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Developing a Knowledge Test to Measure Jute Growers' Knowledge on Climate Adaptive Practices for Planning Their Capacity Building to Combat Natural Disaster

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ABSTRACT

The present study attempts to develop a knowledge test to measure the knowledge of the jute growers about adaptive practices to cope with the disastrous effect of climate variability. Standard procedure was used to construct this knowledge test following calculation of difficulty index, discrimination index and point bi-serial correlation co-efficient (rpbis) for each knowledge item. A total of 18 items with difficulty index value from 58 to 70, discrimination index value from 0.25 to 0.45 and rpbis value above 0.15 was selected for final test battery. Reliability of the knowledge test was measured by split-half method and validity of this testis determined by content validity. This knowledge test would act as a tool for the extension workers to identify the strong and weak areas of knowledge of the jute growers about adaptive measures for climate variability for formulating a good strategy to utilize the strong areas of knowledge for popularization of climate-smart technology and also, for planning capacity building to improve weak areas of knowledge of the farmers. Farmers are the key players of agricultural eco-system management, so their knowledge needs to be upgraded for strengthening the system productivity.

Key words : Knowledge test, Jute farmers, Jute-based agro-ecosystem, Climate adaptive agricultural practices, Capacity building

Introduction

Agricultural ecosystemis a dynamic and complex system comprising of biotic (various organisms) and abiotic (climate and soil) factorswith their direct or indirect interactions influencing the crop growth of a particular area. The unwanted human activities and interferences sometimes affect the balance of agricultural ecosystem and directly or indirectly lead to the environmental pollution and climate change which bring forth several natural disasters ultimately affecting the crops and farming community. It is very important to build farmers' capacity to response to the emergency situations arriving due to the weather vagaries and natural disasters like drought, heavy rainfall, flood, storm, cyclone etc.

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Jute is regarded as "The Golden Fibre of India". It is a traditional crop of the country being cultivated since long especially in the eastern region covering states like West Bengal, Bihar, Assam, Odisha and Meghalaya. Among the jute growing states of India, West Bengal has the largest area under jute cultivation and contributes lion's share of jute production in India. Jute cultivation has significant socio-economic and socio-cultural significance for the majority of the farmers of this state where jute is a major crop in line with rice and potato. The livelihood of the farmers in jute growing districts of West Bengallargely depends on jute cultivation.

Nowadays, the increasing incidences of weather vagaries and natural disasters are sometimes producing an undesirable condition for jute agro-ecosystem. The poor growth of the plants, early flowering, weed infestation, insect pest attack and retting problems results in declining fibre production both in terms of quantity and quality. Farmers face a huge loss for this reason. Besides jute, the preceding and succeeding crops of the jute-based agro-ecosystem are also liable to be affected for these weather vagaries and natural disasters. There are some climate adaptive practices beneficial to the farmers struggling with adverse effect of climate change and farm-level adoption of these practices could pave the way towards climate smart farming. A sound knowledge of jute growers about climate adaptive practices would build them to combat against weather vagaries and natural disasters. Hence, there is a need to develop a scientific tool which can measure the jute growers' knowledge on climate adaptive practices. Developing a knowledge test following standard procedure is a sincere attempt towards this direction. This knowledge test would identify the strong and weak areas of farmers' cognitive domain for planning their capacity building to combat natural disaster.

Materials and method

In this study, knowledge was operationalized as the farmers' familiarity or cognitive acquaintance or awareness about a particular subject or theme (Das *et al.*, 2020). Here the theme is focused on "climate adaptive practices" and magnitude of knowledge of the jute growers will be conclusive from their responses to a set of questions prepared scientifically to test their knowledge. The definition of knowledge given by Bloom *et al.*(1956) which defined knowledge as those behaviour and test situations that emphasized the remembering either by recognition or recall of ideas, materials or phenomenon has been highlighted in our study. A standardized and validated process of knowledge test development was followed which comprised of the following steps.

a) Collection and preliminary selection of items :

The content of the knowledge test is composed of items. A test usually contains problems or tasks graded in difficulty from very easy to very hard by known steps or intervals (Garrett, 1966). These problems or tasks are referred to as items. These are the question statements of the test battery. A comprehensive list of test items regarding adaptive measures for climate variability in jute-based cropping system were collected from relevant literatures available in books, journals and internet. Initially

50 test items were framed covering most of the areas related to climate adaptive practices. The applicability and suitability of these knowledge items in the study area was further validated by the experts and local progressive farmers through pilot study. After the screening, finally 38 test items were selected for item analysis. Following Sarkar *et al.* (2014), necessary care was taken to ensure that theitems were based on the knowledge, which farmers possess. Emphasis was given on measuring procedural knowledge than declarative knowledge due to its strong association with environmental behaviour and positive correlation with risk perception (Renouf and Nisbet, 2008; Bord *et al.*, 2000).

The selection of items was done on the basis of following criteria :

(i) It should promote thinking.

(ii) It should have a certain difficulty.

(iii) It should differentiate the well informed from the less informed.

For administering the items to the respondents for item analysis, these were not converted to close ended questions in order to increase the degree of openness of the response.

b) Item analysis and pre-testing :

The preliminary knowledge test battery was administered to 60 respondents. The scores assigned were 1 for right answer and 0 for wrong answer. Total score of each respondent was ascertained by summing up the score obtained by him/her in each item. After that, respondents were divided into six equal groups of 10 members and were arranged in descending order as per the total score obtained by them. These groups were named as G_1, G_2, G_3, G_4, G_5 and G_6, respectively. For the purpose of item analysis, the middle two groups G_3 and G_4 were eliminated keeping four extreme groups with high and low scores. The data containing to the correct response for all the items in respect of these four groups were tabulated for calculating (1) Difficulty Index, (2) Discrimination Index and (3) Point bi-serial correlation coefficient.

c) Calculation of Difficulty Index :

There are several ways to determine the difficulty of an item as given by Garrett (1966): (i) by the judgment of the competent people who rank the items in order of difficulty, (ii) speed with which the items can be correctly solved and (iii) by the number of examinees in the group who solve the item correctly. In the present study, the method of difficulty index was used to determine the difficulty of an item. The index was calculated by using the following formula :

$$DI = (nc \div N) \times 100$$

Where, DI = Difficulty Index

nc = Number of respondents who answered the question correctly

N = Total number of respondents

d) Calculation of Discrimination Index :

It expresses the extent to which an item discriminates among the subjects who differ sharply in their knowledge measured by the test as a whole. Bean (1953) defined discrimination index as the degree to which the single item separates the superior from the inferior individuals in the trait or group of traits being measured. An item has greater power to discriminate more knowledgeable from less one if it can be

answered correctly only by some instead of whole. On the other hand, a statement which is either answered correctly by everyone or none in the sample has no power of discrimination. Individuals can be discriminated only when they obtain different scores instead of identical scores.

As per Ray and Mondal (2004), the discrimination index can be obtained by calculating the phi-coefficient as formulated by Perry and Michael (1951). However, Mehta (1958) used $E^{1/3}$ method to calculate discrimination index and opined that this method was equivalent to phi-coefficient method and it could be used as a suitable substitute of the earlier method. Hence, The $E^{1/3}$ method was used in the present study to calculate discrimination index and the formula for calculation is given below.

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

Where, S_1, S_2, S_5 and S_6 were the frequencies of correct answers given to a particular item in G_1, G_2, G_5 and G_6 group, respectively

N= Total number of respondents

e) Calculation of Point bi-serial correlation coefficient :

The main objective of calculating point bi-serial correlation coefficient (r_{pbis}) was to determine the internal consistency of the items (Archana *et al.,* 2017) and to know the construct validity of the test (Sarkar *et al.*, 2014). A r_{pbis} value of atleast 0.15 is recommended though it is good to have point bi-serial correlation value of above 0.25. A large r_{pbis} value indicates that a farmer with high overall score is getting the item right and low r_{pbis} indicates that a farmer with low overall scoreis also getting the item right. The following formula is used to calculate r_{pbis} value of the knowledge items.

$$r_{pbis=} \{(M_p-M_q)/SD\}x \text{ “}pq$$

Where, r_{pbis} = Point bi-serial correlation coefficient

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

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

SD=Standard deviation of entire sample

p = Proportion of respondents who answered the item correctly

q = Proportion of respondents who answered the item incorrectly

f) Final selection of the items:

An item having a difficulty index value between 58 and 70, a discrimination index value ranging from 0.25 to 0.45 and r_{pbis} value above 0.15 was selected for final test battery. Thus, finally a sum of 18 items from a total of 38 items was retained for final knowledge test on adaptive measures for climate variability.

g) Testing reliability of the knowledge test:

Reliability refers to the consistency of scores obtained by the same individuals when re-examined with test on different occasions, or different sets of equivalent items, or under variable examining conditions (Anastasi, 1968). It is the accuracy or precision of a measuring instrument (Kerlinger, 2004). In this study, reliability of the test was assessed by using ‘split half’ technique. The final knowledge test consisting of total 18 items was divided

in two sets containing odd and even numbered items. These two test sets were administered to 30 farmers one by one at the same time. The total scores obtained by each of the respondents in odd and even numbered item set were calculated separately. Then the Pearson Product Moment correlation coefficient between the two sets of scores was calculated. The 'r' value calculated was 0.794 and was found significant at 1 percent level of significance. It indicated that the test had high level of internal consistency.

h) Testing validity of the knowledge test :

The validity of the test was established on account of content validity which means the representativeness of the content of a measuring instrument to the whole subject intended to measure. According to Anastasi (1968), content validity involves essentially the systematic examination of the test content to determine whether it covers a representative sample of the behaviour domain to be measured. All possible statements covering all aspects of adaptive measures for climate variability in jute-based cropping system were collected and the same were subjected to measure difficulty index, discrimination index and point bi-serial correlation coefficient to select the final items. Hence, it was logical to consider that the test satisfied representation as well as sensible method of test construction which is the criterion for content validity.

Results and discussion :

The item analysis values *viz.* values of difficulty index, discrimination index and point bi-serial correlation co-efficient of each item of the knowledge test set are given in Table 1.

Table 1. Item analysis values of the knowledge test items

Item no	Item statement	DIFI	DISI	r_{pbis}
1	Name a short duration paddy variety.	61.67	0.1	0.17
*2	What types of material are used for soil mulching?	68.33	0.3	0.39
3	Name a deep rooted crop.	61.67	0.1	0.08
*4	What is drip irrigation?	66.67	0.25	0.25
*5	Give an example of intercropping.	58.33	0.3	0.37
6	Give an example of mixed cropping.	65.00	0.1	0.14
7	What is the difference between intercropping and mixed cropping?	65.00	0	-0.01
*8	What is diversified farming?	61.67	0.3	0.27
*9	What is zero/minimum tillage?	70.00	0.25	0.23
*10	What is the size of a proper drainage channel in jute field?	58.33	0.35	0.35
11	What is resistant/tolerant variety?	61.67	0	0.00

Item no	**Item statement**	**DIFI**	**DISI**	**r_{pbis}**
*12	Name a drought tolerant paddy variety.	61.67	0.25	0.26
13	Name any disease resistant paddy variety.	55.00	0.05	-0.06
*14	Name a flood tolerant paddy variety.	61.67	0.45	0.32
15	What type of tree/shrubs can be grown as windbreak?	60.00	-0.1	-0.01
*16	What is the recommended sowing time of jute?	56.67	0.3	0.22
*17	What is m-Kisan?	60.00	0.4	0.34
18	Name a HYV of jute?	63.33	0.2	0.21
19	Name a HYV of lentil?	68.33	-0.05	-0.10
20	Name a HYV of mustard?	65.00	0.1	0.21
21	Name a HYB of buffalo?	66.67	-0.1	0.10
*22	What is the irrigation schedule for jute during no rainfall situation?	60.00	0.45	0.40
23	What is crop rotation?	70.00	0.15	0.19
*24	Give an example of crop rotation?	66.67	0.35	0.20
25	What is IPM?	70.00	0.2	0.21
26	What do you mean by INM?	73.33	-0.1	-0.10
27	What is the recommended fertilizer dose for jute in rainfed condition?	58.33	0.2	0.23
*28	What do you mean by low cost poly-house?	61.67	0.3	0.32
29	How do you prevent poly-house from pest infestation?	71.67	0.15	0.19
*30	Name a less water consuming crop.	68.33	0.45	0.41
*31	What is the process of crop insurance?	70.00	0.55	0.49
32	How do you enrol for PMFBY?	61.67	0.05	0.04
33	Name a crop used for green manuring.	63.33	-0.1	-0.13
34	What is the use of Soil Health Card?	68.33	0.1	0.03
*35	What is the recommended dose of sulphur for jute crop in draught situation?	60.00	0.3	0.19
*36	Name a profitable cropping system involving jute.	66.67	0.4	0.27
37	What is the longevity duration of CRIJAF Sona powder?	55.00	0.05	-0.06
*38	What type of polythene is used in poly tank?	70.00	0.25	0.34

DIFI= Difficulty index, DISI=Discrimination index, r_{pbis}= Point bi-serial correlation co-efficient

* Items selected for the final knowledge test

Application of the Knowledge Test

This knowledge test was administered to 218 jute growers. A perusal of Table 2 depicts the knowledge of the respondents about different items of adaptive measures of climate variability. It was found that the respondent farmers possessed high knowledge on the items like mulching, intercropping, diversified farming, recommended sowing time of jute to resist premature flowering, irrigation schedule for jute, crop rotation, less water consuming crop and profitable cropping system involving jute (more than 75 % of the respondents answered these items correctly).

Table 2. Knowledge of the respondents about adaptive measures of climate variability (N=218)

Item no	Item statement	Respondents giving right answer (%)
1	What types of material are used for mulching?	76.15
2	What is drip irrigation?	55.96
3	Give an example of intercropping.	85.32
4	What is diversified farming?	79.82
5	What is zero/minimum tillage?	59.63
6	What is the size of a proper drainage channel in jute field?	72.48
7	Name a drought tolerant paddy variety.	54.13
8	Name a flood tolerant paddy variety.	59.63
9	What is the recommended sowing time of jute?	80.28
10	What is m-Kisan?	65.14
11	What is the irrigation schedule for jute during no rainfall situation?	82.57
12	Give an example of crop rotation?	89.91
13	What do you mean by low cost poly-house?	67.89
14	Name a less water consuming crop.	77.98
15	What is the process of crop insurance?	66.06
16	What is the recommended dose of sulphur for jute crop in drought situation?	74.31
17	Name a profitable cropping system involving jute.	77.98
18	What type of polythene is used in poly tank?	66.97

It was also found that farmers had moderate knowledge on the items related to proper drainage channel in jute field, m-Kisan, low cost polyhouse, crop insurance, recommended dose of sulphur for jute crop in drought situation and poly tank (more than 60 % of the respondents answered about these items correctly). It was identified that farmers were having limited knowledge on the items like drip irrigation, zero/minimum tillage and drought and flood tolerant varieties (less than 60 % of the respondents answered about these items correctly).

The farmers were further categorized based on their total knowledge score by calculating the mean score and standard deviation. The farmers whose total scores were greater than (Mean+SD), they were grouped in high knowledge level (5.5 %), farmers having scores less than (Mean-SD) were categorized into low knowledge level (12.39 %) and farmers possessing scores in between (Mean+SD) to (Mean-SD) were grouped into medium knowledge level (82.11 %) (Table 3).

Table 3. Knowledge level of the farmers(N=218)

Sl. No.	Knowledge level	%
1	Low	12.39
2	Medium	82.11
3	High	5.50

Factors influencing knowledge of the farmers about adaptive measures for climate variability

Pearson product-moment correlation analysis was done to identify the factors influencing knowledge of the farmers about adaptive measures for climate variability. Values of the correlation coefficient (r) said that independent variables like age, education, farming experience, training exposure, Change-proneness, level of aspiration, economic motivation, risk bearing ability and awareness were positively related to the knowledge of the respondents at 1% level of significance and variable 'landholding' was found to be negatively related to the knowledge of the respondents at 1% level of significance (Table 4).

Table 4. Correlation between independent variables and knowledge of the farmers (N=218)

Sl. No.	Independent variable	Correlation coefficient (r)
1	Age	0.721**
2	Education	0.196**
3	Landholding	-0.164*
4	Farming Experience	0.833**
5	Training exposure	0.213**
6	Change-proneness	0.196**
7	Level of aspiration	0.198**
8	Economic motivation	0.204**
9	Risk bearing ability	0.193**
10	Awareness	0.897**

Conclusion

Knowledge is the cognitive component of human behaviour which directly influences other components of human behaviour like attitude, skill and

understanding. Researches also proved that knowledge of the human being is a major determinant of adoption behaviour. So comprehending the knowledge of the individuals is very much imperative in social science research. A reliable and valid knowledge test is required for this purpose. In the present study a knowledge test on adaptive measures for climate variability was developed and validated. This knowledge test touched every aspect of adaptive practices for climate variability in jute-based cropping system. It was also found to be highly stable and reliable which was indicated by the highly significant value of reliability test. The extension functionaries can use it to test the knowledge level of jute growers onadaptive measures for climate variability in jute-based cropping system which is a very popular cropping system in eastern India and needs to be made sustainable considering the changing climate. This knowledge test can help the extension workers to identify the strong and weak areas of knowledge of jute growers about adaptive measures for climate variability. This would pave the way to formulate sound strategy to utilize the strong areas of knowledge and build the weak areas of knowledge of the farmers for climate smart jute farming.

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References

Anastasi, A. 1968. Psychological Testing. MacMillan Company, London.

Archana, P., Jagan Mohan Reddy, M., Rao, I. Sreenivasa. and Vidya Saga G. E. Ch. 2017. Construction of Knowledge Test to Measure the Knowledge of Watershed Farmers towards Natural Resource Management Practices. *International Journal of Current Microbiology and Applied Sciences* **6** (9):81-89.

Bean, K.L. 1953. Construction of Educational and Personnel Tests. McGraw- Hill Book Co., New York.

Bloom, B.S., Bhoelhardt, M., Furot, S., Hill, W. and Krathwhol, D.R. 1956. Taxonomy of Education Objective: The Cognitive Domain. Longman's Green and Company, New York.

Bord, Richard, J., Robert, E. O'Connor, Fisher, A. 2000. In what sense does the public need to understand global climate change. Public understanding of Science, **19**(3):461-471.

Das, U., Ansari, M.A., Kameswari, V.L.V. and Bhardwaj, N. 2020. Developing Knowledge Tool using Computer Aided Personal Interview Technique for Assessing the Climate Knowledge of Farmers of Odisha. J. Community Mobilization and Sustainable Development, **15**(3): 661-667.

Garrett, H.E. 1966. Statistics in Psychology and Education. International Book Bureau, Hyderabad.

Kerlinger, F. N. 2004. Foundations of Behavioral research. 2nd Ed. Surjeet Publications, Delhi.

Mehta, P. 1958. A Study of Communication of Agricultural Information and the Extent of Distortion Occurring from District to Village Level Workers in Selected IADP Districts. Ph. D. Thesis, The University of Udaipur, Rajasthan.

Perry, N.C. and Michael, W.B. 1951. The Estimation of a Phi-coefficient. Educational Psychology Measurement, **11**.

Ray, G.L. and Mondal, S. 2004. *Research Methods in Social Sciences and Extension Education*. Kalyani Publishers, Noida (U.P.).

Renouf, C, R. and Nisbet, M.C. 2008. The measurement of key behavioural science construct in climate change research. *International Journal of Sustainability Communication* **3**: 37-95.

Sarkar, S., Padaria, R. N., Vijayaragavan, K., Pathak, H., Bhowmik, A., Kumar, P. and Jha, G. K. 2014. Constructing a Knowledge Test to Measure the Knowledge Level of Farmers about Climate Change in Arid Ecosystem of India. *International Journal of Bio-resource and Stress Management* **5**(4):530-535.