Development and Validation of Knowledge Test on Organic Farming Techniques

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Authors' contributions

The work, statistical analysis and paper drafting was conducted by author PP. Author RNP redrafted the manuscript and revised the paper. Authors RRB, RS, SB and PK managed the literature and corrected the paper. All authors read and approved the final manuscript.

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ABSTRACT

The present study has attempted to develop a knowledge test on organic farming techniques mainly on organic manures and pesticides. Heavy reliance on synthetic chemical fertilizers and pesticides as well as growing awareness of health and environment have been attracting farmers toward organic farming. There is a need of more adoption of efficient organic techniques by farmers to get better and quality yields. The first stage of innovation adoption process is the knowledge stage. To analyze the knowledge gap about the organic farming techniques, a knowledge test was developed. The study was conducted in Gaya district of Bihar with randomly selected 45 farmers using organic techniques and 25 farmers as control. Initially 25 items were selected based on its content validity. Finally, 10 items were retained with reliability of 0.796, dicrimination index of >0.2, and significant t-test between the treated and control groups.

Keywords: Knowledge test; organic farming; reliability; validity.

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1. INTRODUCTION

Heavy agricultural reliance on synthetic-chemical fertilizers and pesticides is having serious impacts on public health and the environment [1]. Growing awareness of health and environment issues associated with the use of chemical fertilizers has led to increase in the interest of people in alternative form of agriculture in the world. The demand for organic food is increasing steadily in both developed and developing countries with average annual growth rate of 20-25% [2]. Certified organic agriculture can reduce reliance on agrichemical inputs as well as make agriculture environmentally and economically sound [3]. Organic farming is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil-biological activity (Alimentations (FAO/WHO). Organic farming includes a wide range of cultural and natural practices that are safe to consumers as well as environment. Organic farming encourages the adoption of practices such as crop, rotation, composting, use of livestock manure, cover crops, mulches and green manures [4]. Indian farming dominated by small and marginal farmers, organic farming is compatible with rural communities and marginal farmers who generally lack capital for synthetic pesticides and inorganic fertilizers. Along with this, the eastern part of India follows organic farming and rural areas of north-eastern India use livestock manure, cover crops and composts in their fields. These areas can be developed into certified organic farms by interventions of organic manure having high efficiency. Organic fertilizers improve the soil by lowering bulk density, reducing soil erosion and improving soil fertility. Organic matter encourages the formation of stable soil crumb structure, thus improving soil internal drainage, infiltration and aeration. The dark colors that form with increasing organic matter content improve soil temperature relations, which improves essential microbial activity and root development. Organic fertilizers support a 'living soil', buffer the soil pH [4]. Since organic fertilizers can be produced on-farm, farmers can cut their fertilization costs; and contamination of soil and water environments with chemicals can be minimized. Rogers [5] in his Innovation decision process concept stated knowledge as first step for adoption of any innovation. McQueen [6] has defined knowledge as experiences, understanding and the comprehension of an environment or the context of a problem which governs our behavior in such a way to get a required response. Also, knowledge is an invisible and intangible asset which cannot be observed directly. It needs a robust testing tool developed using psychometric principles. Observing the emerging importance of organic farming, knowledge as basic step of innovation decision process and invisible characteristic of knowledge, the present study has attempted to develop a knowledge test on organic farming techniques mainly on organic manures and pesticides.

2. MATERIALS AND METHODS

Sullivan [7] has described systemic steps for test construction which involved generation pf pilot test items, expert review of pilot items and calculation of pilot item properties. Test development is highly complex process which includes item collection, item selection based on expert judgment, item analysis (Difficulty analysis, discrimination analysis), testing reliability of the test, the validity of the test and final administration. For the present study, suitable items were generated from review of literature, documented organic manures for the study area by PRAN NGO, this NGO (PRAN) gives training to the farmers of Bihar on the formulation of organic manure and pesticides which have tested high efficiency especially in case of System of Root Intensification (SRI) system. The manure and pesticide used in that area are *Sri-Ghanjeevamitra, Sri-Pran mitra, Sri-Beejamitra, Sri-Upalamitra, Sri-Mungamitra, Sri-Bakramitra, Sri-Gajramitra, Sri-Gaumata Ras, Sri-Bramhashtra, Sothashtra Ras, Sri-kitnasak, Saravkitnashi, Sri-dashparni Aark, Sri-Pyazashtra, Sri-Lahashtra, Sri-Velashtra, Sri-Mahuashtra and Sri-Tulashtra*. The selected test items were reviewed by the experts from PRAN NGO and scientists from IARI. The items were refined based on judgement given by the experts. A total of 25 items were selected for knowledge test development. The items were administered to the 45 randomly selected farmers from Gaya district of Bihar who were trained by PRAN NGO on formulation of these manures and pesticide as well using these manures and pesticides in their field. To analyse the discrimination validity of the test, 25 farmers were randomly selected as control who were not trained and also not using organic manures. A score of 1 and 0 was assigned to the correct and incorrect answer, respectively. Item properties *i.e.* item difficulty and item discrimination indices as well as reliability and validity of the knowledge test were worked out.

3. RESULTS AND DISCUSSION

3.1 Item Difficulty Index

It is also called p-Value. It indicates the proportion of the respondents who have answered the question affirmatively or correctly where correct answer=1 and negative answer=0. If p-Value is high, item is considered as very easy, if p-Value is very high then item is considered as difficult.

pi = (number of people getting an item correct) / (number of people taking the test)

Item difficult analysis revealed that difficulty index (p-Value) ranged between 0.18 and 0.82. It is suggested that a good mix of item battery is desirable with 0.3 to 0.95, items with p-Value greater than 0.95 could be much easy, while item with p-Value less than 0.3 may be too difficult [8]. P-Value lies between 0-1 with middle difficulty items having p-value equals to 0.5, very

difficult items with p-Value<0.2 and very easy item with p-Value>0.9. Since item number 17 (0.18) has p-Value <0.2, so, this item was removed considering it too difficult as rule. Retained 24 items were subjected to further analysis.

3.2 Item Discrimination

It is correlation between an item and the item battery without this item. It is the ability of each individual item to discriminate between people with different levels of knowledge. Correlating each item score with total test score gives item discrimination value. The item discrimination value ranges between -1 to +1. Higher the value better is the item discrimination power of that item. Positive values near 1 are desirable however negative value can be due to the rotation of the item or polarity. With correct rotation, if any item is showing negative value, it must be revised.

Table 1. Difficulty index

S. no.	Items	Difficulty index
1.	Do you know how much quantity of Jaggery is used in *Sri-Jeevamitra*	0.75
2.	Do you know how much quantity of *Besan* (Gram Flour) is used in Sri-Jeevamitra	0.82
3.	Do you know, In how many days *Sri-Jeevamitra* get ready for use?	0.70
4.	Do you know, gap between application of *Sri-Jeevanmitra* in 60-90 days crops?	0.80
5.	For how many days *Sri-Ghanjeevamitra* can be stored?	0.77
6.	Do you know the rate of *Sri-Ghanjeevamitra* in paddy sown by Shree vidhi?	0.80
7.	Do know you the suitable condition for the use of *Sri-Pran mitra*?	0.82
8.	Do you know the rate of poultry waste used in *Sri-Pran mitra*?	0.64
9.	Is Calcium sulphate (Chuna) used in *Sri-Beejamitra*?	0.73
10.	Do you know about ingredients used in *Sri-Upalamitra*?	0.70
11.	In how many days *Sri-Mungamitra* gets ready for use?	0.64
12.	Which cake is used in preparation of *Sri-Bakramitra*?	0.73
13.	What are the ingredients of *Sri-Gajramitra*?	0.64
14.	For pest control, how much neem leaves are used in 10 liter water?	0.61
15.	Do you know against which pest *Sri-Gaumata Ras* is used?	0.57
16.	What is the rate of fruit and vegetable waste in *Sri-Bramhashtra*?	0.57
17.	Do you know against which pest *Sothashtra Ras* is used?	0.18
18.	What are the different ingredients used in preparation of *Sri-kitnasak*?	0.64
19.	Is Parthenium grass used in *Saravkitnashi*?	0.59
20.	In how many days *Sri-dashparni Aark* gets ready for use?	0.70
21.	Which part of onion is used in preparation of *Sri-Pyazashtra*?	0.61
22.	In preparation of *Sri-Lahashtra*, how much iron is used in 2litre of Cow-urine?	0.66
23.	Do you know against which pest *Sri-Velashtra* is used?	0.68
24.	Do you know against which pest *Sri-Mahuashtra* is used in Potato?	0.64
25.	How much quantity of *Tulsi* leaves used in 10 liter of Cow-urine for the preparation *of Sri-Tulashtra*?	0.61

Table 2. Item-total statistics

S. no.	Items	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
1.	Do you know how much quantity of Jaggery is used in Sri-Jeevamitra	15.9556	15.634	.179	.705
2.	Do you know how much quantity of *Besan* (Gram Flour) is used in *Sri-Jeevamitra* ?	15.8889	15.601	.225	.701
3.	Do you know, In how many days *Sri-Jeevamitra* get ready for use?	16.0000	15.364	.240	.700
4.	Do you know, gap between application of *Sri-Jeevanmitra* in 60-90 days crops?	15.9111	15.992	.087	.711
5.	For how many days Sri-*Ghanjeevamitra* can be stored?	15.9333	15.564	.210	.702
6.	Do you know the rate of Sri-*Ghanjeevamitra* in paddy sown by Shree vidhi?	15.9111	15.628	.202	.703
7.	Do know you the suitable condition for the use of *Sri-Pran mitra* ?	15.8889	15.919	.119	.708
8.	Do you know the rate of poultry waste used in *Sri-Pran mitra* ?	16.0667	13.836	.657	.664
9.	Is Calcium sulphate (Chuna) used in *Sri-Beejamitra*?	15.9778	15.840	.112	.710
10.	Do you know about ingredients used in *Sri-Upalamitra*?	16.0000	15.636	.163	.706
11.	In how many days Sri-*Mungamitra* gets ready for use?	16.0667	15.018	.316	.694
12.	Which cake is used in preparation of *Sri-Bakramitra*?	15.9778	15.659	.164	.706
13.	What are the ingredients of Sri-*Gajramitra*?	16.0667	13.836	.657	.664
14.	For pest control, how much neem leaves are used in 10 liter water?	16.0889	14.401	.483	.680
15.	Do you know against which pest *Sri-Gaumata Ras* is used?	16.1333	14.845	.349	.691
16.	What is the rate of fruit and vegetable waste in *Sri-Bramhashtra*?	16.1556	16.134	.013	.719
17.	What are the different ingredients used in preparation of *Sri-kitnasak*?	16.0667	13.836	.657	.664
18.	Is Parthenium grass used in *Saravkitnashi*?	16.1111	15.601	.151	.708
19.	In how many days *Sri-dashparni Aark* gets ready for use?	16.0000	16.545	-.085	.725
20.	Which part of onion is used in preparation of *Sri-Pyazashtra*?	16.0889	15.492	.183	.705
21.	In preparation of *Sri-Lahashtra*, how much iron is used in 2litre of Cow-urine?	16.0444	15.225	.265	.698
22.	Do you know against which pest *Sri-Velashtra* is used?	16.0222	15.886	.089	.712
23.	Do you know against which pest *Sri-Mahuashtra* is used in Potato?	16.0667	13.836	.657	.664
24.	Do you know, How much quantity of *Tulsi* leaves used in 10 liter of Cow-urine for the preparation of *Sri-Tulashtra*?	16.1111	15.783	.104	.712

Table 3. Item-total statistics revised

S. no.	Items	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
1.	Do you know how much quantity of *Besan* (Gram Flour) is used in *Sri-Jeevamitra* ?	7.4889	8.892	.225	.806
2.	Do you know, In how many days *Sri-Jeevamitra* get ready for use?	7.4222	9.159	.240	.810
3.	For how many days Sri-*Ghanjeevamitra* can be stored?	7.4000	9.382	.225	.816
4.	Do you know the rate of Sri-*Ghanjeevamitra* in paddy sown by Shree vidhi?	7.5556	7.162	.840	.738
5.	Do you know the rate of poultry waste used in *Sri-Pran mitra* ?	7.5556	8.343	.356	.790
6.	In how many days Sri-*Mungamitra* gets ready for use?	7.5556	7.162	.840	.738
7.	What are the ingredients of Sri-*Gajramitra*?	7.5778	7.931	.507	.774
8.	For pest control, how much neem leaves are used in 10 liter water?	7.6222	8.377	.327	.793
9.	Do you know against which pest *Sri-Gaumata Ras* is used?	7.5556	7.162	.840	.738
10.	In preparation of *Sri-Lahashtra*, how much iron is used in 2litre of Cow-urine?	7.5333	8.664	.243	.800
11.	Do you know against which pest *Sri-Mahuashtra* is used in Potato?	7.5556	7.162	.840	.738
	Overall Cronbach's Alpha				0.796

Table 4. Independent t-test between farmers using the organic farming techniques and control group

S. no.	Items	Mean difference (n=70)	T-value	P-value
1.	Do you know how much quantity of Besan (Gram Flour) is used in Sri-Jeevamitra	0.82	10.60	<0.01
2.	Do you know, In how many days Sri-Jeevamitra get ready for use?	0.31	2.63	<0.05
3.	For how many days Sri-Ghanjeevamitra can be stored?	0.34	2.99	<0.05
4.	Do you know the rate of Sri-Ghanjeevamitra in paddy sown by Shree vidhi?	0.80	9.86	<0.01
5.	Do you know the rate of poultry waste used in Sri-Pran mitra ?	0.64	6.64	<0.01
6.	In how many days Sri-Mungamitra gets ready for use?	0.60	5.95	<0.01
7.	What are the ingredients of Sri-Gajramitra?	0.52	4.82	<0.01
8.	For pest control, how much neem leaves are used in 10 liter water?	0.02	0.15	0.88
9.	Do you know against which pest Sri-Gaumata Ras is used?	0.58	5.77	<0.01
10.	In preparation of Sri-Lahashtra, how much iron is used in 2litre of Cow-urine?	0.59	5.64	<0.01
11.	Do you know against which pest Sri-Mahuashtra is used in Potato?	0.64	6.64	<0.01

Item discrimination is calculated as point-biserial correlation. Point-biserial correlation of above 0.3 is considered "good". However, Falvey [9] has stated that an item with point-biserial correlation value of 0.2-0.3 is workable but discrimination value below 0.2 is unacceptable. In the present study, item to total score correlation ranged between 0.013 to 0.657 (Table 2). It was found that item number 1,4,7,9,10,12,16,17,18,19, 20,22 and 24 had item bi-serial correlation less than 0.2 (Table 2) so, these items were removed from the test and test was revised. 11 items were again subjected for discrimination analysis. Result in the Table 3 showed that all the items were having Point-biserial correlation >0.2.

3.3 Internal Consistency

It refers to reliability of the knowledge test. It was calculated using Cronbach's alpha. Kline [10] has specified 0.7 as threshold level of the Cronbach's alpha for having desirable internal consistency of the test. Result in the Table 3 showed that all items were having Cronbach's Alpha greater than 0.7. so, all 11 items were retained with overall Cronbach's alpha of 0.796.

3.4 Validity

It is degree to which test is measuring what it is intended to measure. The content validity was established by expert opinion and discriminate validity was computed by comparing the test between the similar groups involved in practice of these organic farming techniques and those who are not involved in its practice. Independent t-test result in Table 4 is showing the significant difference (p-value <0.01 and <0.05) between two groups for all the items except item number 8 (p-Value>0.05). It means items are able to discriminate between farmers having knowledge about organic farming technique and those have not except item number 8. So, 10 items were retained on the ground of reliability and validity for the final knowledge test.

4. CONCLUSION

The study revealed that developing a test involves complex steps which need to be highly considered in accordance with recommended literatures. The process of developing test must lay emphasis on reliability and validity of the test with proper discrimination index. According to values of these reliability and validity one should take decision for rejection and modification of the items. The criteria may vary with the purpose of

developer. However, it is must to check the discrimination index, reliability and validity of the test for the adequate result. The resulted knowledge was used to measure the knowledge level of the farmers to analyses the gap in their knowledge level and further training was provided to enhance their knowledge for better application of the organic practices.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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