

## Construction of a test to measure farmer's knowledge on drone technology

**D Laxman Raj, M C Obaiah, G Sivanarayana V Sitarambabu and M Suresh Kumar**

Department of Agricultural Extension Education, Acharya N G Ranga Agricultural University,  
Agricultural College, Bapatla-522101, Andhra Pradesh, India

### ABSTRACT

In the absence of a standardized instrument to assess farmers' knowledge on drone technology, a knowledge test was systematically developed. Test items were initially compiled from credible and authoritative sources, including crop-specific Standard Operating Procedures (SOPs) for drone-based pesticide application issued by the Ministry of Agriculture and Farmers Welfare, Government of India & Professor Jayashankar Telangana Agricultural University (PJTAU) and the Vyavasaya Panchangam published by Acharya N.G. Ranga Agricultural University (ANGRAU). The preliminary pool consisted of 92 items, which were subjected to expert validation and statistical methods including difficulty index, discrimination index and point-biserial correlation were employed to evaluate item quality. Based on these criteria, 26 items demonstrating acceptable levels of validity and reliability were retained for the final test. During administration, respondents received one point for each correct response, with no penalty for incorrect answers.

**Keywords:** *Drone technology, Knowledge test and Standard operating procedures*

Knowledge is defined as “those behaviours and test situations which emphasizes the remembering either by recognition or by recall of ideas and materials on some phenomenon” (Bloom, 1956).

In the present study, knowledge was defined as the extent of information possessed by farmers regarding drone technology, enabling them to make informed decisions about its applicability to their agricultural practices. To assess this, a knowledge test comprising twenty-six (26) items was developed. Each item was evaluated using a dichotomous scale, assigning a score of ‘1’ for a correct response and ‘0’ for an incorrect one. Thus, the maximum and minimum possible scores were 26 and 0 respectively. The detailed methodology adopted for the construction and standardization of the knowledge test is outlined below.

### MATERIAL AND METHODS

#### Collection of knowledge items

The content of the test was composed of questions called items. A comprehensive list of 92 knowledge questions on drone technology application in the study area were prepared from sources such as publications of Crop specific SOPs for application of

pesticides with drones by Ministry of Agriculture and Farmers Welfare, Government of India and Standard Operating Protocols (SOPs) for drone-based pesticide application in rice by PJTAU, Vyavasaya Panchangam by ANGRAU and discussion with extension personnel working in the study area.

#### Judges rating

The items were given in the form of statements to the judges in relevant field for finding out the degree of relevancy of the items to include in the final schedule or not. The items were selected by adopting weighted mean score method. Extension personnel selected from DAATTCs, KVKs and professors from department of agricultural extension education, agronomy, entomology and plant pathology of Agricultural College, Bapatla. The scores of each statement were summed up to find out the total score of each statement for all the 30 judges. The statements under highly relevant, relevant and irrelevant were taken with weightages 3, 2 and 1 respectively. The possible score for each statement from a judge range in between 1 to 3. The mean score assigned to each statement was calculated by using the following formula.

$$\text{Mean score} = \frac{\text{Total score of each statement}}{\text{Total number of Judges}}$$

After calculating the mean score for all the statements, overall mean score was calculated by adopting the following formula.

Over all mean score =

$$\frac{\text{Total score of all the statement for all the Judges}}{\text{Total No. of statements} \times \text{Total number of Judges}}$$

The statements with their mean score value being equal to or higher than over all mean score, were selected for the final knowledge test.

### Selection of items for item analysis

The screening of items was done based on the criteria followed by Conard (1948)

Response to items should promote thinking rather than routine memorization.

They should differentiate the well-informed respondent from less informed and should have certain difficulty value.

The items included should cover all areas of knowledge about drone technology application.

By using above criteria, 39 items were selected for developing knowledge test, after editing carefully and by subjecting them to expert's endorsement. The experts consisted extension specialists, advisory committee and scientists in the study area.

### Form of items

The items selected for the construction of knowledge test on drone technology application were framed in the objective form viz., multiple choice, fill in the blanks, true or false and yes or no.

### Pre-testing

The items selected for the knowledge test were pre-tested separately by administering the items to 30 farmers. Care was taken to select the matching sample of 30 farmers from non-sampling area.

### Item analysis

Item analysis was done via determining the index of 'Item difficulty' and index of 'Item discrimination'. The 'Item difficulty' indicates the

extent to which an item was difficult. The function of the item discrimination index was used to find out whether an item really discriminates a well-informed farmer from poorly informed farmer.

The raw data obtained was subjected for typical item analysis. The 39 test items were administered to each one of the 30 farmers. The scores assigned were 'one' for correct answer and 'zero' for incorrect response. After computing, the total scores were obtained for each of the 30 farmers on 39 items. They were rank ordered and divided into six equal groups. These groups were labelled as G1, G2, G3, G4, G5 and G6 each group consists of five farmers. For the purpose of item analysis, middle two groups G3 and G4 were excluded retaining only four extreme groups with highest and lowest scores.

After getting the four extreme groups for item analysis, the responses for each of the items were subjected to calculate difficulty index, discrimination index and point biserial correlation as given below.

### Item difficulty index (P)

The item difficulty index was worked out as the percentage of farmers answering for items correctly. The assumption of the item difficulty index was that, the difficulty is linearly related to the level of farmer's knowledge about drone technology application. The items with 'P' values ranging from 0.20 to 0.80 were considered to selection of items for final knowledge test (Table - 1).

$$\text{Difficulty Index} = \frac{\text{No. of farmers answered correctly}}{\text{Total number of farmers}} \times 100$$

### Discrimination index ( $E^{1/3}$ )

The criterion for item selection was the item discrimination index indicated by ' $E^{1/3}$ ' which is calculated by using following formulae.

$$E^{1/3} = \frac{(S_1 + S_2) - (S_5 + S_6)}{\frac{N}{3}}$$

Where  $S_1$ ,  $S_2$ ,  $S_5$  and  $S_6$  are the frequencies of correct answers in groups  $G_1$ ,  $G_2$ ,  $G_5$  and  $G_6$  respectively. N is the total number of farmers of the 30-sample selected for items analysis. The items with  $E^{1/3}$  value ranging from

0.2 to 0.8 were considered for the final selection of items for knowledge test (Table - 1).

### Point biserial correlation ( $r_{pbis}$ )

The main agenda of calculating point biserial correlation ( $r_{pbis}$ ) was to work out the internal consistency of the items i.e., the relationship of the total score to a dichotomized answer to any given item. In a way, the validity power of the item was computed by the correlation of individual item of preliminary knowledge test calculated by using following formulae.

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

Where,

$r_{pbis}$  = Point biserial correlation coefficient

$M_p$  = Mean of the total scores of the farmers who answered the item correctly

or

$$M_p = \frac{\text{Sum of total scores of X and Y}}{\text{Total Numbers of correct answers}}$$

$M_q$  = Mean of the total scores of the farmers who answered the item incorrectly

or

$$M_q = \frac{\text{Sum of total scores of X} - \text{Sum of total scores of X and Y}}{\text{Total Number of wrong answers}}$$

$p$  = Proportion of farmers who correctly answered to item

$$p = \frac{\text{Total number of correct answers}}{\text{Total number of farmers}}$$

$q$  = Proportion of farmers who incorrectly answered to item

$$q = 1 - p$$

$X$  = Total score of the farmer for all items

$Y$  = Response of the individual for the items

$XY$  = Total score of the farmers multiplied by the response of the individual to the item

Items having significant point bi serial correlation at 1% and 5% level of probability was selected for final knowledge test (Table - 1).

### Selection of the items

Items with difficulty level indices ranging from 0.20 to 0.80. Items with discrimination indices ranging from 0.20 to 0.80. Items having significant point biserial correlation either at 1 per cent or 5 per cent level of probability.

Thus, the finally selected knowledge items comprise 4 types of questions i.e., multiple choice, fill in the blanks, yes or no and true or false.

### Reliability of the test

According to Kerlinger (1973) "Reliability is the accuracy or precision of measuring instrument". Reliability of the items was tested by using split half method. The scores obtained by odd numbers of farmers were taken as one set of values and the scores of even numbers of farmers as the second set of values for calculating the correlation coefficient. The correlation co-efficient ( $r = 0.698$ ) was highly significant indicating a high degree of dependability of the instrument for measuring knowledge of the farmers.

### Validity of the test

The content validity of knowledge test was derived a long list of test items representing the whole drone technology application collected from various sources such as Crop Specific SOPs for Application of Pesticides with Drones by Ministry of Agriculture and Farmers Welfare, Government of India and Standard Operating Protocols (SOPs) for Drone based Pesticide Application in Rice by PJTAU, Vyavasaya Panchangam, ANGRAU and discussion with extension personnel working in the study area. It was assumed that the score obtained by administering the knowledge test of this study measures extent of knowledge of farmers on drone technology application.

Thus, the knowledge test developed to measure the knowledge of farmers on drone technology application as it showed greater degree of reliability and validity.

### Administration of the test

All the 26 items in the knowledge test read out to the farmers after establishing rapport with them.

**Table 1. Selection of items for knowledge test by using item analysis**

Item No.	Frequency of correct answers in four extreme				Difficulty index (P)	Discrimination index ( $E^{1/3}$ )	Point Biserial Correlation ( $r_{pbis}$ )
	G1	G2	G3	G4			
1	4	4	1	1	53.33	0.6	0.490*
2	5	4	2	1	66.66	0.6	0.615**
3	5	4	1	2	53.33	0.6	0.517**
4	4	5	1	1	53.33	0.7	0.508*
5	5	4	1	0	53.33	0.8	0.644*
6	5	4	1	0	63.33	0.8	0.756*
7	1	3	2	1	43.33	0.1	0.187 <sup>NS</sup>
8	3	3	0	0	36.66	0.6	0.503*
9	2	2	2	2	43.33	0	0.023 <sup>NS</sup>
10	5	4	2	0	50	0.7	0.648*
11	3	4	2	0	53.33	0.5	0.525*
12	5	4	1	1	60	0.7	0.647**
13	3	2	4	2	50	-0.1	-0.086 <sup>NS</sup>
14	5	5	2	2	70	0.6	0.519*
15	4	2	3	2	56.66	0.1	0.178 <sup>NS</sup>
16	5	5	1	0	53.33	0.9	0.735*
17	4	4	1	1	40	0.6	0.499*
18	2	5	4	3	63.33	0	0.014 <sup>NS</sup>
19	1	4	3	1	36.66	0.1	0.070 <sup>NS</sup>
20	2	3	2	2	46.66	0.1	0.036 <sup>NS</sup>
21	4	4	1	1	53.33	0.6	0.418*
22	5	3	1	1	53.33	0.6	0.499*
23	5	4	2	1	53.33	0.6	0.490*
24	4	4	2	0	56.66	0.6	0.626**
25	5	4	1	1	50	0.7	0.521*
26	1	1	2	4	46.66	-0.4	-0.390 <sup>NS</sup>
27	1	2	1	1	40	0	0.009 <sup>NS</sup>
28	5	4	1	1	46.66	0.7	0.545*
29	2	1	2	0	26.66	0.1	0.174 <sup>NS</sup>
30	5	3	1	1	53.33	0.6	0.499*
31	5	4	2	1	60	0.6	0.619**
32	1	1	1	2	23.33	-0.1	-0.080 <sup>NS</sup>
33	4	5	1	2	60	0.6	0.425*
34	4	0	2	1	43.33	0.1	0.206 <sup>NS</sup>
35	4	1	3	1	36.66	0.1	0.164 <sup>NS</sup>
36	5	4	2	0	53.33	0.7	0.599**
37	5	3	2	0	46.66	0.6	0.526*
38	5	4	2	1	50	0.6	0.557*
39	5	3	2	0	50	0.6	0.575*

The farmers were administered with the questions included in knowledge test.

### Scoring procedure

A score of 1 and 0 was assigned for correct and wrong answer for each item, respectively and the total number of correct responses given by the farmers out of the 26 items was the knowledge score obtained by him or her. Thus, the maximum and minimum possible score was 26 and 0 respectively. The farmers were grouped into three categories based on mean and standard deviation as follows

S. No.	Categorisation	Score
1	Low knowledge	Less than (Mean - SD)
2	Medium knowledge	Between (Mean $\pm$ SD)
3	High knowledge	More than (Mean + SD)

### RESULTS AND DISCUSSION

The standardized knowledge test comprises of 26 items, can be readily adopted by researchers and extension professionals for assessing farmers' knowledge on drone technology. To ensure comprehensiveness and cater to diverse cognitive levels, the test includes a variety of question formats, including multiple-choice, yes/no, true/false and fill-in-the-blank items. This mixed format approach enhances the test's ability to capture nuanced understanding and practical knowledge among respondents.

### CONCLUSION

The test developed using standard procedures can be effectively used by researchers conducting similar studies. Its application can significantly streamline the assessment process by eliminating the

need to develop a new tool from the ground up. By employing this standardized scale, researchers can efficiently evaluate farmers' knowledge on drone technology, thereby facilitating informed interventions and capacity-building programs.

### LITERATURE CITED

- Bloom B S (ed) 1956.** *Taxonomy of Education Objectives*. Vol 1. Cognitive Domain. David Mckay Company, Inc. New York.
- Central Farm Machinery Training and Testing Institute, Budni. 2023.** *Crop specific Standard Operating Procedure (SOP) for the application of pesticides with drones*(Draft). [https://fnttibudni.gov.in/files/Crop\\_Specific\\_SOP\\_2023\\_cdr.pdf](https://fnttibudni.gov.in/files/Crop_Specific_SOP_2023_cdr.pdf) Central Farm Machinery Training and Testing Institute, Budni.
- Conard H S 1948.** Characteristics and uses of item analysis data. *Psychological Monograph: General and Applied*. 62(8): 1-49.
- Kerlinger F N 1973.** *Foundations of behavioral research*. Holt, Rinehart and Winston, Inc. New York.
- Acharya N G Ranga Agricultural University 2024-25.** Vyavasaya Panchangam. Guntur, Andhra Pradesh, India.
- Varma N R G, Babu T K, Ramakrishna A, Sunitha V, Kavitha K, Reddy P R R, Ramana M V, Sridevi G, Ramulu V, Rahman S J, Umadevi G, Rao V V, Jagadeeshwar R and Rao V P 2022.** *Standard Operating Protocols (SOPs) for drone based pesticide application in rice*. Publication No. 41/MG/PJTSAU/2022. Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad 500030. Telangana State, India, 104 p.