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Development and validation of e-learning module towards farmers' rights and landrace conservation

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Abstract
The study investigates the knowledge levels of custodian and non-custodian farmers in Odisha and Uttarakhand regarding landrace conservation and Farmers' Rights. Educational e-learning modules, were developed using ADDIE model and implemented to enhance farmers' understanding. The developed e-module were evaluated by a panel of experts comprising representatives from various organizations, including seed banks, research foundations, conservation organizations, and custodian farmers. Using a five-point Likert checklist, the experts assessed the modules based on five indicators: Objectives, Content, Format and Language, Presentation, and Usefulness. The evaluation revealed that the e-learning module received the highest score for its usefulness, indicating its significant value in the context of landrace conservation. To validate the e-learning module, pre- and post-tests were conducted to measure farmers' knowledge before and after exposure to the content. Two knowledge tests were administered: one focused on landrace conservation and the other on farmers' rights. Results revealed significant improvements in knowledge levels among both groups post-intervention. Custodian farmers demonstrated higher baseline knowledge, likely due to their active engagement in conservation practices. However, the interventions effectively enhanced understanding among non-custodian farmers, narrowing the knowledge gap. Hence, the module was validated and effective in increase knowledge level of farmers towards farmers' rights and landrace conservation.

Keywords: Development, e-learning, farmers', landrace, conservation

1. Introduction
Landraces are dynamic cultivated plant populations with a historical origin and distinct identity, typically characterized by genetic diversity and local adaptation; they are closely linked to farmers' practices of seed selection, field management, and traditional knowledge (Villa et al., 2005) [8]. Despite the widespread adoption of modern cultivars following the Green Revolution in India, a group of dedicated farmers continues to conserve and cultivate landraces (Mishra, 2009) [7]. These farmers, known as custodian farmers or genomic saviours according to the Protection of Plant Varieties and Farmers Rights Act by the Government of India Act (2005), play a vital role in enhancing agro-biodiversity in the country. Studies suggested that farmers conserve landraces of field crops like wheat and paddy for three main reasons in India: to withstand climatic challenges and maintain yields, to

preserve traditional culture and ecosystem services, and to adapt to local environments and support sustainable agriculture (Bisht et al., 2007; Yang et al., 2012; Marone et al., 2021) [2, 9, 6]. Farmers in many regions utilize traditional practices and indigenous knowledge to conserve and enhance landraces. However, their efforts often lack a systematic approach, primarily due to a lack of formal knowledge. Formal knowledge held by farmers regarding conservation practices has the potential to significantly strengthen on-farm preservation of landraces which is crucial as landraces face threats from genetic drift induced by climate change and the pressures of economic development (Benbrahim et al., 2017) [1]. But there were cases where farmers were not able to get rights over the landraces they had maintained and improved for generations, or sometimes the rights were taken by a private entity and farmers lost the benefits. The Protection of Plant

Varieties and Farmers Rights Act by the Government of India Act (2001) recognizes the multiple roles played by farmers in cultivating, conserving, developing and selecting varieties. Farmers engaged in conserving genetic resources and improving landraces and wild relatives of economic plants can be recognized and rewarded through the Gene Fund, but only if the materials they preserve are used as gene donors in registered varieties. However, due to improper documentation and characterisation of farmers' landraces, it became difficult for farmers to register their landraces and gain benefits over their conserved landraces in the market. It is essential for identifying and preserving various landraces, which can be valuable for future agricultural improvement initiatives and seeking protection for landraces under India's Plant Varieties and Farmers' Rights Act of 2001 (Manjunatha et al., 2018) [5]. The study conducted by Chakravorty and Ghosh (2012) [4] in Eastern India underscores the critical importance of conserving and characterisation of rice landraces by identifying 27 distinctive landraces with 22 essential and 24 additional characteristics. It was, therefore, essential to develop a learning module aimed at sensitizing custodian farmers. The module provided them with knowledge on how to enhance their conservation practices for the improvement of landraces. Additionally, it equips them with the procedures for registering the landraces they have preserved for generations, enabling them to assert their rights over these valuable resources.

Material and Methods
The learning module was digitally constructed using Visme software. The module was constructed based on data collection in Odisha and Uttarakhand.

Analysis
- Documentation of major landraces of various field crops like paddy and millets in Odisha
- Documentation of major landraces of crops (paddy, millets and wheat)

Needs Analysis
- Identification of the specific learning needs and gaps related to landrace conservation and farmers' rights while collecting data for other aspects of the study.
- Pre-testing of farmers' knowledge towards farmers' rights and landrace conservation
- Target Audience Analysis: Here, our target audience for both custodian and non-custodian farmers providing them with knowledge towards landraces and their conservation and improvement practices.

Design
- Learning Objectives: Clearly define measurable learning objectives for the e-module formulated. The major objective was to create a foundation for farmers' knowledge base on the conservation of landraces.
- The format of the module was planned
- Planning of subject matter
- Content sequencing
- Language (Hindi)
- Task and Topic Analysis: Breaking down the complex topics of landrace conservation and farmers' rights into manageable learning objectives and sub-topics.
- Sequencing: Organization of the content logically, starting from foundational concepts and progressing to more advanced topics.
- Multimedia elements were planned

Development
- Content Development: Creation of high-quality content, including text, images, videos, and interactive elements. Contents were based on data collected during the study interviewing 420 farmers.
- Storyboard Development: Development of a detailed storyboard outlining the flow of the e-module. Include text, media, interactions, and navigation.
- Courseware Development: The e-module was built using an e-learning authoring tool Visme software.
- Video clipping of interviews of Odisha custodian farmers was also included to provide interactivity in the module.

Step 5: Implementation
Installation and Distribution: Deployment of e-module on the chosen platform in Compact Disc to be circulated in various institutes and NGOs.

Step 6: Evaluation
To evaluate the acceptability of the developed instructional modules, the following experts were involved in evaluating the e-module:
- Seed bank, Bargarh, Kattipali
- MS Swaminathan Research Foundation Officials, Koraput, Odisha
- Himalayan Environmental Studies Conservation Organization's Officials, Odisha
- Custodian farmers (Progressive one)
- Shri. Sudama Sahoo, Bargarh, Odisha
- Shri Narayan Gowda, Bargarh, Odisha
- Rai mati Gujaria (Plant Genomic Saviour awardee)

A five-point Likert checklist was used given by Marin (2003) and Marasigan (2003). The 30 experts examined the modules based on five indicators which include: Objectives, Content, Format and language, Presentation, and Usefulness of the instructional modules. Some modifications to the item format were made to better align them with the purpose of the study. Experts were asked to give responses on five continua from Strongly Agree (5), Agree (4), Undecided (3), Disagree (2) to Strongly disagree (1). The weighted mean score of each indicator was calculated, along with the overall weighted score combining all 5 indicators. The highest score in the evaluation was awarded to the usefulness of the e-learning module, indicating its significant value in the context of landrace conservation. It was found that this module has the potential to greatly benefit day-to-day practices related to the preservation of landraces, offering a practical and valuable resource for those involved in this field. Furthermore, the module's ability to impart knowledge about the essential rules and regulations governing the registration of varieties was seen as a crucial advantage, empowering users with the necessary understanding to navigate the regulatory landscape effectively. What makes this e-learning module particularly commendable is its alignment with the needs of the farmers, as experts evaluating it found that each topic covered addressed the practical challenges and requirements faced by progressive custodian farmers and officials working tirelessly to promote landrace conservation. These findings collectively underscore the module's positive impact and relevance in advancing the goals of landrace preservation.

Table 1: Experts' evaluation checklist of the instructional modules (n=30)

Aspects of e-learning module	Items	Mean ± Standard Deviation
1. Objectives of the module	1. The objectives are clearly stated in behavioural form 2. The objectives are well-planned, formulated, and organized. 3. The objectives stated are specific, measurable, and attainable. 4. The objectives are relevant to the topics of each lesson of the modules. 5. The objectives take into account the needs of the respondents.	4.90 ± 0.25
2. Content of the module	1. The content of each lesson is directly relevant to the defined objectives. 2. The content of each lesson is simple and easy to understand. 3. The topics of each lesson are fully discussed. 4. The topics are supported by illustrative examples, and the practice tasks are suited to the level of the students. 5. Each topic is given equal emphasis in the lesson.	4.00 ± 0.20
3. Format and language of the module	1. The format/layout is well-organized, which makes the lessons more interesting. 2. The language used is easy to understand. 3. The language used is clear, concise, and motivating. 4. The mathematical symbols used are well-defined. 5. The instructions in the instructional modules are concise and easy to follow.	4.00 ± 0.16
4. Presentation of the module	1. The topics are presented in a logical and sequential order. 2. The lessons of the modules are presented in a unique and original form. 3. The learning activities are presented clearly. 4. The presentation of each lesson is attractive and interesting to the farmers. 5. Adequate examples are given to each topic.	4.92 ± 0.25
5. Usefulness of the module	1. The instructional modules will motivate the farmers to conserve landraces. 2. The instructional modules will help the farmers to master the topics at their own pace. 3. The instructional modules will allow the farmers to use their time more efficiently. 4. The instructional modules will develop the need to learn about farmers' rights and landraces 5. The instructional modules will serve as supplementary material that can cater to the needs of the farmers	4.90 ± 0.25

Table 2: Evaluation of training modules: ratings and interpretations

Overall Evaluator's response to modules	Overall Mean Score	Mean Rating	Interpretations
1. Objectives	4.90 ± 0.25	4.5-5	Excellent
2. Content	4.00 ± 0.20	3.5-4.49	Very Good
3. Format and language	4.00 ± 0.16	2.5-3.49	Good
4. Presentation	4.00 ± 0.16	1.5-2.49	Fair
5. Usefulness	4.90 ± 0.25	1.0-1.49	Poor
Final Score	4.36 ± 0.17		

The final score of the e-learning module on all five indicators was within the "Very Good" range of the mean rating. Hence the module was appropriate for delivery to farmers for teaching purposes.

Step 6: Validation
For validation of the e-learning module, a knowledge test was administered as a pre-test to gather baseline information on what the farmers knew before their exposure to the e-learning module and then a post-test was conducted to measure the farmers' score after learning the content of the module. Two Knowledge tests were developed.

a. Knowledge Test for Landrace Conservation: Knowledge Test 1
This knowledge test has been designed to evaluate individuals' understanding of the conservation of landrace crops. It aims to assess their knowledge about the importance of preserving traditional crop varieties, the methods and strategies used in landrace conservation, and

their role in maintaining agricultural biodiversity.

b. Knowledge Test for Farmers' Rights: Knowledge Test 2
This knowledge test was intended to gauge individuals' knowledge of farmers' rights, including their rights related to seeds, and the intellectual property of landraces they conserved. It assesses their comprehension of the legal and ethical aspects surrounding farmers' rights and the importance of protecting the interests of farmers.

Final knowledge test (Farmers' Rights)
In the final knowledge test, 12 items were selected for testing the knowledge level of farmers towards farmers' rights.

Final knowledge test (Landrace conservation)
In the final knowledge test, 18 items were selected for testing the knowledge level of farmers towards landrace conservation

Table 3: Knowledge Test for measuring farmers' knowledge about Farmers' Rights (N=60) (Non-Sampled Region)

Item No.	Items	Difficulty Index	Discrimination Index	Point Biserial Correlation
1.	Do you know that if you conserve any landrace or develop a local variety, it can be registered under your name?	0.60	0.95	0.82**
2.	Do you know there is a law for protecting the landraces you have conserved?	0.53	0.95	0.80**
3.	#How many rights are provided under PPVFR, 2001?	0.13	0.30	ns
4.	#Do you know of any rights related to the protection of plant varieties grown by you?	0.35	0.80	ns
5.	#Do you know what kind of farmers variety can be registered under the government?	0.15	0.45	ns
6.	Do you know when we call a variety a farmer's variety?	0.30	0.75	0.67**
7.	Do you know you can receive a fair share of the benefits from the commercial gains if you register your varieties?	0.60	0.90	0.74**
8.	Do you know there is a provision for providing recognition & and rewards to farmers for contributing to the conservation of traditional varieties?	0.32	0.90	0.84**
9.	Are there any registration fees for variety registration?	0.35	0.85	0.78**
10	Is it legal for someone to sow your produced variety's seeds in his field and use the harvested product?	0.43	0.80	0.66**
11.	#Can someone else sell a variety you created under his/her brand name?	0.55	0.05	ns
12.	#Will a variety bred by a farmer as a plant breeder which is recognized by the PPV&FR Act, 2001 as one of the farmers' rights, also to be considered a "farmer's variety"?	0.08	0.05	ns
13.	What is the duration for which protection is provided to farmers varieties, local varieties, newly-bred varieties by farmers etc.?	0.32	0.75	0.65**
14.	Do you know you can work with scientists (breeders) to jointly develop a variety	0.53	0.95	0.80**
15	Do you know any NGOs working for farmers in helping farmers to register landraces?	0.55	0.60	0.53**
16.	Do you know farmers can be treated the same as breeders if they register their variety under the government?	0.33	0.50	0.47**
17.	Can a farmer or farmers' community directly file for registration of farmers' variety with the Authority HQ or its branches?	0.30	0.55	0.55**

#: Items discarded
**Items were significant at 0.01 level of significance
ns: Items were not significant at 0.01 level of significance

Table 4: Knowledge test for measuring farmer knowledge in landrace conservation (N=60) (Non-Sampled Region)

Item No.	Items	Difficulty Index	Discrimination Index	Point Biserial Correlation
1.	Are there specific crops commonly conserved as landraces in your regions?	0.43	0.70	0.72**
2.	What does "conservation of landraces and their seeds" mean?	0.43	0.70	0.71**
3.	Do you know about the community seed bank?	0.40	0.30	0.35**
4.	Could you please name 5 landraces of paddy grown in your village/area?	0.47	0.60	0.50**
5.	Do you know about wild varieties/species of plants?	0.27	0.80	0.69**
6.	Do you know the expansion of agricultural land has led to the elimination of many native plant species in the region?	0.32	0.55	0.54**

7.	Do you know that using organic matter and compost in the field helps in the conservation of Agro biodiversity?	0.48	0.45	0.46**
8.	#Do you know about useful insects in the field that help in the conservation of Agro biodiversity?	0.05	0.15	ns
9.	Are hybrid seeds and landrace seeds different from each other?	0.40	0.70	0.69**
10	Does saving and exchanging seeds among farmers contribute to landrace conservation?	0.52	0.45	0.42**
11	Does cultural knowledge play a role in landrace conservation by farmers?	0.47	0.60	0.71**
12.	#Do you know about self- and cross-pollinated crops? Can you name some self-pollinated crops and cross-pollinated crops?	0.43	0.00	ns
13.	Can landraces possess unique genetic traits compared to modern cultivated varieties?	0.40	0.80	0.75**
14.	Is the conservation of landraces solely dependent on scientific methods?	0.30	0.70	0.52**
15.	Can landraces adapt better to local environmental conditions compared to commercial varieties?	0.42	0.75	0.76**
16.	Is the practice of selecting seeds from the best-performing plants a method used by farmers to conserve landraces?	0.40	0.80	0.76**
17.	Do some organizations and initiatives focus on promoting the conservation of landraces?	0.40	0.50	0.36**
18.	Is the loss of landraces a concern due to the dominance of modern agricultural practices?	0.37	0.90	0.74**
19.	#Is the use of chemical fertilizers and pesticides compatible with the conservation of landraces?	0.22	0.45	ns
20.	#Is there a risk of losing landraces if they are not actively conserved by farmers?	0.32	0.25	ns
21.	Do landraces generally require fewer external inputs compared to modern varieties?	0.57	0.30	0.52**
22.	Can landraces help in adapting crops to changing climatic conditions?	0.45	0.65	0.50**

#: Items discarded

**Items were significant at 0.01 level of significance

ns: Items were not significant at 0.01 level of significance

Knowledge Index score (KI)

Knowledge Index scores of the sampled custodian and non-custodian farmers were calculated using the formula:

$$K.I. = \frac{Knowldeg\ score\ obtained\ by\ respondent}{Maximum\ Obtainable\ knowledge\ score}$$

Results

Pre-test and Post-test score of knowledge about farmers' rights in Odisha for custodian farmers

In the pre-test phase, Custodian Farmers exhibited a mean knowledge score of 0.52 (Standard Deviation = 0.20, Standard Error Mean = 0.36). A paired differences analysis was conducted to evaluate the significance of this improvement. The mean difference between the post-test and pre-test scores was calculated at 0.12. The standard deviation of the paired differences was 0.13, with a standard error mean of 0.23. The t-value obtained from this analysis was 5.19, and the associated p-value (Sig.) was found to be 0.000, indicating a highly significant difference. The post-test scores of Custodian Farmers significantly differ from their pre-test scores at a 0.001 level of significance (p < 0.001).

Table 5: Pre-test and Post-test score of knowledge of farmers about farmers' rights in Odisha

Custodian Farmers	Mean	-	No.	Std. Deviation	Std. Error Mean
Pre-test Score	0.52	-	30	0.20	0.36
Post-test Score	0.64	-	30	0.11	0.20
Paired Differences	Mean (Post-Pre)	Std. Deviation	Std. Error Mean	t-value	Sig
Post-Test v/s Pre-Test	0.12	0.13	0.23	5.19	.000

Post Test and Pre-test scores of custodian farmers differ significantly at a 0.001 level of significance

Pre-test and Post-test score of knowledge about landrace conservation in Odisha for custodian farmers

Following the educational intervention, during the post-test phase, their knowledge levels exhibited a slight increase, with a mean score of 0.88 (Standard Deviation = 0.08, Standard Error Mean = 0.01). A paired differences analysis was conducted to assess the significance of this change. The mean difference between the post-test and pre-test scores was calculated at 0.03. The standard deviation of the paired differences was 0.08, with a standard error mean of 0.01. The t-value obtained from this analysis was 2.41, and the associated p-value (Sig.) was found to be "ns," indicating that the difference was not statistically significant at a 0.001 level of significance ($p > 0.001$).

Table 6: Pre-test and Post-test score of knowledge of farmers about landrace conservation in Odisha

Custodian Farmers	Mean	-	No.	Std. Deviation	Std. Error Mean
Pre-test Score	0.85	-	30	0.09	0.02
Post-test Score	0.88	-	30	0.08	0.01
Paired Differences	Mean (Post-Pre)	Std. Deviation	Std. Error Mean	t-value	Sig
Post-Test v/s Pre-Test	0.03	0.08	0.01	2.41	$p > 0.001$

ns: Post-Test and Pre-test scores of custodian farmers do not differ significantly at a 0.001 percent level of significance

Pre-test and Post-test score of knowledge about farmers' rights in Odisha for non-custodian farmers
Following the educational intervention, during the post-test phase, their knowledge levels saw a substantial increase, with a mean score of 0.44 (Standard Deviation = 0.18, Standard Error Mean = 0.03). A paired differences analysis was conducted to evaluate the significance of this improvement. The t-value obtained from this analysis was 10.42, and the associated p-value (Sig.) was found to be 0.000, indicating a highly significant difference. The post-test scores of Non-Custodian Farmers regarding Farmers' Rights in Odisha differ significantly from their pre-test scores at an extremely low significance level of 0.001 ($p < 0.001$).

Table 7: Pre-test and Post-test score of knowledge of farmers about farmers' rights in Odisha

Non-Custodian Farmers		Mean	No.	Std. Deviation	Std. Error Mean
Pre-test Score	-	0.13	30	0.14	0.03
Post-test Score	-	0.44	30	0.18	0.03
Paired Differences	Mean (Post-Pre)	Std. Deviation	Std. Error Mean	t-value	Sig
Post-Test v/s Pre-Test	0.31	0.16	0.03	10.42	0.000

Post Test and Pre-test scores of non-custodian farmers differ significantly at a 0.001 level of significance

Pre-test and Post-test score of knowledge about landrace conservation in Odisha for non-custodian farmers
In the pre-test phase, Non-Custodian Farmers demonstrated a mean knowledge score of 0.43 (Standard Deviation = 0.19, Standard Error Mean = 0.03). Following the educational intervention, during the post-test phase, their knowledge levels showed a substantial and noteworthy increase, with a mean score of 0.71 (Standard Deviation = 0.15, Standard Error Mean = 0.03). The mean difference between the post-test and pre-test scores was calculated at 0.28. The standard deviation of the paired differences was 0.17, with a standard error mean of 0.03. The t-value obtained from this analysis was 8.67, and the associated p-value (Sig.) was 0.000, indicating an extremely high level of statistical significance. The post-test scores of non-Custodian farmers regarding landrace conservation in Odisha differ significantly from their pre-test scores at a significance level of 0.001 ($p < 0.001$).

Table 8: Pre-test and Post-test scores of Knowledge's of farmers about landrace conservation in Odisha

Non-Custodian Farmers	-	Mean	No.	Std. Deviation	Std. Error Mean
Pre-test Score	-	0.43	30	0.19	0.03
Post-test Score	-	0.71	30	0.15	0.03
Paired Differences	Mean (Post-Pre)	Std. Deviation	Std. Error Mean	t-value	Sig
Post-Test v/s Pre-Test	0.28	0.17	0.03	8.67	0.000

Post Test and Pre-test scores of non-custodian farmers differ significantly at a 0.001 level of significance

Pre-test and Post-test score of knowledge about farmers' rights in Uttarakhand for custodian farmers
Following the educational intervention, during the post-test phase, their knowledge levels exhibited a notable increase, with a mean score of 0.53 (Standard Deviation = 0.18, Standard Error Mean = 0.03). A paired differences analysis was conducted to evaluate the significance of this improvement. The mean difference between the post-test and pre-test scores was calculated at 0.12. The standard deviation of the paired differences was 0.11, with a standard error mean of 0.02. The t-value obtained from this analysis was 6.15, and the associated p-value (Sig.) was 0.000, indicating a highly significant difference. The post-test scores of Custodian Farmers regarding Farmers' Rights in Uttarakhand differ significantly from their pre-test scores at a 1 percent level of significance ($p < 0.001$).

Table 9: Pre-test and Post-test score of knowledge of farmers about farmers' rights in Uttarakhand

Custodian Farmers	-	Mean	No.	Std. Deviation	Std. Error Mean
Pre-test Score	-	0.41	30	0.20	0.04
Post-test Score	-	0.53	30	0.18	0.03
Paired Differences	Mean (Post-Pre)	Std. Deviation	Std. Error Mean	t-value	Sig
Post-Test v/s Pre-Test	0.12	0.11	0.02	6.15	0.000

Post Test and Pre-test scores of custodian farmers differ significantly at a 0.001 percent level of significance

Pre-test and Post-test score of knowledge about landrace conservation in Uttarakhand for custodian farmers
Following the educational intervention, during the post-test phase, their knowledge levels showed a slight increase, with a mean score of 0.86 (Standard Deviation = 0.09, Standard Error Mean = 0.02). A paired differences analysis was conducted to assess the significance of this change. The mean difference between the post-test and pre-test scores was calculated at 0.01. The standard deviation of the paired differences was 0.07, with a standard error mean of 0.01. The t-value obtained from this analysis was 0.72, and the associated p-value (Sig.) was 0.48, indicating that the difference was not statistically significant at a 1 percent level of significance ($p > 0.001$). The post-test scores of Custodian Farmers regarding landrace conservation in Uttarakhand do not differ significantly from their pre-test scores at a 1 percent level of significance ($p > 0.001$).

Table 10: Pre-test and Post-test score of knowledge of farmers about landrace conservation in Uttarakhand

Custodian Farmers	-	Mean	No.	Std. Deviation	Std. Error Mean
Pre-test Score	-	0.85	30	0.08	0.02
Post-test Score	-	0.86	30	0.09	0.02
Paired Differences	Mean (Post-Pre)	Std. Deviation	Std. Error Mean	t-value	Sig
Post-Test v/s Pre-Test	0.01	0.07	0.01	0.72	0.48

Post Test and Pre-test scores of custodian farmers do not differ significantly at a 0.001 percent level of significance

Pre-test and Post-test score of knowledge about farmers' rights in Uttarakhand for non-custodian Farmers
Following the educational intervention, during the post-test phase, their knowledge levels exhibited a significant increase, with a mean score of 0.47 (Standard Deviation = 0.20, Standard Error Mean = 0.04). A paired differences analysis was conducted to assess the significance of this improvement. The mean difference between the post-test and pre-test scores was calculated at 0.20. The standard deviation of the paired differences was 0.17, with a standard error mean of 0.03. The t-value obtained from this analysis was 6.65, and the associated p-value (Sig.) was 0.000, indicating an extremely high level of statistical significance. The post-test scores of Non-Custodian Farmers regarding Farmers' Rights in Uttarakhand differ significantly from their pre-test scores at a 0.001 level of significance (p < 0.001).

Table 11: Pre-test and Post-test scores of knowledge of farmers about farmers' rights in Uttarakhand

Non-Custodian Farmers	-	Mean	No.	Std. Deviation	Std. Error Mean
Pre-test Score	-	0.27	30	0.17	0.03
Post-test Score	-	0.47	30	0.20	0.04
Paired Differences	Mean (Post-Pre)	Std. Deviation	Std. Error Mean	t-value	Sig
Post-Test v/s Pre-Test	0.20	0.17	0.03	6.65	*0.000

Post Test and Pre-test scores of non-custodian farmers differ significantly at a 0.001 level of significance

Pre-test and Post-test score of knowledge about landrace conservation in Uttarakhand for non-custodian farmers
Following the educational intervention, during the post-test phase, their knowledge levels showed a notable increase, with a mean score of 0.72 (Standard Deviation = 0.08, Standard Error Mean = 0.02). A paired differences analysis was conducted to assess the significance of this change. The mean difference between the post-test and pre-test scores was calculated at 0.15. The standard deviation of the paired differences was 0.12, with a standard error mean of 0.02. The t-value obtained from this analysis was 7.02, and the associated p-value (Sig.) was 0.000, indicating a highly significant difference. The post-test scores of Non-Custodian Farmers regarding landrace conservation in Uttarakhand differ significantly from their pre-test scores at an extremely low significance level of 0.001 (p < 0.001).

Table 12: Pre-test and Post-test score of knowledge of farmers about landrace conservation in Uttarakhand

Non-Custodian Farmers	-	Mean	No.	Std. Deviation	Std. Error Mean
Pre-test Score	-	0.57	30	0.11	0.02
Post-test Score	-	0.72	30	0.08	0.02
Paired Differences	Mean (Post-Pre)	Std. Deviation	Std. Error Mean	t-value	Sig
Post-Test v/s Pre-Test	0.15	0.12	0.02	7.02	0.000

Post Test and Pre-test scores of non-custodian farmers do not differ significantly at a 0.001 percent level of significance

Discussion
In summary, the research highlights significant disparities in knowledge levels between custodian and non-custodian farmers, particularly regarding landrace conservation and Farmers' Rights in Odisha and Uttarakhand. Custodian farmers, actively engaged in conservation efforts and often connected with supportive organizations, exhibit higher knowledge levels due to their ingrained agricultural traditions and hands-on experience. The Educational interventions; e-learning modules, have proven effective in enhancing farmers' understanding of legal frameworks and conservation practices, particularly among non-custodian farmers. Peer-to-peer knowledge sharing and collaborative efforts between government agencies and NGOs play crucial roles in disseminating information and empowering farmers with essential knowledge. While custodian farmers in Uttarakhand show significant improvement in understanding Farmers' Rights post-intervention, there's a need for further efforts to bridge knowledge gaps among both custodian and non-custodian farmers, preserving traditional practices and promoting sustainable agriculture in these regions.

Conclusion
The findings of this study carry several implications for agricultural policy, practice, and future research. Firstly, recognizing the significant knowledge gap between custodian and non-custodian farmers underscores the importance of targeted educational interventions aimed at promoting landrace conservation and awareness of Farmers' Rights. Government agencies and NGOs should prioritize outreach programs and capacity-building initiatives, leveraging peer-to-peer knowledge sharing and collaborative efforts to empower farmers with essential information. Additionally, the success of e-learning modules in improving farmers' understanding highlights the potential for integrating technology-driven solutions into agricultural extension services, particularly in remote or underserved

regions. Moreover, fostering a supportive environment for organic farming practices and landrace conservation can further enhance farmers' knowledge and engagement, contributing to biodiversity preservation and sustainable agriculture. Future research should delve deeper into understanding the socio-economic factors influencing farmers' knowledge levels and the long-term impacts of educational interventions on agricultural practices and livelihoods. By addressing these implications, policymakers, researchers, and stakeholders can work together to strengthen agricultural knowledge systems, promote inclusive development, and ensure the preservation of traditional farming heritage for future generations.

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