Tropical Agricultural Research Vol. 4 1992

Determinants of Farmer Participation in Irrigation Management: the Case of Kimbulwana Oya Scheme

J. Upasena and P. Abeygunawardena[1]

Postgraduate Institute of Agriculture
University of Peradeniya
Peradeniya

ABSTRACT. Poor performance in irrigation schemes in Sri Lanka is attributed to many factors. Incorporating farmer participation to management process has been suggested as a remedy. A reason for this suggestion is that earlier, views of the bureaucrats have often been imposed on farmers. On the other hand, farmer participation may reduce the budgetary burdens of the government on operation and maintenance (O & M) of irrigation systems while the direct benefits of increased productivity will stay with farmers.

The objective of this study was to investigate the factors that influence labour contribution of farmers in operation and maintenance (O & M) activities in a irrigation system. The Kimbulwana Oya scheme was selected as the study area and multiple regression model was used as the analytical tool in this study. The Number of hours of labour contribution to O & M activities was considered as the dependent variable. Thirteen independent variables were used initially. The final regression model explains that the tail end farmers and the new settlers participate more in the O & M work compared to the head end farmers and the old settlers. Years of farming experience is positively related to the labour contribution while a low degree of land ownership, yield and the harvested extent are negatively related to the labour contribution. Further, the well off farmers are less likely to contribute labour for O & M activities. Therefore, more targeted or discriminatory policies need to be developed in the future to increase farmer cooperation in O & M activities.

---

1 Department of Agricultural Economics and Extension

INTRODUCTION

Farmer participation in irrigation management has been suggested as a remedy for management problems experienced in irrigation schemes. This is the current concern all over the world where irrigated agriculture is practised. In Sri Lanka there is evidence of institutions related to the use of irrigation water from ancient times. The customary laws practised in ancient times were revived by the British rulers and were given official recognition to through the Irrigation Ordinance. According to the ordinance, the *Kanna* meeting or the cultivation meeting is the decision making legal body which decides on seasonal operations and the forum to maintain dialogue between the bureaucracy and farmers (IIMI, 1986).

Although this system has been practised for many years, views of the farmers have not been well reflected in the decision making process. Often the views of bureaucrats were imposed on farmers. Further, in the case of major irrigation projects, planning settlement patterns, selection of settlers and objectives of the government were difficult to combine to make participatory management effective. Therefore farmers participation in maintenance and management of irrigation systems has been minimal. Due to this situation and also due to the low economic returns to investments on major irrigation schemes, the state has been compelled to provide direct and indirect assistance to meet the cost of operation and maintenance (O & M) of the schemes. This has become a budgetary burden to the governments (IIMI, 1986).

Recently, several Asian governments as well as development agencies have become concerned with the need to turn over control and/or ownership of assets of government irrigation systems to water users. The growing movement toward turning irrigation systems over to farmers is consistent with the current interest in "privatizing" the state owned production sectors of the economies of developing countries. It is based on the desire to decrease the budgetary burdens of the governments for irrigation O & M and to enhance the long term sustainability of irrigation systems through local control. This will slow down the deterioration of systems and minimize the need for frequent rehabilitation (Vermillion, 1987). The secretary of the Ministry of Lands and Land Development Sri Lanka emphasized "Any government would be interested in participatory management if it could be demonstrated that such measures would help reduce government commitments for maintenance and rehabilitation and more importantly, if it would reduce the grievances

within the farming community, leave alone the governments desire to see a prosperous community" (IIMI, 1986).

Experiences show that there should be incentives for farmers to be organized to facilitate participatory management. There are many factors that stimulate water users to become organized. In Nepal, water rights, resource mobilization, water distribution, sense of belonging to the community, preservation of an individual water share and acquisition of water and humus before the monsoon are found to influence farmer participation in management (Pradhan, 1989). However it is not necessary to have all these elements to present for an irrigation organization to function.

The problem

The government of Sri Lanka has been experimenting with a variety of approaches to build a strong institutional framework for irrigation management for nearly a decade and a half. The major focus has been on developing farmer organizations so that farmers can participate in irrigation management more effectively and re – orient the state agencies responsible for irrigation management, so they can work with farmers in a joint management system (IIMI, 1990). Significant lessons have been learnt from previous exercises in participatory management. Some of those are Gal Oya water management project, Tank Irrigation Modernization Project, INMAS program, Village Irrigation Rehabilitation Project and the Freedom From Hunger Campaign Board. The importance of a catalyst agent in promoting farmer participation is shown in these experiences and it is reflected from the experiences in the other countries too. Although much has been accomplished in the way of participatory management the role assigned to Sri Lanka farmer organizations is still rather limited, compared to some other countries for example Philippines where some farmer organizations manage finances and most O & M functions at secondary canal level (IIMI, 1986).

Most of the farmer organizations which have been established so far, are practising only a few operations of O & M. Cleaning and maintaining of the field canals (FC) are mostly in the responsibility of farmers (Moragoda and Groenfeldt, 1986; Ekanayaka and Groenfeldt,

1986). The objectives of the farmer participation in Mahaweli area according to Kularathna (IIMI, 1986) are:

1. To obtain collective commitment and assistant of farmers in the O & M of the irrigation system.

2. To guide farmers in the efficient use of irrigation water and

3. To involve farmers in the eventual self management of the secondary and tertiary level of irrigation systems.

Although the current farmer organizations have not so far achieved such objectives fully, there is a special case that has emerged at Kimbulwana Oya irrigation scheme towards the success of farmer organizations. Resource mobilization and management are prominent tasks of all irrigation organizations. Three kinds of resources are mobilized – labour, cash and material (Pradhan, 1989). The cash contribution imposed on farmers by the government in 1984 has been the stimuli to Kimbulwana farmers to mobilize labour for O & M with the catalytic activity of the Technical Assistant (TA) of the Irrigation Department (ID).

The Kimbulwana Oya scheme

This is an ancient scheme in the Kurunegala district of the North Western province of Sri Lanka. It was renovated in 1956 and new families who were settled from outside the scheme besides the farm families were living within the location of the scheme before the restoration. In 1984, the government imposed a fee on farmers who received water from the irrigation schemes in order to cover a portion of the O & M cost of the schemes. At this time there was a farmer organization at the scheme.

This organization had already taken over some activities on maintenance of the scheme when the government imposed the O & M fee. Gradually, the organization took over the maintenance of the scheme below the Main canal (MC) level and got exempted from paying O & M fee. They had to pay this fee only once for the first year and the amount collected is maintained as a fund for emergency use in the major repairs collectively with the government funds (Gunadasa, 1989).

OBJECTIVE OF THE STUDY

The International Irrigation Management Institute (IIMI) conducted a study in *Yala* season 1989 to identify the determinants of the farmer organization. Part of the data collected for a broader study was used for this paper. Therefore the objective here is – to identify the factors influencing farmers to contribute labour to O & M work in the Kimbulwana irrigation scheme.

METHODS

Analysis

A multiple regression model was used to established the relationship between the variables concerned. One dependent variable with thirteen independent variables were used in the model.

Sampling and data collection

There are 764 farmer families settled under the scheme. Stratified random sampling technique was adopted to draw a sample of 75 farmers to represent 10% of the total. Stratification was done across the farmer groups which are distributed from the head to the tail end of the scheme. The selected sample of farmers were interviewed using a structured questionnaire in *Yala* season 1989 to gather required information. Dropping the cases with missing data points, 70 observations have been used for the analysis.

Dependent variable (TWH)

The O & M work consists of several activities to which farmers contribute their labour. The main activities are de-silting the canal beds, weeding and repairing the canal bunds, and repairing roads along the water cause-ways. The work is equally shared among farmer groups. But the outcome is different depending on the number of hours that farmers engage in particular work. Therefore the total number of hours worked in O & M work by the respondents in one year (both *Yala* and *Maha*) is considered as the dependent variable.

Independent variables

The factors affecting the number of hours of labour contribution by farmers have been considered as the independent variables. There are thirteen variables and they are as follows.

i. Farmer group (FARMGROU): There are twelve farmer groups in the scheme. Ten on the right bank (numbered from 1 to 10 from the head to tail) and two on the left bank (numbered as 11 in head and 12 in the tail section).

ii. Age group (AGE): Ten groups with five year intervals beginning from less than 25 years to greater than 65 years.

iii. Education level (EDN): Four groups according to the last grade attended in school. Those who are less than grade five, between five and eight, between eight and ten and above ten.

iv. Farming experience (WSFH): Seven groups with five year intervals from less than five years to more than 30 years.

v. Male labour force in the family (LFFM): Number of male adults in the family.

vi. Female labour force in the family (LFFF): Number of female adults in the family.

vii. Degree of ownership of the allotment (OWNER): Six groups identified and numbered as 1 to 6. Owners are defined as farmer himself (1), parents, parents – in – law, brothers/sisters, brothers/sisters – in – law, others (6).

viii. Location along the main canal (LOCM): Head = 1, Middle = 2 and Tail = 3.

ix. Location along the field canal (LOCF): Head = 1, Middle = 2 and Tail = 3.

x. Settler type (TS): New = 1, Old = 2.

xi. Yield/year (TYLD, kg/ha/yr): Average yield in both *Yala* and *Maha* seasons.

xii. Bank of the scheme (BANK): Left = 1, Right = 2.

xiii. Extent harvested (AH): in hectares.

Hypotheses

After identification of the above independent variables the null hypotheses were developed to test them in the multiple regression model. The following independent variables namely FARMGROU, AGE, EDN, WSFH, LFFM, LOCM, LOCF and BANK are expected to have positive relationship with the level of farmer participation in O & M activities. Further all other independent variables identified for the model are expected to be negatively related to the number of hours of labour contribution by the farmers.

RESULTS AND DISCUSSION

The first estimation of the regression model with 13 original variables and 70 observations had the R^2 and adjusted R^2 values 0.38 and 0.23 respectively. The calculated F value for the model was 2.581 and it was significant at 0.007 probability level. Although the model was statistically significant at a very high level, only five independent variables were significant at 5% level. This implies that the error variance of the model is quite high and the explanatory power of the independent variables included in the model is questionable. Further, the estimated R^2 value was also low indicating the poor goodness of fit of the model. The estimated results using the original sample data are summarized in the following equation:

$$\begin{aligned} TWH = \; & 7.71 - 1.12\ FARMGROU + 0.19\ AGE - 0.3\ EDN + \\ & 0.27\ WSFH - 22\ LFFM + 0.23\ LFFF - \\ & 0.0.37\ OWNER + 3.54\ LOCM + 0.64\ LOCF - \\ & 4.08\ TS + 10.05\ BANK - 0.0002\ TYLD - 2.85\ AH \end{aligned}$$

According to the previous findings and related research undertaken in the study area, these variables were included and they are theoretically justified. Therefore it was required to investigate the problems associated with the estimation procedure. Potentially there are two major sources of errors, namely (a) problems associated with the collected information or (b) violations of the classical assumptions of the OLS method.

There are two potential data problems – multicollinearity and presence of outliers. Removal of outliers helped to improve the R^2 and adjusted R^2 to 0.48 and 0.35 respectively. The F value was increased up to 3.751 at the probability level of 0.0003 giving very high significance level to the model. The total number of observations reduced to 67 when outliers were removed. The correlation matrix among the independent variables was estimated. A 0.81 correlation between farmers experiences (WSFH) and age (AGE) was found. Without, deleting variables either age or experiences immediately, more reliable test statistics was performed. Based on the condition number it was decided to drop WSFH from the model. The R^2 changed marginally while adjusted R^2 improved from 0.35 to 0.36.

In order to overcome the problems of violations of assumptions, heteroscedasticity was tested constructing the Goldfeld Quandt test. The test statistics had a F value of 1.12 which was not significant at 5% level with degrees of freedom of 24 and 24. Therefore the possibility of having error term correlated with the magnitude of the independent variable (LFFM) was ruled out. The next potential problem of violation of assumptions, namely autoregression was ruled out examining the DW statistics. This is not a serious problem because of the cross sectional nature of the data. Finally, error plots were taken again to examine the distribution and it was found that the error terms are distributed in a fairly random manner as depicted in Figure 1.

The final model considered as acceptable is as follows :

$$\begin{aligned} TWH = \; & 6.79^{*} - 1.23\ FARMGROU^{*} + 0.21\ AGE^{**} - \\ & 0.23\ EDN^{***} - 0.16\ LFFM^{***} + 0.2\ LFFF^{***} - \\ & 0.58\ OWNER^{**} + 3.8\ LOCM^{*} + 1.2\ LOCF^{*} - \\ & 4.58\ TS^{*} + 11.33\ BANK^{*} - 0.0002\ TYLD^{**} - 3.14\ AH^{*} \end{aligned}$$

*, **, *** – significant at 0.05, 0.2 and 0.5 levels respectively.

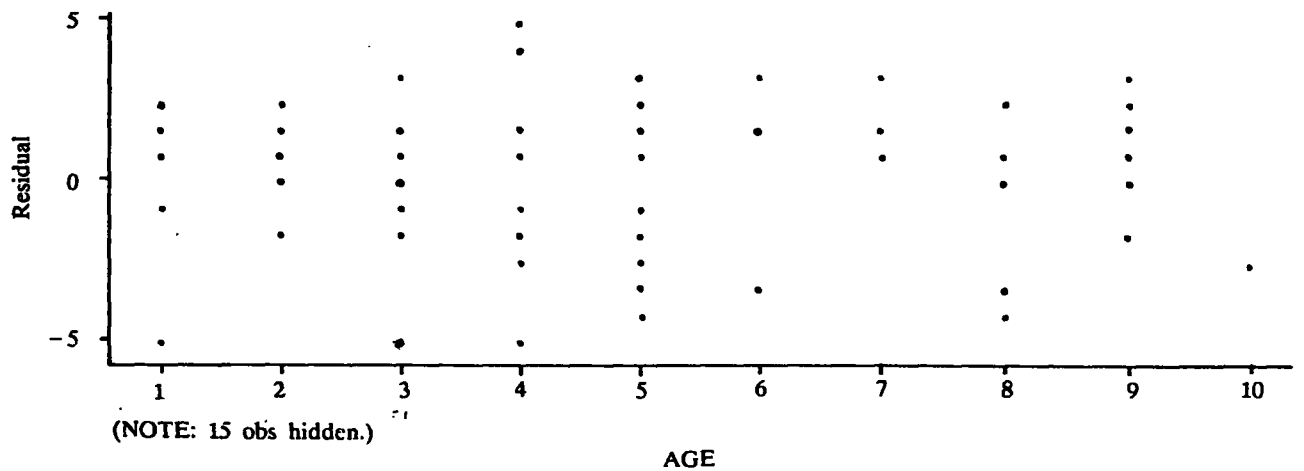

Figure 1. Residual plot of the final model with age variable

In this model, age of the farmer, locations of the field canal, main canal and bank of the scheme variables were positively related to the labour to O & M activities as expected in the process of model building. Degree of the land ownership, settler type, yield and harvested extent have shown negative relationships to the labour contribution in O & M activities. This set of variables have also shown the expected sign in the final model.

There are altogether four variables which showed opposite relationships. The farmer group, education and male labour force in the family were expected to be positively related to the labour contribution, although they gave negative signs. These results however, can be justified with alternative explanations. For example, when the number of male members in the family increase there is a higher probability of earning more income from sources other than agriculture. Therefore the higher income earning farm families may be reluctant to contribute their labour into O & M activities, is because they feel that their opportunity cost of labour is high. In fact this may be consistent with the positive relationship shown by the variable of female labour in the family with the dependent variable. It is understood that apparent opportunity cost of female labour is lower than of male labour. Therefore the families would have felt that it would be better to contribute more from female labour than from male labour.

The relationship of the farmer group to the labour contribution was expected to be positive since ten farmer groups in the right bank were numbered in ascending order from head to tail of the canal and the tail end farmers participate more in the O & M activities due to problems they faced in receiving water. But the negative relationship shown by this variable was due to the higher numbers assigned in ranking to two farmer groups in the left bank. The farmers in these groups have comparatively a negative attitude in participating in the O & M activities.

Although it was expected that education and availability of labour could result in high levels of participation in O & M activities, due to more understanding of the importance of O & M activities, it showed a negative relationship. This can be related to the explanation given for the relationship between variable of the number of male members in the family to the labour contribution. When the farmers' education level is increased, they tend to look for income earning opportunities other than agriculture and are less likely to participate in O & M activities. This

may change with better incentives for such participation because their opportunity cost of labour is comparatively higher.

The variable settler type indicates the negative attitudes of old settlers toward the O & M activities. The variable BANK also conforms to similar results because the right bank comprises new settlers compared with the left bank of the scheme. When paddy yield and extent harvested increase the farmers are less likely to participate in O & M activities. These findings are consistent with the expectations.

Location variables indicate that the tail-end farmers are more willing to participate in O & M activities than the head-end farmers. The variable of farmers age indicates that elderly farmers have more understanding towards their contributions to the O & M activities of the scheme than the young farmers. The results show that they contribute more labour hours than the younger farmers. Ownership variable is numbered in ascending order to represent the descending order of the degree of ownership. Therefore it has given a negative relationship as expected. The degree of ownership indicates that when farmers have no clearly defined property rights, they are reluctant to engage in O & M activities of irrigation infrastructure in the Kimbulwana scheme.

CONCLUSIONS

According to the final results of this study, there are twelve variables which explain the variation in the labour contribution of farmers to O & M work. The intercept indicated that without influence of the given explanatory variables, farmers contribute 6.79 hours of labour to the O & M work. The farmer group variable is negatively related since the two groups in the left bank were assigned higher numbers in ranking. The old settlers have a negative attitude towards the O & M work. Similar results were found in the settler type variable having a high negative relationship with the labour contribution. According to the negative relationship shown by the ownership variable, when the degree of ownership is reduced, farmers are less likely to participate in O & M work. As it was expected yield, extent harvested, age, location along the main canal and field canals showed a positive relationship with the amount of labour contributed to the O & M activities.

Under the present financial crisis in the country, it is highly unlikely that the government will be able to allocate sufficient funds to maintain the vast amount of irrigation structures in the country. If the existing structures are not maintained, eventually a large number of farmers will suffer. Therefore farmer participation through labour contribution to O & M activities was introduced. From a policy perspective it is necessary to re-evaluate the adequacy of the approach and make appropriate changes considering the different conditions existing within the farmer communities. Without more focused or targeted policies it may be extremely difficult to get all farmers to contribute equally to O&M activities in an irrigation scheme. If several options are available to contribute to O & M activities, the chances for success could be higher.

REFERENCES

Ekanayaka R. and D. Groenfeldt (1986). "Organizational Aspects of Irrigation Management at Dewahuwa Tank During *Yala* 1986". Working Paper No. 3, International Irrigation Management Institute, Digana Village, *Via* Kandy, Sri Lanka.

Gunadasa, A.M.S.S. (1989). "The Kimbulwana Oya Irrigation Scheme: An Approach to Improved System Management", Case Study No.2, International Irrigation Management Institute, Colombo, Sri Lanka.

IIMI (1986). "Participatory Management in Sri Lanka's Irrigation Schemes: Proceedings of the Workshop on Participatory Management in Sri Lanka's Irrigation Schemes". International Irrigation Management Institute, Digana Village, *Via* kandy, Sri Lanka.

IIMI (1990). "Resource Mobilization for Sustainable Management: Proceedings of the Workshop on Major Irrigation Schemes", International Irrigation Management Institute, Colombo, Sri Lanka.

Moragoda, R. and D. Groenfeldt (1986). "Organizational Aspects of Irrigation Management in Kalankuttiya Block Mahaweli System H Sri Lanka During the 1986 *Yala* Season 1986". Working Paper No. 11, International Irrigation Management Institute, Digana Village, *Via* Kandy, Sri Lanka.

Pradhan, P.(1989). "Patterns of Irrigation Organizations in Nepal: A Comparative Study of 21 Farmer Managed Irrigation Systems", International Irrigation Management Institute, Colombo, Sri Lanka.

Vermillion, D. (1987). "Turning over Irrigation Systems from the Government of Indonesia to Farmers", Working Paper No. 2, International Irrigation Management Institute. Digana Village, *Via* Kandy, Sri Lanka.