UMA-OYA UPPER WATERSHED MANAGEMENT PROJECT (UWMP) IN SRI LANKA: THE IMPACTS AT HOUSEHOLD LEVEL

J. M. U. I. Jayaweera, Mangala De Zoysa, and Dayananda Kariyawasam

ABSTRACT

The Uma-Oya Upper Watershed Management Project (UWMP) was implemented through training and helping households to conserve natural resources. However, the project has not significantly changed the socio-economic status of the households. Many households' (63%) primary occupation is farming, 21% are illiterate and 31% have primary education. They possess an average of 0.4 ha, either as owned lands (32%), encroached lands (40%), or permit lands (28%). The average annual income is Rs. 51,250 (US $ 550) while 59% households earn less than Rs. 50,000. The project has significantly improved the knowledge of households in the project area, compared to non-project areas, concerning soil erosion (χ^2 = 8.974 and p = 0.0225), impacts of soil erosion (χ^2 = 11.143 and p = 0.0076) and conservation methods (χ^2 = 19.810 and p < 0.0001). They have conserved their environment significantly better than in non-project areas (Tied z = -2.582 and p = 0.0098). The educational level (t = 2.9372 and p = 0.0053), knowledge of environmental conservation (t = 4.3492 and p = 0.0048), and annual income (t = 3.8322 and p < 0.0001) of the households have significantly positive influence, while the extent of land (t = -4.6240 and p < 0.000) has significantly negative influence, on a household's ability and willingness to adopt the conservation measures.

BACKGROUND

Watershed is the total drainage area to some point(s) on a river or stream; or it is the geographical entity drained by a stream system (Ahmed and Nazir, 1999). The land area from which water drains to a given point is synonymous with "catchment" and "drainage basin" (Swaity, 1993). Increased population, intensification of agricultural land use, and growing demand on water for agriculture and other economic needs have strained water resources in the watershed areas. The production process in degraded lands requires large amounts of capital, labor, and other input, often beyond the capabilities of farmers to provide, causing economic problems. Those families depending upon farming begin to suffer as the productivity of the land cannot be completely restored through the use of chemical fertilizer (Blaikie and Brooktield, 1991). Watershed management approach has a strong economic logic as it internalizes many of the externalities involved in both land and water management practices (FAO, 1987). The goal of watershed management is to ensure desirable hydrological behavior while managing for an optimal mix of land use and natural resources conservation, for sustainable development. Effective management of a watershed ensures sustainability of agricultural production without causing deterioration in the resource base (Decuirtains, 1999).

In: Baumgartner, David M.; ed. Proceedings of Human Dimensions of Family, Farm, and Community Forestry International Symposium, March 29 – April 1, 2004. Washington State University, Pullman, WA, USA. Washington State University Extension MISC0526. *ISBN Number 0-9721994-5-4*

Sri Lanka receives 12 million-hectare meters of water annually through precipitation on its landmass of 6.5 million has, from which 65% is lost without being used (Gunathilake, 1990). The Up-country Wet-zone and Intermediate-zone areas, with an average 2,000-mm of annual rainfall, contain most of the watersheds in the country. The central mountains, having a monsoon climate, are subject to very substantial year around variability in the available amount of water. Natural vegetation covering the water sheds have been gradually cleared for establishment of plantation crops and settlements. Most of the watersheds in the country have been cultivated with agricultural crops, particularly tea plantations, denuding the natural forest cover. Some of the mountain watersheds are thickly populated due to prevailing favorable climatic conditions for farming and living. Rapid removal of natural forest vegetation and inappropriate farming practices, together with intensive monsoon rainfall, have lead to excessive soil erosion, landslides and deterioration of bio-physical environment in the area.

Uma-Oya catchment covers 768-km^2 land in an up-country area where the highest area of the watershed is covered by natural forest. In addition to the few remaining natural forests, the catchment is populated with tea estates, rice, potato and vegetable cultivation, and home-garden cultivation on steep slopes without any effective soil conservation measures. As access to new land diminishes and pressure on currently cultivated land increases, farmers are forced to cultivate the same piece of land using higher and higher amounts of fertilizer, causing severe soil erosion and exposing underlying bed rock (Ministry of Agriculture, Land and Forestry, 1997).

The Uma-Oya Upper Watershed Management Project (UWMP) was initiated with the assistance of Asian Development Bank (ADB) to address the severe and critical forest and land degradation problems in Badulla district. There is a very high demand for land, with an average of 0.15 ha per person (Ministry of Agriculture, Land and Forestry, 1997). The project was implemented with the aim of socio-economic growth of the households through environmental stabilization.

The project was a farmer-led, integrated watershed management endeavor, which coordinated concerned implementing agencies at the community level. The management approach was a combination of "Farming Systems Approach" for farmers' own resources and "Watershed Approach" for common property resources. The farmers were involved in "Integrated Watershed Management" through revitalization of collective community spirit and mobilization of their own resources. Farmers were empowered and expected economic growth through environmental stabilization. The project introduced environmentally friendly, socially accepted, quick income generation activities by improving capacity to utilize and conserve land, water and forest resources at the household and community levels. The project has spent an average of Rs. 26,081 (US$ 274) per ha to improve the knowledge and activities of the households towards environmental conservation and improvement of the sustainable farming system.

The main objective of the study was to ascertain the socio-economic profile of the households in the watershed, analyze the improvement of household knowledge on environment

Table 1.— Age composition of households.

Age Group (years)	Number of Households			Tied z-value*	Tied p-value
	Project Area	Non-Project Area	Total		
< 18	118 (36)	106 (38)	224 (37)	-1.31	0.179
19 ~ 55	196 (60)	158 (57)	354 (59)		
56 <	11 (03)	13 (05)	24 (04)		
Total	325 (100)	277 (100)	602 (100)		
χ^{2**}	159.750	117.315	275.507		
P	< 0.000***	< 0.000***	< 0.000***		

Percentages are in parentheses
* The Wilcox on-Mann-Whitney Test
** Observed vs. Expected frequencies
* Significant at p = 0.05

Table 2.—Occupational status of the heads of households.

Occupation	Number of Households			χ^2-value*	p-value
	Project Area	Non-Project Area	Total		
Farming	44 (63)	46 (66)	90 (64)	0.030	0.8600
Non-farming	26 (37)	24 (34)	50 (36)		
Total	70 (100)	70 (100)	140 (100)		

Percentages are in parentheses
* Yates corrected Chi-square N > 15 (2 x 2)

Table 3.—Education levels of households.

Level of Education	Number of Households			Tied z-value*	Tied p-value
	Project Area	Non-Project Area	Total		
Illiterate	60 (19)	63 (23)	124 (21)	-0.54	0.582
Primary	107 (33)	79 (29)	186 (31)		
Lower Secondary	98 (30)	95 (34)	192 (32)		
Upper Secondary	46 (14)	32 (11)	78 (13)		
Higher Education	14 (04)	08 (03)	22 (04)		
Total	325 (100)	277 (100)	602 (100)		

Percentages are in parentheses
* The Wilcox on-Mann-Whitney Test

conservation and to assess the influence of the socio-economic characteristics of the households on conservation of environment under the watershed development project. The study was conducted in villages selected from each "with-project" area and "without-project" area in the upper watershed. A total of 140 households were randomly selected, including 70 from "with-project" areas and 70 from "without-project" areas. All households were interviewed and their actual field conditions observed during the field survey.

SOCIO-ECONOMIC PROFILE OF HOUSEHOLDS

Age Composition

The age compositions of the households in project areas, as compared to non-project areas (Table 1) are not significantly different (z-value = -1.31 and p-value = 0.179). They have similar age compositions. However, the age compositions within the project and non-project areas, as well as the total households, have significant differences. Among the households most belong to the working age group (19 ~ 55 years), while 52% are male. This age class will contribute the primary implementers of improved watershed management.

Occupational Status

It has been revealed that the majority (64%) of the heads of households settled in the watershed (Table 2) are farmers. The rest of the households are engaging in non-farming activities mainly as hired labor in tea plantations. According to the analysis, the occupation of the households in Project areas and Non-project areas have no significant difference (χ^2=0.030 and p=0.8600). The numbers of farming households from the total households are similar in both areas. The project does not cause households to change from non-farming to farming occupations. The non-farming households still prefer to engage in labor occupations despite of their poor wage rates.

Educational Level

As shown in Table 3, a considerable number of family members (21%) in the watershed are illiterate and 31% have only primary education. Compared to the very high national average of 98%, the literacy rate in the study area is very low. The educational level of the members of households between project areas and non-project areas has no significant difference (z-value = -0.54 and p-value = 0.582). The project does not promote raising the educational levels of the families living in the watershed. There is no direct or indirect program of the UWMP focused on promoting the educational status of the families in the project area.

Land Ownership

Only 32% of the households own land (Table 4) while the others cultivate agricultural crops and rare animals on permit lands (28%) and on encroached lands (40%). In other words, most of the households (68%) are cultivating lands without the proper ownership. The statistical analysis shows that land ownership rates are similar for project and non-project areas (G-Squared =

Table 4.—Ownership of lands by the households.

Ownership	Number of Households			G-Squared*	G-Squared p-value
	Project Area	Non-Project Area	Total		
Own	24 (34)	21 (30)	45 (32)	0.745	0.6891
Permit	20 (29)	19 (27)	39 (28)		
Encroached	26 (37)	30 (43)	56 (40)		
Total	70 (100)	70 (100)	140 (100)		

Percentages are in parentheses
* The Gamma Statistic G

Table 5.—Extent of lands of the households (Hectares)

Type	Project	Average	Non-project	Average	Total	Average
Own	8.9 (32)	0.4	7.1 (32)	0.3	16.0 (32)	0.4
Permit	7.1 (26)	0.4	6.9 (31)	0.4	14.0 (28)	0.4
Encroached	11.7 (42)	0.5	8.3 (37)	0.3	20.0 (40)	0.4
Total	27.7 (100)	0.4	22.4 (100)	0.3	50.1 (100)	0.4

Percentages are in parentheses

Table 6.—Annual family income of the households.

Income (Rs. Per Year)	Number of Households			Tied z-value*	Tied p-value
	Project Area	Non-Project Area	Total		
< 25,000	19 (27)	21 (30)	40 (29)	-1.28	0.132
25,001 ~ 50,000	22 (31)	20 (29)	42 (30)		
50,001 ~ 100,000	23 (33)	25 (36)	48 (34)		
100,000 <	06 (09)	04 (06)	10 (07)		
Total	70 (100)	70 (100)	140 (100)		

Percentages are in parentheses
* The Wilcox on-Mann-Whitney Test

Table 7.—Knowledge of households' on environment .

Knowledge	Project Area			Non-project Area			χ^2-value*	p-value
	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median		
Soil erosion	4.15	0.97	4	2.12	0.92	2	8.974	0.0225**
Soil fertility	4.36	0.92	5	3.40	0.72	3	7.040	0.0592
Impact of soil erosion	3.58	1.16	4	1.41	0.56	1	11.143	.0076**
Water retention	2.97	0.84	3	2.42	1.01	3	2.645	0.5330
Conservation Methods	2.68	0.87	3	1.33	0.54	1	19.810	<0.0001**

* Kolmogorov-Smirnov Two-sample Test
** Significant at p=0.05

0.745 and G-Squared p-value = 0.6891). The UWMP has not considered land ownership an important factor in selecting the project areas nor has the project attempted to change the land ownership status of the beneficiaries.

Extent of Lands

The average land holdings of a household in the Project areas is 0.4 has (Table 5), 0.3 ha in Non-project areas, while it is 0.4 ha in the watershed area. Though the man-to-land ratio is very low (0.36) on the steep areas of the watershed this land is highly susceptible to degradation, such that farming here, even at low density, can lead to socio-economic problems and severe environmental hazards. Compared to owned lands (32%), the households utilize a great deal of non-owned lands (68%). Most land use in the watershed is on encroached lands (40%). If the encroachment process in the watershed continues, the households will not be able to reap the expected benefits of the UWMP due to the rapid destruction of the environment.

Income Distribution

The average annual income of Rs. 51,250 (US$ 550) of the households in the watershed is far below the national average of Rs. 80,000 (US$ 830). Moreover, the majority of the households (59%) (Table 6) remain below Rs. 50,000 annual income, which is less than the average income in the watershed. A significant difference can not be observed in household income ($z = -1.28$ and $p = 0.132$) between the project areas (Rs. 53,372) and non-project areas (Rs. 50,073). Even after 4 years of implementation, the project has not been able to improve the income level of the beneficiaries. It could be observed that most of the project beneficiaries have already constructed physical soil conservation structures, mainly slip and spot drain and stone terries, while only few households have adopted agronomic practices such as Sloping Agricultural Land Technology (SALT), reforestation and low tillage in order to conserve the environment in their lands. Indeed, the impact of physical soil conservation methods on the agricultural productivity of land is a slow process compared to the agronomic soil conservation methods. The lack of improved tangible financial benefits of the project is the main reason preventing non-farming households from entering the farming occupations in the project area.

KNOWLEDGE OF ENVIRONMENT CONSERVATION

The improvement of knowledge on watershed environment and skills in environment conservation of households through demonstrations and training programs was one of the main objectives of the project. They have been trained on the main conservation methods of: slip and spot drain, stone terries, SALT, reforestation and low tillage. The improvement of knowledge of the households was measured using 5 point Likert Scale (1-very bad, 2-bad, 3-Indifferent, 4-good and 5-verygood) based on the comparison of knowledge disseminated by the project and the actual level of the knowledge of the household, as shown in Table 7.

There is a significant difference of knowledge between the farmers in project areas and non-project areas about soil erosion ($\chi^2 = 8.974$ and $p = 0.0225$), impacts of soil erosion ($\chi^2 = 11.143$ and $p = 0.0076$) and soil conservation methods ($\chi^2 = 19.810$ and $p < 0.0001$). The analysis shows that the project has improved the knowledge of households on soil erosion, impact of soil erosion and soil conservation methods, which are very important for sustainable watershed management.

Table 8.—Degree of environment conservation by the households.

Degree of Conservation	Number of Households			Tied z-value*	Tied p-value
	Project Area	Non-Project Area	Total		
0%	07 (10)	39 (56)	46 (33)	-2.582	0.0098**
01% ~ 25%	14 (20)	14 (20)	28 (20)		
26% ~ 50%	08 (11)	08 (11)	16 (11)		
51% ~ 75%	26 (37)	04 (06)	30 (21)		
76% ~ 100%	15 (21)	05 (07)	20 (14)		
Total	70 (100)	70 (100)	140 (100)		

Percentages are in parentheses
* The Wilcox on-Mann-Whitney Test
** Significant at p=0.05

Table 9.—Factors influencing the environment conservation.

Factors	Spearman R*	t (N-2)	p-level
Farming / Non-farming	0.2887	0.6742	0.5301
Education Level	0.4216	2.9372	0.0053**
Extent of land	-0.3112	-4.6240	<0.0001**
Own / Not Own Lands	0.5774	1.5811	0.1747
Knowledge of households	0.8713	4.3492	0.0048**
Number of family labor	0.2153	0.8192	0.4174
Annual Income	0.6325	3.8322	<0.0001**

*Spearman Rank Order Correlation
** Significant at p=0.05

Although the knowledge on soil erosion (mean = 4.15) has been improved beyond the level of "good (mean = 4)", the knowledge of the households in project areas concerning the impact of soil erosion (mean = 3.58) and soil conservation methods (mean = 2.68) remains at the level below "good knowledge (mean = 4)". According to the project beneficiaries they have sufficient knowledge on physical soil conservation methods while very poor knowledge in agronomic soil conservation methods. The knowledge of the households on soil erosion and particularly soil conservation methods is not sufficient for sustainable watershed management. On the other hand, knowledge of these issues in the majority of households in non-project areas is even more lacking. Poor knowledge about the impact of soil erosion and soil conservation methods (median = 1), and on soil erosion (median = 2) shows not only the poor diffusion of innovations but also the very destructive situation prevailing in the watershed. As the households in this watershed have been long established, in both project and non-project areas, there is sufficient knowledge and experience about soil fertility and water retention in their agricultural lands. Hence, the project has not made significant further improvement of the knowledge on soil fertility and water retention of the project beneficiaries.

CONSERVATION OF ENVIRONMENT

Degree of Environment Conservation

The researcher evaluated the degree of environment conservation using score methods ranging from 0% to 100% through a thorough observation of the lands belonging to households in project and non-project areas of the watershed. The scores were given based on the expectations of the project and achievements by the households mainly in terms of soil erosion control, improvement of soil fertility and regeneration of the vegetation in the degraded lands in the watershed. It has been revealed (Table 8) that the degree of environment conservation adopted by the households is significantly different between the project areas and non-project areas ($z = -2.582$ and $p = 0.0098$). The households in project areas have conserved their environment of the lands significantly better than the households in non-project areas. Some households (21%) in the project areas have adopted environment conservation measures at the maximum degree of 76% ~100% while many households (37%) have adopted at the degree of 51%~75%. Generally, the majority of the households (58%) in the project areas have improved their environment more than 50% according to the project expectation. It could be observed that most of the households in the project areas have scored poorly for regeneration of vegetation in their degraded lands. However, only very few households (07%) in non-project areas have adopted the environment conservation measures at the maximum degree. Many households (56%) in non-project areas and very few households (10%) in project areas have not adopted any environmental conservation measure. Most of those lands are severely degraded lands that may result in irreversible environmental destruction in the near future unless remedial action is taken.

Factors Influencing Environment Conservation

The analysis shows (Table 9) that the educational level of the households ($t = 2.9372$ and $p = 0.0053$), knowledge of environment conservation ($t = 4.3492$ and $p = 0.0048$) and their annual income ($t = 3.8322$ and $p < 0.0001$) have significant positive influence, while the extent of their land holdings ($t = -4.6240$ and $p < 0.000$) has a significant negative influence, on their adopting environment conservation measures. Among those factors, knowledge of households on environment conservation is highly correlated (Spearman $R = 0.8713$) with environment conservation. In other words, the level of improved knowledge of the households, through the demonstration and training program conducted by the project, have highly influenced them to conserve the environment in their lands to a greater degree. Annual family income also has a high correlation (Spearman $R = 0.6325$) with the degree of adoption of environment conservation. The households who earn higher annual income have adopted the environment conservation at higher degrees. According to the households, the construction of physical soil conservation structures requires capital more than the subsidies given by the project. Therefore, the households with little income are not in a position to construct the physical structures such as slip and spot drain, and stone terries to conserve the environment. Surprisingly, the low-income households have not even adopted low cost conservation measures such as SALT, reforestation and low tillage techniques. Even the educational level of the households has moderate correlation (Spearman $R = 0.4216$) with the degree of environment conservation. It is revealed that a low level of education for the household in the watershed is correlated with neglect of, or damage to, their environment. The extent of land belonging to the household has a considerably negative correlation (Spearman $R = -0.3112$) with the degree of environment conservation. Households with greater land holdings tended to practice less environment conservation. As it was

discussed, the construction of physical conservation structures is costly and the financial needs are greater for larger land holdings requiring conservation.

It is noteworthy that the occupation in farming, ownership of land and number of family members of the households are not significantly correlated with their degree of environment conservation. According to the households the introduced methods of environment conservation by the project are new and high-cost technologies compared to their traditional methods of farming for generations. Hence, the adoption of environment conservation methods needs intelligence/education, knowledge of new technology and financial capital rather than their farming experiences. Even though the ownership of land is a very important factor for rural development and environment conservation projects, the beneficiaries do not consider ownership as an important factor for the success of the project. They are not much concerned about ownership but utilize the encroached as well as permit lands as their own lands. They share the land resources under a customary management system without disturbing the social harmony. Similar to the farming experience, the number of family members does not have much influence on the degree of environment conservation unless they have good knowledge about the new technologies and necessary funds to adopt the conservation measure.

CONCLUSIONS AND POLICY IMPLICATIONS

Conclusions

The project has not changed the farming: non-farming ratio, educational level of the family members, land ownership, extent of the lands, and income and income distribution pattern among the project beneficiaries. The poor adoption of agronomic conservation methods has prevented the households in project areas from reaping higher income from their lands. Therefore, the non-farming households are reluctant to change their occupations.

Although the households have many family members they have comparatively low education levels. Most of them are farmers while many households cultivate lands without proper ownership. Their average annual income is far below to the national average and the majority lies even below the average income.

The project has improved the knowledge of the beneficiaries mainly concerning the soil erosion, impacts of soil erosion and the environment conservation methods particularly through physical structures.

The households in the project areas have successfully adopted the environment conservation measures in their lands. Educational levels of the households, the extent of land they utilize and their knowledge improved by the project have influenced them to conserve the environment of their lands. Farming occupation and ownership of the land make no enough influence for the households to conserve the environment.

Policy Implications

It is an urgent need to promote the basic socio-economic factors, particularly the improvement of the educational level of families and securing land ownership for the households in order to sustainably conserve the environment of the watershed.

Much effort has to be made to improve the knowledge of households and encourage them to adopt low-cost agronomic conservation methods in order to generate more income from the lands, and also to attract more households to sustainable agricultural development and conserve the environment.

REFERENCES

Ahamad, R. and Nazir, T. (1999). Major watershed problem, An introductory training manual on village organization for integrated watershed management in Pakistan, Forest Department, Government of Pakistan, Islamabad.

Blaikie, P. and Brooktield, H. (1993). Land degradation and society, London Routledge.

Decuirtains, S. (1993). Watershed management in the upper Mahaweli catchment area: the role of upper Mahaweli watershed management project. Polgolla, UMM project.

FAO. (1987). Strategies, approaches and system in Integrated Watershed Management; Conservation Guide. 14, Food and Agriculture Organization of the United Nations. Rome.

Gunathilake, H. M. (1990). Institutional aspect of soil conservation in Tobacco land and factors influences tobacco farmers' soil conservation decision in the Hanguranketha Walapane area.

Ministry of Agriculture Land and Forestry (1997). Upper watershed management study, Demographic Socialist Republic of Sri Lanka, Final report.

Swaity, S. A. (1993). Soil erosion and conserve in the humid topics, in World soil erosion and conservation, Cambridge University press, London.

AUTHORS

J. M. U. I. Jayaweera
Department of Agricultural Economics
University of Ruhuna
Sri Lanka

Mangala De Zoysa
Department of Agricultural Economics
University of Ruhuna,
Sri Lanka
mangala@agecon.ruh.ac.lk

Dayananda Kariyawasam
Forest Department
Sri Lanka