A SCALE TO ANALYSE THE SOCIETAL ATTITUDE OF FARMERS TOWARDS ADOPTION OF SCIENTIFIC WATER EFFICIENT PRACTICES IN COMMAND AREAS

ABSTRACT

Water is an essential yet limited natural resource, vital for sustaining life on Earth. Command areas refer to regions supplied by irrigation systems, such as canal networks or reservoirs, which deliver water to agricultural lands. Effective water management in these regions is crucial for optimizing resources, ensuring fair distribution, and enhancing crop production and productivity. While many scales exist to measure farmers' attitudes, none specifically assess attitudes toward adopting scientific, water-efficient practices in command areas. This study attempts to address this gap by developing and standardizing a scale to evaluate farmers' societal attitudes toward such practices. The resulting scale, which has demonstrated high reliability and validity, consists of 40 statements divided into six categories: (a) maintenance of field channels and distributaries, (b) on-farm water management, (c) water-saving techniques, (d) crop selection and cultivation practices, (e) excess water management techniques, and (f) policy, administration, and extension. An Ex-post facto research design was adopted, and the scale was administered to 40 farmers using a simple random sampling technique in the Tungabhadra command area of Karnataka during the 2023-24 period. Findings reveal that a significant majority of farmers (80%) exhibited attitudes ranging from less favourable to favourable toward scientific water-efficient practices, whereas only one-fourth (20%) displayed a more favourable attitude toward these practices.

Keywords: command area, societal attitude, scientific water-efficient practices, reliability, validity.

1. INTRODUCTION

Water is a vital yet scarce natural resource essential for sustaining life on Earth. It plays a critical role in various biological, environmental, and economic processes. For humans, water is crucial for drinking, sanitation, and overall health. In agriculture, it is indispensable for crop growth, livestock care, and food production (UN Water, 2021). Additionally, water is essential for industrial operations, electricity generation, and ecosystem support. In agriculture, water serves as the lifeblood of crop production, with the agricultural sector consuming approximately 70.00 per cent of the world's freshwater resources. Efficient water use in agriculture is vital for enhancing yields, ensuring food security, and supporting rural livelihoods. However, water scarcity and inadequate management often lead to reduced productivity, environmental degradation, and disputes over water use.

Command areas are regions served by irrigation systems, such as canal networks or reservoirs that supply water to agricultural lands. Effective water management in these areas is crucial for optimizing available resources and ensuring equitable distribution. Proper management maximizes productivity by providing crops with the right amount of water at the appropriate time, facilitating healthy growth and higher yields (Hussnain, M., 2018). It also minimizes water waste due to runoff, evaporation, or seepage, thereby enhancing overall water-use efficiency. Sustainable water management practices are essential for protecting the environment, preventing issues like waterlogging and soil salinization, and ensuring long-term resource availability. Given the increasing rainfall variability and more frequent droughts linked to climate change, adaptive water management is essential for building resilience in agricultural and water systems (Smit, B., & Skinner, M. W., 2002).

Irrigated agriculture occupies about 20% of the world's cultivated land but contributes to 40.00 per cent of global food production. On average, it is at least twice as productive per unit of land compared to rainfed agriculture, allowing for increased production intensification and crop diversification (Hussain & Hanjra, 2004; Lipton et al., 2005). Nevertheless, in many command areas, farmers tend to use excessive amounts of water, often treating it as a free resource. This indiscriminate use of irrigation water can leave farmers at the tail end of the irrigation system water-starved, resulting in unequal distribution and escalating disputes over water allocation. It is challenging to regulate the equitable distribution of irrigation water among different reaches unless the end users, or grassroots users, recognize and change their attitudes towards irrigation water as a shared resource.

Farmers’ attitudes toward water as a common good significantly influence conflict resolution in these areas. Recognizing water as a shared resource fosters collaborative problem-solving and can mitigate conflicts (Mollinga, 2003). Understanding these societal attitudes is vital for effective policy development. Farmers who engage in decision-making processes are more inclined to adhere to water regulations and support improved governance systems (Shah, 2009). Furthermore, addressing farmers' social concerns can enhance the adoption of water-saving technologies, such as micro-irrigation (Joshi *et al.,* 2008). Societal attitudes also play a critical role in building long-term resilience in command areas, particularly in the face of climate change and water scarcity challenges (Gupta *et al.,* 2014). Consequently, measuring these attitudes provides valuable insights for shaping policies aimed at promoting sustainable and cooperative water management.

2. MATERIALS AND METHODS

The current study was conducted during the 2023-24 period to develop and standardize a scale for analysing farmers' societal attitudes toward adopting scientific water-efficient practices in command areas. The developed scale was utilized to evaluate the attitudes of farmers in the Cauvery and Bhadra command areas of Karnataka. A total of 40 farmers from the Tungabhadra command area selected randomly and were interviewed for this purpose. An ex-post facto research design was employed, as the researcher had no direct control over the independent variables. These variables had already manifested or were inherently unmanageable. The study made inferences about the relationships between the variables without direct intervention, relying on the associated influence of the independent variables on the dependent variables (Kerlinger, 1966). Based on the cumulative scores, respondents were categorized into less favourable, favourable, and more favourable attitude levels, using the mean score (201.6) and half the standard deviation (3.12) as benchmarks for assessment.

3. RESULTS AND DISCUSSION

3.1 Development of a scale to analyse the societal attitude of farmers towards the adoption of scientific water-efficient practices in command Areas

Societal attitude is operationally defined as the "positive or negative mental predisposition of farmers towards scientific irrigation management practices in command areas." The societal attitude scale was developed using the summated rating method proposed by Likert (1932) and Edwards (1969), following a structured six-stage process: (1) identification of components, (2) collection and editing of attitude statements, (3) relevancy testing, (4) item analysis, (5) reliability assessment, and (6) validity testing (Puneeth Raja and Venkataranaga naik., 2023).

3.1.1. Identification of Dimensions

The summated rating method was employed to identify a comprehensive range of items related to societal attitudes towards adopting modern scientific water-efficient technologies in command areas. Both positive and negative statements were included to capture the full spectrum of attitudes.

3.1.2. Collection and Editing of Items

An exhaustive collection of items reflecting the societal attitudes of farmers was conducted. A preliminary list of 60 items was created, from which 9 statements were eliminated, resulting in 51 statements that were retained for further analysis.

3.1.3. Relevancy Analysis

The schedule containing the 51 items was distributed to 120 judges via Google Forms and personally handed to specialists in agricultural extension, agronomy, and soil science for critical evaluation. The judges assessed the relevancy of each item using a five-point continuum: Most Relevant (MR), Relevant (R), Somewhat Relevant, Less Relevant (LR), and Not Relevant (NR), with corresponding scores of 5, 4, 3, 2, and 1. Judges were also encouraged to suggest modifications, additions, or deletions of statements as needed. A total of 73 judges returned the completed questionnaires and were considered for further processing.

From the collected data, key metrics such as "Relevancy Percentage," "Relevancy Weightage," and "Mean Relevancy Score" were calculated for all 51 societal attitude statements. Individual statements were evaluated for relevancy using established formulae, ensuring the scale accurately reflected the attitudes of farmers toward scientific water-efficient practices.

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

$$MRS = \frac{MR*5 + R*4 + SWR*3 + LR*2 + NR*1}{\text{No. of judges responded}}$$

R.P-Relevancy Percentage

M.R.S- Mean Relevancy Score

Individual items were screened based on these three calculated values. Accordingly, items having relevancy weightage of more than 0.75, relevancy percentage of more than 75% and mean relevancy score more than or equal to 3.00 were included for further analysis. Thus, from out of 51 attitude statements a total of 48 statements were retained for item analysis.

3.1.4. Item Analysis

In the item analysis, 40 respondents were selected from a non-sample area to evaluate their responses to each item using the specified scoring pattern. Based on the total scores obtained, respondents were arranged in descending order. The top 25% of respondents, representing the highest scores, were designated as the high group, while the bottom 25% were classified as the low group. These two groups served as criterion groups for evaluating the individual statements, following the approach suggested by Edwards (1969).

The 't' value for each statement was calculated using the formula:

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

Where,

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

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

$\sum X^2_H$= Sum of squares of the individual score on a given statement for high group

$\sum X^2_L$ = Sum of squares of the individual score on a given statement for low group
n = Number of respondents in each group
$\sum$ = Summation
t = The extent to which a given statement differentiates between the high and low groups.

After calculating the 't' values for all 48 perception statements, those with a 't' value of 1.692 or greater were selected for inclusion in the scale. Out of the 48 statements analyzed, 40 items were found to be significant at the 5% level. This rigorous analysis ensured the reliability of the scale in assessing societal attitudes towards scientific water-efficient practices.

3.1.5. Reliability of the scale

To assess the reliability of the scale, the split-half method was utilized. This method involves dividing the scale into two halves and calculating the correlation coefficient between the scores of each half. In this study, the correlation coefficient for the scale measuring societal attitude was found to be 0.926. To enhance the reliability estimate, the Spearman-Brown formula was applied, yielding a reliability coefficient of 0.96 for the complete set of items.

This high value of 'r' indicates a strong level of internal consistency, which was significant at the one per cent level. Therefore, it can be concluded that the constructed scale demonstrates high reliability, making it a dependable tool for evaluating the societal attitudes of farmers towards the adoption of scientific water-efficient practices in command areas.

a) Half test reliability formula

$$r_{1/2} = \frac{N(\Sigma XY)-(\Sigma X)(\Sigma Y)}{\sqrt{(N\Sigma X^2-(\Sigma X)^2)\,(N\Sigma Y^2-(\Sigma Y)^2)}}$$

Where,
ΣX= Sum of the scores of the odd number items
ΣY = Sum of the scores of the even number items
ΣX^2= Sum of the squares of the odd number items
ΣY^2 = Sum of the squares of the even number items

b) Whole test reliability formula

$$r_{11} = \frac{2 \times r1/2}{1 + r1/2}$$

Where, $r1_{/2}$= Half test reliability

3.1.6. Validity

The data underwent a statistical validity assessment, resulting in a validity coefficient of 0.98 for the scale measuring the societal attitudes of farmers. This value exceeds the standard threshold of 0.70, indicating a high level of validity for the tool developed. Therefore, the validity coefficient demonstrates that the scale is both appropriate and suitable for accurately assessing the societal attitudes towards the adoption of scientific water-efficient practices in command areas

Validity= $\sqrt{r_{11}}$

Administration of the Attitude scale and method of scoring:

The final scale comprises 40 statements designed to assess societal attitudes towards the adoption of modern scientific water-efficient technologies in the command areas of Karnataka. Responses will be collected using a five-point Likert scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree, with scores assigned as 5, 4, 3, 2, and 1 for positive statements. Negative statements will be scored in reverse.

To determine an individual's societal attitude score, the scores for all 40 statements will be summed. The perception scores from this scale will range from a minimum of 40 to a maximum of 200. Based on the calculated mean and half standard deviation, respondents will be categorized into three attitude levels: more favourable, favourable, and less favourable. A higher score indicates a more favourable attitude towards the adoption of scientific water-efficient practices, while a lower score suggests a less favourable attitude toward protected cultivation. This categorization enables a nuanced understanding of farmer attitudes and informs targeted interventions to promote water-efficient technologies.

Table 1: Societal attitude statements included in the table and their ‘t’ values

Sl. No.,	Statements	MRS	RP	t-value
I	**Maintenance of field channel and distributaries**			
1.	Keeping canals free from weeds, plants, stones and other wastes ensures ease of water flow	4.59	91.83	1.71
2.	Canal lining improves irrigation efficiency by preventing seepage and conveyance losses	4.48	89.58	2.20
3.	Regular de-silting is necessary to increase the storage capacity of tanks and channels	4.45	89.01	3.38
4.	Repairing the canal water distribution and measuring structure before monsoon, enhances water conveyance efficiency	4.41	88.17	1.85
5.	An investment in routine field channel maintenance is a dead investment (-)	3.68	73.52	1.95
II	**On farm water management**			
1	Warabandi system or rotational system of irrigation ensures equitable distribution of water among the users	4.46	89.30	1.85
2.	Providing irrigation at critical crop growth stages enhances the irrigation efficiency	4.68	93.52	1.80
3.	Opting micro irrigation techniques helps to conserves irrigation water	4.52	90.42	2.12
4.	Conjunctive use of groundwater and surface water promotes balanced use of irrigation water for particular cropping season	4.34	86.76	1.85
5.	Use of farm-pond/Dug well fed pipe conveyance based pressurized irrigation system to optimize irrigation water	4.30	85.92	2.37
6.	Installation of water regulatory devices in irrigation network helps in regulating excess water flow	4.18	83.66	2.16
III	**Water saving techniques**			
1.	Planned scheduling of irrigation can maximize water productivity	4.54	90.70	1.71
2.	Land levelling and grading improves surface irrigation uniformity and application efficiency	4.34	86.76	2.00
3.	Conservation tillage can save water by reducing evaporation loss	4.15	83.10	1.80
4.	Application of FYM and compost increases water holding capacity of	4.31	86.20	1.80

	the soil			
5.	Adopting rain water harvesting and utilizing it for protective irrigation	4.30	85.92	2.26
6.	Replacement of open field channels with pipe lines can prevent evaporation and seepage losses of irrigation water	4.15	83.10	1.97
7.	Mutual understanding of the neighbour for water sharing avoids wastage of irrigation water	4.24	84.79	2.17
8.	Irrigation scheduling based on external weather conditions (less water in winter) can conserve irrigation water.	4.15	83.10	1.80
9.	Recovering and reusing tail water reduces field runoff, into rivers and other waterways.	4.20	83.94	1.85
10.	Demand-based water release strategies bring down the gap between canal supplies and demand, resulting in effective water management	4.39	87.89	2.17
IV	**Selection of crops and its cultivation practices**			
1.	Selecting the crops in accordance with availability of water helps in optimizing irrigation water	4.66	93.24	1.71
2.	Growing short duration crops during water stress condition is best alternative to obtain additional income	4.34	86.76	3.46
3.	Drought tolerant and less water requirement crop varieties are more promising during water scarcity condition	4.44	88.73	1.80
4.	Opting for recommended cropping pattern could bring down the demand-supply gap of irrigation water	4.30	85.92	2.16
5.	Going for crop rotation with water wise crops in summer helps to get two crops in a year	4.32	86.48	2.09
6.	Sowing of crop according to institutional water scheduling is beneficial	4.10	81.97	1.71
7.	Summer ploughing aids in water conservation by reducing the runoff	4.04	80.85	1.95
8.	Constant application of irrigation water irrespective of crop requirement will increase the yield of crop (-)	4.32	86.48	1.89
V	**Excess water management techniques**			
1.	Planning and maintaining of surface/subsurface drainages avoids waterlogging and salinity problems in command areas	4.51	90.14	2.00
2.	Opting for broad bed furrows, serve as drainage pathway in areas	4.25	85.07	1.85

	with abundant irrigation water supply			
3.	Formation of bunds along borders of the field facilitates conservation of soil and excess water	4.38	87.61	2.16
4.	Application of soil amendments is critical to improve soil fertility in command areas	4.24	84.79	1.75
VI	**Policy, administration and extension**			
1.	Strict enforcement of warabandi system is crucial in command area	4.39	87.89	2.09
2.	Cooperative water management need to be strengthened in command area	4.45	89.01	2.23
3.	Training of farmers on effective water management techniques is essential	4.54	90.70	1.96
4.	Strict enforcement of law is imperative for regular inclusion of water bill by farmers	4.17	83.38	2.44
5.	Levying irrigation water rates on the volume of water delivered discourages over irrigation.	4.13	82.54	2.20
6.	Educating farmers on regulations related to effective water management is necessary	4.30	85.92	1.96
7.	Water for irrigation is more for personal use than for community benefit (-)	4.23	84.51	2.30

3.2. Societal attitude of farmers towards adoption of scientific water efficient practices in Tungabhadra command area

The societal attitude scale developed was administered to 40 farmers in the Tungabhadra command area during 2023-24. The results (Table 2) indicated that less than half (45.00%) of the farmers exhibited a less favourable attitude towards adopting scientific water-efficient practices. This was followed by less than two-fifths (35.00%) showing a favourable attitude, and one-fifth (20.00%) demonstrating a more favourable attitude. The possible reasons for these results could be the situational advantage of having an excess supply of water in command areas, which leads to a lack of interest among farmers in water management practices. Many farmers are still unaware of irrigation scheduling and hold the belief that excess water leads to higher yields. However, this misconception is negatively impacting soil fertility and productivity. Results are similar to Qudsiya *et. al*. 2018 and Naveen kumar *et. al,* 2022.

Table 2: Overall societal attitude of farmers towards scientific water management practices

(N= 40)

Sl. No.	Categories	Societal attitude of farmers		Mean	S.D.
		f	%		
1	Less favourable	18	45.00	201.6	3.128037
2	Favourable	14	35.00		
3	More favourable	8	20.00		
Total		40	100.00		

f= Frequency, % = Percentage

Conclusion

The developed societal attitude scale has proven to be both reliable and valid, making it suitable for assessing farmers' attitudes toward adopting scientific water-efficient practices in command areas. When administered to farmers in the Tungabhadra command area, the scale revealed that a significant portion, 45.00 per cent, exhibited less favourable attitudes. Farmers in arid regions understand the value of water, but in command areas, especially the head reach, excessive water usage leads to unequal distribution, causing water scarcity in the tail end during critical crop growth stages. It is vital to understand farmers' attitudes towards adopting water-efficient practices, as these can save water, reduce the area under excessive cultivation, and enhance food production and security.

Policy efforts should focus on incentivizing the adoption of water-efficient techniques through training, resources, and financial support. Addressing social challenges, such as resistance to change and lack of awareness, requires community-based approaches and farmer engagement. Collaboration between water user associations, agricultural extension services, and policymakers is essential for sustainable water management and improved agricultural productivity.

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