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Development of an Index to Assess Resource Management by Farmers

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Abstract

An attempt has been made to develop an index to assess the resource management by farmers. Based on the review of literature and discussion with experts, 89 indicators were identified under seven dimensions. The relevancy rating was obtained from 60 judges in the concerned area. Accordingly, the dimensions and indicators which were having relevancy percentage of more than or equal to 75.00 per cent and more than or equal to 3.75 mean relevancy score were considered for final selection. Accordingly, 89 indicators classified under natural resource management (27 indicators), human resource management (6 indicators), financial resource management. (11 indicators), physical resource management (19 indicators), agricultural resource management (14 indicators), social resource management (4 indicators) and management of farm animals (8 indicators) were retained after relevancy test for inclusion in the resource management index. The reliability and the validity of the index was 0.754 and 0.868, respectively. The calculation of scale values was done by working out the 'P' based on the formula recommended by Guilford (1954), 'C' scale values was worked out based on hull table (Hull, 1928) for calculating 'R_j' value and finally the scale values (R_c) were worked out for the dimensions of resource management. Further, the composite index for resource management was calculated using the linear aggregation method.

Keywords : Resource management, Dimensions, Indicators, Reliability, Validity

Agriculture enterprise is a way of life for Indian farmers. In an increasing crowded world, the conservation and management of resources is vital to sustain life support system on the earth. The wealth of a nation depends on the richness of the natural resources it is blessed with. Fortunately, India is favoured with such varied resources *viz.,* climate, soil, fauna and flora, production of all types of crops and tree species. As a result, Indian agriculture is seen with diversified farming situations with wide physiographic, geological and climatic features influenced by varied socio-economic characteristics of farm families.The serious concern of declining land man ratio, production, employment and income will be the dictating strategy components as well as investment decisions (Samra and Prathap, 2000). The situation after independence forced the country to give more thrust on enhancement of agricultural production and productivity. Hence, most of the rural / agricultural development programmes implemented during post independence period has resulted in increasing the production mainly through vertical expansion with little horizontal expansion. Though Indian agriculture was successful in attaining food self-sufficiency, the degrading trend of natural and other resources emerged as a serious problem (Anonymous, 2017).

All the agricultural resources can be classified into two ways as fixed and variable resources. The factors of production can be broadly categorized into land, labour, capital and management. The fact remains that all farmers, including small and subsistence farmers, make use of management factor as it is an integral part of production on their farms. As the farm is the basic managerial and decision making unit by which agriculture is carried on, there is a greater need of resource management studies to help the farmers to improve their level of resource management. Better managing resources could increase the farmers' income (Jeroma Kimaro, 2019). Further the farmers should plan the above resources for getting employment and income considerably from agriculture (Anonymous, 2000).

With this background, the present study is taken up to develop an index for analyzing the resource management by farmers.

METHODOLOGY

The resource management by farmers is operationally defined in the present study as the judicious decisions of the farmers regarding the use of scarce and available resources effectively and efficiently without affecting the production environment. Eight steps were followed to develop an index for analyzing the resource management by farmers (Sunitha and Nanjappa, 2015).

Step 1: Identification of Resource Management Dimensions and Indicators

Based on thorough review of literature and in consultation with the scientists of University of Agricultural Sciences, Bangalore, seven dimensions with 99 indicators were included for developing an index to assess the resource management by farmers. The dimensions identified were: (1) natural resource management, (2) human resource management, (3) financial resource management, (4) physical resource management, (5) agricultural resource management, (6) social resource management and (7) management of farm animals. The natural resource management was reclassified into three sub dimensions *viz.,* land resource management, water resource management and natural vegetation management (excluding crops) having eleven, nine and seven indicators, respectively.

Operational Definitions of the Dimensions and Sub Dimensions of Resource Management

Natural resource management is the degree to which the management of natural resources such as land, water, soil and vegetations in particular on enhancing the quality of life for both present and future generations. Land resource management is the process of managing the land resources like soil to make it more profitable. Water resource management is the process of managing and utilizing the available water resources both qualitatively and quantitatively by proper planning. Natural vegetation management (excluding crops) is the proper management of the natural vegetations other than main crop to support the farmers.

Human resource management dimension is the degree to which the management of the human skills, intelligence and knowledge for the use of technology to transform a natural resource into usable and valuable things. Financial resource management dimension is the degree to which the management of monetary resources by the farmers themselves involving mobilization and effective utilization of the available resources. Physical resource management dimension refers to the degree to which the management of the tangible items that are used in the agriculture for the production of goods and services.

Agricultural resource management dimension is the management of all the natural and manmade resources together comprises to support the agricultural production. Social resource management dimension is the degree to which the management of the social resources that have impact on the quality of life of people for the enhancement of standard of living. Management of farm animals dimension refers to the degree to which the rearing and management of the farm animals for the domestic use and to get year round income

Step 2: Relevancy Test of Dimensions and Indicators of Resource Management

Ninety nine indicators classified under seven dimension of resource management were sent to 100 scientists working in State Agricultural Universities, Indian Council of Agricultural Research Institutes and Development Departments, to critically evaluate the relevancy of each dimension and indicator on a five point continuum *viz.,* Most Relevant (MR), Relevant (R), Somewhat Relevant (SWR), Less Relevant (LR) and Not Relevant (NR) with the score of 5,4,3,2 and 1, respectively. The judges were also requested to make necessary modifications and additions or deletion of dimensions and indicators if they desired to. A total of 60 judges returned the questionnaires duly completed and these 60 questionnaires were considered for further processing.

From the collected data, 'Relevancy Percentage (RP)' and Mean Relevancy Score (MRS)' were worked out for all the seven dimensions and ninety nine indicators classified under seven dimension of resource management. Using RP and MRS, the individual dimension and indicator was screened for relevancies using the following formulae.

a) Relevancy Percentage (RP): was obtained by using the following formula.

$$RP = \frac{MR\times5 + R\times4 + SWR\times3 + LR\times2 + NR\times1}{\text{Maximum possible score}} \times 100$$

b) Mean Relevancy Score (MRS): was worked out using the following formula

$$MRS = \frac{MRS = MR\times5 + R\times4 + SWR\times3 + LR\times2 + NR\times1}{\text{Number of judges responded}}$$

Accordingly, the dimensions and indicators which were having 'Relevancy Percentage' of 75 per cent and above and 'Mean Relevancy Score' of 3.75 and above were considered for final selection. Accordingly, 89 indicators classified under natural resource management (27 indicators), human resource management (6 indicators), financial resource management. (11 indicators), physical resource management (19 indicators), agricultural resource management

TABLE 1
Relevancy percentage and mean relevancy score of natural resource management of resource management index (n-60)

Indicators of Resource Management	Relevancy percentage	Mean relevancy score
Natural resource management dimension	93.33	4.66
A. Land resource management - sub dimension		
Selection of suitable crop for the soil	90.12	4.50
Practicing summer ploughing	85.18	4.25
Maintaining optimal crop intensity	87.65	4.38
Application of recommended quantity of organic manures	82.96	4.14
Use of recommended agricultural implements	80.24	4.01
Practicing crop rotation	78.02	3.90
Practicing land leveling	90.60	4.53
Practicing zero tillage / minimum tillage	87.27	4.36
Soil testing once in 3 years	85.45	4.27
Application of fertilizers based on soil test recommendation	84.55	4.23
Ploughing across the slope to prevent soil erosion	86.06	4.30
B. Water resource management - sub dimension		
Rain water conservation	88.88	4.44
Maintaining optimal irrigation to crops	88.14	4.40
Practicing optimal tillage	88.14	4.40
Construction of farm pond	85.67	4.28
Practice mulching	82.71	4.13
Regular cleaning of irrigation channels	83.45	4.17
Diverting excess water for productive purposes	85.99	4.29
Adoption of micro irrigation technologies	80.00	4.00
Adequate drainage facilities	84.56	4.23
C. Natural vegetation management (excluding crop) - sub dimension		
Farm forestry	83.45	4.17
Agro forestry	78.27	3.91
Green and green leaf manuring practice	75.11	3.81
Growing trees as wind brakes	82.22	4.11
Trees and plants as natural fence	83.45	4.17
Recycling of crop wastes	80.00	4.00
Preparation of bio-pesticides from the vegetation available in farm	82.96	4.14

TABLE 2

Relevancy percentage and mean relevancy score of human resource management of resource management index (n-60)

Indicators of Resource Management	Relevancy percentage	Mean relevancy score
Human resource management dimension	83.33	4.16
Employing family labourers	80.98	4.04
Utilizing hired labourers for better turn out	80.49	4.02
Effective supervision of hired labourers	82.22	4.11
Employing labourers for specific work on contract basis	82.46	4.12
Optimal engagement of labourers	83.45	4.17
Employing skilled labourers	88.14	4.40

(14 indicators), social resource management (4 indicators), and management of farm animals (8 indicators) were retained after relevancy test and these indicators were suitably modified and written as per the comments of the judges wherever applicable.

Step 3: Computing Scale Values for Dimensions of Resource Management

The same 60 scientists were presented the seven dimension of resource management to assign rank order based on the relative importance of the dimensions. After receiving ratings from the scientists, the dimensions were used in calculation of scale values. The ranking of the dimensions were done based on their relative importance. Further, the ranks were converted into rank values using the formula:

$$R_i = (n - r_i + 1)$$

Where,

R_i =Rank values;

n = Number of dimensions

r_i = Ranks given by judges to seven dimensions.

$$P = \frac{(Ri - 0.5)}{n} \times 100$$

Where,

P= Centile position

R_i = Rank value

n = Number of dimensions

The calculation of scale values was done by working out the 'P' based on the formula recommended by Guilford (1954), 'C' scale values was worked out based on hull table (Hull, 1928) for calculating 'R_j' value and finally the scale values (R_c) were worked out for the dimensions of resource management.

$$R_j = \sum f_{ji} C$$

$$Rc = (2.357 \times Rj) - 7.01$$

Where,

R_c = scale value

C= Values determined to each centile value

R_i = Rank value

The calculated scale values for the seven dimension of the resource management are presented in Table 8.

The rank-wise dimensions of resource management are presented in Table 9.

It is observed from the Table 9 that human resource management is ranked first (7.13) according to the scale value, followed by natural resource management (6.14) and financial resource management (6.14) occupied second ranks. Agricultural resource management (4.56), physical resource management (3.00), social resource management (2.79) and management of farm animals (1.23) occupied IV, V, VI and VII ranks, respectively based on scale value.

Step 4: Measurement Procedures of Indicators

As the index developed was composite in nature, the indicator measures include both quantitative and qualitative procedures. Under each indicator, suitable sub indicators and variables are identified and levels of measurement are fixed for variables.

Step 5: Schedule Development

A schedule was prepared to elicit appropriate variability for resource management for all the 89 indicators of seven dimensions of resource management. A pilot study was conducted with 30 farmers in three villages of T. Narasipur taluk in Mysore district of Karnataka state (non-sample area) for testing the reliability and validity of index.

TABLE 3

Relevancy percentage and mean relevancy score of financial resource management of resource management index (n=60)

Indicators of Resource Management	Relevancy percentage	Mean relevancy score
Financial resource management dimension	93.33	4.66
Maintenance of annual expenditure record	78.76	3.93
Formal financial services availed in past one year (fixed deposit, mutual funds, recurring deposits, post office schemes, insurance, kissan credit card, loans and government subsidies)	85.92	4.29
Informal financial services availed in the past one year (Money lender/ commission agents. Money from friends/relatives and selling property/pledging property)	84.44	4.22
Purpose of utilizing finances availed from financial service providers (Investment in agriculture, savings, home loans, car loans, festivals, social obligations and household expenses/school fees)	85.18	4.25
Profit utilization pattern (Meeting necessities, education of children, saving for future, farm expansion, investment in farm machineries/ irrigation structures and renovation of existing house)	81.97	4.09
Affordable price to the agricultural inputs	82.46	4.12
Minimization of expenditure on agricultural inputs	80.00	4.00
Information on market price (Middlemen, friends/relatives, mass media, experience and website/internet)	80.30	4.02
Sale of produce (International market, National market, state market, district/ taluk level market, local market, middlemen at village level and shandy)	83.94	4.20
Remunerative price to the main product	82.73	4.14
Remunerative price to the By-product	86.17	4.30

RESULTS AND DISCUSSION

Step 6: Testing for Reliability

Reliability refers to precision of the index developed for any purpose. A reliability test will be reliable when it gives the same repeated result under the same conditions. In any social science research, a newly constructed index has to be tested for its reliability before it is used. The split-half method was employed to test the reliability of the resource management index. The value of correlation coefficient was 0.754 and this was further corrected by using Spearman Brown formula to obtain the reliability coefficient of the whole set. The 'r' value of the index, which was significant at one per cent level indicating the high reliability of the index. It was concluded that the index constructed was reliable.

a) Half test reliability formula :

$$r_{1/2} \frac{N(\sum XY) - (\sum X)(\sum Y)}{\sqrt{(N\sum X^2 - (\sum X)_2)(N\sum Y^2 - (\sum Y)^2)}}$$

Where,

$r_{1/2}$ = Half test reliability

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

N = Total number of items

b) Whole test reliability formula

$$r = \frac{2_{r1/2}}{1 + r_{1/2}}$$

Where,

$r_{1/2}$ = Half test reliability

TABLE 4

Relevancy percentage and mean relevancy score of physical resource management of resource management index

(n=60)

Indicators of Resource Management	Relevancy percentage	Mean relevancy score
Physical resource management dimension	80.00	4.00
Possession of physical assets Borewell, farm pond, machineries etc.)	83.70	4.18
Accessibility to farm machineries hiring hub	86.17	4.30
Accessibility to market	79.75	3.98
Accessibility to farm clinic	82.96	4.14
Accessibility to farm science centres/KVK's	88.88	4.44
Accessibility to Raitha Samparka Kendras (RSK's)	76.54	3.82
Accessibility to seed hubs	82.71	4.13
Accessibility to pesticide/ fertilizer shops	85.92	4.29
Accessibility to Veterinary dispensary	81.23	4.06
Accessibility to Weekly shandy	84.44	4.22
Accessibility to Daily market	84.93	4.24
Accessibility to Regulated market	84.68	4.27
Accessibility to Cooperative societies	80.30	4.02
Accessibility to Milk collection centre's	85.23	4.26
Accessibility to Rural bank/ PAC'S	81.99	4.09
Accessibility to Nationalized Bank	82.67	4.13
Accessibility to Lorry/ Tempo service	81.52	4.08
Accessibility to Bus service	85.18	4.25
Accessibility to Diesel and petrol bank	81.97	4.09

TABLE 5

Relevancy percentage and mean relevancy score of agricultural resource management of resource management index

(n=60)

Indicators of Resource Management	Relevancy percentage	Mean relevancy score
Agricultural resource management dimension	83.33	4.16
Information on selection of crop (Season, irrigation facility, vogue, previous experience, market demand, friends/relatives and consultancy)	88.14	4.40
Adoption of recommended variety	90.12	4.50
Use of seeds from their own field	88.64	4.43
Use of recommended seed rate	84.19	4.20
Maintaining optimum plant population	85.92	4.29
Maintaining recommended spacing	84.44	4.22
Timely sowing	82.71	4.13
Adoption of inter cultivation practices	76.29	3.81
Practicing INM practices	80.00	4.00
Practicing IPM practices	80.14	4.40
Adoption of integrated farming system to utilize the available resources to generate year round income	90.12	4.50
Adoption of recommended post harvest management practices	85.18	4.25
Obtaining recommended quantity of main product	81.52	4.08
Obtaining recommended quantity of by-product	85.18	4.25

TABLE 6

Relevancy percentage and mean relevancy score of social resource management of resource management index (n-60)

Indicators of Resource Management	Relevancy percentage	Mean relevancy score
Social resource management dimension	76.66	3.83
Active participation in different group activities (FIG, CIG, WUA, SHG etc.)	76.79	3.83
Sharing information among farmers	83.45	4.17
Social cohesion existing among the farmers	82.46	4.12
Unity among farmers in solving farmers problems	85.67	4.28

TABLE 7

Relevancy percentage and mean relevancy score of management of farm animals of resource management index (n-60)

Indicators of Resource Management	Relevancy percentage	Mean relevancy score
Management of farm animals dimension	83.33	4.16
Rearing animals on scientific lines	81.52	4.08
Keeping working animals	76.80	3.84
Rearing poultry birds	85.67	4.28
Rearing goats/ sheep	88.88	4.44
Providing balanced feed to the animals	80.00	4.00
Periodical health check up	81.23	4.06
Optimal utilization of animal power	76.54	3.82
Obtaining recommended quantity of animal product	83.70	4.18

Step 7: Validity

It refers to how well a index analyses what it is intended to measure. The square root of whole test reliability value ($r_{1/2}$) gives the validity value. The data was subjected to statistical validity, which was found to be 0.868. Hence, the validity coefficient was also found to be appropriate and suitable for the tool developed.

Step 8: Calculation of Resource Management Index

After data collection, the data obtained for the variables under study was normalized to bring the indicators to

TABLE 8

Calculation of scale values for dimensions of resource management based on the judges rating (n=60)

R_i	R_i	D_1	D_2	D_3	D_4	D_5	D_6	D_7	Total	P	C
1	7	10	15	10	5	10	5	5	60	92.85	7
2	6	15	10	10	10	5	10	0	60	78.57	6
3	5	10	10	15	5	10	5	5	60	64.28	5
4	4	5	10	10	10	5	5	15	60	50.00	4
5	3	10	10	5	5	15	10	5	60	35.71	3
6	2	5	0	5	15	10	15	10	60	21.42	2
7	1	5	5	5	10	5	10	20	60	7.14	1
$\sum f_{ji}$		60	60	60	60	60	60	60	420		
$R_j=\sum f_{ji}C$		335	360	335	255	295	250	210	2040		
$R=R_j/\sum f_{ji}$		5.58	6	5.58	4.25	4.91	4.16	3.5	4.85		
R_c*		6.14	7.13	6.14	3	4.56	2.79	1.23	4.42		

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TABLE 9

Dimension-wise scale values of the resource management (n=60)

Dimension	Scale value	Rank
Human resource management	7.13	I
Natural resource management	6.14	II
Financial resource management	6.14	II
Agricultural resource management	4.56	IV
Physical resource management	3.00	V
Social resource management	2.79	VI
Management of farm animals	1.23	VII

the same standard by transforming them to pure dimensionless numbers.

The functional relationships between the indicators were established before the normalization of indicators whether they have positive or negative relationship.

For the indicator which has positive functional relationship with their respective dimensions, the normalization was done using equation.

$$Y_{ij} = \frac{X_{ij} - \text{Min}(X_{ij})}{\text{Max}(X_{ij}) - \text{Min}(X_{ij})}$$

Where,

Y_{ij} = Unit standard score of the i^{th} respondent on j^{th} dimesion

X_{ij} = Score of the i^{th} respondent on j^{th} dimension

Min X_{ij} = Minimum score on the i^{th} respondent on j^{th} dimension

Max X_{ij} = Maximum score on the i^{th} respondent on j^{th} dimension

For the indicator, which has negative functional relationship with their respective dimensions, then normalization was done using equation.

$$Y_{ij} = \frac{\text{Max}(X_{ij}) - X_{ij}}{\text{Max}(X_{ij}) - X_{ij}}$$

The normalized indicators were weighted following the method developed by Iyengar and Sudarshan (1982) in which they linked weight to variance across the indicators. More precisely they postulated that

$$W_j = C \sqrt{\text{Var}(Y_{ij})}$$

Where,

W_j = Assigned weights

C = Normalizing constant

Y_{ij} = Unit standard score of the i^{th} respondent on j^{th} dimension

The normalized indicators are then multiplied with the assigned weights to construct the indices separately for each dimension of Resource Management Index (RMI) *viz.,* human resource management (HRM), natural resource management (NRM), financial resource management (FRM), agricultural resource management (ARM), physical resource management (PRM), social resource management (SRM) and management of farm animals(MFA). Finally, the composite index for resource management was calculated using linear aggregation method as,

$$RMI = HRM+NRM+FRM+ARM+PRM+SRM+MFA$$

The overall Resource Management Index was categorized into three group namely low, medium and high based on mean and standard deviation.

An index consisting of seven dimensions will be helpful to assess the resource management of farmers and it will enable the researchers to take up studies on resource management in different farming situations. Scale values will be used to identify the status of resource management by farmers in different farming situations such as assured irrigation, protective irrigation and dry land situations.

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