Standardized Scale for Measuring the Scientific Temperament of Farmers

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ABSTRACT

Temperament has a genetic and biological basis, although environmental factors and maturation modify the ways an individual personality is expressed. The term "goodness of fit" refers to the match or mismatch between temperament and other personal characteristics and the specific features of the environment. This investigation involved to construct a scale for measuring scientific temperament of farmers in pursuance of the objective, the development of a tool to quantify the scientific temperament of farmers became one of the prime concerns of this investigation. An exhaustive survey conducted on temperament revealed that there should be an appropriate tool for measuring the scientific temperament of farmers. Therefore, it was considered logical to develop and standardized a scale on scientific temperament. Operationally, it has been defined in this study as "Farmers mental disposition related to items pertaining to four areas of human behaviour viz-a-viz- scientific attitude, scientific habit, scientific knowledge and scientific method". The result shows that correlation coefficients value r = 0.83, r = 0.78. r = 0.76 and r = 0.81 for scientific attitude, scientific habit, scientific knowledge and scientific method respectively were observed highly significant, stable or dependable for measurement. Out of 30 items related to scientific attitude, 20 items and out of 20 items related to scientific habit, 10 items were found to be significant and 30 and 15 statements in scientific knowledge and scientific methods respectively constitute the scale for scientific temperament.

***Key words**: Farmers; Standardised s cale; Attitude; Habit; Knowledge; Scientific temperament;*

Scientific temperament is an attitude that one wants the people to inculcate so that they use ways and methods of science in every sphere of their life. In fact, the scientific temperament is very useful for people when they deal with the non-scientific issues of the society. Scientific temperament is a world vision or a metaphysical view of the world that allows us to critically analyze the individual and social behaviour. It has been defined in this study as farmers mental disposition related to the items pertaining to four areas of human behaviour i.e. scientific attitude, scientific habit, scientific knowledge and Scientific method.

Scientific attitude is a composite of a number of mental habits or of tendencies to react consistently in certain ways to a novel or problematic situation. These habits or tendencies include accuracy, intellectual honesty, open-mindedness, suspended judgment, criticalness and a habit of looking for true cause and effect relationships. It is a cognitive concept; scientific attitudes are normally associated with the mental processes of an individual. Scientific habit is also a main feature of scientific temperament. A person having scientific habit always keeps on thinking that every work is governed by scientific laws and there is some reason behind every work. Thinking based on scientific habit is free from conservatism, superstition, narrow and rigid outlook. Scientific knowledge is attributed to some facts and principles that are acquired through the long process of inquiry and investigation. The investigation takes a long time because it goes through various aspects to come to a conclusion and the aspects include all the laws, theories, concepts and models. The definition can be expressed in other way also and we can say that it is a kind of knowledge that is acquired by the systematic study and is organized in accordance with some general principles. We can say that it is mathematics that serves the basis for most of the scientific knowledge that we have today.

Scientific method refers to a body of techniques for investigating phenomena, acquiring new knowledge or correcting and integrating previous knowledge. To be termed scientific, a method of inquiry must be based on gathering observable, empirical and measurable evidence subject to specific principles of reasoning. A scientific method consists of the collection of data through observation and experimentation, and the formulation and testing of hypotheses. Although procedures vary from one field of inquiry to another, identifiable features distinguish scientific inquiry from other methods of obtaining knowledge. Scientific researchers propose hypotheses as explanations of phenomena, and design experimental studies to test these hypotheses. These steps must be repeatable, to predict future results.

Today it is possible to find a solution to this situation by using the potential of scientific temperament among the farmers to meet their needs. Hence this study was undertaken to develop and standardize a scale for measuring the scientific temperament of farmers.

METHODOLOGY

The study was conducted in Saran district of Bihar in India during 2009 to 2011. There are 21 Blocks in the Saran district of Bihar. Out of 21 blocks, 5 blocks had been selected randomly from Saran district for the purpose of the study. The selected blocks were Chapra, Garkha, Ekma, Manjhi, and Rivilganj. Two gram panchayats from each block were selected randomly. Hence the total number i.e. ten gram panchayat i.e. Nawaji tola, Ghengta, Mahmda, Pirouna, Hansrajpur, Bhorunpur, Manjhi (East), Manjhi (west), Sengertola and Semaria were selected for the purpose of study. The total number i.e. twenty villages were selected randomly from the selected Gram Panchayat for the purpose of study. A list of farmers (respondents) were prepared from the selected Gram Panchayats and 8 per cent farmers had been selected randomly from the each selected gram panchayats i.e. 200 farmers were selected randomly from the selected villages.

This investigation involved to construct a Scale for measuring scientific temperament of farmers in pursuance of the objective, the development of a tool to quantify the scientific temperament of farmers became one of the prime concerns of the investigation. An exhaustive survey conducted on temperament revealed that there should be an appropriate tool for measuring the scientific temperament of farmers. Therefore, it was considered logical to develop and standardize a scale on scientific temperament.

To find out the discriminating index each of item's 't' value was calculated. The calculation formula of 't' is given below:

$$t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\frac{S_{H^2}}{n_H} + \frac{S_{L^2}}{n_{LH}}}}$$

Where,

$\bar{X}_H =$ The mean score on a given statement for the high group

$\bar{X}_L =$ The mean score on the same statement for the low group

$S_{H^2} =$ The variance of the distribution of responses of the high group to the statement

$S_{L^2} =$ The variance of the distribution of responses of the low group to the statement

$n_H =$ The number of subjects in the high group

$n_L =$ The number of subjects in the low group

If $n_H = n_L = n$, as will be the case if we select the same percentage of the total number of subjects for the high and low groups, then formula can be written.

$$\frac{\bar{X}_H - \bar{X}_L}{\sqrt{\frac{\sum(X_H - \bar{X}_H)^2 + \sum(X_L - \bar{X}_L)^2}{n\,(n-1)}}}$$

Where,

$$\sum(X_H - \bar{X}_H)^2 = \sum S_{H^2} - \frac{\sum X_H)^2}{n}$$

and

$$\sum(X_L - \bar{X}_L)^2 = \sum S_{L^2} - \frac{\sum X_L)^2}{n}$$

Out of 30 items related to scientific attitude, 20 items and out of 20 items related to scientific habit, 10 items were found to be significant.

Equal weightage was given to all the items assuming that all the items included were equal in difficulty to understand. The following formula was used to work out Scientific Knowledge Index (SKI) .

$$SKI = \frac{X_1 + X_2 + X_3 \ldots\ldots\ldots + X_n}{N} \times 100$$

Where, $X_1, X_2, X_3 \ldots\ldots\ldots X_n$ are correct answers for first, second, third …….nth questions and N is the maximum score possible to secure or the number of questions i.e.30.

The following formula was used to work out Scientific Method Index (SMI).

$$SMI = \frac{X_1 + X_2 + X_3 \ldots\ldots\ldots + X_n}{N} \times 100$$

Where, $X_1, X_2, X_3 \ldots\ldots\ldots X_n$ are correct answers for first, second, third …….nth questions and N is the maximum score possible to secure or the number of questions i.e. 15.

RESULTS AND DISCUSSION

There are several techniques available for constructing scale but all of them are not equally useful for the present study. While looking into the need of this study and effectiveness of the available techniques of constructing scale, the *"Thrustone's" equal appearing interval scale (1928)* and *Likert's technique (1932)* of summated rating scale are considered most important. Out of the two, Likert's technique is given priority for the present study as it requires less number of judges to start with. It is also less time consuming as compared to Thrustone's scale. Thus a Likert technique was followed for constructing the scale to measure the scientific temperament of farmers.

The construction and standardization of the scale to measure the scientific temperament of farmers followed the procedure usually adopted for such purposes (*Lindquist 1951, Cronbach 1960*). The steps which followed for the results of scale construction are as follows:

Item Collection: As a first step in developing scale, a number of statements specifying scientific temperament were collected through survey of literature and interviewing the experts in the field of extension, sociology and psychology who had intimate knowledge of the area. Thus, a list of 35 statements in scientific attitude, 25 in scientific habit, 35 in scientific knowledge and 20 in Scientific method were drafted. Throughout the course of preparation of the list, the question of applicability of items suited to the area was always kept in view.

Editing of items : The initial test of the items thus drawn was further pruned in order to retain the more essential items and eliminate those which were comparatively less essential. The criteria used in this preliminary selection were as follows:

(a) Items should be suitable for the area

(b) Items should be good indicator of scientific temperament

(c) Items should be storable

Stress was given on items that could be answered easily; care was taken to see that the test included items that covered aspects of scientific temperament like scientific attitude, scientific habit, scientific knowledge and scientific habit. Along with the criteria for selection as mentioned above, criteria used for eliminating items were (a) items which were vague (b) confusing or non specific were eliminated (c) duplication of items and redundancy was avoided, (d) items which were purely subjective and did not lend themselves to objective assessment, screened out.

The statements so collected were also edited in light of informal criteria suggested by *Thrustone and Chave (1928), Wang (1932), Bird (1940), Edward and Kilpatrich (1948).* These statements were framed in such a way that they expressed the positive or negative feeling in order to get a five points judgment, five alternative response categories ranging from "strongly agree" to "strongly disagree" were assigned to each statement for the Scientific attitude and scientific habit. The statements so collected regarding scientific attitude and scientific habit were discussed with experts. They were requested to add/delete or modify any statement which they deemed fit for inclusion or deletion. They were asked to check the statements for being favourable or unfavourable towards the scientific attitude and scientific habit. Again the statements were rewritten in the light of criticisms and comments of the experts. After editing the total number of the statements was 30 in scientific attitude and 20 in scientific habit. Efforts were made to select equal number of positive and negative statements for scientific attitude and scientific habit respectively, in case of scientific knowledge and scientific method the number of statements were 30 and 15 respectively after editing.

Item selection : "Statement analysis is an important step in constructing a valid and reliable scale" (*Edward, 1957*). The adequacy of a test depends upon the care with which the items of the list have been chosen (*Garrett, 1981*). It is, therefore, necessary to analyse each item in order to retain only those which suit the purpose and rationale of the device being constructed. To find out the suitability of an item, item discriminating index was calculated.

Item Discriminating Index: The most important index is the item discriminating index. This index indicates whether the items measured what is designed to measure. Discriminating value refers to making distinctions between persons having greater or lesser knowledge or skill in the area measured by the evaluator. A test item possesses adequate discriminating power when it is capable of differentiating between superior and inferior farmers.

In this study, the internal criterion was used for finding out the discriminating index of an item. The internal criterion makes use of total score in selecting the upper and lower groups. Therefore, on the basis of total score on the "Scientific temperament inventory" the upper 27 percent and lower 27 per cent cases were selected for item analysis. *Ebel (1929)* has described two important advantages of using internal criterion as a basis for selecting upper and lower groups. The first is 'relevance' and the second is 'convenience'.

The reason for selecting the upper 27 per cent and the lower 27 per cent of the cases for item analysis is that 'it proves the best compromise between desirable but inconsistent aims.

(a) To make the extreme group as large as possible
(b) To make the extreme group as different as possible

Also *Kelley (1939)* stated that item validities divided by upper and lower group technique tend to reach maximum reliability when the proportion of case in each of this subgroup is 27 per cent. The upper and lower group is based on the assumption that the variable being measured by the individual item and by the whole test is distributed along the normal curve.

The statements were first introduced to a group of thirty experts and were asked to respond to each one of the statement in terms of their own agreement or disagreement and the responses were recorded with a tick mark in the proper columns representing the five categories. The scoring system for each positive statement was 5 to 1 from SA to SDA and for each negative statement was 1 to 5 from SDA respectively.

The score of each expert on the scale was calculated by summing the weights of the individual item. 27 per cent of the subject with highest total scores and also 27 per cent of the subjects with lowest total scores were taken assuming that these two groups provided criterion group in terms of which two groups high and

Table 1. Critical ratio value of Scientific Attitude

Statement	CR value
HYV (High Yielding Varieties) has capacity to solve the food problems of the country.	3.57*
Sustainability can be achieved through using the practices of traditional way of farming.	2.44*
Plant diseases are curse of God.	3.76*
Suggestions from scientist play an important role in enhancing the productivity.	0.89
Using of improved implements can save time & labour during farming processes.	4.28*
HYV are not better than local varieties.	1.25
Plan of work provide appropriate price for the agricultural products.	2.43*
Bio fertilizers maintain the fertility of soil.	2.60*
The successful farmers depend on their hard work and latest knowledge in agriculture.	4.10*
Man has been kept in respective strata by God and it is no use trying to change it.	2.43*
Traditional way of farming is the best.	2.93*
A farmer should be adopting the practices of progressive farmers.	3.63*
Uses of excessive chemical fertilizers spoil the soil.	1.23
Women cannot claim equality as they are inferior to men.	0.79
A good farmer tries out new practices on its own field.	1.12
Successful farming depends on farmer's fate and God blessings.	2.45*
Crop production can be enhanced through use of fertilizers.	1.21
More production and economic profit are the aims of scientific farming.	2.79*
Farming is sorriest of all the professions.	3.45*
Birth control is curse to human family.	4.32*
A good farmer doesn't experiment with new ideas in farming.	2.66*
It is cruelty to use bullocks for cultivation.	1.62
To get better output in farming a farmer should enjoy to work with his farm labourers.	1.24
The cultivation of HYV's is not profitable.	3.45*
Progressive farmers should be helpful to other farmers in adopting scientific way of farming.	4.76*
Birth control should be encouraged because it would lead to prosperity of human family and country.	0.48
Disease / Insect could effectively be controlled by using recommended doses of Pesticides / Insecticides.	3.23*
Improved implements are inefficient.	2.54*
Scientific knowledge could never be equal to indigenous knowledge.	3.28*
A farmer shouldn't feel satisfied with his present way of farming	0.94

Table 2. Critical ratio value of Scientific Habit

Statement	CR value
Used to read farm magazines regularly to upgrade the knowledge level.	0.58
Always used the recommendations of scientific views.	1.46
Used to participate in demonstration session.	1.24
Do you used to follow crop rotation, multiple cropping etc.	1.33
Farming can be treated as business rather than a way of life.	4.32*
Don't care the sequences while doing a work.	2.98*
New farm practices implement immediately after knowing about it.	0.56
Used to get soil tested before starting the cultivation of crop.	2.86*
Always trying to get HYV's seed for sowing purpose.	3.56*
Spraying pesticides before occurrence of diseases.	1.22
Take care about cost ad benefit ratio of crop production.	0.77
Prefer traditional believes rather than the scientific investigation.	0.98
Used to store the produce for better prices in future.	4.56*
Used to wash sprayer after spraying.	0.65
Used to think that auspicious moments are more important than hard work, while starting any work.	3.87*
Used to go to temple for God Grace.	4.55*
Try to search the possible tentative solution in mind.	1.20
Used to sown the seed without seed treatment.	2.87*
Used to go for earthing up in intercultural operation.	4.87*
Used to visit the training centre to get the solution of agricultural problems.	3.79*

low evaluate by the individual statement. For evaluating the responses of high and low groups to the individual statement, critical ratio value was worked out by using the formula and procedure given by *Edward (1957).*

Both positive and negative statement for the scientific attitude and scientific habit and their critical ratio value are presented in Table 1 and 2.

For the remaining two components of scientific temperament namely scientific knowledge and scientific method, indexes were prepared on the basis of recommendations given by the Department Of Agriculture. Govt. of U.P. and N.D. University of Agricultural and Technology Kumarganj, Faizabad. The total numbers of statement prepared were 35 and 20 in scientific knowledge and scientific method respectively. These indices were pretested with a sample of 30 farmers other than the sample respondents. During pretesting, farmers were not in a position to answer certain questions in relation to scientific knowledge and scientific method. Finally non response statements were eliminated. After elimination there were 30 and 15 statements in scientific knowledge and scientific method respectively.

Scientific Knowledge Index (SKI) : Knowledge in the present study has been defined as "A body of understood information possessed by a farmer about a particular agricultural technology"

The present study aims at finding out levels of scientific temperament of farmers regarding the recommended package of practices in the cultivation of different crops. This requires measurement of scientific knowledge as component of scientific temperament on all aspects of the recommended technology of cultivation in all 30 questions regarding soil, variety, crop rotation, sowing time, seed rate, seed treatment, spacing, planting method, fertilizer application, irrigation, intercultural operations, weed control and yield were included in the schedule to test the scientific knowledge of farmers.

Scientific Method Index (SMI): Scientific method in the present study has been referred as "a procedure for practicing a particular agricultural technology".

The present study aims at finding out the level of scientific temperament regarding the recommended package of practices in cultivation of different crops. This requires measurement of scientific method as part of scientific temperament on all aspects of recommended technology. In all 15 questions regarding land preparation, sowing time, seed-dormancy, seed treatment, spacing, fertilizer, intercultural operation, irrigation, spraying of pesticide, weed control, harvesting, yield, storage etc. were included in the schedule to test the scientific method of farmers. Equal weightage was given to all the items, assuming that all the items included were equally difficult to understand.

Reliability of Scale : Test reliability indicates the extent to which individual differences in test scores are attributable to chance errors of measurement and the extent to which they are attributable to true differences in the characteristic under consideration. There are various methods to calculate reliability of the test i.e.

test-retest method, split half method, method of rational equivalence, standard error of measurement and probable error of measurement. In the present study test - retest method was used.

The scale was administered twice to the same 30 respondents. Thus two sets of score were obtained for 30 respondents. The means of a correlation coefficient (r) which is called coefficient of stability of dependability. As evident from the highly significant correlation coefficients (r = 0.83, r = 0.78. r = 0.76 and r = 0.81 for scientific attitude, scientific habit, scientific knowledge and scientific method respectively). The scales under study were observed highly stable or dependable for measurement.

Validity of the scale : Validity is the extent to which a test measures that it proposes to measure to examine the validity of the test, content and cross validity was found out. 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. Moreover, content validity depends upon the relevance of the individuals test responses to the behaviour under consideration, rather than upon the apparent relevance of item content. To determine the content validity of the test after preparing the first draft of the test it was given to different experts belonging to different descriptions for their opinion and suggestion regarding the appropriateness and relevance of the test items, type of items suitability, language clarity, ambiguity, difficulty level etc. thus, content validity is most often determined on the basis of expert judgment. The test analyst examines carefully on outline of the content and object of the unit for which the test was designed.

Since the content of the scales was derived from authentic sources like books, journals and expert's opinion, it is assumed that the scores obtained by administering the scales of this study will measure what it intends to measure. Further 't' value being significant for the statements it is assumed that the scale is valid.

Administration of the scale : The finally selected 20 statements for the attitude scale 10 statements for the habit scale were randomly arranged to avoid response biases. Out of 20 selected statements for scientific attitude the 10 statements were taken for indicator of favourable attitude and other 10 statements were of the indicator of unfavourable statements. Out of 10 selected statements for the habit scale, 5 statements were indicator of positive habit and other 5 statements were indictor of negative habit. Against each of these 20 statement in attitude and 10 statements in habit, thus arranged. There were five columns representing a five point continuum of agreement and disagreement to the statements as followed by *Likert (1932)* in his summated rating technique of attitude measurement. The five point on the continuum were strongly agree, agree, undecided, disagree, and strongly disagree with weight of 5, 4, 3, 2, 1 respectively to favourable statements and with weight 1, 2, 3, 4 and 5 respectively for the unfavourable statements.

With this format of attitude and habit scales, the statements were then administered to the respondents and they were asked to respond to each one of 20 and 10 statements in terms of their own agreement or disagreement and the responses were recorded with a tick mark in the proper columns representing the five categories. After recording the responses of the 20 and 10 statements, the scoring was done. The total score for an individual was the sum of the product for the attitude and habit scales, for scientific knowledge and scientific method the respondents were asked to answer the questions.

CONCLUSION

The human mind, the human psyche and the human temperament are very complex entities, and the factors and the forces that could influence and / or determine their make up at any given time can be so many and so varied that prediction of individual human behaviour in a given situation, or under a given circumstances, becomes almost impossible. However scientific temper can be acquired by or promoted among people and the results of the correlation coefficients r = 0.83, r = 0.78. r = 0.76 and r = 0.81 for scientific attitude, scientific habit, scientific knowledge and scientific method respectively are highly significant in this investigation. So it can be said that the scales under study were observed highly stable or dependable for measurement and out of 30 items related to scientific attitude, 20 items and out of 20 items related to scientific habit, 10 items were found to be significant and 30 and 15 statements in scientific knowledge and scientific methods respectively constitute the scale for scientific temperament of farmers.

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