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Construction and Standardization of Knowledge Test to Measure the Knowledge of Farmers on Water Management Practices in Sugarcane

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ABSTRACT

About two- third of population in India depends on agriculture either directly or indirectly for survival. Agriculture has boosted up the GDP to 18.80% (2021-22) from 17.80% (2021-22). But the agriculture sector has always been at the mercy of water supplies. Farmers now confront even higher uncertainties about water availability due to climatic changes. Though water management practices are being followed by farmers it has not covered the entire state. Hence, it is high time to popularize and make farmers adopt water management practices to all the sectors of farming community. The first level in the adoption process is to know the knowledge of farmers on a particular innovation. In this study, knowledge test was constructed to know the level of knowledge on water management practices among sugarcane growers. Sugarcane is one of the water intensive crops which requires 1500-3000 litres of water to produce 1 Kg of sugarcane.However, due to lack of region specific test to measure the level of knowledge of sugarcane farmers on water management practices, it was deemed necessary to develop a test specifically for this purpose.

Key words : *Water management practices, Knowledge test, Construction, Standardisation.*

Introduction

Water is an essential component of agricultural productivity and is crucial for food security. About 70.00 per cent of global freshwater withdrawals and 90.00 per cent of global groundwater is consumed by agricultural sector (Siebert *et al.*, 2010). A total of 20.00 per cent of total cultivated land represents irrigated agriculture and it generates 40.00 per cent of all food produced globally. Rivalry for water resources is anticipated to increase as a result of population expansion and urbanisation with an emphasis on agriculture. By 2050, it is estimated that world's population is projected to reach over 10 billion (Rosa

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et al., 2020). In this regard, it is predicted that agricultural production will need to increase roughly by 70.00 per cent. With these issues, climate change on other hand is foretold to aggrandize the existing water issues. However, the future demand for water across all sector would necessitate a re-allocation of up to 40.00 per cent of water from lower to higher productivity especially in areas with shortage of water. In Tamil Nadu, the main source of irrigation water is groundwater from wells/ tube wells. Due to the state's rapidly dropping water table, 0.16 million of the 1.8 million wells in the state are declining. (GOI, 2019). Also, of the 385 blocks in Tamil Nadu, 90 blocks are dark (groundwater extraction exceeding 100.0 %), 89 are grey (extraction exceeding 65.00%) and remaining 226 are white (extraction is less than 65.00%). But suitable water management practices will foster the efficient use of water. Government of India is taking various measures in order to improve the Water Use Efficiency.

Sugarcane is one of the most important cash crops. India is the second largest producer of sugarcane globally. Among the states, Tamil Nadu stands fourth in sugarcane cultivation. But Sugarcane is also a water intensive crops which requires 1500-3000 litres of water to produce 1 Kg of sugarcane. In order to improve water management among farmers Government of India promotes Pradhan Mantri Fasal Bima Yojana among farmers. With the aim of covering entire area under Micro Irrigation, the state extended additional subsidy for other essential components which has not been covered under MI subsidy. Yet there is a gap in adopting water management practices among farmers. Hence, as a part of Ph.D. work, the researcher wants to test the knowledge level of sugarcane farmers on Water Management Practices. It was deemed necessary to construct a test as there was no suitable knowledge test concentrating on the study area.

Methodology

In the present study, "Knowledge level" denoted the level of understanding gained by the farmers on the water management practices. A knowledge test was developed and standardized to measure the knowledge of farmers on crop based water management practices. It comprises of 4 stages to develop and standardize a knowledge test which includes:

1. Collection of knowledge items
2. Item analysis
3. Reliability assessment
4. Validity assessment

Collection of knowledge items

In order to set the seal on the quality of the knowledge test, it was prepared by consulting with scientists from the Water Technology centre, subject matter specialists, extension functionaries and the process was supplemented with review of literature from the package of practices recommendations of Tamil Nadu Agricultural University through agritech portal. The content of the test consisted of items relevant to water management practices. The knowledge test consists of various components like Frequency of irrigation, intensity of irrigation, types of irrigation, water requirement of the crop, drainage facilities, micro irrigation system, irrigation intervals, intercropping, selection of varieties, intercultural operations etc. After ensuring that the item pool has covered all the components it was sent for judges rating.

Judges rating

In order to find the relevancy of items the selected 45 items for were subjected to 20 scientists in Water Technology Centre, Krishi Vigyan Kendra and State Agricultural Department officials. The scientists were asked to rate the items as Most relevant, Relevant and Irrelevant based on a three-point continuum scale. A score of 3,2,1 was given to Most relevant, Relevant and Irrelevant respectively.

Framing of items

After judges rating, a total of 35 questions of mean more than or equal to 2.105 were selected for constructing a knowledge test. The items were organized into objective form viz., choose the correct answer and yes or no.

The following criteria have been used to choose items for selection of items for item analysis:

i) Response to an item should encourage critical thinking
ii) Items included should have a specific level of difficulty
iii) The test should cover all the components of the knowledge selected for the subject.

Pre-testing

The selected 35 items were administered to 60 farmers of sugarcane crop. Absolute care was taken that the selected farmers does not belong to the sampling area. In order to divide the 60 respondents into 6 equal groups the scores obtained by them were summed up and arranged in descending order. Those groups were labelled as G_1, G_2, G_3, G_4, G_5 and G_6. In order to carryout item analysis middle two groups viz., G_3 and G_4 were eliminated. Thus, now it has only extreme groups of high and low scores namely G_1, G_2, G_5 and G_6.

Item analysis

Item analysis is usually carried out to acquire three types of information viz., Item difficulty index, Item discrimination index and Point bi- serial correlation (Guilford, 1954)

Item difficulty index

Item difficulty index is indicated as p value. Item difficulty index is generally a proportional metric. It gives the percentage of farmers providing correct answers to the given item. This index indicates as to which extent the given item is difficult. The item difficulty index is linearly related to the knowledge of water management practices of each crop. The formula used for calculating the index is as follows:

$$\text{Item Difficulty index} = \frac{\text{Number of correct answers for ith item}}{\text{Total number of respondents}} \times 100$$

In this study, p value ranging from 0.2 to 0.8were taken into account for the final selection (Kumar *et al*., 2015).

Item discrimination index

Item discrimination is calculated from equal sized high and low scoring groups. It is used to examine how well an item is able to discriminate between good and poor informed respondent. The formula suggested by Mehta (1958) which is used to calculate item discrimination index is as follows:

$$E^{1/3} = \frac{(S1 + S2) - (S5 + S6)}{N/3}$$

Where S_1, S2, S_5 and S_6 are frequencies of correct answers in groups G_1, G_2, G_5 and G_6 respectively. The total of respondents in the sample is denoted as N.

The items with discrimination index ranging from 0.2 to 0.8 are selected (Kumar *et al*., 2015).

Point biserial correlation (r_{pbis})

The internal consistency of the item can be calculated using Point Bi-serial correlation. This gives the relationship of total score to dichotomized answer to any given item. The formula used for calculating Point Bi-serial correlation was given by (Garret, 1967)

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

Where,

r_{pbis}= Point bi-serial correlation co efficient

M_p= Mean of total scores of respondents who answered each item correctly

Or,

$$M_p = \frac{\text{Sum of XY}}{\text{Total number of correct answers}}$$

M_q= Mean of total scores of respondents who answered each item incorrectly

Or,

$$M_p = \frac{\text{Sum of X- Sum of XY}}{\text{Total number of wrong answers}}$$

SD= Standard deviation of the entire sample

P= Proportion of respondents giving a correct answer to an item

Or,

$$P = \frac{\text{Total number of correct answers}}{\text{Total number of respondents}}$$

q= 1- p

where, P= Total number of correct answers/ Total number of respondents

X= Total scores of farmers for all items

Y= Response of individual for the items. Correct= 1, Wrong= 0.

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

Items having significant point bi-serial correlation either at 1 percent or 5 per cent were selected.

Final selection of items

For an item to be selected in the test it should follow three criteria namely, the range of difficulty index should range from 0.20 to 0.80. The discrimination index ranging from 0.2 to 0.8 and point bi-serial correlation coefficient should be significant at 0.01% or 0.05% of probability. Thus, a total of 18 items were finally selected for administration.

Reliability assessment

Reliability is an important component to measure the quality of research. It exhibits how effectively a method or test measures something. Reliability concerns more on consistency. Split half reliability was administered in this study. The total set of 18 items were divided into two halves (odd numbered questions and even numbered questions) and were regulated from 30 respondents separately. The correlation was accounted by the scores obtained by the respondents over each of this half-length test with the spearman brown formula:

$$r_{xy} = \frac{\Sigma(X - \overline{X})\ (Y - \overline{Y})}{\sqrt{[\Sigma\ (X - \overline{X})^2]\ [\Sigma Y - \overline{Y})^2]}}$$

Where,

X= Respondent's score on the first half of the items,

X = Mean score on the first half of the items

Y= Respondent's score on second half of the items

Y= Mean score on the second half of the items

The correlation coefficient was quantified and 'r' value was found to be 0.63 which was significant at 1 per cent level of significance for sugarcane farmers. The reliability coefficient showed that internal consistency was high for the test.

Table 1. Respondents in four extreme groups

Item No.	Frequencies of correct answer of respondents in four extreme groups				Frequency of correct answers	Difficulty index	Discrimination index	r_{pbis}	S/R
	S1	S2	S5	S6					
1	10	9	6	6	45	0.75	0.35	0.623**	S
2	10	9	7	3	41	0.68	0.45	-0.357	R
3	8	8	5	5	39	0.65	0.3	0.476**	S
4	8	6	6	5	38	0.63	0.15	0.337^{NS}	R
5	5	4	2	1	18	0.30	0.3	-0.356^{NS}	R
6	9	7	5	3	34	0.57	0.4	0.530^{NS}	R
7	10	8	4	3	35	0.58	0.55	0.491**	S
8	9	8	6	6	43	0.72	0.25	0.393*	S
9	3	3	1	0	10	0.17	0.25	0.273^{NS}	R
10	8	7	4	4	33	0.55	0.35	0.496^{NS}	R
11	9	9	7	5	44	0.73	0.3	0.539**	S
12	10	8	7	6	46	0.77	0.25	0.224**	S
13	10	7	5	4	38	0.63	0.4	0.621**	S
14	8	7	4	3	31	0.52	0.4	-0.137^{NS}	R
15	9	8	6	3	37	0.62	0.40	0.423**	S
16	9	9	5	5	41	0.68	0.40	0.712**	S
17	8	7	5	4	35	0.58	0.30	0.750**	S
18	9	9	8	5	46	0.77	0.25	0.084^{NS}	R
19	10	8	3	2	33	0.55	0.65	0.192^{NS}	R
20	10	9	8	6	47	0.78	0.25	0.279^{NS}	R
21	9	8	8	2	42	0.70	0.35	0.200^{NS}	R
22	10	8	6	5	42	0.70	0.35	0.499**	S
23	9	8	7	6	44	0.73	0.20	0.050^{NS}	R
24	9	8	4	3	33	0.55	0.50	0.596**	S
25	8	8	5	2	33	0.55	0.45	0.440*	S
26	9	7	2	2	37	0.62	0.60	0.507**	S
27	4	3	2	1	14	0.23	0.20	-0.14	R
28	10	7	5	3	35	0.58	0.45	0.216**	S
29	8	7	2	2	25	0.42	0.55	-0.337^{NS}	R
30	9	9	6	5	42	0.70	0.35	0.331**	S
31	9	9	2	1	26	0.43	0.75	0.305*	S
32	8	7	6	6	40	0.67	0.15	0.536^{NS}	R
33	4	2	1	1	11	0.18	0.20	0.069^{NS}	R
34	8	7	6	6	40	0.67	0.15	0.567**	S
35	9	9	4	3	34	0.57	0.55	-0.279^{NS}	R

*- Significant at 0.05%, **- Significant at 0.01%, NS- Non- Significant, r_{pbis}- Point Bi- serial Correlation, S-Selected, R-Rejected.

Validity assessment

In relation to the knowledge test constructed the items with highly significant Point bi-serial correlation (r_{pbis}) at 0.01 level of probability indicated that the items are valid. Moreover, judges opinion was used to test content validity. As the test included all the contents as indicated by experts it could be argued as being content validity.

Practicability of test and scoring pattern

The final knowledge test items were sorted into multiple choice questions and yes or no type. A score of '1' was given to the respondent who gives correct answer whereas '0' was given for the incorrect answers. Thus a know ledge test of a respon-

Table 2. Items selected for inclusion in final knowledge test

S. No.	Items selected	Correct answers
1.	________is practical approach to sugarcane production which involves less seed setts and less water a) Sustainable Sugarcane Intensification b) Sustainable Sugarcane Initiative c) Sugarcane Sustainable Improvement	Sustainable Sugarcane Intensification
2.	In the SSI method, ___________ canes/ acre is required. a) 450- 500 canes* b) 500- 600 canes c) 400 - 500 canes	450- 500 canes
3.	Sugarcane needs more water at which crop growth stage? a) Tillering stage b) Grand growth stage c) Both a and b	Tillering stage & Grand growth stage
4.	_____________ is the application of fertilizers with water. a) Irrigation b) Fertigation c) Sterilization	Fertigation
5.	Name any 'N' source fertilizer we can use in fertigation a) Urea b) MOP c) Rock Phosphate	Urea
6.	Name any 'K' source fertilizer we can use in fertigation a) Urea b) MOP c) Rock Phosphate	Murate of Photash (MOP)
7.	In drip irrigation, ________ months old setts should be planted a) 6-7 b) 7-8 c) 3-4	6-7
8.	Fertigation improves _________________________ a) Fertilizer Use Efficiency b) Soil compaction c) Mechanic damage	Fertilizer Use Efficiency
9.	Fertigation reduces _____________ a) Mechanical damage to the crop b) Burning the plant root system c) Both a & b	Mechanical damage to the crop &Burning of plant root system
10.	______________ is the best method to save irrigation water in sugarcane. a) Furrow irrigation b) Drip irrigation c) Flood irrigation	Drip irrigation
11.	In ___________ irrigation, water is always applied more than the biological demand of the crop which may affect the crop growth. a) Flood b) Trench c) Micro	Flood
12.	During maturity stage irrigation should be done at the interval of ____ days a)10 b) 20 c)15	15
13.	_______________ means irrigating the furrows of odd numbers initially followed by irrigating the furrows of even numbers after 7 to 15 days a) Alternate furrow irrigation b) Trash mulching c) Flood irrigation	Alternate furrow irrigation
14.	"Per drop more crop" is the key goal of _______ a) Flood irrigation b) Micro irrigation c) Furrow irrigation	Micro irrigation
15.	_____________reduces the water logging in the field? a) Mulching b) Earthing up c) Fertigation	Earthing up
16.	In SSI, by maintaining wide spacing (5 x 2 feet) in the main field reduces the seed requirement by 75% per acre. Yes/ No	Yes
17.	Do you know any shortage in irrigation would lead to reduced sett yield? Yes/ No	Yes
18.	Micro irrigation methods helps to reduce the water loss from the source to root zone. Yes/ No	Yes

dent will be given as sum of score of correctly answered questions. The range of possible knowledge scores was 0 to 18. Based on the mean and standard deviation, the responses will later be divided into three categories (low, medium, and high).

Conclusion

Knowledge test to measure the knowledge of water management practices will play a significant role in adopting water management practices. In agriculture location specific information is essential. Since there was no location specific test to measure the knowledge of water management practices in sugarcane this study was constructed. Since validity and reliability were carried out this test is highly stable.

References

Guilford, J. P. 1954. *Psychometric Methods.* Mc Graw Hill, New York.

Kumar, G. A., Sailaja, V., Satyagopal, P. V. and Prasad, S. V. 2015. Construction and standardization of knowledge test to measure the knowledge level of farmers on SRI technology. *Indian Research Journal of Extension Education.* 15(4): 161-166.

Mehta, P. 1958. *A study of communication of Agricultural information and the extent of distortion occurring from District to village level workers in selected I.A.D.P. Districts.* Ph. D. Thesis. The University of Udaipur, Rajasthan.

Siebert, S., Burke, J., Faures, J.M., Frenken, K., Hoogeveen, J., Döll, P. and Portmann, F.T. 2010. Groundwater use for irrigation–a global inventory. *Hydrol. Earth Syst. Sci.* 14: 1863–1880

Rosa, L., Chiarelli, D. D., Rulli, M. C., Dell'Angelo, J. and D'Odorico, P. 2020. Global agricultural economic water scarcity. *Science Advances.* 6(18): eaaz6031.