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Research article

Profile Characteristics of Watershed Farmers and the Extent of Adoption of NRM Practices in Watershed Areas of the Andhra Pradesh State

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Abstract

This study describes the association between the profile characteristics of watershed farmers and the extent of adoption of various NRM (Natural Resource Management) practices in watershed areas of the Andhra Pradesh state. The results indicate that positive and significant relationships were seen between profile characteristics such as training undergone, team work, risk-taking ability, input usage pattern, farm size, environmental awareness and socio-political participation and the extent of adoption of NRM activities. The value of the coefficient of multiple determination (R^2) indicates that a combination of six independent variables (farm size, training, input usage pattern, environmental awareness, risk-taking ability and group communication) could explain 78.49 % of the variation in the dependent variable of the extent of adoption of NRM practices.

1. Introduction

The nature and status of natural resources play pivotal roles for sustainable yields in various crops. The potential of resources such as soil and water is decreasing by alarming proportions, thereby affecting farming situations as well as crop production, both at micro and macro levels. The isolated approach of natural resource management (resources often are analyzed and planned for independently leading to isolated approaches) does not yield the expected results, whereas community-based management give the maximum benefits

to farmers in terms of soil, water and moisture conservation for the sustainable use of these resources for better crop production.

Importance of the study

Over the next 20–25 years, global food demand is expected to increase by around 50 %, largely due to demand in developing countries. The challenge is to increase production without damaging the natural resource base. Various technologies for Integrated Natural Resource Management (INRM) have been developed, but adoption has been poor for various technical, socio-economic, and institutional reasons. To date, a great deal of past work has been focused at the plot and farm level, with little farmer involvement in developing the research agenda. Work needs to be extrapolated to include more farmer involvement in the research process in order to answer the key question of under which conditions rural households are encouraged to reinvest in their agro-ecosystems. Encouraging such investment involves several challenges:

- Improving returns from such investments;
- Creating market access for smallholder farmers;
- Improving research–extension–farmer links;
- Development of enabling policies on soil, water and biodiversity;
- Integration of livestock–wildlife–crop systems;
- Development of drought mitigation strategies;
- Capacity building and better information flow;
- A clear gender perspective in research and training.

The number of IWMPs (Integrated Watershed Management Programs) present in India during the period 2009-2015 was 8214. Among all the 29 states, Maharashtra has the highest number of watershed programs (1186), followed by Rajasthan (1025), Uttar Pradesh (612), Gujarat (610), Karnataka (571), Madhya Pradesh (517) and Andhra Pradesh (432).

Andhra Pradesh occupied seventh position in India. In Andhra Pradesh, out of 432 projects, 367 were implemented by government organizations and 65 by NGOs (Non-Government Organizations). Mahabubnagar, Anatapur and Prakasham were the leading districts in the number of IWMPs in the state of Andhra Pradesh. Out of an allocated budget of 2, 26,290.11 lakhs, the budget allotted for NRM activities was 1, 26,722.47 lakhs. The number of NRM beneficiaries under these projects was 65,076.

Every IWMP had 8-10 micro watersheds. Under these 432 IWMPs, 10351 micro watersheds were completed in the state of Andhra Pradesh. Whereas, 33,411 micro watersheds are still in the process of implementation.

Activities performed under IWMPs

The activities performed under the IWMPs along with the percentage of budget allocation accounted for entry point activities (4 %), institution and capacity building (5 %), production enhancement (10 %), livelihood assets (9 %), NRM (56 %), consolidation (3 %), administration (10 %), DPR (1 %) and monitoring (2 %). This clearly indicates that NRM is considered as the prime component of watershed projects. Hence, much focus should be given to assessing needs, designing execution and evaluation of NRM activities in a watershed. Care should be taken in designing the NRM activities according to the farming situation, micro climate and considering the overall socio-economic profile of the farmer.

The major NRM activities covered were soil and water technologies like stone bunding, mulching with agricultural waste, vegetative barriers, loose boulder structures, farm ponds, dug out ponds, check walls, check dams, small and mini percolation tanks, contour bunds, contour trenches etc. The farmers need to have comprehensive knowledge of all these practices/technologies for better conservation of natural resources like soil and water to derive maximum dividends in crop production. There is every need to gauge the degree of natural resource management behavior of the farmers for sustainable use of those resources. Keeping this in view, the present investigation is entitled "A study on the association of profile characteristics of watershed farmers with the extent of adoption of various NRM practices in watershed areas of the Andhra Pradesh state". The study mainly aims to find out which factors will influence a farmer's adoption of various NRM practices and also how far the variables put together explain variation in the extent of adoption of NRM practices.

2. Material and Methods

An ex-post facto research design was adopted for the study, since the variables chosen for the study have already occurred. Andhra Pradesh was selected purposely for the study since the researcher hails from the same state and is familiar with the local language, which helped to build up quick rapport and also enable in depth study combined with personal observation, making the research results useful to watershed user groups and officials of the Integrated Watershed Management Program (IWMP), Watershed Computer Centers (WCCs), District Water Management Agency (DWMA), Scientists of Agricultural University and other NRM related projects in the state. Three regions were selected as the watershed project based NRM activities were widely practiced in these regions. From each region, one district was selected based on the highest number of watersheds (**Figure 1**, **Figure 2** and **Figure 3**). Accordingly, Mahaboobnagar in Telangana, Anathapur in Rayalaseema and Prakasham in Coastal Andhra were selected. From each district two IWMPs were selected, from each IWMP area one mandal was selected, from each mandal four villages were selected and from each village ten watershed farmers were randomly selected. Thus, a total of six (6) IWMPs, six (6) mandals, twenty-four (24) villages and two hundred and forty (240) farmers were considered as the sample for the study. The variables were the

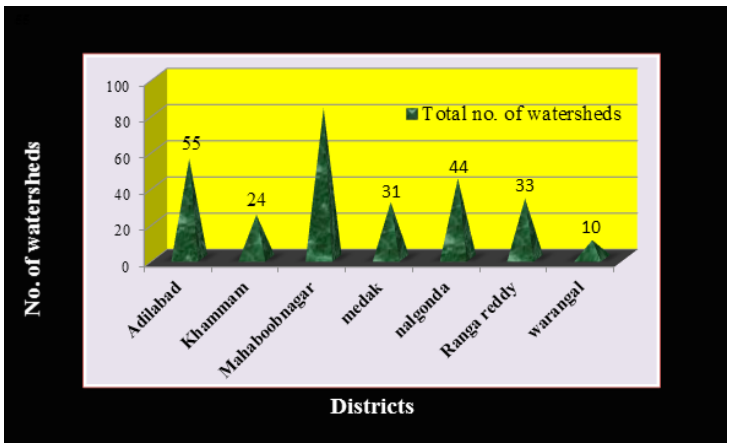

Figure 1: No. of watersheds in Telangana region during 2009-2014

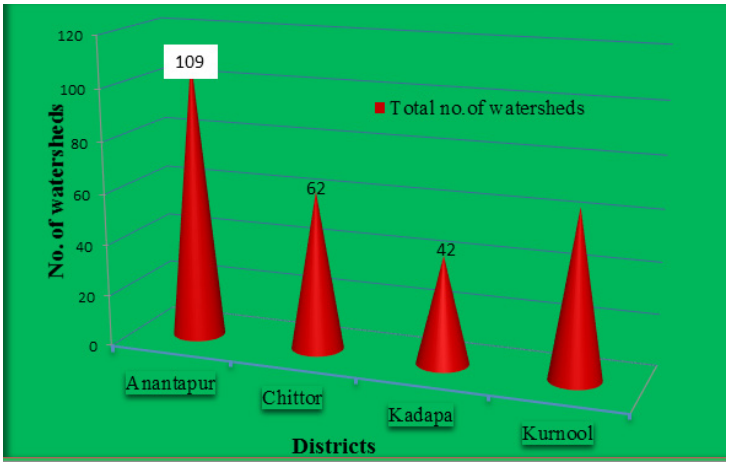

Figure 2: No. of watersheds in Rayalaseema region during 2009-2014

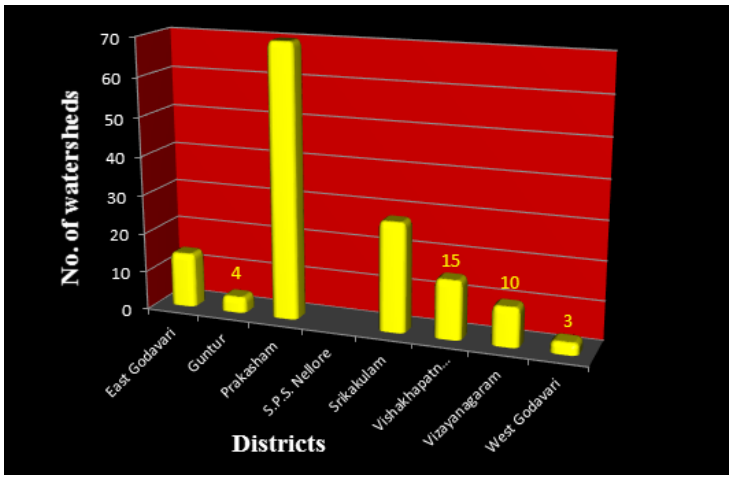

Figure 3: No. of watersheds in Coastal Andhra region during 2009-2014

extent of adoption as the dependent variable, and age, education, farm size, farming experience, training undergone, extension contact, input usage pattern, environmental awareness, socio-political participation, mass media exposure, information-seeking behavior, innovativeness, risk-taking ability, status of watershed, group cohesiveness, group communication, group leadership, team work and group norms as the independent variables for the study.

2.1 Statistical tools

The following statistical tests and measures were used for the analysis of the data.

Coefficient of Correlation (r)

This was used to test the relationship between the dependent and independent variables. The formula used was as follows:

$$r = \frac{\Sigma xy - \frac{\Sigma(x)\,\Sigma(y)}{n}}{\sqrt{\left[\Sigma x^2 - \frac{\Sigma(x)^2}{n}\right]\left[\Sigma y^2 - \frac{\Sigma(y)^2}{n}\right]}}$$

Where,

r = Correlation coefficient
n = Number of respondents
Σ = Sum of scores of Independent Variable
Σy = Sum of scores of Dependent Variables
Σx^2 = Sum of squares of scores of independent variables
Σy^2 = Sum of squares of scores of dependent variables
Σxy = Sum of scores of independent variables multiplied by the scores of dependent variables

The computed 'r' values were then compared with the table values of coefficient of correlation at one and five per cent levels of probability for their significance **[1]**.

Multiple Linear Regression analysis

This statistical tool was used to study the combined or pooled effect of the independent variables over the dependent variable.

y1 = a1 + b1 x1 + b2 x2 +----------+ b14 x14

y2 = a2 + b1 x1 + b2 x2 +---------- + b14 x14

y3 = a3 + b1x1 + b2 x2 + ----------+ b14 x14

a1, a2, a3 = constants

b1 = regression coefficient

x1 to x14 = independent variables selected for the study

y1, y2, y3 = dependent variables

The regression co-efficient was tested for its significance and the following formula was used:

$$t_{(n-k-1)}\ d.f. = \frac{bi}{SE_{(bi)}}$$

Where,
n = number of observations
k = number of independent variables
SE = standard error
bi = regression coefficient
t = test criterion for significance

Coefficient of Multiple Determinations (R^2)

$$R^2 = \frac{\text{Regression sum of squares (RSS)}}{\text{Total sum of squares (TSS)}}$$

Where,
$RSS = b_1\Sigma_{x1}\, y + b_2\Sigma_{x2}\, y + \text{--- ---- --- --} + b_{21}P\Sigma_{x21}\, y$
$TSS = \Sigma y^2$

R^2 is always less than unity and expressed as a percentage. It measures the extent of the variation in the dependent variable (y_i) that can be explained by the independent variables (x_i) together.

This is further extended to step down analysis by which we measure the variables, which mainly contribute to the maximum variation through the elimination process.

Step down regression analysis

The step wise regression analysis was used to select the minimum number of variables necessary to account for almost as much of the variance as it is accounted for by the total set of independent variables. The increase in R^2 was tested for its significance at each step and stopped at a step where the further increase in R^2 was not significant.

3. Results and Discussion

It It is revealed in **Table 1** that the calculated 'r' values between training undergone, team work, input usage pattern, environmental awareness, socio-political participation and the extent of adoption of NRM practices were greater than the 'r' value at a level of probability of 0.05. Hence, the null hypothesis was rejected and the empirical hypothesis was accepted. These results are in line with the findings of **[2]**-**[5]**. The calculated 'r' value of the variables farm size and risk-taking ability were greater than table 'r' value at a level of probability of 0.01. These results are in line with the findings of **[6]**-**[9]**. Hence, the null hypothesis was rejected and the empirical hypothesis was accepted. Therefore, it can be concluded that there was a positive and significant relationship between the extent of adoption of NRM practices and the variables training undergone, team work, risk-taking ability, input usage pattern, farm size, environmental awareness and socio-political participation. These results are in line with the findings of **[10]**, **[11]**.

It can be inferred from **Table 1** that profile characteristics such as training undergone, team work, risk-taking ability, input usage pattern, farm size, environmental awareness and socio-political participation had positive and significant relationships with extent of adoption of NRM practices by the watershed farmers. The farmers who had large land holdings coupled with having undergone more training programs possessed more risk-taking ability, this facilitated them to take up more NRM practices in their fields. High frequency of non-chemical usage made the farmers more readily acceptant of NRM technologies. Awareness of contemporary changes in the environment at a macro level in terms of changes in ecological balance, changes in various environmental parameters, and changes in the status of natural resources helped the farmers adopt need-based NRM practices. These results are in line with the findings of **[12]**-**[15]**. A farmer should adopt technologies if he or she continuously participates in the decision-making process of various formal and informal social organizations present in the village. Participation in the team-building process of the teams/groups working towards the design and implementation of watershed management programs facilitated the adoption of the NRM technologies by farmers, compared to those who did not participate in the teams. These results are in line with the findings of **[16]**.

Table 1: Correlation of profile characteristics of watershed farmers with the extent of adoption of various NRM practices

S. No	Independent variables	Extent of adoption
1	Age	0.1123NS
2	Education	0.1162NS
3	Farm size	**0.2235****
4	Farming experience	0.1199NS
5	Training undergone	**0.1279***
6	Extension contact	0.1181NS
7	Input usage pattern	**0.1418***
8	Environmental awareness	**0.1549***
9	Socio-political participation	**0.1601***
10	Mass media exposure	0.0809NS
11	Information seeking behavior	0.0889NS
12	Innovativeness	0.1133NS
13	Risk-taking ability	**0.7268****
14	Status of watershed	0.1199NS
15	Group cohesiveness	0.1142NS
16	Group communication	0.1144NS
17	Group leadership	0.0734NS
18	Team work	**0.1655***
19	Group norms	0.1222NS

* Significant at a level of probability of 0.05 (0.1269)
** Significant at a level of probability of 0.01 (0.1663) NS –Non Significant

The value of the coefficient of multiple determination (R^2), as given in **Table 2**, indicates that the six independent variables (farm size, trainings, input usage pattern, environmental awareness, risk-taking ability and group communication) together explain up to 78.49 % of the variation of the dependent variable of the extent of adoption of NRM practices. The computed F-value and corresponding partial regression coefficient (b) values of these six variables were found significant at a level of probability of 0.01. Hence the null hypothesis was rejected and the empirical hypothesis was accepted for these six variables and vice-versa for the other thirteen variables. These results are in line with the findings of **[17]**-**[20]**.
The results for NRM practices can be best visualized in large farm

holdings, where knowledge and skills acquisition was higher due to the farmers undergoing more training, leading to more adoption. The behavioral pattern of using organic inputs very frequently helped farmers to attain a comprehensive understanding of the applicability of the technologies, the high level of consciousness on changes in the environment at a macro level helped to gauge the logistics of the practicability of various NRM technologies, thereby increasing the extent of adoption. The degree of withstanding the risks incurred by taking up the innovations definitely augments the extent of adoption of NRM activities. The smooth and hassle-free exchange of ideas and information among the members of a group enables them to acquire the right information at the right time which in turn leads to better adoption. These results are in line with the findings of **[21]**, **[22]**.

Table 2: Multiple linear regression analysis of selected independent variables of watershed farmers with the extent of adoption of NRM practices (n=240)

No.	Variable	'b' value	SE	't' value
X_3	Farm size	0.11035**	0.0513	2.152
X_5	Training undergone	0.23235**	0.1069	2.173
X_7	Input usage pattern	1.24796**	0.2834	4.403
X_8	Environmental awareness	0.41904**	0.1374	3.050
X_{13}	Risk taking ability	0.94008**	0.3041	3.092
X_{16}	Group communication	0.85022**	0.3244	2.621

R^2 = 0.7849 F value = 125. ** Significant at 1% level of probability

4. Conclusion

It can be concluded that the profile characteristics of training undergone, team work, risk-taking ability, input usage pattern, farm size, environmental awareness and socio-political participation had a positive and significant relationship with the extent of adoption of NRM practices by the watershed farmers. The six independent variables, namely farm size, training undergone; input usage pattern, environmental awareness, risk-taking ability and group communication, together explain up to 78.49 % of the variation in the dependent variable of the extent of adoption of NRM practices.

Implications for the study

- The officials of IWMP and DWMA should instill the spirit of team work among the farmers in attending various NRM activities to derive maximum benefit.
- The officials of IWMP, DWMA and SDA should strive to enhance the adoption quotient of NRM activities.
- A regulatory body must be formed with the officials and farmers to supervise various NRM activities under watershed.
- Village panchayats should take initiative to merge groups with overlapping interests.
- Since the majority of the respondents were small and marginal, NRM technologies should be developed to suit the needs and requirements of these farmers. In particular, the technologies should be user-friendly, low cost and compatible.
- The low level of participation of farmers at various stages in watershed management programs can be improved by enlightening the farmers on the need and importance of participation and what kind of benefits are accrued through participation. Local bodies should strive to ensure participation of farmers.
- All the groups working at a village level should be networked to share any reliable information on NRM among all the members in the groups.
- In order to enhance the degree of favorability of farmers to NRM, they need to be oriented on the value of various kinds of NRM technologies, the long and short-term benefits accrued, ecological balance and the improvement in status of natural resources.
- The importance of community participation and group dynamics should be highlighted to the farmers to increase the success rate of NRM activities.
- The extent of adoption of some NRM technologies is medium to high, because of financial support provided by the government, whereas the maintenance of these technologies is poor. Hence the officials of IWMP, DWMA, SDA, KVK and SAU should provide continuous technical advice and supportive mechanisms to sustain these NRM technologies.

References

[1] R. A. Fisher and F. Yates. "Statistical tables for biological, agricultural and medical research," 6th ed., London, Oliver and Boyd, 1963.

[2] P. R. K. Reddy and K. Mohan "Profile characteristics of farmers under tank irrigation commands," *Karnataka J. Agric. Sci.*, vol. 25, no. 3, pp. 359-362, 2012.

[3] M. H. Omid, M. Akbari, K. Zarafshani, Gh. H. Eskandari and H. Sh. Fami. "Factors influencing the success of water user associations in Iran: A Case of Moqan, Tajan, and Varamin". *J. Agr. Sci. Tech.*, vol. 14, no. 1 pp. 27-36, 2012.

[4] M. Abdolmaleky, M. Chizari, J. F. Hoseini and M. Homaee, "Factors affecting farmers' engagement to co-management of watershed conservation programs in Hamedan Province, Iran," *World Applied Sciences Journal*. vol. 12, no. 8, pp. 1307-1313, 2011.

[5] A. J. Farinde, K. O. Soyebo and M. O. Oyedokun, "Improving farmers attitude towards natural resources management in a democratic and deregulated economy: Honey production experience in Oyo state of Nigeria," *J. Hum. Ecol.*, vol. 18, no. 1 pp. 31-37, 2005.

[6] N.D. Peterson."Excluding to include: (Non)participation in Mexican Natural Resource Management," *Agriculture and Human Values*, vol. 28, no. 1 pp. 99-107, Jan. 2010. Doi: https://doi.org/10.1007/s10460-010-9258-x

[7] A. Kulshrestha, T. S. Kushwaha, Y. K Singh and D. P Rai, "Adoption of watershed technologies by the farmers in Morena district of Madhya Pradesh". Indian Res. J. Ext. Edu., vol. 10, no. 2 pp.58-60, May. 2010.

[8] A. Bhattacharya, "Sustainable livelihood based watershed management-watershed plus approach," 1st Working Group Meeting of ERIA. Manila, Philippines, 2008.

[9] S. Ghosh, D. Chandra, P. Nanda, D.K. Panda, A. Mishra, N. Sahoo and A. Kumar. "Waters users group dynamics and mobilization for participatory irrigation management," Research Bulletin No. 31, Water Technology Centre for Eastern Region (WTCER-ICAR), Bhubaneswar, Orissa, India, 2006.

[10] P. P. Marenya and C.B. Barrett, "Household-level determinants of adoption of improved Natural Resources Management practices among smallholder farmers

in Western Kenya," *Food Policy*. vol. 32, no. 4 pp. 515-536, 2007.

[11] S. S. Dolli, "Sustainability of natural resource management in watershed development project," Ph.D dissertation, University of Agricultural Sciences, Dharwad, India, 2006.

[12] M. Alam, M. Rakkibu and M. Rahman. "People's Attitude towards Social Forestry": A Case Study in Rajshahi," *Journal of Environmental Science and Natural Resources*, vol. 5, no. 1 pp. 217-222, Aug. 2012. Doi: https://doi.org/10.3329/jesnr.v5i1.11585

[13] K. Prabhakar, K. Lavanya latha and A. P. Rao. "Prakasam district farmer's participation in Non-governmental organizations (NGOS) watershed programme," *International NGO Journal,* vol. 6, no. 10, pp. 219-223, Oct. 2011.

[14] S. S. Dolli, D. M. Chandaragi, G. M. Varadaraju and L. V. Hirevenkanagoudar. "Association of personal and situational factors with knowledge level of farmers about sustainable natural resource management," *Mysore Journal of Agricultural Sciences*, vol. 44, no. 1, pp.205-208, 2010.

[15] M. Z, Rahman, and M. Yamao. "Farmers' Attitude towards Participatory Resource Management for Sustainable Farming Development - A Study from Bangladesh," *Journal of Rural economics,* Special issue. The Agricultural Economics Society of Japan. Tokyo. 2005.

[16] K. Bhaskaran and C. Praveena. "Adoption of improved dryland agricultural technology in an Integrated Dryland Agriculture Development Project in Andhra Pradesh". *Indian J. Ext. Edu*., vol. 18, pp. 32-39, 1982.

[17] S. B. Goudappa, S. Surekha, B. S. Reddy and A. M. Benki. "Extent of participation of farmers in planning and implementation of community based tank management project in Raichur district," *Indian Research Journal of Extension Education*. Vol. 8, pp. 272-276, Jan. 2012.

[18] Savita. "Impact of community based tank management project on socio-economic status of beneficiary farmers in Bidar district," M. S. Thesis. University of Agricultural Sciences, Dharwad, India, 2011.

[19] A. Nanthakumaran and K. Palanisami, "Farmer participation on water management in the tank irrigated systems in Tamil Nadu," *Int. Conf. on Sustainable Built Environments* (ICSBE), Kandy, Sri Lanka, 2010.

[20] A. Berjesh and K. Ajay. "Knowledge of farmers about soil and rainwater conservation technology and its determinants," *Agriculture Science Digest*, vol. 29, no. 4 pp. 283-286, 2009.

[21] P. Prashanth, "Stakeholder analysis of tank management under project and non project areas in Andhra Pradesh," Ph.D. dissertation, Telangana State Agricultural University, Hyderabad, India, 2015.

[22] T. Gebrelibanos, and M. Assen. "Farmers' attitudes towards land resource conservation and its implication for sustainable land management in the Hirmi watershed, Northern Highlands of Ethiopia," *Journal of Sustainable Development in Africa*. vol. 15, no. 1, pp. 43-55, 2013.