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Full Length Research Paper

Borehole provision and sustainability to guarantee potable water availability for progressive poverty reduction in Ghana

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This study establishes the prime essence of providing measures for borehole sustainability immediately after borehole provision to guarantee potable water availability for progressive poverty reduction. The sample size was 1,200 household respondents from eighty communities provided with boreholes selected by simple random sampling technique. Primary data were collected from the Atebubu and Afram Plains Districts in Ghana through the use of quantitative and qualitative research instruments. The study's results show that 90.8% of survey respondents indicated that their community boreholes were "currently working", as at the time of the survey. Also, 85.0% of the respondents indicated that their communities owned the boreholes, 99.5% indicated willingness on the part of community members to sustain boreholes, while 86.4% indicated that their households contribute funds as levies for borehole maintenance. Ensuring effective borehole sustainability practices is therefore quintessential to poverty reduction efforts. When boreholes become dysfunctional, poverty reduction processes become jeopardized and enter a reversal mode which if not resolved early, gains in poverty reduction are lost.

Key words: Boreholes, handpump sustainability, poverty reduction, WATSAN committee, operation and maintenance, community level management.

INTRODUCTION

The Atebubu and Afram Plains Districts are located in the Brong Ahafo and Eastern regions of Ghana respectively. Though both districts have very fertile lands supportive of agrarian livelihoods, their levels of poverty were very high (World Vision Ghana, 2007a, b). Both districts also lacked basic socio-economic infrastructure. In terms of commonality of adverse geography, these districts were the most guinea worm endemic in the country as at 1990 prior to the provision of boreholes. Their geographical location is primarily rural and the two districts share almost the same climatic types and same geological formations (Government of Ghana, 2007). However, in terms of geographical space and locations, the two districts are almost 312 km apart.

From 1990 to 2003, World Vision Ghana Rural Water Project drilled 363 boreholes in 249 communities in the Atebubu and Afram Plains Districts to provide potable water to support the efforts at eradicating waterborne/related diseases, especially guinea worm (World Vision Ghana, 2003). As boreholes provided in rural communities continue to function well and people in households continue to patronize them, their health also improves. This avails them of unlimited substantive freedoms from which they continue to direct more time and energy into their occupational livelihoods to earn income. This further resulted in wealth creation and improved quality of life, and eventually in sustained, progressive poverty reduction.

Due to the fact that borehole sustainability is crucial for the well-being of rural households, it calls for strong, local level water governance institutions to mobilize communities to continually keep their boreholes functioning to reap the unlimited benefits of potable water availability especially towards poverty reduction.

From the community meetings held during the field survey for this study, and listening to community members recount their past experiences of the gruesome physical and mental fatigue, incapacitation by water borne/related illnesses, such as guinea worm and diarrhea, and the social and economic desperation they have endured, then it is understandable why they will not compromise and lose the substantive freedoms they have gained as a result of boreholes provided in their communities. Thus, borehole sustainability is central to household and community well being for sustained poverty reduction and many rural communities are prepared to do anything possible to keep their boreholes running, barring aquifer failure.

This evidence buttresses Harvey and Reed"s assertion that, in terms of boreholes sustainability, „a non-functioning hand pump is a stark symbol of unfulfilled expectations and unchanging poverty" (Harvey and Reed, 2004: 84).

By implication, wherever boreholes are functioning consistently over a long period there must be obvious evidence of progressive poverty reduction in these rural communities.

In assessing the sustainability of boreholes in this study, the term „sustainability" is used to imply how boreholes function over a period of time. Thus, when boreholes continue to produce water over a certain lifespan, at the same quality and quantity as at its inception, then it can be termed as being sustainable. This is on condition that the borehole has not been dysfunctional to warrant complete rehabilitation (Abrams, 2011; Fisher, 2011; Koestler and Koestler, 2008; Fosenka, 2008).

The import of this definition serves to give much direction for this study as it helps to determine and define the issues under review. In relation to this study, boreholes sustainability will be considered with much emphasis on borehole hand pump operation, repair and maintenance to ensure and assure continual potable water supply to rural communities over a long period, and how that can foster sustained reduction in poverty.

All major efforts made at reducing poverty ultimately depend on the availability of potable water. Also, people daily depend on potable water to maintain their health and develop their potentials. Thus, the availability of boreholes enables people develop their capabilities and acquire skills and the instrumental freedoms they need to enhance the choices they make to shape their future. When people therefore lack potable water due to broken down and unrepaired boreholes in rural communities, their freedoms and options become limited most often by poverty orchestrated by water borne/related illnesses. Also they become subject to other social and environmental disadvantages and vulnerabilities (Bartram, 2008; Pruss-Ustun, 2008; UNDP, 2006; Sachs, 2005).

Problem statement

It has been noted that even in developing countries where successful efforts have been made to provide and expand access to improved water sources by providing boreholes, sustainability has become a major problem. As noted by Skinner and others, the main recurring problems with rural water facilities are the lack of technical and financial capacity to maintain assets. This situation leads to rapid deterioration of rural water supply facilities to a point where they are no longer able to provide the intended service, and people reluctantly revert to surface water sources (World Bank, 2010a; Skinner, 2009; Mba and Kwankye, 2007).

It has been estimated that on the average, one in three rural water facilities needs rehabilitation, and for a significant number of countries, the proportion increases to almost one in two of such as is found in Nigeria, Tanzania, Madagascar, Malawi, and the Democratic Republic of Congo (World Bank, 2010a).

It has also been noted that the lack of proper maintenance and repairs on boreholes in rural areas indicates weaknesses in the water governance institutions, as well as the lack of appropriate technology. Also, weak institutional capacity and insufficient maintenance is worsened by much attention not being paid to choice of technology. Poor maintenance schedules and the lack of a supply chain to adequately supply borehole spare parts negatively impacted boreholes maintenance and repairs (Fisher, 2011; Fosenka, 2008; Harvey and Reed, 2007).

Studies conducted by Montgomery and others have indicated that the large percentage of non-functioning boreholes in Africa depicts the lack of adequate operation and maintenance regimes, and the lack of sustainability backstopping services in rural communities. For instance, from eleven countries surveyed in Sub-Saharan Africa, water facilities found functioning ranged from 35-80% (Montgomery et al., 2009; Colvin and Saayman, 2007). In South Africa, another study also documented as many as 70% of boreholes in the Eastern Cape not working. Furthermore, 7,000 wells and boreholes surveyed in Tanzania showed on the average that 45% are still functional, and only 10% of water facilities that were 25 years or older are still functioning (World Bank, 2010a).

This study brings to the fore the sustainability strategies and processes built into the borehole drilling operations in the Atebubu and Afram Plains Districts of Ghana by World Vision to ensure the sustainable provision of potable water to the rural communities and the direct linkages to poverty reduction.

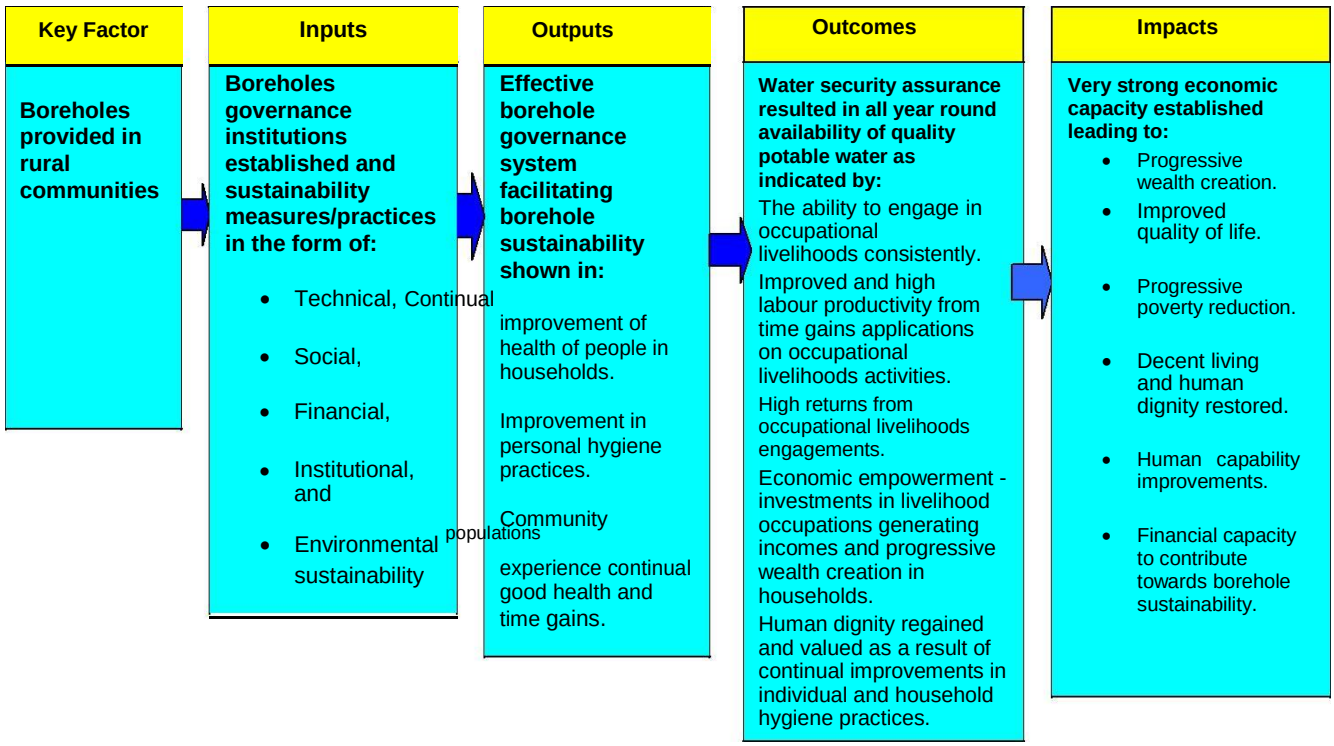

Figure 1. Theory of change/conceptual framework - borehole sustainability for progressive poverty reduction.

Source: Author's construct

METHODOLOGY

For this study, the population of interest was drawn from rural communities where World Vision Ghana Rural Water Project drilled 363 boreholes in 249 communities in the Atebubu and Afram Plains Districts from 1990 to 2003. The sampling frame was thus based on the database of boreholes drilled. The probability sampling technique was employed to obtain the sample needed for the study. This technique allowed for each individual unit in the population universe to have a chance or probability of being included in the sample. Specifically, the probability technique - Simple Random Sample (SRS), was used to select the samples (communities and respondents) for this study (Guiseppe, 2006).

Thirty-two per cent of communities with boreholes (Programme communities) were sampled. This gave a total of eighty communities with boreholes (Atebubu - 41; Afram Plains - 39). Large communities with populations over 5,000 were not included in the sampling frame so as to minimize biases. Fifteen respondents were selected from each programme community to arrive at a household respondent sample size of 1,200. Primary data were collected from communities sampled using an integrated approach of quantitative and qualitative data collection methods. Information were collected on the situation before and after boreholes were provided in terms of the sources of water, the availability and access to potable water, boreholes sustainability institutions, practices, strategies and the capacity for engaging in livelihoods occupations.

Most questions were structured in the form of Likert scale, while other questions were structured with responses in basic „Yes" or „No" formats. The quantitative data were analyzed through the use of SPSS computer-based analysis applications to generate the results. The unit of analysis was „households". Non-parametric data analysis methods, especially descriptive statistics were employed to analyze data.

Theoretical and conceptual framework for boreholes sustainability

Figure 1 shows the theory of change undergirding borehole sustainability in terms of operation and maintenance. The framework shows the key factor, inputs, outputs, outcomes and impacts.

The key factor is boreholes provided in rural communities as a direct response to the vital need of potable water to improve the quality of life and as means for emergence out of poverty. The inputs are the five factors depicted as technical, social, financial, institutional, and environmental sustainability. In explaining the elements comprising the five factors, technical sustainability involves Water and Sanitation (WATSAN) Committee Training; Pump Maintenance

Technicians (PMT) training; spare parts being available, accessible and affordable; borehole repairs and maintenance by PMTs; and functional adult literacy training for youth and adults to know much about boreholes and hand pumps.

Social sustainability comprises community leadership initiatives; community mobilization and participation, community ownership of boreholes, community awareness creation on sustainability issues, generational training of youth in communities, and monitoring of boreholes performance by WATSAN Committees and Pump Maintenance Technicians. Financial sustainability embraces community mobilization to strengthen willingness to pay levies for boreholes maintenance and repair; community fundraising activities, household levies collection and banking, and borehole funds utilization and accountability.

Institutional sustainability refers to WATSAN Committees formed, and Women‟s groups formed, trained and active. Environmental sustainability involves actions by communities towards ecology sustenance for aquifer recharge, and mitigating effects of climate change to sustain groundwater sources.

The outputs are indicated as: effective borehole governance system facilitating borehole sustainability shown in the continual improvement of health of people in households, improvement in personal hygiene practices, and community populations experiencing continual good health and time gains.

The outcomes reflect as: water security assurance resulting in all year round availability of quality potable water as indicated by the ability to engage in occupational livelihoods consistently; improved and high labour productivity from time gains applications on occupational livelihoods activities; high returns from occupational livelihoods engagements; economic empowerment through investments in livelihood occupations generating incomes and progressive wealth creation in households; and, human dignity regained and valued as a result of continual improvements in individual and household hygiene practices.

The impacts of boreholes sustainability reflect as very strong economic capacity established leading to: progressive wealth creation, improved quality of life, progressive poverty reduction, decent living and human dignity restored, human capability improvements, and, financial capacity to contribute towards borehole sustainability.

RESULTS

Borehole sustainability is critical for poverty reduction and human well-being and it calls for strong, local level water governance institutions to mobilize communities to continually keep their boreholes functioning to reap the unlimited benefits of potable water availability in their communities. The study‟s results show that 90.8% of respondents indicated that their community boreholes were “currently working”, as at the time of the survey.

This is a practical evidence of high level impact and a major sustainability indicator of community ownership of boreholes. It also indicates the ability of communities to operate and maintain their boreholes to assure continual availability of potable water to support improvements in health and hygiene practices, and ultimately free people to engage in their livelihood occupations to earn income progressively to reduce poverty.

Boreholes provision in the Atebubu and Afram Plains Districts have provided several freedoms to households such as freedoms that are empowering children access and enjoy quality education, and thereby offering them hope and a future out of poverty; freedoms and benefits that now cement marriage bonds in these communities, freedoms of celebrating and worshipping God, freedoms of strengthened social cohesion, freedoms from incapacitating and debilitating water-borne/related diseases, and freedoms of mobility. Also the freedoms of improved economic potentials, capacity for wealth creation, enhanced and seemingly unlimited opportunities for capability development to the utmost of one‟s potential, all have been made possible through the provision of boreholes in rural communities in the study area.

With these benefits evident, it cannot be overemphasized that borehole sustainability is central to sustaining all the substantive and instrumental freedoms gained, and the chain of processes facilitating progressive poverty reduction.

Unlike the scenario indicated earlier in this study‟s introduction, which depicted a very high rate of non-functioning boreholes scattered in some countries in Sub-Saharan Africa, this study however revealed that boreholes sustainability has been a high priority for communities served in the Atebubu and Afram Plains Districts. For instance, in this study, 85.0% of respondents indicated that their communities owned the boreholes as depicted in Figure 2. This indicates high level awareness of their responsibility to sustain the boreholes to ensure availability of potable water for their households. Figure 2 also indicates that where borehole sustainability is weak, low level of responsibility exist without a high commitment for ownership of boreholes by communities.

Again, Figure 2 further indicates that communities have been highly sensitized and trained and they know that the boreholes belong to them and not to the District Assembly (local government authority) nor to World Vision - the provider of the borehole. Thus, they have to assume ownership and total responsibility to ensure the long-term operational success of the boreholes to continually meet their water needs.

In terms of commitment, 99.4% of respondents (very willing - 91.1%, and partially willing - 8.3%) indicated willingness on the part of community members in

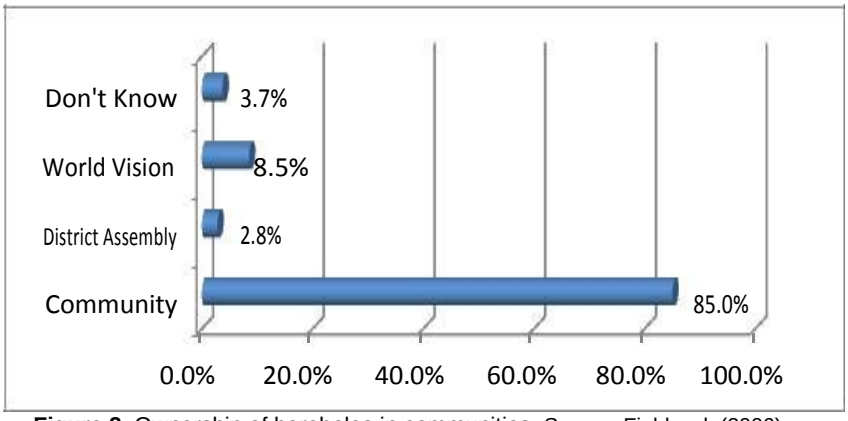

Figure 2. Ownership of boreholes in communities. Source: Fieldwork (2006).

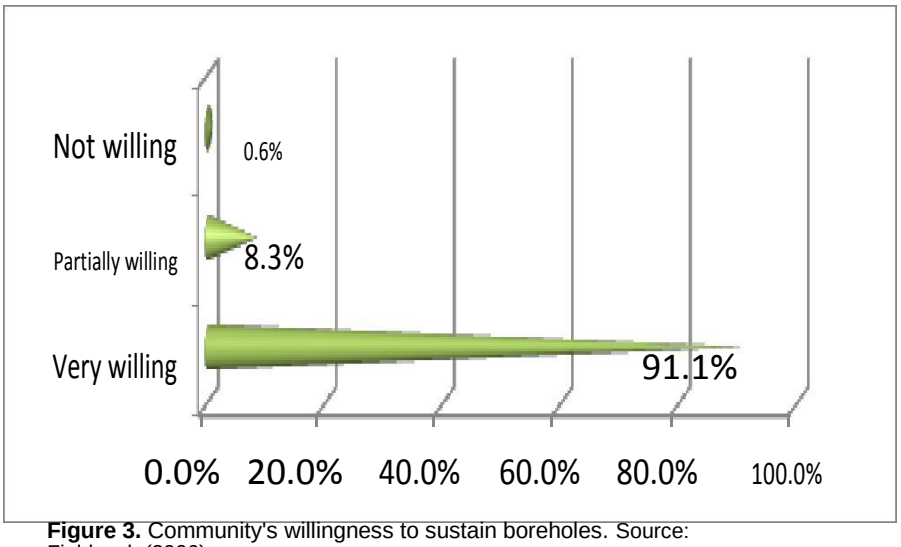

Figure 3. Community's willingness to sustain boreholes. Source: Fieldwork (2006).

households to sustain boreholes as depicted in Figure 3. Further, the results in Figure 3 are very significant because a lack of commitment in terms of willingness to facilitate boreholes sustainability through maintenance and repairs is tantamount to ensuring failure of the boreholes and reverting to traditional surface sources of water, that is, in terms of individuals, households and community well-being. Meanwhile, 86.4% of respondents indicated that their households contribute funds as levies for borehole maintenance, which they view as very important to the continual operation of boreholes in their communities.

Results from the study further showed that 86.5% of respondents indicated that trained Pump Maintenance Technicians (PMTs) were available and firmly in charge of boreholes repair and maintenance. At the same time, 62.3% of respondents indicated generational capacity building of PMTs to replace those who migrated from their communities.

Again, 87.8% of respondents indicated that borehole sustainability was on-going through the maintenance and repairs activities of local PMTs. Also prompt access to pump parts was indicated by 88.7% of respondents, while 85.1% indicated the availability of trained PMTs to service boreholes in communities. Thus, each community provided with a borehole had the ability to facilitate repairs at all times of the year, if only they have the right spare parts in stock or know where to acquire them.

It was observed that 84.8% of respondents indicated that the formation and training of local water governance institutions, termed Water and Sanitation (WATSAN) Committees, has greatly promoted the sustenance of boreholes in communities. For instance, 84.9% of respondents indicated borehole monitoring by WATSAN Committees as having been supportive to borehole maintenance. WATSAN Committees were indicated by 75.1% of respondents as being still functional in their communities as at the time of the survey.

Local chiefs or tribal leaders often have a major influence within communities and their involvement may be the difference between success and failure. In this study, 92.9% of respondents indicated that boreholes

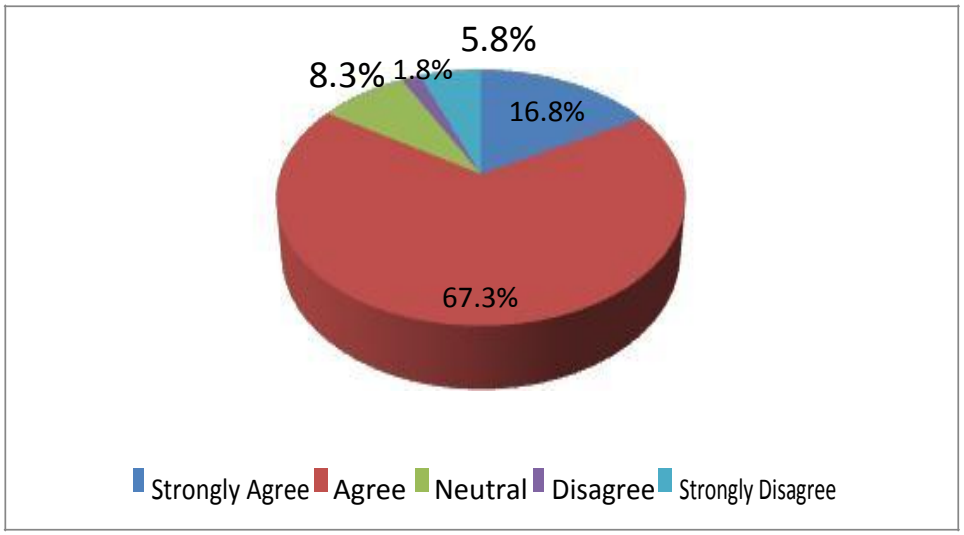

Figure 4. Boreholes provided facilitating wealth creation and reducing poverty in households. Source: Fieldwork (2006).

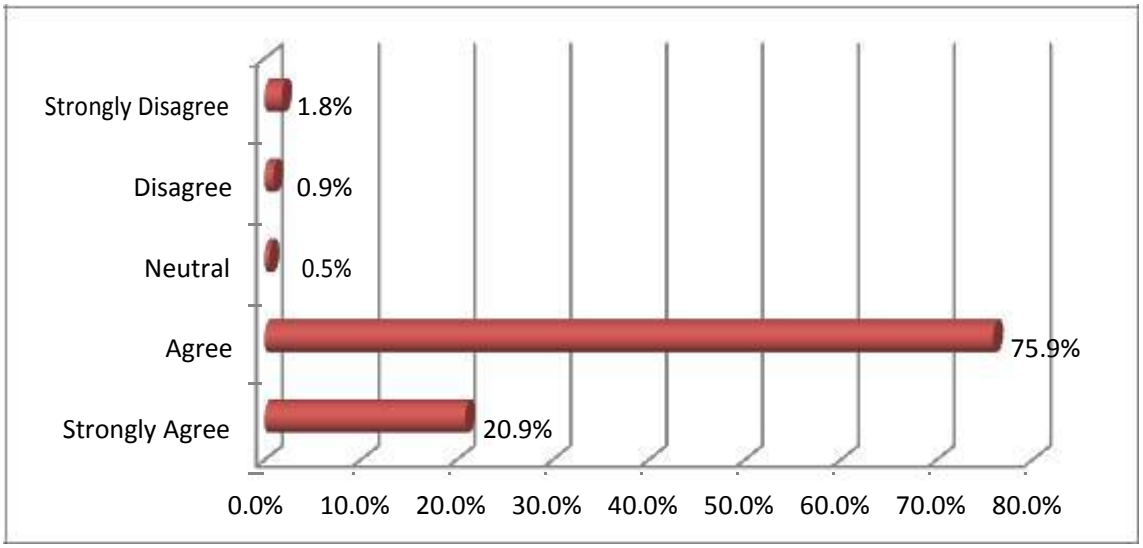

Figure 5. Intangible values - freedoms gained from boreholes provision. Source: Fieldwork (2006).

sustainability has also thrived much through community leadership mobilization efforts.

In terms of utility friendliness, 83.0% of respondents indicated that the standardization of hand pumps (use of the Indian Mark II Modified) has enabled Pump Maintenance Technicians (PMTs) master the repair and maintenance of the boreholes. For 90.3% of respondents, due to effective pump maintenance, potable water is available all year round from the boreholes and this study is of the view that should such practice continue, potable water availability is assured. Also, 84.1% of respondents (strongly agree - 16.8% and agree - 67.3%) indicated that potable water availability from the boreholes has enabled households generate income and create wealth to reduce poverty as depicted in Figure 4. This has actually gone a long way to improve the quality of life and fostering progressive poverty reduction in the study area.

It is obvious that for poverty reduction to be sustained, boreholes sustainability will have to be a prime concern to all community members who have to support the water governance institutions (WATSAN Committees) established to function effectively. In that respect, 96.8% of respondents indicated boreholes sustainability as being quintessential for sustainable livelihoods, improving the quality of life, and facilitating reduction in poverty in their households.

In relation to direct poverty reduction, as many as 96.8% of respondents (Strongly agree - 20.9% and 75.9% agree) indicated having gained intangible values such as substantive freedoms, dignity, hope, and options in life as shown in Figure 5. The provision of boreholes in the Atebubu and Afram Plains districts created the

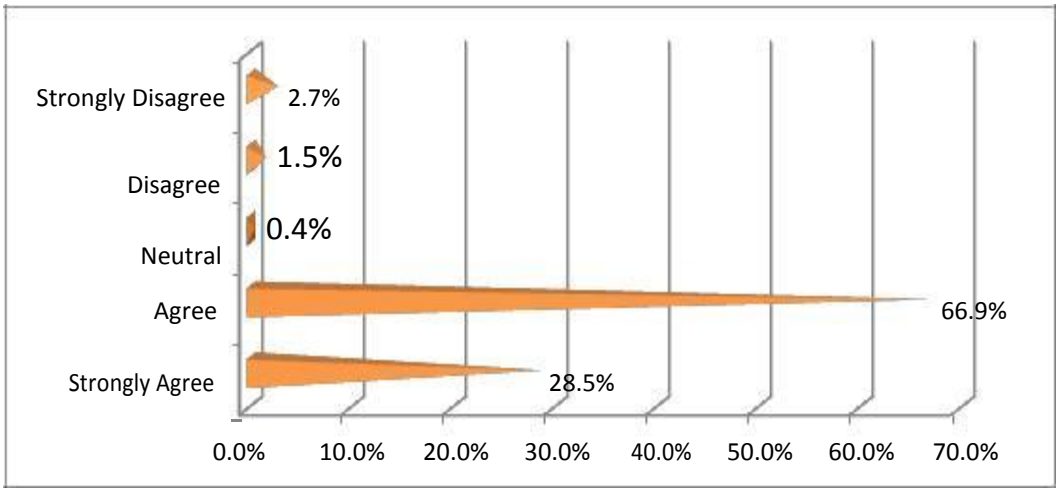

Figure 6. Boreholes provided facilitating freedoms from the effects of the physical environment. Source: Fieldwork (2006).

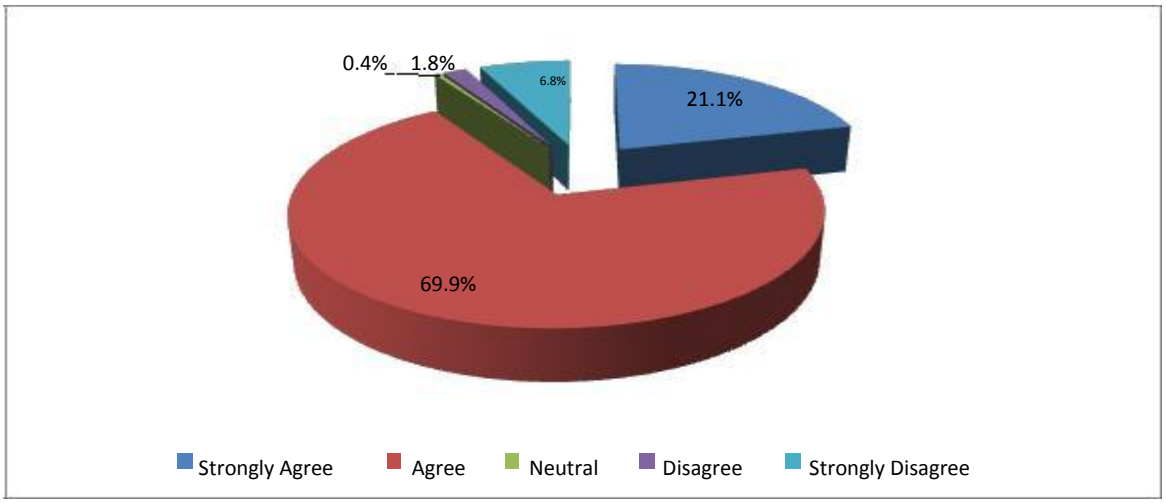

Figure 7. Boreholes provision creating enabling environment for economic enterprises development in households. Source: Fieldwork (2006).

platform for individual and community empowerment to enable the inhabitants emerge out of poverty in a sustainable way. The empowerment gained implies the expansion of freedom of choice and actions which were previously not available.

As depicted in Figure 6, 95.4% of respondents in programme communities (strongly agree - 28.5% and 66.9% agree) affirmed that the borehole investments have led to the eradication of guinea worm and other water borne/related diseases and facilitated the restoration of freedoms from effects of the inclement physical environment. This empowered them to seriously engage in occupational livelihood activities which further facilitated reduction in poverty in households in the study area.

Again, 91.0% of respondents (strongly agree - 21.1% and Agree - 69.9%) indicated that boreholes provision had created an enabling environment for economic enterprises development in households as depicted in Figure 7. These enterprises include agro-processing facilities such as milling of cereals - maize, rice, millet, and root crops processing.

In summary, the results from this study as depicted in Figures 4, 5 and 6 show the essential need for borehole sustainability measures to be put in place after the borehole infrastructure provision to assure and sustain continual availability of potable water and progressive poverty reduction in the beneficiary rural communities.

DISCUSSION

The estimated functionality of hand pumps installed on boreholes in rural areas of Sub-Saharan is 66.0% (RWSN, 2010). Several reasons assigned for this very high failure rate include poor community mobilization towards the execution of borehole provision in communities

poor community cohesion, lack of community participation or very low community involvement in the boreholes provision processes. This further leads to lack of community ownership of the borehole(s), inappropriate hand pump technology imposed on communities, no post-project backstopping for capacity building from Government agency or donor agency that provided the boreholes, and the lack of access to spare parts. In this study, 84.8% of respondents indicated that the formation and training of local water governance institutions, termed Water and Sanitation (WATSAN) Committees, and the capacity building of local hand pump maintenance technicians by World Vision during the programme implementation has greatly promoted the sustenance of boreholes in communities.

Furthermore, Fisher (2011) has indicated that in order to sustain boreholes repairs and maintenance, there is need for the policy framework from Government outlining its support for rural communities. This should be in the form of the Government‟s long term funds mobilization strategy, as well as a policy guideline standardizing the hand pump technology. For instance, in this study, 83.0% of respondents indicated that the standardization of hand pumps (use of the Indian Mark II Modified) has enabled Pump Maintenance Technicians (PMTs) master the repair and maintenance of the boreholes.

Sufficient capacity at community level such as hand pump technical skills acquisition and the availability of trained Pump Maintenance Technicians in a community is also absolutely essential. Fisher further indicates that borehole toolkits and spare parts should be located within local hardware stores within communities or available at the nearest market center or town to enhance access.

Boreholes with hand pumps installed on them are the most common technology adopted to implement rural water programmes in Sub Saharan Africa. However, these show low levels of being sustainable because of technical and management challenges. There is further indication that boreholes currently serve an estimated 1.5 billion people globally, and has proved to have very high reliability if properly managed and maintained (MacDonald, 2005). Again, in Africa, about 250,000 boreholes with hand pumps are serving several rural communities. However, as at 1994, about 40-50% of the hand pumps had broken down. For instance, in Mali, an evaluation organized in 1997 indicated that 90% of borehole hand pumps are non-functional. The main reason attributed to the low functioning rate and low sustainability level of borehole hand pumps was the lack of sufficient attention to borehole operation and maintenance by the beneficiary communities, as well as by the service providers – Government and donors (Harvey and Reed, 2004; MacDonald, 2005).

Currently, many rural communities depend solely on boreholes for potable water availability in their households. So the failure of such boreholes impacts directly and in many ways on their occupational livelihoods, their hopes, and their aspirations. Also the socio-economic impact of non-functioning boreholes is very far-reaching, especially when it compromises the effectiveness and quality of basic education delivery in rural communities. This limits children‟s ability to progress on the education ladder to the tertiary level, they are unable to access the highly paid job market and thus remain at the poverty *status quo*. This eventually becomes a major drawback on progressive poverty reduction processes (Psacharopoulos and Patrinos, 2007).

The current dependency level on boreholes by rural communities globally is estimated to be 75%. This evidence indicates that boreholes serve critical social and economic functions in rural communities which have far-reaching benefits by reducing health hazards and improving economic and social opportunities (World Bank, 2010a; Bartram, 2008; Pruss-Ustum et al., 2008; Foster et al., 2006). However, there are several factors that affect the possibility of a borehole continually functioning after its completion. These factors may be technical and relating to the sufficiency of the groundwater as stored in the aquifer serving that borehole to meet community population demand. When the daily rate of water extraction exceeds the daily rate of aquifer recharge the borehole will eventually dry-up.

This study however does not delve into this geological factors affecting boreholes sustainability but is directed towards the technical factors relating to the handpump installed on the borehole and the local capacity available to ensure repair and regular maintenance so as to facilitate continual extraction of water. Other factors which limit sustainable borehole performance considered in this study relate to the strength of community leadership initiative; level of community ownership of boreholes; and community willingness to contribute funds for borehole repairs and maintenance over the long haul.

Comparative analysis estimates indicate that as at 2006, 60.2% of hand pumps fixed on boreholes in Nigeria were non-functioning. The main reason assigned for these hand pump failures was lack of maintenance of the hand pumps after installation. So with continued usage, serious wear and tear occurred until they finally ceased functioning (Eduvie, 2006). In this study, however, 83.3% of respondents in communities provided with boreholes surveyed gave indication that the boreholes were promptly repaired by the trained Pump Maintenance Technicians when they break down. This has helped to prevent people from reverting to old sources of surface water and resulting in sustained poverty reduction. Furthermore, results from this study as indicated by 85.0% of survey respondents, points to the fact that community borehole sustainability should essentially be the role of inhabitants of communities. Of prime importance is the fact that borehole sustainability is critical for poverty reduction and the well-being of

household issues such as health, hygiene, and occupational livelihoods development for earning income.

The management of boreholes by communities is meant specifically to empower and encourage community ownership and taking full responsibility for boreholes sustenance. In that respect, community mobilization efforts are more often directed towards soliciting community involvement and inculcating a sense of responsibility and ownership. However, this does not at all times stimulate the willingness required to accept immediate responsibility and voluntarily contribute funds for boreholes repairs and maintenance over the long haul. As such, several hundreds of boreholes become non-functional when challenges emerge relating to operation of the hand pumps (RWSN, 2010; Fosenka, 2008; Harvey and Reed, 2007). It should be noted that while community ownership does not in any way resolve the challenge of ensuring boreholes sustainability, it creates the avenue for social mobilization for communities to be passionate about the continual functioning of their boreholes and being prepared to take absolute responsibility (Schouten, 2006).

On its own, a hand pump on a borehole is not able to assure water security until there is active community involvement, which is key to the whole process (Fosenka, 2008; Schouten, 2006). The results from this study indicate that community involvement should be spontaneous if households really see the need for potable water as the basic solution and pathway out of poverty as indicated by the Theoretical and Conceptual framework (Figure 1).

Ensuring continuous flow of potable water requires active community participation and Schouten is of the view that community level management of boreholes might be the best approach but it should go with motivation incentives to the local WATSAN Committee members and Pump Maintenance Technicians.

From this study, 86.4% of respondents indicated that their households contribute funds as levies for borehole maintenance and repairs. Thus, essentially, there will always be the need to sensitize and educate communities about the need to raise funds to manage (maintain and repair) boreholes, using their internally-generated resources than to wait for hand-outs from donors or some intervention from Government (Fosenka, 2008; Harvey and Reed, 2007).

While the social cohesion of any given community may have a significant impact on sustainability of boreholes, more often than not however, it is assumed that people in rural communities have the means and the same concern to promptly take actions towards boreholes management and sustainability. In reality though, it requires intensive and sustained community mobilization efforts to get people to acquire the high sense of responsibility needed to be proactive on issues relating to boreholes sustainability to facilitate progressive poverty reduction. This does not imply people are unaware of the implications of when a borehole breaks down (Skinner, 2009).

It is a fact that when people lack access to potable water their entire lives become disrupted and that often leads to insecurity and high level risks which include poor personal hygiene, poor health conditions, loss of human dignity, livelihoods dislocation due to time lost searching for water, and children"s education compromised in terms of access and quality (World Bank, 2010; La Frenierre, 2009; Pruss-Ustun et al., 2008; UNDP, 2006).

Results obtained from this study show 86.5% of respondents indicating that trained Pump Maintenance Technicians (PMTs) were available and firmly in charge of boreholes repair and maintenance as at the period of the survey. It is therefore of much importance that rural communities be supported and their capacities built to be able to operate, maintain and repair their boreholes by themselves to ensure and assure continual water availability for their households. However, the proof of boreholes sustainability are whether water continues to flow with the original certified excellent quality and also in same quantities as at its inception as planned (Abrams, 2011); and whether hand pump mechanics trained and intended to provide maintenance services for the boreholes are still available in the communities or have migrated.

The prevalent view over the past two decades indicates general acceptance that rural communities in developing countries should take full responsibility for the sustainable management of the water infrastructure investments made in their communities (World Bank, 2010b; Mays, 2007). By implication, communities should manage the operation, maintenance and repairs of all boreholes provided in their communities. This paradigm allocates responsibility for the continual operation of boreholes from government and donor agencies to rural communities (Burgi and Rydbeck, 2010; World Vision Ghana, 2003).

Mays (2007) further sees this opportunity of managing boreholes by community members as promoting the sense of ownership and instilling a sense of responsibility on borehole end users. The school of thought promoting this paradigm believes that people in rural communities can ensure continual potable water availability in their communities if choice of ownership of the boreholes has been understood and embraced by them and not imposed by the provider. In this instance, it is hoped that they will always be in readiness to contribute human resources for capacity building and the financial resources required to effectively maintain and repair boreholes when they cease functioning (African Development Bank, 2011; Burgi and Rydbeck, 2010; World Vision Ghana, 1996, 2003).

Major causes of breakdown or non-sustainability of boreholes include boreholes constructed without adequate consultation with communities and lack of community involvement which led to lack of ownership by

communities, and so repairs and maintenance do not happen (Mays, 2007). Other causes are where Water and Sanitation (WATSAN) Committees, Pump Maintenance Technicians and other interest groups have all lost interest in sustaining the boreholes; and, where trained Pump Maintenance Technicians (mostly volunteers) at community-level have migrated from the community and a new generation has not been trained.

Conclusion

The theory of change relating to borehole sustainability as shown in Figure 1 depicts the borehole sustainability practices, measures and strategies and their interrelationships as implemented in the Atebubu and Afram Plains Districts, which if sustained, can in the long run foster improved health and time gains utilization on occupational livelihoods to accelerate the reduction of poverty in rural communities. Thus, ensuring achievement of continual water supply to facilitate improvement in the quality of life and to sustain poverty reduction should be at the center of the management of boreholes in all rural communities. It is a precondition for being able to sustain and increase occupational livelihoods investment returns and achieving dynamic economic growth within geographic space.

The findings from this study show that 85.0% of respondents indicated that their communities owned the boreholes; 99.4% of respondents indicated willingness on the part of community members in households to sustain boreholes; 86.4% of respondents indicated that their households contribute funds as levies for borehole maintenance and repairs; 86.5% of respondents indicated that trained Pump Maintenance Technicians (PMTs) were available and firmly in charge of boreholes repair and maintenance; 62.3% of respondents indicated generational capacity building of PMTs to replace those who migrated from their communities; 87.8% of respondents indicated that borehole sustainability was on-going through the maintenance and repairs activities of local PMTs.

The results further indicated that prompt access to pump parts was indicated by 88.7% of respondents, while 85.1% indicated the availability of trained PMTs to service boreholes in communities; 84.8% of respondents indicated that the formation and training of local water governance institutions termed Water and Sanitation (WATSAN) Committees has greatly promoted the sustenance of boreholes in communities; 92.9% of respondents indicated that boreholes sustainability has also thrived much through community leadership mobilization efforts; 90.3% of respondents indicated that due to effective hand pump maintenance, potable water is available all year round from the boreholes; and 84.1% of respondents indicated that potable water availability from the boreholes has enabled households generate income and created wealth to reduce poverty.

Essentially, what the findings have revealed is that empowering rural households for self-motivated boreholes sustainability is quintessential for maintaining all capacities that support households to be able to engage in their occupational livelihoods. It is an essential precondition for ensuring households well-being and the economic empowerment of households to enable them eventually break free from the poverty trap as indicated by Sachs (2005) and be able to sustain reduction in poverty to a point of eradication over the long haul.

Thus, it is obvious that any community which reneges on this key obligation of boreholes sustainability will not enjoy the flow and benefits of potable water for long-term poverty reduction. Institutions having oversight of water infrastructure management such as District and community level WATSAN Committees and hand pump technicians have to be established, trained and encouraged to effectively perform their duties to assure all-year-round availability of potable water in rural communities served with boreholes.

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