**Empowering Farmers: Creation of an E-Learning Module on Farmers' Rights and Landrace Conservation Using the ADDIE Model and Knowledge Test**

**Abstract**

India's agricultural landscape is characterized by a rich diversity of traditional crops and landraces, vital for food security and cultural heritage. However, genetic erosion threatens this biodiversity due to the widespread adoption of high-yield varieties. This study investigates the impact of an e-learning module on farmers' awareness of Farmers' Rights and landrace conservation in Odisha and Uttarakhand, India. The module, developed using the ADDIE Model, underwent expert evaluation and knowledge tests for validation. For evaluation purposes, 30 experts were involved. The validation process involved 60 farmers (30 custodians and 30 non-custodian farmers) for the pre-test and post-knowledge tests in Odisha and Uttarakhand, respectively. A total sample size of 120 farmers was used for validation. Findings reveal significant improvements in knowledge levels among both custodian and non-custodian farmers following the intervention, particularly regarding Farmers' Rights. However, non-custodian farmers also demonstrated improved understanding, highlighting the module's effectiveness. The study underscores the importance of educational interventions in enhancing farmers' awareness of their rights and responsibilities in landrace conservation. The integration of the ADDIE Model with knowledge test validation proved effective in developing and validating the e-learning module.

Key words: e-learning module, food security, agro-biodiversity, genetic erosion

**Introduction**

India stands as a beacon of agro-biodiversity, boasting a rich tapestry of wild species, traditional crops, and landraces that have been cultivated for generations. This wealth of agricultural diversity forms the backbone of the country's food security, cultural heritage, and economic prosperity. India is home to approximately 15,658 rice landraces alone, underscoring the vastness of its agricultural heritage (Jacob *et al*., 2020). Landraces, characterized by their resilience, adaptability to local conditions, and intrinsic nutritional value, have been cultivated over centuries without formal crop improvement interventions (Villa *et al*., 2005). These crops have been nurtured for their ability to withstand pest attacks, satisfy culinary preferences, uphold cultural significance, and even serve commercial interests (Yadav *et al*., 2024). India has many special traditional crops and landraces that show how important it was to keep old farming traditions alive. For example, there's the fragrant *Kalajeera* rice grown in Odisha, the famous *Kasturi* Basmati rice from Uttarakhand, and the red rice from Chhattisgarh. Also, in places like Odisha and Madhya Pradesh, there are lots of different kinds of millet landraces being cultivated. But at the same time, the loss of these landraces is prevalent (Uzoma et al., 2021; Safaruddin et al., 2023; Nichols and Greer, 2016). The widespread use of high-yield crop varieties, along with shifting market demands due to population changes, and the lack of proper documentation of traditional varieties have contributed to a decline in genetic diversity among crops (FAO, 2019). This loss of diversity, known as genetic erosion, has serious consequences for agriculture and food security. Traditional local cultivars and landraces, which were once widespread, have become confined to small geographic areas. As a result, there's a risk of losing these valuable genetic resources altogether. Furthermore, the decline of these traditional varieties is not only a loss of biodiversity but also a loss of local cultural heritage and knowledge associated with farming practices (Yadav, 2023). Furthermore, the lack of awareness among custodian farmers about their rights, benefits, and incentives associated with conserving landraces exacerbates this situation, though India is the first country in the world that provides some laws or acts for Farmers’ Rights known as Protection of Plant Varieties and Farmers Rights, 2005. This research aims to investigate the impact of farmer awareness and education initiatives on the conservation of traditional crop varieties in Odisha and Uttarakhand. By assessing the effectiveness of a learning module designed to inform farmers about the landraces suitable for cultivation in their area, as well as the benefits and conservation practices associated with these crops, this study seeks to address the knowledge gap among custodian farmers. Promoting the conservation of traditional landraces is essential for enhancing agricultural biodiversity, resilience, and food security. Educational interventions can play a crucial role in promoting sustainable agricultural practices and preserving indigenous knowledge for future generations.

**Materials and Methods**

*Development of an e-learning module*

The development of the e-learning module followed a structured approach based on the ADDIE Model, encompassing the Analysis, Development, Design, Implementation, and Evaluation phases. In the Analysis phase (Phase I), the process commenced with the documentation of landraces and analysis of landrace-specific conservation practices in Odisha and Uttarakhand. Additionally, recorded interviews of individuals conserving landraces are compiled to enrich the module's content. Expert consultations involving progressive farmers, scientists, and extension functionaries are conducted to gather insights and needs for the module. Moving to the Design phase (Phase II), careful consideration was given to structuring the content through chunking, avoiding technical jargon, and maintaining succinct sentences. Language selection was deliberate, with Hindi chosen for broader accessibility, supplemented with localized languages such as Odia and Hindi in interview clips. Multimedia elements, including video clips and subtitles, were incorporated to enhance comprehension and engagement. Storyboarding was employed to outline the module's structure and visual elements effectively. In the Development phase (Phase III), video editing and module creation were carried out using designated software, The Video was edited using the “Filmora application” and the e-learning module was developed by using “The Visme application” and “Microsoft Office PowerPoint 2010” ensuring compatibility and user-friendliness. The module was then published in CD-ROM format for distribution. Upon Implementation (Phase IV), the module was presented to experts and subsequently to custodian and non-custodian farmers for evaluation and feedback. In the Evaluation phase, a Likert scale was utilized to assess the module's acceptability, involving experts from various organizations and custodian farmers. Evaluation criteria included; Objectives, Content, Format and language, Presentation, and Usefulness. For further validation, two knowledge tests were constructed.

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Figure 1: Interface of e-learning module

*Development of Knowledge test*

Step 1:A preliminary test consisting of 17 statements for Knowledge Test 1 (Farmers’ Rights) and 22 statements for Knowledge Test 2 (Landrace conservation) was done with 60 respondents in non-sampled regions of Odisha and Uttarakhand states of India. The non-sampled regions were Patrapali and Marakuta villages in Odisha. In Uttarakhand, Ambivala and Bhowali villages were the non-sampled regions. These items were analyzed using statistical indexes. Score ‘1’ was assigned to the right answer and ‘0’ to the wrong answer.

Step 2: Item Analysis: three indexes, i.e., difficulty index, point biserial correlation coefficient, and discrimination index, were calculated for the final selection of items

*Difficulty Index*

The difficulty index measures the degree of complexity of an item or indicates how much a question is difficult. A question (or item) should not be too simple that everyone can pass, nor too hard that no one can pass. In this study difficulty index is symbolized as K

K =$ \frac{C}{N}$

Where, C= Number of respondents who correctly answered

N=Total number of sampled respondents (N=60)

Items having a Difficulty Index value within 0.30–0.70 were selected for the final knowledge test. The difficulty index was calculated for each statement/item separately.

*Discrimination Index*

This index helps to determine whether a particular item or question possesses the ability to differentiate between well-informed and not-informed individuals. To calculate the Index, the scores obtained for each statement, which were derived by adding up the scores from the subcategories of each statement across all samples, were organized in descending order. These scores were then divided into six groups, denoted as G1, G2, G3, G4, G5, and G6. The middle two groups, G3 and G4, were excluded from further analysis. Instead, the focus was placed on the four terminal groups: the high-score groups (G1 and G2) and the low-score groups (G5 and G6). For each statement, the DI was computed separately using the following formula:

D.I**=** $\frac{\left(S1+S2\right)-(S5+S6)}{N/3}$

Where, DI = Discrimination index, S1, S2, S5, & S6 are the frequencies of right answers in group of G1, G2, G5 and G6 correspondingly. N is the total number of samples for item analysis. The items within a range from 0.40 to 0.70 were selected for the final knowledge test.

*Point biserial correlation*

The point-biserial correlation coefficient is a statistical measure used to assess the relationship between a dichotomous (binary) variable and a continuous variable. In the context of a knowledge test, it can be used to evaluate how individual test questions (items) discriminate between individuals who possess knowledge on a particular topic and those who do not.

 *rp*​*b* = $\frac{M1-M0}{σ}$$√\frac{p(1-p)}{N}$

*rp*​*b*: Point-biserial correlation coefficient.

*M*1: Mean test score of individuals who answered the question correctly.

*M*0: Mean test score of individuals who answered the question incorrectly.

*Σ*: Standard deviation of the overall test scores.

*P*: Proportion of individuals who answered the question correctly (the dichotomous variable).

*N*: Total number of individuals in the sample.

If the correlation coefficient for an item is statistically significant at the 1 per cent level of significance, it was selected for the final scale

**Final knowledge test**

In the final knowledge test, 12 items and 18 items were selected for testing the knowledge level of farmers towards farmers’ rights and landrace conservation.

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| Table 1 (a) 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\*\* |
|  |  *#: Items discarded* *\*\*Items were significant at 0.01 level of significance* *ns: Items were not significant at 0.01 level of significance* |

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| Table 1: (a).contd.. Knowledge Test for measuring farmers’ knowledge about Farmers’ Rights (N=60) (Non-Sampled Region) |
| Item No. | Items | Difficulty Index | Discrimination Index | Point Biserial Correlation |
| 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* |

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| Table 1 (b) 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 Agrobiodiversity? | 0.48 | 0.45 | 0.46\*\* |
| 8. |  #Do you know about useful insects in the field that help in the conservation of Agrobiodiversity? | 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\*\* |
|  | *#: Items discarded* *\*\*Items were significant at 0.01 level of significance* *ns: Items were not significant at 0.01 level of significance* |

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| Table 1 (b).contd.. Knowledge Test for measuring farmer knowledge in landrace conservation (N=60) (Non-Sampled Region) |
| **Item No.** | Items | Difficulty Index | Discrimination Index | Point Biserial Correlation |
| 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 and Discussion**

For further validation of the e-module, before administering it to our targeted audience (sampled) evaluation of the module was done by experts using A five-point Likert checklist 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 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 experts include some progressive custodian farmers, members of research institutions working in the same field, local-level extension personnel of NGOs and members of seed banks; some of them are listed below

* Anubhav seed bank, Bargarh, Odisha
* *Desi Bihan Surakhya Samiti* (An NGOworking in western Odisha for seed conservation and sustainable agricultural practices)
* Bijju Patnaik Agro-Biodiversity Centre, MS Swaminathan Research Foundation, Koraput, Odisha
* Himalayan Environmental Studies Conservation Organization’s Officials, Dehradun, Uttarakhand
* Custodian farmers (Progressive one)
	+ Shri. Sudama Sahoo, Bargarh, Odisha (Founder, Anubhav seed bank, conserved 1100 paddy landraces)
	+ Shri Narayan Gowda, Bargarh, Odisha (Member of *Desi Bihan Surakhya Samiti)*
	+ Shrimati Raimati Gujaria, Koraput (Plant Genomic Savior awardee by Protection of Plant Varieties and Farmers Rights, New Delhi)

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| Table 2: 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 form2. 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 landraces5. The instructional modules will serve as supplementary material that can cater to the needs of the farmers | 4.90 ± 0.25 |
| Overall Mean Score | - | 4.36 ± 0.17 |

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| Table 3: Evaluation of training modules: ratings and interpretations (Marin and Marasigan, 2003) |
| Mean Rating | Interpretations |
| 4.5-5 | Excellent |
| 3.5-4.49 | Very Good |
| 2.5-3.49 | Good |
| 1.5-2.49 | Fair |
| 1.0-1.49 | Poor |

*Expert’s Evaluation*

Table 2 presents the mean scores provided by 30 experts for the e-module across five parameters. The overall mean score, encompassing all parameters, was 4.36 ± 0.17. According to Table 3, the module falls within the "Very Good" criteria range, indicating its suitability for further validation. It was evident that the presentation of the module was highly appreciated by the experts. The logical sequencing, attractiveness, use of local language (*Hindi* and *Odia*), and use of interactive video contributed to this high score, indicating that the module was engaging and effectively structured. The experts perceived the module as highly useful and motivating for farmers. It was seen as a valuable resource for learning at one's own pace and efficiently utilizing time, while also fostering awareness about farmers' rights and landraces.

**Validation of e-learning module**

The knowledge test was administered to 30 custodians and 30 non-custodian farmers in Odisha and Uttarakhand. Pre-test and Post-test scores were calculated for both custodian and non-custodian farmers.

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| Table 4: Pre-test knowledge index score of farmers about farmers’ rights and landrace conservation in Odisha |
|  | Farmers’ Type | No. | Mean | Std. Deviation | Std. Error |
| Farmers rights | Custodian | 30 | 0.52 | 0.20 | 0.04 |
| Non-custodian | 30 | 0.13 | 0.14 | 0.03 |
| t-statistics | t value | Sig. | Mean Difference | Std. Error Difference |  |
| 8.94 | .000 | 0.39 | 0.04 |  |
|  | Farmers’ Type | No. | Mean | Std. Deviation | Std. Error |
| Landrace conservation | Custodian | 30 | 0. 85 | 0.10 | 0.18 |
| Non-custodian | 30 | 0.43 | 0.19 | 0.34 |
| t-statistics | t value | Sig.  | Mean Difference | Std. Error Difference |  |
|  | 10.83 | .000 | 0.42 | 0.04 |  |

Both in Odisha and Uttarakhand, there's a substantial disparity between the knowledge levels of custodian and non-custodian farmers regarding both farmers' rights and landrace conservation (p=0.000). The mean scores for custodian farmers are notably higher than those for non-custodian farmers in both states, indicating a greater understanding among custodian farmers. This was possibly due to their direct involvement in conservation practices and their access to resources and knowledge-sharing platforms within the seed bank or similar organizations. It was noteworthy that the average mean score of respondents towards farmers' rights was significantly lower compared to their knowledge level regarding landrace conservation. This implied a significant knowledge gap among farmers, particularly concerning their rights in landrace conservation and registration.

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| Table 5: Pre-test knowledge index score of farmers about farmers’ rights and landrace conservation in Uttarakhand |
|  | Farmers’ Type | No. | Mean | Std. Deviation | Std. Error |
| Farmers rights | Custodian | 30 | 0.41 | 0.20 | 0.04 |
| Non-custodian | 30 | 0.27 | 0.17 | 0.03 |
| t-statistics | t value | Sig. | Mean Difference | Std. Error Difference |  |
| 2.93 | 0.00 | 0.15 | 0.05 |  |
|  | Farmers’ Type | No. | Mean | Std. Deviation | Std. Error |
| Landrace conservation | Custodian | 30 | 0. 85 | 0.10 | 0.18 |
| Non-custodian | 30 | 0.43 | 0.19 | 0.34 |
| t-statistics | t value | Sig. | Mean Difference | Std. Error Difference |  |
|  | 2.98 | 0.00 | 0.14 | 0.000 |  |

**Effectiveness of E-Learning Intervention on Knowledge Levels of Custodian Farmers**

In custodian farmers, after the intervention of the e-learning module significant increase was seen in the knowledge level of farmers (post-test) towards farmers' rights in both states. This demonstrates a substantial improvement in the knowledge of custodian farmers regarding Farmers' Rights in Odisha following the e-module intervention. This positive outcome aligns with similar findings from previous research conducted by Singh *et al.* (2021) which also highlighted the positive impact of an information module on improving farmers' knowledge. The educational module, in this case, played a pivotal role in imparting knowledge, and its effectiveness was further confirmed by Verma *et al.* in 2021, particularly among commercial farmers. One of the key takeaways from this intervention was the dissemination of critical information related to the Protection of Plant Varieties and Farmers' Rights (PPVFR) Act. Many farmers were previously unaware of fundamental rules under the PPVFR Act, such as the absence of registration fees for farmers, the potential for recognition and awards for conserving landraces, and the rights of farmers to be treated similarly to breeders if they registered their landraces. The intervention succeeded in exposing custodian farmers to this essential knowledge. This newfound awareness about their rights and the benefits of landrace conservation can empower custodian farmers to make informed decisions and take full advantage of the legal and recognition aspects of the PPVFR Act. But, in case of knowledge level towards landraces conservation, there was no significant increase in the knowledge level of farmers. Following the educational intervention of the e-learning module, during the post-test phase, their knowledge levels exhibited a slight increase in both states. The mean difference between the post-test and pre-test scores indicated that the difference was not statistically significant. It was possible that custodian farmers already possessed a relatively high level of knowledge about the subject matter before the intervention. In such cases, there could be limited room for significant improvement, resulting in a lack of statistical significance despite the increase in scores. If custodian farmers' initial knowledge was near or at a ceiling level (i.e., they already had a comprehensive understanding of the topic), the e-learning module might not have provided substantial additional knowledge that would lead to a significant difference in scores. Similar findings were proposed by Jasinskas and Simanavičienė (2008) where no significant increase in knowledge was shown after the intervention of the learning module.

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| Table 6: Paired difference between Pre-test and Post-test score of knowledge of custodian farmers about farmers’ rights and landrace conservation in Odisha |
| Farmers’ rights | 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 |
| Landrace conservation | 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 |

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| Table 7: Paired difference between Pre-test and Post-test score of knowledge of custodian farmers about farmers’ rights and landrace conservation in Uttarakhand |
| Farmers’ rights | 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 |
| Landrace conservation | 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 |

**Effectiveness of E-Learning Intervention on Knowledge Levels of non-Custodian Farmers**

In Odisha, the post-test scores exhibited a significant and highly statistically significant enhancement in the understanding of Farmers' Rights among non-custodian farmers. This improvement underscores the effectiveness of the e-learning intervention in imparting knowledge and emphasizing the practical relevance of Farmers' Rights to agricultural practices. By focusing on the direct benefits and implications of these rights if they conserve traditional landraces, the module motivated learners to engage actively and apply the acquired knowledge, particularly in landrace cultivation. Similarly, in Uttarakhand, the post-test analysis demonstrated a substantial improvement in the knowledge of non-custodian farmers regarding Farmers' Rights, indicating the positive impact of the e-learning module intervention. Moreover, concerning landrace conservation, the educational intervention led to a significant enhancement in understanding among non-custodian farmers.

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| **Table 8: Paired difference between Pre-test and Post-test scores of knowledge of non-custodian farmers about farmers’ rights and landrace conservation in Odisha** |
| Farmers’ rights | 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 |
| Landrace conservation | 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 |

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| **Table 9: Paired difference between Pre-test and Post-test scores of knowledge of non-custodian farmers about farmers’ rights and landrace conservation in Uttarakhand** |
| Farmers’ rights | 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 |
| Landrace conservation | 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 |

**Conclusion**

The findings of this study underscore the critical role of educational interventions, specifically e-learning modules, in enhancing the knowledge levels of custodian and non-custodian farmers regarding Farmers' Rights and landrace conservation. Following the intervention of the e-learning module, custodian farmers exhibited a significant increase in their knowledge levels regarding Farmers' Rights in both Odisha and Uttarakhand. This indicates the effectiveness of the module in disseminating essential information about farmers' rights, including the recognition, benefits, and legal aspects associated with conserving traditional landraces. Overall, the integration of the ADDIE Model with knowledge test validation proved effective in developing and validating the e-learning module on farmer awareness and education initiatives.

**Policy Implication**

Policymakers could consider integrating these modules into existing training programs to enhance farmers' awareness and understanding of their rights and responsibilities in landrace conservation. Agricultural extension services play a crucial role in disseminating information and knowledge to farmers. Extension workers should be trained to deliver e-learning modules effectively and facilitate discussions and practical demonstrations to reinforce learning outcomes among farmers.

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