

Determinants of Operation and Maintenance Performance of Rural Water Supply Facilities in Cambodia: Does Social Capital Matter?

IDO Ayako*

Abstract

An increasing number of development projects are taking a community-based approach in rural areas of developing countries. Using this approach, beneficiaries' capacity to manage these projects is of vital importance. However, very few empirical studies have been undertaken to date to examine what types of capacity or assets possessed by the beneficiaries are essential for them to organize collective action and consequently to enhance the performance of community-based rural water supply projects.

This paper examines the factors that help users to better operate and maintain water supply facilities with handpumps (HWSFs) at the village level, using three rural water supply projects implemented in 11 Cambodian villages by two external donor agencies as a case study. It also analyzes which of the factors are more important than others. Based on data collected at household and village levels, the case study revealed that social capital, particularly as defined by norms HWSF users share for cooperation in operation and maintenance (O&M), was a more important factor than other selected factors representing human resources, productive assets and social capital and helped them to better operate and maintain HWSFs at the village level. Furthermore, hygiene education classes, which emphasize the importance of O&M and water user groups' roles, proved to be a secondary crucial factor and helped strengthen these norms of cooperation among facility users.

1. Introduction

In recent years, there has been a rapid growth in interest in the concept of social capital (Coleman 1988, Putnam, Leonardi, and Nanetti 1993, Grootaert 1998, Uphoff 2000). Scholars and development practitioners searching for clues to explain the differences in project performance that could not be fully explained by differences in the quality and quantity of inputs have applied the concept of social capital to explain the differences. Furthermore, the endeavors of donor agencies wishing to make the best use of their limited budgets have also accelerated this trend. However, despite the increased popularity of the concept of social capital, there is little convincing empirical evidence to support the argument that social capital has a positive influence on project performance.

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Failure of the state to deliver adequate levels of public services in many developing countries has led to a shift from the traditional top-down approach to a community-based approach. Thus, development agencies and local governments now pay more attention to building the capacity of target communities in planning and managing public service delivery at the village level. In the rural water supply sector, this trend is strong as in remote villages where water supply facilities (WSFs) are installed, the villagers must undertake their operation and maintenance (O&M) themselves. Although the importance of beneficiaries' contributions to development projects has been emphasized in the literature (Chambers 1997, Uphoff 2000), very few empirical studies have been undertaken to date to examine what types of capacity or assets possessed by the beneficiaries are essential for them to organize collective action and consequently to enhance the performance of community-based rural water supply projects.

Using rural water supply projects in Cambodia as a case study, this paper examines the factors that help users to better operate and maintain WSFs with handpumps (HWSFs) at the village level and furthermore, which of the factors are more important than others, as O&M performance is a key determinant of project success. It particularly looks at HWSFs as these are widely installed in rural water supply projects. I include social capital as one of these factors to examine its influence on O&M performance. Findings of this study should help improve the O&M performance of HWSFs at the village level, and ultimately lead to sustainable rural water supply service. The HWSFs here relate to deep wells served by handpumps with concrete aprons. The operation deals with the actual running of a service (e.g. pump handling) and maintenance deals with activities that keep the system in proper working condition, including management, repairs and preventive maintenance (Brikké 2000: 42).

In Cambodia, national coverage of rural water supply services (safe drinking water) was estimated to be only 31.7% in 2004 (Ministry of Rural Development (MRD) 2005). The shortage of water supply services is particularly critical in rural areas where poverty persists. The Cambodian Government has recognized this situation and is aiming to increase the proportion of the rural population with access to safe water from 24% in 1998 to 50% in 2015 as part of its Millennium Development Goals (*ibid.*).

This study is based on my fieldwork conducted in 11 rural Cambodian villages located in four provinces and peri-urban areas in July-August, 2002. Both quantitative and qualitative data were collected through questionnaire surveys conducted in the form of semi-structured interviews at household and village levels, interviews with government officials, and reviewing project evaluation reports of related donor agencies. In addition, on-site observation was conducted and field notes were taken in the villages.

I chose Cambodia as a case study for three main reasons. First, development aid agencies have implemented many community-based rural water supply projects in Cambodia since 1993 for

reconstruction of the country. Second, a comparative case study allowed me to examine why HWSFs are well looked after in some villages but not in others. After the withdrawal of development aid agencies, some projects were discontinued, resulting in some facilities breaking down and being left unrepaired in some villages. Third, very few empirical studies on the relationship between social capital and project performance have focused on Cambodia, due to difficulties in collecting first-hand data on sensitive topics related to social capital such as mutual trust and social networks. Cambodia has experienced tragic violent armed conflicts for over twenty five years, and the destruction of social capital brought about by these conflicts, particularly during the Pol Pot regime, is immeasurable (Chandler 2000, Colletta and Cullen 2000). For these three reasons, Cambodia is a good case study from which to draw lessons on collective action mechanisms in rural water supply projects.

The remainder of this paper is structured as follows. Section 2 reviews key definitions of social capital and discusses the relevance of this concept to analyzing HWSF O&M performance. Section 3 identifies forms of social capital in rural Cambodian villages. Sections 2 and 3 provide some background for the empirical analysis in Sections 4 and 5. Section 4 presents a hypothesis to be tested in this study, describes data collection methods, and explains variables used in the statistical analysis. Section 5 explores the factors that help users to better operate and maintain HWSFs at the village level and furthermore, which of the factors are more important than others, by presenting the results of the statistical analysis. Section 6 summarizes the findings and discusses some policy implications.

2. HWSF O&M Performance and Social Capital

2.1 The Definitions of Social Capital

Since Putnam et al's book (1993) *"Making Democracy Work"* popularized the concept of social capital in development literature, many scholars in various fields have applied it to both empirical research and theory.

There is no universally accepted definition of social capital as the term encompasses abstract and diverse phenomena. The most widely-accepted and narrow definition of social capital belongs to Putnam, who defines it as "features of social organization, such as trust, norms, and networks, that can improve the efficiency of society by facilitating coordinated actions" (Putnam et al. 1993: 167). Coleman (1988) considered social capital as a variety of different entities with two common elements: showing some aspects of social structure and facilitating certain actions of actors within the structure. Coleman's view of the concept includes vertical as well as horizontal networks and is broader than that of Putnam who focused on horizontal networks.

Social capital is an accumulation of social, institutional, and psychological assets such as networks, rules, norms, and attitudes that enable people to act collectively (Uphoff 2000). It facilitates collective action to achieve common goals by reducing transaction costs and by solving collective

action problems such as free riding.

In this paper, I use the term social capital to mean social networks and social norms embedded in the social structures of the society that enable people to coordinate collective actions and to achieve their desired goals.

2.2 Relevance of the Social Capital Concept to Analyzing HWSF O&M Performance

To justify the relevance of the social capital concept to analyzing HWSF O&M performance, this sub-section first suggests that social capital encompasses two of three basic elements (i.e. “resources”, “organizations”, and “norms”) of “social capacity”¹ which often determine the success of development projects. It then discusses findings of previous studies concerning determinants of O&M performance and furthermore the impact of social capital on the outcomes of rural water supply projects.

2.2.1 Social Capital as Elements of “Social Capacity” of Beneficiary Communities

Research suggests that the “social capacity” of beneficiary communities provides the basis for the receiving mechanism of outside assistance and therefore considerably affects project performance (Jones and Yogo 1994, Japan International Cooperation Agency (JICA) and Institute for International Cooperation (IFIC) 1996). JICA and IFIC (1996), which draw on Jones and Yogo’s earlier work (1994) on the utilization of self-organizing capabilities of communities in development projects, suggest that three basic elements constitute social capacity: “resources”, “organizations”, and “norms”. First, resources signify all the goods and services necessary to improve peoples’ livelihoods and productive activities. They include land, human resources (e.g. labor force, skills), physical resources (e.g. facilities, equipment), and financial resources, etc. Second, organizations offer mechanisms for obtaining, utilizing and managing resources for production and consumption activities. Third, organizations create norms which resource users need to share for the sustainable use of such resources.

These three elements are useful to assess the social capacity of communities in project sites to determine project performance. Among these three, existing literature on rural water supply projects has confirmed the importance of resources, in terms of human resources (e.g. basic skills in O&M, negotiating skills), physical resources (e.g. spare parts) and financial resources (e.g. O&M funds) for project success (Rondinelli 1991, Isham and Kähkönen 1999). While human, physical and financial resources are important assets, there has been a rapid growth in interest in “social capital” as another important asset influencing project performance. The concept of social capital encompasses the two elements of social capacity, “organizations” and “norms”. Since this framework of social capacity is useful to identify key factors affecting HWSF O&M performance, I modify and use this framework to select variables for empirical analysis in Sections 4 and 5.

2.2.2 Determinants of O&M Performance and Impact of Social Capital on Outcomes of Rural Water Supply Projects

Brikké (2000: 45–46) provides a comprehensive overview of critical factors which influence O&M performance of rural WSFs. He classified these factors into four categories: community factors, technical factors, environmental factors, and the legal and institutional framework.

The community factors which are likely to influence O&M are participation of all social groups in the community and both men and women, financial and administrative management carried out by a legitimate and organized community structure, availability of technical skills to carry out O&M, capacity and willingness to pay, and the community's needs for improved service. To achieve the first two factors, communities need to mobilize their social networks and form norms of cooperation. Although Brikké's findings do not particularly look into handpump projects, they suggest the importance of social capital in O&M of rural WSFs as a whole. As for the remaining factors, the technical factors include technology selection, the availability, accessibility and costs of spare parts, and the cost of maintenance while environmental factors are the quality of water sources, its quantity and continuity. All these factors are influenced by the legal and institutional framework.

Isham and Kähkönen (1999) empirically examined the impact of social capital on the outcomes of rural water supply projects in Indonesia. Their study reveals interesting results which caution that social capital does not always affect community-based rural water supply projects. They argue that the impact of social capital on the outcomes of the projects depends on the types of technology adopted. They measured social capital using eight indicators, such as density of membership, social interaction, and neighborhood trust. They compared two types of water facilities - public wells and piped connections. No social capital indicator was positively associated with the improved household health for public wells. However, for piped connections, five social capital indicators were significant and positive determinants of improved household health, this difference being attributed to piped systems requiring more skills and collective efforts to design, construct and perform O&M activities.

If the impact of social capital on project outcomes is technology dependent, how are HWSFs that are widely installed in rural water supply projects influenced by it? Most of the available findings on the role of social capital in handpump projects have relied on case studies lacking detailed analysis and very few quantitative studies have been undertaken. Therefore, this study, by adopting an integrated quantitative and qualitative approach, adds empirical evidence on the impact of social capital particularly on HWSF O&M performance, as project outcomes hinge greatly on O&M performance.

3. Social Capital in Rural Cambodian Villages

Past armed conflict, particularly during the Democratic Kampuchea period (1975–79), has severely depleted social capital in Cambodia (Meas 1995, Colletta and Cullen 2000). During this

period, in order to make Cambodia an economically self-sufficient country by increasing agricultural production, the Khmer Rouge forced all residents of Phnom Penh and provincial towns to move out of the city and the towns and made them work as agricultural laborers in rural areas together with rural peasants forming work units (Chandler 2000, Colletta and Cullen 2000). Furthermore, those forced to move from Phnom Penh and the towns were classified as “new” people, and they were treated more severely than “old” people, rural peasants (*ibid.*). Therefore, the reorganization of the population into work units as well as fragmentation between “old” and “new” caused disruption of family units and neighborhood networks (Colletta and Cullen 2000). The Khmer Rouge also plotted to destroy trust among Cambodians (Meas 1995). “Community and family members were encouraged to spy and report on each other, destroying trust...” (Colletta and Cullen 2000: 11). It denied and destroyed what Cambodian society had previously fostered — culture, religion, organizations, networks, norms, and even the family (*ibid.*). Furthermore, it is estimated that nearly two million Cambodians lost their lives due to starvation, execution, hard work, and disease (Chandler 2000). As a result, these devastating experiences created distrust and feelings of aversion to organizational activities among Cambodians and therefore have made it difficult for villagers to organize collectively to achieve common goals (Meas 1995). Then, how about the current situation in rural Cambodian villages? Are any forms of social capital helping villagers organize collective actions today for achieving common goals? This section identifies various forms of social capital existing in rural Cambodian villages today by reviewing existing literature, with particular focus on villagers’ social networks and social norms of cooperation. To identify these networks, I discuss the types of associations and organizations existing in rural Cambodian villages since the empirical literature such as Putnam (1993) argues that community members tend to form networks through organizations. I also discuss informal networks in the villages. Discussion of norms of cooperation underlying social networks is integrated into the analysis of the social network. Understanding social capital existing in rural Cambodian villages today serves a basis for further discussion of the relationship between social capital and HWSF O&M performance in Section 5.

3.1 The Debate Over Social Capital in Villages

There has been on-going debate over whether or not rural villagers in Cambodia are cooperative when the villages organize some communal activities such as socioeconomic development projects or when someone in their village needs other villagers’ help. Some scholars argue that cooperation among them has been and is still quite limited (e.g. Ovesen et al. 1996). According to Ovesen et al. (1996), the individualism and relative independence of Cambodian peasants are attributed to self-sufficiency and relative abundance of land. In contrast, Ledgerwood (1998) challenges the views of Ovesen et al. by pointing to the existence of active intra-village cooperation, strong bonds of kinship, and long-term friendships, based on Ebihara and her fieldwork in the early 1990s in a rural Cambodian

village where Ebihara first conducted earlier research in 1959–60. Meas (1999: 61–62) argues that under the authoritarian regimes in Cambodia, distrust undermined the relationship between individuals and also cast doubt on the usefulness of social institutions and structures. However, he believes that Cambodia has now reached a stage where it can once again recreate communities based on mutual trust.

3.2 Associations/Organizations and Informal Networks in Villages

Associations and organizations established to work towards common purposes in Cambodian villages can be classified under three broad categories; pagoda committees, Village Development Committees (VDCs), and associations and organizations which provide specific services. The most important organizations in Cambodian villages are pagoda committees (Thion 1999). They are established by villagers and play central roles not only in organizing religious ceremonies such as Pchum ben (festival to honor the dead), but also in carrying out social and welfare-oriented activities in rural villages such as road and school repair (Krishnamurthy 1999). For these occasions, villagers contribute their time, money and labor, and cooperate with each other to carry out these ceremonies and activities successfully (*ibid.*). Secondly, VDCs are organized by MRD, international organizations, or NGOs to promote participatory rural development at the village level (Rusten et al. 2004). They are usually the main contact point in the villages for outside agencies when development projects are to be carried out in the villages. In many villages, VDCs function as executive committees of the village chief and perform similar jobs as the village chief to mobilize villagers for meetings and monitor projects (*ibid.*). Finally, in rural areas, there are other types of associations and organizations which provide such specific services as rice banks and village banks (Krishnamurthy 1999). These are either established by villagers, international agencies, or NGOs, and they endeavor to cater for the daily needs of villagers.

Though spontaneous and irregular, informal networks also serve as essential support mechanisms for the villagers' lives when needs arise, such as wedding ceremonies, funerals, "sharing food, donating or lending cash, exchanging labor, providing emergency financial and other assistance, and giving psychological support" (Ledgerwood 1998: 141). These informal networks also help associations and organizations work. They are shaped primarily by kinship and familial affinity, followed by long-term friendships (*ibid.*).

The effect of the emergence of a cash economy on social capital cannot be ignored (Krishnamurthy 1999). Since villagers must earn more cash income with increasing monetization of economy even in rural areas, "old networks based on the concept of mutual help are giving way to new networks based on rigid reciprocity and the need to earn cash income" (*ibid.*: 61). Furthermore, since more connections with outside villages provide increased opportunities for villagers to acquire economic capital without investing in social capital in their villages, villagers are not inclined to make

efforts to maintain intra-village networks (Hughes 2001). Consequently, this situation weakens the networks among villagers and reduces their ability to work collectively for common goals.

The literature on social capital among rural Cambodian villagers suggests, despite the armed conflict's influence, villagers today appear to organize themselves to achieve common goals, utilizing their social capital, as measured by social networks and norms of cooperation. Using rural water supply projects in Cambodia as a case study, the following two sections empirically examine if social capital helps facility users to better operate and maintain HWSFs at the village level and its relative importance with other users' capacity or assets in conducting O&M of HWSFs.

4. Empirical Analysis

4.1 Hypothesis

Based on the literature review on social capital's influence on O&M performance and the outcomes of rural water supply projects, social capital as elements of beneficiary communities' social capacity, and some empirical evidence of organized activities in rural Cambodian villages, I pose the following hypothesis: social capital is a more important factor than other factors such as human resources and productive assets of facility users for better performance in O&M of HWSFs at the village level.

I focus on "human resources", "productive assets", and "social capital" of facility users as possible determinants of HWSF O&M performance for the following reason. As I discussed in Section 2, prior research by JICA and IFIC (1996) argues that three main elements of social capacity of beneficiary communities such as "resources", "organizations", and "norms" are important for the good performance of development aid projects. Since this framework of social capacity as possible determinants of project performance enables me to identify the factors of facility users affecting HWSF O&M performance, I have modified this framework in the following manner and used it in this study. I reclassified those three elements by combining "organizations" and "norms" into "social capital", and by dividing "resources" into "human resources" and "productive assets". This reclassification enables me to examine the relative importance of social capital in determining HWSF O&M performance compared with two other resources possessed by facility users.

Better performance in O&M here means achieving a higher level of O&M performance as measured by two variables stated in sub-section 4.3, namely, "technical O&M evaluation" and "user evaluation of O&M performance".

4.2 Data Collection

4.2.1 Project Background Information

This study examines the determinants of HWSF O&M performance in three projects (two JICA

projects under Japanese Government's official development assistance (ODA) and one project sponsored by the United Nations Children's Fund (UNICEF) in Cambodia.

A "JICA Project in Southern Cambodia"² (1996–2002) installed one HWSF each in 20 pilot villages in five provinces in Southern Cambodia (Kampong Speu, Kandal, Prey Veng, Svay Rieng, and Takeo) and peri-urban areas in 1997 (JICA 2001). The other project, "JICA Project in Central Cambodia"³ (2000–2002) also installed one HWSF each in 30 priority villages in two provinces in Central Cambodia (Kampong Cham and Kampong Chhnang) in 2001 (JICA 2002). These projects take a village level operation and maintenance (VLOM) approach. Based on needs assessment, facility users' willingness to participate in O&M activities, groundwater basin characteristics, both projects identified these villages. The purposes of the pilot were to identify the effectiveness and problems of installed HWSFs and their O&M system. The results were reflected in groundwater development plans which are made by Japanese Government's ODA for Cambodia to increase the proportion of the rural population with access to safe water in those provinces. Inputs, in terms of HWSFs, formation of Village Water Committees (VWCs)/Water Point Committees (WPCs)⁴ and provision of hygiene education classes, to these two JICA projects were the same. The VWCs/WPCs here correspond to "organizations which provide specific services" discussed in sub-section 3.2.

A "UNICEF-sponsored Project" commenced in 1985 to provide water to 700 villages in two provinces of Kampong Speu and Kandal, and the Municipality of Phnom Penh (Davis et al. 1992). The project either installed HWSFs or rehabilitated existing wells. Since the early phase of the project was relief oriented, the situation neither allowed to form water user groups nor to provide hygiene education classes to users (ibid.). However, although official water user groups were not formed there, facility users appeared to cooperate with each other in O&M and someone in the interviewed users' household learned about hygiene practices at school.

4.2.2 Sample Data

From the project villages of the three projects under this study explained in sub-section 4.2.1, I selected 11 villages in four provinces (Kampong Chhnang, Kampong Speu, Kandal, and Takeo) and peri-urban areas in Cambodia as sites for my survey. Nine surveyed villages comprise seven pilot villages (in three provinces of Kampong Speu, Kandal, and Takeo, and peri-urban areas) of the "JICA Project in Southern Cambodia" and two priority villages (in Kampong Chhnang province) of the "JICA Project in Central Cambodia". From the UNICEF-sponsored villages, I selected two villages near the JICA pilot village in Kampong Speu province. HWSFs in these two villages were installed in 1986 and 1987. The main criteria for selecting 11 villages for my survey were villages suffering from acute water shortages and hence HWSF demand was high, installed HWSFs were similar, and either official or unofficial water user groups have operated and maintained the facilities for at least one year, this being considered sufficient time for them to find ways to cooperate in O&M, create norms of cooperation, and have O&M experiences to evaluate their O&M performance. In addition, I took into

account similarities of village characteristics in terms of social environment, O&M conditions and economic conditions, etc.

I carried out two types of questionnaire surveys in the form of semi-structured interviews during my fieldwork in July-August, 2002: Using a random sampling method, a household questionnaire survey with 30 HWSF users (household heads) in each of 11 villages amounting to 330 users in total; and another questionnaire survey with VWC/WPC members in nine JICA villages, and with village heads in two villages who had installed HWSFs sponsored by UNICEF. Furthermore, I interviewed officials of rural water supply sections in the Provincial Department of Rural Development (PDRD) in the three provinces of Kampong Speu, Kandal and Takeo as well as officials of the Department of Rural Water Supply (DRWS) of MRD to see how they evaluate HWSF O&M performance in the surveyed villages. In addition, technical evaluations done by engineers regarding facility conditions and my own on-site observation of the surveyed villages provided supplementary information.

4.3 Variables

My analysis of the collected data involves three levels and utilizes both quantitative and qualitative approaches. First, Pearson correlation analysis is employed to find which of the variables I selected for “human resources”, “productive assets” and “social capital”, have significant correlations with “HWSF O&M performance”. Second, comparative analysis (independent samples t-test) is used to examine if there are any significant differences in factors affecting “HWSF O&M performance” between high and low O&M performing village groups by dividing the 11 survey villages into these two groups. Third, factors affecting HWSF O&M performance are examined through more detailed analyses of village cases by analyzing village level data shown in Table 3, results of my questionnaire survey with VWC/WPC members, and qualitative data gathered during my interviews with HWSF users and VWC/WPC members.

Based on my literature review, I selected 11 variables in total to capture and measure the four factors of “HWSF O&M performance”, “human resources”, “productive assets”, and “social capital”. These selected variables were then used for testing my hypothesis stated in sub-section 4.1. The following is a description of the variables used in the analyses.

a. HWSF O&M performance

I employ two variables (1) and (2) below to capture the degree of HWSF O&M performance, namely; “technical O&M evaluation” and “user evaluation of O&M performance”. While “technical O&M evaluation” was carried out by engineers of MRD or JICA, “user evaluation of O&M performance” was provided by facility users in surveyed villages. “Technical O&M evaluation” alone may not provide sufficient information about how HWSFs have actually been operated and maintained, and therefore, evaluation of O&M performance by facility users was included to provide essential information to accurately assess the degrees of HWSF O&M performance.

(1) “Technical O&M evaluation” is a variable that draws on the results of the technical evaluation of the condition of the HWSFs and their repair done by engineers of MRD or JICA (JICA 2001, results of technical O&M evaluation by MRD staff during my fieldwork for two UNICEF-sponsored villages). This evaluation focuses on four aspects of HWSFs, namely, (1.1) condition of the handpump, (1.2) condition of the concrete apron & drainage, (1.3) hygiene condition around the HWSF, and (1.4) repair of the handpump. It uses the following scales; 3 = good, 2 = fair, 1 = bad for aspects (1.1), (1.2), and (1.3) above, and 3 = yes, 2 = not necessary, and 1 = no for (1.4). The mean of these four aspects’ scores was calculated for each village.

(2) “User evaluation of O&M performance” is a variable that draws on the results of the user evaluation of their O&M performance, focusing on three aspects, (2.1) level of cooperation of users in O&M, (2.2) satisfaction level of users in O&M, and (2.3) functioning of VWC/WPC. This evaluation uses the following four-point scale; 4 = very cooperative/very satisfied/strongly agree, 3 = cooperative/satisfied/agree, 2 = average/disagree, and 1 = not cooperative/not satisfied at all/strongly disagree. The mean of these three aspects’ scores was calculated for each household.

b. Factors attributable to HWSF users that may affect HWSF O&M performance

Factors attributable to HWSF users that affect the HWSF O&M performance may include those concerning human resources, productive assets, and social capital. To measure these three factors, I developed the following nine variables in total.

b.1 Human resources

Two variables (3) and (4) represent the degree of endowment of human resources in surveyed villages.

(3) “Years of schooling” is a variable referring to the number of years of schooling of the user (household head) interviewed. Schooling provides a foundation for subsequent learning such as basic skills in O&M and enhances negotiation skills. These capacities are expected to facilitate collective action in O&M activities and improve O&M performance.

(4) “Attendance in hygiene education classes” is a dummy variable determining whether any family member of the interviewed user had attended hygiene education classes provided by the projects or had learned about hygiene practices at school (1 = yes, 0 = no). Hygiene education classes entail the following: a) activities that would make HWSF users fully understand the importance of O&M activities, user O&M responsibilities, and proper use of HWSFs, b) guidance in community-based HWSF management including VWC/WPC establishment and setting up rules for running VWCs/WPCs, and c) hygiene education programs. Knowledge of hygiene practices and awareness regarding the importance of HWSF O&M increase users’ willingness to contribute to O&M activities and may enhance O&M performance.

b.2 Productive assets

Three variables (5), (6), and (7) described below seek to measure the amount of productive assets

possessed by HWSF users. A large volume of literature (e.g. Isham and Kähkönen 1999) has argued for the importance of available and appropriate materials and parts for proper functioning of O&M. Thus, users' capacity to pay O&M costs, which is affected by their level of income, is presumed to influence O&M performance. Since income alone cannot capture the actual financial situation of farmers, "arable land" and "livestock" were also included as variables for productive assets.

(5) "Annual income" is a variable that refers to the amount of users' annual household income (US\$).

As of July 2002, 1 US dollar was equal to 3,900 riels.

(6) "Arable land" indicates how much arable land a household owns (ha).

(7) "Livestock (cows)" indicates how many cows a household owns. The cows are chosen as a variable for livestock as they are often the most expensive livestock villagers own.

b.3 Social capital

Social capital is a difficult concept to measure. Nevertheless, I attempted to capture the levels of HWSF users' social capital using the following four variables (8), (9), (10) and (11):

(8) "Norms of cooperation" indicates a user's perception of the level of norms of cooperation shared among HWSF users or villagers. The HWSF users self-evaluated the level of norms of cooperation by responding to the following three statements: (8.1) users should cooperate in O&M, (8.2) when the HWSF is broken, users will contribute money and time, (8.3) villagers help each other when in trouble. Users responded to these statements using the following four-point scale: 4=strongly agree/contribute a lot, 3=agree/contribute some, 2=disagree/contribute very little, and 1=strongly disagree/contribute nothing. The mean of these three statements' scores was calculated for each household. Since existing literature posits that norms facilitate collective action (Putnam 1993), I included this variable to examine whether norms of cooperation shared among users help them perform better in O&M activities.

(9) "Networks inside the village" indicates the extent of important networks a user has in the village.

Users are asked to list up to three people with whom they have discussed important issues in the previous three years. The figures are shown in percentages. The number of people listed by a user were divided by three which is the maximum number of people they can list. Following Putnam's argument (1993) that horizontal networks promote collective actions, this variable attempts to capture the extent of users' intra-village networks.

(10) "Networks outside the village" is a dummy variable which indicates whether a user interviewed has networks outside the village (1=yes, 0=no). Existing literature suggests that the influence of external market forces weakens social capital among Cambodian villagers (Krishnamurthy 1999). Thus, this variable captures the extent of villagers' outside networks to examine whether such networks influence the HWSF O&M performance.

(11) "User membership in organizations" is a dummy variable which indicates whether any family member of a user belong to any organization in the village (1=yes, 0=no). Putnam (1993) argues

that membership in social organizations can be a source of social networks that build social capital. According to Putnam (ibid.: 173), “the denser such networks in a community, the more likely that its citizens will be able to cooperate for mutual benefit”.

Summary statistics of the variables used in my analyses are shown in Table 1.

Table 1 Summary Statistics of Variables Used in the Study

Variables	Mean	Standard Deviation
HWSF O&M Performance		
(1) Technical O&M evaluation ^{*1}	2.500	.296
(1.1) Condition of handpump ^{*2}	2.909	.302
(1.2) Condition of concrete apron & drainage ^{*2}	2.455	.522
(1.3) Hygiene condition around HWSF ^{*2}	2.091	.831
(1.4) Repair of handpump ^{*2}	2.546	.522
(2) User evaluation of O&M performance ^{*1}	3.310	.693
(2.1) Level of cooperation of users in O&M ^{*3}	2.920	.842
(2.2) Satisfaction level of users in O&M ^{*3}	3.600	.709
(2.3) Functioning of VWC/WPC ^{*3}	3.410	1.105
Human Resources		
(3) Years of schooling	4.890	3.480
(4) Attendance in hygiene education classes (1 = yes, 0 = no)	.564	.497
Productive Assets		
(5) Annual income (US\$)	269.71	342.07
(6) Arable land (ha)	.662	.633
(7) Livestock (cows) (number)	1.867	2.038
Social Capital		
(8) Norms of cooperation ^{*1}	3.342	.661
(8.1) Users should cooperate in O&M ^{*3}	3.520	.840
(8.2) When HWSF is broken, users will contribute money and time ^{*3}	3.240	.998
(8.3) Villagers help each other when in trouble ^{*3}	3.260	.886
(9) Networks inside the village (%)	60.173	32.959
(10) Networks outside the village (1 = yes, 0 = no)	.339	.474
(11) User membership in organizations (1 = yes, 0 = no)	.321	.468

Notes: N = 330 except for technical O&M evaluation (N = 11). See sub-section 4.3 for details of variables.

^{*1} Values for (1) (2) and (8) are means of several criteria selected for each variable (1) (2) and (8). The selected criteria are shown below each variable (1) (2) and (8).

^{*2} Values indicate means of the variables measured by the 3-point scale ranging from 1 to 3 (see sub-section 4.3 for details).

^{*3} Values indicate means of the variables measured by the 4-point scale ranging from 1 to 4 (see sub-section 4.3 for details).

Sources: The author's questionnaire survey. Results for the technical O&M evaluation were taken from a JICA report (2001) and assessment by MRD officials.

5. Results and Discussion

5.1 Factors Affecting HWSF O&M Performance

5.1.1 Correlations between HWSF O&M Performance and Factors Attributable to HWSF Users that may Affect HWSF O&M Performance

Table 2 shows the results of my analysis to test if correlations exist between HWSF O&M performance and the selected variables for each of the three factors identified above.

Two variables showed significant positive correlations with “user evaluation of O&M performance” when all 11 surveyed villages data were used (hereafter “11 Villages Case”). The first variable, “attendance in hygiene education classes”, showed a significant and weak positive correlation with the O&M performance score ($r = .332^{**}$, $p < .01$). In villages where many people attended hygiene education classes or learned about hygiene practices at school, HWSF users highly assessed the degree of HWSF O&M performance. According to my interviews with VWC/WPC members, one of the merits of VWC/WPC members providing such hygiene education classes to users at an initial stage of projects was that users became more cooperative as they better understand project objectives, importance of O&M, rules for using HWSFs, and their O&M responsibilities. These findings suggest that such classes may promote O&M activities among users.

The second variable, “norms of cooperation”, also showed a significant and strong positive correlation with “user evaluation of O&M performance” ($r = .686^{**}$, $p < .01$), which confirms the importance of this variable for high HWSF O&M performance, but might also suggest that norms of cooperation are strengthened by the O&M activities. The Pearson correlation coefficient of this correlation was higher than that of correlation between the above-mentioned “attendance in hygiene education classes” and “user evaluation of O&M performance”. This indicates “norms of cooperation” has a stronger relationship with “HWSF O&M performance” than “attendance in hygiene education classes”, which suggests the relative importance of “norms of cooperation” compared with “attendance in hygiene education classes” for “HWSF O&M performance”.

No significant correlations were identified between “technical O&M evaluation” and the other variables. Furthermore, two HWSF O&M performance variables, “technical O&M evaluation” and “user evaluation of O&M performance”, did not show a significant correlation. The latter result indicates that even where HWSF conditions are good, users do not always highly evaluate their O&M performance. These results may be because some surveyed villages have big discrepancies between scores for “technical O&M evaluation” and those for “user evaluation of O&M performance” for some reason. To identify these villages, I referred to Table 3, where 11 surveyed villages were grouped into either a high or a low O&M performing village group according to the values of these two HWSF O&M performance variables per village. Originally, these groupings were done to identify determinants of high or low O&M performing villages in sub-section 5.1.3. The values per village for

Table 2 Pearson Correlation Coefficients Between HWSF O&M Performance and Human Resources, Productive Assets and Social Capital

	HWSF O&M Performance			
	11 Villages Case		9 Villages Case	
	Technical evaluation (N = 11)	User evaluation (N = 330)	Technical evaluation (N = 9)	User evaluation (N = 270)
Human Resources				
Years of schooling	.153	— .019	.160	— .019
Attendance in hygiene education classes	.228	.332**	.396	.352**
Productive Assets				
Annual income	— .038	— .073	.015	— .166**
Arable land	.081	— .050	— .020	.044
Livestock (cows)	.429	.016	.387	.076
Social Capital				
Norms of cooperation	— .062	.686**	.259	.532**
Networks inside the village	— .165	.082	— .007	.031
Networks outside the village	— .154	.089	.111	.011
User membership in organizations	— .070	— .030	— .027	.008
HWSF O&M Performance				
User evaluation	.262	—	.689*	—

Notes: **Correlation is significant at the .01 level (2-tailed). *Correlation is significant at the .05 level (2-tailed).

See sub-section 4.3 for details of variables.

Sources: Questionnaire survey conducted by the author. Results for the technical O&M evaluation were taken from a JICA report (2001) and assessment by MRD officials.

the two variables were calculated from the results of the technical O&M evaluation and my household questionnaire survey. Villages with shaded cells in Table 3 belong to a low O&M performing village group and villages with no shading belong to a high O&M performing village group.

When the high and low O&M performing village groups were compared in terms of the “technical O&M evaluation” and “user evaluation of O&M performance” based groupings, two villages, E and F, had mixed results. Village E was in the high O&M performing village group based on “technical O&M evaluation”, but in the low O&M performing village group based on “user evaluation of O&M performance”. The converse applied to Village F. Village E had two more recently installed HWSFs close to users’ houses, so that the surveyed facility was neither often used nor looked after well (Ido 2003). Consequently, as shown in Table 3, Village E got a high score in “technical O&M evaluation” as the HWSF is in perfect condition, but users evaluated their O&M performance low as they rarely conduct O&M. Conversely, Village F got a low score in “technical O&M evaluation” as the concrete

Table 3 Technical O&M Evaluation Score and Mean of Each Variable used in this Study per Village

Projects/Provinces/Villages Variables		JICA Project in Southern Cambodia ^{*4}						JICA Project in Central Cambodia ^{*5}		UNICEF-Sponsored Project			
		Peri-urban	Peri-urban	Takeo	Takeo	Takeo	Kandal	Kg. Speu	Kg. Chhnang	Kg. Chhnang	Kg. Speu	Kg. Speu	
		A	B	C	D	E	F	G	H	I	J	K	
HWSF O&M Performance													
1	Technical O&M evaluation (mean of four variables below (1.1–1.4))	2.50	2.50	2.25	2.50	2.75	2.25	3.00	2.75	2.75	2.25	2.00	
1.1	Condition of handpump ^{*1}	3	3	2	3	3	3	3	3	3	3	3	
1.2	Condition of concrete apron & drainage ^{*1}	2	2	3	2	3	2	3	3	3	2	2	
1.3	Hygiene condition around HWSF ^{*1}	2	2	1	2	3	2	3	3	3	1	1	
1.4	Repair of handpump ^{*2}	3	3	3	3	2	2	3	2	2	3	2	
2	User evaluation of O&M performance (mean of three variables below (2.1–2.3))	3.523	3.157	3.223	3.567	2.643	3.557	3.490	3.610	3.710	2.790	3.143	
2.1	Level of cooperation of users in O&M ^{*3}	3.10	2.67	3.00	3.10	2.33	3.50	3.27	3.13	3.40	2.17	2.50	
2.2	Satisfaction level of users in O&M ^{*3}	3.87	3.27	3.27	3.87	2.83	3.77	3.53	3.93	3.93	3.47	3.83	
2.3	Functioning of VWC/WPC ^{*3}	3.60	3.53	3.40	3.73	2.77	3.40	3.67	3.77	3.80	2.73	3.10	
Human Resources													
3	Years of schooling	3.47	6.60	5.83	4.77	6.40	6.03	5.50	3.50	3.87	5.23	2.63	
4	Attendance in hygiene education classes (1 = yes, 0 = no)	.900	.267	.467	.733	.400	.767	.467	.767	.867	.100	.467	
Productive Assets													
5	Annual income per user household (US\$)	417.11	748.48	285.30	191.31	169.61	279.92	238.89	189.40	105.90	222.99	117.89	
6	Arable land per user household (ha)	.391	.000	.753	.765	.937	.590	.992	.387	.763	.958	.742	
7	Livestock (cows) per user household (number)	1.27	.00	2.93	2.13	2.67	1.73	3.13	1.93	2.27	1.10	1.37	
Social Capital													
8	Norms of cooperation (mean of three variables below (8.1–8.3))	3.433	3.057	3.403	3.537	2.813	3.580	3.343	3.430	3.723	3.003	3.433	
8.1	Users should cooperate in O&M ^{*3}	3.57	3.30	3.67	3.67	2.97	3.97	3.63	3.73	3.80	3.07	3.37	
8.2	When HWSF is broken, users will contribute money and time ^{*3}	3.40	3.40	3.07	3.47	2.20	3.50	2.97	3.23	3.70	3.17	3.50	
8.3	Villagers help each other when in trouble ^{*3}	3.33	2.47	3.47	3.47	3.27	3.27	3.43	3.33	3.67	2.77	3.43	
9	Networks inside the village (%)	68.97	57.70	68.87	61.13	57.67	72.13	62.10	49.93	57.77	47.77	57.87	
10	Networks outside the village (1 = yes, 0 = no)	.233	.333	.433	.533	.267	.700	.200	.367	.300	.233	.133	
11	User membership in organizations (1 = yes, 0 = no)	.433	.367	.733	.333	.567	.733	.300	.000	.067	.000	.000	

Notes: N = 30 in each village, except for the technical O&M evaluation where N = 1 for each village. See sub-section 4.3 for details of variables.

Except for values of the technical O&M evaluation (1.1–1.4), the values in this table are means. The scales used for technical O&M evaluation are as follows; ^{*1}3 = good, 2 = fair, 1 = bad. ^{*2}3 = yes, 2 = not necessary, 1 = no. Respondents used the following scales to respond to the statements; ^{*3}4 = very cooperative/very satisfied/strongly agree/contribute a lot, 3 = cooperative/satisfied/agree/contribute some, 2 = average/disagree/contribute very little, 1 = not cooperative/not satisfied at all/strongly disagree/contribute nothing. ^{*4}This project is a part of JICA's study titled "The Study on Groundwater Development in Southern Cambodia". ^{*5}This project is a part of JICA's study titled "The Study on Groundwater Development in Central Cambodia". For two variables, "technical O&M evaluation" and "user evaluation of O&M performance", villages with shaded cells belong to a low O&M performing village group and villages with no shading belong to a high O&M performing village group. See Table 5 notes for grouping criteria.

Sources: Questionnaire survey conducted by the author. Results for the technical O&M evaluation were taken from a JICA report (2001) and assessment by MRD officials.

apron/drainage and hygiene conditions around the HWSF were poor due to frequent use. However, according to my interviews and questionnaire surveys, users in Village F appeared to be very cooperative in O&M and it ranked fourth among 11 villages for “user evaluation of O&M performance”. As these two village cases demonstrate, if one evaluates HWSF O&M performance either in technical terms or based on user evaluation, one cannot accurately assess the O&M performance of the village. Therefore, triangulation of information using multiple methods and investigators is of vital importance to accurately measure HWSF O&M performance.

Based on the discussion above, I removed Villages E and F from my database and reconducted the correlation analysis between two “HWSF O&M performance” variables for the remaining nine villages. The result is shown as “9 Villages Case” in Table 2. The result showed that there was a significant and strong positive correlation between these two variables ($r = .689^*$, $p < .05$), which the correlation analysis in “11 Villages Case” did not show as discussed above. This result indicates that in villages where “technical O&M evaluation” is high, users highly evaluate their O&M performance. Furthermore, I reconducted correlation analyses between “HWSF O&M performance” variables and the selected variables for each of the three factors attributable to HWSF users that may affect HWSF O&M performance. The results are also shown as “9 Villages Case” in Table 2. As was the case with “11 Villages Case”, no significant correlations were identified between “technical O&M evaluation” and any variables, but two variables, “attendance in hygiene education classes” and “norms of cooperation” showed similar trends with the results of “11 Villages Case” having significant and weak/moderate positive correlations with “user evaluation of O&M performance” (“attendance in hygiene education classes”: $r = .352^{**}$, $p < .01$; “norms of cooperation”: $r = .532^{**}$, $p < .01$).

5.1.2 Correlations among Human Resources, Productive Assets and Social Capital

Several noteworthy significant correlations were identified among variables selected as possible determinants of HWSF O&M performance, “human resources”, “productive assets”, and “social capital”, as shown in Table 4. This analysis was done to further identify which HWSF user assets have significant relationships with the two variables “attendance in hygiene education classes” and “norms of cooperation”, which I identified as having significant positive correlations with O&M performance (as evaluated by users) in sub-section 5.1.1. The results of this analysis provide additional findings regarding user assets that may indirectly influence O&M performance.

The results showed that two variables, “attendance in hygiene education classes” and “norms of cooperation” had a significant and weak positive correlation ($r = .207^{**}$, $p < .01$). This result can be interpreted in two ways. Firstly, in villages where the level of norms of cooperation among users is high, more users tend to attend hygiene education classes. Another interpretation is that hygiene education classes promoted the formation of norms of cooperation among users. Voices from the HWSF users and VWC/WPC members in all surveyed villages where the projects provided hygiene education classes and officials of DRWS and PDRD support the latter and they emphasized the visible

Table 4 Pearson Correlation Coefficients among Human Resources, Productive Assets and Social Capital

	Human Resources		Productive Assets			Social Capital			
	Years of schooling	Attendance in hygiene education classes	Annual income	Arable land	Livestock (cows)	Norms of cooperation	Networks inside the village	Networks outside the village	User membership in organizations
Human Resources									
Years of schooling	—								
Attendance in hygiene education classes	— .106	—							
Productive Assets									
Annual income	.119*	— .035	—						
Arable land	.029	— .042	— .172**	—					
Livestock (cows)	.050	.099	— .080	.365**	—				
Social Capital									
Norms of cooperation	— .020	.207**	— .159**	— .013	.085	—			
Networks inside the village	— .043	.125*	.029	— .051	.010	.017	—		
Networks outside the village	.090	.063	.119*	— .056	.012	— .021	.356**	—	
User membership in organizations	.094	.082	.035	.025	.122*	.030	.352**	.110*	—

Notes: ** Correlation is significant at the .01 level (2-tailed). * Correlation is significant at the .05 level (2-tailed).

N = 330. See sub-section 4.3 for details of variables.

Source: Questionnaire survey conducted by the author.

positive effects of hygiene education classes on users' cooperative attitudes towards O&M activities, which is attributable to users' better understanding of the importance of O&M and their O&M responsibilities (my interviews, July-August, 2002).

The results showed two more significant but very weak correlations. "Attendance in hygiene education classes" had a significant and very weak positive correlation with "networks inside the village" ($r = .125^*$, $p < .05$). This result indicates that the more intra-village networks villagers have, the more villagers attend hygiene education classes. "Norms of cooperation" had a significant and very weak negative correlation with "annual income" ($r = -.159^{**}$, $p < .01$). This result is consistent with the argument made by Hughes (2001) that villagers' increased connections outside the village for acquiring economic capital weaken intra-village networks of mutual support.

5.1.3 Determinants of High and Low O&M Performing Villages

This section conducts a comparative analysis between high and low O&M performing villages to identify the factors that help HWSF users to better operate and maintain HWSFs at the village level. More precisely, I divided the 11 surveyed villages into high (6 villages) and low (5 villages) O&M performing village groups based on two "HWSF O&M performance" variables and performed

independent samples t-tests to examine if there are statistically significant differences between the two groups on any variables representing “human resources”, “productive assets” and “social capital” that may affect HWSF O&M performance. The values shown in Table 3 for each surveyed village from the technical O&M evaluation and my household questionnaire survey were used to calculate mean values for each variable used in this analysis for these two groups, the results of which are shown as “11 Villages Case” in Table 5.

The results of the t-tests revealed that there were statistically significant differences between the two groups on only two variables, “attendance in hygiene education classes” and “norms of cooperation”.

Regarding means of the variable “attendance in hygiene education classes”, while there was a statistically significant difference between the two groups according to the “user evaluation of O&M performance” ($t(9)=4.371, p<.05$), only a trend toward a statistically significant difference was shown between the two groups according to the “technical O&M evaluation” ($t(9)=1.996, p(=.077) <.10$). These results indicate attendance rates in hygiene education classes are significantly higher in the high O&M performing village group compared with the low O&M performing village group.

With regard to the means of the other variable “norms of cooperation”, there was a statistically significant difference between the two groups according to “user evaluation of O&M performance” ($t(9)=2.945, p<.05$). This indicates that in the high O&M performing village group, the level of “norms of cooperation” is significantly higher compared with the low O&M performing village group.

No variables selected for productive assets in this study showed statistically significant differences between the high and the low O&M performing village groups for both technical and user O&M evaluations. Differences in capacity to pay for O&M cost between villages have not affected HWSF O&M performance to date, primarily because no major HWSF breakdown has ever occurred in the surveyed villages.

As discussed above, when the 11 surveyed villages were divided into the high or the low O&M performing village groups based on village scores of “technical O&M evaluation”, only a trend toward a statistically significant difference between the two groups was shown for one variable, “attendance in hygiene education classes”. Therefore, for the same reason discussed in sub-section 5.1.1, I removed Villages E and F from my database and reconducted the independent samples t-tests for the remaining nine villages. The results are shown as “9 Villages Case” in Table 5. As a result, for both technical and user O&M evaluations, means for “attendance in hygiene education classes” between five high and four low O&M performing villages were significantly different ($t(7)=3.618, p(=.009) <.05$), and means for “norms of cooperation” showed a trend toward a statistically significant difference between the two groups ($t(7)=2.068, p(=.094) <.10$). These results were consistent with the results based on “user evaluation of O&M performance” of the “11 Villages Case”.

Results of the t-tests in this sub-section showed that there were statistically significant

Table 5 Comparison Between High and Low O&M Performing Village Groups for Factors Affecting HWSF O&M Performance

Variables	11 Villages Case						9 Villages Case		
	HWSF O&M Performance						HWSF O&M Performance		
	Technical evaluation			User evaluation			Both technical and user evaluations		
	High O&M p.v. group (H) N=6 ²	Low O&M p.v. group (L) N=5 ²	t-test for equality of means	High O&M p.v. group (H) N=6 ²	Low O&M p.v. group (L) N=5 ²	t-test for equality of means	High O&M p.v. group (H) N=5 ²	Low O&M p.v. group (L) N=4 ²	t-test for equality of means
	Mean	Mean	t	Mean	Mean	t	Mean	Mean	t
HWSF O&M Performance									
Technical O&M evaluation ¹	2.708	2.250	4.131**	2.625	2.350	1.666	2.700	2.250	3.240**
User evaluation of O&M performance ¹	3.424	3.174	1.203	3.576	2.991	4.893**	3.580	3.078	5.219**
Human Resources									
Years of schooling	4.585	5.264	-.822	4.523	5.338	-1.004	4.222	5.073	-.967
Attendance in hygiene education classes (1 = yes, 0 = no)	.689	.414	1.996*	.750	.340	4.371**	.747	.325	3.618**
Productive Assets									
Annual income (US\$)	218.70	330.92	-1.028	237.09	308.85	-.636	228.52	343.67	-.849
Arable land (ha)	.706	.609	.515	.648	.678	-.157	.660	.613	.203
Livestock (cows) (number)	2.233	1.427	1.563	2.078	1.613	.827	2.147	1.350	1.262
Social Capital									
Norms of cooperation ¹	3.380	3.295	.493	3.508	3.142	2.945**	3.493	3.224	2.068*
Networks inside the village (%)	59.595	60.868	-.262	62.005	57.976	.860	59.980	58.053	.373
Networks outside the village (1 = yes, 0 = no)	.317	.366	-.482	.389	.280	1.112	.327	.283	.497
User membership in organizations (1=yes, 0=no)	.283	.367	-.470	.311	.333	-.125	.227	.275	-.268

Notes: ** $p < .05$, * $p < .10$. See sub-section 4.3 for details of variables. ¹See sub-section 4.3 for scales used for the variables. ²Abbreviation: O&M p.v. group = O&M performing village group. 11 surveyed villages or 9 surveyed villages (11 surveyed villages minus 2 villages (Villages E and F)) were divided into two groups - either a high or a low O&M performing village group as follows based on village scores of "technical O&M evaluation" and/or "user evaluation of O&M performance" shown in Table 3. When grouping, I also referred to JICA reports (2000, 2001) to understand details of their O&M evaluation. Among 3 villages (Villages A, B, and D) ranked 5th for "technical O&M evaluation", Village B is ranked with a low O&M performing village group due to long downtime (3 months) in 2000 (JICA 2000, 2001).

(11 Villages Case)

Technical O&M evaluation:

{ High O&M performing village group comprises 6 villages: A, D, E, G, H, and I;
low O&M performing village group comprises 5 villages: B, C, F, J, and K.

User O&M evaluation:

{ High O&M performing village group comprises 6 villages: A, D, F, G, H, and I;
low O&M performing village group comprises 5 villages: B, C, E, J, and K.

(9 Villages Case)

Both technical & user O&M evaluations:

{ High O&M performing village group comprises 5 villages: A, D, G, H, and I;
low O&M performing village group comprises 4 villages: B, C, J, and K.

Sources: Questionnaire survey conducted by the author. Results for the technical O&M evaluation were taken from JICA reports (2000, 2001) and assessment by MRD officials.

differences between the high and the low O&M performing village groups for means of two variables, “attendance in hygiene education classes” and “norms of cooperation”. These indicate that in the high O&M performing village group, attendance rates in hygiene education classes and the levels of norms of cooperation in O&M are significantly higher compared with the low O&M performing village group. Considered collectively, the correlation analyses results in sub-section 5.1.1—which showed these two variables’ significant positive relationships with “HWSF O&M performance”—and the findings in this sub-section suggest that higher attendance rates in hygiene education classes and higher levels of norms of cooperation help users to better operate and maintain HWSFs at the village level.

5.2 Social Capital which Helps Users to Better Operate and Maintain HWSFs

The above results indicate that norms of cooperation and networks, the two types of social capital I focused on in this study, help users to better operate and maintain HWSFs. This sub-section examines through more detailed analyses of the surveyed villages, types of networks and norms that help users to better operate and maintain HWSFs.

What forms of community networks fostered among HWSF users induce their cooperative behavior in performing HWSF O&M? Strong ties among community members are observed in four (A, D, H, and I) of five (A, D, G, H, and I) high O&M performing villages grouped based on both technical and user O&M evaluations (see Table 3 for grouping). Among these four villages, H and I are Cham villages. Chams, who are Muslims speaking Khmer, are known for having a greater sense of solidarity among village community members compared to the Khmer’s (Ovesen et al. 1996). According to my interviews with VWC/WPC members and HWSF users in Villages H and I (August 2 and 3, 2002 respectively), participation rates of the villagers in communal works including HWSF O&M activities are generally quite high, and if someone does not cooperate on a communal work, their religious leaders, the hakkams, persuade the person to help with the work. In these two Cham villages, household heads attend mosques in their villages every Friday to listen to the hakkams’ preach and these gatherings are also effectively used to invite villagers to cooperate in communal works (ibid). The strengthened solidarity through these gatherings, religious events, and other communal works appeared to help the users to perform HWSF O&M. In the third village, A, 38 out of 126 households are headed by females whose husbands were mostly killed under the Pol Pot regime. According to my interviews with VWC/WPC members in Village A (July 30, 2002), cooperation among the women seemed very strong in this village. In Village A, five of the seven VWC/WPC members are women and therefore HWSF users, who are mostly women, seemed to be very cooperative in HWSF O&M activities. The fourth village, D, is made up of families and relatives. Chairperson of VWC and HWSF users in Village D mentioned that thanks to their kinship networks, the villagers are very cooperative in HWSF O&M activities and other communal works such as road repairs (my interviews,

July 31, 2002). In the remaining Village G, no prominent ties among community members were identified (my interviews with VWC/WPC members and HWSF users in Village G, July 26, 2002). Village G's high score in "technical O&M evaluation" might be attributable to one female VWC member who lives adjacent to the HWSF. She takes initiative in conducting daily HWSF O&M by encouraging other users to handle the handpump properly and keep the HWSF areas clean (*ibid.*).

No prominent community ties were identified in Village F either, which is in a high O&M performing village group based on "user evaluation of O&M performance". However, Village F has the second highest mean value for "norms of cooperation" among 11 surveyed villages, and furthermore, this village has more users who agreed with the statement that 'users should cooperate in O&M'. According to my interviews with VWC/WPC members in Village F (July 23, 2002), the villagers in this village are accustomed to working collectively for annual communal projects such as road repair and small dike making to cope with flood damage and therefore, cooperation levels of the villagers in community projects are quite high. The Village F results suggest that its high levels of norms of cooperation helped users to better operate and maintain its HWSF.

Conversely, according to the results of my questionnaire surveys and interviews with HWSF users and VWC/WPC members, in the low O&M performing villages B, C, E, J and K (Village E is in a low O&M performing village group only based on "user evaluation of O&M performance"), networks among users that support HWSF O&M activities appeared to be weaker. Villages J and K had HWSFs installed in relief-oriented projects in the mid-1980s without water user groups being formed or hygiene education classes provided. In these villages, users self-evaluated their level of cooperation in O&M as low and hygiene conditions around the HWSFs were poor as shown in Table 3. These results affirm the importance of water user groups and providing users with hygiene education classes which include awareness raising regarding the importance of O&M for HWSF O&M activities. Village B is located on the outskirts of the capital city where relationships between neighbors are extremely weak, while Village E had two more recently installed HWSFs located close to users' houses, so that the surveyed facility was neither often used nor looked after well (Ido 2003). In Village C, 38% of total users live in a neighboring village and therefore, cooperation in O&M from those living outside the village appeared to be rather limited (*ibid.*).

What types of intra-village networks do individual HWSF users consider important? In the questionnaire, I asked users to list a maximum number of three people with whom they discussed important issues in the previous three years. While 27 out of 330 respondents listed no one, 76.8% of the listed people were family members or relatives, followed by neighbors (17.7%), the village chief (3.2%), friends (2.0%) and high monks (0.3%). These results confirmed the argument made by Ledgerwood (1998) that strong bonds within Cambodian villages are mainly those of kinship and to a lesser extent long-term friendship, and that intra-village cooperation is still alive.

To sum up, the village survey results suggest that family members, relatives and neighbors are

important contacts for villagers and that intra-village networks formed by religious influence, solidarity among women and kinship are likely to induce their cooperative behavior and help users to better perform in HWSF O&M.

6. Conclusion

This paper examines the factors that help users to better operate and maintain HWSFs at the village level, and furthermore, which of the factors are more important than others, through fieldwork in 11 rural Cambodian villages, where two external donor agencies implemented three rural water supply projects. To address this research question, I tested the following hypothesis: social capital is a more important factor than other factors such as human resources and productive assets of facility users for better performance in O&M of HWSFs at the village level. In this concluding section, I discuss the main findings from my analyses and some policy implications for future rural water supply projects.

The results of empirical analyses supported my hypothesis mentioned above and this study revealed that in my surveyed villages, social capital, particularly as defined by norms of cooperation shared among HWSF users, whereby they should cooperate in O&M, was quite influential and more important in determining the HWSF O&M performance at the village level than other selected variables representing human resources, productive assets, and social capital of HWSF users. This result suggests that while existing literature presents a mixed picture regarding influence of past armed conflict on social capital among Cambodians and on their ability to work collectively for achieving common goals, HWSF users in my surveyed villages now share norms of cooperation which help them to jointly perform HWSF O&M.

In addition, this study found that one of the human resources' variables, "attendance in hygiene education classes", was the only other variable which enhanced HWSF O&M performance at the village level, following the aforementioned variable "norms of cooperation". Another important finding regarding these two variables, "norms of cooperation" and "attendance in hygiene education classes" was that there was a weak but significant positive correlation between these two variables. This finding and my interviews with HWSF users, VWC/WPC members, and the government officials demonstrate that hygiene education classes first provided by PDRD with DRWS/JICA support and later by VWCs/WPCs in nine surveyed villages of two JICA projects help users raise their awareness regarding the importance of HWSF O&M for their sustainable use and consequently these classes help form such norms of cooperation among users. This is because these classes cover not only hygiene education but VWC/WPC establishment for the VLOM, and awareness raising on the importance of HWSF O&M and user O&M responsibilities.

This study could not find any variables representing users' productive assets which are conducive

to HWSF O&M by users. Differences in capacity to pay for O&M cost between villages have not affected HWSF O&M performance to date, primarily because no major HWSF breakdown has ever occurred in the surveyed villages.

This study identified several types of strong community ties formed by kinship, religious influence, and solidarity among women in four of five villages in a high O&M performing village group where attendance rates in hygiene education classes and level of norms of cooperation were significantly higher than a low counterpart. In the surveyed villages, networks inside the village centered around kinship and to a lesser extent, neighbors, village chiefs, friends, and high monks as important contact people. The effectiveness of establishing VWCs/WPCs for O&M activities was also confirmed. In villages with VWCs/WPCs, villagers were more cooperative in O&M activities and O&M performance was higher. In these cases, outsiders who had encouraged beneficiaries to form water user groups play an important role in forming or strengthening social capital.

This study offers several policy implications for improving future rural water supply projects. With beneficiary communities assuming increasingly important roles in projects, the sustainability of village level O&M systems and capacity building of users and local government become indispensable. Firstly, formation of norms of cooperation for O&M should be further promoted. Although it takes time to raise awareness of beneficiaries towards the importance of O&M of public goods, the sustainability of water projects cannot be ensured without their participation. Secondly, interlinked with the first, for such awareness raising and for proper conduct of O&M activities, water user meetings in which hygiene education classes are also provided need to be held as a part of water projects in all target villages. Village meetings or pagoda activities might also offer valuable opportunities for such awareness raising. In these cases, it is essential to seek the participation of all user households including women, who play a major role in collecting and managing water, and the poor. Finally, the capacity building of local government staff who provide VWC/WPC members with guidance in HWSF management methods (e.g. rule-making) and training in HWSF repair methods, assist VWC/WPC members in providing hygiene education classes to HWSF users, and support subsequent O&M activities by communities should be further promoted in rural water supply projects so that the water supply service is both demand-responsive and sustainable.

Notes

- 1 Social capacity can be understood as the self-organizing capability of a community to utilize and manage resources and services necessary for productive activities and residents' livelihoods based on particular rules and norms in response to external environmental change and new resource inputs (JICA and IFIC 1996).
- 2 This project is a part of JICA's study titled "The Study on Groundwater Development in Southern Cambodia".
- 3 This project is a part of JICA's study titled "The Study on Groundwater Development in Central Cambodia".
- 4 A VWC consists of one chairperson, one secretary and one accountant and it deals with water problems in the

village. A WPC is the smallest unit of organization by users for HWSF O&M. Two caretakers selected from the WPC are responsible for checking and repairing HWSFs and two other caretakers clean the concrete apron areas and provide hygiene education to users. Some development agencies refer to the “VWC/WPC” as a “water user group”.

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