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Exploring the effect of ICT-based climate smart portal on dairy farmers' knowledge against climate resilient practices

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ABSTRACT:

The current investigation seeks to assess the knowledge of dairy farmers with the effectiveness of an information communication technology (ICT) based dairy information portal against the adoption of climate-resilient dairy farming practices in the vulnerable district of Madhya Pradesh, India. The study was conducted following an exploratory research design with stratified random sampling. The study was conducted on dairy farmers of four districts selected as their vulnerability towards climate change indicators from low to very high categories. Initially, the reliable and valid knowledge test was developed and then introduced among the respondents for pre-test knowledge scores. After that, a demonstration of the climate-smart dairy information portal (DIP) at the farmer's field was performed. Finally, the post-test knowledge score was assessed. The findings of the study depicted that farmer's knowledge was significantly increased after exposure to DIP. Indicated by a significant value of Wilcoxon $Z=8.16$, $p<0.01$, and t-test $t=11.223$, $p<0.01$. In this research, efforts were made to test the pre and post-exposure knowledge level of respondents on the developed knowledge test. After exposure to DIP, more than half i.e.

37.50 and 39.37 percent of the respondents had a medium to a high level of knowledge regarding climate-resilient dairy farming practices. The use of the ICT-based tools with local content and language effectively improved dairy farmers' understanding of climate-resilient practices indicating its potential tools in extension systems to improve literacy among rural communities.

Key Words: Dairy information portal, Knowledge, Climate-resilient practices, Farmers, Impact assessment

1. INTRODUCTION:

Dairy farming in India has been done since the ancient period of time. In the year 1998, India surpassed the USA with 80.6 million tons of milk production. Since then, India has maintained its position as the world's largest milk producer. The main reason behind this is the execution of government support, operation Flood, cooperative system, technology intervention, breeding policy, and the major one is the highest numbers of livestock in India. The livestock sector acts as both a victim and contributor to climate change. Dairy animals can sustain a physiological body temperature of 38.4 to 39.1 degrees Celsius thanks to their thermoneutral zone (TNZ), which ranges between 16 and 25 degrees Celsius. However, air temperatures above 20–25°C in temperate climates and 25–37°C in tropical climates like India cause heat stress because they increase heat gain over what the body loses (Ghezzi et al, 2024; Silanikove and Koluman, 2015). Extreme weather poses increasing risks to India's agriculture and allied sectors, which include dairy and contributes 17 percent to the country's GDP. Moreover, it has been determined that the dairy industry may have a considerable impact on greenhouse gas emissions; therefore, it is imperative that dairy farmers implement climate-resilient practices that are beneficial for both i.e. livestock as well as for the environment. In developing countries, the ratio of extension workers and farmers is very low resulting in less direct contact, lack of information has always affected the growth and development of dairying. In this scenario, mass media such as radio, television, print, internet, etc. have been playing remarkable roles in communicating knowledge to the farming community. Mass media not only influences the farmers but also helps to increase the knowledge, public attitude, and behaviours that have been well esteemed via several research studies. Researchers (Fu and Akter, 2012), also found that high productivity, fewer disease

occurrences, and finally subsequent increase in income can be attributed to the availability of quality extension services. Hence, corporations between network providers and research institutes should be promoted as part of bridging the extension gap and enhancing e-literacy among farmers. Madhya Pradesh consists of central plateau hill and western plateau hills region among 15 Agroclimatic regions of India. This is a large state depending on climatic sensitive sectors like agriculture, livestock, and forestry for their livelihood and one of the first states in the country to have a state action plan on climate change (SAPCC) approved by state and national steering committees. As per the agro-climatic diversity of the state, strategic planning must be focused on regional concerns so a climate-resilient state was developed (Dubey et al., 2017). As per EPCO research data, the composite vulnerability index was formulated and categorized in the districts of Madhya Pradesh. Farmers in Madhya Pradesh currently have very limited access to ICT-based weather information and agro-advisory services (Gangopadhyay et al, 2019). Lack of knowledge on climate resilient practices and e-literacy, hamper the rate of adoption among farming communities (Diniso et al., 2022). Adoption of climate resilience dairy farming practices leads to increased resilience and consistency in milk yields despite varying climate conditions. These practices in dairy production range from feeding management, housing management, health management, and providing climate services to dairy farmers to take up primary and secondary dairy products preparation to have an additional income. So, the onus is on research institutions, governments, and extension agencies to sensitize the farming community about the creeping danger of climate change on the dairy production system and motivate them to adopt the practices that would provide a shield against the losses incurred due to potential changes in climate. An effective tool for addressing more localized climate risks and farmers' production system-related issues is a two-way information flow model. Presently, the major work on the dissemination of climate-resilient dairy farming practices in India was conducted by ‘Agricultural Technology Application and Research Institutes (ATARI)’ and National Innovation on Climate Resilient Agricultural (NICRA)’, which were mentioned in their annual reports. For the development of a sustainable dairy production system knowledge and adoption of resilient practices were of utmost importance. By considering the above facts, the present study was designed with the objective of

documenting the existing climate-resilient dairy practices performed by the farmer under the selected vulnerable zone of M.P, after developing the need-based climate-smart "Dairy Information Portal (DIP)" focusing on climate-resilient dairy practices. Finally, the effectiveness and utility of the portal were evaluated by changes in knowledge and farmer's attitude toward the portal.

2. METHODOLOGY-

2.1 Locale of the study and sampling plan-

In four distinct Madhya Pradesh districts viz; Shahdol, Rewa, Narsinghpur, and Jabalpur from the most vulnerable to the least vulnerable and from various agroclimatic zones, the study was carried out using an ex post facto research design in 2023. Two more blocks were chosen randomly from each district, and two villages were chosen randomly from each block. Therefore, a total of 16 villages from four districts were selected for the present study. 10 dairy farmers from each village were selected on the basis of their work experience and herd size (a farmer who has had a minimum herd size of 4 dairy animals in the last 5 years was selected as a sample for the present study) hence, total 160 farmers were selected for the present study.

2.2 Knowledge test development and its administration: The statement for assessing knowledge on climate-resilient dairy farming practices was identified and developed with the consultation of experts, reviewing the literature, and after the pilot study. After developing a knowledge test on climate-resilient dairy farming practices, the reliability and validity of the test were assessed in non-sample farmers. Then the final and refined knowledge test (22 statements were finalized for the knowledge test) (Annexure I) was introduced on a two-point scale i.e. prior to the exposure of the portal and after the exposure of the portal. Before the interventions of the portal, a demonstration of the portal was conducted at the farmer's doorstep regarding how to open it, how to register in the portal, what are information available in the portal, how anyone raises queries, etc.

2.3 Development of dairy information portal: The portal contained the different climateresilient dairy farming practices as per climatic condition i.e. summer/heat waves and winter/cold waves with displaying of real-time temperature (^{0}C), relative humidity

(%), wind velocity (km/hour), visibility (meter) data in the portal (Figure 1). The difference between pre and post-test scores was calculated as the change in knowledge of the respondents. The portal includes recognized climate-resilient dairy farming techniques in Hindi (the local language) and English (the universal language). To make the information easily understood by illiterate farmers, all of the information is provided in the local language and accompanied by photographs and audio support.

2.4 Effectiveness and perceived utility of portal: Furthermore, the impact is very important in explaining the effect and level of adoption in the long term. Hence, in the present study effectiveness (short term) of the portal measure in terms of improving farmers' knowledge, was analyzed by pre and post-test scores of the farmers and statistically checked by the 'Wilcoxon signed ranks test'.

Furthermore, the perceived utility of the DIP portal in transmitting information to needy farmers was evaluated by examining the usefulness, relevance, simplicity, audio-visual quality, and accessibility issues of DIP contents. The aforementioned terms were operationalized as follows:

i. **Perceived Utility:** The respondent's perception of the climate-smart dairy information portal (DIP)'s usefulness is expressed here. The classifications were not useful, very useful, and useful.

ii. **Relevance of DIP-** It indicates the extent to which the respondent thinks the information on the Climate Smart Dairy Information Portal (DIP) is appropriate. The answers were noted as pertinent, appropriate, and irrelevant.

iii. **Simplicity and clarity of content-** This pertains to the respondent's perception of how easily understandable the content was on the Climate Smart Dairy Information Portal (DIP). It was rated as difficult, very simple, and simple.

iv. **Visual Quality-** This demonstrates the manner in which the climate-smart dairy information portal (DIP) presents its content to capture respondents' attention. It was graded as excellent, good, and poor.

v. **Audio Quality-** This is a reference to the respondent's perception of the voice backup's clarity, pitch, and pronunciation. It was graded as excellent, good, and poor.

In order to evaluate the portal's perceived usefulness in providing information to farmers in need, 80 respondents out of 160 were chosen at the field level for the utility assessment.

3. RESULTS AND DISCUSSION:

Climate Smart-Dairy information portal (CSDIP): This is the bilingual (Hindi & English) dairy information portal have the following charaterstic:

Contents:

- Climate change scenario of Madhya Pradesh
- Indigenous breeds of Madhya Pradesh
- Climate-resilient dairy farming practices
- Audio in the Hindi language of some important resilient dairy farming practices
- Registration and query form for farmers

3.2 Effectiveness of the DIP on knowledge gain against climate-resilient dairy practices:

In this see the effectiveness of the developed ICT-based climate smart DIP on climate resilient dairy farming practices in terms of knowledge gain. Under this efforts were made to test the pre and post-exposure knowledge level of respondents on the developed knowledge test. Table 1 clearly depicts that the mean score for a set of data for the post-test is clearly greater than the Pre-test.

Table 01: Mean knowledge score of respondents at pre and post exposure of portal in selected districts:

District	N=160	Pre test Mean±SD	Post test Mean±SD	Z value
Jabalpur	40	8.70±1.41	10.40±1.67	4.45**
Rewa	40	7.56±1.26	9.56±1.84	5.17**
Narsinghpur	40	7.93±0.94	9.78±1.65	4.97**
Shahdol	40	7.50±1.28	8.95±2.08	5.52**
Total	**160**	**7.91±1.31**	**9.83±1.78**	**8.16****

****Significant at 1 % level of significance**

Among the districts, the mean score for a post-test of Jabalpur district was the highest (10.40) followed by Narsinghpur, Rewa, and Shahdol. The post-test data is eventually higher than the mean pre-test score. The Jablpur district is least vulnerable and the farmers followed the number of climate-resilient dairy practices. Their knowledge score towards the practices is enhanced even more via exposure to the dairy information portal.

3.2.1 Statistical analysis of pre and post knowledge score applying Wilcoxon signed ranks test statistics: Further, the null hypothesis is checked via test statistics. The Z value was 8.16 and showed significance at $p<0.05$ level (95% confidence interval) of significance Table 3).

Table 2: Wilcoxon Signed Ranks Test

Ranks	Districts				
	Jabalpur	**Narsinghpur**	**Rewa**	**Shahdol**	**Overall**
Negative Ranks	04	02	01	00	19
Positive Ranks	26	32	35	37	116
Ties	10	06	04	03	25
Total	40	40	40	40	160
Mean Rank					
Negative Ranks	4.50	7.50	6.50	.00	36.55
Positive Ranks	17.19	18.13	18.84	19.00	73.15

Table 3: Test statistics of Wilcoxon Signed Ranks

	Jabalpur	**Rewa**	**Narsinghpur**	**Shahdol**	**Overall**
Z	4.45**	5.17**	4.97**	5.52*	8.16**
Asymp.sig. (2 tailed)	.000	.000	.000	.000	.000

** Significant at $p<0.05$, * Significant at $p<0.1$

Hence, it can be interpreted that two (pre and post-test scores) sets of scores were significantly different. The similar finding were also noticed by (Sinha, 2017; Lal et al., 2016). Further more significant value of Z, confirms the assumption and rejects the null hypothesis that respondents

in all four districts gained significant knowledge about climate-resilient dairy farming practices via exposure to DIP (Table 2).

Comparison of the 'Wilcoxon Signed Ranks Test' and paired 't' statistics: In the test score, the paired 't' test was applied, and the Z-statistics value with the 't' test. The Table 4 result clearly indicated the complete alignment of 't' value knowledge gains and Z-value knowledge gain. The null hypothesis H0, according to which there are no significant differences between the participants' pre-and post-test scores in any given area or the distributions of the test scores are the same, was tested using the Wilcoxon signed-rank test. Stated differently, the null hypothesis was rejected due to the significant differences observed in the scores obtained by the participants in the pre-test and post-test. Moreover, it may be concluded that the DIP is the most suitable method for improving the knowledge of respondents. Similar findings were also noticed by (Marwa et al., 2020), who showed that the use of ICT-based services increases annual milk production and household income by 13 % and 22%.

Table 4: Mean knowledge score due to exposure of dairy information portal, paired t-test (n=160)

Districts	Mean knowledge scores		Mean knowledge gain	Percent of knowledge gain	't' value knowledge gain
	Pre exposure	Post exposure			
Jabalpur	08.70	10.40	1.70	19.54	5.588**
Rewa	07.57	09.56	1.99	26.28	8.444**
Narsinghpur	07.93	09.78	1.85	23.32	6.871**
Shahdol	07.50	08.95	1.45	19.33	6.040**
Overall	07.92	09.83	1.91	24.11	11.223**

**Significant at p<0.05

3.3 Assessment of the DIP among the respondents

The DIP was developed with the intention to provide information to dairy farmers to combat against impact of climate change on dairy animals, so they can adopt climate-resilient dairy farming practices timely and make decisions as early as possible accordingly to prevent loss. Hence, the perceived utility and opinion of respondents in terms of the usefulness of the content, relevancy of the portal, simplicity in using the portal, audio quality, and visual quality of the portal were assessed. The respondents were asked on a three-point continuum i.e. on each aspect. Further, results were summarized in frequency and percentage. It is assumed that the greater the frequency of farmers in positive aspects of the various components of DIP greater its effectiveness. Assessment of the DIP was analyzed under the following heading:

3.3.1 Perceived utility of DIP based on its contents:

Following the respondent (n=80)'s demonstration of the system, a question regarding the overall perceived utility of DIP was posed. According to the results (Table 5), 51.00 percent of respondents thought DIP was very helpful, and 47.50 percent said they used it to help them make decisions. Just one respondent thought it was pointless. Similar findings were also published by (Sinha, 2017; Thammi et al., 2006), who developed a poultry expert system (PES) and tested the opinions of sixty veterinarians and veterinary students regarding its perceived usefulness. He learned that PES was thought to be more successful at making decisions regarding chicken farming, especially in situations where specialists were not available; this allowed farmers to save time, money, and effort. Several research and real-world examples have demonstrated that the way information is presented affects how well students learn. The following qualities should be present in content: precision, ease of understanding, and relevance to the subject. Table 5 shows that, among respondents, 56.25 percent felt that the DIP's content was appropriate for the topic at hand, while 37.50 percent felt that it was relevant. However, just 6.25 percent of respondents said it had nothing to do with the topic. This could be because they are knowledgeable, progressive farmers who need more information in-depth about a particular area of the topic. According to (Kenneth, 2001), rural farmers enjoy it when locally relevant content is developed.

Table 5: Perceived utility of dairy information portal on DIP contents (n=80)

Category	Frequency	Percentage
Perceived utility		
Very useful	41	51.25
Useful	38	47.50
Not useful	01	01.25
Relevancy of dairy information portal		
Appropriate	45	56.25
R66evant	30	37.50
Irrelevant	05	06.25
Simplicity and clarity of dairy information portal		
Very simple	35	43.75
Simple	40	50.00
Difficult	05	06.25
Visual quality of dairy information portal		
Very good	47	58.75
Good	30	37.50
Not good	03	03.75
Audio quality of dairy information portal		
Very good	61	76.25
Good	14	17.50
Not good	05	06.25

Recognize the subject; the information should be presented in an easy-to-understand manner. We inquired about the respondents' thoughts regarding the DIP's content's simplicity.

According to Table 5's results, 50.00 percent of respondents said it was simple, and 43.75 percent said it was very easy to understand. However, a mere 6.25 percent of them stated that it is challenging and requires further clarification. To keep a learner's interest and attention, there must be a visual appeal. Regarding the DIP, 58.75 percent of respondents said it holds interest very well, while only 3.75 percent said it is not good (Table 5). According to (Thammi et al., 2006), PES's user-centred design has made sure that users connect with the system that was created just for them. The current study's findings were consistent with findings (Phand, 2016).

The voice backup in Hindi, the local tongue, supports the DIP's content. Thus, even those without literacy skills can comprehend. The respondents were questioned regarding the clarity, pitch, and pronunciation of their voices. According to Table 5, 76.25 percent of respondents stated that the DIP's voice quality is very good, while 17.50 percent said it was good and 6.25 percent said it needed to be improved.

3.3.2 Constraints in accessibility of portal (n=80)

This constraint hampers the respondent's interest in using the portal /application for the purpose of enticing the information on the concerned topic. The reason behind this may be a lack of e-literacy. The data revealed that (Table 6) the problem with internet connection in rural areas is the major constraint faced by 68.75 percent of the respondents followed by problems in reading the screen text (61.25 %) and lack of skill in operating a smartphone (56.25%).

Table 6: Constraint perceived by the respondents while using the dairy information portal (n=80)

S. No.	Constraints	Yes	No
1.	Lack of skill in operating smart phone	46 (57.50)	34 (42.50)
2.	Problem in internet connection in rural area	55 (68.75)	25 (31.25)
3.	Problem in reading the screen text	49 (61.25)	31 (38.75)
4.	Difficulties in understanding the portal language	39 (48.75)	41 (51.25)
5.	Non availability of time	45 (56.25)	35 (43.75)

The researcher (Gangopadhyay et al., 2019) found that low level of access to ICT services in Madhya Pradesh. Most of the farmers use smartphones for entertainment rather than getting technical /scientific information on concerned subject. The nonavailability of time was also found major reason, which hinder portal utilization.

The reason may be that, most of the farmers are involved in various sources of livelihood and engagement in work at the farm as well as at home. To minimize the constraint in using the ICT application, real-time information to dairy farmers on various managemental practices should be sent via regular messaging and continuous monitoring and feedback. Farmers can also reduce the impact of climate change and variability by implementing practices like the utilization of improved seeds, collecting rainwater, crop/livestock insurance, and ICT-based agro-advisories, among others (Mittal, 2012; Altieri and Nicholls, 2017). According to numerous studies (Balasundram et al., 2023; Sigdel et al., 2022; Chikaire et al., 2017; Nzonzo and Mogambi, 2016), integrating ICT into farming practices requires having appropriate ICT literacy skills. Thus, low levels of ICT literacy and farmer poverty may act as impediments to the adoption of ICT in agriculture and related industries. According to (Cecchini and Raina, 2002), using ICT tools in rural India is severely hampered by illiteracy, a lack of infrastructure, and a lack of education.

4. CONCLUSION:

Conclusively, the dairy information portal has emerged to be an effective tool in terms of knowledge gain. The post-test data is evidently higher than the mean pre-test score. Farmers' knowledge was significantly increased after exposure to DIP. It can be concluded from the study that, the conceptual model of DIP was found effective in disseminating need-based information in general and specifically on climate-resilient dairy farming practices with relevant photos, video, and audio can help in the future to revamp farmer’s perceptions, knowledge and adoption towards the development of resilient livestock production systems. Dairy farmers have the challenges of getting timely and reliable information on farm management and specifically information on climate mitigation practices and hence limit them from achieving their farm's full potential. The application of information and communication technologies as farming extension tools has the power to improve farmer’s income overall.

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Annexure I

Table 01: Developed knowledge test for dairy farmers to climate-resilient dairy farming practices

S.No.	Selected items	Response	Score
1.	Do you change dietary fiber intake during summer or heat-stressed conditions?	Increase Decrease	0 1
2.	Do you supplement animal's diet with fat during heat stress?	By pass fat/ whole/crushed oilseeds Any other	1 0
3.	Do you add feed additives combined formulation during heat stress?	Buffer (sodium bicarbonate), antioxidants (vit. A and E), yeast culture, niacin/ or mineral mixture, vitamin yeast culture Any other	1 0
4.	Do you provide fresh and cool water to animal during heat stress?	Yes No	1 0
5.	Do you know the crop suitable for silage making?	Leguminous crop Non-leguminous crop	0 1
6.	Do you know the climate-resilient crop or fodder variety?	Yes No	1
7.	Do you select breeds of animals according to the local environment and farming system?	i. Crossbreds ii. Indigenous breeds iii. Exotic breeds	0 1 0
8.	Which breeding strategy is useful for strengthening our indigenous breeds from the view of conserving our local biodiversity?	Grading up/ selective breeding Crossbreeding (0)	1 0
9.	Which practice of breeding should be followed in animals so as reduce the chance of any kind of contamination/disease transfer?	i. Natural Service ii. Artificial insemination	0 1
10.	Which of the practice increases the conception rate in dairy animals?	Feeding of mineral mixture @ 60gm/day and deworming twice in a year Use of dewormer	1 0 0

		Spray of insecticide	
11.	Do you isolate sick animals from the healthy ones in a separate house/shed?	Yes No	1 0
12.	Do you vaccinate all the animals of the herd as per recommended schedule in cool hours?	Yes No	1 0
13.	Do you go for parasite control measures like deworming and ectoparasite control?	Yes No	1 0
14.	Do you know that in which season high incidence of mastitis happen?	Winter Hot humid weather Rainy	0 1 1
15.	What can be used for reducing the incidence of mastitis?	Mineral mixture feeding Albendazole Feeding of 2 gm Vitamin E and Selenium	0 0 1
16.	Do you provide physical protection and shelter management practices for protecting animals from extreme climatic conditions?	Provide shed /proper ventilation/sprinkler, mister etc. Any other	1 0
17.	Do you paint the roof with radiating paints white outside and black inside during summer? (Yes/No)	Yes No	1 0
18.	Do you cover young calves with blanket (gunny bag) during winter?	Yes No	1 0
19.	Do you utilize farm waste for biogas plant composting?	Yes No	1/0
20.	Do you go for making dung cakes/vermicomposting?	Yes No	1/0
21.	How do you dispose animal's carcasses?	Burial Any other	1 0
22.	Knowing of weather forecast (Yes/No)	Yes No	1/0