



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; SP-9(5): 222-227
Received: 22-02-2026
Accepted: 25-03-2026

Suman Sant
Assistant Professor, Department of
Veterinary and Animal Husbandry
Extension Education, CVSc & AH,
Rewa, NDVSU, Jabalpur, Madhya
Pradesh, India

Deepika Diana Jesse Arland
Assistant Professor, Department of
Veterinary Physiology and
Biochemistry, CVSc & AH, Mhow,
NDVSU, Jabalpur, Madhya
Pradesh, India

Sulochana Sen
Assistant Professor, Department of
Animal Genetics and Breeding,
CVSc & AH, Rewa, NDVSU,
Jabalpur, Madhya Pradesh, India

Corresponding Author:
Suman Sant
Assistant Professor, Department of
Veterinary and Animal Husbandry
Extension Education, CVSc & AH,
Rewa, NDVSU, Jabalpur, Madhya
Pradesh, India

Development of a knowledge assessment tool for evaluating dairy farmers' understanding of dairy waste management in India

Suman Sant, Deepika Diana Jesse Arland and Sulochana Sen

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i5Sc.5549>

Abstract

Majority of the organic waste in India is not disposed properly due to the lack of knowledge and an important resource gets wasted likewise. Therefore, a tool in the form of knowledge test was developed and standardized for measuring the knowledge of dairy farmers regarding dairy waste management like dung and urine. A total number of 97 items were collected in the form of open-ended and multiple choice questions which were served to 36 farmers for their response. Data were analyzed for calculating difficulty and discrimination index and 26 items falling between the difficulty index of 30 to 80 and discrimination index of 0.22 to 0.55 were selected for calculating reliability and validity. Split-half reliability was calculated using Spearman Brown Prophecy Formula and was found to be 0.918. The correlation coefficient was calculated to be 0.49 and was significant ($p < 0.05$). Therefore, the final knowledge test containing 34 items related to livestock waste was standardized. The test can be used for assessing the knowledge gap of the dairy farmers for dairy waste management and suitable interventions can be made for enhancing the knowledge, thus converting the dairy waste to wealth.

Keywords: Knowledge, dairy waste, management, difficulty index and discrimination index

Introduction

According to the 20th Livestock Census, the livestock population in India is 536.76 million, which produces approximately 1655 million tons of dung per year. In urban and peri-urban areas, a large volume of dairy animal waste is flushed with water, leading to significant effluent discharge into nearby drainage systems. The most common problem with livestock waste is that it contributes to large-scale emissions of Carbon Dioxide, thereby contributing to global warming. It further pollutes water sources, which play a key role in the spread of infectious diseases (Singh *et al.*, 2019) ^[5].

Knowledge

Knowledge is often defined as a belief that is true and justified. The state of knowing about a particular fact or situation. Knowledge tests are a mechanism to measure farmers' knowledge and abilities and provide a snapshot of farmers' performance in a particular context. Therefore, to determine respondents' knowledge level regarding Dairy waste management. The present study was conducted to provide a clear understanding of dairy owners' existing knowledge and practices regarding waste handling. A knowledge test on dairy waste management was developed and standardized.

Materials and Methods

The knowledge test was developed according to Edwards's (1957) ^[1] method. Item Collection: The knowledge test consists of different types of questions, called items, and scores were assigned to them. Items for the test were compiled through literature, discussions with field extension personnel, subject matter specialists, academicians, and the researcher's own experience. According to the criteria laid by Edwards (1957) ^[1],

- Table no. 1 shows that the 97 items initially selected encompass major areas of dairy waste management.
- These 97 Items/questions were administered to 36 dairy farmers from the villages of Bhir, Devtalab, and Bahuti in the Mauganj district of Madhya Pradesh, in the non-sample area.
- The responses were quantified by giving a score of one (1) to the correct response and zero (0) to the incorrect response, or in case farmers do not know the answer.
- Thus, the total number of correct answers rendered by an individual was the knowledge score secured by him. Thus, the range of obtainable scores was 0-97.

Item analysis

The item analysis of a test usually yields two kinds of information: item difficulty and item discrimination.

- The index of the item difficulty reveals how difficult the item is, whereas
- The item discrimination indicates the extent to which an item discriminates between the well-informed farmer and the poorly informed ones.
- After calculating the scores for 36 respondents, they were arranged in descending order.
- These 36 respondents were then divided into six equal groups, each having six respondents. Respondents in each group have been arranged in descending order by the score each obtained.
- These groups were named as G1, G2, G3, G4, G5 and G6 respectively.
- For item analysis, the middle two groups, i.e., G3 and G4, were eliminated.
- Only four extreme groups with high (G1, G2) and low scores (G5, G6) have been considered for the computation of item difficulty and their discrimination indices.

Difficulty index

Difficulty index (D.I.) = $R/T \times 100$

Where,

R = Number of respondents who got the item right.

T = Total number of respondents

Discrimination index

The discrimination index was calculated by using the method suggested by Mehta (1958) [4]. The formula by which the item discrimination index was calculated is specified:

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

Where,

S1, S2, S5 and S6 = Frequencies of incorrect answers in G1, G2, G5 and G6 groups respectively

N = Total number of respondents in the sample of item analysis

Based on the results of the difficulty and discrimination index

Final selection of items was done. Two criteria, viz., item difficulty and item discrimination index, were used to select items for the final format of the knowledge test. Of 97 items, only 34 were included in the final format of the knowledge test.

Reliability and validity

Further, all the knowledge items were subjected to reliability and validity.

Reliability in the present study was measured using the split-half method, in which the 34-item format was split into two halves of 17 each, and the instrument was administered to 60 farmers. Two sets of scores were obtained and were correlated using the correlation between forms (r).

Reliability of full test

Spearman-Brown Prophecy Formula (also known as Spearman-Brown Prediction Formula) was used to calculate the reliability of the full test and is given as follows:

$$\text{Reliability of test} = 2r/1+r$$

Where,

R = Reliability of full test

r = Correlation between two half tests

Results and Discussion

Table no. 2 shows the final selection of knowledge items based on item difficulty and discrimination index, and the details are explained below.

Selection of items for the test

- Responses were collected from 36 respondents on 97 items related to dairy waste management.
- For the selection of items in the final format of the knowledge test, two criteria, viz., item difficulty and item discrimination index, were considered.
- In the present study, items with difficulty indices ranging from 25 to 75 and discrimination indices ranging from 0.2 to 0.55 were included in the final format of the knowledge test, as described by Mehta (1958) [4].

According to this procedure, 34 items were selected for the final format of the knowledge test on dairy waste management and are given in Table 1.

Table 1: Indices of difficulty and discrimination for items included in the final format of the knowledge test

Sl. No.	Questions	Difficulty index	Discrimination indices
A. General knowledge about livestock waste			
1.	Which country possesses largest livestock in the World?	52.78	0.08
2.	What% of dairy farms of the country are located in the Urban and peri urban areas?	38.89	0.50
3.	Which state has the highest number of Livestock?	27.78	0.33
4.	How much dung is excreted by an adult animal (400 kg) in a day?	55.56	0.42
5.	How much urine is excreted by an adult animal (400 kg) in a day?	44.44	0.50
6.	Wastewater in a dairy farm is generated from which activities?	83.33	0.50
7.	How much wastewater is generated from a dairy farm on cleaning the shed and bathing an animal daily?	16.67	0.25
8.	Which type of gases are produced from dung?	16.67	0.33
9.	Dung is used for what purpose?	94.44	0.17
10.	Dairy animal's urine used for what purpose?	16.67	0.00

11.	What is the moisture% of Dung?	25.00	0.50
12.	Why is proper livestock waste management important?	33.33	0.50
B. Livestock waste Storage			
13.	How many times a day dung should be cleaned to keep the shed clean?	66.67	0.50
14.	Where livestock waste should be stored after cleaning from shed?	44.44	0.42
15.	What should be the minimum distance of dung storage from water sources?	11.11	0.08
16.	What should be done to dung after collecting from the shed to prevent pollution and health hazard?	94.44	0.17
17.	What is composting?	22.22	0.33
18.	What is vermicomposting?	22.22	0.50
19.	In vermicomposting how many days old cow dung should be used to avoid excess heat.	19.44	0.33
20.	How many days is required to make vermicompost ready ?	16.67	0.42
21.	What is the optimum moisture% level of vermicompost?	16.67	0.42
22.	What is the optimal temperature range for proper decomposition in vermicomposting ?	100.00	0.00
23.	What is the colour of vermicompost ?	19.44	0.42
24.	What is biogas?	13.89	0.17
25.	What is the composition of Biogas?	8.33	0.25
26.	What are the uses of Biogas?	58.33	0.25
27.	What are the merits of Biogas?	36.11	0.42
28.	What is the optimum pH for biogas production?	8.33	0.25
29.	What should be the optimum Solid Concentration in slurry for biogas production?	33.33	0.75
30.	What is the optimum C:N ratio for biogas production?	5.56	0.00
31.	What is the optimum digester temperature for biogas production?	11.11	0.17
32.	Biogas produced (in m3) per kg of cattle dung under standard conditions is.	0.00	0.00
33.	What is the starter culture used in biogas production?	69.44	0.42
34.	Is it safe to use biogas in the kitchen?	58.33	0.75
35.	How to identify the leakage of biogas from the plant?	8.33	0.17
36.	For how many days the running plant can be left without daily feeding?	16.67	0.25
37.	How much quantity of cattle dung and water should be used daily for 1 m3 biogas plant?	27.78	0.50
38.	What is the proportionate of mixing cattle dung and water for biogas plant?	16.67	0.33
39.	What should be done if the flames are long?	13.89	0.00
40.	Other animal waste /excreta can be used for biogas?	33.33	0.33
41.	What is the minimum distance to be maintained while constructing the biogas plant near water bodies to prevent contamination?	33.33	0.50
42.	Which machine is used to convert biogas into electricity.	8.33	0.17
43.	Full form of CBG?	25.00	0.33
44.	CBG has calorific value and other properties similar to CNG and can be utilized as green renewable fuel as replacement of CNG in?	25.00	0.25
45.	How long does it take to build a biogas plant?	5.56	0.08
46.	Is there any chance of transmitting pathogens through using the digested slurry from the biogas plant?	50.00	0.67
47.	Is there any waste treatment to be followed for slurry disposal?	50.00	0.00
48.	Who developed NADEP method of organic composting?	11.11	0.33
49.	The recommended size of the tank in NADEP composting is?	13.89	0.17
50.	Raw materials required for filling NADEP tank	50.00	0.50
51.	The important technique in the manufacture of Nadep compost is that the entire tank should be filled in one go, within hours and should not go beyond 48 hours, as this would affect the quality of the compost.	25.00	0.42
52.	Before filling: the tank is plastered by?	25.00	0.42
53.	Roof/shed is necessarily required in which composting method?	16.67	0.17
54.	After this filling the tank is not disturbed for except that it is moistened at intervals of every 6-15 days.	25.00	0.50
55.	From each NADEP tank approximately tons of compost is prepared	11.11	0.17
56.	Within how many days NADEP compost is prepared ?	2.78	0.08
57.	What are the different types of environmental pollution caused by improper disposal of livestock waste?	66.67	0.17
58.	How does livestock waste pollute air?	88.89	0.33
59.	How does livestock waste pollute water?	58.33	0.25
60.	How does livestock waste pollute soil?	33.33	0.25
61.	How does livestock waste pollute ground water?	8.33	0.08
62.	How does livestock waste pollute surface water?	30.56	0.33
63.	How does livestock waste affect air quality?	83.33	0.17
64.	How does livestock waste is responsible for greenhouse gas and climate change ?	8.33	0.08
65.	How does livestock waste responsible for bad odor?	58.33	0.50
66.	How does livestock waste spread pathogens?	22.22	0.17
67.	What types of disease can happen due to drinking of water contaminated by livestock waste?	80.56	0.33
68.	Manure contains which essential plant nutrients?	13.89	0.08
69.	What causes land application of animal manure?	22.22	0.08
70.	Why is soil test conducted?	36.11	0.33
71.	How to maintain nutrients in manure?	33.33	0.33
72.	When is manure applied to the crop?	66.67	0.58

73.	Which factors are considered for application of manure in the field?	61.11	0.67
74.	How do you determine the quantity of manure to be applied to your crop?	58.33	0.33
75.	In which seasons manure with highest and lowest N content to be applied in the field ?	2.78	-0.08
76.	What methods do you follow to prevent manure runoff from the field?	50.00	0.67
77.	The pasture grazed by livestock spread with manure may cause parasitic infestation in animals.	100.00	0.00
E. Government Schemes, rules and regulation for Livestock waste disposal and management			
78.	What is GOBARdhan scheme?	16.67	0.33
79.	What is Swachh Bharat Mission (SBM) ?	50.00	0.58
80.	What are the objectives of Solid Waste Management Rules, 2016 ?	22.22	0.25
81.	What are the objectives of Waste to Energy (WTE) Projects ?	33.33	0.58
F. Environmental Issues In Dairy Farms / Hygienic Management			
82.	What should be the minimum distance between water resource and manure storage area in dairy farm?	11.11	0.25
83.	How long manure should not be accumulated in a place?	58.33	0.33
84.	Cattle dung is discharged along with waste water into the drains leads to	58.33	0.33
G. Guidelines For Waste Management in Dairy Farms Located in Urban and Peri-Urban Area			
85.	At what interval cow dung should be collected from a farm ?	75.00	0.58
86.	How premises and its surrounding areas should be properly sanitized and disinfected?	50.00	0.42
87.	What should be the minimum distance between dairy farm and residential area?	19.44	0.33
88.	What should be the minimum distance between dairy farm and hospital and school ?	52.78	0.33
89.	How far should dairy farms and cow sheds be located in areas with shallow groundwater depth and particularly from alluvial areas to prevent ground water pollution ?.	22.22	0.17
H. Dairy farms and gaushalas may be allowed to follow minimum distance criteria given below, which may be subject to vary with the local conditions:			
90.	What should be minimum distance of gaushalas from National Highways?	25.00	0.50
91.	What should be minimum distance of gaushalas from State Highways?	19.44	0.25
92.	What should be minimum distance of gaushalas from major drinking water reservoir on catchment side?	44.44	0.17
93.	What should be minimum distance of gaushalas from drinking water source like wells, summer storage tanks, other tanks (drinking water)?	30.56	0.50
94.	What should be minimum distance of gaushalas from major water sources like River and Lake?	22.22	0.00
95.	What should be minimum distance of gaushalas from Canals?	38.89	0.42
96.	What should be suitable shape of gutter or drain in animal house ?.	50.00	0.17
97.	What should be the optimum width of the drains of a gaushala?	58.33	-0.08

Reliability of the knowledge test

Reliability is the accuracy or exactness of a measuring instrument (Kerlinger 1964) [3]. Reliability regarding the present study was measured by the split-half method. The reliability of the test was (r) 0.87, which showed that the knowledge test was reliable. The internal consistency of the test was calculated using Cronbach's alpha, and the value was calculated to be 1, testifying to the internal consistency of the knowledge test. All the coefficients were found to be significant at the one percent level of significance. Hence, the knowledge test constructed was highly stable and reliable.

Validity of Knowledge Test

The knowledge items in the preliminary test concerning knowledge regarding dairy waste management were collected

from dairy owners. The empirical type of validity, which Guilford (1946) [2] called intrinsic validity, was determined by taking the square root of the calculated reliability coefficient. The content validity of the knowledge test was ensured by discussing it thoroughly with the members of the advisory committee.

$$\text{Validity} = \sqrt{r}$$

The validity of the test was found to be 0.927. It showed that the Knowledge test was quite valid.

Final selection of items

The final knowledge test is given in Table 2, and finally, 34 items were selected for the test.

Table 2: Knowledge test on Dairy waste management

Sl. No.	Item no.	Questions	Difficulty index	Discrimination indices
A. General knowledge about livestock waste				
1.	2.	What% of dairy farms of the country are located in the Urban and peri urban areas?	38.89	0.50
2	3.	Which state has the highest number of Livestock?	27.78	0.33
3	4.	How much dung is excreted by an adult animal (400 kg) in a day?	55.56	0.42
4	5.	How much urine is excreted by an adult animal (400 kg) in a day?	44.44	0.50
5	11.	What is the moisture% of Dung?	25.00	0.50
6	12.	Why is proper livestock waste management important?	33.33	0.50
B. Livestock waste Storage				
7	13.	How many times a day dung should be cleaned to keep the shed clean?	66.67	0.50
8	14.	Where livestock waste should be stored after cleaning from shed?	44.44	0.42
9	26.	What are the uses of Biogas?	58.33	0.25
10	27.	What are the merits of Biogas?	36.11	0.42
11	33.	What is the starter culture used in biogas production?	69.44	0.42

B. Livestock waste Storage				
12	37.	How much quantity of cattle dung and water should be used daily for 1 m ³ biogas plant?	27.78	0.50
13	40.	Other animal waste /excreta can be used for biogas?	33.33	0.33
14	41.	What is the minimum distance to be maintained while constructing the biogas plant near water bodies to prevent contamination?	33.33	0.50
15	43.	Full form of CBG?	25.00	0.33
17	44.	CBG has calorific value and other properties similar to CNG and can be utilized as green renewable fuel as replacement of CNG in?	25.00	0.25
18	50.	Raw materials required for filling NADEP tank	50.00	17
19	51.	The important technique in the manufacture of Nadeep compost is that the entire tank should be filled in one go, within hours and should not go beyond 48 hours, as this would affect the quality of the compost.	25.00	18
20	52.	<i>Before filling:</i> the tank is plastered by?	25.00	19
21	54.	After this filling the tank is not disturbed for except that it is moistened at intervals of every 6-15 days.	25.00	20
C. Environmental Impacts				
22	59.	How does livestock waste pollute water?	58.33	21
23	60.	How does livestock waste pollute soil?	33.33	22
24	62.	How does livestock waste pollute surface water?	30.56	23
25	65.	How does livestock waste responsible for bad odor?	58.33	24
26	70.	Why is soil test conducted?	36.11	25
27	71.	How to maintain nutrients in manure?	33.33	26
E. Environmental Issues In Dairy Farms / Hygienic Management				
28	83.	How long manure should not be accumulated in a place?	58.33	0.33
29	84.	Cattle dung is discharged along with waste water into the drains leads to	58.33	0.33
G. Guidelines For Waste Management in Dairy Farms Located in Urban and Peri-Urban Area				
30	86.	How premises and its surrounding areas should be properly sanitized and disinfected?	50.00	30
31	88.	What should be the minimum distance between dairy farm and hospital and school ?	52.78	31
H. Dairy farms and gaushalas may be allowed to follow minimum distance criteria given below which may be subject to vary with the local conditions:				
32	90.	What should be minimum distance of gaushalas from National Highways?	25.00	32
33	93.	What should be minimum distance of gaushalas from drinking water source like wells, summer storage tanks, other tanks (drinking water)?	30.56	33
34	95.	What should be minimum distance of gaushalas from Canals?	38.89	34

Conclusion

- As long as there is life on earth, dairy waste will be produced, and managing that waste will be a real challenge.
- The test can serve as a tool to ascertain the knowledge of stakeholders regarding the management of dairy waste.
- The test can be used by researchers, institutes, and organizations to ascertain the knowledge of respondents under study.
- The test can be used for estimating the net knowledge deficit regarding dairy waste management that will thrust policy-making in this direction.
- Assessment of knowledge gain and knowledge-enhancing interventions can be made using the test.
- The test items presented in the test are simple in nature and easily understandable, making the test handy to use.
- It also promotes the dairy industry as a profitable one, along with milk and dairy products. Dung and urine act as an extra income source via various types of organic manures such as compost, vermin compost, bio-enriched compost, etc.

Application of research

The test can be used for estimating the net knowledge deficit regarding dairy waste management that will thrust policy-making in this direction.

Research Category

Original Ph.D. work research article

Abbreviations

D.I. (Difficulty index).

Acknowledgement

Author thankful to Major advisor, Dr. Bhabesh Chandra Das, Professor and Head, Department of Veterinary Science and Animal Husbandry, Rewa, NDVSU, Jabalpur (M.P.). for Ph.D. work entitle "Assessment of dairy waste management practices followed by urban and peri-urban dairy farmers of Vindhya region of Madhya Pradesh"

Author Contributions

All authors equally contributed.

Study area / Sample Collection

villages of Bhir, Devtalab, and Bahuti in the Mauganj district of Madhya Pradesh

Conflict of Interest

None declared

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

References

1. Edwards AL. Techniques of attitude scale construction. New York: Appleton-Century-Crofts; 1957.
2. Guilford JP. New standards for test evaluation. Educ Psychol Meas. 1946;6:427-439.
3. Kerlinger FN. Foundations of behavioural research. New York: Holt; 1964.
4. Mehta P. A study of communication of agricultural information and extent of distortion occurring from district

to village level workers in selected IADP of Udaipur, Rajasthan. Udaipur: Rajasthan Agricultural University; 1958.

5. Singh A, Tiwari R, Panda P, Joshi P, Dutt T. Development and standardization of knowledge test for organic waste management. Int J Curr Microbiol Appl Sci. 2019;8(8):1443-1449.
<https://doi.org/10.20546/ijcmas.2019.808.168>