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Research Article

INSTRUMENT TO ASSESS THE FARMERS' PARTICIPATION IN EFFECTIVE CANAL IRRIGATION MANAGEMENT IN KRISHNA COMMAND AREA

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Abstract: In the present study, an attempt was made to develop an instrument to measure the farmers' participation in effective canal irrigation management. Farmers' participation in effective canal irrigation management is defined as the extent of water users' involvement in different activities *viz*., equitable distribution of irrigation water, crop selection and management, scheduling of irrigation water, water delivery system and maintenance of field channels etc., for effective management of irrigation water. The method of summated rating scale suggested by Likert (1932) and Edwards (1969) were followed in the develop an instrument through six stages *viz*., identification of dimension, collection of items/statements, relevancy analysis, item analysis, reliability and validity of the scale. Based on the review of literature and discussion with experts in the related areas, six dimensions *viz*., farmers' participation in formulation of guidelines, planning and implementation activities, maintenance activities, responsibility sharing, crop planning activities and integrated crop management were listed and 60 items/statements were enlisted. Based on the relevancy percentage equal and more than 80.00 percent and mean relevancy score of equal and more than 4.00 were considered for inclusion in the item analysis. After the relevancy analysis and item analysis, out of 60 items/statements, 34 statements were retained. In order to compute the scale values for each of the identified dimensions by adopting normalized ranking method recommended by Guilford (1954) and the total scale value ranges from 9.340 to 2.537, with farmers' participation in integrated crop management got highest rank and formulation of guidelines got lowest rank. The developed instrument was found to be reliable (0.96) and valid (0.98), hence it can be used to measure the farmers' participation in effective canal irrigation management.

Keywords: *Farmers' participation, Canal irrigation management, Relevancy percentage, Reliability, Validity*

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Introduction

India with 2.4 percent of the world's total area has 16 percent of the world's population but has only 4 percent of the total available fresh water [1]. This clearly indicates the need for water resource management, conservation and optimum use. The problem that seem to emerge with the rapid growth of the population and the consequent rise in demand for water leads to water shortages, which will be a greater concern in the coming years.

Water is a critical input in agriculture, nearly all its aspects having a determining effect on the eventual yield. Quality seeds and fertilizers fail to give optimum yield if plants are not optimally watered. The increasing scarcity of water for agricultural production around the world is a major cause for concern. Therefore, there is a need to make prudent and economic use of water by improved and scientific water management practices.

The development and construction of irrigation dam is not an end in itself. The operation and maintenance of created system is more important for realizing the full benefits envisaged in the project. Irrigation management is a social process, which deals with not only efficient use but also equitable distribution of irrigation water. Therefore, Participation is crucial for agriculture development and is one of the critical components for success of natural resource management. Research reviews revealed that, there is no proper measuring procedure on participation of farmers' in effective canal irrigation management hence; an attempt has been made;

To develop an instrument to assess the farmers' participation in effective canal irrigation management

Material and Methods

The present study was carried out during 2018-2019 by employing a scientific methodology to develop an instrument to measure the farmers' participation in effective canal irrigation management. The developed instrument was tested for its reliability and validity. The detail steps followed in the methodology are explained under the steps listed below. Develop an instrument to assess the farmers' participation in effective canal irrigation management: Farmers' participation in effective canal irrigation management is operationally defined as extent of water users' (farmers) involvement in different activities *viz*., equitable distribution of irrigation water, crop selection and management, scheduling of irrigation water, water delivery system and maintenance of field channels etc., for effective management of irrigation water. The method of summated rating scale suggested by Likert (1932) and Edwards (1969) were followed in the development of the instrument through the following steps *viz*., identification of dimensions, collection of items/statements, relevancy analysis, item analysis, reliability and validity of the scale [2,3].

Identification of dimensions

The first step in development of instrument was the identification of dimensions pertaining to farmers' participation in effective canal irrigation management. Six major dimensions related to farmers' participation in effective canal irrigation management were identified based on review of literature and discussion with experts in the field of agricultural extension, agronomy and extension officers of Command Area Development Authority (CADA).

Table-1 *Statement wise Relevancy Percentage and Means Relevancy Score of farmers' participation in effective canal irrigation management, (n=79)*

SN	Statements	Relevancy Percentage	Relevancy Weightage	Mean relevancy score
I.	Farmers' participation in formulation of guidelines			
1.	Follow the warabandi schedule of the available water in irrigation system	83.79	0.83	4.18
2.	Agree to follow proper irrigation methods	88.6	0.88	4.43
3.	Take appropriate measures to avoid water wastage	89.62	0.89	4.48
II.	Farmers' participation in planning and implementation activities			
4.	Involve in the selection of site for construction of field channels	89.11	0.89	4.45
5.	Estimate amount of irrigation water required for crops	87.84	0.87	4.39
6.	Planning to repair distributaries/ field channels prior to monsoon	91.64	0.91	4.58
7.	Planning to increase the row width to minimize the flow of water. *	82.53	0.82	4.12
8.	Planning to install borders or blocked end furrows	80.25	0.8	4.01
9.	Recording irrigation date and amount of water to be applied to the field	85.82	0.85	4.29
III.	Farmers' participation in maintenance activities			
10.	Maintain the irrigation and drainage structures for proper flow of irrigation water	92.91	0.92	4.64
11.	Participation on reconstruction/repair of distributaries/ field channel	88.6	0.88	4.43
12.	Attending training organized by CADA for improving irrigation practices	85.82	0.85	4.29
13.	Participation in monitoring uniformity flow of irrigation water	87.08	0.87	4.35
14.	Participation in cleaning field channel	86.83	0.86	4.34
15.	Not to attend meetings for repair and maintenance*	81.01	0.81	4.05
IV.	Farmers' participation in responsibility sharing			
16.	Farmers are not ready to pay water charges for usage of amount of water*	82.02	0.82	4.1
17.	Collection of water charges	82.53	0.82	4.12
18.	Contributing money for maintenance of field channel	81.77	0.81	4.08
19.	Discussing one's experience on irrigation water management with fellow farmers	83.54	0.83	4.17
20.	Participation in training organized by WUCS	83.03	0.83	4.15
21.	Motivating other farmers to participate in the water use activities	84.81	0.84	4.24
V.	Farmers' participation in crop planning activities			
22.	Adopting the recommended cropping pattern to save water	89.11	0.89	4.45
23.	Deciding the improved seed varieties	81.51	0.81	4.07
24.	Deciding other crops based on availability of water	89.11	0.89	4.45
25.	Deciding the area under each crop in advance	88.86	0.88	4.44
26.	Using irrigation water based on critical stages of crops	91.89	0.91	4.59
27.	Decision on time required to irrigate their field	86.58	0.86	4.32
28.	Deciding suitable management practices to conserve water	87.08	0.87	4.35
VI.	Farmers' participation in integrated crop management			
29.	Adopting the recommended seed rate which are drought tolerant	86.83	0.86	4.34
30.	Growing long duration crops during drought condition*	89.36	0.89	4.46
31.	Practicing the best/ improved method of sowing	86.83	0.86	4.34
32.	Involve in maintenance of plant population in relation to available water	87.84	0.87	4.39
33.	Use conservational tillage, to improve the water infiltration rate	85.06	0.85	4.25
34.	Use of cover crops/green manures to minimize leaching and erosion	89.62	0.89	4.48

**Negative statements*

The major six dimensions identified were: (1) formulation of guidelines, (2) planning and implementation activities, (3) maintenance activities, (4) responsibility sharing, (5) crop planning activities and (6) integrated crop management.

Collection of items/statements

The items on farmers' participation in effective canal irrigation management were collected exhaustively. Tentative list of 60 items/statements pertaining to the farmers' participation in effective canal irrigation management was prepared based on the available literature and discussion with agriculture extension experts, agronomists and CADA officials.

Editing of the items

The statements were edited as per the 14 points criteria enunciated by Edwards (1969) and Thurstone and Chave (1929) [3,4]. As a consequences nine statements were eliminated and the remaining 51 statements were included study.

Relevancy analysis

51 items/statements under different dimensions were sent to 140 experts in the field of Agricultural Extension, Agronomy, CADA and other related areas to critically evaluate the relevancy of each items/statement on five point continuum *viz*., Most Relevant (MR), Relevant (R), Somewhat Relevant (SWR), Less Relevant (LR) and Not Relevant (NR) and the above responses were assigned the score of 5,4,3,2,1, respectively for positive statements and reverse procedure was followed for the negative statements. The judges were also requested to make necessary modifications and additions or deletion of statements, if they desire so. A total of 79 judges returned the questionnaires duly completed were considered for further processing. From the data gathered, "relevancy percentage" "relevancy weightage" and "mean relevancy score" were worked out for all the 51 statements. Using the criteria individual statements were screened for relevancies by the following formulae.

Relevancy Percentage (RP)

$$R.P. = \frac{MR\ X\ 5 + R\ X\ 4 + SWR\ X\ 3 + LR\ X\ 2 + NR\ X\ 1}{Maximum\ possible\ score} \times 100$$

Relevancy Weightage (RW)

$$R.W. = \frac{MR\ X\ 5 + R\ X\ 4 + SWR\ X\ 3 + LR\ X\ 2 + NR\ X\ 1}{Maximum\ possible\ score}$$

Mean Relevancy Score (MRS)

$$M.R.S. = \frac{MR\ X\ 5 + R\ X\ 4 + SWR\ X\ 3 + LR\ X\ 2 + NR\ X\ 1}{No.\ of\ judges\ responded}$$

Where,

MR= Most Relevant

R= Relevant

SWR= Somewhat Relevant

LR= Less relevant

NR= Not relevant

Accordingly, statements having relevancy percentage equal and more than 80.00 percent and mean relevancy score of equal and more than 4.00 were considered for inclusion in item analysis.

Thus, 34 statements were retained out of 51 statements and these statements were considered for further processing and suitably modified as per the comments of experts wherever applicable [Table-1].

Calculation of scale values for each dimension

In order to compute the scale value for each of the identified dimensions by adopting normalized ranking method recommended by Guilford (1954) [5]. A list of 79 experts working in related area was prepared and considered for seeking opinion. The judges were requested to give rank order based on the relative importance of the six dimensions selected on farmers' participation in effective canal irrigation management. After receiving ratings from the judges, they were used for calculation of scale values. Based on their relative importance, dimensions were ranked and then converted in to rank values using the formula

Ri = (n-ri+1)

Where, Ri = Rank values

n = Number of dimensions

ri = Ranks given by judges to six dimensions

The calculation of scale value consists of working out the centile position (P) based on the formula recommended by Guilford (1954) [1], then for working out values determined for each centile value (C) was done. Based on Hull Table [6], calculating Rank value (Rj) and finally determining the scale values (Rc) [Table-2].

P=(Ri-0.5)100/n

Rc = 2.357*Rj – 7.01

Where, P = Centile position

C = Values determined for each centile value

Rj = Rank value

Rc =Scale value

n = Number of indicators

Table-2 *Calculation of scale values of all the dimensions based on the judges ranking*

ri	Ri	D1	D2	D3	D4	D5	D6	Total	P	C
1	6	7	7	6	9	8	42	79	91.67	9
2	5	8	3	5	28	21	14	79	75	6
3	4	10	19	4	22	16	8	79	58.33	5
4	3	9	28	25	9	6	2	79	41.67	5
5	2	12	7	24	8	23	5	79	25	4
6	1	33	15	15	3	5	8	79	8.33	2
Fji		79	79	79	79	79	79	474		
Rj=fjiC		320	374	355	442	410	548			
R=Rj/fji		4.051	4.734	4.494	5.595	5.19	6.937			
Rc*		2.537	4.148	3.582	6.177	5.223	9.34			

Where, ri = Ranks given by judges to six dimensions

Ri = Rank values

Rc = 2.357*Rj – 7.01

(Note: 2.357 and 7.01 are constant values)

P = Centile position

C = Values determined to each centile value

Table-3 *Scale values for six dimensions of farmers' participation in effective canal irrigation management*

SN	Dimensions	Final scale value	Rank
1	Formulation of guidelines	2.537	VI
2	Planning and implementation activities	4.148	IV
3	Maintenance activities	3.582	V
4	Responsibility sharing	6.177	II
5	Crop planning activities	5.223	III
6	Integrated crop management	9.34	I

It is apparent that all the six dimensions will not contribute equally towards farmers' participation in effective canal irrigation management. Hence the variation in contribution of each dimension represented by assigning different weightage ranging from 9.340 to 2.537 with this farmers' participation in integrated crop management got highest rank (I) and formulation of guidelines got lowest rank (VI) (Table 3).

Item analysis

To delineate the statements based on the extent to which they can differentiate farmers' participation in effective canal irrigation management, item analysis was carried out on the items/statements selected in the first stage. For item analysis, thirty farmers were selected from non-sample area and the respondents were asked to indicated their participation in each of the items/statement on a three points continuum like "regularly, occasionally and never". The scoring pattern adopted for positive statements were 3, 2 and 1 and scoring was reversed for negative statements.

Based on the total scores obtained, the respondents were arranged in descending order. The top 25 percent of the respondents with their total scores were considered as high group and the bottom 25 percent as low group. These two groups provide criterion groups in terms of evaluating the individual statements suggested by Edwards (1969). 't' value was calculated for each of the statement by using the following formula:

$$t = \frac{\bar{X}_H - \bar{X}_L}{\sqrt{\frac{\left(\sum \bar{X}_H{}^2 - \frac{(\sum \bar{X}_H)^2}{n}\right) \times \left(\sum \bar{X}_L{}^2 - \frac{(\sum \bar{X}_L)^2}{n}\right)}{n(n-1)}}}$$

Where,

XH = the mean score on given statement of the high group

XL = the mean score on given statement of the low group

∑x2H = Sum of squares of the individual score on a given statement for high group

∑x2L = Sum of squares of the individual score on a given statement for low group

n = Number of respondents in each group

∑ = Summation

T = the extent to which a given statement differentiate between the high and low group.

After computing the 't' value for all the 34 statements, and only those with 't' value equal and greater than 2.145 were finally selected for inclusion in the scale. Wherein, all the 34 items/statements were significant at 5 percent.

Standardization of instrument

Reliability and Validity of the scale

Reliability of the scale

Reliability in its true sense refers to precision of the instrument constructed for any purpose. It is otherwise called extent to which repeated measure produces the same result. In any social science research newly, constructed instrument has to be tested for its reliability before it is used.

To establish reliability of the developed instrument a pilot study was conducted by administering the instrument to the 30 farmers in non-sample area comprising 34 items/statements. Split-half method developed by Brown prophecy was employed to measure the reliability of the scale. The reliability co-efficient of split-half test using Karl Pearson's co-efficient (r1/2) was found to be 0.93. The reliability coefficient of the tool was found to be 0.96, which is higher than the standard score of 0.70, indicating the constructed instrument is highly reliable.

Half test reliability formula

$$r_{½} = \frac{N(\sum XY) - (\sum X)(\sum Y)}{\sqrt{(N\sum X^2 - (\sum X)^2)(N\sum Y^2 - (\sum Y)^2)}}$$

Where, r1/2=half test reliability

∑X =Sum of the socres of the odd number items

∑Y =Sum of the scores of the even numbers items

$\sum X^2$ = Sum of the squares of the odd number items

$\sum Y^2$ = Sum of the squares of the even number items

The Half test reliability which was found to be 0.93

Whole test reliability formula

$$r11 = \frac{2 \times r1/2}{1 + r1/2}$$

Where, r11=whole test reliability

r1/2=half test reliability

The Whole test reliability which was found to be 0.96

Validity of the scale

Validity refers to the ability of the instrument to measure what it supposed to measure. Validity of an instrument is the property which ensures that the test scores obtained measure the variable they are supposed to measure. Content or construct and statistical validity are the methods generally followed to know the validity of the scale. The data were subjected to statistical validity, the validity co-efficient for the instrument was found to be 0.98, which is greater than the standard requirement of 0.70, hence the validity coefficient was found to be most appropriate and suitable for the tool developed.

$Validity = \sqrt{r11}$

Validity which was found to be 0.98

Thus, the developed instrument to measure the farmers' participation in effective canal irrigation management was feasible and appropriate [Table-4].

Table-4 *Reliability and Validity of the instrument*

Particulars		Values
Reliability	Split-half (r1/2)	0.93
	Whole-test (r11)	0.96
Validity	Statistical validity	0.98

Administering the scale: The final instrument consisting of 34 statements were administered, to 30 respondents. The responses were collected on a three points continuum, namely "regularly, occasionally and never" and responses were assigned the score of 3, 2, and 1, respectively for positive statements and reverse scoring procedure was used for negative statements.

Table-5 *Elimination of statements at different steps of the instrument construction*

SN	Steps in instrument construction	No. of statements	
		Statements considered	Statements retained
1	Collection of items	60	60
2	Editing of items	60	51
3	Relevancy analysis	51	34
4	Item analysis	34	34
5	Reliability and validity	34	34

The elimination of statements at various steps of the instrument construction is presented in [Table-5]. In the first step of collection of items/statements, the number of statements considered were 60 and number of statements were retained were 60. In the second step i.e., editing of items, number of statements were considered 60 and 51 statements were retained. In the third step of relevancy analysis, 34 statements were retained out of the 51 statements. The fourth step of the instrument construction is item analysis, where in the number of statements considered were 34, and the same 34 statements were retained. In the fifth step of findings reliability and validity, the number of statements were considered 34 and same 34 statements were retained. Hence, the final instrument consisting of 34 statements.

Results and Discussion

The present instrument was developed by the following methodology from social science perspective to objectively assess the farmers' participation in effective canal irrigation management. The dimensions and items/statements were finalized based on the review of vast literature and also discussion with the experts in the related area. A list of 60 statements pertaining to the farmers' participation in effective canal irrigation management was prepared and based on the relevancy percentage equal and more than 80.00 percent and mean relevancy score of equal and more than 4.00 were considered for the inclusion in item analysis. After the relevancy analysis and item analysis, out of 60 statements, 34 statements were retained in the final instrument [Table-1]. Six dimensions identified for the study assumed scale values ranging from 9.340 to 2.537 indicating different weightage to be assigned based on the expert's opinion arrived through judges rating. The scale values of respective dimensions were presented in the [Table-2]. The developed instrument was found to be reliable (0.96) and valid (0.98) [Table-4]. The instrument helps in identifying the factors leading to farmers' participation effective canal irrigation management, which will further support in framing policies by the Government, designing training programmes on effective use of irrigation water and proper guidelines or motivation from Water Users Cooperative Societies *etc*., will help to improve the participation of the farmers in effective canal irrigation management.

Conclusion

The instrument consisting of six dimensions for the study and the scale values ranging from 9.340 to 2.537 and based on the relevancy percentage equal and more than 80.00 percent and mean relevancy score of equal and more than 4.00 were considered for the inclusion in item analysis. After the relevancy analysis and item analysis out of 60 statements, 34 statements were retained in the final scale. The developed instrument was found to be reliable (0.96) and valid (0.98), hence the instrument can be further used to measure the farmers' participation in effective canal irrigation management.

Application of research: The study was conducted in three districts of Krishna Command Area and the constructed instrument was mainly helpful to measure the head reach and tail-end farmers participation in effective canal irrigation management.

Research Category: Agricultural Extension

Abbreviations: CADA: Command Area Development Authority
WUCS: Water Users Cooperative Society,

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Study area / Sample Collection: Vijaypura, Kalaburagi, Yadgiri districts

Cultivar / Variety / Breed name:

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