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Sustainability Assessment of Community-Based Water Supply Projects in Sudan using Sustainability Index and Multivariate Analysis

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ABSTRACT

In the current paper, sustainability assessment framework was designed using a set of multidimensional indicators to assess and monitor eight community-based water supply management in four different states in Sudan. The assessment framework consisted of site visits, a systematic secondary information collection, and analysis approach and documents reviews. A sustainability index was developed based on the projects stakeholder's discussions and the dataset were further analyzed using multivariate analysis techniques. The study revealed that 89% of the implemented water projects had low sustainable performance although they are considered as young projects (1-4 years age projects). According to Principal component analysis (PCA), 39% of the low sustainability performance of the projects was mostly related to the poor organizational and financial capacity of the communities and poor post-implementation governmental and/or external agencies involvement and support in terms of monitoring, capacity building facilities, and financial support. There is a strong need to develop post implementation strategies and models and mechanisms to backup community-based water projects technically as well as financially to assure the sustainability and verify the project implementation goals.

Keywords: Community-Based management; sustainability index; water supply projects; multivariate analysis

1. INTRODUCTION

Poverty elimination assessment research has consistently shown that improvements in water services are a core element in most strategies designed to alleviate poverty. These water utility projects were considered to be a one-time investment by most of the governments and there was little participation from the community. This has led to a poor maintenance and misuse and threatened the main developmental goals. Community-Based Water Supply Management (CBWSM) is one the many interventions designed to address the rural domestic water supply and sustainability problem and has gained considerable prominence since the late 1980s (Hayami and Godo, 2005). Community-based water supply management is now is the most important tools to deliver greater access, equity and sustainability in service delivery including the sub-Saharan African region where the slowest progress towards meeting the MDG targets in rural domestic water supply has so far been registered (Supply, 2014).

In 2010 Sudan had a total population of more than 36 million people according to

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world bank (World Bank, 2015), more than 10 million people did not have access to safe drinking water (Omer, 2010). Therefore, considerable government and donor funding was channeled towards implementing integrated community development projects in specific areas of Sudan. However, these were limited in scope and duration, while opportunities for scaling up successful experiences to the national level were difficult due to lack of financing and limited institutional capacity. In the period 2005-2011, many community developmental projects have been implemented in Sudan and funded by the national government and multinational partners. Most of these projects aimed to meet the urgent community driven recovery and development needs in the war affected and underdeveloped areas of North Sudan by providing social and economic services and infrastructure.

For the community-based management (CBM), projects' sustainability is a major cause of concern to all the stakeholders (Dube, 2012; Harvey and Reed, 2003; Montgomery et al., 2009). Functional Sustainability as a concept is defined to mean a continuation of water supply services over a long period of the initial investment, or the ability of the water source to continuously yield adequate clean and safe water for the users at any particular time (Carter and Rwamwanja, 2006; LockWood and Smit, 2011). From this context, there is different factors influences community-based water supply (CBWS) project's sustainability which includes: policies and legislation, institutional structures, social aspects, technology used, financial issues and capacity building (Mays, 2007). The application of Monitoring and Evaluation systems to assess water facility projects helps decision makers to plan for the sustainability of the future projects based on the performance of the existing projects. Projects' sustainability can be measured and/or assessed using different Sustainability indicators, which are either qualitative and/or quantitative. Indicators currently used to measure aspects of sustainability are not mandatory, leading to subjective monitoring (Lim et al., 2004). Therefore, it is essential that a modest number of key sustainability indicators be incorporated into projects' monitoring systems.

In the present study, the sustainability of nine community-based water projects was assessed using sustainability index and a set of multidimensional sustainability indicators (Technical, social/environmental, financial and organizational) were used. The interrelationships between sustainability and the indicators and sub-indicators used were identified using multivariate analysis techniques. To our knowledge, this is the first study which deeply analyzes community-based management approach experience in Sudan, which helps in identifying limitations and opportunities for future improvement.

2. METHODS

2.1 Study area

The study aimed to assess the sustainability of nine different community-based projects distributed over five localities in four different states in Sudan (Fig. 1). These community-based projects were co-funded by the National Ministry of Finance (NMF), and multi-donor trust fund (MDTF) and monitored by the World Bank (WB). The project aimed to meet the urgent community driven recovery and development needs in the war affected and underdeveloped areas of North Sudan by providing social and economic services and infrastructure. An environmental and social impact assessment (ESIA) study was carried out before the projects implementations according to World Bank requirements to assure minimal future environmental, water resources and social impacts of the projects. Types of water supply projects and numbers of population served are shown in Table 3.

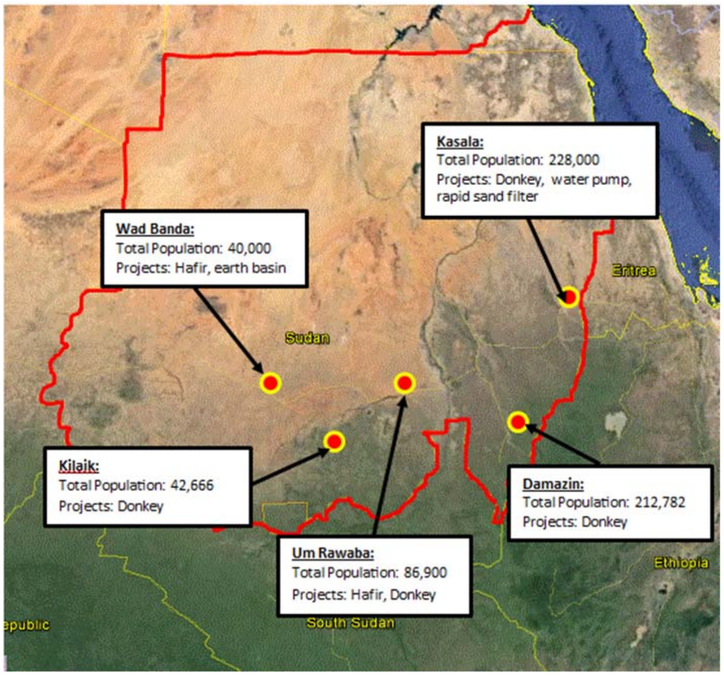

Figure 1 Sampling sites map showing the projects investigated and the number of population

2.2 Community-based water projects' sustainability index

The sustainability index was calculated for community-based water projects data collected over a predetermined period (three visits over one year period), and not for a single visit dataset. Also, projects with at least one year of operation were assessed; therefore, the sustainability index represents the long-term or steady status of community-based water projects sustainability. The sustainability index development process can be categorized in four steps as follows:

2.2.1 Selection of sustainability indicators

Sustainability indicators and sub-indicators were mainly selected based on literature review and a workshop discussion which was conducted with the participation of representatives from the NGOs, The Ministry of Finance and National Economy, Ministry of Water Resources and Electricity, projects' engineers and social mobilisers. From a general point of view, community-based water supply projects can be assessed based on four major aspects which are: Technical, Social, and Environmental, financial and organizational aspects. Based on these criteria, community-based water projects indicators and sub-indicators were selected. According to these criteria, nine indicators, and 23 sub-indicators were selected for development of the sustainability index (Table 1).

2.2.2 Appropriation of weight factors for the sustainability index

Based on previous community-based projects' experiences in Sudan, and according to the integrated vision of sustainability adopted by the stakeholders, it was suggested to assign all criteria with similar weight and not to undervalue any of them. Although, the significance of different water project's indicators and sub-indicators on the overall sustainability of water projects were not equal. For example, fund availability and community participation in fund allocation and other organizational sub-indicators are more significant and threatening to the project sustainability in comparison with social and environmental parameters. This concept was considered in the development of the sustainability index by assignment of weight factors for input sub-indicators. Weight factor states the relative importance and effect of the input parameters in the final score of the sustainability index. Since the effectiveness of the sustainability index depends on the assignment of proper weight factors for input parameters, this attempt was performed in contribution with projects' stakeholders using the Delphi technique. The assigned weight factors of input parameters are given in Table 1.

Table 1 Criteria, Indicators, and sub-indicators with weight factors

Criteria	Indicator	Sub-indicator	Assigned weighting factor (q_i)	Relative weight
Technical	Yield and quality	Reliability	0.021	0.0254
		Quality	0.021	0.0254
		Accessibility	0.021	0.0254
	Physical status	Design and site suitability	0.021	0.0254
		Functionality of the system	0.021	0.0254
		Suitability of the system	0.021	0.0254
	Water point functionality	Water quality and contamination	0.031	0.0375
		Spillages and drainage system	0.031	0.0375
	Demand	Water fetching time	0.031	0.0375
		System adequacy	0.031	0.0375
Social	Use of the facility	Usage behavior	0.0625	0.0242
		Inclusion	0.0625	0.0242
		Equity	0.0625	0.0242
		Social participation in O & M	0.0625	0.0242
Financial	Funds	Fund availability for O & M	0.15	0.1814
		Community participation in fund allocation	0.1	0.1209
Organizational	CBO of users	Regular meetings	0.039	0.0472
		CBOs effectiveness	0.044	0.0532
	Facilities' operators	More than one facility operators	0.028	0.0326
		Operators' effectiveness	0.028	0.0326
		Book recording system	0.028	0.0326
	Coordination	Cooperation with external agencies	0.039	0.0472
		Support from local authorities	0.044	0.0532
			$\sum = 1$	$\sum = 1$

2.2.3 Calculation of the sustainability index

The Arithmetic method was used for calculating the sustainability index, where the values of sub-indicators were aggregated to obtain the values of the indicators which subsequently aggregated to obtain the values of indicators as well as for the overall sustainability score. The overall sustainability score was calculated according to the following formula:

$$S_i = \sum_{i=1}^{n} Wi \times \left\lfloor \frac{q_i}{q_{max}} \right\rfloor$$

Where S_i referes to sustainability index value, w_i is the weighting factor, q_i is the rating score for the defined indicator and q_{max} is the maximum score assigned for the defined indicator. Table 2 shows the sustainability scale based on the index value.

2.2.4 Sensitivity analysis of the sustainability index

A sensitivity analysis was conducted to assess the influence of input parameters on the results of the overall sustainability index score. This action was implemented by removing the indicators with high weighting factors from the index calculation and comparing the output data of the reduced index to the original index results.

2.3 Multivariate analysis

Multivariate analysis of sustainability score data sets was performed using Hierarchical Cluster analysis (HCA), Principal Component Analysis (PCA) to give more insight on the interrelationships between the different indicators. The Statistical Package XLSTAT package software was used for both the HCA and the PCA.

3. RESULTS AND DISCUSSION

The data collected from the sustainability assessment framework were analyzed to assess the sustainability performance of the selected projects. As mentioned, water projects subjected to the assessment and monitoring framework are those projects, which were implemented and entered operation phase for at least one year. In total, nine different water projects were assessed.

3.1 Sustainability analysis

According to the sustainability assessment results, all water projects were accounted as sustainable projects; although 8 out of 9 projects scored as low sustainable (Table 3). That means 89% of the studied projects are already running with a low sustainability performance although these projects are considered as young projects (age range between 1 and 4 years).

According to Fig. 2, most projects showed low sustainability performance in technical, financial and organizational related aspects (67%, 56% and 67% of the projects respectively), although 67% of the projects showed an excellent sustainability performance in social aspects. This result highlights the issue of that social participation alone is not enough to guarantee the sustainability of community-based projects.

For the technical aspects, the lowest sustainability score was recorded in a hafir project in Wad Banda locality (Fig. 3). The low sustainability performance for technical aspects was due to sub-indicators low scores, namely for reliability (due to the low rains in the area), quality (due to accumulation of algae and mud in the system), design and site suitability (due to its distance from the served communities) and functionality of the system (due to malfunctioning of water pumps) sub-indicators. On the other hand, the lowest financial sustainability score was recorded for both a hafir project in Um Rawaba locality and a rapid sand filter in New Halfa locality (Fig. 3). Both projects suffered from low fund availability for operation and maintenance, but the situation was more significant for the sand filter project in New Halfa, due to the high O & M costs of the Rapid sand filter. While for the organizational issues, as mentioned before, 67% of the projects were assessed as organisationally low sustainable. The lowest sustainability score was recorded for hafir project in Wad Banda locality (Fig. 3).

Low organizational sustainability score in this project was due to the weak performance of the community-based unit (CBU) which has been selected by the community members to manage daily mandates of the project.

Table 2 Sustainability scale

Sustainability status	Sustainability rate	Index value	Description
Sustainable	Excellent	0.81-1.0	All sub-indicators within the objectives
	Good	0.71-0.80	sub-indicators rarely departed from the objectives
	Low	0.51-0.70	Sub-indicators sometimes departed from the objectives
Unsustainable	Marginal	0.31-0.50	Sub-indicators often departed from the objectives
	Poor	0.0-0.3	Sub-indicators are departed from the objectives

Table 3 Projects sustainability performance

State	**N. Kordofan**				**S. Kordofan**	**Blue Nile**	**Kassala**		
Locality	Um Rawaba		Wad Banda		Kilak	Damazin	Kassala rural		New Halfa
No. of people served	86,900		40,000		42,666	212,782	156,000		72,000
Project code	UR-Site 1	UR-Site 2	WB-Site 1	WB-Site 2	K-Site 1	D-Site 1	KR-Site 1	KR-Site 2	NH-Site 1
Project	Hafir	Donkey	Hafir	Earth Basin	Donkey	Donkey	Doneky	Water pumps	Rapid Sand Filter
Age (years)	1.9	2.8	1.4	2.2	3.6	4.1	1.8	3.3	1.7
Score	0.59	0.63	0.53	0.60	0.62	0.63	0.75	0.57	0.56
Sustainability status	Low	Low	Low	Low	Low	Low	Good	Low	Low

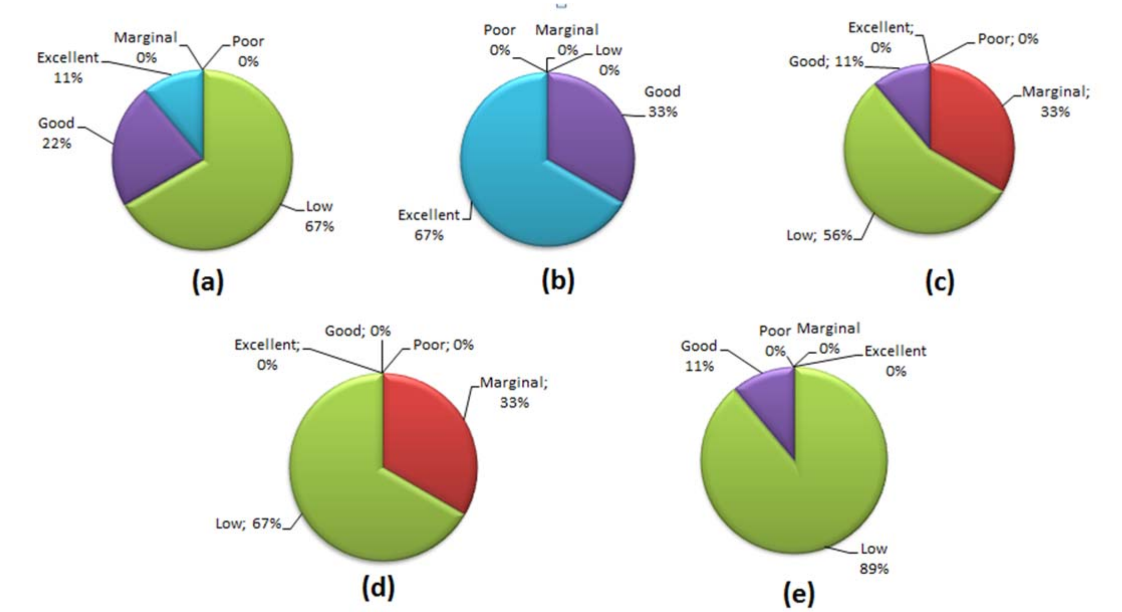

Figure 2 Sustainability performance of projects (%), in relation to Technical (a); Social (b); Financial (c); Organizational (d) criteria aspects and the overall performance (e)

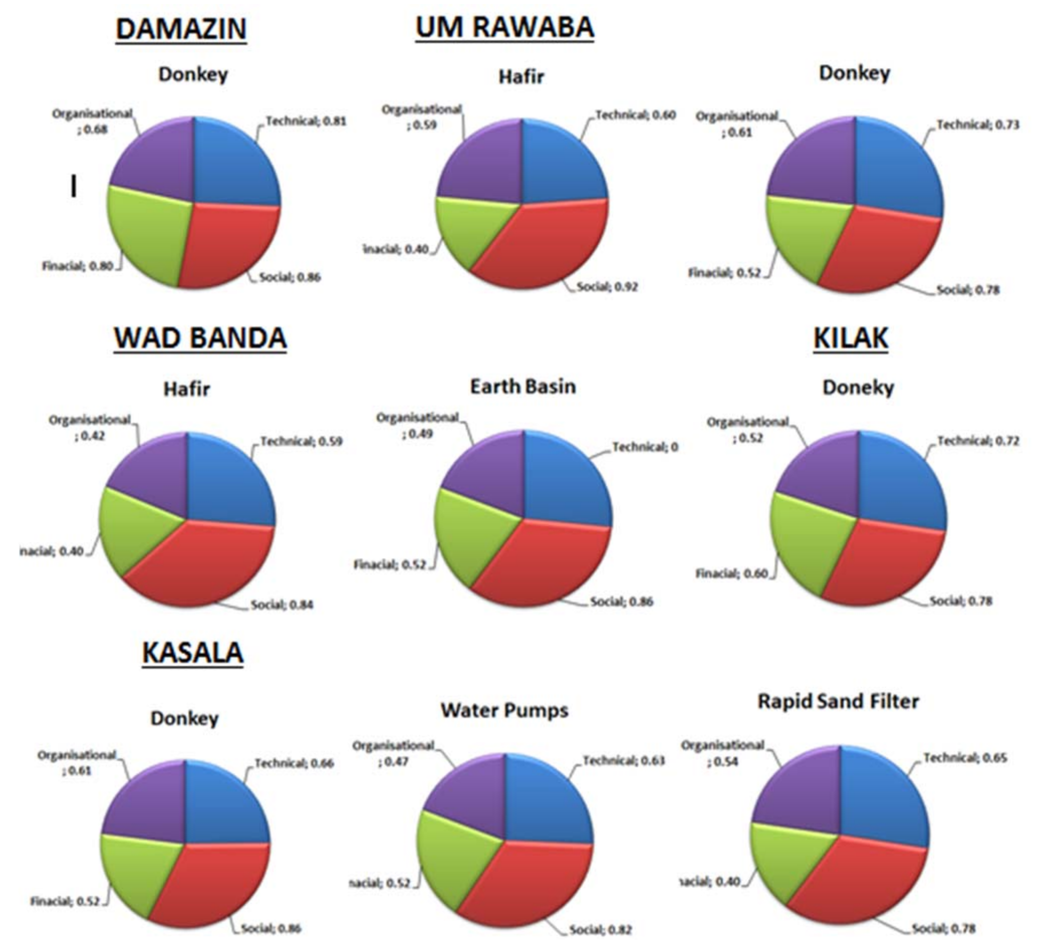

Figure 3 Sustainability performance for different community-based water projects

3.2 Sustainability index sensitivity

The sustainability index developed in the current study shows an overall suitability for community-based water projects taking into account technical, social, financial and organizational aspects of community-based water supply projects. The most important preferences of the sustainability index used in the current study are a simple calculation, flexibility in selection of sustainability indicators, sub-indicators and judgment criteria, weighting of input sub-indicators and presentation of the steady status of sustainability.

Sensitivity analysis indicated that the sustainability index formulation was developed correctly and removal of the most violator input sub-indicators scores changed the index score and designation in the expected direction. The sustainability index and its sub-indices are simple, flexible, stable and reliable indexing systems and could be used as suitable tools for assessment of assessing the sustainability of other community-based water projects.

3.3 Multivariate analysis of Sustainability indicators

Multivariate analysis was carried out to assess and quantify the relationship between different sustainability indicators from one side and their effect on the projects' overall sustainability. According to Hierarchical Cluster analysis (HCA), four main clusters were formed (a, b, c and d) (Fig. 4). In Cluster (a), social and organizational sub-indicators were aggregated showing a strong relationship between these two aspects, while cluster (c), mainly aggregated organisational and technical aspect indicating stronger correlation indicating that there might be an indirect relationship between social and technical issue. Besides, clusters (b) and (d) consisted of environmental and quality related issues respectively. It is clear that the willingness of communities to accomplish their roles and responsibilities is one of the major pre-requisites for successful community-based development projects. However, communities' willingness is not enough for assuring the sustainability of these projects.

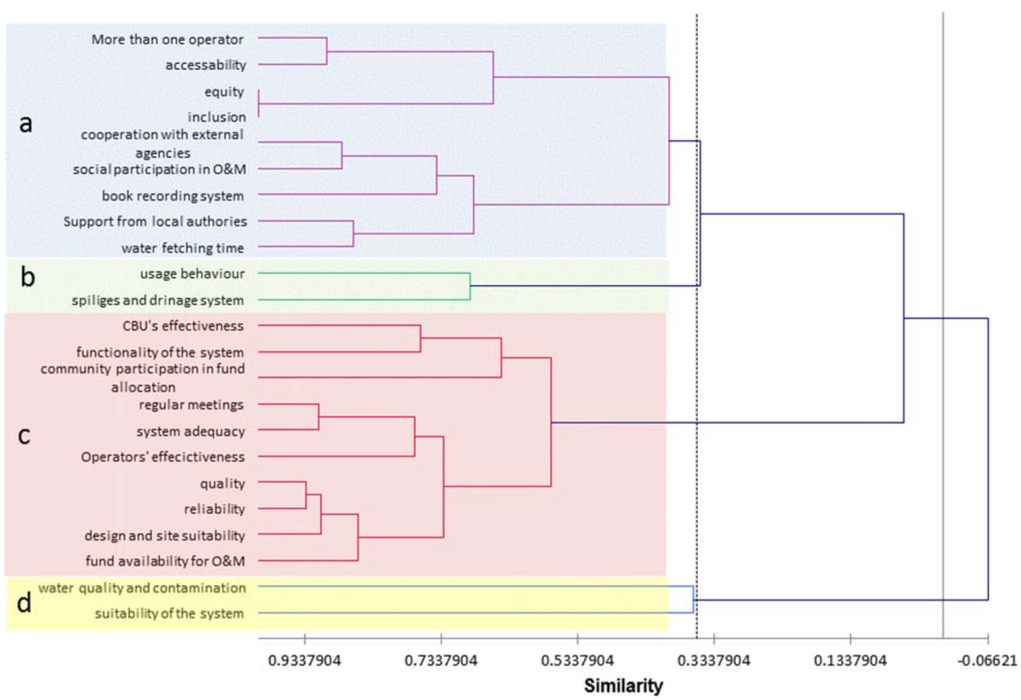

Figure 4 Hierarchical Cluster Analysis (HCA) of sustainability sub-indicators

Principal component analysis (PCA) of major sustainability criteria (technical, social, financial and organizational) to evaluate their impact on projects' overall sustainability. 82% of the variation in the projects' sustainability was related to these criteria indicating that there are other external factors explaining the rest 18% of the sustainability variations. The results showed that there is a strong correlation between technical, financial and organizational criteria from one side and the overall projects' sustainability on the other side (Fig. 5). According to PCA analysis, 68% of the variations the projects' overall sustainability were related and explained by the technical, financial and organizational aspects, while 16.8% of the variations in projects' sustainability was explained by social aspects.

According to PCA analysis of the sub-indicators, 68% of the variations in the projects sustainability was explained by the sub-indicators used in the current study. 39% of the sustainability is mostly altered by technical and organizational aspects of the projects, while 28.9% was related to social/environmental and financial aspect (Table 4).

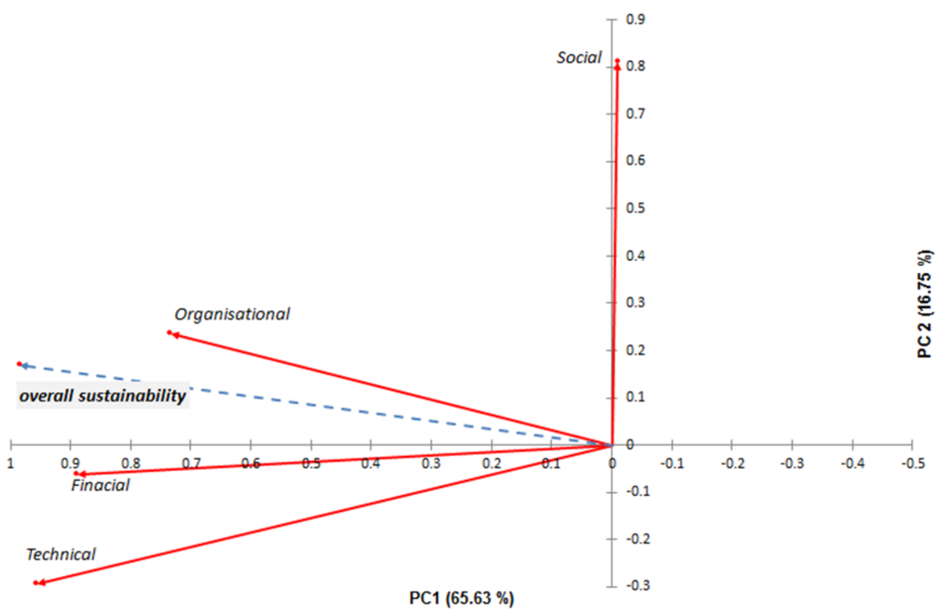

Figure 5 Principal Component Analysis (PCA) of sustainability criteria and projects' sustainability

Table 4 PCA correlation between variables and factors for sustainability sub-indicators (to be continued)

	F1	F2	F3	F4	F5
Reliability	0.922	0.237	-0.090	-0.038	-0.253
Quality	0.953	0.247	0.108	0.120	0.003
Accessibility	0.685	-0.421	0.449	-0.173	0.338
Design and site suitability	0.896	0.183	0.288	-0.103	-0.210
Functionality of the system	0.673	0.352	0.139	0.023	0.361

Table 4 PCA correlation between variables and factors for sustainability sub-indicators

	F1	F2	F3	F4	F5
Suitability of the system	-0.431	0.051	-0.577	-0.402	0.533
Water quality and contamination	0.277	0.484	-0.333	-0.750	-0.064
Spillages and drainage system	-0.461	-0.728	0.312	-0.345	0.065
Water fetching time	0.326	-0.814	0.044	0.346	0.303
System adequacy	0.911	-0.200	-0.121	-0.141	-0.183
Usage behavior	-0.497	-0.713	-0.411	-0.195	0.020
Inclusion	0.244	-0.742	0.170	-0.601	-0.023
Equity	0.244	-0.742	0.170	-0.601	-0.023
Social participation in O & M	0.083	-0.770	-0.433	0.223	0.117
Fund availability for O & M	0.868	0.341	-0.287	-0.137	-0.072
Community participation in fund allocation	0.595	0.503	-0.430	-0.057	0.364
Regular meetings	0.883	-0.295	-0.176	0.107	-0.060
CBOs effectiveness	0.765	0.120	0.158	0.184	0.560
More than one facility operators	0.610	-0.526	0.592	-0.041	-0.010
Operators' effectiveness	0.753	-0.134	-0.531	-0.029	-0.032
Book recording system	0.529	-0.590	-0.392	0.186	-0.385
Cooperation with external agencies	0.121	-0.789	-0.544	0.189	-0.009
Support from local authorities	0.105	-0.894	0.046	0.266	0.049

*Values in bold correspond for each variable to the factor for which the squared cosine is the largest

3.4 Community-based water projects in Sudan

Among the many interventions designed to address the rural domestic water supply and sustainability problem, Community-based Management (CBM) has gained considerable prominence since the late 1980s. Essentially CBM owes much of its origin from the neo-liberal traditions of a reduced role of the state, human rights and empowerment approaches aim development. CBM ought to achieve specific objectives including: (a) Identifying development priorities by the target community itself (b) Strengthening the civic skills of the poor through community organizations and (c) Enabling communities to work together for the common goods (Mansuri and Rao, 2003). However, the sustainability of CBM remains low and limited throughout sub-Saharan Africa including Sudan due to limitations associated with the current perceptions in CBM and conceptual misunderstandings. Based on our study, sustainable CBWS project is influenced by different internal as well as external factors affecting its functional ability, which also have been indicated by many previous researchers (Barnes et al., 2011; Harvey and Reed, 2007; Rondinelli, 1991; Whittington et al., 2009). These factors can be classified into three major levels Macro, Meso, and Micro-levels (Table 5).

Table 5 Determinants of community-based water projects in Sudan

Macro and Meso-level determinants
Lack of trust and transparency between different stakeholders' levels
Lack of enough software activities
Politics influences budgets allocations
Different stakeholders roles interferences
Lack effective system of monitoring for CBUs activities
Undermining the role of NGO's
Limited role for private sector participation
Market dynamics and spare part prices inflation
Micro-level determinants
Lack of accountability between community members and CBUs
Communities' financial ability
Lack Funding allocation and management skills
Intermittent supply and/or poor water quality water supply
External support dependency

3.5 Macro and Meso-level CBM functional determinants

Although community participation and management seem to be a useful tool for sustainable community-based water resources management (Dube, 2012), the perceptions of community participation and community management still confusing for some stakeholders and needs to be defined. According to Harvey and Reed (2007): "Community participation is a prerequisite for sustainability, i.e., to achieve efficiency, effectiveness, equity and replicability but community management is not". Community participation is a consultative empowerment process designed to establish communities as effective decision-making entities (i.e. community involvement throughout the project cycle). Community management can be viewed as a form of community participation. (Wegelin-Schuringa, 1998), where Community management is a bottom-up development approach whereby community members have a say in their development and the community assumes control-managerial, operation, and maintenance responsibility-for the water system (Doe and Khan, 2004). This misunderstanding and undermining view of the different stakeholder for the importance of CBWS projects has been reflected in many practices. Macro and meso-level constraint are related to legislations, policies, and funds that influence CBWS projects. Table 4 shows major Macro and Meso levels factors affecting the performance of CBWS projects in Sudan.

Among other factors, the conflict in roles between and among key water sector personnel at local government level which would affect, both directly and indirectly, the effectiveness of CBM in enhancing opportunities for operation, maintenance, and sustainability of point-water supply facilities. Also, there is a lack of mutual understanding and cooperation bridges between the communities and the other external institutions especially the governmental authorities which are needed for sustainability requirements (Rondinelli, 1991; Whittington et al., 2009). This is because of the governmental authorities as well as, in some cases, the donating agencies, has a common misconception that these services can be autonomously managed by the local communities which are always not the case. This misconception might be due to that the governmental authorities and/or the supporting agencies do not understand the needs of the communities for such a supporting system, or they do not have a conceptual model on how to structure and organize this support system after project implementation. In water projects investigated in the current study, understanding the importance of support system after the projects phase out is existing, but the mechanisms and the tools for accomplishing this at the right time were lacking. While the governmental authorities step aside, leaving the service delivery and support to be carried out by the project funding agencies and/or external agencies and their interference is only for consultation when needed. Such attitude has been reported in different developing countries especially in the sub-Saharan Africa (Colin, 1999; Harvey and Reed, 2007).

In the current study, it was observed that most of the sustainability related problems were mainly due to poor community management as reflected by the PCA results which showed that 39% of the projects' sustainability was mostly correlated to community organization issues (Fig. 6). This is in accordance with Harvey and Reed (2007), who also indicated that most of the projects related to the community management do not occur immediately after the commissioning of the improved water supply facility, but sometimes later within 1-3 year, which is similar to the projects' age subjected to the assessment in the current study. Therefore, software activities to leverage communities ability in managing the implemented projects are one of the major governmental aspects that should be focused on. Also, building the capacity of rural communities served by water facilities to demand social accountability are key strategies that could potentially improve the impact of limited funding in service delivery. According to interviews with different projects' stakeholder, the reason behind the lacking of enough software activities is funding availability. However, giving the priorities to hardware activities rather than software is a major issue. Although 'internal budget switching' from software to hardware activities could be positive step toward a much better impact on decentralized financing on CBM and functional sustainability of rural point water facilities, undermining the role of community training on implement projects management can jeopardize the whole sustainability issue of the project.

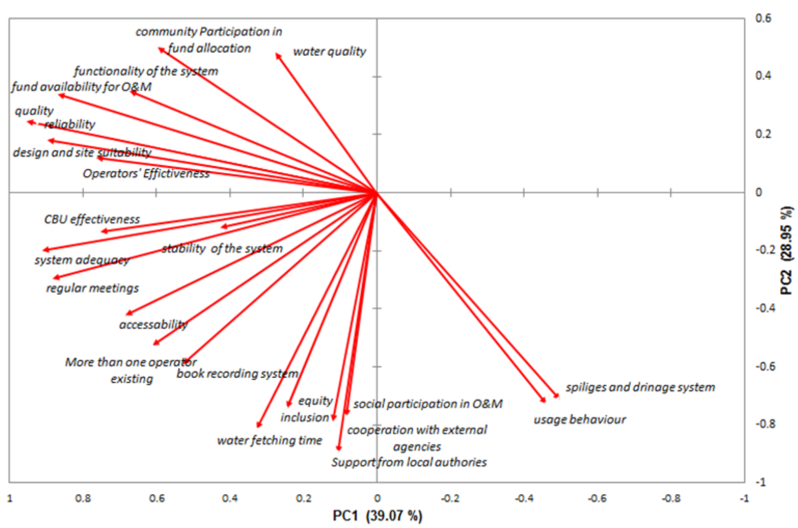

Figure 6 Principal Component Analysis (PCA) of sustainability sub-indicators and projects' sustainability

An effective monitoring system for the performance of any sector constitutes an enabling effort to enhance public sector efficiency and effectiveness which has also been reported by different researchers (Awortwi, 2003; Helmsing, 2002). On the other hand, it is worth mentioning that the local NGOs are excluded from this equation, and their role in communities support in the studied areas is still negligible. The lack and/or the unaligned approaches of NGOs and local governments (LGs) for CBM effectiveness are due to skepticism from both sides. Unfortunately, poor working relations between local governments and NGOs has a reflection on the effectiveness CBM of water point sources and affecting the functional sustainability of water facilities (Quin et al., 2011). Collaborations with NGOs can either be informal relationships between NGOs and projects' stockholders or can be a formal partnership which is a formal linkage between stakeholders for the purpose of achieving certain goals (Busenberg, 2000; Raik et al., 2005; Selin and Chevez, 1995; Tucker, 2004; Turner, 1999; Zanetell and Knuth 2002). Such informal relationships and/or formal partnerships were not adequately and efficiently available in the projects assessed in the current study, where other stockholders were not actively involved in the projects cycles. Such ignorance of the other stakeholders and/or other goals interested parties gave them a feel distance and resulted in weakening further collaborations during post projects implementation phase. Therefore, the inclusion of other stockholders from the beginning of the project cycle is necessary.

3.6 Micro-level CBM functional determinants

Micro-level determinants are related to issues related directly to the community regarding structure, function or management. In general, CBUs are responsible for managing daily operational mandates for the implemented project. Each project CBU unit consists of 8 to 10 members elected annually by the community based on gender as well as tribal considerations.

The responsibilities of the CBUs is described in a community Act, which also includes annual meetings with the community to review reports, budgets and to discuss projects constraints. One of the indicators of a functional CBM system is the ability of CBUs to mobilize the rest of the water user community for meetings over their roles and responsibilities in water and sanitation issues (Montgomery et al., 2009). In most projects, no such meetings were held for one year now. Besides, many of the committee members whose have either tribal or financial influence placed themselves in the committee (especially the chairperson). Such approaches inside the CBUs have led to a deterioration in the relationship between the community and the CBU members and drastically affected the projects' performance and overall sustainability. This was also reflected by the results obtained in the current study, where a significant relationship between the CBU's effectiveness and regular meetings was observed (Fig. 6). Interviews with community members projects have reflected that, in most cases, although the project has delivered the water consistently to beneficiaries, community members show dissatisfaction of the CBU members management attitude. This deficiency in internal community management has also been reflected by Peter and Nkambule (2012), reflecting the need for external support to monitor and evaluate CBUs performance and to follow up the meetings conducted within the community.

Another determinant that affects the communities' performance in managing implemented projects is their financial ability. The success of CBM models in ensuring functional sustainability of point-water facilities largely depends on the ability and willingness of water users to participate in water-related community development initiatives, especially by making financial contributions to meet the initial cost of construction, major repairs and routine O & M (LockWood and Smit, 2011). The assumption held by many of research studies is that low-income households are more unwilling to pay for services because of issues of affordability. However, findings showed that willingness rather that (financial) ability accounted for the limited financial contributions to O & M. According PCA analysis (Fig. 6), there is a strong correlation between reliability, quality, and functionality of the system on one side and funds availability for O & M on the other side, indicating that The actual and perceived quality of safe water service delivery (access to, and functionality levels of water sources) have a potential effect on the motivation of the community to participate in O & M of improved water facilities.

CONCLUSIONS

Questioning the feasibility of community-based water projects and their sustainability status was the main objective of the current study. It was clear that the willingness of the community to be positively involved and/or participate with their facilities and manpower in water projects planning and implementation in rural areas were not the sole factor for assuring the sustainability of these projects. There are still limitations in Sudan with the current community-based management approaches either at Macro and meso levels or at the micro-levels. According to the present study, these limitations were mainly related to organizational and financial aspects at all levels. Although most of the studied community-based water projects showed high community participation during the project planning and implementation phases, this motivation started to decline after the project phase out and handling the service to the community. This is mainly because the communities felt that these projects' management responsibility is bigger than their capacities especially if they are not supported and trained. Also, transparency and accountability issues are at all levels. Therefore, there is a need to develop models and mechanisms for supporting and backing up the communities in managing their projects after their implementation. Besides, community-based management water supply projects are still in the government's back yards i.e. the government should back up these communities technically and financially to assure the sustainability of the implemented projects. This backup mechanism should involve all stakeholders (i.e. governmental institutions, funding agency, NGOs, privet sectors, etc.) and it should not be time limited to assure the projects sustainability and achieve the Developmental Goal addressed by the United Nations.

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