



## **Development and Standardization of Scale to Measure Role of Farm Women towards Natural Resource Management Activities**

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### **Authors' contributions**

*This work was carried out in collaboration between both authors. Author NS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author NS cross checked analyses of the study & the literature searches along with references. All authors read and approved the final manuscript.*

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### **ABSTRACT**

Natural resources are important for human beings to sustain life on earth. However, continuous use of natural resources by the human beings, had affected the earth. There is need to manage our natural resources to improve the sustainability of the natural resources. Women have always come to forward to conserve and protect natural resources because they are the primary users of natural resources traditionally as well as modern. In this paper, A scale has been developed and standardized that can be used to measure the role of farm women towards natural resource management activities. The scale was developed by using the technique of "Scale Product Method" which combines the Thurston's technique of equal appearing interval scale for selection of the items and Likert's technique of summated rating for ascertaining the response on the scale. A total of 78 Natural Resource Management (NRM) activities were selected. Based on Scale (median) value and Q value, 72 Natural Resource Management (NRM) was selected to measure the role of farm women towards natural resource management activities. The co-efficient of

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reliability was calculated by the Rulon's formula i.e. 0.81 and the content validity was observed thoroughly. The reliability and validity of the scale indicate its consistency and precision of the results. This scale can be used to measure the role of farm women in natural resource management activities.

*Keywords: Natural resource management; role; scale; farm women; technique; scale development.*

## 1. INTRODUCTION

Natural resources are important for human beings to sustain life on earth. Natural resources are such as soil, water, livestock, forest, fuel wood/ firewood etc [2-4]. However, continuous use of natural resources by the human beings, had affected the earth to such an extent that infinite resources are slowly becoming finite such as water resource, which was infinite resource once. There is need to manage our natural resources to improve the sustainability of the natural resources. Almost half of the Indian population belongs to female population. Women have always come to forward to conserve and protect natural resources because they are the primary users of natural resources traditionally as well as modern [12-14]. Women play the primary role of natural resource management as they are the majority of workers on the land. As the primary providers of water, food and energy at the household and community levels, women in rural settings are generally highly dependent on natural resources for their livelihoods. An attempt was made to develop a scale, which can scientifically measure role of farm women in natural resource management [10,11]. The importance of the developed scale is that it fulfils the the main purpose of helping the researchers/policy makers/government officials to find out the role of farm women in major natural resource management activities [8,9]. So, that they can bring new policies/schemes in future for farm women engaged in natural resource management activities and also farm women may get their required recognition by the society [5-7]. All possible efforts were made to make the study more meaningful and precise but due to paucity of time at the disposal of investigator, the present investigation bears this usual limitation as follows;

- The study was delimited to Bikaner district of Rajasthan.
- The study was delimited to farm women regarding natural resource management.
- The scale was delimited to role performance of farm women.

## 2. METHODOLOGY

To measure the role of farm women in natural resource management activities, a scale was developed by using the technique of "Scale Product Method" which combines the Thurston's technique of equal appearing interval scale for selection of the items and Likert's technique of summated rating for ascertaining the response on the scale as proposed by Eysenck and Crown (1949). The procedure to select final activities to measure the role of farm women in natural resource management activities has been explained with an example and selected as well as rejected natural resource management activities are also enlisted.

The formulas that have been used to determine the scale value and quartile value are as follows:

$$S = L + \frac{0.30 - \Sigma P_b}{P_w} * i$$

To determine value of Q, two other point were measured, the 75th centile and 25th centile. The 25th centile was obtained by the formula.

$$C_{25} = L + \frac{0.25 - \Sigma P_b}{P_w} \times i$$

Where,

C25 = The 25th Centile value of the statement

L = The Lower limit of the interval in which the 25th Centile falls

$\Sigma P_b$  = The sum of the proportion below the interval in which the 25th centile falls

$P_w$  = The proportion within the interval in which the 25th Centile falls

i = The width of the interval and is assumed to be equal to 1.0 (one)

The 75th centile was obtained by the formula:

$$C_{75} = L + \frac{0.75 - \Sigma P_b}{P_w} \times i$$

Where,

C75 = The 75th Centile value of the statement.

L= The Lower limit of the interval in which the 75th Centile falls.

$\Sigma P_b$  = The sum of the proportion below the interval in which the 75th Centile falls.

Pw = The proportion within the interval in which the 75th Centile falls.

I=The width of the interval and is assumed to be equal to 1.0 (one).

### 2.1 Steps in Development of Role Scale

The detailed steps which were followed and standardization of the scale to measure the role of farm women towards natural resource management activities are given below:

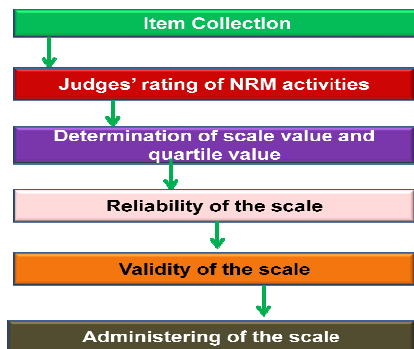


Fig.1 Steps involved in development of scale for farm women towards NRM activities

### 2.2 Item Collection

The items making up a role scale are known as activities. The 78 major and specific activities which come under natural resource management were collected from the relevant literature as well as constructed through discussion with experts and major advisor. The 72 activities thus selected were arranged in various major categories and edited on the basis of the criteria laid down by Edward (1957).

### 2.3 Judges' Rating of Role Performance Activities

In order to judge the degree of "Most Relevant" to "Not Relevant" of each activity on the three point equal appearing interval continuum, a panel of thirty (30) judges was selected. The selected activities were shown to the experts from various departments for Standardization. Their valuable suggestions were considered for the analysis.

### 2.4 Procedure to Select Final Statements

The data from the 30 judges were arranged in the form as shown in Table 1. The table shows the frequency distribution of judgments made by the judges for the activity No.18 on three categories (Explained with example).

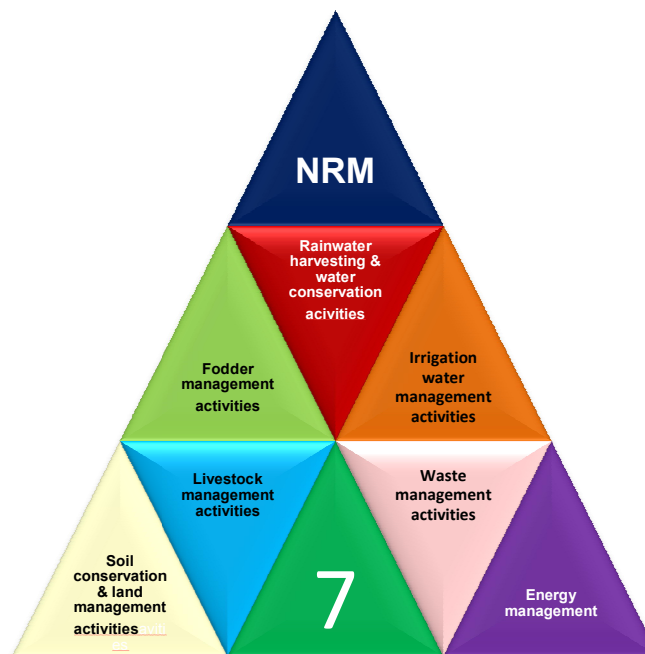


Fig.2 The major categories of natural resource management activities

**3. RESULTS AND DISCUSSION**

As shown in Table 2, three rows are used for each activity. The first row gives the frequency (f) with which the activity was placed in each of the three categories. The second row gives these frequencies as proportions (p). The proportions are obtained by dividing each frequency by n i.e. the total number of the judges (here it is 30). The third row gives the cumulative proportions (cp), that is the proportion of the judgments in a given category plus the sum of all the proportions below the categories.

**3.1 Determination of Scale Value and Quartile Value**

If the median of the distribution of the judgment for each statement is taken as the scale value of the activity, then the scale values can be found from the data arranged in the number of the Table 2 by means of the following formula:

$$S = L + \frac{0.30 - \sum P_b}{P_w} * i$$

Substituting in the above formula to find out the scale value for the activity number 18 in Table 2:

$$S = 1.5 + \frac{0.30 - 0.06}{0.27} * 1$$

$$S = 1.5 + 0.89$$

$$S = 2.39$$

The scale value can be found in the same manner for the other activities.

Thurstone and Chave [1] used the inter-quartile range Q as a means of the variation of the distribution of the judgments for a given statement. To determine value of Q, two other point were measured, the 75th centile and 25th centile. The 25th centile was obtained by the formula.

$$C_{25} = L + \frac{0.25 - \sum P_b}{P_w} * i$$

Where,

- C25= The 25th Centile value of the statement
- L= The Lower limit of the interval in which the 25th Centile falls
- ΣPb= The sum of the proportion below the interval in which the 25th centile falls
- Pw= The proportion within the interval in which the 25th Centile falls
- i= The width of the interval and is assumed to be equal to 1.0 (one)

For the activity no.18 in Table 2,

$$C_{25} = 1.5 + \frac{0.25 - 0.06}{0.27} * 1$$

$$C_{25} = 1.5 + 0.70$$

$$C_{25} = 2.20$$

The 75th centile was obtained by the formula:

$$C_{75} = L + \frac{0.75 - \sum P_b}{P_w} * i$$

**Table 1. Frequency of the distribution of judgment made by judges on three categories for activity No. 18**

S.No.	Distribution of the judgement for the activity no. 18	Frequency
1	Not relevant	02
2	Relevant	08
3	Most relevant	20
Total		30

**Table 2. Summary of judgments made by judges on three categories for activity No. 18**

Activity no. 18	Sorting categories			Scale value	Quartile value
	1	2	3		
F	02	08	20	2.39	1.86
P	0.06	0.27	0.67		
Cp	0.07	0.34	1.00		

Where,

$$Q = C75 - C25$$

C75= The 75th Centile value of the statement

Substituting the values,

L= The Lower limit of the interval in which the 75th Centile falls

$$Q = 4.06 - 2.20$$

ΣPb = The sum of the proportion below the interval in which the 75th Centile falls

$$= 1.86$$

Pw= The proportion within the interval in which the 75th Centile falls

In this manner the interquartile range (Q) for each statement was worked out for determinations of ambiguity involved in the statements. Only those statements were selected whose median values were greater than Q value. In case of activity no. 18, S = 2.39 and Q = 1.86. Hence, the activity number 18 was selected.

I= The width of the interval and is assumed to be equal to 1.0 (one)

For the activity no.18 in Table 2,

$$C75 = 1.5 + \frac{0.75 - 0.06}{0.27} * 1$$

$$C75 = 1.5 + 2.56$$

$$C75 = 4.06$$

Thurstone and Chave [1] described another criteria in addition to Q as a base for rejecting activity in scales constructed by the method of the equal appearing interval. Accordingly when a few activities had the same scale values, the activity having lowest Q values were selected. To understand this procedure, the activities were examined for the scale in Table 3.

Then the interquartile range would be given by taking the difference between C75 and C25, thus,

**Table 3. Selection of natural resource management activities by the judges for the role scale based on scale value and inter quartile range**

S. No	Activities	Scale value	Quartile value	Selected/ Rejected
<b>A) Rainwater harvesting and water conservation activities</b>				
1	Development of gully plugs along slopes	1.6	0.3	Selected*
2	Selection of slope breaks for storage in gully plug	1.6	0.5	Selected*
3	Construction of contour bunds on sloping grounds	1.6	0.5	Selected*
4	Construction of check dams/nala bund across streams	1.7	0.4	Selected*
5	Development of downstream water cushion chamber in check dams/nala bund	1.7	0.4	Selected*
6	Preparation of percolation tanks/earthen dams by submerging highly permeable land	1.7	0.7	Selected*
7	Construction of recharge shaft in village tanks	1.8	0.6	Selected*
8	Cleaning of existing and abandoned dug wells to use them for recharge structure for conservation	1.8	0.5	Selected*
9	Periodic chlorination of dug wells for controlling bacteriological contaminations	1.8	0.5	Selected*
10	Construction of underground dam to store water upstream below ground surface	1.8	0.2	Selected*
11	De-silting of canals/tanks during summer months	1.8	0.3	Selected*
12	Avoiding leakage of water from the taps	1.8	0.3	Selected*
13	Using minimum amount of water to bath	1.9	0.8	Selected*
14	Do not leave the tap running while washing the clothes	1.9	0.8	Selected*
15	Storage of drinking water in potable earthen pots	1.9	0.6	Selected*
16	Using water from cooked vegetables for cooking dal or rice	1.9	0.5	Selected*
17	Maintenance of water conservation structures	1.9	0.4	Selected*

S. No	Activities	Scale value	Quartile value	Selected/ Rejected
<b>B) Soil conservation and land management activities</b>				
18	Sowing seeds of improved varieties	2.4	1.9	Selected*
19	Moderate use of fertilizers	2.0	1.5	Selected*
20	Terracing	2.0	1.8	Rejected
21	Contour ploughing	2.0	1.8	Rejected
22	Green manuring	2.0	1.3	Selected*
23	Crop rotation	2.2	1.5	Selected*
24	Preparation of field bunds	2.2	1.4	Selected*
25	Strip cropping	2.2	2.0	Rejected
26	Land levelling	2.2	1.5	Selected*
27	Deep ploughing	2.4	1.3	Selected*
28	Cover crops	2.4	2.1	Rejected
29	Wind breaks and shelterbelts	2.4	2.3	Rejected
30	Mulching	2.4	1.2	Selected*
31	Zero tillage/minimum tillage/direct seeding	2.5	1.2	Selected*
32	Application of organic fertilizers	2.5	1.4	Selected*
33	Planting trees, plants and shrubs	2.5	1.3	Selected*
<b>C) Irrigation water management activities</b>				
34	Preparation of basins (basin irrigation)	2.5	1.3	Selected*
35	Cleaning of mains and submains (Sprinkler & drip irrigation)	2.5	0.4	Selected*
36	Fitting of pressure gauge (Sprinkler & drip irrigation)	2.5	0.9	Selected*
37	Injecting chemical fertilizers (Sprinkler and drip irrigation)	2.5	0.8	Selected*
38	Cleaning of emitters (drip irrigation)	2.5	0.8	Selected*
39	Fitting of pipes (drip irrigation)	2.5	1.2	Selected*
40	Installation of tape with emitters (drip irrigation)	2.5	1.4	Selected*
41	Installation of venture and filter tank ( sprinkler & drip irrigation)	2.6	1.4	Selected*
42	Scheduling irrigation	2.6	1.0	Selected*
<b>D) Livestock management activities</b>				
43	Artificial insemination	2.6	1.1	Selected*
44	Use of mineral mixture for feed	2.7	1.3	Selected*
45	Cleaning of cattle shed	3.0	1.0	Selected*
46	Care of sick animal	2.7	1.4	Selected*
47	Breeding of animals	2.7	1.4	Selected*
48	Milk processing	2.8	1.0	Selected*
49	Record keeping	2.8	1.0	Selected*
50	Balanced diet	2.8	1.2	Selected*
51	Preparation of manures	2.8	1.2	Selected*
52	Disease management	2.9	1.3	Selected*
53	Excreta management	2.9	1.3	Selected*
54	Marketing of produce	2.9	1.4	Selected*
55	Grazing of animal	2.9	1.4	Selected*
<b>E) Waste management activities</b>				
56	Minimal or no usage of plastic	2.9	2.0	Selected*
57	Formation of manure pit	3.0	2.2	Selected*
58	Segregating of household waste	3.0	2.1	Selected*
59	Reuse and recycling of non-biodegradable solid waste	3.0	1.9	Selected*
60	Feeding biodegradable waste to cattle	3.1	1.6	Selected*
61	Reuse greywater for irrigation and gardening	3.2	1.8	Selected*
<b>F) Energy management activities</b>				

S. No	Activities	Scale value	Quartile value	Selected/ Rejected
62	Using smokeless chulha	3.2	2.0	Selected*
63	Using biogas plant	3.3	1.7	Selected*
64	Using solar panels to save electricity	3.3	2.0	Selected*
65	Turn off the lights when not in use	3.3	2.2	Selected*
66	Using cow dung cakes	3.4	2.0	Selected*
67	Using agro waste	3.4	1.6	Selected*
68	Using LPG stoves	3.4	1.8	Selected*
69	Avoiding unnecessary use of kerosene	3.4	2.0	Selected*
<b>G) Fodder management activities</b>				
70	Mixed fodder system	3.5	2.7	Rejected
71	Hay making	3.5	2.1	Selected*
72	Silage making	3.5	2.1	Selected*
73	Determining good silage quality	3.5	2.0	Selected*
74	Chaffing of fodder/straws/stovers	3.6	1.9	Selected*
75	Creation of fodder bank	3.6	1.9	Selected*
76	Controlling grazing	3.6	2.1	Selected*
77	Feed –cum- shade trees/looping trees	3.8	2.0	Selected*
78	Storage of fodder	3.8	2.0	Selected*

### 3.2 Final Activities for Role Scale

When there was a good agreement among the judges in judging the degree of agreement or disagreement of a statement, Q was smaller compared to the scale value obtained. Thus, only those activities were selected whose median (scale) values were greater than Q values. However, when a few activities had the more or less similar scale values, statements having lowest Q value were selected. Based on the median and Q values, 72 activities out of 78 activities numbering 1,2,3,4,5,6,7,8,9,10,11,12, 13,14,15,16,17,18,19,22,23,24,26,27,30,31,32,3 3,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48, 49,50,51,52,53,54,55,56,57,58,59,60,61,62.,63,6 4,65,66,67,68,69,71,72,73,74,75,76,77,78 of the original list were finally selected to constitute role scale.

### 3.3 Reliability of the Scale

A scale is reliable if it consistently produces the same results when applied to the same sample. In the present study, split-half method of testing reliability was used because of limited time and resources available with the researcher. The 72 activities were divided into two halves with 36 odd numbered in one half and 36 even-numbered activities in the other. These were administered to 25 respondents who were non-sample. Each of the two sets of activities was treated as a separate scale and then these two subscales were correlated. The co-efficient of reliability was calculated by the Rulon’s formula (Guilford, 1954), which came to 0.81. Thus, the

scale developed was found reliable and considered good. To understand this procedure, the activities were examined for the scale in Table 4.

The co-efficient of reliability was calculated by the following Rulon’s formula:

$$rtt = 1 - \frac{\sigma^2 d}{\sigma^2 t}$$

Where,

$$\sigma^2 d = \frac{\sum d^2 - \frac{(\sum d)^2}{n}}{n}$$

$$\sigma^2 t = \frac{\sum t^2 - \frac{(\sum t)^2}{n}}{n}$$

rtt= coefficient of reliability  
 $\sigma^2 d$ = variance of these differences  
 $\sigma^2 t$ =variance of total score

#### Calculation:

$$\sigma^2 d = \frac{485 - (105)^2/25}{25}$$

$$\frac{485-441}{25}$$

=1.76

**Table 4. Reliability test (split-half reliability)**

S. No.	Total score of odd activities (x)	Total score of even activities (y)	Difference D (x-y)	d <sup>2</sup> (x-y) <sup>2</sup>	Total score of odd and even activities t= (x+y)	t <sup>2</sup>
1	90	92	2	4	182	33124
2	96	90	6	36	186	34596
3	95	91	4	16	186	34596
4	98	94	4	16	192	36864
5	97	92	5	25	189	35721
6	95	91	4	16	186	34596
7	97	94	3	9	191	36481
8	95	92	3	9	187	34969
9	95	92	3	9	187	34969
10	98	94	4	16	192	36864
11	95	90	5	25	185	34225
12	94	90	4	16	184	33856
13	95	92	3	9	187	34969
14	98	93	5	25	191	36481
15	95	92	3	9	187	34969
16	98	93	5	25	191	36481
17	98	92	6	36	190	36100
18	96	92	4	16	188	35344
19	97	95	2	4	192	36864
20	97	92	5	25	189	35721
21	98	92	6	36	190	36100
22	94	89	5	25	183	33489
23	97	90	7	49	187	34969
24	96	91	5	25	187	34969
25	92	90	2	4	182	33124
Total	2391	2295	Σd=105	Σd <sup>2</sup> =485	Σt=4691	Σt <sup>2</sup> =880441

$$\begin{aligned}\sigma^2 t &= \frac{880441 - (4691)^2/25}{25} \\ &= \frac{880441 - 880219.24}{25} \\ &= 8.87\end{aligned}$$

$$\begin{aligned}r_{tt} &= 1 - \frac{1.76}{8.87} \\ &= 0.81\end{aligned}$$

### 3.4 Content Validity of the Scale

The validity of the scale was examined for content validity by determining how well content

were selected by discussing it with specialists of extension and academicians. The content of the scale was realised applicable to measure attitude of teachers towards application of multimedia in higher agricultural education by the experts. Thus, the present scale satisfied the content validity.

### 3.5 Administration of the Scale

The selected 72 activities for the final format of the role scale were arranged according to subcategories of natural resource management. Against these 72 activities, there were three columns representing five points continuum of relevancy to the activities. The three points on continuum were never performed, sometimes performed and always performed with respective weightage of 1, 2 and 3.



#### 4. CONCLUSION

Farm women are the primary users of natural resources. Thus, management of natural resources and its activities are moreover dependent on farm women. The scale developed will be useful to measure the role of farm women towards natural resource management activities. Researchers can use the scale in future in similar studies. The role scale developed was found 81 per cent reliable and considered good. The present study concluded a lot of major activities of natural resource management in which farm women are generally engaged. It can be concluded that almost in every aspect, farm women were engaged in every form. It was recommended to reduce the limitations of the present investigation by doing research activity in broad area and on heterogenous sample.

#### DISCLAIMER

Authors have declared that no competing interests exist. 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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