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Development of a knowledge scale for dairy farmers on disaster mitigation post-2018 Kerala floods

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Abstract

Kerala experienced one of its most devastating flood disasters in August 2018, severely impacting the livestock sector through significant losses of dairy animals and a sharp decline in milk production across the state. This deluge highlighted the important need to educate and equip dairy farmers so that they can better prepare for and respond to future calamities with confidence and tolerance. In this setting, the current research aimed to develop and standardise a reliable scale specifically designed to assess dairy farmers' knowledge levels regarding disaster mitigation strategies. Initially, through careful consideration and differentiation between highly knowledgeable and less knowledgeable dairy farmers, a comprehensive set of 26 items was constructed, ensuring thorough coverage of all critical aspects related to disaster mitigation, including preparation, response, and recovery phases. Following a rigorous relevancy test conducted with input from extension specialists and subject matter experts, the pool was refined to 19 high-quality items that demonstrated strong alignment with the objectives. Scores derived from these 19 items underwent detailed item analysis, incorporating key statistical measures such as the difficulty index, discrimination index, and point biserial correlation to evaluate their psychometric properties. For the final knowledge scale, items which met stringent requirements—that is, a difficulty index between 0.25 and 0.75, a discrimination index above 0.2, and point biserial correlation values significant at the 5% level—were selected. Ultimately, 12 items were selected, forming a robust and focused instrument. Cronbach's alpha was used to measure the reliability of this knowledge test, and the results demonstrated an exceptional value of 0.881, which underlines the scale's excellent parametric stability and implies exceptionally high levels of internal consistency among the items. This constructed knowledge test reveals itself as very reliable, valid, and consistent evaluation test for assessing dairy farmers knowledge level about disaster mitigation. vulnerable areas.

Keywords: Disaster mitigation, knowledge scale, dairy farmers, Cronbach's alpha, item analysis

Introduction

A framework for assessing and assimilating new information and directing decision-making is provided through knowledge, which is described as a dynamic integration of contextual experience, values, information, and expert insight. (Davenport & Prusak, 1998) ^[2]. This foundational concept underpins adaptive behaviours in agricultural communities facing environmental challenges. The present investigation draws from the theoretical foundation that individuals continuously adapt to their surrounding environments—particularly those tied to their livelihoods—by enhancing their knowledge bases, practical skills, and strategic approaches to utilise natural resources amid uncertainties sustainably. Such adaptations stem from ongoing daily interactions with the ecosystem, keen observations of natural patterns, and iterative experimentation to refine practices over time.

Kerala's topography and climatology amplify its flood risks, as the state receives an average annual rainfall of about 3000 mm, primarily from the South-West monsoon, North-East monsoon, and pre-monsoon summer showers. Over the six-month monsoon period spanning June to December,

these systems deliver nearly 90% of the precipitation, channelling intense downpours across steep, undulating terrains into major river systems via extensive networks of streams and waterways. High-intensity monsoon rains accelerate water flows, overwhelming river capacities and precipitating flash floods. In 2018, Kerala recorded exceptionally heavy cumulative rainfall of 2346.6 mm between June 1 and August 19, exceeding normal levels by 15% in June, 18% in July, and a staggering 164% in August, triggering the historic deluge. (SDMA, 2018) ^[12].

The 2018 Kerala floods inflicted unprecedented devastation on the livestock sector within animal husbandry, marking one of the most severe impacts in recent history. Losses included approximately 46,000 cattle, 20,000 goats, and 1.76 crore poultry birds swept away or perished due to drowning and related hazards. United Nations assessments pegged the combined economic damages across agriculture, fisheries, and livestock at ₹7,155 crores, underscoring the scale of recovery challenges. Despite these setbacks, Kerala's livestock sector remains a cornerstone of agricultural growth, contributing around 27% to the state's Gross State Value Added (GSVA) in agriculture—slightly

above the national average—and positioning it as a vital economic pillar. (Govt. of Kerala, 2018)^[7].

Flood disasters wreak havoc on livestock enterprises through multifaceted disruptions, including acute shortages of feed and fodder, loss of shelter, and heightened physiological stress on animals, which compromises immunity and elevates susceptibility to infectious outbreaks. Prolonged inundation exacerbates pathogen transmission, malnutrition, and stress-induced health declines, often culminating in mass mortalities. Given these vulnerabilities, equipping dairy farmers with comprehensive knowledge on disaster mitigation—encompassing pre-flood preparations, immediate response protocols, and post-flood recovery—is essential for minimising future losses and enhancing sectoral resilience. Flood disasters severely disrupt livestock production systems by destroying feed resources and animal shelters, leaving animals in prolonged stress and suboptimal living conditions. As a result, affected livestock frequently experience malnutrition and chronic stress, which compromise immune responses and increase susceptibility to a range of infectious and production-limiting diseases. (Gaviglio, 2021)^[5]. No standardised scale previously existed to quantify dairy farmers' knowledge on these fronts, particularly in flood-vulnerable Kerala contexts, prompting this study to devise and validate such an instrument tailored to local realities.

Methodology

Knowledge refers to the organised collection of factual and conceptual information that individuals retain, forming the foundation for informed decision-making and behavioural responses (Swanson, 1994)^[13]. Individual knowledge as originating in personal minds through experiences, learning, and cognitive processes, emphasising its role as a foundational asset in organisations. (Ragab and Arisha, 2016)^[10]. In behavioural sciences, knowledge exerts profound influence over both overt actions and covert thought processes, making its accurate measurement pivotal for targeted interventions. A well-constructed knowledge test precisely gauges the depth of domain-specific awareness among respondents at the point of assessment, derived from their responses to meticulously designed questions.

The development and standardisation of this disaster mitigation knowledge test encompasses sequential phases from item generation to final validation. This systematic approach ensures psychometric rigour, enhancing the instrument's applicability in extension education and farmer training programs.

Item Collection

The knowledge test's content comprised objective-format questions (items) drawn from an expansive pool curated through exhaustive literature reviews, consultations with authoritative textbooks on disaster management and livestock resilience, and interactive discussions with subject matter specialists, extension officers, and field practitioners. This multi-source strategy guaranteed comprehensive domain coverage, spanning flood forecasting, animal evacuation, fodder preservation, health management, and policy awareness. Following compilation, the initial pool

underwent meticulous scrutiny by a panel of experts to eliminate redundancies and refine phrasing, yielding items precisely calibrated to probe flood-affected dairy farmers' disaster mitigation acumen.

Relevancy Rating

Not all collected items equally contribute to measuring target knowledge levels, necessitating expert validation to filter for relevance. Accordingly, an initial list of 26 statements was circulated to a 45-member judge panel comprising extension education specialists, researchers, and policymakers. Judges evaluated each item on a four-point continuum—most relevant (4), relevant (3), somewhat relevant (2), not relevant (1)—to quantify suitability for assessing flood-affected dairy farmers' disaster mitigation knowledge.

Responses facilitated computation of relevancy metrics

1. Relevancy percentage (summing scores from most to somewhat relevant categories, converted to%),
2. Relevancy weightage ($RW = [MR + R + SWR + NR]/MPS$), and
3. Mean relevancy score ($MRS = [MR + R + SWR + NR]/N$), where MR, R, SWR, NR denote frequency-weighted scores, MPS is the maximum possible score, and N is the number of respondents.

The knowledge items satisfying, relevancy percentage >70%, $RW > 0.70$, $MRS > 2.8$ —advanced, were selected, resulting in 19 selected statements.

Item Analysis

Item analysis statistically evaluates individual question performance to refine test quality, identifying items that effectively differentiate knowledge levels while pinpointing ambiguities for revision. Grounded in the interaction between respondent ability and item difficulty, this process optimises predictive validity, as articulated in foundational psychometric models. Here, 19 pre-selected items were administered to 60 dairy farmers from flood-affected panchayats, (30 each from Perumatty and Kozhinjampara panchayats in Palakkad district), scored dichotomously (1 for correct, 0 for incorrect/unknown), and analysed for difficulty index, discrimination index and point biserial correlation.

Difficulty Index

The difficulty index, known as the p-value or item ease, represents the proportion of examinees who answer a test item correctly, expressed as a percentage from 0 to 100, where higher values indicate easier items. The difficulty index, also termed the p-value or item ease, measures the proportion of respondents who correctly answer a test item, expressed as a percentage ranging from 0 to 100—higher values signify easier items. Items with p-values below 0.25 are considered excessively difficult, while those exceeding 0.75 are too easy; the ideal range for effective items lies between 0.25 and 0.75 (Hingorjo & Jaleel, 2011)^[8]. The difficulty index for the 19 items was established by dividing the number of right answers for each item by the total number of respondents by following formula.

$$P_i = \frac{n_i}{N_i} \times 100$$

P_i = difficulty index in percentage of the i^{th} item

n_i = number of respondents giving correct answer to i^{th} item

N_i = total number of respondents to whom the items were administered i.e. 60

Discrimination Index

Taib and Yusoff (2014) [15] explain that the discrimination index measures how effectively a test item differentiates between high-performing and low-performing respondents. Consequently, only items exhibiting robust discriminatory ability—successfully distinguishing varying knowledge levels—were included in the final scale. Discrimination indices for the 17 items were computed via the E1/3 method: respondents (60 total) were divided into six equal groups of 10, ranked by descending knowledge scores; the middle two groups were discarded, and indices were calculated using the top and bottom (extreme) groups

It is calculated by the following formula:

$$E1/3 = \frac{(S1+S2) - (S5+S6)}{N/3}$$

Where,

N = No. of respondents

$S1$ and $S2$ - frequencies of correct answers of the highest and higher scores, correspondingly

$S5$ and $S6$ - frequencies of correct answers of lower and lowest scores, correspondingly.

Point bi-serial correlation (Rpbis)

The point-biserial correlation coefficient is a correlation that measures the relationship between one continuous variable and one dichotomous (binary) variable. (Demirtas and Hedeker, 2016) [3]. By computing the relationship between each item score and the total test score of all respondents, point biserial correlation, a form of product-moment correlation, reveals the predictive ability of an item (Essen

& Akpan, 2018) [4]. The point biserial correlation between each item and the total test score was computed with the objective of measuring the internal consistency of dichotomously scored items. The point bi-serial correlation was calculated as follows

$$R_{pbis} = \frac{M_p - M_q}{\sigma} \times \sqrt{pq}$$

where,

R_{pbis} = The point bi-serial correlation

M_p = The mean of the total score of the respondents who answered an item correctly

M_q = The mean of the total score of the respondents who answered an item incorrectly, σ is the standard deviation of the entire sample

p = The proportion of the respondents giving the correct answer to an item

q = The proportion of the respondents giving an incorrect answer to an item.

The computed point bi-serial correlation (R_{pbis}) values were analysed statistically by employing $n-2$ degrees of freedom,

Results and Discussion

The 19 knowledge items, sourced from various references, were administered to 60 respondents, with scores assigned as 1 for correct responses and 0 for incorrect ones. Scores derived from these 19 items underwent detailed item analysis, incorporating key statistical measures such as the difficulty index, discrimination index, and point biserial correlation to evaluate their psychometric properties. (Table 1). Knowledge Items meeting the following criteria—difficulty index between 0.25 and 0.75, discrimination index above 0.20, and point biserial correlation significant at the 5% level—were selected. Eventually, 12 items were selected, forming a robust and focused instrument. (Table 2) which efficiently distinguished well-informed from less-informed respondents without being overly difficult or easy.

Table 1: Calculation for the selection of suitable knowledge items for disaster mitigation

Sl. No.	Knowledge items	DI	DcI	PBCV
1	Flood mitigation project of Kerala launched in 2015 is Operation Anantha	11.67	0.35	0.411
2	The drought mitigation project launched in Kerala is Mazhapolima	18.33	0.55	0.525
3	Indigenous breeds are more suitable breed of cattle to cope up with flood disaster*	71.67	0.3	0.352
4	Which fodder is suitable to be stored as dry fodder for future use in event of flood disaster?(Name any one)*	68.33	0.3	0.353
5	What are the crop residues which can be stored for use in event of flood disaster? (Name any one)*	60.00	0.45	0.423
6	Name some unconventional fodder which may be used immediately after flood disaster (Name any one)*	70.00	0.25	0.287
7	There is no need for any animal health management measures to be taken up immediately after flood	85.00	0.25	0.377
8	No need for any vaccination for animals after flood disaster	86.67	0.25	0.198
9	The possible risk of spread of Zoonotic disease after flood disaster is high*	45.00	0.7	0.649
10	Loose housing system for dairy animals are the best housing system to with stand flood disaster*	68.33	0.4	0.392
11	For flood disaster prone area, the best roofing material used is concrete*	43.33	0.65	0.61
12	Flood cess by Government of Kerala is 1 per cent of SGST levied*	38.33	0.45	0.449
13	Flood cess by Government of Kerala is levied for 2 years*	35.00	0.55	0.456
14	Check dams are constructed for the purpose of checking the speed of runoff water thereby reducing impact of flood disaster	85.00	0.2	0.2
15	Construction of buildings along the flood plain needs permission from Local planning Authority*	68.33	0.55	0.384
16	Long term plan of comprehensive drainage plan to mitigate flood disaster is contour mapping	15.00	0.25	0.257
17	In coastal area construction activities should not be taken beyond Vulnerability line	8.33	-0.05	-0.074
18	Mangroves are planted along the coast to mitigate tsunami*	66.67	0.5	0.4
19	Rebuild Kerala is a State Government initiative aimed at rebuilding life in Kerala after the floods*	71.67	0.4	0.413

*Statements selected for the knowledge test

Standardisation of the knowledge scale

Validity of the knowledge test

Validity in testing refers to the extent to which empirical evidence and theoretical rationale support the intended interpretations and uses of test scores (Kane, 2016) [9]. The validity of the knowledge test was ascertained by content validity, where the knowledge items were rigorously selected after consultation with subject matter specialist. Rigorous item selection—incorporating difficulty index, discrimination index, and point biserial correlation—ensured a representative and logical test construction, fulfilling content validity criteria.

Reliability of the knowledge test

The consistency with which a measure provides stable and repeated results when evaluating the same phenomenon under similar circumstances is referred to as reliability. (Taherdoost, 2016) [14]. A reliable instrument gives the same results throughout multiple evaluations of the same attribute, reflecting the genuine constancy of the construct it measures (Sarmah & Hazarika, 2012) [11].

Cronbach's alpha coefficient was used to assess the

reliability of the knowledge test. The knowledge instrument was administered to 40 flood-affected dairy farmers, randomly selected from Permatty and Kozhinjampara panchayats in Palakkad district. Collected responses were tabulated and analysed to compute the alpha value using the standard formula (Cronbach, 1951) [1].

$$\alpha = \frac{K}{K-1} \left(\frac{\sum_{i=1}^K \sigma^2 y_i}{\sigma^2 x} \right)$$

Where,

α = Cronbach's alpha reliability coefficient,

K = Number of items,

$\sigma^2 y_i$ = the variance of item i for the current sample of persons,

$\sigma^2 x$ = the variance of the observed total test scores.

The Cronbach's alpha value of 0.881 indicated excellent reliability, reflecting strong internal consistency among the 12 items on disaster recovery mitigation.

Table 2: Results of the Cronbach's alpha test for the internal consistency of the knowledge test for disaster mitigation

Item	Scale mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item - Total Correlation	Cronbach's Alpha if Item Deleted
Item 1	2.52	12.538	0.447	0.879
Item 2	2.51	12.274	0.519	0.875
Item 3	2.53	12.949	0.326	0.885
Item 4	2.48	11.709	0.663	0.867
Item 5	2.49	11.998	0.578	0.872
Item 6	2.51	12.024	0.601	0.870
Item 7	2.48	11.169	0.832	0.856
Item 8	2.52	12.238	0.546	0.874
Item 9	2.50	12.260	0.512	0.876
Item 10	2.48	11.440	0.746	0.861
Item 11	2.49	12.094	0.555	0.873
Item 12	2.50	12.010	0.593	0.871

The statistics of respondents were calculated and the Cronbach's alpha was found to be excellent at 0.881 for disaster mitigation, which is very high and indicate strong internal consistency among the items of the knowledge test in their respective domains.

George and Mallery (2003) [6] projected the following guidelines for interpreting Cronbach's alpha: >0.9 (excellent), >0.8 (good), >0.7 (acceptable), >0.6 (questionable), >0.5 (poor), and <0.5 (unacceptable). Although alpha values can increase with more items, this effect diminishes beyond a certain point. The present study's knowledge test achieved an excellent alpha of 0.881, confirming strong internal consistency among items and the suitability of the scale for reliable data collection.

Conclusion

The scale demonstrates strong reliability and validity, ensuring accurate and consistent measurement of knowledge levels. High positive correlations among all items confirm excellent internal consistency, negating the need for additional revisions or retesting. During administration, correct responses receive one mark each, while incorrect or "don't know" answers score zero; total scores enable

categorisation of respondents into low, medium, or high knowledge groups. This structured approach effectively assesses dairy farmers' disaster mitigation knowledge, supporting targeted training interventions. With minimal modifications, the scale can be adapted for use in similar contexts beyond the study area.

References

1. Cronbach LJ. Coefficient alpha and the internal structure of tests. *Psychometrika*. 1951;16(3):297-334. doi:10.1007/BF02310555
2. Davenport TH, Prusak L. Working knowledge: How organizations manage what they know. Boston: Harvard Business School Press; 1998.
3. Demirtas H, Hedeker D. Computing the point-biserial correlation under any underlying continuous distribution. *Commun Stat Simul Comput*. 2016;45(8):2744-2751. doi:10.1080/03610918.2014.900363
4. Essen UJ, Akpan ET. Application of point biserial correlation in item analysis. *Glob J Educ Res*. 2018;17(1):45-53.
5. Gaviglio A, Demartini E, Coderoni S. A theoretical

- framework to assess the impact of flooding on dairy cattle farms. *Sustainability*. 2021;13(11):6127. doi:10.3390/su13116127
6. George D, Mallery P. *SPSS for Windows step by step: A simple guide and reference (4.0 update)*. Boston: Allyn & Bacon; 2003.
 7. Government of Kerala. *Kerala floods 2018: Post-disaster needs assessment report*. State Disaster Management Authority; 2018. <https://sdma.kerala.gov.in/wp-content/uploads/2019/08/Memorandum1-Floods-2018.pdf>
 8. Hingorjo MR, Jaleel F. Item's difficulty: An inappropriate concept. *J Pak Med Assoc*. 2011;61(12):1220-1222.
 9. Kane MT. Explicating score and test score in terms of validity. *Psychometrika*. 2016;81(2):381-400. doi:10.1007/s11336-015-9480-5
 10. Ragab M, Arisha A. Elements of individual knowledge: A practitioner's perspective. In: 8th European Conference on Intellectual Capital, Ca' Foscari University of Venice, Italy; 2016.
 11. Sarmah R, Hazarika M. Reliability analysis: A review. *Int J Eng Res Technol*. 2012;1(8):1-5.
 12. State Disaster Management Authority (SDMA), Kerala. *Kerala floods - 2018*. 2018. <https://sdma.kerala.gov.in/wp-content/uploads/2019/08/Memorandum1-Floods-2018.pdf>
 13. Swanson RA. *Analysis for improving performance: Tools for diagnosing organizations and documenting workplace expertise*. San Francisco: Berrett-Koehler Publishers; 1994.
 14. Taherdoost H. Validity and reliability of the research instrument; how to test the validation of a questionnaire/survey in a research. *Int J Acad Res Manag*. 2016;5(3):28-36. doi:10.2139/ssrn.2835685
 15. Taib F, Yusoff MSB. Difficulty index, discrimination index, sensitivity and specificity of long case and multiple choice question formats in paediatrics examination. *J Taibah Univ Med Sci*. 2014;9(2):110-114. doi:10.1016/j.jtumed.2014.01.004