Research Article

Indian Journal of Extension Education
Vol. 62, No. 4 (October–December), 2026, (155-161)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Prevalence of ITK Practices among Rice Farmers in Odisha: An Indian Knowledge System Perspective

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HIGHLIGHTS

- Family eldership remains the prominent informal channel of ITK dissemination.
- Extension contact and farming experience boosts up ITK adoption while economic motivation drives away from it.

ARTICLE INFO

Keywords: Adoption, IKS, Indigenous technical knowledge, ITK, Odisha, Regression, Rice, Traditional.

https://doi.org/10.48165/IJEE.2026.62422

Citation: Jayasingh, D. K., Behera, P., & Behera, K. (2026). Prevalence of ITK Practices among Rice Farmers in Odisha: An Indian Knowledge System Perspective. *Indian Journal of Extension Education*, *62*(4), 155-161. https://doi.org/10.48165/IJEE.2026.62422

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ABSTRACT

The study was conducted in 2025 to list out the Indigenous Technical Knowledge (ITK) practices with its extent of adoption among rice growers and the determinants influencing such adoption. Multi-stage random sampling was followed to culminate 320 respondents across four districts of the Odisha. Majority of the respondents exhibited moderate extent (51.25%) of ITK adoption. Botanical preservation of stored grains and sun-drying of paddy seeds recorded the highest adoption indices. Family eldership transpired as the primary source of ITK information. Multiple linear as well as stepwise regression models concurred that extension contact, farming experience and age have positively, whereas economic motivation has negatively, governed adoption extent of ITKs. Stepwise model kept four predictors delineating variance comparable to the linear model, underlining the efficiency of targeted extension-driven interventions for sustaining indigenous farming knowledge.

INTRODUCTION

India has achieved food self-sufficiency through modern intensive farming practice, though disproportionate to local resources (Ahmed et al., 2021), caused environmental pollution and reduced yield viability (Pandian et al., 2024), leaving one-third of arable land uncultivable (Krishna Chaitanya, 2024). Traditional knowledge of farming, are being looked at by agri-scientists as a sustainable alternative. Earning importance for sustainable development in 1980s globally, this particular knowledge now being rebranded as Indian Knowledge System (IKS) with its adoption being encouraged in diverse sectors including agriculture for sustainability (Das, 2025). The Indian Knowledge System (IKS), based on centuries of observation, experimentation and experience, is an invaluable repository of farming wisdom. In contrast to the existing intensive farming systems, IKS focuses on self-reliance, ecological balance, diversity and community participation. Many of the classical texts, as revered under IKS, such as *Vrksayurveda* (1000 CE), *Krishi Parasara* (400 BCE to 400 CE) and *Brihat Samhita* (1000-400 BCE) provisions standardized insights into soil

Received 17-07-2026; Accepted 01-09-2026

classification, seed treatment, irrigation, plant protection and astronomical alignment congruence for farming, illustrating an integrated understanding of surroundings with its elements.

Such knowledge bank draw support from native oral customs and community practices such as local seed preservation, mixed cropping, luni-solar calendars and botanical pesticides which empowered the local farmers to counter the issues of pest invasion, disease attack, soil degradation and climate variability (Panda, 2026). The incorporation of such local traditional knowledge with scientific innovations along with sustainable practices is invaluable in current era (Mahajan, 2024). Since traditional agri-knowledge has been key areas within IKS; it manifests as Indigenous Technical Knowledge, which are practical, field-tested knowledge developed and passed down by farming communities (Singh et al., 2026) for practices from seed treatment till post-harvest storage. This eco-friendly, generationally refined knowledge can integrate with modern practices for production and sustainability (Praveenkumar et al., 2025). ITKs embodies accrued community wisdom sustained through oral transmission as cultural heritage (Borah et al., 2023) and disseminated via folklore, rituals and demonstration.

Several empirical studies on the adoption of ITK have been conducted in various agro-ecological settings. In Nepal, majority of the farmers studied had average level of adoption of Indigenous Technological Knowledge for agricultural practices (Khatri et al., 2021). Extension contact, education and market distance were identified as significant factors related to the adoption of indigenous knowledge-based livelihood practices in Ethiopia (Mengistu, 2024). However, within India, and Odisha specifically, empirical assessment of ITK adoption remains scarce with contemporary efforts mostly focused on documentation of ITKs rather than quantification of adoption extent or its determinants, especially towards rice farming-despite being state's predominant livelihood activity across agro-climatically diverse coastal, plateau and interior zones. Keeping in view of the above notion, an investigation was carried out on to assess the prevalence of ITK practices of rice growing farmers in Odisha.

METHODOLOGY

The study was conducted in the four prominent rice growing districts of Odisha- Bargarh, Ganjam, Kalahandi and Kendrapada whereby each of them belonged to different agroclimatic zones as classified for the state. The respondents were the rice growing farmers who had been following their ITK practices in their rice farming procedures since generations to pass over. Multi-stage sampling was followed over, whereby two blocks from each district and two villages from each block were selected randomly, thus constituting 16 villages from eight blocks under four districts. Twenty farmers were selected as respondents randomly, thus constituting total sample of 320 respondents.

Extent of Adoption of ITK practices has been operationalized as the degree to which farmers individually or collectively execute indigenous practices instead of or alongside, modern methodologies as relevant for paddy farming practices as suitable to their region. At first, a list of ITK practices followed in paddy cultivation in the sampled region was generated. A three-point continuum was followed namely as 'Fully adopted', 'Partially adopted' and 'Not adopted' for each item in the list with their respective corresponding scores of 3, 2 and 1 respectively. Respondents were asked to rate these items based on their perceived notion of adoption of concern ITK practice and later transformed to values by employing the scoring pattern. The index score for each respondent, as conducted Pateriya et al. (2026). in their study at Bundelkhand region of Uttar Pradesh, was formulated as follows:

$$\text{Adoption index} = \frac{\text{Total adoption score obtained for the respondent}}{\text{Maximum possible adoption score}} \times 100$$

Average and standard deviation of all the scores was calculated and employed in half-standard deviation method to generate the classification of respondents into low, medium and high extent of adoption based on their scores (Jayasingh & Mishra, 2024).

Factors relevant to the investigation were identified based on a comprehensive literature review, followed by the guidance of expert consultation. Then, a structured questionnaire was prepared with the help of scales taken up for the suitability to measure the concern factor as independent variable with a pre-testing exercise followed with modifications to make it adaptable for the concerned sample (Sahoo et al., 2025). Multiple linear regression was employed to assess the combined effect all and independent effect of each variable on extent of adoption followed by stepwise regression to determine the most parsimonious model. The research was carried on from March 2025 to December 2025 under the aegis of ex-post facto research design.

RESULTS

ITKs as practiced by the rural respondents

The Indigenous Technical Knowledge practices being employed by farm respondents are depicted in Table 1 along with its purpose, application and its degree of integration by them in terms of adoption index percentage. These practices cover the entire crop production system, from pre-sowing seed treatment to post harvest storage. Practices associated with seed include copper vessel sprouting, sun drying and summer ploughing for better seed germination and to remove soil-cum-seed borne pathogens. The low-cost, locally available solutions include weed and pest management practices like spiked harrowing, kerosene execution, straw mulching and use of botanical pest repellents such as neem and tobacco-garlic infusions. Stored grains were protected from insects and moisture by storage-related ITKs such as red pepper treatment, earthen pot smoking, cinnamon-ash treatment, and mud-plastered bamboo silos.

As per information depicted in Table 1, 'Botanical preservation of stored grains' had highest Adoption index (90.30), followed by 'sun-drying of paddy seeds' (89.43) and 'earthen pot smoking' (79.57), which showed that farmers were heavily dependent on plant protection and thermal methods of preservation. The other two were comparatively less adopted are 'Kerosene oil application' (51.13) and 'Tobacco-garlic infusion' (51.53), which may be attributed to change in the preference of input or perceived effectiveness. Overall, the table points to the ongoing value of traditional ecological knowledge for sustainable pest, storage and soil management.

Majority of the respondents (51.25%) were in medium extent of practice category. This was followed by 32.50 per cent of the

Table 1. List of Indigenous Technical Knowledge practices prevalent in the region, their working and its extent of practice as expressed by respondents

ITKs	Purpose	Remarks	Adoption Index
Accelerated seed sprouting in copper vessels (*Anda re Gajaa Maaribaa*)	Ensuring rapid, uniform seed germination before broadcasting	Anaerobic heat generated inside sealed vessel induces sprouting	87.97
Botanical preservation of Stored grains (*Nimba O Beguniaa Patra Sangraha*)	Protecting stored grains from pest attack by leaves of Neem and *Begunia*	Release of volatile compounds, act as powerful repellent and anti-feedant	90.30
Sun-drying of paddy seeds (*Bihana Khara Sekiba*)	Breaking seed-borne pathogens and deep embryo dormancy	Exposure to direct summer heat, killing hidden eggs and fungal spores	89.43
Mechanical spiked harrowing (*Bida Chaleiba*)	Thinning out overcrowded crops and uproot younger weeds	Dragging the wooden-spiked country *Bida* for weed shearing, improving soil aeration	65.43
Straw mulching (*Acchadana/Nauda Biccha)*	Suppressing weed-seed germination while preserving soil capillary moisture	Thick physical layer of straw creating light blockade and reduced evaporation	74.10
Kerosene oil (*Keropal Tela/Ghasatela Prayoga*)	Controlling destructive termite infestations at the root level	Broadcasting kerosene-soaked sand creating hydrocarbon film, suffocating the pests	51.13
Ash-dusted cover(*Paunsa Gunda Pakeiba*)	Anchoring delicate seedling radicles, before heavy monsoon	Spreading alkaline ash forms heavy matrix over bed, as protective barrier	73.87
Cement-groundnut-jaggery baits (*Gua Cementa Phaandaa*)	Eliminating field rats along narrow clay boundary walls	Dry bait acting lethal after ingested by rodents	55.80
Tobacco-garlic infusion (*Dhuaanpatra-Rasuna Gunda spray*)	Controlling heavy sucking pests like Brown Plant Hopper	Boiled mix of tobacco waste and crushed garlic inducing paralyzing effect on pests	51.53
Red pepper in storage (*Sukhilaa Lankaa Gunda Sanjoga*)	Keeping store-grain beetles and grain moths away from household food reserves	Dropping whole dried hot chillies in storage bins driving the pests away	85.53
Earthen pot smoking (*Haandi Dhuan Pratha)*	Sanitization of empty traditional grain storage structure	Burning dried dungs, red chillies and neem leaves inside bins, sealed for a day	79.57
Cinnamon with wood ash treatment (*Daalchini Paaunsa Gunda*)	Shielding saved seed bags from early weevil destruction	Powdered mixture creating an abrasive dust desiccant, harming pest attack	55.13
Mud-plastered bamboo grain silos (*Dhaana Kudhira*)	Storing grains safely for seasons	Bamboo bins plastered with cow dung and clay: forming insulated-resistant container	83.73
Underground or airtight curing of rice (*Khani Chaaula*)	Making fresh, non-sticky, easily digestible rice	Rice packed in earthen pots, sealed with wet cow dung, undergoing hermetic CO_2 curing	72.87
Summer ploughing (*Khara Chaasa*)	Eradicating soil-borne pathogens and pest pupae	Soil turning in May exposes pests and spores to lethal solar sterilization	83.60

respondents having low extent of ITK adoption and 16.25 per cent of the respondents had high extent of ITK adoption. This distribution indicates that although a large number of farmers still use indigenous practices to a moderate extent, there is no significant uptake of the full range of ITKs by the larger group, and almost one third of respondents had very little interaction with indigenous practices. The findings are in line with that Keerthana and Divakaran (2021) reporting moderate extent.

Informational source

Table 2 illustrates about the preferences for informational sources of ITK awareness by the respondents whereby ‘Family eldership’ received highest response (86.25%) reflecting the dominance of inherited, lineage of traditional knowledge bank within households. Then comes ‘Community events’ (71.25%) which comprises of organized gatherings such as festivals and village functions followed by ‘peer-to-peer observation’ referring to direct farmer-to-farmer learning through field-level interaction (68.75%), together showcasing the reinforcement of ITKs through structured social interaction and collective field experience. The cultural embedding of ITKs in oral tradition was further expressed in folklore and proverbs, cited as informational source by 62.50 percent of farm respondents. ‘Informal village spaces’ such as casual gathering points including tea stalls or village squares (56.25%) and ‘local conduits’, referring to intermediary individuals such as priests, school teachers, input dealers or panchayat members (48.75%) were comparatively less relied upon but remained meaningful, unstructured means of knowledge dissemination.

Table 2. Sources of ITK information as perceived by farm respondents

Source	Percentage
Family eldership	86.25
Folklores and proverbs	62.50
Community events	71.25
Informal village spaces	56.25
Peer-to-peer observation	68.75
Local conduits	48.75

Regressional analysis factors towards extent of adoption of ITKs

Since F-value acts as initial check point of regressional fitted models, findings of Table 3 with its F-value of 26.57, significant at

Table 3. Multiple linear regressional analysis of factors towards extent of adoption of ITKs
$F(15, 304) = 26.57^{**}$; $R^2 = 0.567$; adjusted $R^2 = 0.543$; (n=320)

Variable	Coefficients (B)	Std. error	t-value	*p*-value
Age	2.345	1.188	1.974*	0.049
Gender	1.112	0.642	1.732	0.084
Education	12.349	27.750	0.445	0.657
Family type	-7.342	4.389	-1.673	0.095
Farming experience	4.318	1.933	2.234*	0.026
Occupational status	1.119	1.006	1.112	0.267
Annual Income	4.532	2.417	1.875	0.062
Landholding	0.112	0.147	0.764	0.445
Cosmopoliteness	0.894	15.960	0.056	0.955
Mass media exposure	1.113	0.458	2.432*	0.016
Economic motivation	-4.756	1.712	-2.779**	0.006
Decision making	1.184	0.772	1.533	0.126
Social norms	2.341	2.610	0.897	0.370
Extension contact	7.223	2.314	3.122**	0.002
Innovativeness	5.327	2.841	1.875	0.062

*=Significant at 5% level; **=Significant at 1 % level; NS=Non-significant.

one percent level, reaffirms the significance of explanation of ITK adoption by the variables and the same is conveyed again in the F-values to that of Table 4 also. In Table 4, the R^2 value of 0.567 meant that all the predictors explained about 56.7 percent of variation caused in extent of ITK adoption. Though the adjusted R^2 value was only slightly lower, indicating that there was not a significant amount of inflation due to a few minor, less meaningful variables.

At one percent level of significance, variables such as 'Extension contact' and 'Economic motivation' showcased positive and negative contribution respectively towards variation in extent of ITK adoption of farmer respondents whereas the likes age, farming experience and mass media exposure expressed significant contribution at five percent level of significance. The remaining set of predictors like education, cosmopoliteness, etc., conveyed contribution yet in non-significant manner.

Table 4 shows the stepwise regression results of the most parsimonious predictors of adoption of ITK. The four variables in the full model were also included in the reduced model: Age, Farming experience, Economic motivation, and Extension contact, and they produced an values of R^2 (0.531) and an Adjusted R^2 (0.524), as less different to the ones under full model, allowing the eleven variables to be excluded for the sake of parsimony without any significant contribution. The considerably greater F-value in the stepwise model opines greater statistical efficiency, as the same variance (R^2=0.531) was explained using far fewer predictors, consuming fewer degrees of freedom and yielding a more powerful test of overall significance. The findings of these table were somewhat analogous to the ones obtained by Patial (2025) and Pooja et al. (2025).

DISCUSSION

The ITK practices with the highest adoption indices such as botanical preservation and sun-drying can be explained by their intuitive, low-resource nature and their protective effects likely reinforced through farmers' recurrent observation across seasons. It is plausible that under resource constrained systems, neem-based chemical-free biochemicals are deemed as alluring option with no dependence on external inputs whereas low cost and simplicity feature of sun-drying well explains its continuation as a traditional seed-treatment method. Similarly, in comparision to the higher extent in case of earthen pot smoking and mud plastered bamboo silos, indigenous storage structures still remain prevalent particularly where modern options remain inaccessible. These indigenous structures reflect farmer's practical wisdom of microclimate controlling through cow dung and clay as natural insulating materials. Conversely, the decline in adoption of tobacco-garlic infusion and kerosene oil could be attributed to a shift towards synthetic pesticides, variable labour availability and lower perceived efficacy of such indigenous options, suggesting towards evolving priorities, market accessibility and exposure to readily available innovative technologies.

Most of the farmers are using ITK practices selectively, rather than completely, as indicated by majority of respondents, which

Table 4. Stepwise regressional analysis of factors towards extent of adoption of ITKs
$F(4, 315)=73.45^{**}$; $R^2= 0.531$; adjusted $R^2= 0.524$; (n=320)

Variable	Coefficients (B)	Std. error	t-value	*p*-value
Age	4.723	2.016	2.343*	0.020
Farming experience	2.387	0.831	2.874**	0.004
Economic motivation	-3.342	0.974	-3.432**	0.001
Extension contact	1.784	0.842	2.118*	0.035

*=Significant at 5% level; **=Significant at 1 % level; NS=Non-significant

are possibly linked to practical considerations as some ITKs are comparatively more labour-intensive or time-consuming and maybe perceived as less beneficial relative to modern alternatives. While the present study did not directly assess the intergenerational knowledge transmission or resource access as variables, it is quite possible that high adopters are more likely to have thrived from stronger knowledge transmission within families, more shortage of modern inputs or a deliberate preference for sustainable practices as these notion do require further investigation to concur. The comparatively low-adoption segment may reasonably reflect a gradual decline in traditional knowledge, potentially linked to generational change, migration, diminishing elder dominance, or spiked penetration of conventional technologies, consistent with broader documented concerns regarding the erosion of ITK when transmission is not actively sustained. This is in keeping with a general issue in the ITK concerns that there lies potential loss of knowledge through discontinued use when it is not transmitted socially, extended, or documented in a farming community and eventually eroding the foundations of knowledge systems of Indian farming culture. Gogoi et al. (2026) concluded that wider adoption of ITKs demands for scientific validation, proper documentation and integration with modern practices.

The predominance of family eldership as the paramount information source justifies the household as the primary unit of transmission for ITK, which involves experiential knowledge transmission across generations, without formal instruction. This is a familiar pattern, since indigenous knowledge is, by nature, tacit, and is often best expressed through demonstration and lived experience rather than documented sources. Community events, such as festivals and organized village gatherings, along with peer-to-peer observation—direct farmer-to-farmer learning through field-level interaction—together emerged as strong collaborators in ITK dissemination, providing structured and experiential spaces for collective learning, reinforced through social validation. In contrast, informal village spaces (e.g., casual gathering points such as tea stalls or village squares) and local conduits (e.g., intermediary individuals such as input dealers or panchayat members) showed comparatively lower reliance, which may indicate a gradual erosion of these more spontaneous, unstructured interaction points—possibly linked to shifting social arrangements or reduced day-to-day community engagement. This distinction suggests that while organized and experiential community-based transmission channels remain robust, the more informal, incidental avenues of knowledge exchange may be weakening, underscoring the layered and uneven nature of ITK's social transmission pathways. These findings collectively point to the fragility of ITK systems should intergenerational and community-based transmission—particularly its informal, everyday channels—continue to deteriorate, reinforcing the need for purposeful documentation and extension-supported efforts to sustain the foundation of Indian Knowledge Systems in rural farming communities. Sindhu and Malik (2020) as well as Yimchunger et al. (2026) concurred that the absence of documentation and preservation efforts in ITKs has led towards the brink of dying out.

The level of agreement among the multiple linear and stepwise methods validates the interpretation that extension contact and economic motivation are the main factors that influence ITK adoption. Extension services seems to have a role in bridging traditional practices and formal agricultural science (Raji et al., 2024), as farmers with more contact with extension staff are more likely to validate, refine and maintain traditional practices rather than replacing them. Conversely, the significant negative contribution towards ITK adoption by economic motivation suggests about that in present era, the farming sector, driven by profit maximization, opt for modern methodologies with its benefits of faster and quantifiable returns as compared to traditional counterparts (De La Cruz et al., 2023). The age and farming experience that were controlled for in both models also help to corroborate the experiential and accumulative process of ITK acquisition, such that older farmers and those with more years of experience have more time to observe, experiment and internalize traditional methods, instead of modern methods, through the process of successive cropping seasons. Rizki and Andini (2025) also concluded from their review that older farmers possess extensive experience and knowledge depth in farming traditions which has been the basis of their livelihood sustenance. Importantly, the considerate spike in F-value under stepwise model, as compared to linear model, illustrates the statistical efficiency of the reduced model in explaining near about equivalent magnitude of variance by utilizing the four of the original 15 predictors. These findings tentatively recommends that interventions directed on empowering extension systems can be associated with enhanced and effective results in ITK adoption followed by retention, then that of broader, less-targeted socio-demographic interventions, though this inference would benefit from confirmation through intervention-based or longitudinal research. The confluence of the linear and stepwise regression models reinforces the robustness of the findings; that direct institutional involvement, economic rationality, and farming experience are the main factors shaping ITK adoption in the study area, while general socio-demographic and attitudinal characteristics are not. The outcomes of this research provide unambiguous, practical guidance to policy and extension practitioners to reinforce indigenous traditional knowledge as a subset of Indian Knowledge systems in today's agricultural extension systems.

CONCLUSION

Indigenous Technical Knowledge still persists as resource optimizing, ecologically sustainable and socio-culturally compatible aspect of paddy farming in Odisha, furnishing affordable solutions for seed treatment, pest management and food-grain storage. However, the prevalence of low-medium adopters along with downward trajectory on informal community channels signals towards possible erosion of such generational wisdom. The findings of regressional model advocates the dependency of ITK retention on institutional engagement rather than socio-demographic alone. Focused extension interventions instead of broad-based programmes should be emphasized for ITK conservation. An important function of agricultural extension is also ensuring documentation, scientific validation and linkage of ITK with modern practices to preserve such heritable lineage and fuel-up the efforts for revival forgotten paradigms of Indian Knowledge System in farming sector. This investigation provides indispensable region-specific insights, but further testing in a variety of agroclimatic zones and crop systems is required to ascertain its broader generalizability.

DECLARATIONS

Ethical approval and consent to participate: The study was approved by the research Advisory Committee of Department of Extension Education, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha. However, the informed consent was sought from all the respondents.

Data availability statement: Data are available with first author and may be provided on reasonable request.

Consent of publication: All the participants provided consent for publication

Conflict of interest: No conflict of interest among the author

Authors' Contribution: DKJ conceived and designed the study as the main researcher and drafted the discussion section of the manuscript. PB served as cooperating technician, conducted the data analysis, and contributed to the methodology. KB served as cooperating scientist, contributed to the methodology, and critically revised the manuscript. All authors read and approved the final manuscript

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