (Awareness-practice Gap Binary Specification)

	Estimated Equation			**Constant Probability**		
	Departure=0	Departure=1	Total	Departure=0	Departure=1	Total
P(Departure=1)<=Constant	15	13	28	0	0	0
P(Departure=1)>Constant	93	166	259	108	179	287
Total	108	179	287	108	179	287
Correct	15	166	181	0	179	179
% Correct	13.89	92.74	63.07	0.00	100.00	62.37
% Incorrect	86.11	7.26	36.93	100.00	0.00	37.63
Total Gain*	13.89	-7.26	0.70			
Percent Gain**	13.89	NA	1.85			
E(Departure=0)	43.10	64.90	108.00	40.64	67.36	108.00
E(Departure=1)	64.90	114.10	179.00	67.36	111.64	179.00
Total	108.00	179.00	287.00	108.00	179.00	287.00
Correct	43.10	114.10	157.20	40.64	111.64	152.28
% Correct	39.91	63.74	54.77	37.63	62.37	53.06
% Incorrect	60.09	36.26	45.23	62.37	37.63	46.94
Total Gain	2.28	1.37	1.71			
Percent Gain	3.65	3.65	3.65			

Note: '*' measures absolute improvement and "**' measures relative improvement. Success cut-off: Constant = 0.5

Table 6: Hosmer-Lemeshow Tests for Goodness of Fit (Awareness-practice Gap Binary Specification)

Quantile of Risk		Departure=0		Departure=1		Total	H-L
Low	**High**	**Actual**	**Expect**	**Actual**	**Expect**	**Observations**	**Value**
0.4249	0.4996	15	15.0271	13	12.9729	28	0.00011
0.5023	0.5437	11	13.5763	18	15.4237	29	0.91924
0.5437	0.5711	16	12.8486	13	16.1514	29	1.38780
0.5713	0.5883	15	11.7626	13	16.2374	28	1.53647
0.5883	0.6163	8	11.5261	21	17.4739	29	1.79025
0.6191	0.6442	9	10.6794	20	18.3206	29	0.41804
0.6464	0.6728	10	9.48423	18	18.5158	28	0.04242
0.6728	0.6983	11	9.10221	18	19.8978	29	0.57669
0.7041	0.7572	7	7.74999	22	21.2500	29	0.09905
0.7607	0.8303	6	6.24339	23	22.7566	29	0.01209
	Total	108	108.000	179	179.000	287	6.78216
H-L Statistic		6.7822		Prob. Chi-Square(8)		0.5603	
Andrews Statistic		7.4277		Prob. Chi-Square(10)		0.6845	

Note: Goodness-of-Fit Evaluation for Binary Specification, Andrews and Hosmer-Lemeshow (H-L) Tests, Grouping based upon predicted risk (randomize ties)

In Table 5, the model on expectation prediction deviation offers better prediction for departure = 1 and not for departure = 0 at cut-off 0.5. The total percent gain is 13.89 and with expectation at 3.65 for departure 0.

From Table 6, the Hosmer-Lemeshow Test divides observations into risk quantiles for awareness-practice gap analysis from observed and expected frequencies (departures 0 and 1). The binary specification fits the model deployed with H-L statistic at 6.78 (chi-square p=0.56, df=8) and Andrews statistic at 7.43 (chi-square p=0.68, df=10).

Conclusion

The findings of this study provide an analytical overview of how institutional economics interacts with climate-resilient agriculture (CRA) and integrated farming systems (IFS) in hydropower-affected villages in Odisha. The results consistently highlight North's uncertainty reduction as the only statistically significant and positive contributor (Tables 2–4), underscoring the importance of institutional clarity, secure land rights, and compensation mechanisms in strengthening CRA engagement. While Commons transaction governance, Veblen social norms, and Ostrom's collective action show weak or insignificant effects, their directional trends suggest latent institutional influences that merit deeper exploration. The contribution of IFS variables, though not statistically significant, indicates potential complementarities between awareness and practice that could be harnessed through skill development and training. The consequences of these findings are two-fold. First, they reveal that institutional clarity is pivotal for bridging the awareness–practice gap in climate-smart villages; second, they expose the limitations of relying solely on traditional institutional constructs without embedding them in localised governance frameworks. The study's constraints of time, cost, and a limited sample of 287 households restrict generalizability, yet they provide a valuable pilot for policy experimentation. Future research should expand sample size, integrate longitudinal data, and explore hybrid models combining institutional economics with socio-ecological resilience metrics. This would enable more robust policy design for Odisha Hydropower Corporation Limited (OHPCL) and the Government of Odisha, ensuring that CRA and IFS evolve into scalable, replicable frameworks for sustainable rural transformation.

Given the constraints of this study and the limited sample of 287 households through purposive sampling, with difficult accessibility to survey sites, especially during monsoons, and the absence of external funding, the future scope of work lies in expanding both scale and depth. Larger, representative samples across diverse hydropower-affected regions would strengthen statistical validity and allow comparative analysis. Longitudinal surveys could capture seasonal and temporal variations in climate-resilient agriculture (CRA) and integrated farming systems (IFS). Incorporating mixed methods quantitative econometric modelling alongside qualitative community narratives would enrich institutional insights. Future research should also explore partnerships with government agencies, NGOs, and hydropower management bodies to secure funding, improve logistical feasibility, and translate findings into actionable policies for climate-smart village development. Also, with funding opportunities, extensive research is feasible using the Computer-Assisted Personal Interview (CAPI) tool in the World Bank-supported Survey Solutions designer for online and offline questionnaire surveys.

Abbreviations

Df: Degrees of Freedom, FES: Family Economic Status, H-L Test: Hosmer-Lemeshow Test, HPP: Hydro Power Project, IFS: Integrated Farming System, MAE: Mean Absolute Error, MAPE: Mean Absolute Percentage Error, OHPCL: Odisha Hydropower Corporation Limited, OSACC: Odisha State Action Plan to Climate Change, PDS: Public Distribution System.

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Author Contributions

Swagat Kishore Mishra: Conceptualization, Study Design, Questionnaire Design, Survey Reporting, Questionnaire Validation, Data Analysis, Writing – Original Draft and Review, Technical Accuracy, Clarity of Presentation, Application of Quantitative Tools, Econometric Analysis, Proof Checking, Editing, Bibhunandini Das: Data Analysis, Writing – Original Draft and Review, Technical Accuracy, Clarity of Presentation, Pramod Kumar Patjoshi: Questionnaire Validation, Data Analysis, Writing – Original Draft and Review, Technical Accuracy, Clarity of Presentation, Application of Quantitative Tools, Econometric Analysis.

Conflict of Interest

The authors have no conflicts of interest to declare.

Data Availability

Data will be shared upon a reasonable request.

Declaration of Artificial Intelligence (AI) Assistance

The authors declare that no generative AI or AI-assisted technologies were used in the preparation of this manuscript.

Ethics Approval

The study including the Questionnaire Schedule was reviewed by the Centurion University of Technology and Management (CUTM), which determined that the study was exempt from formal ethical approval. Informed consent was obtained from all participants during field survey.

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References

1. García MA, Castro-Díaz L, Villamayor-Tomas S, *et al*. Are large-scale hydroelectric dams inherently undemocratic? Global Environmental Change. 2021; 71:102395. doi: 10.1016/j.gloenvcha.2021.102395
2. Zaied YB, Cheikh NB, Nguyen P. Modelling nonlinear water demand: The case of Tunisia. Economics Bulletin. 2017; 37(2):637-644. doi: 10.1080/00036846.2014.1002896
3. López-Feldman A, Chávez E. Remittances and natural resource extraction: Evidence from Mexico. Ecological Economics. 2017; 132:69-79. doi: 10.1016/j.ecolecon.2016.10.010
4. Mirumachi N, Torriti J. The use of public participation and economic appraisal for public involvement in large-scale hydropower projects: Case study of the Nam Theun-2 Hydropower Project. Energy Policy. 2012; 47:125-132. doi: 10.1016/j.enpol.2012.04.034
5. Mayeda AM, Boyd AD. Factors influencing public perceptions of hydropower projects: A systematic literature review. Renewable and Sustainable Energy Reviews. 2020; 121:109713. doi: 10.1016/j.rser.2020.109713
6. De Faria FA, Davis A, Severnini E, *et al*. The local socio-economic impacts of large hydropower plant development in a developing country. Energy Economics. 2017; 67:533-544. doi: 10.1016/j.eneco.2017.08.025
7. Førsund FR. Hydropower economics. New York: Springer; 2005. doi: 10.1007/978-0-387-73027-1
8. Xue B, Sun Z. Economics of hydropower energy: A critical assessment. Energy Sources Part B: Economics, Planning, and Policy. 2018; 13(1):33-36. doi: 10.1080/15567249.2017.1402102
9. Hennig T, Wang W, Feng Y, *et al*. Review of Yunnan's hydropower development: Comparing small and

large hydropower projects regarding their environmental implications and socio-economic consequences. Renewable and Sustainable Energy Reviews. 2013; 27:585-595.
doi: 10.1016/j.rser.2013.07.023

10. Sovacool BK, Walter G. Internationalizing the political economy of hydroelectricity: Security, development and sustainability in hydropower states. Review of International Political Economy. 2019; 26(1):49-79.
doi: 10.1080/09692290.2018.1511449
11. Allen DW. The institutional revolution: Measurement and the economic emergence of the modern world. Chicago: University of Chicago Press; 2024.
doi: 10.1332/251569212X15664519360579
12. Achour N, Pantzartzis E, Pascale F, Price AD. Integration of resilience and sustainability: From Theory to Application. International Journal of Disaster Resilience in the Built Environment. 2015 Sep 14; 6(3):347-62.
https://doi.org/10.1108/IJDRBE-05-2013-0016
13. Myrdal G. Institutional economics. Journal of Economic Issues. 1978; 12(4):771-783.
doi: 10.1080/00213624.1978.11503577
14. Coase RH. The institutional structure of production. In: Handbook of New Institutional Economics. Cham: Springer Nature Switzerland; 2025:37-46.
doi: 10.1007/978-3-031-50810-3_319
15. Williamson OE. The economics of governance. American Economic Review. 2005; 95(2):1-8.
doi: 10.1257/000282805774669880
16. North DC. Institutions and the performance of economies over time. In: Handbook of New Institutional Economics. Cham: Springer Nature Switzerland; 2025:25-35.
doi: 10.1007/978-3-031-50810-3_2
17. Veblen T. Mr. Cummings's strictures on The Theory of the Leisure Class. Journal of Political Economy. 1899; 8(1):106-117.
doi: 10.1057/9780230245723
18. Knight J. Institutions and social conflict. Cambridge: Cambridge University Press; 1992.
ISBN: 0521421896
19. Ayala L, Pérez C. Macroeconomic conditions, institutional factors and demographic structure: What causes welfare caseloads? Journal of Population Economics. 2005; 18(3):563-581.
doi: 10.1007/s00148-005-0225-6
20. Ostrom E. Doing institutional analysis, digging deeper than markets and hierarchies. In: Handbook of New Institutional Economics. Cham: Springer Nature Switzerland; 2025,73-102.
doi: 10.1007/0-387-25092-1_31
21. Cairney P. Understanding public policy: Theories and issues. London: Bloomsbury Publishing; 2019.
ISBN: 9781137545183
22. Hodgson GM. Formal and informal institutions: Some problems of meaning, impact, and interaction. Journal of Institutional Economics. 2025; 21:e1.
doi: 10.1017/S1744137424000249
23. Engerman SL, Sokoloff KL. Institutional and non-institutional explanations of economic differences. In: Handbook of New Institutional Economics. Cham: Springer Nature Switzerland; 2025:757-784.
doi: 10.1007/978-3-031-50810-3_30
24. Waddoups J, Tilman R. Thorstein Veblen and the feminism of institutional economists. International Review of Sociology. 1992; 3(3):182-204.
doi: 10.1080/03906701.1992.9971127
25. Ramstad Y. Is a transaction a transaction? Journal of Economic Issues. 1996; 30(2):413-425.
doi: 10.1080/00213624.1996.11505805
26. Rutherford M. Understanding institutional economics: 1918–1929. Journal of the History of Economic Thought. 2000; 22(3):277-308.
doi: 10.1080/10427710050122521
27. Zhang A. Transaction governance structure: Theories, empirical studies, and instrument design. International Journal of Commerce and Management. 2006; 16(2):59-85.
doi: /10.1108/10569210680000208
28. Armitage D. Governance and the commons in a multi-level world. International Journal of the Commons. 2008; 2(1):7-32.
doi: 10.18352/ijc.28
29. Kunawotor M, Ahiabor G, Yobo E. Government size, institutional quality and economic welfare in Africa. International Journal of Social Economics. 2025; 52(4):578-590.
doi: 10.1108/IJSE-01-2024-0075
30. Yudihutomo DC. Institutional approach in economics and institutional economic thinking. Demagogi: Journal of Social Sciences, Economics and Education. 2024; 2(2):81-88.
doi: 10.61166/demagogi.v2i2.19
31. Bastia DK, Behera SK, Panda MR. Climate resilient alternate land use systems for sustainable development in rainfed agro-ecology of Odisha. Indian Journal of Dryland Agricultural Research and Development. 2020; 33(1):35-39.
doi: 10.5958/2231-6701.2020.00002.0
32. Behera UK, France J. Integrated farming systems and the livelihood security of small and marginal farmers in India and other developing countries. Advances in Agronomy. 2016; 138:235-282.
doi: 10.1016/bs.agron.2016.04.001
33. Das A, Datta D, Samajdar T, *et al*. Livelihood security of small holder farmers in eastern Himalayas, India: Pond based integrated farming system a sustainable approach. Current Research in Environmental Sustainability. 2021; 3:100076.
doi: 10.1016/j.crsust.2021.100076
34. Dadabhau AS, Kisan WS. Sustainable rural livelihood security through integrated farming systems: A review. 2013:207-215.
doi: 10.5958/j.0976-0741.34.3.005
35. Hamid FS, Loke YJ, Chin PN. Determinants of financial resilience: insights from an emerging economy. Journal of social and economic development. 2023 Dec; 25(2): 479-99.
https://doi.org/10.1007/s40847-023-00239-y
36. Lopez-Feldman A. Climate change, agriculture, and poverty: A household level analysis for rural Mexico. Economics Bulletin. 2013; 33(2):1126-1139.
doi: eb-12-00918
37. Commons JR. Law and economics. In: Law and Economics. Vol. 1. London: Routledge; 2024, p. 432-444.
doi: 10.4324/9781003550150
38. Weingast BR. The performance and stability of federalism: An institutional perspective. In:

Handbook of New Institutional Economics. Cham: Springer Nature Switzerland; 2025: 159-183. doi: 10.1007/978-3-031-50810-3_8
39. Haldar S, Behura D, Nuppenau EA, *et al*. Does institutional innovation in groundwater sharing stimulate market led farming systems? A case study from coastal districts of Odisha. doi.org/10.2139/ssrn.4777342
40. Amorim G, Da Silva ME. Governance and growth: A panel VAR approach. Economic Bulletin. 2016; 43(4):1896-1907. doi: 10.5937/ekonhor2302117A
41. out C, Sharma A. Bridging the gap: Exploring adaptation strategies for climate-resilient agriculture and enhanced livelihoods in Odisha. In: Climate, Environment and Agricultural Development: A Sustainable Approach towards Society. Singapore: Springer; 2024: 57-74. doi: 10.1007/978-981-97-8363-2_4
42. Anantha KH, Garg KK, Dixit S. Building resilience to climate change in agriculture: Integrated natural resource management and institutional measures. In: Global Climate Change: Resilient and Smart Agriculture. Singapore: Springer; 2020:109-136. doi: 10.1007/978-981-32-9856-9_6
43. Palombi L, Sessa R. Climate-smart agriculture: Sourcebook. Rome: Food and Agriculture Organization; 2013. ISBN: 978-92-5-107720-7
44. Das U, Ghosh S, Mondal B. Resilience of agriculture in a climatically vulnerable state of India. Theoretical and Applied Climatology. 2020; 139(3):1513-1529. doi: 10.1007/s00704-019-03061-x
45. Bahinipati CS. Assessment of vulnerability to cyclones and floods in Odisha, India: A district-level analysis. Current Science. 2014; 107(12):1997-2007. http://www.jstor.org/stable/24216033
46. Panda J, Parashari GS. Empirical evaluation of agricultural resilience to climate change: An application to the Indian state of Odisha. Theoretical and Applied Climatology. 2024; 155(9):8681-8702. doi: 10.1007/s00704-024-05154-8
47. Odisha State Action Plan on Climate Change (OSAPCC). Odisha State Action Plan on Climate Change 2018–2023. Bhubaneswar: Forest and Environment Department, Government of Odisha; 2018. https://climatechangecellodisha.org/pdf/State%20Action%20Plan%20on%20Climate%20Change%202018-23.pdf
48. Smirnov V, Wait A. Industry sunk cost and entry dynamics. In: Contemporary Issues in Economics and Econometrics: Theory and Application. 2004:34. doi: EB-04L10008A
49. Mishra AK, Mishra S, Biswal S, *et al*. Performance and impact analysis of climate-smart agriculture (CSA) practices in Odisha. In: Transition to Regenerative Agriculture: Principles and Indicators of Soil Health Management. Singapore: Springer Nature; 2025:1-25. doi: 10.1007/978-981-96-1421-9_1
50. Sharma S, Rana DS, Jat ML, *et al*. A compendium of technologies, practices, services and policies for scaling climate smart agriculture in Odisha (India). CGIAR Research Program on Climate Change, Agriculture and Food Security; 2025. https://hdl.handle.net/10568/106888
51. Kearney J. Food consumption trends and drivers. Philosophical Transactions of the Royal Society B: Biological Sciences. 2010; 365(1554):2793-2807. doi: 10.1098/rstb.2010.0149
52. Bellanthudawa BK, Pawuluwage SM, Nawalage NM, *et al*. Climate change, sustainable food systems, and community-based adaptation: Resilience strategies in the global south. In: Climate Change, Food Security, and Land Management: Strategies for a Sustainable Future. Cham: Springer Nature Switzerland; 2025, p. 1-30. doi: 10.1007/978-3-031-71164-0_16-1
53. Tolulope OY, Bamidele J, Eleke UP, *et al*. Adapting to environmental changes and climate impacts in rural communities: A comprehensive review. Global Journal of Earth and Environmental Science. 2025; 10(1):1-7. doi: 10.31248/GJEES2024.169
54. Chandana TS, Praveena PL, Lakshmi T, *et al*. Sustainable livelihood security of integrated farming systems practicing farmers through different enterprise combinations in Andhra Pradesh. Indian Journal of Extension Education. 2023; 59(1):101-106. doi: 10.48165/IJEE.2023.59121
55. Behera UK, Amjath Babu AB, Kaechele H, *et al*. Energy self-sufficient sustainable integrated farming systems for livelihood security under a changing climate scenario in an Indian context: A case-study approach. CABI Reviews. 2015; 10:1-11. doi: 10.1079/PAVSNNR201510019
56. Sahoo HK, Behera B. Integrated farming system for resource recycling and livelihood security for marginal farmers in three disadvantaged districts of Odisha. Indian Journal of Soil Conservation. 2017; 45(2):203-213. https://www.researchgate.net/publication/334598299_Integrated_farming_system_for_resource_recycling_and_livelihood_security_for_marginal_farmers_in_three_disadvantaged_districts_of_Odisha
57. Hans A, Rao N, Prakash A, Patel A. Engendering climate change. Boca Raton: CRC Press; 2021. doi: 10.4324/9781003142409
58. Dev I, Singh R, Garg KK, *et al*. Transforming livestock productivity through watershed interventions: A case study of Parasai-Sindh watershed in Bundelkhand region of Central India. Agricultural Systems. 2022; 196:103346. doi: 10.1016/j.agsy.2021.103346
59. Arif M, Kumar K, Meena AL, *et al*. Strategies and management practices for enhancing long-term sustainability through resilient farming systems. In: Sustainable Agriculture Management in Semi-Arid Climates. Cham: Springer Nature Switzerland; 2025. doi: 10.1007/978-3-031-94066-8_5
60. Prasad YG, Maheswari M, Dixit S, *et al*. Smart practices and technologies for climate resilient agriculture. Hyderabad: Central Research Institute for Dryland Agriculture (ICAR); 2014. ISBN: 978-93-80883-30-4
61. Rai RK, Bhatta LD, Acharya U, *et al*. Assessing climate-resilient agriculture for smallholders. Environmental Development. 2018; 27:26-33. doi: 10.1016/j.envdev.2018.06.002

62. Kumar S, Ranjan S, Sow S, *et al*. Climate-resilient agriculture for sustainable crop production: New adaptation and mitigation strategies. Boca Raton: CRC Press; 2026.
ISBN: 9781998511143.
doi: 10.1201/9781998511150
63. Reddy PP. Climate resilient agriculture for ensuring food security. New Delhi: Springer India; 2015.
ISBN: 978-81-322-2198-2
64. Singh VK, Rathore SS, Singh RK, *et al*. Integrated farming system approach for enhanced farm productivity, climate resilience and doubling farmers' income. Indian Journal of Agricultural Sciences. 2020; 90(8):1378-1388.
doi: 10.56093/ijas.v90i8.105884
65. Mishra DK, Paltasingh KR, Senapati AK, *et al*. Towards a sustainable and equitable agricultural development in Odisha. In: Trajectories of Development. London: Routledge; 2026, p. 135-162.
doi: 10.4324/9781003616788-9
66. Srivastav AL, Dhyani R, Ranjan M, *et al*. Climate-resilient strategies for sustainable management of water resources and agriculture. Environmental Science and Pollution Research. 2021; 28(31): 41576-41595.
doi: 10.1007/s11356-021-14332-4
67. Ekka P, Patra S, Upreti M, *et al*. Land degradation and its impacts on biodiversity and ecosystem services. In: Land and Environmental Management through Forestry. 2023;77-110.
doi: 10.1002/9781119910527.ch4
68. Wilson ML, Van Buren R. Leveraging millets for developing climate resilient agriculture. Current Opinion in Biotechnology. 2022; 75:102683.
doi: 10.1016/j.copbio.2022.102683

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