A Model for Water and Sanitation Technology Adoption in Developing Communities

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Introduction

Lack of access to water and sanitation services in low-income communities results in adverse impacts to human health, environmental degradation, and pervasive poverty due to associated constraints on economic development. Yet at the beginning of 2008, at least 1.1 billion people worldwide lacked access to an improved source of drinking water, and around 2.6 billion lacked access to improved sanitation services (UNDP 2006). To meet this need for services, affected communities must select and adopt service options that can be sustained by their local capacity. As a next and equally as important step, education and marketing programs that will support the effective and sustainable adoption of these technologies must also accompany their implementation.

Capacity Factor Analysis (CFA) is a conservative method for planning municipal sanitation systems that facilitates sustained access to safe, reliable, and affordable services to developing communities. Though CFA, as explained by Louis and Bouabid (2006), itself contributes to appropriate technology selection, acceptance and effective use of the technology in the community is just as important and not currently addressed in the CFA framework. Black (1998) for instance attributes many of the water and sanitation system failures in developing communities to both inappropriate technology selection and poor design of implementation programs. The rationale for adopting these technologies is often poorly communicated and excludes system users and/or community or household decision makers.

To assist in the identification of the individual, community, and technological attributes affecting new technology acceptance for each capacity factor included in the CFA, a case study was performed in Tourou, Cameroon. This case considered the introduction of ceramic water filters for household drinking water treatment in a rural community.

Capacity Factor Analysis

Capacity Factor Analysis (CFA) is a conservative method used to assess a community's capacity to manage municipal sanitation services (MSS) and select service options that are appropriate for the local context. The goal of this decision support system is to improve technology selection by ensuring that the technologies chosen do not exceed the community's ability to support them. A community's capacity to manage MSS technologies is assessed through eight capacity factors: Service; Institutional; Human Resources; Technical; Economic & Financial; Environmental & Natural Resources; Energy; and Socio-Cultural (Louis, 2003).

Community Capacity Level

The CFA method first defines the individual requirements that constitute each of the eight capacity factors for municipal sanitation services. The assessment for each capacity factor is performed by measuring the community's capacity for each requirement and comparing it to an established international service benchmark for that requirement. The community's overall Community Capacity Level (CCL) is determined by the lowest capacity factor score.

Technology Requirement Level

MSS technologies have been given corresponding classifications to complement the community assessment. This rating, which uses the same scale as the CCL, is called a Technology Requirement Level (TRL), and is equivalent to the technical know-how required to successfully support the technology (Ahmad, 2004). Thus, a community can acquire appropriate technologies to meet their MSS needs by selecting technologies with a TRL rating that does not exceed its management level or CCL; in other words, the conservative rule for selection is TRL = CCL. This conservative approach assures the community of its capacity to manage the selected technology option. As its capacity develops, the community can reassess its ability and progress to more sophisticated systems.

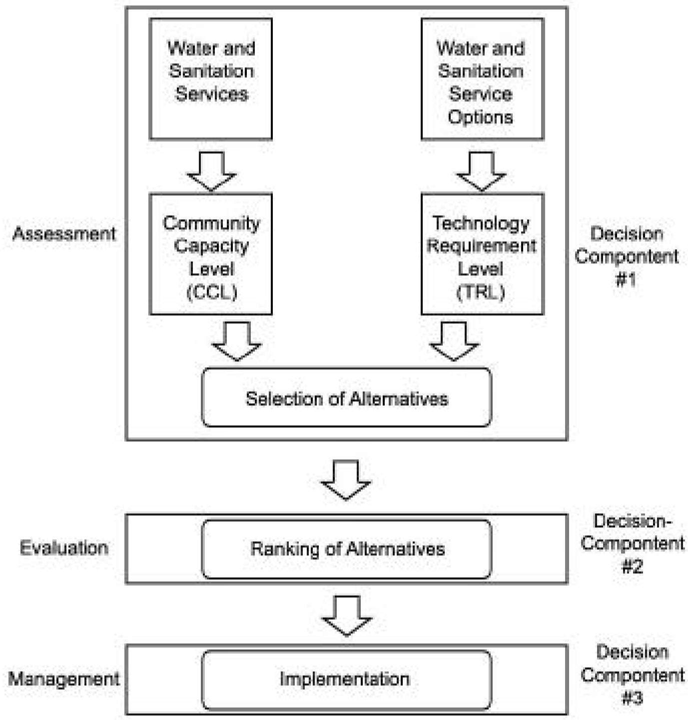

Figure 1. Conceptual model of Capacity Factor Analysis (CFA) framework.

Case Study Objectives and Methods

This work uses the CFA method and focuses on the introduction of ceramic water filters for household (point-of-use) water treatment into the rural community of Tourou, Cameroon. A case study of Tourou was performed to assist in the identification of the attributes affecting new technology acceptance for each capacity factor. The community of Tourou was assessed during the summer of 2008, during which time 130 surveys were orally administered to female heads of households in three different villages to identify traditional perceptions of MSS technologies and the factors influencing adoption decisions.

Table 1. Description of surveys completed by village

Village	Number of Surveys	Surveyed Population	Average Household Size	Village Population	Percent of Village Surveyed
Tourou-centre	71	451	6.4	4,176	10.8%
Ldalou	31	211	6.8	2,411	8.8%
Moutaz	28	200	7.1	1,985	10.1%

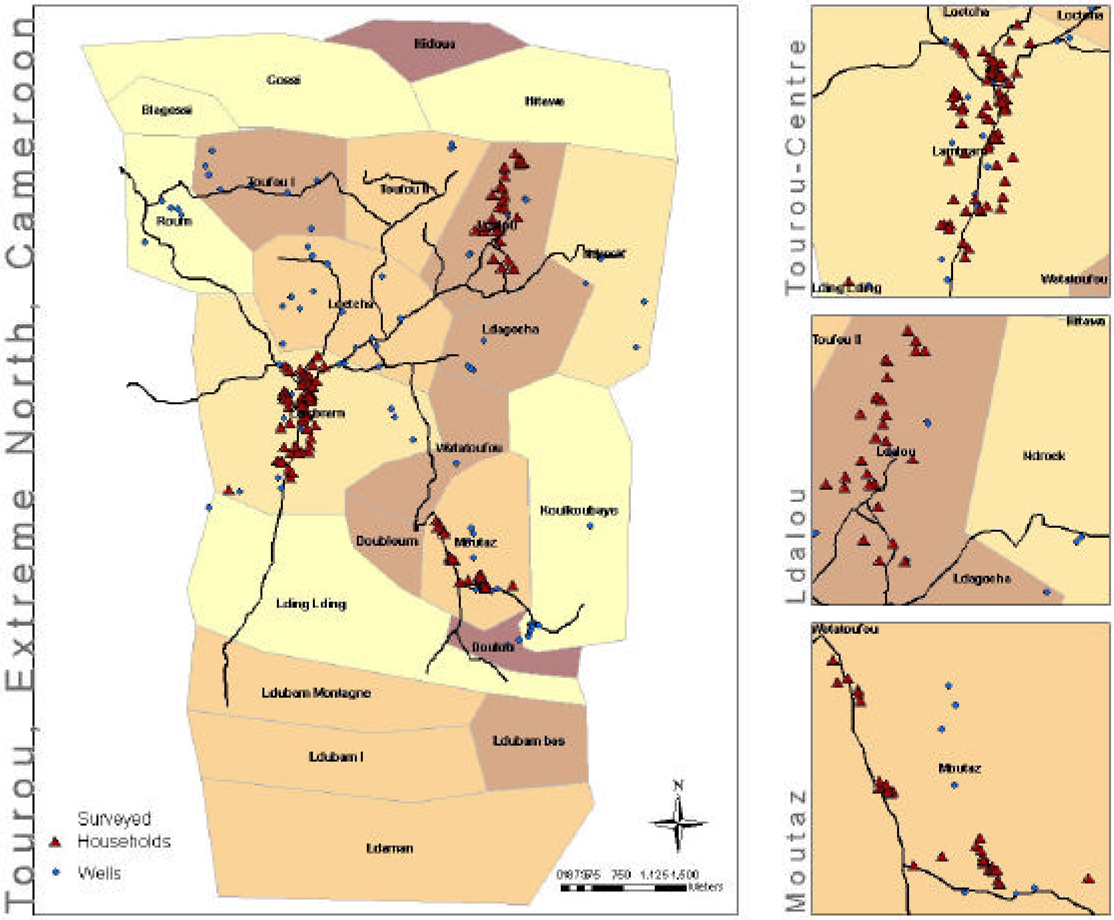

Figure 2. Map of surveyed households (denoted by red triangles) and tested wells (blue circles).

Results and Conclusions

Based on the results of the surveys, correlation dealing with population characteristics and technology adoption were identified for Tourou using statistical tests. These socio-cultural and technical factors of influence are listed below and are highlighted for future integration into the CFA process.

Female French Literacy and Technology Adoption

To determine the relationship between French literacy in the female heads or households and adoption of pit latrines and drinking water treatment, a two-tailed Fisher's exact probability test was used. Female French literacy and drinking water treatment showed statistical significance within a confidence level of 10%, meaning that women who are French-literate were more likely to use drinking water treatment. Female French literacy and latrine use displayed no statistical significance. There are a number of reasons why this correlation might hold for drinking water treatment and not for latrine use. While pit latrines are now a community norm with knowledge passed between friends and neighbors, drinking water treatment is not. Women were more often cited formal education (primary school) as a source of knowledge about drinking water treatment. This might be because women who are literate in French have attended school for an average of 4.3 years, 3.8 years more than women without French literacy, and hygiene education is part of the national primary school curriculum. The opportunity to attend school likely correlates to higher income households. Because they can communicate easily in French, these women also presumably have a higher degree of interaction with health workers and other professionals visiting the community, as affirmed by Rogers (2003). These findings suggest that information about French literacy, household income, and formal education, all of which can be collected through the community assessment process, will be important factors in predicting technology adoption. Low performance in these areas might predict lower levels of technology adoption and therefore an area in need of more targeted resources to achieve the desired adoption levels.

Female Employment and Technology Adoption

Households with a higher percentage of employed women and with a higher overall percentage of employed members tended to have higher rates of technology adoption both for household water and sanitation technologies. Households using latrines have an average of 7% more employed women and 5% more overall employed members than those without latrines.

Concurrent Technology Use

Households using one of the technologies (i.e., either latrine or water treatment) were much more likely to use the other technology as well, displaying a high degree of statistical significance. Although this strong positive correlation could be attributed to a variety of factors, it might imply that the households with latrines but not yet treating drinking water would be more predisposed towards adopting a drinking water treatment technology.

Discussion

This paper presents a way of determining community capacity to sustain WATSAN education and marketing programs and the results of such a program analysis in Tourou, Cameroon. The next step will be to develop a list of educational and marketing strategies that can be matched to the CCL determined through the proposed research. Case studies in the future that use this assessment technique to plan education and marketing programs would serve to validate it. These should be done in an area where the Capacity Factor Analysis has been used to select the MSS technologies in use. This future work will help strengthen and validate the model.

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