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Culture in rural water and sanitation projects: a case study

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A case study of a water and sanitation project under construction in Emem, Ghana is used as a basis for consideration of how culture impacts on the engineering design and implementation of projects in rural communities in less developed countries. The hypothesis is that local culture is an important consideration if long term sustainability is to be achieved. It was found that, contrary to expectations, cultural issues such as religious belief had no direct bearing on the design parameters of the project. However, an understanding of local culture was vital in establishing lines of communication during the construction phase. Different attitudes to problem solving between foreign engineers and local people created some problems, but in other cases were complementary. It is concluded that engineers working on such projects need a clear understanding of their own world view in order to relate properly to their clients.

Introduction

Culture is a somewhat nebulous concept that has been defined in numerous ways by a variety of authors (see for example Kroeber and Clyde 1952). For the purposes of this paper, culture is defined as, "the cumulative deposit of knowledge, experience, beliefs, values, attitudes, meanings, hierarchies, religion, notions of time, roles, spatial relations, concepts of the universe, and material objects and possessions acquired by a group of people in the course of generations through individual and group striving" (Samovar 1994). Thierry Verhelst describes the way that culture can be the mechanism by which communities choose whether to accept or reject interventions being introduced into their society from outside. *"The ability to select outside influences, to make a choice, is extremely important. Every community must be able to make a free choice between what it considers to be useful and beneficial and what it considers to be superfluous and harmful… It is culture, which contains these values and determines the priorities; it is also culture which directs the choices in accordance with these priorities,"* (Verhelst 1994).

It seems logical therefore that culture should be a key concern of the foreign engineer involved in water and sanitation projects. The foreign engineer needs to consider how the proposed technologies, and the values those technologies embody, will be perceived by the local community. Culture is an important concern for all aspects of the project; not only in technology selection, but also in the system design and the design and implementation process. Hofstede (1980) provides a framework for assessing the differences between cultures based on four (later increased to six) dimensions and highlights the importance of understanding other cultures to successfully navigate cultural borders. If systems are not designed in a way that is a good cultural fit for the local community, development interventions may fail, wasting valuable resources and leaving communities without access to vital water and sanitation facilities.

This problem is illustrated by Baptista (2010), in which local culture was overlooked during the design of a piped water system. For many complex cultural reasons the social risk associated with utilising the implemented system meant that the intervention was rejected by the community. Technical and economic considerations were allowed to transcend social and cultural concerns, to the complete detriment of the project and local community.

This paper explores the impact of culture on water and sanitation projects through a case study of a project currently being undertaken by author Furber during fieldwork which is being carried out in the Kwahu South District in the Eastern Region of Ghana. The paper begins with an overview of the project, looking at the technical, economic and social issues encountered. Some of the problems that arose during design and implementation are then explored. This is followed by discussion about the extent to which culture has been a relevant factor during the project and in what sense it was significant. Consideration is then given to how foreign engineers can work more effectively in local cultures.

Method

The significance of culture to engineers working on water and sanitation projects was explored during six months of field work in the Kwahu South District of Ghana's Eastern Region. The authors collaborated with volunteer organisation, Original Volunteers, and worked with a number of rural communities as they engaged in water and sanitation projects to develop their villages.

Action research (Lewin, 1946) was chosen as the predominant methodology for this research for a variety of philosophical and practical reasons; not least because it can be appropriately applied to real life problems which cannot be controlled under laboratory conditions. This is a means of *learning by doing*, involving a cyclical process of planning, acting, observing and reflecting (Kemmis and Wilkinson, 1998).

One of the projects, a Water and Sanitation Project in the village of Emem, is used here as a case study to explore the way that culture is entwined with the work of engineers. The research methods employed included interview and focus groups with the community and a reflexive diary was kept by author Furber, recording observations and reflections upon which many of the opinions described here are based.

The Water and Sanitation Project in Emem

Emem is a small village situated on the southern shore of the western arm of Lake Volta in Ghana's Eastern Region. It has a population of around 200 people, the predominant ethnicity in the village is of Ewe lineage. Prior to the project, the community collected their water from the lake and all but one household used the water without any form of treatment, with inevitable health consequences. A handful of families had dug their own simple latrines consisting of a pit with a floor made from timbers and mud and walls made from timbers recycled from old boats. Apart from these few people, the rest of the community had no form of toilet and went 'free range' in shrubbery around the village.

The village had been visited by a local Non-Governmental Organisation (NGO) but had been left disappointed as the NGO had been unsuccessful in their attempts to source ground water. The NGO use the same approach for all their projects and only use borehole technology in the provision of water to communities. The NGO have a good approach to their projects, incorporating community management and an educational programme into their work but they do not have engineers working for them who can advise on a range of appropriate technologies that could be employed. As a result, the NGO have been unable to help communities such as Emem where they have not found groundwater, and the village has been left without access to clean water.

To find a solution to the community's water and sanitation problems a pump and water transmission pipe has been installed to bring water into the centre of the village and a coarse gravel filter and slow sand filter is currently being constructed to treat some water to drinking water quality. Improved ventilated pit latrines will be constructed around the village and trenches dug to control rainwater runoff. The community set up a water and sanitation committee to manage and maintain the systems and income generating activities are being incorporated into the project to boost the ability of the village to provide the petrol needed to run the pump. This includes a community farm, which will be irrigated along the same pipe that transports the water to the village, and investment in fish farming. Finally the system will be insured through the purchase of cows: if the system were to need investment then a cow would be sold to raise the necessary funds and a new calf bought to safeguard the future.

Case study aspects

Technical issues

The key technical issue encountered thus far during the project was the difficulty in predicting water level in the lake. The water level changes rapidly as dams both upstream and downstream are controlled for hydropower production. This is combined with a high degree of seasonal variation in rainfall.

This made selecting the location for the pump problematic, as ideally the pump would be situated above the highest water level but always close enough to the water that the intake hose could reach the water at its lowest, without exceeding the suction capacity of the pump. The rapid variation in water level of in excess of 10 m meant that the system had to be designed to be as flexible as possible (see Giesen et al 2001). The final design of the water transmission system can be seen in Figure 1.

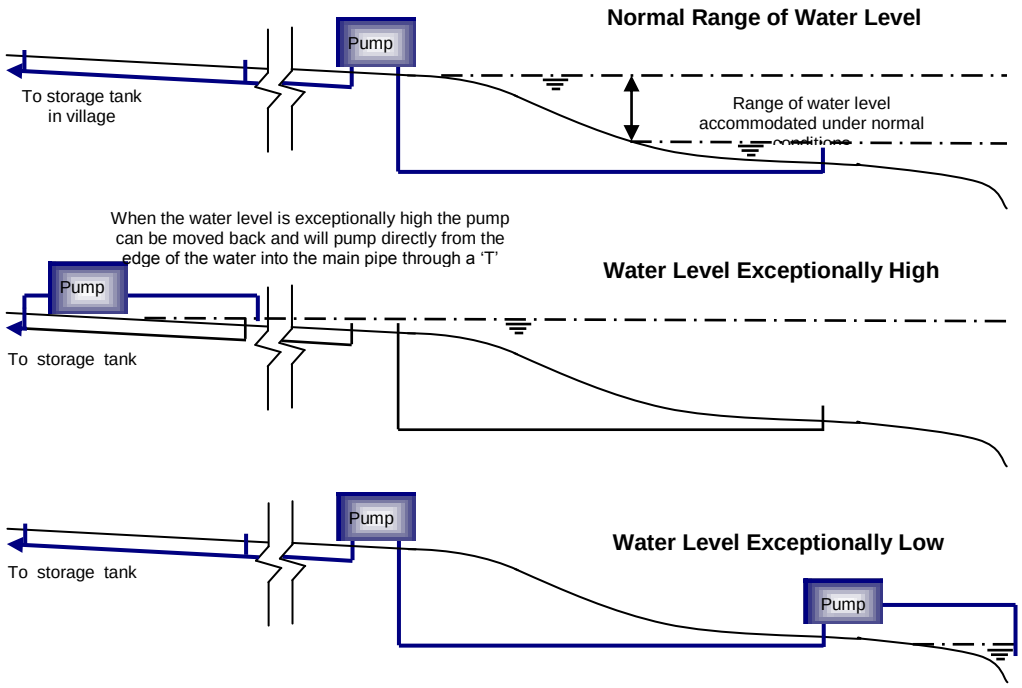

Figure 1. Schematic Elevation of Pump-Pipe System Installed in Emem

At intervals along the length of the pipe to the village, 'T' sections have been fitted to cope with the possibility of the water level rising above the level of the pump house. In this situation the pump can be removed from the pump house and relocated at the first 'T' section above the level of the water. In this way water can still be pumped into the village.

The 'U' shaped intake meant that for the majority of the time the water is collected a significant distance from the edge of the lake. This has the advantage of improving the quality of water taken into the system. The water close to the shore of the lake is of a lower quality with a higher risk of contamination by human and animal excrement.

Economic issues

The water and sanitation system is reliant upon the ability of the community to raise the necessary funds to ensure petrol is available for the pump. In the longer term it can be expected that more substantial amounts of money will need to be available for replacement of parts of the system, for example when it is necessary to replace the pump. It was also anticipated that the implemented system would provide a first boost to the community in terms of improving the health of their village; it was hoped that the community would see the systems as a starting point from which to continue to improve and upgrade their systems gradually as more capital becomes available.

The estimated cost of running the pump to supply the water system was around 1 - 2 Ghana Cedi (£ 0.5 – 1) each day. This provided enough petrol and oil to for the pump to fill the 5m3 water storage tank in the village. In initial discussions (firstly the chief and elders but also confirmed by other members of the community) the community were confident that between them it would be possible to collect the money required to keep the pump operating.

There was a greater desire among the community however to become more economically active. This was an issue that arose particularly in early meetings with the women in the village, when discussions were taking place regarding the development priorities of the community. The women were eager to extend farming in the village by the introduction of irrigation systems that would allow farming through the dry season and extend the range of crops they could grow on their fields.

To accommodate the community's desire to be more economically active it was decided that the 'T' sections described earlier to accommodate high water levels could double as outlets to irrigation channels under normal water level conditions. It was further decided that everyone in the community should benefit equally from this, and that the land between the lake and the village along the majority of the length of the pipe was therefore designated as a community farm. The profits of the farm would go first to the running costs of the water system and any remainder would be saved for general upgrading of the village. The second pump was available for individuals to use to irrigate their farm land providing they could afford to pay for the petrol.

The idea for ensuring the long term sustainability of the system came from Abraham, one of the elders in the community. It was apparent that whilst the village could manage small running costs, they did not have the financial leverage to cope with large expenses such as pump replacement. Abraham introduced the idea of 'cow insurance'. 'Cow insurance' is a very simple idea whereby calves are purchased and reared into cows over the period of a few years. It is possible to buy a calf for about 150 Cedi (£75) and a mature cow can be sold for 7-800 Cedi (£350-400). A mature cow can therefore be sold to finance a new pump (costing around 350 Cedi) and new calf, still leaving a profit of about 200 Cedi that can be spent improving the community.

Social issues

Social considerations were of great significance throughout the project at Emem. The project, in the form described above, was only feasible due to the level of cohesion exhibited by the community; as well as their strong social structure and leadership. Many aspects of the project design and implementation were selected because of the social situation of the community at Emem.

Underlying many of the decisions taken regarding the design and implementation of the project was the ability of the community to organise and share work which would benefit the community at large, without the need to remunerate individuals for work done that benefited a wider population than themselves or their own family. This was evident, for example, in the project implementation phase where members of the community organised and executed digging trenches, laying pipes and setting up the pump and tanks. This meant limited funds could be conserved for other purposes as the majority of the labour was free as it was provided by the community.

The water transmission system requires the community to raise funds to buy petrol for the water pump. The community decided that they would rather each family contributed equally to the running costs, irrespective of the amount of water actually used. They did not feel that pay per bucket was necessary and might be a bad idea because it might inhibit some members of the community from having access to clean water. When someone was unable to pay for their water they preferred that they would be subsidised by the slightly better off elders or chief. This offer came from the elders who did not want anyone in the community to remain drinking untreated lake water but was supported by many of the community members consulted.

One concern that arose was that individuals were worried that some members of the village would not put as much effort into the community farm as would be required for its success. As a result it was decided that the community farm should be divided into seven smaller sections with each section being allocated to one of the seven families in the village. Everyone in the village is associated in some way with one of the seven families, be it through marriage or distant relatives. The family unit, the community said, would be able to spread the work equally over all the members and organise itself in some way to ensure the work got done. The same arrangement was chosen for the fish farms.

The women were concerned about the water treatment systems being played with and ruined by the children and the elders were keen to ensure that water was not wasted and was fairly distributed around the village. For these reasons it was decided that the drinking water tap would not be left open all day. They preferred to open the tap for short periods during the morning and afternoon, during which time everyone would collect all the water they need throughout the day. This, the community said, was how the taps worked in big cities such as Accra and Kumasi.

Issues in design and implementation

Design parameter information

Throughout the project, one of the issues experienced was accessing the information required upon which to base the design of the system. Ideally a fuller understanding of the water levels in the lake would have been obtained prior to commencing construction and more geological data would have been available. In some regards, understanding historical data on water levels in the lake is inadequate due to the political aspects of the dam management.

The authors' experience of dealing with Government Institutions was varied in Ghana. On the positive side all the Institutions visited were extremely welcoming and happy to give up their time to discuss the project. Gaining access to even the highest level of director was simply a case of knocking on their door and introducing yourself.

Often the problems arose where there was only one person who could provide the information sought and that person was out of the office. After three failed attempts to catch the director of the Geological Survey Department in Koforidua, seventy five kilometres from the project, time pressures meant construction had to begin. The backhoe arrived on site and everyone just hoped we would not hit bed rock whilst digging the deep trench between the intake and pump. At the time of writing, water quality results are still awaited from the Ghana Standards Board. Results were promised three weeks following submission of the water samples, now some eight weeks ago.

Concepts of time

One cause of contention that arouse frequently throughout the fieldwork was the different concept of time held by those from foreign and local cultures. For Westerners time is linear and keeping to time schedules is held as critical to the efficient running of projects involving construction. Western attitudes to time are manifest in idioms such as, 'time is money' and 'the early bird catches the worm'.

Local Ghanaian ways of thinking about time differ significantly. Mayers and Lingenfelter (2003) compare Western and African concepts of time in a very relevant manner. Traditional African culture sees time as marked by naturally occurring events which occur in irregular and variable time periods rather than rigidly marked out by a clock. A Ghanaian who holds this viewpoint will not become stressed by an event occurring later than scheduled, whereas this can lead to a deep rooted feeling of anxiety amongst Westerners who feel that time is being wasted. For the Ghanaian, it is the event that marks the fact that time is passing. When the event is over, the time has passed, irrespective of whether the Westerner's watch indicates that this has taken one hour or one week.

Organising the working day proved to be stressful during the project work. During the rainy season access to the site was not possible by road, and it was necessary to take a boat to reach the village. As this was reasonably expensive it was preferred that everyone going to the site met so that only one journey was necessary. Coordinating the collection of skilled labourers and translators was often very frustrating. Similarly when using local taxis, it was normal for them to arrive hours late or to take the project team on a half hour detour during the journey so that the driver could accomplish another task.

That is not to say that local concepts of time did not provided benefits for the project. The local attitude towards making time to help others was incredibly refreshing. It was never felt that someone was rushing off to their next scheduled appointment and did not have time to talk. During the project a plumber was consulted to help with some of the practical details and he helped to purchase the required pipes and spent several days on the site helping with the construction. It was only later realised that he was due to travel to Accra to work on another job and that that had been set back by several days because of his assistance to the project at Emem. There was not one occasion during the project when a paid worker complained that they had worked too many hours or that they needed to leave early to get to another appointment.

Nevertheless, this difference in world view was the cause of a barrier to each culture understanding the other. Despite the authors' prior awareness of the differences in attitude towards time, finding ways to work effectively in a culture with this alien viewpoint proved inconceivably challenging. We were often left exasperated during the project due to local timekeeping or felt guilty that another project was being held up.

There were of course exceptions to this generalisation found during the fieldwork. The mason who worked on the project was frequently half an hour early for work in the morning, and there were some taxi drivers who were more accustomed to working with obrunis (the white people). As the project progressed this issue became less problematic, as the authors found more local people who could bend to their own way

of viewing time. That is not to say that the authors think their way of viewing time is *right* or *better* or that this is the *correct* approach, but no other way of reconciling this cultural gap was found during the project.

Concepts of space

During the fieldwork, it became clear that local and foreign concepts of space also differed significantly. In their own country the foreign engineer is accustomed, for example, to specifying the depth of a trench in millimetres. It is common to indicate on design drawings that a trench should be dug to 450 or 600mm. In Ghana trenches are deep or shallow. The distance to the next village might be near or far. Asking the distance to the market in miles or kilometres is futile as the local people have no concept of how to answer the question in this way.

At Emem, the community were asked to dig shallow trenches for the water transmission pipeline along the majority of the route but the trench was to be deep as it passed under a dirt track road occasionally used by cars. It was then necessary to closely observe the depth to which the trench was dug and point out the locations where it further digging was required. As time passed, author Furber, who was overseeing the trench digging, had to become better at judging distances by eye. This was useful in order to spot those locations in which measurements were significantly different from the original design. It was often useful to cut a stick to the length to which the ground should be dug. This proved an effective way to communicate the depth and gave the community an easy way to check their work.

Discussion

Prior to the fieldwork it was hypothesised that cultural factors would be important during the water and sanitation project. It was suggested that culture might be another dimension of parameters for the design of the water and sanitation systems. This theory in part arose out of literature such as Meyer (1999) who describes the local Ewe culture. In Ewe culture, ancestral spirits inhabit various natural habitats. Some spirits chose to live in water and can become angered by water being drawn in containers made of modern materials (Meyer 1999). This has very apparent implications for engineers who plan to use a variety of manmade objects to suck water out of the lake and pump it into the local village. In the same way that technical or economic considerations may rule out the use of a particular technology, it was thought cultural considerations could rule out the use of a technology or demand its adaptation.

Despite various conversations with the community at Emem during the fieldwork about how the water would be extracted from the lake, this is an issue that never seemed to arise. The community did explain that there is a spirit in the water; it is disrespectful to the spirit, for example, for women to enter the water when they are menstruating. But the spirit in the water did not at any point result in any tangible implications for the design of the water and sanitation systems. Despite the authors' best efforts to seek out cultural issues there are no examples that arose during the field work of local belief systems leading to concrete repercussions for the water and sanitation project.

At Emem culture proved not to be another aspect that needed to be considered alongside the other aspects. But that is not to say it was not of fundamental importance. On a more subtle level culture, viewed as the way people think and solve the problems they encounter in their everyday lives (see Verhelst's definition of culture, Verhelst 1989; Nisbett also links culture to thought process, Nisbett 2003), had an important impact on all aspects of the project. In this way culture was less another aspect to be considered with parameters that would impact on the design of the water and sanitation systems. It was rather an underlying concern which impacted on all aspects of the project. It influenced the way in which the technical, economic and social problems that arose were approached and overcome. It led directly to many of the issues that were encountered.

The project provided an arena where problems arose and various parties were engaged in finding solutions. It became apparent during the field work that the foreign engineers approach to problem solving differed vastly from that of the local community. Ansari (2001) notes how the engineering world view, "either implicitly or explicitly uses physics and chemistry as the basic theoretical and practical framework for problem solving". The engineering approach to designing the water and sanitation systems at Emem was to collect as much design data as possible and then to create a number of solution options that were technically possible. The options could then be evaluated on the basic of criteria such as cost, social acceptability and cultural fit.

The community on the other hand solved problems by doing and experiencing. Given their way it is likely that the community would have begun construction on the first day and solved the issues as they arose. Trial

and error techniques are combined with local knowledge of what has worked before in similar situations, and everyone pulls together and perseveres until a satisfactory solution is found to the problem at hand.

The resolution of these cultural tensions should perhaps begin with engineers assessing the relevance of their approach when working in cultures other than their own. Engineers could benefit from some critical reflection of the assumptions that they hold as a starting point for recognising that there are alternative ways of thinking and solving problems that are equally as valid as their own scientific method. Ansari (2001) refers to Roszak while remarking on "science's implicit worldview and assumptions about the nature of reality" (Roszak 1972). Years of scientific training result in engineers holding a scientific perspective so deep-seated and subconscious that many probably do not even realise that their viewpoint is held only by a sub-set of people with similar learning experiences; that other ways exist (see for example, Aikenhead2007, Mazzocchi 2006).

At the same time, understanding the strengths of a scientific world view could help engineers to better understand the positive role they could play in helping communities reach their development goals. Engineers need to find ways to use their skills in a way that complements the thought process and problem solving ability of local communities.

The ability of local communities to innovate with little by way of resources has been documented by Srinivas (2008). This was confirmed by the community of Emem during the fieldwork on many occasions. When a battery operated drill could not be come by, the community were able to make tight fitting holes for connecting the pipes to the water tank using only parts from a bicycle pump heated over a fire; they made tools from scrap bits of metal, cutting down the capital cost of the system and used the inner tube of tires to create a water tight temporary connection for the pump when the water transmission system was being tested. Engineering knowledge was useful for presenting a range of technology options to the community and anticipating problems that may arise, as well as optimising the system design to cut down operating costs in the long term.

Wider implications of research

The paper has presented a case study in which the implications of local culture on a water and sanitation project are explored. As with all case studies the question arises as to the extent to which the finding can be generalised to inform other projects of a similar nature.

At Emem it was found that cultural values and beliefs did not play an important role in the design and implementation of the systems. It cannot, however, be assumed that this is a result that holds true generally. The next village may take a different view on the use of modern materials in water bodies inhabited by spirits, or there may be entirely different considerations to take into account. It is important to explore this type of issue on a case by case basis. Smith provides an example of how water use in the UK can vary considerably depending on the culture and religion of the user (Smith, 2006).

The finding that culture impacts subtly on all aspects of the water and sanitation project due to the differences in the ways people think and approach problem solving is however likely to be more generally true. The engineer undertaking a water and sanitation project in the village next to Emem is likely to come across similar issues to the ones experienced by the authors.

The engineer in other regions of Ghana and Africa, or in Asia or South America may not experience exactly the same issues, but it is supposed that they may have something to gain from the realisation that culture is likely to impact on their projects in a similar but different manner.

Conclusions

Culture, defined as the way people think and solve problems has a fundamental impact on water and sanitation projects. Cultural differences were the root cause of many of the issues experienced during the construction of a water and sanitation project at Emem in Ghana. However there was no evidence in this project that cultural influences such as religious belief impacted directly on the design parameters of the project. Rather the effect of cultural differences was in the communication of project and wider community information between Western engineers and local people (and vice versa). However it was also found that different approaches to problem solving could be complementary.

It is concluded that engineers working with communities on development projects need a greater awareness of the assumptions that are at the core of their worldview in order to be able to better appreciate outlooks of those from different cultures. Understanding a multitude of approaches could broaden the foreign engineer's problem solving tool box and help engineers to become more effective at helping rural communities meet their development priorities.

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