

**SCHOOL OF PUBLIC HEALTH**

**COLLEGE OF HEALTH SCIENCES**

**UNIVERSITY OF GHANA**

**MONITORING AND EVALUATION TOOLS FOR SANITATION: A  
COMPARATIVE STUDY OF MOBILE PHONE AND TRADITIONAL  
PAPER BASED SURVEY OF DEFECATION PRACTICES IN THE  
NINGO-PRAMPAM DISTRICT OF GHANA**

**BY**

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THE REQUIREMENT FOR THE AWARD OF DOCTOR OF  
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**DECLARATION**

I, Sarah Effuwah Van-Ess, author of this thesis do hereby declare that except for references to other authors' work, which have been duly acknowledged, this work is the result of my own research work, carried out solely as partial fulfilment of the requirements for the award of Doctor of Philosophy in Public Health, under the supervision of Professor Moses Aikins and Dr. Justice Nonvignon and presented to the School of Public Health, University Of Ghana, Legon, and has neither in part nor in whole been presented elsewhere for another degree.



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Date .....

## ABSTRACT

### **Introduction**

The Millennium Development Goal targets for sanitation seems unachievable by the 2015 deadline. Therefore, the 2010-2015 Joint Monitoring Programme strategy requires sustainable and continued efforts at all levels to improve this. However, there are data challenges and limitations from existing Monitoring and Evaluation (M & E) survey tools. In most developing countries such as Ghana, data collection is traditional paper based. However, mobile phone use and access is high and therefore the need for new innovative M & E tools. This study compared the validity, reliability, feasibility and cost effectiveness of using mobile phone SMS M & E survey tool and a traditional paper based survey tool in a rapidly expanding peri-urban setting in Prampram, in the Ningo-Prampram District of the Greater-Accra Region of Ghana, for monitoring sanitation practices.

### **Methods**

The study was a comparative prospective cohort study and used both qualitative and quantitative methods for data collection. Four hundred and fifty-eight respondents were randomly selected based on data from the Dodowa Health Research Centre. Validity was measured using Cronbach's alpha and Kappa for varying levels of agreement for both tools. Reliability was measured using the test-retest method. Various response rates were compared for feasibility on levels of acceptability and ease of use. The total costs of the tools were estimated and compared.

### **Results and conclusions**

There were no significant differences in the reliability and validity of the paper based tools and the mobile phone SMS tools. However, although the mobile phone SMS M & E survey tool is feasible and potentially acceptable in terms of reliability, validity, cost and timely collection of

sanitation data for effective policy formulation, there are challenges, which could be further addressed.



## **DEDICATION**

This thesis is dedicated to God, my supervisors, my children, husband and family for the moral and emotional support given to me during the conduct of the research.



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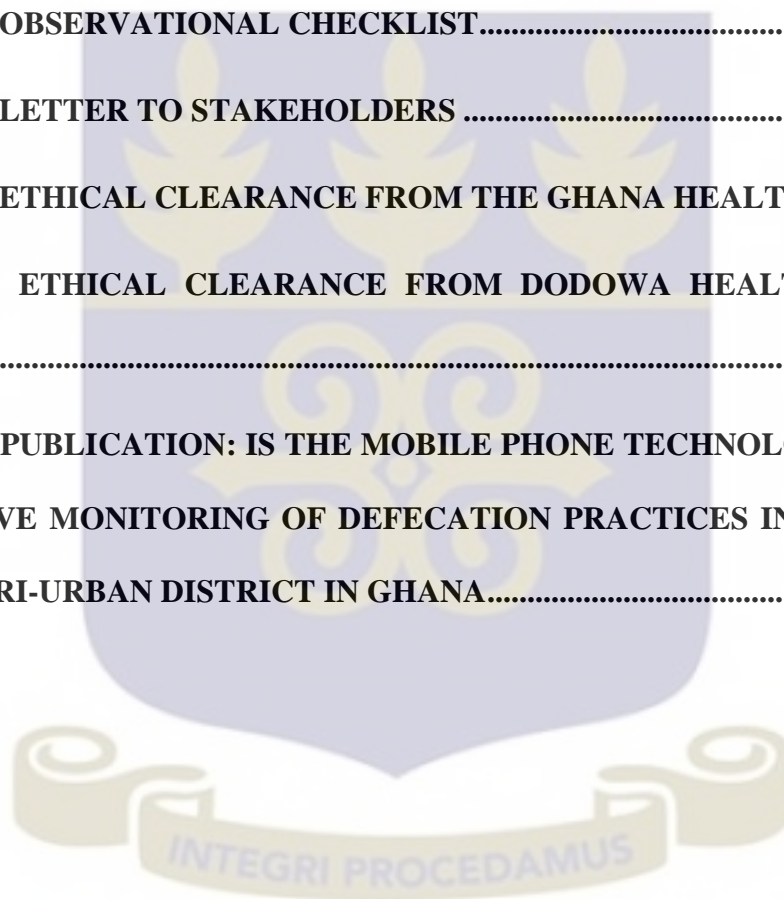
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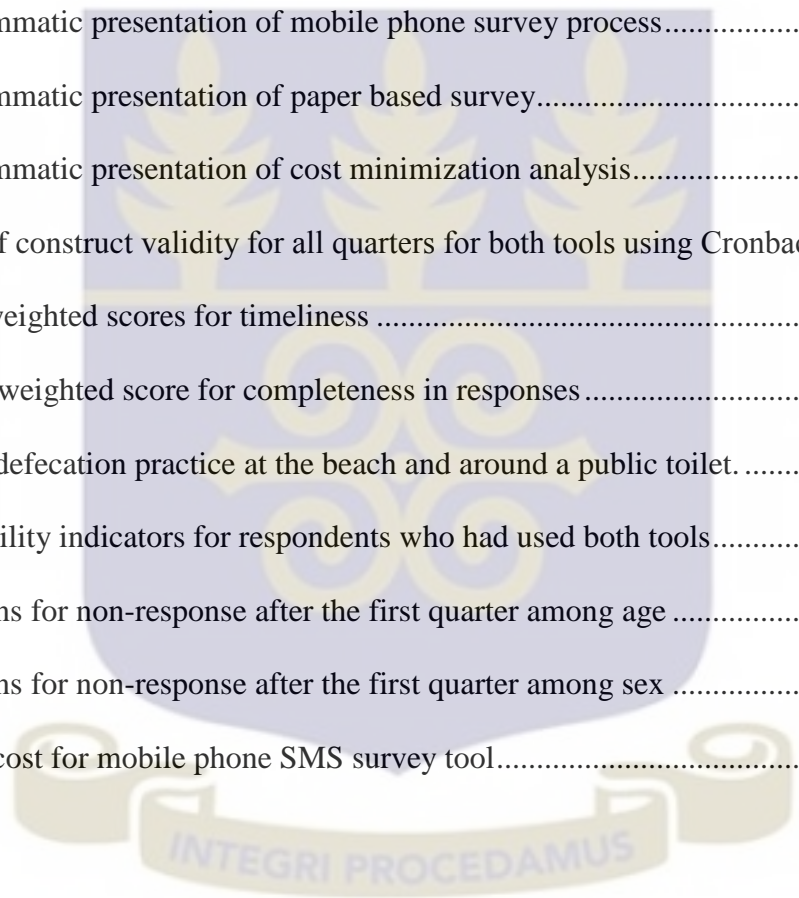
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## LIST OF ABBREVIATIONS

CBA	-	Cost-benefit Analysis
CEA	-	Cost-effectiveness Analysis
CHPS	-	Community-Based Health Planning and Services
CIA	-	Central Intelligence Agency
CMA	-	Cost Minimization Analysis
CMAJ	-	Canadian Medical Association Journal
CUA	-	Cost-utility Analysis
CWSA	-	Community Water and Sanitation Agency
DALYs	-	Disability-adjusted Life Years
DANIDA	-	Danish International Development Agency
DD/MM/YYYY	-	Date/Month/Year
DHRC	-	Dodowa Health Research Centre
DHDSS	-	Dodowa Health and Demographic Surveillance System
DPCU	-	District Planning Coordinating Units
ESP	-	Environmental Sanitation Policy
FGDs	-	Focus Group Discussions
HDS	-	Health and Demographic Survey
IDIs	-	In-depth Interviews
GDP	-	Gross Domestic Product
GHS	-	Ghana Health Service (GHS)
GSS	-	Ghana Statistical Service
ICER	-	Incremental Cost-effectiveness Ratio



IT	-	Information Technology
ITU	-	International Telecommunication Union
JMP	-	Joint Monitoring Program for water and sanitation
KVIP	-	Kumasi Ventilated Improved Pit Latrine
M & E	-	Monitoring and Evaluation
MDG	-	Millennium Development Goals
MICS	-	Multiple Indicator Cluster Survey
MLGRDE	-	Ministry of Local Government Rural Development and Environment
MP	-	Mobile Phone
MPT	-	Mobile Phone Technology
NSO	-	National Statistical Offices
PDA	-	Personal Digital Assistants
Q1	-	First Quarter
Q2	-	Second Quarter
Q3	-	Third Quarter
Q4	-	Fourth Quarter
QALYs	-	Quality-adjusted Life Years
SMS	-	Short Messaging Service
SUSA	-	Sustainable Sanitation
UK	-	The United Kingdom
UNICEF	-	The United Nations Children's Fund
USA	-	The United States of America
WHO	-	World Health Organization

## DEFINITION OF KEY TERMS

In the context of the present study, the terms below are defined as follows:

**Table 1: Definition of key terms**

1.	Mobile Phone or Cell Phone	A mobile phone is a device that can make and receive voice calls to other phones and send and receive short messaging services (SMS) messages. The two terms are used interchangeably.
2.	Defecation	This refers to act of voiding feces from the bowel.
3.	Hand-washing	This involves mechanically removing transient organisms from hands with soap and water.
4.	Reliability	The reliability of the survey tool is the degree of consistency or dependability with which the instrument measures what it is supposed to measure.
5.	Validity	Validity is the degree to which the instrument measures what it is intended to measure, in this case using JMP standards as the reference.
6.	Improved sanitation	The concept of ensuring that there is hygienic separation of human excreta from human contact.
7.	Improved Sanitation Facilities	They are toilet facilities such as the flush or pour-flush connected to either a piped sewer system, a septic tank or a pit latrine; a ventilated improved pit (VIP) latrine; a pit latrine with slab or a composting toilet and constructed according to acceptable standards.
8.	Unimproved Sanitation	Unimproved sanitation facilities do not ensure the hygienic separation of human excreta from human contact.
9.	Unimproved Sanitation Facilities	Unimproved facilities include pit latrines without a slab or platform, hanging latrines, bucket latrines and open defecation.
10.	Shared Sanitation	This is the situation where toilet facilities of an otherwise acceptable type is shared between two or more households and is still considered as an unimproved facility. Only facilities that are not shared or not public are considered as improved facilities.
11.	Open Defecation	This happens when human feces are disposed off in fields, forests, bushes, open bodies of water, beaches or other open spaces or disposed with solid waste.
12.	Paper or Paper based or Traditional paper based survey	The type of survey in which data collection is done by visiting households and asking questions on the accessibility to basic sanitation and recording on paper. The three terms are used interchangeably.
13.	Mobile Phone or SMS Text survey	The type of survey in which data collection is done by approaching households in an automated way by using mobile phone text messages. The two terms are used interchangeably.

## CHAPTER ONE

### 1.0 INTRODUCTION

#### 1.1 Background to the study

In the past two decades, the World Health Organization, (WHO) and the United Nations Children's Fund (UNICEF), under the Joint Monitoring Programme (JMP) for water and sanitation have made advances in the availability and quality of data on the global accessibility to basic sanitation (WHO & UNICEF, 2014). This is in an effort to track progress in sanitation and the methods used to measure progress on accessibility to basic sanitation. The shift from provider-based to user-based data, more standardized data, more expanded JMP database and greater disaggregation of data has allowed categories such as open defecation to be highlighted (WHO & UNICEF, 2014). However, data challenges and limitations from existing Monitoring and Evaluation (M & E) tools still exist (WHO & UNICEF, 2014). For instance, a major information gap relates to the proxy for sustainable access to basic sanitation, which is the use of improved sanitation facilities, since some countries consider shared facilities as an improved facility. Again, the measurement of the actual use and sustainability of sanitation facilities remains an aspect for further consideration in terms of the progress to accessibility to basic sanitation. As well, the current JMP method of monitoring progress on global accessibility to basic sanitation is exclusively on the basis of the types of facilities used. This indicates that other important parameters, such as the availability and access to adequate sanitation facilities, or the reliability and sustained functioning of sanitation systems are not captured (WHO & UNICEF, 2012). This problem stems from the fact that no generally agreed-upon standards have been set and thus, sustainability has not been adequately defined in measurable terms, especially since it encompasses several aspects (WHO & UNICEF, 2012). Additionally, data collection on hand-

washing with soap has been challenging at the household level and is often not reported by the JMP (WHO & UNICEF, 2014).

Globally, these limitations mean that effective M & E of sanitation is lacking in order to address the current monitoring challenges and those that lie ahead, especially in the developing countries, most of which are experiencing rapid population growth (McFarlane, 2008a, McFarlane, 2008b). Most of these population in developing countries live in low-income peri-urban settlements which create a great demand for housing and infrastructure including sanitation services especially for the poor who are living outside the designated residential areas resulting in illegal settlements or slums (World Bank, 2010; WHO & UNICEF, 2012). The term peri-urban often describes a formerly rural area located on city outskirts that has urbanized with diverse multiple uses (Watson, 2009). In these areas, sanitation services are not adequate and systems are poorly planned, designed, and maintained leading to the generation of different kinds of solid waste, including human excreta which are dumped and discharged directly to the open environment resulting in unpleasant living conditions and public health risks (Montgomery, 2008; Dye & Williams, 2010). According to the JMP reports, data on access to improved sanitation in urban areas differs from that of rural areas (WHO & UNICEF, 2012; 2014). Rapidly urbanizing rural population may also vary in their sanitation needs as compared to that of urban settlements. Huge migration effects may also distort the tracking and progress of sanitation data (UN Habitat, 2011; Konradsen, 2010). Aggregate numbers would otherwise mask these variations in both rural and urban areas. Unfortunately, disaggregation at other important levels is not available in the JMP data. This weakness in the JMP data pivots on the absence of reliable data, which is essential to help in the understanding of service provision for the poor, especially in urban areas. Reliable

data provides information to enable consumers, service providers, policy makers and donors act more decisively and to monitor the impact of their interventions.

In addition, the current JMP report still indicate that about 2.5 billion people representing 38% of the global population do not have access to basic sanitation. This has contributed to an estimated 2.2 million annual deaths attributable to poor hygiene, lack of sanitation and inadequate water supply (WHO & UNICEF, 2014). In addition, there is less than a year to the 2015 deadline for the Millennium Development Goals (MDGs) and the world still remains off track for the sanitation target. Accordingly, as part of the 2010-2015 JMP strategy, sustainable and continued efforts are required to decrease all disparities and inequities associated with the non-achievement of Target 10 of MDG 7; which seeks to halve the population of people without sustainable access to basic water supply and sanitation by 2015. The highlights in terms of the limitations of existing tools imply the essence of better data collection tools (WHO & UNICEF, 2012). As such, efforts at global, national and local levels to improve this target have been made. This includes refined sanitation monitoring and evaluation towards the achievement of these targets (Cotton & Batram, 2008, Evans et al., 2004; 2010).

In light of the above, the need for new, innovative M & E tools is important and a UN-Habitat (2011) report suggests that, innovative monitoring of the Millennium Development Goals (MDGs) targets and the gathering of reliable data for decision making will help to address major weakness in the sanitation sector (Cairncross et al., 2010). This study tested one such new, innovative M & E tool using the mobile phone technology in a rapidly growing peri-urban settlement in Ghana's sanitation sector.

### **1.1.1 Basics of monitoring and evaluation**

Monitoring can be defined as the routine tracking of the key elements of a program usually the inputs and outputs, through record-keeping, regular reporting and surveillance systems as well as observation (Zall & Rist, 2004). It is the checking of progress against plans. This includes the accountability of the resources used and the results obtained; informed decisions on the future of the initiative and empowerment of beneficiaries of the initiative (Lamhaugea et al., 2013). Monitoring is a periodically recurring task ideally beginning in the planning stage of a project or program. Monitoring allows results, processes and experiences to be documented and used as a basis to steer decision-making and learning processes (UNAIDS, 2008a).

Evaluations on the other hand can be defined as the episodic assessment of the change in targeted results that can be attributed to a program or project intervention (Craig, 2013). Evaluation attempts to link a particular output or outcome directly to an intervention after a period of time has passed. Evaluation helps to draw conclusions on the relevance, effectiveness, efficiency, impact and sustainability of a program intervention (UNAIDS 2008b; Khasakhala & Kloos (2013).

Monitoring and Evaluation (M & E) is thus an embedded concept and constitutive part of every project or program design and not an imposed control instrument by the donor or an optional accessory of any project or program (Bamberger, 2009). It is an essential part of any program and indicates whether a program is making a difference and for whom (Yawson & Sutherland, 2010). Monitoring and Evaluation in general can be defined as acquiring, analyzing and making use of relevant, accurate, timely and affordable information from multiple sources for the

purpose of program improvement (DeLay et al., 2006). In the same way, M & E of sanitation interventions is essential for measuring the success of sanitation programs through lessons learned and the need for adjustments and corrections for further improvement. Huge investments in sanitation programs by governments and funders require continuous M & E so as to afford accountability and transparency to investors (Zall & Rist, 2004). Governments, donors and researchers continue to work to improve data collection systems, and ensure that data is collected with more regularity (Cairncross et al., 2010; UN, 2011).

### **1.1.2 Global sanitation data flow**

In most developing countries, sanitation M & E data and reports are often generated frequently for use by various stakeholders (World Bank, 2013). Particularly in sub-Saharan Africa, such reports enable donors and local governments to reach common decisions through a harmonized monitoring system and provides a platform for effective data sharing with an aim to achieve common goals and targets (WHO & UNICEF, 2012; 2013).

The availability and accessibility of reliable, accurate and valid data is essential (WHO & UNICEF, 2012) since data acquired through monitoring is used for evaluation. Information gathered in relation to these aspects during the monitoring process provides the basis for the evaluative analysis. Therefore, data generated from individual countries for the purposes of reports by the JMP must be precise and dependable. The JMP, launched by WHO and UNICEF in 1990, focuses on the status of national monitoring which is provided regularly based on information gathered by country agencies and ministries of health through questionnaires (WHO & UNICEF, 2010a). These country agency reports include the National Statistical Offices

(NSO), the Health and Demographic Survey (HDS) and the Multiple Indicator Cluster Survey (MICS) (JMP & WHO, 2008; JMP & WHO, 2010). In most low and middle-income countries, these questionnaires are paper based and are conducted as large field surveys as is the case in Ghana. This is a common feature in research and although capacity and administrative problems with the collection data are common, these surveys are often the only way to collect reliable data.

### **1.1.3 Sanitation data flow in Ghana**

In Ghana, the Ghana Statistical Service (GSS) is mainly responsible for the collection of national sanitation data based on information gathered through the traditional paper based questionnaires. Data is also collected through the Demographic and Health Surveys (WaterAid, 2011). According to Ghana's revised Environmental Sanitation Policy (ESP) (2010), the Ministry of Local Government Rural Development and Environment (MLGRDE) through the Environmental Health Sanitation (EHS) Units at all levels generates data on sanitation. The environmental officers and assistants collect and compile sanitation data at the community levels. These data are collated at the District, Municipal, and Metropolitan Assembly levels through the District Planning Coordinating Units (DPCU) and forwarded to both the Regional Coordinating Planning Unit (RCPU) and the regional environmental offices for onward submission to the Head offices. All M & E activities are the responsibility of the DPCU, which is to submit quarterly reports to the national level (ESP, 2010).

Although a National Sanitation Policy exists, there is no doubt that Ghana's sanitation sector is complex with overlaps and gaps (Konradson, 2010). For instance, at the district level sanitation data collection is the responsibility of EHS units, however, all planning and M & E

responsibilities lie with the DPCU with the District Assembly in charge of M & E protocols. Again, given the important role of the DPCU, efforts are made by the District Assembly to attract and retain qualified and dedicated personnel to work in the Unit. This is coupled with the unavailability and use of inefficient statistical software for the generation of meaningful data. For most districts, the task of data collection is paper based and cumbersome as well as inefficient due to the lack of these personnel and efficient software.

In Ghana, districts use their M & E system as a reporting system for the collection of data at the local and household level. This data goes up to national level for further analysis and interpretation (ESP, 2010). However, data, which is collected at the household level, is not disaggregated resulting in insufficient amount of data to create an appropriate precision level (WHO & UNICEF, 2012). Disaggregation of data is not available at these levels for age, sex, vulnerability, usage patterns, slum and peri-urban groups (WHO & UNICEF, 2010a). In addition, data generation targets at the district levels are hardly met resulting in paucity of sanitation data at higher levels (GWSP, 2010). Data generation and disaggregation is important so as to meet the specific needs of these groups. The result is that the link between data collection and data utilization is weak (GWSSP, 2009). Since the JMP acknowledges the need for a critical review of the challenges of sanitation monitoring and evaluation (M & E) at all levels towards the attainment of the MDGs sanitation targets, an examination of all issues specific to a more efficient M & E is essential.

Therefore, in recent times, there has been significant discussion about the need to strengthen and promote the linkages between national data and more localized district monitoring programs and

processes. As a drive toward a sector wide approach at the district level, there is the need for the production of data in a regular, valid and reliable manner (GCWSA, 2011). The paper based data collection has been the standard and traditional method for decades but errors are frequent, storage costs are prohibitive, and the costs of double data entry are high (Anokwa et al., 2009; Johansen & Wedderkopp, (2010); MacKenzie et al., 2011). Above all, they are also time-consuming (Bliven et al., 2001; Bent et al., 2005; MacKenzie, 2011). Paper based surveys with a cost component of postage tend to be costly, even when using a relatively small sample. This shows that the costs on a large scale survey using mailed questionnaires can be enormous (Salaffi et al., 2009, 2013).

Handheld devices such as personal digital assistants (PDAs) are also increasingly being used in data collection (Seebregts et al., 2009; Lane et al., 2006). Personal Digital Assistants are not without problems of their own including the challenges associated with having to download data (Waddle, 2003; Vivoda & Eby 2006). In addition, data can be corrupted if PDAs are damaged, or data can be lost if PDAs are misplaced or stolen (Cheng et al, 2011; Oystein & Hagen, 2007). The use of online surveys circumvents this problem by eliminating the need for paper and other costs, such as those incurred through postage, printing, and data entry (Llieva et al., 2002; Watt, 2003,1999; Witmer et al., 1999). Recently, electronic methods of data collection have been developed in order to merge the process of data collection and data entry (Shirima et al., 2007).

Wireless and mobile phone technologies have the potential to overcome some of these limitations where households participate in surveys via an automated process of mobile phone text messaging or Short Messaging Service (SMS) (Zhang et al., 2012; Free et al., 2013; Prue et

al., 2013). Moreover, they can be adapted for use in field research settings (Kaplan, 2006; Patnaik et al, 2009; Wei et al, 2011; Mahmud & Nesbit, 2010). Low and middle-income countries lack the infrastructure in many research field settings to accommodate adequate fixed line internet access, whereas wireless networks allow access to telecommunications in a region where fixed lines remain limited (Ahlers-Schmidt, 2010; Collins, 2012). The affordability and availability of mobile phones and wireless networks make them a viable alternative to paper based methods and even PDAs (Anokwa, et al., 2009; Cheng et al., 2011). Therefore the need for more innovative technologies for generating data through effective monitoring and evaluating of sanitation progress cannot be underestimated (Thomson et al., 2012b; Mckay & Pickens, 2010; Vallejo et al., 2007). One such technology is the mobile phone (MP) text messaging; which is an automated, cheaper, more accurate and reliable means of continuously collecting, analyzing and disseminating disaggregated data (Zurovac et al., 2011, 2012).

#### **1.1.4 Age of mobile technology**

Mobile phone subscriptions stood at almost 6.8 billion by the end of 2012, with 89% in the developing world according to the International Telecommunication Union (ITU) 2013 report. Thus more people today have access to a mobile phone than to a toilet (UN, 2013). One of the recent markers of human development has been the rate at which access to mobile phones is outpacing access to basic human needs (Swendeman & Rotheram-Borus, 2010). Therefore, it is not surprising that mobile phones are already being used as tools for data collection and dissemination across multiple sectors, such as health, socio-economic development, agriculture, natural resource management, disaster relief, and their relevant subsectors in international development (Hellstrom, 2010; UNICEF, 2010). In several health monitoring mechanisms,

mobile phones are employed for monitoring medication compliance (Atun & Sittampalam, 2009; Ryan, 2012), disease outbreaks and inventories of drugs in remote locations (Lester & Karanja, 2008; Odermatt, 2012). In the water and sanitation sector, mobile phones are used to monitor and track breakdown in water points and sanitation facilities (Mckay & Pickens, 2010; Mukherjee, 2011).

Consequently, water and sanitation practitioners recognize and have begun to tap the potential of these phones, as tools to improve services, by amassing and disseminating information quickly, cheaply, easily and thoroughly; directly to or from the deprived and underserved populations who mostly need these services (UNESCA, 2009; Thomson et al, 2012a). In this way, the urban and rural poor have a way to share information on their basic needs for water and sanitation since their problems are often undetectable at higher levels of policymaking (Thomson et al., 2012b). Since information is potent, yet limited, the mobile phone can bridge information gaps by changing and improving data production, communication and sharing (Hope et al., 2012; Global WSH, 2010); and remains one of the communication options for rapid information transfer and service facilitation by giving people a real and direct voice (Hutchings et al., 2012). In this way, Governments can serve vulnerable communities better (Cairncross et al., 2010; UN, 2011; Thomson et al., 2012a).

## **1.2 Statement of the problem**

The sanitation data generation at the district level is a requirement in Ghana according to the revised national Environmental Sanitation Policy (2010), which is to be reported during every quarter of a year as part of the districts responsibilities in terms of general monitoring and

evaluation (NDPC, 1994). The most common survey method of collecting data at the district level has been the paper based surveys where households are visited and data is recorded using paper and pencil. Sanitation data covers human excreta disposal and the type of toilet facilities used. This requires an excessive amount of time for respondents to answer and is also cumbersome considering that these questionnaires can be numerous if the number of respondents is huge (Shirima et al., 2007).

In addition, reminisce on the part of the respondents on the activities engaged in for the purposes of the survey, data accuracy about activity type, start or end time and location the paper based survey is subject to their memory retention which could result in recall bias (Fisher et al., 2012). Again, there is the problem of estimation of significant time and money for allotting, collecting survey materials and for editing and inputting collected data (Salaffi et al., 2009, 2013). Therefore, a comparison between the new innovative survey methods such as the mobile phone technology and existing technologies such as the paper based for sanitation data collection at the district level could be informative in terms of cost and efficiency in terms of response rate; and hence its opportunities, acceptability, feasibility and opportunities at the district and community levels.

Currently at the district level, the paper based surveys are being used and therefore, there is the identification of monitoring gaps due to its expensive, cumbersome and time-consuming nature. These gaps include poor data processing and analysis for effective linkages to inform policy (GWSP, 2010). This has contributed to poor monitoring and evaluation in terms of continuous sanitation data generation. Cheaper and more effective tools which users will accept as feasible

and sustainable for capturing and managing performance data to support sector monitoring are needed. Sanitation data collection is focused on the type of toilet facility used. However, for the purpose of this study, only data collected for either the use of improved or unimproved toilet facility is highlighted.

It is estimated that roughly 98% of Ghana's 24.5 million population have access to mobile telephones (NCA, 2013); indicating that mobile phone technology may be a good tool for use in the sanitation sector performance evaluation. This study sought to compare the use of mobile phone technology as a monitoring and evaluation tool as against the paper based tool; in the sanitation sector at the district level which could bridge the gap for standardized, frequent, accurate, valid and reliable data.

### **1.3 M & E tools assessment conceptual framework**

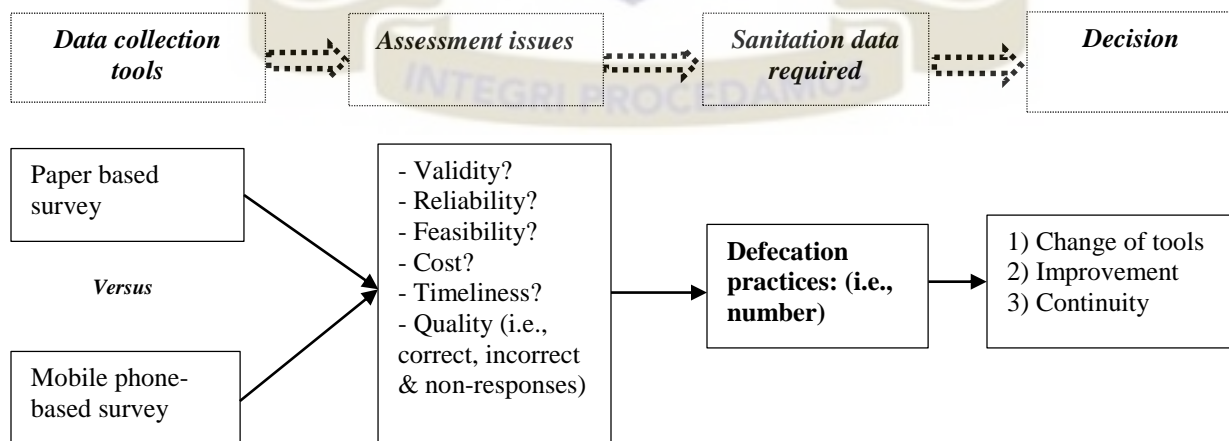
Monitoring and evaluation (M & E) are extensively acknowledged as being critical elements of managing and implementing projects, programmes and policies in both public and private sector organizations (Jones, 2011). Jones points out that the production and use of M & E information during and after an intervention is generally regarded as a core platform in systems for reporting and accountability, in demonstrating performance, or for learning from experience and improving future work. Furthermore, Jones (2011) indicated that monitoring and evaluating programs and projects present some particular challenges and complexities, namely, (1) there is a range of conceptual and technical challenges; (2) the nature of policy influencing work presents further challenges to more traditional M&E approaches and (3) there are further practical problems that constrain the production and use of knowledge about influencing activities.

These challenges present serious difficulties for strategic decisions, for the adaptation of implementation, and for reporting to funders about where their money has gone (Jones, 2011). There are, however, a number of frameworks and approaches to help users overcome the conceptual and technical difficulties. The vast majority of these involve, either explicitly or implicitly, developing a ‘theory of change’ (TOC). This is referred to in many ways, such as ‘logic model’, ‘programme theory’ or ‘roadmap’, but it is, basically, a model of how the programme and project activities are envisaged to result in the desired changes in people’s lives (Whelan, 2008).

According to Whelan (2008), at its simplest, theory of change is a dialogue-based process intended to generate a ‘description of a sequence of events that is expected to lead to a particular desired outcome.’ This description is usually captured in a diagram (or logic model) and narrative to provide a guiding framework for the project team and stakeholders (Whelan, 2008). Logic models are “graphic depictions of the relationship between a program’s activities and its intended outcomes” (USDHHS, 2005). Although logic models can vary in structure, they often contain the following basic elements: (1) Inputs (i.e., resources available to a program (including human, financial, organizational, and community resources); (2) Activities (i.e., what a program does with the above inputs (processes, tools, actions); (3) Outputs (i.e., direct products of program activities); (4) Outcomes (i.e., intermediate changes resulting from a program’s activities and outputs, sometimes divided into short and longer term outcomes (changes in behavior, knowledge, skills, status and level of functioning); and (5) Impacts (i.e., ultimate change as a result of program activities) (USDHHS, 2005; W.K. Kellogg Foundation, 1998).

Currently at the district level, sanitation data collection has been through the traditional paper based tool. However, given the expensive, time-consuming and cumbersome limitations of the paper based tool, there has been the need to look for an alternative tool to address these challenges. Figure 1 is framed on the idea of the “theory of change” or the logic model to assess and compare the two tools in their ability to collect the required sanitation data (i.e., defecation practices). The framework describes the planned process for the comparative evaluation of the tools from assessment, data required and decision making. The assessment of the tools in data collection covers validity, reliability, feasibility, cost, timeliness and quality. The aggregation of timely, completed responses serves as the basis for determining the differences. The essence is to generate the required dependable sanitation data on defecation practices. Based on this assessment, a decision will be taken whether to continue using the paper based M & E survey tool, seek improvements or propose a change of the paper based M & E survey tool. Ultimately, the decision will lead to improved district level data processing and analysis for effective linkages to inform policy in the sanitation sector.

**Figure 1: Conceptual framework for assessment of M & E data collection tool for sanitation**



#### **1.4 Justification**

The most common survey method of collecting data at the district level has been the paper based in-person interview. Respondents are asked questions so as to fill out and record paper based questionnaire sheets for particular time durations. However, there are several problems with this traditional survey method because of the great amount of time it takes for respondents to fill out these questionnaires and the bulky nature of these questionnaires if the number of respondents is huge. This is in addition to the cost of training survey or field enumerators in any survey. Since most respondents may have to recollect the activities engaged in for the purposes of the survey data accuracy about activity type, start or end time and location, the paper based in-person survey depends mostly on their memory retention. There is also the evaluation of considerable time and money for distributing, collecting survey materials and for editing and inputting collected data.

Therefore, a comparison between the new innovative survey methods such as the mobile phone technology and existing technologies such as the paper based for sanitation data collection at the district level could be informative in terms of its cost, that is efficiency in terms of response rate; and hence its opportunities, acceptability, and feasibility at the district and community levels. The evaluation and comparison of such new technologies could be used as baseline data with a national scalability potential. The study also examined its advantages and disadvantages over conventional surveys, by comparing data collected by the mobile phone survey with those collected by the conventional paper based survey, and by analyzing participants' preferences in between two survey methods and M& E tools. The study will help address the gap of cumbersome and expensive paper based in-person survey methods as against the use of mobile

phones as an M & E innovative tool in the sanitation sector at the district level. This would enable captured data to be used at higher levels of the district, national and international level. Collecting, aggregating, and analyzing data continuously from remote regions and making the data available in a transparent and automated way could help identify where investments are most urgently needed and can improve the long-term project monitoring and also contribute to better planning (Randrianasolo et al, 2010; Morris, 2009).

### **1.5 Research questions**

This study had the following research questions:

1. Is the mobile phone SMS M & E survey tool more valid, reliable and effective than the paper based M & E survey tool for sanitation data collection?
2. Which of the two sanitation data collection M & E survey tools (mobile phone SMS and traditional paper based survey tools) is less costly in a peri-urban settlement?

### **1.6 General objective**

The general objective of the study was to compare the validity, reliability, effectiveness, feasibility, cost and cost minimization of using an automated mobile phone SMS or text messaging defecation behaviour practice M & E survey tool to that of a traditional paper based defecation behaviour survey tool in a rapidly expanding peri-urban setting in Prampram, in the Ningo-Prampram District of the Greater-Accra Region of Ghana.

### **1.7 Specific objectives**

The specific objectives were:

1. To compare the validity of the mobile phone survey and traditional paper based defecation practice surveys tools.
2. To compare the reliability of the mobile phone and traditional paper based defecation practice surveys tools.
3. To determine the defecation practice rate using the mobile phone and traditional paper based surveys tools.
4. To compare the feasibility of the mobile phone survey and traditional paper based defecation practice surveys tools.
5. To estimate the cost of the mobile phone survey and traditional paper based defecation practice surveys tools.
6. To compare the cost of the mobile phone survey and traditional paper based defecation practice surveys tools.

### **1.8 The SUSA-Ghana project**

The Sustainable Sanitation (SUSA-Ghana) project establishes the significance of sanitation on human health and development among Ghana's peri-urban poor. Typical in most peri-urban settlements, Ghana faces the challenges of rapid, unplanned urbanization in the Greater Accra Region of Ghana (Konradsen, 2010). As much as 50% of Ghana's 23 million populations live in urban environments, with only 27% of urban residents having access to improved sanitation and only 13% are connected to sewerage facilities. The rapid rate of urban growth has overtaken the efforts by appropriate authorities to meet demand for public services. Several research studies

and policy documents clearly show that the sanitation challenge in Ghana is multifaceted (GWSSP, 2009; Konradson, 2010). The Ghanaian Revised Environmental Sanitation Policy designates the poor sanitation facilities as a “national crisis” (ESP, 2010).

As a result, a joint collaboration between the University of Copenhagen, the University of Ghana and the Kwame Nkrumah University of Science and Technology (KNUST), with funding from the Danish government sought to address the key determinants of the adoption of sanitation facilities in the peri-urban town of Prampram in the Ningo-Prampram District. The SUSA-Ghana project is spanned in six different work packages.

*Work Package One:* Work Package One had the objective to find local institutional and individual capacity building needs and to plan and launch the SUSA project effectively. This included stakeholder analysis, site visitations, discussions with partners, and reviews of existing data.

*Work Package Two:* Work package two, focused on the Preferences and Practices in Peri-Urban Sanitation. Its objective was to understand sanitation practices and preferences among residents in rapidly growing townships and the social, economic and cultural barriers to the acceptance of selected latrine technologies and human excreta management approaches. The work package was to map and to try to understand community practices and preferences for sanitation, which is essential to the promotion of sustainable peri-urban sanitation systems. The study was to serve as the baseline and provides critical inputs to the other work packages.

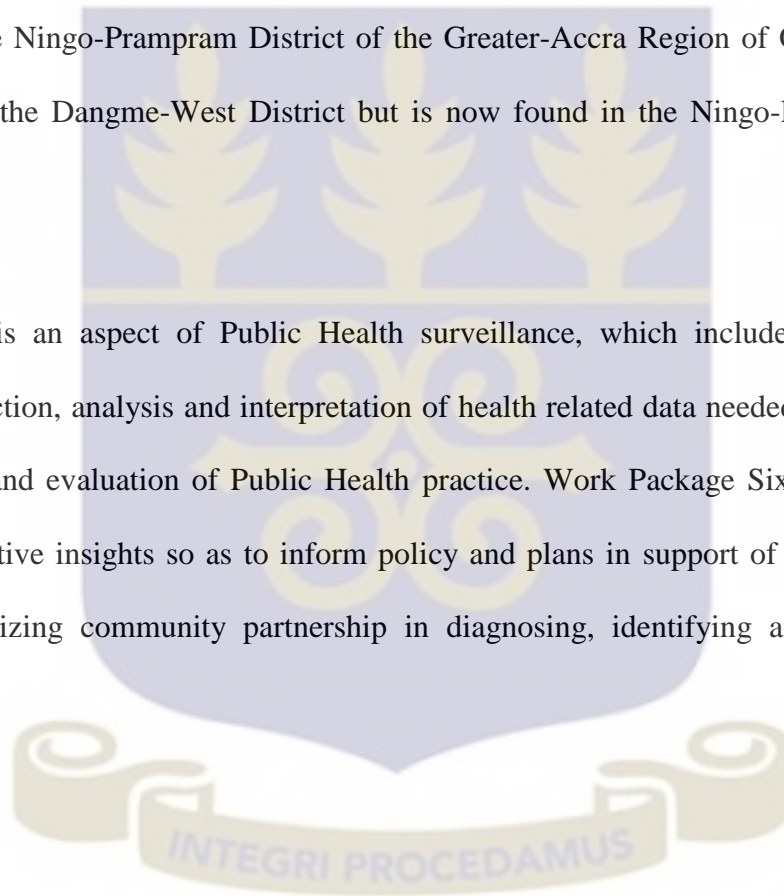
*Work Package Three:* Work package three pivoted on the Technical and Urban Planning Barriers to Improved Sanitation with the main objective to test a methodology in which sustainable latrine technologies and waste management solutions can be implemented with the considerations of user preferences and technical infrastructure limitations. Work package three created a new and innovative approach to selecting a total sanitation solution by evaluating both the technology and the space in which it is situated.

*Work Package Four:* Work Package Four researched into Occupational Health Risks In Waste Removal and Treatment. In this work package the main objective was to identify occupational health risks across the sanitation life cycle in peri-urban Ghana. It aimed to assess the knowledge and perceptions on hygiene and health risks among people engaged in emptying, transporting, treating, disposing and otherwise handling excreta. Such information is essential to establish risk models for the different types of occupational exposure to excreta and in designing the study on risk factors for helminth infections. The problems with inadequate and unsafe treatment and disposal of excreta were addressed with an assessment of the effectiveness of current methods to treat excreta for designing and testing improved ways to obtain a waste product that can safely be disposed off or used as a fertilizer.

*Work Package five:* The fifth Work Package attempted to answer Sanitation Business Systems in Peri-Urban Settings. It explored the strengths and weaknesses of select business models to increase latrine uptake, waste removal and treatment or re-use in peri-urban Ghana.

*Work Package Six:* This study was nested in this SUSA project as the sixth work package and compared the traditional paper and mobile phone defecation practices survey tools for monitoring and evaluating the sanitation sector. It aimed to test how mobile phone technology could be used to improve monitoring of defecation practices in the sanitation sector. In this study we compared the validity, reliability and cost minimisation of a defecation survey of a mobile phone SMS based survey with a paper based survey in a rapidly expanding peri-urban setting in Prampram, in the Ningo-Prampram District of the Greater-Accra Region of Ghana. Prampram, was formerly in the Dangme-West District but is now found in the Ningo-Prampram District since June 2012.

Data collection is an aspect of Public Health surveillance, which includes the continuous, systematic, collection, analysis and interpretation of health related data needed for the planning, implementation and evaluation of Public Health practice. Work Package Six looked at one of such new innovative insights so as to inform policy and plans in support of community health efforts by mobilizing community partnership in diagnosing, identifying and solving health problems.



## CHAPTER TWO

### 2.0 LITERATURE REVIEW

#### 2.1. Introduction

This chapter presents a review of literature on defecation practices in general. It also reviews the validity, reliability, cost, effectiveness, cost minimisation and feasibility of the two survey tools in terms of data collection. Furthermore, it reviews literature on the two-way SMS text messaging using mobile phones as defecation practice survey tools as compared to that of paper. It discusses the global sanitation policies and challenges of global sanitation monitoring and M & E approaches. Finally, the methodological approach to sanitation data collection in general is also examined.

##### 2.1.1 Definition of sanitation

Sanitation includes everything from defecation practices, the safe collection, and disposal of human excreta (i.e. feces and urine) (WHO & UNICEF, 2010c; Katukiza et al., 2010). It also covers the management of solid waste such as trash or rubbish (WHO & UNICEF, 2010c; Mara et al., 2008, 2010). Furthermore, defecation practices encompass the availability, accessibility and affordability of toilet facilities (Rabbi & Dey, 2013; Bandaa, 2007). It also includes some socio-cultural behaviours and practices including hand-washing (Curtis & Cairncross, 2003; Luby et al., 2005). The use of unimproved toilet facilities is however one of the challenging aspects of sanitation (Jenkins & Scott, 2007). These unimproved toilet facilities are most available across Africa and Asia (WHO & UNICEF, 2010a). These are a heterogeneous collection of unimproved facilities with poorly understood health impacts (Jenkins & Curtis, 2005; WHO & UNICEF, 2012). Yet, these are the most prevalent sanitation options in Africa and some parts of Asia, used by half of the population, urban and rural, rich and poor alike

(Muwuluke, 2007, WHO & UNICEF, 2012). Traditional latrines are also the fastest growing form of sanitation in Africa reaching an additional 2 to 3 percent of the population each year (Banda et al., 2007).

Improved sanitation, on the other hand, is mainly the privilege of wealthier urban residents (Rabbi & Dey, 2013; Kulabako et al., 2007). Flush toilets, mostly connected to septic tanks rather than to sewers, remain a luxury (Kulabako et al., 2008). These have made headway in just a handful of countries (Katukiza et al., 2010). Though, the prevalence of open defecation has declined, the coverage of traditional latrines is growing much faster than any of the improved alternatives (Banda, 2007). Often the first challenge for most countries is the lack of an outline of what sanitation really means (Isunju et al., 2011). Another, challenge is the selection of the various aspects of sanitation that are most important (Schouten & Mathenge, 2010). Isunju et al. (2011) conclude that each community, region or country considers the most cost-effective options of sanitation for national plans and policies.

Sanitation can act at different levels in terms of protecting the household, the community and society (Rabbi & Dey, 2013). For example, a poor design or inappropriate location may lead to migration of waste matter and contamination of local water supplies putting the community at risk (Katukiza et al., 2010; Kulabako et al., 2010; Schouten & Mathenge, 2010). For countries with very low access to basic sanitation, the effective management of excreta at the household level is a challenge (Eriksson et al., 2002, 2009). Typically, slums in developing countries lack basic sanitation services (Howard et al., 2003). In these rapidly growing congested urban communities, some form of off-site sewerage sanitation may be the only viable choice (Howard

et al., 2003; Kulabako et al., 2010). However, an appropriate control of excreta disposal may have the greatest health implications and benefits (Eriksson et al., 2002, 2009). In more developed countries or communities a more complete solution might include a focus on protecting the environment as a whole (Paterson et al., 2007).

### **2.1.2 Global defecation practices**

The Joint Monitoring Program for Water and Sanitation (JMP) reports that in 2013, almost two thirds (64%) of the world's population relied on improved sanitation facilities, while 14% continued to defecate in the open (WHO & UNICEF, 2014). By the end of 2013, there were 2.5 billion people who lacked access to an improved sanitation facility. Of these, 761 million use public or shared sanitation facilities and another 693 million used facilities that do not meet minimum standards of hygiene (unimproved sanitation facilities). The majority (71%) of those without sanitation live in rural areas, where 90% of all open defecation takes place (JMP, 2013). The decline in the population practicing open defecation has differed from region to region. Eastern Asia, South-eastern Asia and the Latin America and Caribbean regions have seen a steady decline since the JMPs earliest measurements describing conditions in 1990 (WHO & UNICEF, 2012). In Southern Asia, the population practicing open defecation peaked around 1995, after which it declined. However, Sub-Saharan Africa is the only region where number of people defecating in the open is still increasing (WHO & UNICEF, 2012).

### **2.1.3. The JMP definition of defecation practices**

According to the JMP, an improved sanitation facility is one that separates human excreta from human contact on a hygienic basis (WHO & UNICEF, 2012; JMP, 2013). The coverage

estimates for improved sanitation facilities are presented by the proportion of the population that accessed the use of an improved type of sanitation facility (WHO & UNICEF, 2012). These estimates are often derived from the average of data from household surveys or censuses (JMP, 2013), often by the use of the traditional paper survey tools.

There are two broad categories of sanitation facilities, the improved and unimproved facilities (WHO & UNICEF, 2010). Under the unimproved categorization, there is the open defecation where human faeces are disposed of in fields, forests, bushes, open bodies of water, beaches or other open spaces or disposed of with solid waste (WHO & UNICEF, 2006a; Kjellen, 2001). Generally, the unimproved facilities do not ensure hygienic separation of human excreta from human contact (WHO & UNICEF, 2012; JMP, 2013). Another group of unimproved facilities are the shared sanitation facilities. These unimproved facilities also include pit latrines without a slab or platform, hanging latrines and bucket latrines (WHO & UNICEF, 2012). Sanitation facilities of an, otherwise, acceptable type should not be shared between two or more households (JMP, 2013).

Only appropriate facilities that are not shared or not public are considered improved (JMP, 2013). Shared improved sanitation facilities, although are likely to ensure hygienic separation of human excreta from human contact, are still considered unimproved (WHO & UNICEF, 2012). Generally, improved sanitation categorization include the following facilities: (1) unshared flush or pour flush to piped sewer system or septic tank (2) unshared pit latrine or the ventilated improved pit (VIP) latrine and (3) unshared pit latrine with slab and composting toilet (WHO & UNICEF, 2012; JMP, 2013).

Pit latrines are the dominant type of excreta disposal facilities in most urban slums (Howard et al., 2003; Kulabako et al., 2010). However, it is difficult to operate them on a sustainable basis (Howard et al., 2003). This is because they pollute drinking water sources where faecal sludge management is inadequate (Chaggu et al., 2002). This resultant effect is often the uncollected mixed solid waste and grey water being discharged into the environment without treatment (Paterson et al., 2007). Consequently, an outcome of a constraint for sustainability of these urban slums sanitation evolves (Chaggu et al., 2002). Sustainability requires institutional arrangements and collection of the waste, treatment, reuse and safe disposal complement each other (Kulabako et al., 2010). It is affected by interlinked factors including low household incomes, lack of financial incentives for service providers, limited accessibility, lack of ownership and municipal recognition (Franceys, 2008; Jenkins & Sugden, 2006). However, a number of technologies could be applied in slums subject to the feasibility criteria in different practical situations (Franceys, 2008).

#### **2.1.4 Ghana's defecation practices**

Ghana's 2011 population stands at close to 25 million (JMP, 2013). It also currently has a total open defecation rate of 19%, an urban open defecation rate of 7% and a rural open defecation rate of 33% (WHO & UNICEF, 2014). This is confirmed by the fact that most urban and peri-urban households in Ghana use public latrines while a larger proportion of rural households defecate in the open (JMP, 2013). The widespread traditional use of public toilets and bucket (pan) latrine technologies for sanitation in Ghana is rather distinctive among low and middle-income groups (Ayee & Crook, 2003; WHO & UNICEF, 2006a). Typically, countries in Africa depict a historical government policy of actively constructing and managing public toilets for

household use (Ayee & Crook, 2003). As a consequence, private investment in sanitation and household coverage is comparatively low (Owusu, 2010; Ayee & Crook, 2003; WHO & UNICEF, 2006a).

Public toilets are managed mostly by local governments and are often in very deprived and inadequate conditions and have no privacy (Owusu, 2010). These public toilets are commonly non-water based. In some cases, flush toilets (water closets or WCs) have been installed in public toilets but this is rare (Furlan, 2010).

Ghana's rapid urbanization with about half of its residents living in urban settings is one of the reasons why access to unimproved sanitation is high (Owusu, 2010). Although there have been efforts by the governments in waste management, dumping in rivers and drains remains a challenge (Furlan, 2010). Toilets are often full and many public toilet facilities are poorly managed (Konradsen, 2010). The Ningo-Prampram District of the Greater Accra Region is no exception to this urban transition being experienced throughout Ghana (Konradsen 2010). Its major towns, Dodowa and Prampram, face the challenge where the majority of households (43%) have no toilet facility and use the bush, beach or the field instead (Kjellen, 2001).

### **2.1.5 Challenges of defecation practices**

According to the WHO, open defecation may be defined as defecation in fields, forests, bushes, bodies of water or other open spaces (WHO & UNICEF, 2006a, 2006b). The huge problem is that close to 1.1 billion people still practice open defecation globally (WHO & UNICEF, 2012). This means that most countries in sub-Saharan Africa and Asia may not be able to meet the

MDG sanitation targets (WHO & UNICEF, 2012). Although, the proportion of the world's population that practices open defecation is however on the decline, all efforts are aimed at ending open defecation (WHO & UNICEF, 2010b; 2012; 2014). The problem of poor sanitation is also related to several diseases and is a global crisis directly impacting the health, education, productivity and economic status of a household (WHO, 2004; Curtis & Cairncross, 2003). This is because, poor sanitation allows for sewage or waste to flow directly into water bodies, affecting coastal and marine ecosystems, fouling the environment and exposing millions of children to disease (Buttenheim, 2008; Jinadu & Esmail, 2004). Several studies have shown that human excreta have been implicated in the transmission of many infectious diseases including cholera, typhoid, infectious hepatitis, polio, cryptosporidiosis and worm infestation (Curtis and Cairncross, 2003, UN Habitat, 2011).

The poor understanding of sanitation at the individual, community and societal level regarding adequate sanitation is at the heart of the sanitation challenge (Genser et al., 2008). This is because although most people are aware that poor sanitation has an adverse health impact, there is a low awareness as to its extent (Rutstein, 2000; Victora et al., 1988). This low awareness is evident in most governments since improving sanitation is habitually low on the list of priorities for these governments. For these same governments, there are other pressing needs such as food supply, education, medical treatment and dealing with war and conflict (Nyamwaya, 2003; Marmot, 2005; Marmot & Wilkinson, 2009). Furthermore, sanitation is usually paired together with safe water as a single development goal (Mara et al., 2007). The merging of sanitation with drinking water services in some countries has created the perception that sanitation is mainly a household issue (Marmot, 2005). In addition, water has traditionally received greater emphasis

and more resource allocation (Mara, 2003; Bolt & Cairncross, 2004; Mara et al. 2007). The breakdown of country overheads on both sanitation and drinking water shows that funding for drinking water is often three times higher than that for sanitation (Gandy, 2008; WHO & UNICEF, 2004, 2010c). The lack of clear identification of institutional roles and responsibilities for sanitation in several countries further compounds the sanitation problem (Nyamwaya, 2003; WHO & UNICEF; 2004). Thus, sanitation and hygiene education is especially difficult to place as a priority area in most countries (Marmot & Wilkinson, 2009).

Additionally, society regards the issue of untreated excreta with either deep disgust, as culturally unacceptable, or with indifference (O'Hara et al., 2007). Open defecation and inadequate sanitation on the environment negatively affect the economies of countries (Saxena & Prakash, 2008). Typically, open defecation greatly impacts on the tourism industry since it does not attract investors and tourists who may contribute to economic growth (Hutton et al., 2007; Saxena & Prakash, 2008). This is particularly true in the context of urbanization and rapid population growth (UN Habitat, 2011; Hutton et al., 2007).

### **2.1.6 Approaches to ending open defecation**

As part of the post 2015 MDG targets the United Nations emphasizes the need to eliminate open defecation (WHO & UNICEF, 2014; JMP, 2013, 2012). The feasibility of changing entrenched habits like open defecation is achievable (Bennell, 2002). Additionally, teaching school children facts about health risks and safe hygiene practices helps them develop essential life skills that they share with their families (UNICEF, 2008; Cohen, 2005; Bennell, 2002).

Most communities have attained the Open Defecation Free (ODF) status through Community-led Total Sanitation (WaterAid, 2011a). This approach aims to educate households, along with the availability of local and sustainable solutions and services which as a first step is focused on changing entrenched habits (Cohen, 2005). Community-led and driven programmes that use local, sustainable technologies, coupled with an enabling environment and good partnerships between public and private sectors are the key factors in achieving universal sanitation and eliminating open defecation (WaterAid, 2011b).

All successful sanitation programmes have in common the main objective of a good sanitation system (UN Habitat, 2011). These sanitation systems have an underlying aim to protect and promote human health by providing a clean environment and breaking the cycle of disease (UNICEF, 2008). In order to be sustainable, a sanitation system has to not only be economically viable, socially acceptable and technically and institutionally appropriate, but it should also protect the environment (Black & Fawcett, 2008). Thus, improved sanitation is essential to the achievement of all MDG's (i.e. eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child-mortality; improve maternal health; combat HIV and AIDS; malaria and other diseases; as well as ensure environmental sustainability) (JMP, 2010). For this reason, the responsibility of adequate sanitation provision should be that of a combined and united effort (UNDP, 2006, 2009; CMAJ, 2012).

All governments have the responsibility of setting policies and enforcing regulations within the sector to ascertain that a clean and healthy living environment is created for its people (Isunju et

al., 2011). Most governments have a national strategy of action that specifies how monitoring on these MDG targets would be met (WaterAid, 2011a). At the national level, there is the creation, coordination and the evidence of intersectoral plans and policies with adequate budget allocations (Mara, 2007, 2008; Paterson et al., 2007). At the local level, efforts on the elimination of open defecation focus on effective delivery of services, operation and maintenance of existing systems and services (Eriksson et al., 2002, 2009). In more developed countries or communities a more complete solution include a focus on protecting the environment as a whole (Paterson et al., 2007, Mara, 2010).

Again, these strategies reflect any accelerations or progress to achieve the MDG target (WHO & UNICEF, 2010b). In addition, there are innovations for local solutions that are sustainable and affordable especially for the poorest communities (WHO & UNICEF, 2012; JMP, 2013). At the same time, individuals and households have the role of establishing and sustaining their own well being by adopting improved sanitation and hygiene practices (McDonald et al., 2008). Collaborations and public-private partnerships with organizations around the world network to achieve pro-poor, affordable and sustainable sanitation programmes that prioritize the rural areas in developing countries (Sun et al., 2010). Building capacities in communities and having partners for sustaining hygienic practices and access to facilities is greatly important (WaterAid, 2011a).

### **2.1.7 Global sanitation policies**

Global sanitation policies are often positioned as a dynamic interface in the economic, social and environmental scopes (Isunju et al, 2011); which are the three main interconnected spheres; and

national policy implementation action (Spaargaren et al., 2006). This is because these global policies often collect, produce and examine a wide range of economic, social and environmental data and information from which reviews of common challenges are utilized for decisions on national policy options (Scheinberg et al, 2011). It aids in the discussions of several governments on joint platforms of action to deliberate on evolving global challenges (WHO/UNICEF, 2012). For concerned and enthusiastic governments, these global sanitation policy bodies direct and guide them on how to effectively translate global policy frameworks developed into country specific policies (Hendricksen et al, 2012). This may however require technical support, and may benefit the government in building national capacities (WSP, 2012).

Consequently, sustainable sanitation in Sub-Saharan Africa and other developing countries is still high on the world's agenda with only three years more to the 2015 deadline of the United Nation's (UN) Millennium Development Goals (MDGs) (WHO/UNICEF 2012). Sub-Saharan Africa's low sanitation coverage has been attributed to low prioritization by most governments, which contributes to the perpetuation of poverty (WaterAid 2011). Thus, Sub-Saharan African governments in particular have been confronted with an ever-increasing demand for adequate sanitation and better monitoring and evaluation systems (WHO & UNICEF, 2012; ODI, 2004). Black and Fawcett argue that performance measurement and progress monitoring for achieving the MDGs has therefore resulted in numerous initiatives, including more commitments to political obligations, changes in policies (Black & Fawcett, 2008) and poverty reductions strategies from both the international community and national governments.

One of the main purposes of monitoring the MDGs has been to track progress and assess current status toward achieving these goals (WHO/UNICEF 2010). This means that the availability and accessibility of reliable, accurate and valid data is important. Reliable and accurate data from continuously monitored systems with proper evaluations of programs (WHO/UNICEF 2012; McConville 2008), also serve as means of performance measurement (UNICEF 2010).

### **2.1.8 Sanitation policies in developing countries**

Sanitation efforts to improve the standards and living conditions among the world's poor are urgent (WHO & UNICEF, 2012). Sanitation as a vital intervention requires global collaboration and attention as a means to reduce or prevent diarrhea and other seriously debilitating conditions, especially among children (UNICEF 2007, Bartlet, 2008).

Lack of supportive policies to offer the foundation for planning and implementing sanitation programs is a gap in the aim of improving sanitation coverage (WHO & UNICEF, 2012). Strategies in the forms of performance measurement tools often function as an emphasis on basic and major components of sound sanitation policy and programming (GWSP, 2010). The strategies are mostly useful for policymakers in national governments, donor agencies, and significant players involved in supporting policy reform initiatives, which focuses on improving sanitation services. Again, the tools create methods of direction for sanitation data collection (World Bank, 2013).

Therefore, governments, which recognize and support the significance of positioning sanitation as a critical intervention to reduce or prevent diarrhea, especially among children, often promote

sanitation. These governments in addition, seek ways to build political will in support of sanitation programs (World Bank, 2013). As well, other sanitation programs are appraised and evaluated to define what lessons have been learnt. As a result, these efforts contribute to sector deliberations on underpinning principles and best practices especially as they relate to community and household-based approaches to sanitation (Barreto & Buzie, 2008; Pahl-Wostl, 2002).

The sanitation task is no doubt a daunting one especially in rapidly growing peri-urban areas (UN Habitat 2011; United Nations, 2008). Hendriksen et al. (2012) acknowledges that a large number of rural and urban poor households live in unhealthy environments due to the lack of access to adequate sanitation and promotion of appropriate hygiene behaviors. He also argues that health threats in urban settings are often greater than in dispersed rural ones. In addition, several pilot projects on sanitation focus on these households (Hendriksen et al., 2012).

## **2.2 Validity of data in the context of survey tools**

From the review, it is evident that most validity studies on survey tools combine evaluations of both validity and reliability. This indicates the paucity of empirical studies on validity studies alone. Table 2 presents only studies on validity of data in the context of survey tools. The review comprises ten studies covering the period 2005 and 2014. Six of the studies reviewed were in Europe (Londoño & Schulz, 2014, Benito et al., 2013, Craig et al., 2013, Kurnaz & Kapci, 2013, Gudbergson et al., 2011, Rothwell, 2005), four in the United States of America (Blackman et al., 2013, Brains et al., 2010, Cozby, 2009; Bernabe-Ortiz et al. (2008), and one in Australia. (Babet de Wit et al., 2012). The studies include the evaluation and validation of new survey tools

(Londoño & Schulz, 2014, Benito et al., 2013; Bernabe-Ortiz et al. 2008) and the assessment of criterion validity of a questionnaire (Craig et al., 2013, Babet de Wit et al., 2012). In addition, two of the studies compare the validity of two survey tools by calculating the coefficients of Spearman's correlation (Kurnaz & Kapci, 2013, Gudbergesen et al., 2011). One study examines the validity of a newly developed computer-assisted touch-screen as against the traditional paper questionnaires in terms of direct data recording. Three of the studies analyze some determinants for validity and presents a general overview of validity and its measurement (Brains et al., 2010, Cozby, 2009, Rothwell, 2005). Blackman et al., (2013) evaluate the internal and external validity of mobile interventions through systematic literature review by utilizing the RE-AIM (reach, effectiveness, adoption, implementation, and maintenance) framework.

Validity is the extent to which any instrument measures what it is intended to measure or that ability of a study to precisely answer the questions it is intended to answer (Brains et al., 2010; Gudbergesen et al., 2011). Validity is significant in cost-effective methods, which accurately measures the idea or construct in a question (Cozby, 2009). There are different types of validity including the construct, content and criterion validity, which can broadly be grouped under the internal and external validity (Rothwell, 2005). For results, which can be generalizable to the larger population under study, the validity is termed external validity (Blackman et al., 2013). Age, sex, ethnic origin, socio-economic status may all limit generalizability (Cozby, 2009).

In a recent study by Kurnaz & Kapci (2013) in Turkey, the validity of two tools was tested based on the assessments on their criterion validity. Babet de Wit et al., (2012) in a New Zealand study evaluates the criterion validity using the test-retest method. Similarly, Craig et al., (2013) in a

study in Scotland argues that criterion-related validity or predictive validity occurs when the purpose is to use an instrument to estimate some input form of behavior.



**Table 2: Empirical studies on the validity of survey tools**

No	Author, region & year	General objectives	Overview of methods	Analytical technique	Key findings	Recommendations
1	Londoño & Schulz, (2014), Switzerland.	To validate a tool to assess patient's health knowledge use, using the paper-pencil and online methods.	Review of scientific literature and several interviews.	Statistical analysis of the face and content validity of the tool using correlation coefficient.	The final tool has a 0.97 intra-class correlation coefficient (ICC), indicating a strong level of agreement among experts on the ratings of the response options.	The newly developed tool contributes to enriching the measurement of a more advanced health literacy dimension.
2	Benito et al. (2013), Spain.	To develop and validate a new psychometric tool using qualitative methods.	The criterion validity concept was used to determine its clinical applicability.	Preliminary questions were based on a 5-point Likert scale.	The criterion-related correlations indicated adequate criterion validity.	The new tool showed good psychometric properties.
3	Blackman et al. (2013), U.S.A.	To assess mobile health innovations and define generalizability of both internal and external validity across different populations.	Systematic Review	The RE-AIM (reach, effectiveness, adoption, implementation and maintenance) framework was adopted.	More emphasis and effort is needed on research designs to highlight and report on both internal and external validity.	In future researches, there is the need to report on representativeness, backgrounds and extent to which measurements are done.
4	Craig et al. (2013), Scotland.	An overview of Criterion-related validity or predictive validity.	Review of articles	Qualitative Analysis.	Evaluations of Public Health interventions must identify a wider range of outcomes.	The logic model-based outcomes as frameworks are useful tools.
5	Kurnaz & Kapci (2013), Turkey.	Comparison of two survey tools.	Evaluation of the applicability of the two survey tools.	A correlation of moderate to high was used for test for an adequacy of fit.	Both questionnaires had acceptable validity properties.	Both tools could be applied for the assessment of peer aggression and victimization.
6	Babet de Wit et al. (2012), New Zealand.	To evaluate the criterion validity of a one-item questionnaire based on e-mails phones.	The test-retest method was used.	A seven-item scale was used.	The survey questionnaire showed substantial agreement.	The survey questionnaire was a valid evaluation tool.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
7	Gudbergesen et al. (2011), Denmark.	To compare data based on touch screen to data based on traditional paper versions of questionnaires.	The study was carried out in a repeated randomized crossover design.	The Spearman correlation coefficient and intra-class correlation coefficient was used.	The newly developed computer-assisted touch-screen questionnaires are directly comparable and therefore valid for recording of data.	The patients prefer touch screen and further advantages are less need for staff assistance.
8	Brains et al. (2010), U.S.A.	An overview of generally how validity can be understood.	Review of articles.	Coding of relevant validity themes.	Validity is that ability of a study to precisely answer the questions it is intended to answer.	Validity may be a good measurement of accuracy.
9	Cozby (2009), U.S.A.	To describe validity of measurements	Combining helpful pedagogy and literature review	The book points out numerous behavioral details that we tend to overlook because they seem obvious.	The book speaks of bias in research that is more accidental than obvious and examines potential flaws in thinking and researching, and provides methods to avoid these problems.	Concise and strategic approach to methodological decision making is important.
10	Bernabe-Ortiz et al. (2008), Peru.	To compare and evaluate the data quality of the paper and hand held computers.	Cross-sectional methods were used to compare response rates.	Correlation coefficients were calculated for both tools and compared.	The handheld computers showed a high level of agreement between the two tools of paper and hand-held computers.	It is feasible to develop a low-cost application for handheld computers for collecting field data in a developing country.
11	Rothwell, (2005), U.K.	This review discusses those determinants for validity and presents a checklist for clinicians.	Systematic reviews	-	External validity should be highly considered, particularly for some pharmaceutical industry trials, a perception that has led to underuse of treatments that are effective	Greater consideration of external validity in the design and reporting of randomized control trials.

### **2.3 Data reliability and validity in relation to measurements in survey tools**

As already discussed, several studies test both the validity and reliability of survey tools concurrently as shown in Table 3. The review covers thirty-six studies over the period of 1980 to 2014. Sixteen of the studies reviewed were in Europe, eleven in United States of America, four in Canada (Brussoni et al., 2013, Cook et al., 2003, Godwin et al., 2003, Brosseau et al., 2001) and five in Australia (Ly & Goldberg, 2014; Braham et al., 2004, Telford et al., 2004, Lim, 2008, 2010). Twenty-four of the studies assess the validity and reliability of survey tools. Eight of the studies estimate the reliability of the survey tool using the Cronbach's alpha and the test-retest method. Out of the eight studies using the test-retest method, only two studies (Gigantesco et al., 2003, Barker & Orrell, 1999) estimate for reliability by calculating for the Cohen weighted kappa. In terms of validity, four studies (Stewart et al., 2010, Wynd et al., 2003, Gigantesco et al., 2003, Barker & Orrell, 1999) compute for the content validity of the survey tools whilst another three (Skudal et al., 2012, Bjertnaesa et al., 2010, Milano et al., 2007) calculate for the construct validity of the tools. Only one study (Terwee et al., 2007) determines validity in terms of the construct, content, and criterion, internal and external validities simultaneously. Another study (Godwin et al., 2003) assesses validity in terms of the external validity or its generalizability and internal validity, which focuses on the reliability of results.

Only the study by Brosseau et al. (2001) measure validity in the context of the face validity of the survey tool. Three of the studies are comparative studies which test for the validity and reliability of the paper, telephone and online survey tools (Brussoni et al., 2013), the practicality of SMS texts for data collection as against the traditional paper tool (Whitford et al., 2012) and

the validity and reliability of computer touch-screen as compared with that of the paper survey tool (Frennered et al., 2010).

The concepts of validity and reliability relate to measurements, which are tested within the framework of a set of standards that are broadly accepted (Bjertnaesa et al., 2007, 2010, Garrat et al., 2010). Thus, validity and reliability are theoretically oriented concepts because both inevitably raise the question of the purpose of an instrument in use as debated by Brock-Utne (1996) and Milano et al. (2007). Similar to reliability, validity is that aim of achieving a standard accurate indicator that characterizes the anticipated and only the intended concept (Streiner & Norman, 2008; Michener, 2002). The choice of any measurement tool is determined by the intended use of the tool, the concept to be measured, the type of questions, and the cost of the tool (Masso, 2010; Terwee et al., 2007). Again, an invalid measurement would not affect its reliability if it produces consistent results on repeated measurements (Vallejo et al., 2007; Godwin et al., 2003). Significant is the credibility of the finding in any study taking into consideration all assumptions (Creswell & Miller, 2000). The study discusses that, for a meaningful comparison of any questionnaire, quality criteria for measurement in terms of the design, methods, and outcomes of studies are essential.

Terwee et al. (2007) generally emphasizes that validity should measure all variables. The study further highlights three types of validity (1) construct (2) criterion and (3) concept validity. *Construct validity:* The construct validity and reliability concept is also demonstrated through findings in a study in Canada (Salaffi et al. (2005). Here, the similarities in the construct validity of the two instruments, the correlations between the instruments and their respective symptoms

and function dimensions were tested and compared using Spearman's rank correlation coefficient. There is further support for the essence of validation of data collection tools with studies from Frennered et al. (2010) and Brussoni et al. (2013). Frennered et al. (2010) in a study in Sweden validated a computer touch-screen system, which had been developed for patient self-recording. The validity and reliability of this method was compared with the use of regular paper-and-pen questionnaires. Results from the study indicated good kappa agreements using measurements from Pearson correlations. This led to the conclusion that the computerized touch-screen questionnaires virtually eliminated missing values and therefore showed good validity and reliability compared to paper the form. Similarly, Brussoni et al., (2013) from a British Columbia study in Canada compared three questionnaire types (i.e paper-pencil, online or by telephone). The study determined the reliability and construct validity of the questionnaires. Using the self-report of respondents as the gold standard the study concluded that all three questionnaires were appropriate instrument for collecting data.

*Criterion validity:* Criterion-related validity compares the findings of a study against an established standard. This is well demonstrated by Brosseau et al., (2001) in another Canadian study where the criterion validity of a newly developed tool was determined. Studies by Benito et al. (2013) in Spain show how the criterion validity concept can be in the development and validation of a new questionnaire with the use of a five-point Likert scale. Whitford et al., (2012) in Scotland also test the reliability, validity, acceptability, and practicality of short message service (SMS) messaging for collection of research data. Validity was assessed by comparison of responses to text questions and the same question administered by phone a day later. Reliability was assessed by comparison of their responses to two SMS messages sent one

day apart. Results indicated that respondents found that the SMS method was a convenient, acceptable, easy and functional method of gathering and providing large volume of data. The study concluded that SMS was a valid method for capturing research data.

*Content validity:* Content validity depends on the extent to which the empirical measurements reflect a specific domain of content (Wynd et al., 2003). Findings from Wynd et al. suggest that content validity is often established through qualitative expert reviews and analysis of reviewer agreements. Further analysis using a multi-rater kappa coefficient of agreement was used to measure the proportion agreement ratings among the experts. The findings supported conclusions that there was the need for the elimination or revision of some items. Another study in North Carolina in America showed that a newly, developed questionnaire demonstrated strong evidence for construct validity and reliability (Stewart et al., 2010, 2005). The study concluded that the evaluation instrument holds considerable promise for data collection in further research.

Kottner & Dassen (2008), in a study in Germany, test for the inter-rater reliability of a tool by using the Pearson's product-moment correlation and Cohen's kappa. This is demonstrated through the reproducibility and consistency of the results obtained. Further arguments by Mendoza et al., (2010) and Schilling, (2007) suggest that reliability indicators may not necessarily be valid. The more consistent the results given by repeated measurements, the better the reliability of the measuring procedure. Conversely, the less consistent the result means the lower the reliability of the data. (Evenson et al., (2006; 2008). Reliable data may also be collected in real time instead of estimated data (Telford et al., 2004; Lim, 2008). A high

agreement in the validity and reliability of a questionnaire enhances a study's ability to plan for and address the needs of target groups (Braham et al., 2004, Lim, 2010).



**Table 3: Empirical studies on both reliability and validity of survey tools**

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
1	Ly & Goldberg, (2014), U.S.A.	To validate a newly developed tool by testing for its validity and reliability.	An online survey was used.	Scale validation included tests to determine reliability, validity and factor structure.	Analyses indicated that the tool is reliable and demonstrates content validity, construct validity and acts in theoretically expected ways.	The tool promises an easy-to-administer and self-report measure of respondent perceptions.
2	Brussoni et al. (2013), British Columbia, Canada.	Test for validity and reliability of the paper, telephone and online survey methods.	Data were collected at the time of recruitment and at one-month post injury.	Repeated measures analysis (rANOVA).	The EQ-5D-3L™ is an appropriate instrument for collecting health related quality of life data among injured children.	The EQ-5D-3L™ may be administered via paper-pencil, online or by telephone.
3	Skudal et al. (2012), Finland, Faroe Islands, Norway and Sweden.	To evaluate the Nordic Patient Experiences Questionnaire (NORPEQ) for data quality, reliability and validity.	The NORPEQ was mailed to patients randomly selected after receiving inpatient treatment in Finland, Norway and Sweden and was also included in a national survey in Norway and in the Faroe Islands.	Dimensionality was assessed using principal component analysis, Cronbach's $\alpha$ . Construct validity was assessed by correlation.	Principal component analysis identified one component with six experiences items. Mean NORPEQ scores ranged from 74 to 79 on the 0–100 scale, where 100 represents the best possible experiences.	The NORPEQ is a brief measure of patient experiences that covers important aspects of the healthcare encounter. It shows good evidence of reliability and validity.
4	Whitford et al. (2012), Scotland.	To test for the validity, reliability, acceptability and practicality of SMS texts for data collection.	Validity for data was compared with data collected by phone also within 24hours.	Correlation validity between the text responses was as expected.	The SMS provided an easy and functional method for capturing research data.	The SMS was a valid method for gathering large volume of data.
5	Garrat et al. (2011), Norway.	To development and evaluation of the PEQ-CAMHS Outpatients paper questionnaire.	The test-retest method was used	Cronbach's $\alpha$ was used to assess reliability.	The PEQ-CAMHS Outpatient questionnaire had acceptable validity and reliability properties.	The PEQ-CAMHS Outpatients questionnaire may be used.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
6	Bjertnaesa et al. (2010), Norway.	To test for reliability and construct validity while reliability of the Norwegian EUROPEP questionnaire using paper mails.	Patients consulting General Practitioners (GP) in Norway were interviewed on the Norwegian EUROPEP at home.	Factor analysis and Cronbach's alpha for internal consistency reliability were used.	The questionnaire met the criterion of 0.7 for Cronbach's alpha. The GP-level reliability was more than 0.7 for both scales, but 9 of 23 items were below the criterion of 0.7.	The Norwegian EUROPEP instrument has satisfactory Psychometric properties but need further improvement.
7	Frennered et al. (2010), Sweden.	The patient self-recording on a computer touch-screen was developed and the validity of method compared with the use of regular paper-and-pen questionnaires.	Self-reporting questionnaires in order to collect data on different variable by answering a mailed questionnaire.	The agreement concerning background history questions, were measured by kappa values and the Pearson correlations.	The agreement concerning background history questions, measured by kappa values was generally good (0.71-1.0); and the correlations (Pearson) were 0.72 and 0.87.	Computerized touch-screen questionnaires virtually eliminate missing values and show good validity and reliability compared to paper forms.
8	Garrat et al., (2010), Norway.	To assess the validity of Patient Experiences Questionnaire (PEQ) using paper mails.	The two versions were pretested through cognitive interview. The PEQ was then mailed to patients after inpatient treatment.	Regression analysis was used to examine the impact of response scale on missing data, floor and ceiling effects.	Regression analysis showed that the type of scale explained a significant component of the variation in both floor and ceiling effects.	The five-point scale performed better than the 10-point scale and the revised PEQ will be used in Norwegian national surveys.
9	Lim et al., (2010), Australia.	To compare SMS, paper and online diaries on response rate, timeliness, completeness of data and acceptability.	Participants were randomised into one of three groups of SMS, online or paper (by post). An online survey was conducted at the end of 3 months.	The correlation between all three types of data collected was determined.	SMS is a convenient and timely method of collecting brief behavioural data, but online data collection was preferable to most participants and more likely to be complete.	Data collected by retrospective tools were found to agree substantially with data collected through weekly self-reported ones.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
10	Masso et al (2010, Spain).	To identify articles and reports on patient's safety perception published between 1989 and 2006.	Ten databases (EMBASE, MEDLINE, PsychINFO, SCOPUS, Science Citation Index Expanded, Social Science Citation, IME, Sociological Abstracts, LILACS and The Cochrane Library.	From the 699 articles, 18 were selected.	Eight articles determined the frequency of experiences related to adverse events and the safety perception reported by patients, seven focused on the impact of the adverse events regarding the communication to the patient, and three included patient's opinions about the management and disclosure of adverse events and proposals to prevent them.	The incidence of adverse events reported by patients was similar to that estimated by other procedures. The patient's concept of adverse events was different from that of the physician.
11	Mendoza et al. (2010), U.S.A.	To evaluate and compute the reliability and validity for a hand-raising and paper travel survey tool.	Test-retest reliability was obtained 3-4 hours apart. Convergent validity of the SRTS travel survey was assessed by comparison to parents' report.	Reliability was determined in two ways: correlations between the research assistants' ratings to that of the Principal Investigator (PI) and intra-class correlations (ICC) across research assistant ratings.	The survey tool had high test-retest reliability ( $\kappa = 0.97$ , $n = 96$ , $p < 0.001$ ) and convergent validity ( $\kappa = 0.87$ , $n = 81$ , $p < 0.001$ ) and specificity (83%) were acceptable.	The questionnaire reliably collected and indicated validity for most items when compared with parental reports.
12	Stewart et al. (2010), North Carolina, U.S.A.	To evaluate the reliability and content validity of Uncertainty Scale for Kids (USK) of children with cancer using qualitative interviews.	Interview data from the Stewart's (2003) qualitative study of uncertainty in children undergoing cancer treatment were used to generate items for the Uncertainty Scale for Kids (USK).	The Cronbach's alpha and test-retest correlations were used.	The USK demonstrated strong reliability (Cronbach's alpha = .94, test-retest $r = .64$ , $p = .005$ ) and preliminary evidence for validity was supported by significant associations between USK scores and cancer knowledge.	The USK shows promise as a psychometrically sound instrument to measure uncertainty in children and adolescents.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
13	Evenson et al. (2008), U.S.A.	To assess the criterion validity and test-retest reliability of the paper-pencil and hand-raising modes of a questionnaire.	To assess test-retest reliability, respondents completed a travel survey on 2 consecutive school days; and for criterion validity, parents completed a travel survey on 5 consecutive weekdays.	-	Test-retest reliability of all questions indicated substantial agreement between parental and child reports.	-
14	Kottner & Dassen, (2008), Germany.	To investigate the reliability and validity of the Braden scale for predicting the risk for pressure ulcers.	Literature review.	The inter-rater reliability revealed that numerous statistical approaches and coefficients are used (Pearson's product-moment correlation, Cohen's kappa).	These coefficients were calculated for the individual items and the overall Braden score and were used inconsistently.	It is recommended to present intra-class correlation coefficients in combination with the overall percentage of agreement.
15	Lim et al., (2008), Australia.	To compare SMS, paper and online diaries on response rate, timeliness, completeness of data and acceptability.	Participants were randomised into one of three groups of SMS, online or paper (by post). An online survey was conducted.	The correlation between all three types of data collected was determined.	SMS could be used as potential data collection tool.	The SMS was effective and acceptable to respondents as a data collection tool.
16	Streiner & Norman, (2008), U.K.	To enable groups who often have limited knowledge of statistics, to both develop scales to measure non-tangible health outcomes, and better evaluate and differentiate between existing tools.	An overview of literature.	-	A broader understanding of how to evaluate the existing tools were highlighted.	In future, the book could serve as a practical guide in assessing the level of reliability and validity of new measurement tools.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
17	Bjertnaesa et al. (2007), Norway.	To test for reliability and construct validity while reliability of the Norwegian EUROPEP questionnaire using mails.	Respondents were interviewed on the new tool at home.	Factor analysis and Cronbach's alpha for internal consistency reliability were used.	The questionnaire met the criterion of 0.7 for Cronbach's alpha.	The tool has Psychometric properties but need further improvement.
18	Milano et al. (2007), Italy.	To describe the validity and reliability of the Italian version of the EUROPEP paper instrument for patient evaluation of general practice care.	A survey was performed among patients who visited a general practice using the 23-item EUROPEP questionnaire.	Data were analyzed with respect to item response rate, item-scale correlation, internal consistency reliability and construct validity of the instrument.	The item response rate was good for 17 items, acceptable for four items and problematic for one item. The item-scale correlation largely exceeded a value of 0.40 for all items in both scales. The internal consistency of the aggregated scores was also very good, the reliability coefficients being 0.95 and 0.90.	The Italian EUROPEP is a valid and easy-to-use instrument for gathering information on patients' experience with and evaluation of general practice care.
19	Schilling et al. (2007), Los Angeles, U.S.A.	To develop and psychometrically test an instrument designed to measure adherence behaviors of patients with end stage renal disease (ESRD)	In-depth literature reviews and in consultation with clinical experts and a survey were done.	Test-retest reliability (Cronbach's alpha) was evaluated using intra-class correlation coefficients (ICC) between frequencies of responses.	The strong test-retest stability existed across all items of the ESRD-AQ, with ICCs ranging from 0.83 to 1.00. Correlations indicated that self-reported adherence behaviors and perceptions were consistent across the two administrations of the ESRD.	The findings support that the instrument is reliable and valid, and is easy to administer. Future studies are needed in a larger sample to determine whether additional modifications are needed.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
20	Terwee et al. (2007), Netherlands.	To develop quality criteria for design, methods, and outcomes of studies health status questionnaires for content validity, internal consistency, criterion validity, construct validity, reproducibility, longitudinal validity and responsiveness.	For each measurement property a criterion was defined for a positive, negative, or indeterminate rating, depending on the design, methods, and outcomes of the validation study.	-	The criteria can be used in systematic reviews of health status questionnaires, to detect shortcomings and gaps in knowledge of measurement properties, and to design validation studies.	The future challenge will be to refine and complete the criteria and to reach broad consensus, especially on quality criteria for good measurement properties.
21	Vallejo et al., (2007), Spain	To compare the reliability and validity of the paper-pencil and online versions of the same questionnaire.	The survey approach was used.	The Cronbach's alpha and test-retest correlations were used	The paper-and-pencil scores were higher than online ones. Even when an online test has shown acceptable reliability and validity values, the use of normative data from paper-and-pencil questionnaires may not be appropriate	Although the online version could be taken as being equivalent to its classic paper-and-pencil version, and its internal consistency is high, further research is crucial.
22	Evenson et al. (2006), U.S.A.	To determine the item specific reliability for a paper self-report questionnaire.	Reliabilities of questionnaire was determined by assessing all items on the tool.	Test-retest reliability was determined using kappa coefficients, overall and separately by grade. Adjusted mixed model logistic regression was also used.	Item-specific reliabilities for questions assessing various perceived safety were highly agree and correlated good physical activity objectively measured physical activity	The study provides support for the use of the questionnaire as a reliable instrument.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
23	Salaffi et al. (2005), Italy.	To compare reliability and validity of a survey tool in three groups of patients.	The generic Medical Outcome Study Short Form-36 item health status questionnaire (SF-36) was administered to a cohort of Osteo-Arthritis patients.	Statistical Correlations were used.	No statistically significant differences in SF-36 scores were found among the three groups of OA patients. The physical and mental summary scales of the SF-36 were closely correlated ( $p < 0.0001$ ).	The use of generic studies of OA where comorbidity is common should be useful in characterizing the global burden of this disease.
24	Stewart et al. (2005), U.S.A.	To describe the procedures used in employing content validity in the development of a self-report instrument.	Content validity in self-report instruments,	A panel of content experts reviewed all qualitative interviews.	The review tasks were effectively performed considering the relevance.	The development and evaluation of instruments to index cognitive and emotional processes is a priority for pediatric nursing research.
25	Braham et al. (2004), Australia.	To test the reliability and validity of two data collecting systems.	Four random audits of primary data collected were conducted and compared to data collected by a second batch of data collectors.	The level of agreement was assessed in both data collecting systems.	There was no significant difference in data collected by the primary data collectors and the random audits.	Reliable primary data should allow for the generalisation of study findings to the wider population.
26	Telford et al. (2004), Australia.	To develop a reliable, valid, and feasible method for assessing physical activity among children.	Test-retest reliability and the criterion validity of a proxy questionnaire and a children's self-report questionnaire was determined.	-	The proxy questionnaire provided a reliable measure of the type, frequency, and duration of children's physical activity.	For future researches, it will be important to combine questionnaire and objective measures as a means of measuring for validity and reliability.
27	Cook et al. (2003), Canada	To compare a telephone interview to an in-person interview using the same questionnaire and memory aids in both.	Respondents completed a telephone interview and at least four weeks later, completed an in-person interview. Memory aids included a life events calendar, cue lists, and worksheets.	Agreement values, measured by kappa or weighted kappa, were measured.	The good to excellent level of agreement found in this study indicates that telephone administration of our questionnaire with extensive memory aids is a reliable method of obtaining detailed exposure information relative to in-person interviews	Information obtained by telephone interviews and in-person interviews is generally considered comparable; and extensive memory aids can be used in both survey methods.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
28	Godwin et al. (2003), Canada	To determine the balance external validity (generalizability) and internal validity (reliability of results) is ever-present in pragmatic randomized controlled trials.	Two pragmatic randomized controlled trials were conducted on interventions in the management of hypertension in primary care	-	Clinical trials conducted in community practices present investigators with difficult methodological choices related to maintaining a balance between internal validity (reliability of the results) and external validity (generalizability).	To maintain generalizability i) exclusion criteria must be kept to a minimum. To maintain internal validity) randomization and blinding is critical.
29	Wynd et al. (2003), U.S.A.	To determine the content validity.	Literature review	By computing a content validity index (CVI), using ratings of item relevance by content experts.	Lynn's (1986) criteria in terms of I-CVI must be followed in order to feasibly determine the content validity of the tool.	In summary, we recommend that for a scale to be judged as having excellent content validity, it would be composed of items with I-CVIs that meet Lynn's (1986) criteria
30	Gigantesco et al. (2003), Italy.	To validate a brief self-completed questionnaire in psychiatric wards (Rome Opinion Questionnaire for Psychiatric Wards).	Face and content validity was assessed by eight psychiatrists and two patient focus groups.	The factor analysis included principal component analysis; Cronbach's alpha and Cohen's weighted kappa.	Inpatients found the questionnaire to be acceptable. The final version was evaluated for acceptability, factor structure, internal consistency, and test-retest reliability.	The questionnaire seems to be adequate for evaluating patients' opinions on care in inpatient psychiatric wards. Due to its user-friendliness, it may be particularly suitable for routine use.
31	Michener et al., (2002), U.S.A.	To examine the psychometric properties of the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES).	The reliability and validity of the tool was evaluated.	The form was completed during the initial, evaluation, 24 to 72 hours after the initial visit, and after 3 to 4 weeks of physical therapy.	The test-retest reliability (intra-class correlation coefficient [one-way random-effects], 0.84; 95% CI lower limit, 0.75) and internal consistency (Cronbach $\alpha$ , 0.86) values were acceptable. The standard error of the measure was 6.7.	The results indicate that the ASES is a reliable, valid, and responsive outcome tool.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
32	Brosseau et al., (2001), Canada	To examine the intra- and inter-tester reliability of the universal goniometer (UG) and parallelogram goniometer (PG).	The criterion validity and the intra- and inter-tester reliability of the same instruments were tested.	Intra-class correlation coefficients [ICCs] and Criterion validity (r) were measured.	Intra- and inter-tester reliability were high for both goniometers. The results for the criterion validity varied.	It is recommended that the same therapist take all the measurements when assessing for UG and PG goniometric measurements on patients with knee restrictions.
33	Creswell & Miller, (2000), U.S.A.	To identify and develop appropriate reliability and validity procedures and frameworks in research.	-	-	-	There is the need for validation of research studies to fit respondents' realities. And credibility.
34	Barker & Orrell (1999), London, UK.	To determine the content validity of The Psychiatric Care Satisfaction Questionnaire (PCSQ).	Tests of acceptability, validity and reliability were undertaken using surveys and interviews.	Test-retest reliability was done using Cohen's $\kappa$ and Cronbach's $\alpha$ .	Test-retest reliability was adequate (Cohen's $\kappa$ 0.48–0.80) and internal consistency of the PCSQ was good, at 0.82 (Cronbach's $\alpha$ ).	The PCSQ has good validity and reliability, indicators. It has good psychometric properties and can be a useful tool for measuring patient satisfaction.
35	Brock-Utne (1996), Norway.	An overview of validity and reliability in the African Educational context.	-	-	-	Both qualitative and quantitative research methods must assure appropriate measurements of reliability and validity.
36	Messick, (1980), U.S.A.	To establish the adequacy of the construct validity of a tool.	The first set of answers provided an evidential basis for test interpretation, and the second set, a consequential basis for test use.	Questions of the appropriateness of test use in proposed applications were used.	The article stresses (a) the importance of construct validity for test use because it provides a rational foundation for prediction and relevance and (b) the importance of taking into account the value implications of test interpretations.	The construct validity of a tool is a measure of its inferred characteristic on scientific grounds

## **2.4 Effectiveness of the mobile phone and paper survey tools**

### **2.4.1 Mobile phone and paper survey tools**

Several studies compare the effectiveness of other technologies such as mobile phone and computer to the paper survey tools as a form of data collection survey tools concurrently as shown in Table 4. The review covers fifty- three studies over the period of 2000 to 2013. Nine of the studies reviewed were in Europe, thirty-two in America, seven in Asia, four in Africa including Ghana and one in Australia.

Effectiveness may be defined as the measured change in conditions resulting from a promotional programme or an intervention (Couper, 2000). It may also be defined as the extent to which goals are attained and targeted problems are solved (Cleland et al., 2007). These goals once attained, promises a successful outcome. Peterson (2000) from the perspective of research suggests that, for every successful study the right questions need to be asked. This implies the use of constructive and effective questionnaires or instruments for appropriate data collection.

Martin (2000) argues that, generally, the data collection process, although a very important aspect of research can be extensive and tiresome. This is because significant and essential information in the data collection process could be lost or impaired owing to a number of factors. These factors include unavailability of respondents, wrong timing and inappropriate measurement tools, inconsistencies in responses, existing culture, environment and policies. For valuable, accurate, reliable and effective data, different data collection methods may be more suitably utilized for the various specific conditions (Martin, 2000). Staton (2006) and Bradley et al., (2012) confirm this in their studies. Findings from their work indicate that, survey

researchers have been using many approaches and methods, such as paper, mail, telephone, and e-mail, to collect data. They also argue that in the past decade, more innovative modes of conducting surveys have gained major popularity. According to Martins (2002), the traditional paper-pencil questionnaires are the commonest means of data collection.

However, as compared to the traditional paper based surveys, there are newer surveys including the mobile phone technology, which have several advantages (Patnaik, 2009). This includes shorter time for the completion of the survey, lower delivery cost, more design options, consistency in responses and less data entry time (Anokwa, et al, 2009; Patnaik, 2009). However, these surveys often face specific challenges, such as losing participants who do not have either Internet or mobile phone access, and having low response rates that could lead to biased results (Schonlau, 2002; Groves, 2006; Fricker, 2002, Bradley et al., 2012).

Among various survey challenges for these innovative approaches, low response rates become a main concern in affecting the quality of the survey (Crawford et al., 2001; Dommeyer & Moriarty, 2000). The response rate is generally defined as the number of completed units divided by the number of eligible units in the sample (Bradley et al., 2012). It is the most widely used and frequently computed statistic to measure the quality of surveys. The relationship between response rate in a survey and the effectiveness of the survey has been evident even in earlier studies (Fox et al., 1988; Heberlein & Baumgartner, 1978; Singer, 1978; Yu & Cooper, 1983). In addition, it is acknowledged that a wide variety of factors also influence response rates including the culture, policies and environment within which the study is done (Couper et al., 2004; Dillman, 2000, 2007a, 2007b; Manfreda et al., 2008). Also in these newer surveys, there are

theoretical or practical relationships among various factors including sampling methods, target population characteristics, methods of contact, questionnaire length, monetary incentives, non-monetary incentives, response facilitators, and appeals (Cook et al., 2000; Sheehan, 2001; Edwards et al., 2002).

Several studies have indicated that low response rate of a survey sample leads to nonresponse error, which has been identified as one of the challenges when using text messaging for data gathering (Moller et al., 2012; Kew, 2010; Bexelius et al., 2009; Roberts & Gorman, 2009; Cocosila et al., 2008; Anhoj & Moldrup, 2004). In these studies text messaging response rates ranged between an average of 14% to 100% and is dependent on several factors which, can affect the response rate of text messaging surveys including finding operational mobile phone numbers, appropriate introduction to the aims of the study, benefits to respondents, and respondents' awareness of the study. According to findings from studies by Bexelius et al., (2009), randomly selected mobile phone numbers from the Swedish population registry achieved a response rate of 14% whilst that of Kew (2010) had a response rate of 100%. Li et al. (2013), argue that respondents are more likely to complete the text messaging survey when they respond to the first text message question and thus the need to explore how the response rate can be increased. In addition, levels of literacy and occupation (Kew, 2010; Haberer et al. 2010), the exact time of the day (Schembre & Yuen, 2011; Brick et al., 2007) and the level of convenience of the tool in use (Roberts & Gorman., 2009; O'Toole et al., 2008) were associated with response rates.

Free et al. (2013) and Prue et al. (2013) have also tested in their studies whether short message service (SMS) was a promising and effective tool for gathering data for research and clinical purposes. Automated text messages were sent to mobile phones and text responses recorded electronically. They suggested that the method was cheap and simple and allowed rapid communication with people involving minimum disturbance. This is supported by the International Telecommunication Union (ITU) (2011) report that ownership of mobile phones has increased and it is estimated that the rate of mobile phone ownership in the Americas is 94.1%.

Current global figures show that there are close to 6.8 billion mobile phone sub-scribers worldwide (ITU, 2013). Since there were only one billion subscribers in 2002, it is apparent that use of this technology is growing rapidly (Rowling, 2009). Ninety-five percent of countries in the world have mobile phone networks, and the majority of these countries have more mobile phone than landline subscriptions (Rice, 2003). In nearly a third of the countries, the number of cell phones in use is greater than the number of people living in those countries, according to the Central Intelligence Agency (CIA, 2009). Thus, ownership of a mobile phone is more common than a home landline. Woods et al. (2012) and Bradley et al. (2012) also affirm that these statistics suggest that mobile phones may be an effective means of capturing research data from a wide public.

Mobile phone text messaging is a potentially powerful tool for behavior change because it is widely available, inexpensive, and instant (Cole-Lewis, 2010; Noordam et al., 2011). However, strictly using an Internet-based method for collecting data could bias the results because for

instance older patients and those with more severe comorbidities may not respond (Kurniawan, 2008). Therefore, it is more important and favourable to create the opportunity for mixed methods of answering (Oulasvirta & Brewster, 2008). In addition, the internet questionnaire system requires an initial financial investment as argued by Blaya et al. (2008).

Koshy et al. (2008) in their study on the use of short message service (SMS) as a means of appointment reminders emphasized on the SMS as a cost-effective and time-efficient approach to reduce non-attendance for general improvement in outpatient healthcare services. The study concluded that the SMS system is more cost-effective and involves less labour. Zhang et al. (2012) in a study in China examined whether smartphone data collection was more effective than the traditional paper survey and acknowledged that there is paucity of literature in terms of how they compare. Respondents were randomly assigned to either a smartphone or a paper questionnaire group. The two data collection methods were compared for variances in data quality, total time used, costs and challenges encountered. The study concluded that smartphones could be effectively used for household data gathering. Similar to the studies by Koshy et al. (2008), Bradley et al. (2012) observed that most respondents found the technology to be effective and acceptable. This was because the reminders, which were beneficial, did not involve a great amount of daily staff time. Haynes and Sweeney (2006) in a study to determine the outcome of telephone appointment reported a reduction in the absenteeism rate from 11.7% to 4%. Shoffner et al. (2007) showed that mobile phone reminders were effective as reminders when mental therapists effectively contacted clients in a mental health center. Geraghty et al. (2007) established that SMS reminders were effective for clients seeking healthcare.

Zhang et al. (2012) in China, used smartphones for data collection and the whole data collection process compared with that of paper. The study concluded that in both types of survey tools, eliminated data recording and entry errors, had similar inter-rater reliability, and took an equal amount of time per interview. The costs for the smartphone survey tool were more than the paper method on a smaller scale survey. However, the study concludes and proposes that the costs for both methods could be comparable on a large-scale. Cleland et al. (2007) also argue that connecting mobile phone technology with electronic data collection generally improve compliance.

In a qualitative study, data were collected using an electronic peak flow meter linked to a mobile phone. According to the findings from the study, respondents agreed that mobile phone technology would be beneficial in clinical practice and research. The technology was also acceptable to the respondents on a high degree. Patnaik et al. (2009) propose that even though mobile phones have widely been used in data collection in health, financial, and environmental data, only few studies have examined the study of the possible errors along the data collection process. The study quantitatively evaluates data entry accuracy on mobile phones in a resource-poor setting in India through three user interfaces of electronic forms, SMS, and a voice messaging system. The study concludes that some challenges exist for the different backgrounds and methods of data gathering. The study further cautions the use of electronic interfaces, especially in resource-poor settings and suggests the prospect of voice messaging for the collection of accurate data. However, there is scarcity of information on sanitation data collection in terms of toilet facility use and hand-washing using the SMS text messaging. Several paper based studies have concluded that the hand washing with soap at critical moments range

from zero to 34 percent (Steiner-Aseidu et al., 2011; Afroza, 2007; GHW 1, 2008; Dykes, 2008; Scott et al, 2003).



**Table 4: Empirical studies on the effectiveness of the mobile phone and paper survey tools**

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
1	Free et al., (2013), U S.A.	To evaluate the effectiveness of mobile technology based health interventions.	Systematic review.	Random effects of pooled meta-analysis estimates were calculated.	Mobile technology-based outcomes increased compared to the gold standard of paper.	Short Messaging Services appointment reminders have modest benefits and may be appropriate for data collection implementation.
2	ITU (2013), U.S.A.	To improve the accessibility and affordability of broad-band Internet	Compilation of global reports.	Desk Review.	Information Communication Technology subscriptions is rapidly expanding globally.	Information Communication Technology become a vital set-up, and continues as significant as ever.
3	Li et al., (2013), China.	To test the effectiveness of using text messaging as against a paper-pencil tool for data collection.	Comparison of the response rates and acceptability levels of the two tools.	Frequencies of response rates and levels of acceptability were calculated.	The text-messaging tool had a low response rate and low acceptability level.	Further research on the effectiveness of techniques, which can increase the response rates and acceptability levels, is required.
4	Prue et al., (2013), Bangladesh.	To determine the effectiveness of using text messaging as against a paper-pencil tool for data collection.	Based on phone calls, data was collected using an initial mobile phone call.	Frequencies of response rates and levels of acceptability were estimated.	Mobile phone technology was found to be an efficient and effective method for rapid data collection.	The mobile phone technology, when combined with appropriate knowledge may be applicable to other hard-to-reach data collection areas.
5	Bradley et al., (2012), South India	To test technical and operational effectiveness and user acceptability of mobile phones for data collection.	Estimation of response rates and acceptability levels of the two tools.	Response rates and acceptability levels were estimated.	Mobile phone response rates were comparatively higher, with little evidence of biases. The methodology was highly acceptable.	The success and wealth of data produced, indicates that it can be an important tool for gathering data in low literacy but high populations.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
6	Moller et al., (2012), Denmark.	To evaluate the effectiveness of short messaging service (SMS) for data collection.	Response rates and acceptability levels were computed.	Response rates and acceptability levels were computed.	Response rates for the SMS were comparatively higher, with little evidence of biases. The methodology was highly acceptable.	The mobile phone tool promises a huge potential for data collection.
7	Woods et al., (2012), South Africa.	To assess the effectiveness of cell phone text messaging for data gathering.	Response rates and acceptability levels were estimated.	Response rates and acceptability levels were calculated.	The response rate ranges for the cell phone illustrates the promise of the SMS system as a tool in surveillance.	The use of text messaging promises to provide effective learning opportunities, and improve a wide range of services.
8	Zhang, (2012), China.	To compare smartphone data collection versus the use of pen-and-paper for infant feeding practices of the Maternal Newborn Child Health household survey.	Randomization of participants to either the smartphone or a pen-and-paper questionnaire group. A pair of interviewers simultaneously questioned mothers on infant feeding practices.	Inter-rater Reliability and frequencies for levels of acceptability were determined.	The smartphone method was acceptable to interviewers, and for data collection, compared with pen-and-paper, eliminated data recording and entry errors, had similar inter-rater reliability, and did not result in data loss.	Smartphone data collection should be further evaluated for other surveys and on a larger scale to deliver maximum benefits in China and elsewhere.
9	ITU (2011), U.S.A.	An update on the evolution rates in the global mobile sector.	Compilation of global reports.	Desktop review of literature.	Despite high growth rates in the mobile sector, major differences in mobile penetration rates remain between regions and within countries.	A variety of services specifically target the MDGs in areas such as e-government, e-education and e-health.
10	Noordam et al., (2011), The Netherlands.	To analyze, on the potential of mobile phones to improve maternal health services in Low and Middle Income Countries (LMIC).	Wide search for scientific and grey literature using various terms linked to: maternal health, mobile telecommunication and LMIC.	Desk review literature.	Mobile phone access to communication has several essential components to improve data collection services and hence the use of mobile phones has much potential.	Mobile phones can be used to benefit data collection and needs to be further explored, taking into consideration privacy and confidentiality.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
11	Schembre & Yuen, (2011), U.S.A.	To examine the effectiveness of a computer automated text-messaging for data collection.	SMS responses were received daily with minor variations by observation day or day of the week.	The test-retest method was used.	Data collection was effective for the SMS computer automated text-messaging for data collection.	Further research is required into the potential of the computer automated text-messaging for data collection.
12	Steiner-Asiedu et al., (2011), Ghana	To determine on hand-washing patterns among school children in Ghana.	Compilation of reports on hand-washing practices among young school children	Desk review of literature.	It is necessary to advocate for hand-washing among school children as a habit.	Awareness on hand-washing with soap in young children in Ghana.
13	Cole-Lewis, (2010), U.S.A.	To test whether mobile phone text messaging is a potentially powerful tool for data collection.	A systematic review was performed.	All available literature was reviewed.	The mobile phone text messaging is widely available, inexpensive, and instant.	Methodological issues and gaps in the literature are highlighted, and recommendations for future studies are provided.
14	Haberer et al., (2010), Uganda.	To compare the effectiveness of mobile phone technologies such as interactive voice response (IVR) and short message service (SMS) text messaging.	Qualitative interviews were conducted to assess participant impressions of the technologies.	Response rates were calculated.	Respondents' interest and response rates were high.	Mobile phone technologies make frequent, brief adherence interviews possible in resource-limited settings
15	Kew, (2010), Malaysia.	To compare the efficacy and effectiveness of data collection via Short Message Service (SMS).	A cross sectional study was carried out during a double blind, randomized controlled trial.	Estimation of response rates.	The response rate scores via Short Message Service (SMS) from respondents was 100%.	Text messaging via mobile phones an excellent instrument for effective data collection.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
16	Anokwa et al., (2009), U.S.A.	To compare the effectiveness of data gathering using mobile phones.	Estimation of response rates.	Test-retest technique was used.	The challenges of existing data collection tools and the rapid increase in mobile phone growth and its subsequent prospect for timely and efficient data collection.	Accurate and dependable data is one of the essential elements in the realization of goals for dependable data.
17	Rowling, (2009), U. S.A.	To assess the usability of broad-band Internet	Compilation of Information Communication reports.	Desk Review.	Information Communication Technology has a huge expanse of benefits globally.	Information Communication Technology becomes necessarily essential as in various organizational settings.
18	Bexelius et al., (2009), Sweden.	To compare the use of Short Message Service (SMS) on mobile phones and the use of telephone interviews in collecting self-reported data.	Respondents were assigned to either the SMS group or the telephone group.	Estimation of response rates.	Data collected via SMS was not statistically significantly different from data collected through telephone interviews	Though the response rate was low, SMS could be an effective method for collection of data.
19	CIA, (2009), U.S.A.	To assess the growth rate of broad the Internet usage as a global picture.	Compilation of reports.	Desk review of literature.	Information Communication Technology has a huge expanse of benefits globally.	Information Communication Technology is rapidly encompassing data collection.
20	Patnaik, (2009), India.	To compare the electronic forms, Short Messaging and the voice interactive data collection tools, in real-time.	Respondents were randomized into either electronic, SMS or voice groups.	Estimation of response rates.	The response rates for the voice interactive data collection tool were the highest and avoided errors.	Further, the study raises the possibility of using voice as a low- data collection tool.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
21	Blaya, (2008), Peru.	To compare the data collection efficiency of and the resources required to develop, implement and transfer the Personal Digital Assistant-based system (PDA) in a resource-poor setting.	Time frames of data collector tools using the PDA-based and paper systems: developing, implementing and transferring the two tools.	The total time to develop and implement the intervention was calculated.	The PDA-based system drastically reduced the effort required to collect data from remote locations.	In the light of the findings the software could reap the benefits of this technology.
22	Cocosila, (2008), Canada	To determine the time and efficiency limitations using text as a data collection tool.	An exploratory study based on a 1-month trial of a prototype system was conducted.	Total time frequencies were estimated.	A benefit perception proved to condition the respondents' willingness to use the services if necessary.	Wireless text messaging reminders could improve data collection.
23	Dykes, (2008), Ghana.	To report on hand-washing patterns in Ghana as	Compilation of Ghanaian reports on hand-washing practices	Desk review of literature.	It is essential to advocate for global hand global hand-washing as a disease prevention strategy.	There is the need to increase the awareness on hand-washing with soap in Ghana.
24	Global Hand-Washing 1, (2008), U.S.A.	To advocate for hand-washing of with soap to achieve the sanitation Millennium Development Goals (MDGs).	Compilation of country based global reports on hand-washing practice.	Desk review of literature.	It is essential to advocate for global hand global hand-washing as a disease prevention strategy.	There is the need to input resources for the campaign for a good global future.
25	Koshy, (2008), U.K.	To compare Short Messaging Service (SMS) to the traditional paper collection tool.	Evaluation of response rates was estimated.	Total response rates and frequencies were computed.	The use of SMS t reminders potentially offers an effective and efficient strategy to decrease non-attendance and so improve healthcare delivery.	The findings should be confirmed with a more rigorous study design before a wider roll-out
26	Kurniawan, (2008), U.K.	To investigate issues related to the use of mobile phones by people aged 60 years and above.	This study combines qualitative and quantitative analysis methods.	Response rates, codes and themes were determined.	The study revealed that older people are passive users of mobile phones, that they experience fear of consequences of using unfamiliar technology.	Gender differences in preferred design features of data collection tools should be considered in future.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
27	Manfreda et al., (2008), U.S.A.	To compare the effect of incentives web data collection tools of a postal mail and an email	Systematic review of literature was done.	Meta-analysis was conducted.	There were no significant differences in effect of incentives on response rates between modes of data collection tools.	Incentives could be accessed for both data collection tools.
28	Oulasvirta & Brewster, (2008), U.S.A.	To compare the effectiveness of the mobile phone technology to the computerized data collection tools.	An overview of literature was performed.	Desktop reviews were done.	Mobile phones effectively competed with computers as data collection tools	Mobile phones have the potential of improving data collection.
29	O' toole et al., (2008), Australia.	To explore optimal strategies to maximize telephone survey participation.	Respondents were randomized into an incentive and non-incentive group.	Total response rates were estimated.	A combination of approaches, such as incentives and interviewer training, remains a good strategy to maximize telephone response rates.	The use of other future technologies to telephone surveys, such as internet-based approaches, should be investigated.
30	Scott et al., (2008), U.S.A.	To determine on hand-washing facility types.	Compilation of reports on hand-washing facilities.	Desk review of literature.	The hand-washing facility type relates to hand-washing patterns.	Communal hand-washing should be globally prevented.
31	Roberts & Gorman, (2008), U.S.A.	To assess the efficacy and effectiveness of data collection via Short Message Service (SMS).	An overview of literature.	Desk review of literature.	The response rate via Short Message Service (SMS) from respondents illustrated good levels of efficacy and effectiveness.	Text messaging via mobile phone an excellent instrument for effective data collection.
32	Afroza, (2007), Indonesia.	To determine on hand-washing patterns among school children in Yogyakarta.	Compilation of reports on hand-washing practices among young school children	Desk review of literature.	It is necessary to advocate for 1 hand-washing among school children as a habit.	There is the need to increase the awareness on hand-washing with soap in young children in Yogyakarta.
33	Brick et al., (2007), U.S.A.	To compare Short Messaging Service (SMS) to the traditional paper collection tool.	Evaluation of response rates was estimated.	Total response rates and frequencies were computed.	The use of SMS t reminders potentially offers an effective and efficient strategy to decrease non-attendance and so improve healthcare delivery.	The findings should be confirmed with a more rigorous study design before a wider roll-out

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
34	Cleland et al., (2007), U.S.A.	To compare the effectiveness and acceptability of data collection using Short Message Service (SMS).	A qualitative interview study using a purposeful sample was conducted.	Relevant themes were coded.	The response rate via Short Message Service (SMS) from respondents was effective and acceptable.	Text messaging via mobile phone an excellent instrument for effective data collection.
35	Dillman, (2007 a), U.S.A.,	To assess contributory factors to measurement errors relating internet data collection.	An overview of literature was performed.	Desktop reviews were done.	The study summarizes recent research to provide an overview of how choosing the web mode affects the asking and answering of questions.	Researchers can strategically use visual design to get respondents to provide their answers in a desired format.
36	Dillman, (2007 b), U.S.A.	To determine contributory factors to bias relating to internet data collection.	An overview of literature was performed.	Desktop reviews were done.	The culture, policies and environment within the context of a research could affect research outcomes.	Although the Internet technology seems effective for a survey design, some innovations might affect its outputs'
37	Shoffner et al., (2007), U.S.A.	To examine whether mobile phone reminders increases response rates	Respondents were randomized into one of three conditions consisting of no reminder calls, therapist made calls, or staff made calls.	Mixed-effects logistic regression was used to analyze the data.	Findings from the second pilot study replicated findings from the first, with direct contact resulting in significantly more effective data collection.	The mobile phone could be a potential for effective data collection.
38	Geraghty et al., (2007), Ireland,	To examine the effectiveness of a SMS reminders were effective for clients.	SMS responses were received daily with minor variations daily.	The test-retest method was used.	Data collection was effective for the SMS computer automated text-messaging for data collection.	Further research is required into the potential of the computer-automated text-messaging for data collection.
39	Groves, (2006), U.S.A.	To assess contributory factors to biases relating to mobile phone data collection.	An overview of literature was performed.	Desktop reviews were done.	Non-response rates relate to research biases.	Statistical expressions of nonresponse bias can be translated into causal models to guide future hypotheses about when nonresponse causes bias.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
40	Hanes & Sweeney, (2006), U. S.A.	To assess contributory factors to measurement errors relating internet data collection.	An overview of literature was conducted.	Desktop reviews were done.	The study highlights recent researches and outlines an overview of how study designs affect response rates.	Researchers can strategically use visual design to get respondents to provide their answers in a desired format.
41	Staton, (2006), U.S.A.	To compare the effectiveness and acceptability of data collection using Short Message Service (SMS) as against paper.	Response rates and acceptability levels were computed.	The test-retest method was used.	The text messaging as data collection tool was acceptable and effective.	In future researches, the mobile phone holds the potential of effective data collection.
42	Anhoj & Moldrup, (2004), Denmark.	To evaluate the effectiveness of short messaging service (SMS) for data collection.	Response rates and acceptability levels were computed.	Response rates and acceptability levels were computed.	Response rates for the SMS were comparatively higher, with little evidence of biases. The methodology was highly acceptable.	The mobile phone tool promises a huge potential for data collection.
43	Couper et al., (2004), U.S.A.	To examine a newly developed Short Messaging Services (SMS) tool by testing for its effectiveness.	An online survey was used.	The test-retest method was used.	Analyses indicated that the tool is effective and acts in theoretically expected ways.	The tool promises an easy-to-administer and self-report measure of respondent perceptions.
44	Rice, (2003), U.S.A.	To compare the effectiveness of internet and mobile phone Short Messaging Services (SMS) as data collection tools.	Respondents were Randomized into each group.	Inter-rater Reliability and frequencies for levels of acceptability were determined.	The smartphone method was acceptable to interviewers, and for data collection, compared with pen-and-paper, eliminated data recording and entry errors, had similar inter-rater reliability, and did not result in data loss.	Mobile phone data collection tools should be further evaluated for other surveys and on a larger scale to ensure optimal effects.
45	Edwards et al. (2002), U. K.	To identify methods to increase response to postal questionnaires.	Systematic review of randomized controlled trials of any method to influence response to postal questionnaires.	The Odds Ratios were determined.	The odds of responses were more than doubled when a monetary incentive was used.	Researchers using postal questionnaires can improve the quality of their research by using the strategies shown to be effective in this systematic review.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
46	Martins, (2002), U.S. A.	To compare the effectiveness of internet and mobile phone Short Messaging Services (SMS) as data collection tools.	An overview of literature was performed.	Desktop reviews were done.	The text-messaging method was acceptable to interviewers, and for data collection, compared with pen-and-paper.	Mobile phone data collection should be further evaluated for other surveys.
47	Schonlau, (2002), U. S. A.	To compare the effectiveness of personal emails and world wide web as data collection tools	An overview of literature was performed.	Desktop reviews were done.	Nonetheless, it is possible to implement Internet-based surveys in ways that are effective and cost-efficient.	The Internet will continue to grow in importance for conducting certain types of research surveys
48	Cook et al., (2001), U.S.A.	To explore factors associated with higher response rates in electronic surveys reported in both published and unpublished research.	Systematic review performed.	Meta-analysis was done.	The number of contacts, personalized contacts, and pre-contacts are the factors most associated with higher response rates in the Web studies.	Response representativeness is more important than response rate in survey research. However, response rate is important if it bears on representativeness.
49	Crawford et al, (2001), U.S.A.	To explore factors associated with higher response rates in electronic surveys as against web surveys.	Systematic review performed.	Meta-analysis was done.	The number of contacts, personalized contacts, and pre-contacts are the factors most associated with higher response rates in the Web studies.	Response representativeness is more important than response rate in survey research. However, response rate is important if it bears on representativeness.
50	Sheehan, (2001), U.S.A.	To explore factors associated with higher response rates in electronic surveys as against web surveys.	Systematic review performed.	Meta-analysis was done.	Correlation and regression analyses suggest that year that the survey was undertaken and number of follow-up contacts had the most influence on response rates	Strong strategies are needed to prevent the e-mail as a data collection system from becoming obsolete.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
51	Couper, (2000), U.S.A.	To validate a newly developed tool by testing for its validity and reliability.	An online survey was used.	Scale validation included tests to determine reliability, validity and factor structure.	Analyses indicated that the tool is reliable and demonstrates content validity, construct validity and acts in theoretically expected ways.	The tool promises an easy-to-administer and self-report measure of respondent perceptions.
52	Dillman, (2000), U.S.A.	To examine the effectiveness of emails for data collection.	An overview of literature was performed.	Desktop reviews were done.	The email was effective and acceptable as for large data collection.	The email as a tool promises a huge potential for data collection.
53	Dommeyer & Moriarty, (2000), U.S.A.	To evaluate the effectiveness of email (SMS) for data collection.	An overview of literature was performed.	Desktop reviews were done.	Response rates for the SMS were comparatively higher, with little evidence of biases. The methodology was highly acceptable.	The computer world wide is rapidly emerging as an answer to dependable data collection.



## 2.5 Types of economic evaluation

According to Donaldson et al. (2002), economic evaluation is founded on the basis of opportunity cost. Every resource used has a corresponding opportunity cost; which is the benefit that would have been derived had the resource been used in satisfying an alternative need (Donaldson et al., 2002). Economic evaluations also relate to issues of efficiency in achieving a goal at minimal cost and maximizing benefit (Donaldson et al., 2002). Drummond et al., (2005) also try to explain and argue out the framework for economic evaluation of programmes in general. Economic evaluation also relates to the analysis of the costs as inputs, and resultant effects or outputs of alternative courses of action (Drummond et al., 2005). This may be termed as a comparative analysis since it compares the costs and resultant effects of alternative programmes as in Figure 2. It also allows some decisions and conclusions to be made regarding which of the alternative programmes is useful and efficient.

The key economic concepts of scarcity and choice are basic principles in economic evaluation. Resources are limited and are not readily obtainable in the amounts that would have permitted society to satisfy all its wants. Drummond et al. (1987, 2005) explain the framework for economic evaluation of programmes and indicate the important lines of cost by suggesting practical means of estimating such costs. Due to the significance and realism of the framework, this study adapts it. The framework has two broad components showing costs and consequences of improvising for sanitation data collection tools.

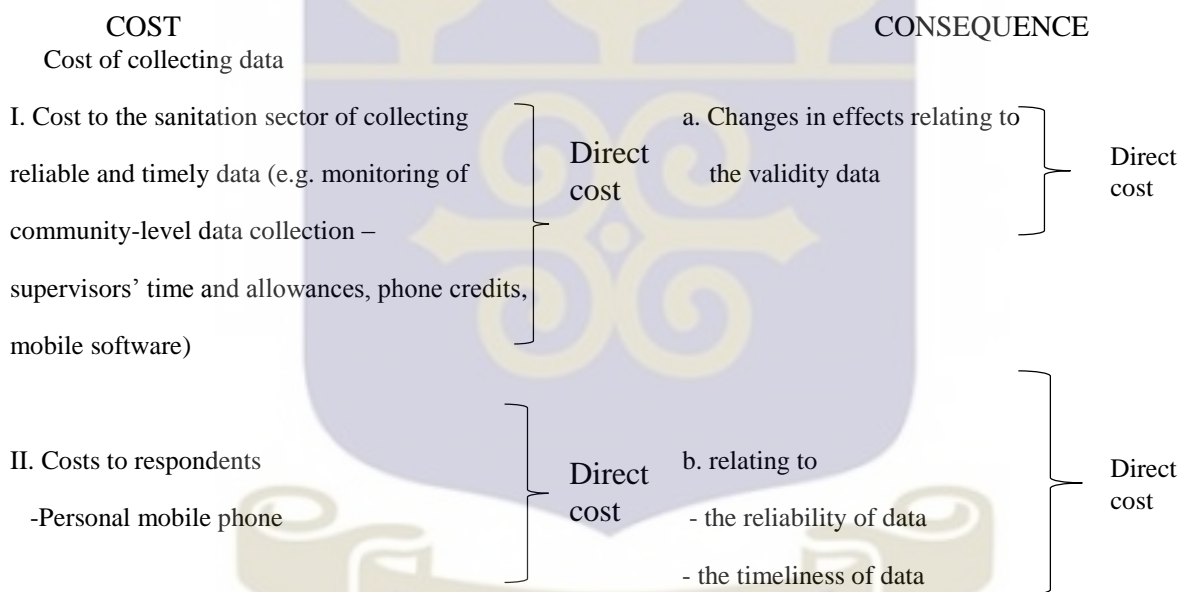
The cost component identifies three categories of costs. The first two categories identify the costs of setting up and monitoring the new mobile phone sanitation survey software and the third category identifies the costs associated with standard traditional data collection options such as the use of paper and all costs which associated to this option. The first set of cost

consists of direct costs to the sanitation project as a whole. These include costs incurred on training and monitoring of the field assistants, which come in the form of recurrent costs such as monthly field allowances for the field assistants, fuel costs and vehicle maintenance, mobile phone credit for the software and respondents; and overhead costs such the cost of setting up the mobile phone survey software and consultation fees. Enlisting the individual components used for setting up the software outlines such costs. In this study, the second category comprises costs incurred by respondent household of the SMS text messages since their personal mobile phones and credit was used, although GHS1.00 was used for the mobile phone credit. The costs also include out-of-pocket expenses and inputs by the mobile phone respondents into sending answers to the SMS platform by the use of their personal phones. This includes the time spent by the field assistants in educating and sensitizing the SMS text recipients. The indirect and intangible costs are negligible and are excluded from the cost.

As argued by Hagberg (2007), there are four main types of economic evaluation, which are cost-effectiveness analysis (CEA), cost-utility analysis (CUA), cost-benefit analysis (CBA) and cost-minimization analysis (CMA). The CEA, the CUA and CBA explain both the costs and resultant effects of alternative programmes but differ in their measurement of outcome (Drummond et al., 1987). CEA measures the costs of alternative programmes in monetary units and the consequences in natural units such as the total number of lives saved. In this case, the resultant effect of the programme under consideration is challenging to measure in monetary terms. Cost-effectiveness analysis ensures that an intervention that yields the best effects at least cost is recommended and if implemented, some resources could be freed for use by other competing health intervention. However, CBA calculates and measures both costs and resultant effects in monetary units; while CUA calculates costs in monetary units and resultant effects in utility-effectiveness such as satisfaction for a set of preferred

outcomes. An example of utility measure is quality-adjusted life year (QALY). Another example is the disability-adjusted life years (DALYs). As a result, CUA is sometimes regarded as a type of CEA as it also does not quantify consequences in monetary terms. On the other hand, CMA concept adopts and accepts that alternative programmes being evaluated achieve similar resultant effects or outcomes; such that only costs are evaluated and the programme with the least cost outcome is favoured. Drummond et al. (2005) explain and term this type of evaluation as partial economic evaluation.

**Figure 2: Types of costs and consequences of collecting reliable and timely data**



Source: Drummond et al. (1987, 2005)

### 2.5.1 Review of cost-effectiveness analysis studies

From the reviews, several studies compare the cost-effectiveness of some interventions by comparing data collection via mobile phone and computer technologies to that of paper as shown in Table 5. The review is based on twenty-one studies over the period of 1987 to 2013. Three of the studies reviewed were in Europe (Kollman et al., 2007; Bleichrodt & Quiggin, 1999; Boot & Cairncross, 1993), fourteen in America, one in Asia (Li

et al., 2013) and three in Africa (Mahmud & Nesbit, 2010; Tomilson et al., 2009; Jenkins & Scott, 2007).

Cost-effectiveness is defined as the cost, in monetary terms, of producing a unit of effect through an intervention (Gold et al, 1996; Bleichrodt & Quiggin, 1999). Cost-effectiveness analysis allows programme managers, governments, donors and researchers to compare programme costs with performance (UN, 2011). A cost-effectiveness analysis can reveal the effects resulting from an investment and compare different interventions on their relative merits. The assessment of the cost-effectiveness of sanitation interventions, including dependable and timely data is necessary to ensure improved health in developing countries. Reliable and accurate data can greatly improve the benefits of sanitation programmes in developing countries at relatively limited costs (WHO & UNICEF, 2012). A programme may, for example, spend US \$10 000 on interventions and reduce the number of cases from 10 000 to 8000. Its cost-effectiveness is then expressed as US\$5 per case averted (Varley et al. 1998).

Sanitation programmes generally aim at improving specific behaviours, such as human excreta disposal and hand-washing (Curtis et al., 2011). Performance is measured in terms of the expected outcomes, such as the increased percentage of household members having access to and effectively using sanitary latrines, or the increased percentage of persons washing hands properly after defecation or handling excreta (Lopez-Quintero et al., 2009). Some programmes also use the term effectiveness in relation to health impacts, such as a lower number of diarrhoeal cases or deaths (Curtis et al., 2000). In this context, effectiveness is defined as the measured change in sanitation conditions resulting from a sanitation intervention and effects on morbidity and mortality are defined as impact.

The Millennium Development Goals (MDGs) represent a renewed commitment to address the most enduring failures of human development (WHO & UNICEF, 2010a). For the sanitation sector, the goal is to halve the proportion of people without sustained access to safe drinking water and basic sanitation by 2015 (JMP, 2010). At mid-term, numerous initiatives were under way to report progress (JMP, 2010). However, while huge investments are made, little is known about whether the resulting facilities are used effectively and good hygiene habits have developed (WHO & UNICEF, 2012). Only through this can the goals benefit health and reduce poverty; access alone is not enough (Boot and Cairncross 1993, Jenkins & Scott, 2007). Moreover, under the prevailing resource constraints the cost-effectiveness of all interventions is especially important (JMP, 2012).

Tomlinson et al. (2009) in his study implemented the research with low direct costs of materials. Although there is no comparison of costs to a paper based survey tool the study assumes a likely cost of \$0.30 for paper, printing and data entry costs. The study concludes that cost effectiveness of this mobile phone approach requires further investigation. Kollmann et al. (2007) in his study asserts that respondents did not incur any costs and also gave no costs throughout the study. As a conclusion, future researches need to incorporate the cost component. In addition the costs of the service delivery as a whole were difficult to estimate. The operating cost was dependent on the number of users and the make-up of the service, while cost for the health care delivery was dependent on the total monitoring time. As a recommendation, the study suggests that automatic data analysis and alerts could be useful in detecting abnormalities by decreasing labor costs. However, the study cautions that the methods involved are very complicated and includes various stakeholders.

According to another study by Nichols et al. (2008) in the U.S.A., initial set up costs per respondent stood at about US \$115 with estimated monthly maintenance costs of roughly US \$15. This was in the non-intervention group. Setup costs for the mobile phone intervention per respondent had an extra US \$100 with monthly maintenance costs of approximately US \$10. In its findings, a simple, and cheap monitoring intervention could empower people where mobile phones have been effectively used to achieve major goals given that the implementation is in a rural setting. Considering the limitations of human resource, a useful important aspect of this method includes the target population themselves, which needs a multidimensional and sustained approach.

The whole aim of acceptability, determination of the cost-effectiveness, and evaluation of the sustainability of the peer-reviewed programs can be achieved. Mobile phones technology could offer one practical approach for increasing reliability of gathering data. Li et al. (2013) also conclude that the total costs of the paper based survey were much higher than the costs of the text messaging tool: ¥5993.1 (US \$953.12) and ¥1954.5 (US \$310.84), respectively. Costs per questionnaire for the face-to-face survey were also higher than for the text messaging tool: ¥33.9 (US \$5.39) and ¥19.7 (US \$3.13) for all questionnaires, respectively, and ¥34.4 (US \$5.47) and ¥27.1 (US \$4.31) per completed questionnaires, respectively. The Incremental Cost-Effectiveness Ratio (ICER) was calculated to be ¥102.2 (US \$16.25), meaning the cost of the face-to-face survey for each percentage increase of completion rate was ¥102.2 (US \$16.25) compared to the text messaging survey.

Mahmud & Nesbit (2010) in a study of community volunteers from local settings in Malawi, aimed for reducing the waiting time in health facilities, where a lot of time is lost in accessing healthcare. In a pilot trial in Malawi, a group of community volunteers were given cell

phones for the management of patient adherence reporting, appointment reminders, and physician queries. This was in an effort to totally reduce the travel time and replace it with communication via text messages. At the close of the trial, the hospital saved close to 2,048 hours of worker time with US \$2,750 on net (US \$3,000 in fuel savings minus US \$250 in operational costs), and increased the capacity of the treatment program. The study concluded that m-Health interventions could be cost-effective answers to communication challenges in rural settings of the developing world. Furthermore, Cohen & Reynolds (2008) and Goldie et al., (2005) argue that the term cost-saving and cost-effectiveness differ since it is possible for the cheaper alternative and less effective option to be preferred on economics grounds especially in extremely resource challenged settings. According to Cape et al., (2013), the use of a cost-effectiveness plane gives a better means of graphically presenting cost-effectiveness results. Such cost-effectiveness plane illustrate quadrants depicting the less costly and more effective intervention as against a standard in which case the intervention is accepted; or a more costly and less effective intervention which is often not desired. Within these two levels lie the potentially acceptable less costly but more effective zone on one hand and the more costly and more effective zone on the other hand.



**Table 5: Empirical studies on cost-effectiveness**

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
1	Li et al., (2013), China.	To test the cost-effectiveness of using text messaging as against a paper-pencil tool for data collection.	Comparison of the response rates and acceptability levels of the two tools.	Frequencies of response rates and total costs were calculated.	A cost-effective data collection method is crucial for high quality monitoring of health interventions. The traditional face-to-face data collection method is labor intensive, expensive, and time consuming.	With the rapid increase of mobile phone subscribers, text messaging has the potential to be used for evaluation of population health interventions in rural China.
2	JMP, (2012), U.S.A.	To examine the effectiveness of accurate and dependable data collection in achieving Millennium Development Goals (MDGs).	Compilation of country based global reports.	Desk review of literature.	A growing understanding of what drives hygiene behaviour and creative partnerships are providing fresh approaches to change behavior using cost-effective means.	Innovative monitoring of the Millennium Development Goals (MDGs) targets and the gathering of reliable data for decision making will help to address major weakness in the global sanitation sector
3	WHO & UNICEF (2012), U.S.A.	To examine the effectiveness of in data collection in achieving Millennium Development Goals (MDGs).	Compilation of country based global reports.	Desk review of literature.	It is important to improve on global sanitation data compilation.	Relevant, accurate, timely and affordable information from multiple sources should be sustainable to achieving sanitation Millennium Development Goals (MDGs).
4	Curtis et al., (2011), U.S.A.	To promote safe hygiene as the single most cost-effective means of preventing infectious disease.	Overview of literature.	Desk review of literature.	Evidence shows the benefit of improved hygiene, especially for improved hand-washing and safe stool disposal.	Full and active involvement of the health sector in getting safe hygiene to all homes, schools, and institutions is essential.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
5	U.N. (2011), U.S.A.	To discuss the cost-effectiveness of mobile phone technology in data collection in achieving sanitation Millennium Development Goals (MDGs).	Compilation of UN reports.	Desk review of literature.	The sanitation task is no doubt a daunting one especially in rapidly growing peri-urban areas.	Lack of supportive policies to offer the foundation for planning and implementing sanitation programs is a gap in the aim of improving sanitation coverage.
6	JMP, (2010), U.S.A.	To discuss the effective means of achieving water and sanitation Millennium Development Goals (MDGs).	Compilation of country based global reports.	Desk review of literature.	Hygiene promotion is one aspect of ensuring behaviour to change behavior using accurate and affordable approaches.	Meeting Millennium Development Goals (MDGs) sanitation targets is essentially necessary in the global sanitation sector.
7	Mahmud & Nesbit, (2010), Malawi.	To test the feasibility of communication via text messages.	Estimation of response rates.	Test-retest technique was used.	The study showed that m-Health interventions can provide effective solutions to communication barriers in the setting of rural hospitals in the developing world.	The results of the retrospective mobile health (m-Health) pilot could eliminate several data collection limitations.
8	WHO & UNICEF, (2010), U.S.A.	To evaluate updates on water and sanitation Millennium Development Goals (MDGs).	Compilation of country based global reports.	Desk review of literature.	In hygiene is low both in the health and in the water and sanitation sectors.	A growing understanding of what drives hygiene behaviour and creative partnerships are providing fresh approaches to change behaviour.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
9	Tomilson et al., (2009). South Africa.	To investigate the feasibility, the ease of data collection using mobile phones.	A web-based system was developed to allow electronic surveys or questionnaires to be designed on a word processor, sent to, and conducted on standard entry level mobile phones.	Test-Retest technique was used.	The system permitted the early detection of data fabrication in combination with real-time quality control and data collector supervision.	The benefits of mobile technology, is a feasible method of data collection that needs to be further explored.
10	Lopez-Quintero et al., (2009), Colombia.	To determine on hand-washing patterns among school children in Bogota.	A survey was conducted on hand-washing practices among young school children.	Desk review of literature.	Hand-washing behaviors and intentions among school children in Bogotá, Colombia, needs a critical look to help identify and overcome barriers to proper hygiene practices.	Scarcity of adequate facilities in most schools in Bogotá could prevent children from adopting proper hygienic behavior.
11	Cohen & Reynolds, (2008), U.S.A.	To provide the reader with an understanding of the theoretical underpinnings of CE analysis in medical literature.	An overview of literature.	Desk review of literature.	The discipline of cost-effectiveness (CE) analysis has developed over several decades as a tool for objectively examining benefits in light of incremental costs.	Key principles reviewed include the importance of proper incremental and the effect of time for good decision-making.
12	Nicholas et al., (2008), U.S.A.	To examine the cost-effectiveness of a randomized, clinical trial of a home-based intervention.	Respondents were into three groups of individual sessions, home sessions and telephone sessions. Control caregivers received two "check in" telephone calls.	Incremental cost-effectiveness ratio (ICER), the additional cost to bring about one additional unit of benefit was determined.	The ICER showed that intervention caregivers had 1 extra hour per day not spent in caregiving, at a cost of \$5 per day.	The intervention improved cost-effective management of care respondents' behavioral problems.
13	Jekins & Scott, (2007), Ghana.	To develop a behavioral approach to assess household demand for improved sanitation in Ghana	A national survey was conducted on the availability improved sanitation facilities.	Frequencies of response rates were calculated.	Motivating and constraining factors are compared at each adoption stage and strategies likely to increase toilet installation in Ghana	Household demand for improved sanitation in developing countries is an important social and behavioral process with implications for public health, sanitation policy and planning.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
14	Kollman et al., (2007), Austria.	To evaluate the feasibility and cost-effectiveness of mobile phone-based data collection intervention.	The data were then processed to generate statistics and trends, which were provided for the patient and his/her health care professional via a Web portal	Frequencies of response rates were calculated.	The mobile phone as patient terminal seems to provide a ubiquitous, easy-to-use, and cost efficient solution for patient-centered data acquisition	To confirm the promising results of the pilot trial further research has to be done to study cost-effectiveness.
15	Drummond et al., (2005), U.S.A.	To discuss new updates on methodological approaches, including cost effectiveness acceptability curves, sensitivity analysis, and value of information analysis.	There is an expanded chapter on the use of economic evaluation, including discussion of the use of cost-effectiveness thresholds, equity considerations and the transferability of economic data	Review of literature and empirical research.	This highly successful textbook mirrors the huge expansion of the field of economic evaluation in health care.	The book promises a good guide for future commissioning, undertaking of cost-effective health care decisions.
16	Goldie et al., (2005), U.S.A.	To assess the cost-effectiveness of a variety of cervical-cancer screening strategies in India, Kenya, Peru, South Africa, and Thailand.	Primary data were combined with data from the literature for an overview of cost-effectiveness	Desk review of literature.	Cost per year of life saved that was less than each country's per capita gross domestic product--a very cost-effective result, according to the Commission on Macroeconomics and Health.	Cervical-cancer screening strategies are cost-effective alternatives to conventional three-visit cytology-based screening programs in resource-poor settings.
17	Biechrodt & Quiggin, (1999), The Netherlands.	To illustrate that cost-effectiveness analysis is consistent with cost-benefit analysis if the lifetime utility function is additive over time	An overview of literature.	Desk review of literature.	The willingness to pay for QALYs depends on wealth, remaining life expectancy and health status	Cost-effectiveness analysis is consistent with cost-benefit analysis if the lifetime utility function is additive over time.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
18	Varley, (1998), U.S.A.	To discuss whether water and sanitation programmes are not a cost-effective in relation to health sector resources.	An overview of literature.	Desk review of literature.	Cost-effectiveness analysis indicates that some water supply and sanitation interventions are highly cost-effective for the control of diarrhea.	Cost-effectiveness analysis should measure the incremental health impacts attributable to health sector.
19	Gold et al., (1996), U.S.A.	To develop consensus-based recommendations guiding the conduct of cost-effectiveness analysis (CEA).	An overview of literature.	Desk review of literature.	Although CEA does not reflect every element of importance in health care decisions, the information it provides is critical to informing decisions about the allocation of health care resources	The recommendations define a "reference case" cost-effectiveness analysis, a standard set of methods to serve as a point of comparison across studies
20	Boot & Cairncross, (1993), U.K.	To explore development approaches for changes in human behavior.	An overview of literature.	Desk review of literature.	The study summarizes recent research to provide an overview on strategies for changing human behavior.	A wide variety of observation and interview methods are described, together with suggestions for adopting the right combination of methods to local circumstances.
21	Drummond et al., (1987), U.S.A.	To discuss cost effectiveness and benefits.	An overview of literature.	Desk review of literature.	This book explains the general essence of cost-effectiveness benefits.	The book promises a good guide for future commissioning, undertaking of cost-effective health care decisions.

### **2.5.2 Review of cost minimization analysis studies**

This review is based on ten studies over the period of 1990 to 2014 as shown in Table 6. Four of the studies reviewed were in Europe (Prydz, 2013; Kobelt et al., 2002; Briggs & O'Brien, 2001 & Reinsch & Beswick, 1990); three in America (Cape et al., 2013; Ballivian & Azevedo, 2013 & Adeyemi et al., 2012) and three in Africa (Heerden et al., 2014; Dillon, 2012 & Caeyers et al., 2011).

Cost-minimization analysis is one of the economic evaluation techniques, and is a method used to measure and compare the costs of different interventions (Briggs & O'Brien, 2001). The principal limitation of this cost evaluation methods is that it can only be used to compare interventions that provide the same benefits (Kobelt, 2002). Cost-minimization analysis is used when two or more health care interventions have the same outcomes. In such a case, the analysis can be limited to costs if conclusive evidence demonstrates that the treatments being evaluated are equally effective and that they produce no meaningful difference in health outcome. A decision maker who is responsible for all relevant costs will choose the treatment with the lowest total cost. This ensures that resources will be used efficiently (Kobelt, 2002).

In this way, policy makers can be informed on the choice of intervention with the lowest total cost (Briggs & O'Brien, 2001). The assessment of costs is identifying through the computation of all resources used and quantifying them accordingly (Newby & Hill, 2003). The most common perspectives often used are societal perspective (includes all costs incurred by respondents and society in general) (Rascati, 2009).

Costs are also significant in the context of determining whether these new approaches to data collection are feasible and whether they are a viable improvement over more traditional collection methods (Prydz, 2013). The general finding seems to be that all the phone methods are much cheaper than traditional survey methods, but knowing that they also have more limitations, the resulting cost depends heavily on the context in which they are implemented (Prydz, 2013).

Caeyers et al. (2011) also compared pen-and-paper interviewing (PAPI) to computer-assisted personal interviewing (CAPI) where the big difference is the upfront hardware and software costs that can be associated with CAPI implementation in comparison to PAPI (Caeyers et al., 2011). In the experiment of Caeyers et al. (2011), which had quite high upfront cost compared to hardware and software, a break-even point between the two methods at 4,000 questionnaires was calculated. Below 4,000 questionnaires, paper was cheaper and above this CAPI was cheaper. Thus, a survey of 2,500 households would be US\$13,500 more expensive on CAPI, while a survey of 10,000 households would be US\$54,000 cheaper on CAPI than on paper.

Ballivian and Azevedo (2013) also present some of the best-cost comparisons. In their pilot in Honduras and Peru, they found that phone surveys approximately halves the cost of face-to-face visits (US\$25 vs. US\$40 per interview for a 1,500 sample). IVR and SMS is much cheaper at US\$17 and US\$8 per survey, which is expected given that these surveys are much less costly because the enumeration is done automatically without any labor costs.

Heerden et al. (2014), compared the cost of the traditional paper method with mobile phone-assisted personal interviewing. Costs associated with the two survey methods were calculated.

Findings suggested that the mobile phone–assisted personal interviewing was becoming a more widely used technique to collect survey data. In another study, Cape et al., (2013), explained the different types of economic evaluations with a focus on cost minimization, emphasized on spending by utilizing more cost evaluation interventions and concluded that an understanding of economic evaluations helps in well-informed decisions. Adeyemi et al. (2012), in a retrospective study using Medicaid claims, identified patients with bipolar disorder and found no statistically significant differences between the groups for all mental health-related costs or total costs. Dillon (2012), also compared the cost of face-to-face interviews with mobile phone survey. On the basis of the estimation and comparison of total cost, the average cost of the phone survey interviews was US\$6.98, while the face-to-face interviews cost US\$97 each (Dillion, 2012).

Reinsch & Beswick (1990) compared the voice mail to the conventional mode of communication. A cost minimization analysis of respondents' preferences showed that cost minimization could predict individual channel selections and provides a partial basis for managerial decisions.

Ultimately, it is very difficult to make general statements about the precise cost minimization of the methods. It depends both on local contexts, and moreover on the purpose and relative benefits from the data collected.

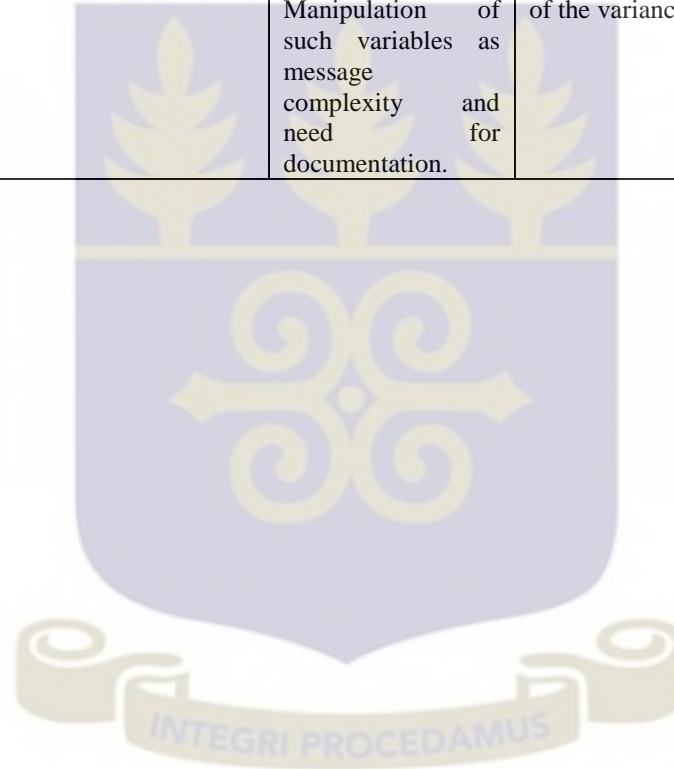
**Table 6: Cost minimization Analysis studies**

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
1	Heerden et al. (2014), South Africa	To compare the cost of the traditional paper method with mobile phone-assisted personal interviewing.	One hundred health research interviewers trained to use traditional pen-and-paper (PAP) survey methodology were recruited and randomly assigned to either a PAP or an MPAPI group. After receiving training on the survey instrument, each of the 100 interviewers conducted interviews with the same five interviewees, for a total of 500 interviews.	Costs associated with the two survey methods were calculated. Very low error rates were achieved in both PAP and MPAPI, with a total of 381 data errors identified in 21,500 survey items.	Findings suggest that experienced, well-trained interviewers using a short, well-constructed survey can produce very low error rates, independent of survey mode and the benefits of MPAPI would be magnified as the size and complexity of the study increases.	Mobile phone-assisted personal interviewing (MPAPI) is becoming a more widely used technique to collect survey data.
2	Prydz, (2013), France	To provide an overview of technological innovation in data collection in developing countries, with a focus on those technologies that have become feasible due to the rapid rise in mobile phone connectivity.	Desk review.	The review of tools and experiences.	Findings indicate that new technologies can substantially advance the production of faster and more frequent data, even in the most challenging institutional and capacity constrained environments. New survey technologies can both improve the speed, accuracy and costs of 'traditional' surveys.	Improved statistics produced through these new approaches is an important step towards strengthening evidence-based policy making.
3	Cape et al., (2013), Canada.	To describes different types of economic evaluations	An overview of literature. A hypothetical study was included to illustrate how a cost analysis evaluation is performed	Desk review of literature.	Cost containment can help optimize spending by utilizing more economic evaluation interventions.	An understanding of economic evaluations, will aid well-informed decisions.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
4	Ballivian & Azevedo (2013), Peru and Honduras	To empirically test whether cellular phone communication technology will reduce the time and cost of collecting household survey data from a probabilistic sample without compromising data quality.	The design was a test-retest design of the communication mode.	Internal validity was assessed using Rasch analysis. Total costs were computed.	The results suggest that using mobile phones for short and frequent surveys can produce high-quality data more quickly – and more cheaply on a per survey basis – than traditional methods, and can be a valuable complement to less frequent, more comprehensive, more expensive household surveys.	The most desirable use of the L2L model of mobile surveys may be as a complement to on-going national surveys which collect mobile phone numbers of household members
5	Adeyemi et al. (2012), USA	A retrospective study using Medicaid claims identified patients with bipolar disorder for whom oral second-generation antipsychotics were prescribed and compared rates of adherence, persistence of use, and costs across five groups of patients taking aripiprazole, olanzapine, quetiapine, risperidone or ziprasidone.	Medicaid claims data for 2,446 bipolar patients were analyzed from eight states. The 18-month observation period included the six months before and the 12 months after the index prescription date.	Mental health-related prescription costs, total prescription costs, total mental health-related costs, and total costs were assessed. Ziprasidone was the comparator.	Mental health-related prescription costs and total prescription costs were lower for risperidone than ziprasidone.	No statistically significant differences were found between the groups for all mental health-related costs or total costs.
6	Dillon (2012), Tanzania	To compare the cost of face-to-face interviews with mobile phone survey	High-frequency household survey with farmers in remote rural areas,	Estimation and comparison of total cost	The average cost of each of the 2677 phone survey interviews was \$6.98, while the face-to-face interviews cost \$97 each.	The mobile phone technology has a high potential for collection of large data in surveys in rural areas.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
7	Caeyers et al. (2011), Tanzania	To compare pen-and-paper interviewing (PAPI) to computer-assisted personal interviewing (CAPI).	Randomized survey experiment among 1840 households	A number of regression analyses using the consumption aggregates as dependent and explanatory variables were used.	Paper interviewing, which had quite high upfront cost compared to hardware and software available, calculate a break-even point between the two methods at 4,000 questionnaires. Below this, paper is cheaper and above this CAPI is cheaper.	Though CAPI product leads to higher fixed up-front costs, it has lower variable per-questionnaire costs and is recommended for surveys.
8	Kobelt et al. (2002), UK and Sweden	Two simulation models were developed to analyze the cost of new treatments that affect the progression of rheumatoid arthritis (RA).	Use of data from 2 cohorts of patients with early RA who had been followed up since disease onset (up to 15 years).	A regression model was used to estimate transition probabilities conditional on age, sex, and time since onset of disease, in order to allow simulation of different patient cohorts. Costs and utilities associated with different HAQ levels were based on data from the cohort studies and surveys.	Costs increase and quality of life decreases as RA progresses.	The 2 models, which were based on different patient cohorts, reach a similar conclusion in terms of the effect of RA over 10 years. They appear to accurately capture disease progression and its effects and can therefore be useful in estimating the cost of new treatments in RA.
9	Briggs & O'Brien (2001), UK	To compare cost-benefit analysis (CBA), cost-utility analysis (CUA), cost-effectiveness analysis (CEA) and cost-minimization analysis (CMA).	Comparative study to compare the various economic evaluations.	Two examples from published CEA are employed to illustrate the issues.	In rare circumstances CMA may be justified as a legitimate form of analysis.	Analytic focus should be on the estimation of the joint density of cost and effect differences.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
10	Reinsch & Beswick (1990), UK	To compare voice mail to conventional of communication.	Comparison of total cost of the two communication channels.	A cost minimization analysis of individuals' preferences. Manipulation of such variables as message complexity and need for documentation.	Results support eight of ten hypotheses derived from a perspective of cost minimization with exogenous variables accounting for about 21 percent of the variance.	Cost minimization can apparently predict individual channel selections and provide a partial basis for managerial decisions about adopting voice mail.



## **2.6. Feasibility, acceptability, sustainability and challenges of mobile phones in data collection**

The feasibility, acceptability, sustainability and challenges of mobile phones for data collection is evaluated by several studies which compare other technologies such as mobile phones and the internet to the paper survey tools as a form of data collection survey tools as shown in Table 7. The review covers fifty studies over the period of 1999 to 2013. Five of the studies reviewed were in Europe, twenty-four in America, nine in Asia, seven in Africa including Ghana and five in Australia.

In current years, there have been awareness of the feasibility and potential use of mobile phone technology for different aspects of service particularly in low-income settings (Ball et al., 2005; Lasica, 2007; Bengtsson et al., 2011; Li et al., 2013). As reported by the United Nations and ITU (2013), the extensive use of mobile technology demonstrates feasibility for information and communication approaches throughout the world. Presently, as many as 64% of the global mobile phone users are in the developing world (Adler, 2007). Therefore, the universal development of mobile phones is a significant element in the promise of mobile technologies for data collection and hold substantial effect and outcomes in developing countries (Lasica, 2007; Adler 2007; Mishra & Singh, 2008). Several of communities across Africa and Asia who lack access to traditional phone communication now use mobile phones on a consistent basis (ITU, 2008).

Furthermore, people are gaining access to the Internet via mobile phones globally and this may be the situation across the world by 2020 (Raine & Anderson, 2008; DeRenzi et al., 2011).

Hinckson & Duncan, (2011) argue that mobile technology has already been widely adopted around the world; its utilization is growing at a rapid rate not just for interpersonal communication but as an important aspect of communication infrastructure for several industries (Donner, 2008a, 2008b). Communication by mobile phone is a cheaper option as compared to the landline telephones or standard Internet (Mishira & Singh, 2008). Adler (2007) and Li et al. (2013) also explain that mobile phones have managed to penetrate parts of the globe where other infrastructure is absent. In the developing world, mobile-phone subscriptions have skyrocketed from nearly zero a decade ago to 50% of today's population and fixed telephone lines have reached less than one-sixth of the people (ITU, 2008; Alder, 2007). Instead of the recall of events, information or pictures may now be entered through a website because observations can directly be relayed from the field (Patrick et al., 2008, 2009; Pyke-Grimm et al., 2011)

While there have been a number of studies integrating mobile phones in general, interest has been evoked specifically in the area of sanitation (WHO & UNICEF, 2012). This is important, given the potential of these technologies to serve as catalysts for reaching the Millennium Development Goals for 2015 (WHO & UNICEF, 2012). For instance, intermediate and final outcomes intended by a particular planned intervention using the mobile phone technology could be possible (Glanz et al, 2008). The reliability, validity, feasibility, sustainability and challenges of this new innovative technology will also answer the effectiveness and cost minimization of this approach. Communication technology, electronic communication, wireless technologies, telecommuting and the internet make it possible for future advancement in globalization (Glanz et al, 2008, Butterfoss et al., 2008). The implication is positive development in terms of identifying, implementing and evaluating solutions (Bellhouse, 2000; Wallerstein, 2006). This is

evident in cases where continuous data collection needs to be facilitated as argued by Minkler et al. (2008).

In terms of the acceptability and practicality of SMS for data collection respondents are asked if the whole process of receiving and sending SMS text messages was convenient, a nuisance, easy to do or time consuming. This is evident in the study of Bradley et al. (2012) and Li et al. (2013) where most respondents found the technology to be effective and acceptable because the reminders, which were beneficial, did not involve a great amount of time. The use of cell phone reminders was also practical and acceptable to the respondents. The study, however, cautions more research work to determine its effect on adherence and on health outcomes.

Fjeldsoe (2009) expresses his view that, mobile phones also offer a two-way communication system. As demonstrated by works of Koshy et al. (2008) and Zhang et al., (2012) the technology allows respondents to receive reminders and instructions depending on the time or location. Donner (2008a) and Lim (2010) discussed that much as mobile technology is progressively foremost for communication but it is not limited to, text messaging, video messaging, voice calling, and internet connectivity. Fjeldsoe (2009) and Krishna (2009), also, support this argument. Several innovations have been developed that address an array of issues such as improving the convenience, speed, and accuracy of communication in general as well as data collection (Adler, 2007; Hughes, 2009).

In addition, the studies of Heinonen et al., (2012) asserted that in terms of responses, the mobile phone technology questionnaire was easy to use and quick to learn. However, problems such as

network connectivity and restrictions for only a few characters on the mobile phone tool were evident. Heinonen et al. (2012) discuss that the respondents also made unconstructive comments on the relevance, monotony of the questionnaires and lack of opportunity to explain and add responses. Some of the respondents who did not use their own phone indicated that the use of the new mobile phones were cumbersome which made it challenging for them to remember to respond. The study however concluded that the response rate and usability of the mobile phone technology were good throughout the intervention. To improve on the limitations of such studies, the mobile phone tool should be validated against another tool such as the paper based tool (Jaspan et al., 2007; Kaplan, 2006).

Again in comparison with other studies there was a low dropout rate although the duration of the study was quite long and demanding as suggested by Heinonen et al., (2012). It is important that the method does not stress the respondent and are not lost to follow up or dropout since there should be no missing data (Heinonen et al., 2012). The issue of prepaid subscriptions was also a challenge in addition to inconsistencies in internet and network connections. Unexpected costs related to some subscriptions were also incurred. These factors could affect the sustainability of such new technologies on larger scales of data collection. Advantages of the mobile phone technology in data collection include the reduction of systematic errors caused by self-disclosure and recall (Allen et al., 2007; Ferguson et al., 2006; Graham et al., 2003). Allen et al. (2007) argues that pictorial dimensions results in more frequent reporting of events than in paper based face-to-face interviews. In addition, Allen et al., (2007) suggests that it is not clear if there fewer recall problems, or anonymity permitting truthfulness. Hays et al., (2001) support the arguments of Heinonen et al., (2012) by indicating that there could be high dropout rates for mobile phone

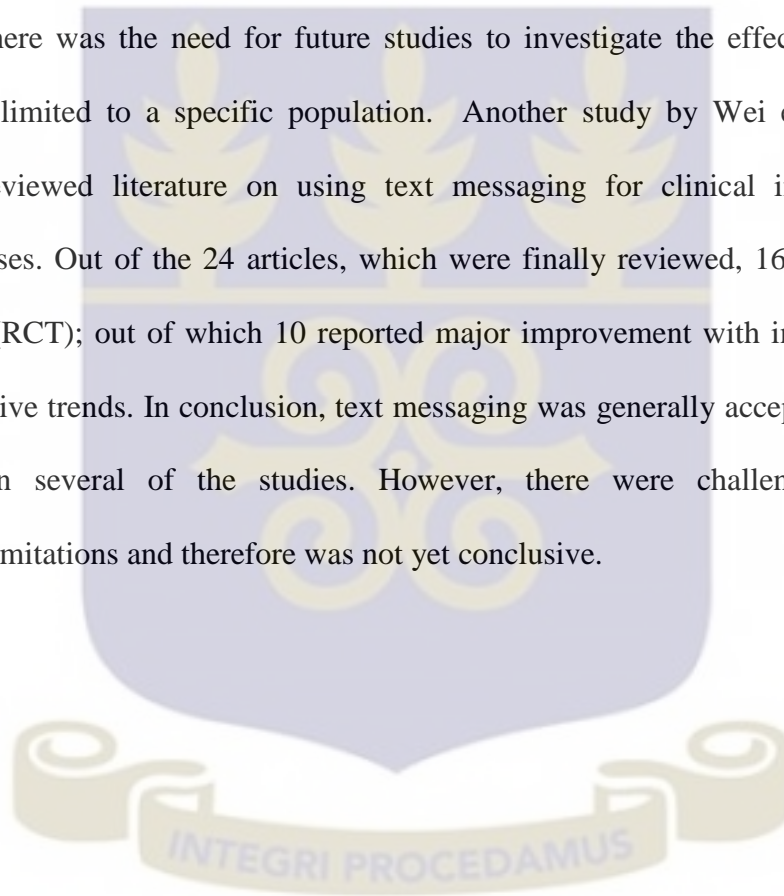
tools, varying according to the population, the subject matter and study length. Gribble et al., (1999) also suggest that study results are often challenged by sampling, participation and measurement biases, such as response bias (Gribble et al., 1999), recall bias (Gillmore et al., 2001; Jaccard et al., 2004; Schroder et al 2003), social desirability bias (Fenton et al 2001; Hanck et al., 2008; Hoppe et al., 2000); reactivity bias (Gillmore et al., 2001; Hoppe et al., 2000; Jaccard et al., 2004), fatigue and habituation effects (Fenton et al., 2001; Gillmore et al., 2001) and interviewer bias (Catania, 1999; Fenton et al., 2001). Respondent privacy, confidentiality, widespread availability of mobile phones, low cost of mobile phone technology, literacy and mobile phone use practices should also be important factors to consider preceding the use of mobile phone technology in data collection (Maumbe & Okello, 2013). This is to promote acceptance and effectiveness, which may determine the level of sustainability for such a technology in the context of data collection (Maumbe & Okello, 2013; Li et al., 2013). However Li et al., (2013) concluded from their findings that the text-messaging tool was feasible, low in cost, but had a low response rate.

Tomlinson et al., (2009) tested and explored the feasibility, the ease of implementation, and degree to which respondents with very little knowledge of data collection could be effectively trained in data collection using mobile phones. In the study, a web-based system was set up and linked to mobile phones using electronic surveys or questionnaires. Results from the study showed that there were no data loss and data fabrication was quickly detected due to real-time quality control and efficient supervision. In conclusion, the study confirmed the advantages and effectiveness of mobile technology, over PDAs in terms of data loss and uploading challenges, which offers mobile phones as a feasible method of data collection requiring further exploration.

In a previous study by Crankshaw (2010) in South Africa, the feasibility and acceptability for appointment reminders and adherence messages via patients' cellular phones was tested. Respondents were adults, 18 years and above who accessed treatment. A structured questionnaire was used for data collection of socio-demographics and also to determine mobile phone accessibility and patterns of use. Findings from the study indicated that a majority of respondents (81%) reported current ownership of a cellular phone. More females than men turned off their cell phones during daytime and were more likely to share their cell phone with others or leave it in a place where someone else could access it. The study concluded that mobile phone technology for intervention purposes was feasible and recommended further research into the essence of gender-based analyses in informing future outcomes.

In another study Anokwa et al. (2009) in Australia discussed that accurate and dependable data is one of the essential elements in the realization of goals by many institutions in the developing world. The study considered the challenges of existing tools and the rapid increase in mobile phone growth and its subsequent prospect for timely and efficient data collection. Here, the Open Data Kit (ODK) is tested for its efficiency and timeliness in data collection using cell phones. Conclusions from the study show that the tools are easy to use and may be used for larger populations. Previously, Anhoj & Moldrup (2004) in a randomized controlled study examine the feasibility and acceptability of mobile telephone short-message service (SMS) as a novel means of monitoring asthma episodes. Findings revealed and concluded that SMS is feasible, suitable, dependable, affordable, sustainable and safe means of telemedicine that could be used in asthma control.

In contrast to Anokwa et al. (2009) a study by Nelson et al., (2011) showed that although text messaging is a main form of communication globally, very little research has been conducted to evaluate its effectiveness. Using a clinical dental setting, respondents in the intervention arm, received a short message service (SMS) text message whilst the control group received a voice message. The study concluded that SMS text messages were not as effective as voice reminders for patients in the dental clinic and may not be the choice method of reminding patients about appointments. There was the need for future studies to investigate the effect of text message reminders when limited to a specific population. Another study by Wei et al., (2011) also systematically reviewed literature on using text messaging for clinical interventions from electronic databases. Out of the 24 articles, which were finally reviewed, 16 were randomized controlled trials (RCT); out of which 10 reported major improvement with interventions and 6 reported progressive trends. In conclusion, text messaging was generally acceptable and showed early efficacy in several of the studies. However, there were challenges in terms of methodological limitations and therefore was not yet conclusive.



**Table 7: Empirical studies on the feasibility, acceptability, sustainability and challenges of mobile phones in data collection**

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
1	Maumbe & Okello, (2013), South Africa	To determine the level of Information Communication	Review of literature.	Desk review of existing literature.	The emerging use of Information and Communication could improve the agricultural Sector.	These studies could be further extended to other sectors.
2	ITU, (2013), U.S.A.	To improve the accessibility and affordability of Broadband Internet services worldwide to usher in an inclusive information society.	Compilation of global reports.	Desk review.	According to ITU estimates, by end 2013 there will be 6.8 billion mobile-cellular subscriptions, almost as many as there are people on the planet; and there will be an estimated 2.7 billion people using the Internet worldwide.	As more and more people join the global information society, networks become an indispensable infrastructure, and remain as relevant as ever.
3	Li et al., (2013), China	To test the feasibility of using text messaging as against a paper-pencil tool for data collection.	Comparison of the response rates and acceptability levels of the two tools.	Frequencies of response rates and levels of acceptability were calculated.	The text messaging tool had a low response rate and low acceptability rates.	Further research is needed to evaluate effectiveness of methods that can improve the response rates and acceptability levels.
4	Heinonen et al., (2012), Finland	To evaluate the use of a mobile phone application for recording data.	Differences between the groups were assessed using t-tests for continuous variables.	Statistical analysis was performed using the Mann–Whitney test and the Kolmogorov–Smirnov test.	The mobile phone diary is an effective and usable tool for self-reported data collection.	In further studies more research on the usability of mobile solutions as a research tool in different subject areas is needed.
5	Bradley, (2012), South India	To evaluate technical and operational feasibility and user acceptability of mobile phones for data collection.	Evaluation of response rates and acceptability levels of the two tools.	Response rates and acceptability levels were estimated.	Response rates were high, with little evidence of biases. The methodology was highly acceptable	The success and wealth of data produced, indicates that it can be an important tool for gathering data in low literacy but high populations.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
6	WHO & UNICEF (2012), U.S.A	To test feasibility of mobile phone technology in data collection in achieving sanitation Millennium Development Goals (MDGs).	Compilation of country based global reports.	Desk review of literature.	It is important to improve on global sanitation data compilation.	There is the need to invest our mission for sustainable, equitable development with renewed vigour in creating a successful sustainable universal global future.
7	Zhang, (2012), China.	To compare smartphone data collection versus the use of pen-and-paper for infant feeding practices of the Maternal Newborn Child Health household survey.	Randomization of participants to either the smartphone or a pen-and-paper questionnaire group. A pair of interviewers simultaneously questioned mothers on infant feeding practices.	Inter-rater Reliability and frequencies for levels of acceptability were determined.	The smartphone method was acceptable to interviewers, and for data collection, compared with pen-and-paper, eliminated data recording and entry errors, had similar inter-rater reliability, and did not result in data loss.	Smartphone data collection should be further evaluated for other surveys and on a larger scale to deliver maximum benefits in China and elsewhere.
8	Bengtsson et al., (2011), Haiti.	To estimate the magnitude and trends of population movements during disaster management using mobile phones.	Geographic positions of SIM cards were determined by the location of the mobile phone tower through which each SIM card connects when calling.	Reports are produced from outbreak areas at its immediate onset and within 12 hours of receiving data.	To demonstrate feasibility of rapid estimates and to identify areas at potentially increased risk of outbreaks, we produced reports on SIM card movements from a cholera outbreak area at its immediate onset and within 12 hours of receiving data.	Results suggest that estimates of population movements during disasters and outbreaks can be delivered rapidly and with potentially high validity in areas with high mobile phone use.
9	DeRenzi et al., (2011), India.	To discuss common challenges and lessons learned about deploying mobile tool.	Comparison of existing literature.	Desktop literature view.	There is the need for a framework in which analysis of the different ways of data collection tools help strengthen existing systems	They can also address challenges in monitoring and supervising a large geographically based data collection.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
10	Hinckson & Duncan, (2011), New Zealand.	To assess the trends of data collection methods between 2004 and 2008.	Data were drawn from surveys conducted between 2004 and 2008.	Meta-analysis was conducted.	Existing data methods were effective although the mobile phone technology has huge potentials as for data collection.	In further studies the mobile phone technology may be efficient for large data collection.
11	Nelson et al., (2011), U.S.A.	To compare the feasibility text messaging and voice reminders as a dominant form of communication.	Respondents were randomly assigned to either the text messaging and voice groups.	The unadjusted odds ratio (OR) for the type of communication used was estimated.	Text messages were feasible but not as effective as voice reminders for patients for data collection.	Future studies should investigate the effect of text message reminders when limited to populations outside the university setting.
12	Pyke-Grimm et al., (2011), U.S.A.	To determine the feasibility, acceptability, and usability of collection method of Web-based multisite data collection using electronic instruments.	The test-retest method was used.	Statistical analysis demonstrated no evidence of systematic or clinically significant bias.	Web-based data entry is feasible and acceptable to respondents.	The use of this strategy in future intervention trials could improve decision-making.
13	Wei et al., (2011), U.S.A.	To test the feasibility and sustainability of text messaging in data collection. .	Systematic Review.	Desktop review.	Text messaging received good acceptance and showed early efficacy in most studies.	However, the evidence base is compromised by methodological limitations and is not yet conclusive.
14	Crankshaw (2010), South Africa.	To explore the dynamics and patterns of cellular phone use among this population, in order to ascertain whether clinic contact via patients'	Differences between the groups were assessed using t-tests for continuous variables.	Response rates and acceptability levels were estimated.	Cellular phones were a feasible and acceptable modality for appointment reminders and adherence messages.	The use of cellular phones for intervention purposes is feasible and should be further investigated.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
15	Mahmud & Nesbit, (2010), Malawi.	To test the feasibility of communication via text messages.	Estimation of response rates.	Test-retest technique was used.	The study showed that m-Health interventions can provide effective solutions to communication barriers in the setting of rural hospitals in the developing world.	The results of the retrospective mobile health (m-Health) pilot could eliminate several data collection limitations.
16	Anokwa et al., (2009). Australia.	To compare the feasibility of data gathering using mobile phones.	Estimation of response rates.	Test-Retest technique was used.	The study concludes that there are challenges of existing tools and the rapid increase in mobile phone growth and its subsequent prospect for timely and efficient data collection.	Accurate and dependable data is one of the essential elements in the realization of goals for dependable data
17	Fjeidsoe, (2009), Australia.	To compare paper reviews to mobile telephone short-message service (SMS) for health interventions.	Systematic review.	Desktop review of literature.	SMS-delivered interventions have positive short-term behavioral outcomes.	Further research is needed allow the full potential of this medium to be explored.
18	Tomilson et al., (2009).South Africa.	To investigate the feasibility, the ease of data collection using mobile phones.	A web-based system was developed to allow electronic surveys or questionnaires to be designed on a word processor, sent to, and conducted on standard entry level mobile phones.	Test-Retest technique was used.	The system permitted the early detection of data fabrication in combination with real-time quality control and data collector supervision.	The benefits of mobile technology, is a feasible method of data collection that needs to be further explored.
19	Hughes, (2009), U.S.A.	To explore the feasibility, the ease of data collection using mobile phones.	Two sets of surveys were conducted and response rates were calculated.	Test-Retest technique was used.	One of the benefits in using cellphones is its level of privacy.	From the results, cell phones could be an ideal medium for data collection.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
20	Krishna, (2009), U.S.A.	To evaluate the empirical evidence related to the role of cell phones and text messaging interventions.	Scientific literature was searched to identify controlled studies, which evaluated cell phone voice and text message interventions.	Desktop review of literature.	The findings that enhancing standard care with reminders, disease monitoring and management, and education through cell phone voice and short message service can help improve health outcomes and care processes have implications for both patients and providers.	Communication technologies can help in providing informational support for improving disease-related health outcomes.
21	Mishira & Singh, (2009), Italy	To assess the use of mobile phone technology in data collection.	Systematic review of several the classification of technologies currently used for m-Health globally.	Desktop review of literature.	The overall development of m - Health will be driven by the consumer demand, value added service by the mobile phone industry and health-care policy makers in the near future.	The use of m-Health could be an effective method of identifying and monitoring health issues, as well as guiding the formulation of health policies.
22	Patrick, 2009, U.S.A.	To evaluate a text message-based intervention designed to help individuals lose weight using mobile phones.	A mixed-model repeated-measures analysis compared the effect of the intervention group to the comparison group on weight status over the 4-month intervention period.	Analysis of covariance (ANCOVA) models examined weight change between baseline and 4 months after adjusting for baseline independent variables.	Intervention participants stated that they would recommend the intervention for weight control to friends and family.	Text messages might prove to be a productive channel of communication to promote behaviors that support weight loss in overweight adults.
23	Raine & Anderson, (2009), U.S.A.	To explore the future of privacy in terms of personal data collection using both mobile phone technology and the conventional paper tools.	Personal data collection was gathered from several experts.	Desktop literature review.	People's life experiences teach them that revealing their private information allows commercial organizations poised to target their needs.	The future of privacy in light of the technological change, ever-growing monetization of digital encounters,

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
24	Butterfloss et al., (2008), U.S.A.	To relate the constructs of communication structure and processes to coalition formation.	Systematic Review	Meta-analysis of existing literature was conducted.	Open an frequent communication enhances a positive organizational cli	Communication is key in the formalization of rules, roles, structures and procedures
25	Donner, (2008a), U.S.A.	To examine and compare paper reviews roughly 200 recent studies of mobile (cellular) phone use in the developing world and identifies major concentrations of research	Systematic review.	Meta-analysis of existing literature was conducted.	Determinants of mobile adoption often dwell on the impacts of mobile use, and from those focused on the interrelationships between mobile technologies and users.	The discussion considers the implications of the resulting review and typology for future research.
26	Donner (2008b), India.	To examine the current diversity of projects and approaches in mobiles for development	Systematic review.	Meta-analysis of existing literature was conducted.	Implications for the breadth and depth of the technology's impact on development largely rest on communication.	By focusing on choices that cut across domains, the highlights and elements, which vary, have not been observed to correlate with most project success.
27	Glanz et al., (2008), U.S.A.	To evaluate current applications of these communication theories in selected health promotion programs and interventions.	Compilation of chapters	-	Effective communication of programs could influence health behavior, including health promotion and education programs and interventions.	Important future directions for research and practice in health promotion and health education pivot on effective communication.
28	Hanck et al., (2008), India.	To compare the feasibility of a computer-assisted approach of data collection to a traditional paper approach.	A cross-sectional survey was conducted with respondents.	Multiple logistic regression analysis was used to test for response differences to questions	The study demonstrated a higher reporting of risky sexual behaviors and lower reporting of condom use, with no conclusive response patterns among sensitivity-neutral items.	The findings suggest that the computerized approach provides a promising technique for improving accurate data reporting.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
29	Koshy et al., (2008), India.	To compare Short Messaging Service (SMS) to the traditional paper collection tool.	Evaluation of response rates was estimated.	Total response rates and frequencies were computed.	The use of SMS reminders potentially offers an effective and efficient strategy to decrease non-attendance and so improve healthcare delivery.	The findings should be confirmed with a more rigorous study design before a wider roll-out
30	ITU (2008), U. S.A.	To highlight growth rates in the global mobile sector.	Compilation of global reports.	Desktop review of literature.	Despite high growth rates in the mobile sector, major differences in mobile penetration rates remain between regions and within countries.	A range of valuable online services specifically target the MDGs in areas such as e-government, e-education and e-health.
31	Lim, (2008), Australia.	To compare Short Messaging Service (SMS) to the traditional paper collection tool.	Comparison of the response rates and acceptability levels of the two tools.	Frequencies of response rates and levels of acceptability were calculated.	Text messaging could be an effective mode of communication, and this advantage can be used in the health sector.	Text messaging is likely to become more and more commonly used for data collection purposes, evaluation of its benefits and effectiveness is essential.
32	Minkler, (2008), U.S.A.	To examine the goal of enhancing the capacity of communication in health promotion.	Systematic review.	Meta-analysis of existing literature was conducted.	Effective communication increases participatory outcomes and effectiveness..	The communication research process, offers the opportunity to achieve “partnership synergy,”
32	Patrick, (2008), U.S.A.	To assess the usability and affordability of mobile phones.	Review of available reports.	Desk review of available literature.	Usability and affordability, is available in all settings such as low-income, rural, and remote areas.	Mobile phone technology may be considered for the delivery of healthcare services.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
33	Alder, (2007), U.S.A.	To discuss an overview of wireless technology in healthcare and how it is evolving.	An overview of wireless literature in health care.	Desk review of available literature.	Wireless technology in health care has evolved, and is available or now under development	Wireless technology enables effective monitoring, and supports potentially in the health care by making it available globally.
34	Jaspan et al., (2007), South Africa.	To compare the feasibility of self-administered paper questionnaires with Personal Digital Assistant (PDA) questionnaires to collect data.	Respondents were randomized into either the paper or the PDA group.	Kappa values for the two tools were estimated.	There was a high level of agreement between data collected via each method. Data collected from the PDA questionnaires were more complete.	PDAs may be a useful method to collect sensitive, self-reported information from adolescents in resource-limited settings.
35	Allen et al., (2007), Tanzania.	To compare electronic diaries and face- to- face paper interviews (FFPI).	Respondents were randomized into either the paper or the computerized diary group.	The Wilcoxon rank test, the McNemar test and the Kruskal–Wallis analysis of variance was used to compare frequencies.	Compared with FFPIs, electronic diaries resulted in higher reporting of socially stigmatized activities.	Electronic diaries may be considered in future for reporting of socially stigmatized activities.
36	Lasica, (2007), U.S.A.	To examine the ongoing digital information technology.	An overview of literature.	Desk review of available literature.	The new revolution on mobility for economic models for businesses and governments, social services, economic development, and personal identity has escalated.	There could be profound changes ahead as a result of the convergence of wireless technologies and the Internet.
37	Kollman et al., (2007), U.S.A.	To evaluate the feasibility and user acceptance of a mobile phone-based data service.	A software application was developed to support related data with synchronization to the remote database at the monitoring center.	Frequencies of response rates and levels of acceptability were calculated.	The mobile phone seemed to provide a ubiquitous, easy-to-use, and efficient solution for data acquisition.	Further research has to be done to study the long effectiveness of mobile phones.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
38	Kaplan, (2006), U.S.A.	To examine whether fixed and mobile telephones is, or could be, an effective healthcare intervention	A Web-based and library database search was undertaken.	Desktop review of literature.	Mobile phones may be an enhancement to data collection in terms of stigma and privacy.	It is difficult to generalize because of the different outcome measurements and should be further researched.
39	Wallerstein, (2006), U.S.A.	To evaluate the goal of enhancing the capacity of communication in health promotion.	An in-depth literature review of the philosophical principles and the complex realities of evaluations.	Desktop review of literature.	Effective communication of programs could the success of interventions.	Future research and practice in health promotion and health education pivots on effective communication.
40	Ferguson et al., (2006), Kenya.	To evaluate the feasibility and user acceptance of a mobile phone-based data service.	Outcome variables frequencies and means were measured.	Frequencies of response rates and qualitative quotes were calculated.	The study affirms the value of diaries as an elicitation method for data collection in a resource-poor setting.	The use of diaries largely could circumvent conventional methods where sensitive information is being sought.
41	Ball et al., (2005), Australia.	To examine the feasibility and effectiveness for a telephone-mediated intervention.	Respondents were randomized to either the print or print-plus-telephone mediated intervention group	The test-retest method was employed.	Measures of self-reports showed increases for the intervention groups.	The telephone-mediated intervention could be an effective data collection tool.
42	Anhoj & Moldrup, (2004), Denmark.	To evaluate the feasibility of using short message service (SMS) for diary data collection through mobile phones.	The study included quantitative response rate data, and data from a focus group discussions.	Frequencies of response rates and qualitative quotes were computed.	The mobile phone was feasible and acceptable as a tool for the self-monitoring and data collection.	The mobile phone may be used as a tool for the self-monitoring and data collection.
43	Jaccard et al., (2004), U.S.A.	To test the accuracy of self-reports.	Self-reports of the number of partners were obtained on a weekly basis.	The test-retest method was used.	From the results accuracy rates of recall was relatively high.	Accuracy rates may vary for respondents and were found to be relates to one's propensity in a recall bias.

No	Author, region & year	General Objectives	Overview of methods	Analytical technique	Key Findings	Recommendations
44	Graham et al., (2003), U.S.A.	To test the authenticity of self-reports.	Generally, reports of the number of partners were obtained on a periodic basis.	The test-retest method was used.	From the results biases were relatively low.	Recall bias should be mitigated in self-reported research.
45	Schroder et al., (2003), U.S.A	To examine the role of recall biases in non-responses.	Overview of literature was done.	Desk review of literature was conducted.	Recall biases may be inevitable in some self-reports.	Generally, recall biases could be eliminated to minimize non-responses.
46	Gillmore et al., (2001), Switzerland.	To systematically examine whether different methods of data collection are more prone to fatigue and social desirability effects.	Respondents were randomly assigned to either a self-administered diary condition or a telephone-administered interview.	The test-retest method was used.	Daily data collection occurred over a sufficiently long period (8 weeks) to allow some types fatigue effects	Fatigue effects could result in response decay for both socially desirable and socially undesirable data.
47	Fenton et al., (2001), Sweden.	To assess the methodological challenges in computer survey research.	Overview of literature was conducted.	Desk review of literature was performed.	All epidemiological research aims to achieve accuracy in estimation.	Strategies for reducing measurement error may include a number of Computer-assisted techniques.
48	Hays et al., (2001), U.S. A.	To evaluate the level of ease and satisfaction of data collection of three diary designs and a phone-in regimen.	A self-completed questionnaire at the end of the study collected comparative retrospective data.	The test-retest method was conducted.	Respondents assigned to the electronic diary group expressed dissatisfaction with the design and were worse at recalling data at the end of the study.	The phone-in diary was associated with greater accuracy.
49	Hoppe et al., (2000), U.S.A.	This article compared two methods of collecting daily data: self-administered diaries and telephone interviews	Respondents were randomly assigned to either the written diary or the telephone interview conditions	Frequencies of response rates and qualitative quotes were computed.	Telephone response rates did not differ from that of self-administered diaries.	The two methods of collecting daily data could be effective in data collection.
50	Gribble et al., (1999), U.S.A.	To examine interview modes, measurements, methodological issues.	Overview of literature was conducted.	Desk review of literature was performed.	Telephone interviews also imposed considerably higher numbers of biases.	Reducing response bias could contribute to a better understanding of the prevalence and patterns of behaviours.

## **2.7 Challenges of global sanitation monitoring and evaluation**

Monitoring and evaluation of sanitation is vital for ascertaining the real effectiveness of sanitation related projects. Donors and funding agencies, which run sanitation projects related to targeting the MDGs, need a feedback of the extent of progress of these sanitation projects (WHO & UNICEF, 2010a). Several governments may also target this feedback progress report for sound sanitation policies. However, this is also reliant on the reliability of the data collected, the efficiency of the monitoring systems in place and the effectiveness of the evaluation processes.

The challenges of global sanitation monitoring include poor linkages between the different monitoring levels (JMP, 2011). It also involves the use of diverse specifications across various countries where different measurements are done in defining sanitation issues and trends (WHO & UNICEF, 2012). The essence of relating local, national and global levels is important and means that, global indicators must translate into national policy-making processes. There is also the need to standardize and agree on how measurements should be done and monitored to relate to the particular setting. Another challenge is in the definition and classification of the particular setting; whether it is urban, rural or peri-urban. These difficulties in definitions, impact negatively on monitoring and evaluation of sanitation progress towards the sanitation targets for MDGs. This implies that various monitoring systems at different levels need to be examined and reviewed. As well, survey types, supporting monitoring methods and existing data sources and tools such as the DHS and MIC need to be standardized to ensure reliability, validity and accuracy of data. Also, to ensure sustainability, the cost-effectiveness of monitoring sanitation indicators cannot be overlooked. Continuous efforts are being made to formulate indicators, which have been limited by these country specific measurements. An example is the assessment

by WHO and UNICEF (2000) on global water supply and sanitation with the aim to standardize the indicators.

Efficient monitoring mechanisms are therefore key for the formulation of good policies, planning frameworks and successful implementation interventions in the sanitation sector. Country data must be accurate, obtainable and regularly reviewed so as to inform the decision-making process. However, the unavailability and insufficiency of technical capacity, at most levels and evaluation monitoring is a huge challenge. As a result a majority of existing sanitation monitoring and evaluation systems have complex databases.

### **2.8 The Joint Monitoring Program role in global sanitation monitoring and evaluation**

The UN assigned the World Health Organization (WHO) the role of reporting on progress in access to water supply and sanitation services during the International drinking water Supply and Sanitation Decade, from 1981-1990. Prior to 1990, data on water and sanitation were provided regularly by WHO based on information gathered by country agencies and ministries of health through questionnaires (WHO & UNICEF, 2010). Consequently, WHO and UNICEF launched the Joint Monitoring Program for Water Supply and Sanitation (JMP) in 1990. The first two reports of the JMP, focused on the status of national monitoring supported by the JMP. The data showed the situation at the end of 1991 and status as of 31 December 1994, relying on information provided by the Demographic Health Survey (DHS) and the Multiple Indicator Cluster Survey (MICS) (JMP & WHO, 2008; JMP & WHO, 2010). To further improve this, the JMP has worked with several countries to develop a common understanding of monitoring methods, examine the probability of harmonizing monitoring approaches and encourage greater

collaboration among national agencies; as well as between national agencies and JMP. Once definitions are clarified at national level, it is possible to make national and JMP definitions correspond better. The JMP objective is to ensure comparability between countries (World Bank, 2010, 2014). Yet, attempts by JMP to reconcile data have been greatly hampered by the unconventional platforms of the different approaches used by different countries. However, it is not within the JMP's mandate or capacity to set definitions and methods in every country. JMP therefore continues to collaborate with other country-based organizations to pursue this task (JMP & UNICEF, 2010).

Currently, the National Statistics Office (NSO) in each country is responsible overall for national data. However, individual line-ministries responsible for actual service provision also have their own monitoring mechanisms. These NSOs mostly rely on household surveys and census data, for tracking progress of the sector. At country level, however, differences may be observed in the figures on sanitation facilities presented by different agencies, which translate into differences between these national estimates and those at the MDG level. This is because different line ministries have various actors in charge of national monitoring. For instance, some national definitions such as basic sanitations may be actually shared facilities, which are not improved facilities by JMP's definition. Thus, it is common to find different measurements and aspects of sanitation using varied definitions; intended for different national uses and platforms (JMP & UNICEF, 2010). In the analysis of national data, the definition of population density by JMP is significant because it characterizes the number of people in a location, therefore the total populations used, as denominators should be well defined. Denominators for the same country could vary depending on the data source, as may be the case for DHS and MICs. For some

country surveys, the estimates are centered on the provider-based data which focuses on coverage and the number of facilities built; rather than user-based data which provides information on the actual use of sanitation infrastructure, resulting in different estimates. Therefore it is important to have an agreement or a consensus on what is being measured for various parameters, so as to ensure comparability. The accuracy and validity of sanitation data also relates to the clarity of definitions by enumerators who collect the data and how that data is classified and applied. It is also challenging for most governments to disaggregate sanitation data from that of water since the two components are usually combined in same programs. In the same way, funds for both sectors are often lumped together in budgets and distributions, thus providing donors and recipient governments scanty information on how much is spent on sanitation.

The JMP also uses different household surveys as data resulting in lack of information on usage of improved sanitation facilities in public places such as schools, hospitals and marketplaces for certain groups who spend time in these locations. This gap in global M&E for sanitation is significant and needs to be addressed.

## **2.9 Importance of reliable data**

Many low and middle-income countries as a prerequisite must produce reliable and dependable data to receive funds and aid (UN, 2011; World Bank, 2013). This is because donors currently readily fund countries that produce reliable data on projects, which are monitored and also helps in evaluating the successes of such projects. It also allows for the accountability on how funds were disbursed. Thus, although more reliable data is important, many countries are poorly

equipped to meet this. For instance as a way of addressing health problems in developing countries, donors require the number of persons dying or experiencing such health events. Non-provision and poor generation of reliable data greatly affects sound policy decisions, since weak sanitation sectors often stem from weak information gathering (Schwartlander, 2001). According to Schwartlander (2001) over 90% of low-income countries lack well-functioning data and information systems, which are fundamental for the creation and generation of basic data. Schwartlander defines an information system as a compilation or set of statistics from different sources, for the purpose of obtaining information about the status, provision and use of the particular services, and the impact on the general population's health. From the definition, the first aim of a sanitation data and information system is to identify the sanitation issues so as to inform all programme designs and policy choice. In addition, it helps to forecast future sanitation related scenarios and finally to monitor and evaluate the implementation of these sanitation policies.

Yet, for most low-income countries the problem lies with the absence of sanitation data and information systems from the planning stage through to the budgeting and implementation stages. As a result, decision makers are unable to identify problems and needs and track progress, evaluate the impact of interventions and make evidence based decisions on sanitation policies, programme design, and resource allocation. Therefore the WHO along with UNICEF on the JMP platform in a global partnership and collaboration with all countries aims to tackle the challenges of data and information low-income countries. This is in an effort to assist those countries and governments in building sanitation data systems which will assess the current status, identify gaps, and develop a national plan for improving the data information system

(Presser et al., 2004). The whole initiative is that efforts to improve on these data information systems within countries would be financed by resources in the countries themselves so as to ensure their sustainability. Helping countries build and sustain data systems can be challenging and one way to address this would be for WHO and UNICEF to promote systems that are appropriate to the infrastructure, technological capacity and budgets of these sanitation sectors.

In the poorest countries, it might be helpful to design and implement and sustain a simple pencil-and-paper based information system which contains reliable data and, therefore, more likely to be used by policy-makers at different levels. For such countries innovations such as launching directly a nationwide, computer-based information system which is vulnerable to power failures, software crashes and inadequate Information Technology (IT) skills of sanitation personnel is a high-risk strategy. Conversely, in larger federal states, testing with different types of data information systems in different parts of the country helps to find the best option in terms of sustainability and acceptability. To enhance their own capacity also implies that countries must link the sustainability of such systems to their preparedness to invest in these data information systems.

The development of a framework that countries can use as a guide could be informed by experiences from other countries. Male-Mtikasa (2005) agrees that low-income countries need to develop data information systems to measure results in line with MDG sanitation goals.

The commitment to achieving these sanitation targets increasingly recognize that effectiveness is highly linked to a country's willingness and capacity to generate and manage data which is

fundamental to the entire development framework with the greatest impact on reducing mortality and disability. Since databases are tools for collating and analyzing data and information there is the need for a sound network and collaboration among other national data and information agencies such as DHS, GSS and the MICs (GWSP, 2010; WHO & UNICEF, 2010).

### **2.10 The role of incentives in non-response surveys**

According to Abraham et al., (2009), nonresponse bias is highly unaffected by a growing non-response rate. Keeter (2000) affirms that this holds valid for several topics in research studies. Curtin et al. (2000, 2007), and Merkle & Edelman (2002) suggested only a weak relationship between nonresponse and bias. This is supported by Groves (2006) in a meta-analysis who argues that that majority of the variables in research studies are only weakly associated with the cause of nonresponse. Knack, (1992) explains that there are two major factors affecting response rate which are the extent of making contact with a respondent and the willingness to participate.

In addition, factors such as social integration and sense of responsibility also affect response rate. Cantor et al. (2008); Singer, (2002); and Singer & Kulka (2002) argue that in recent research studies, the emphasis is mostly on short-term incentive effects on response rates without much attention to ethical issues. Porst & von Briel (1995) argue that interest in the topic, respect for organization, length of survey topic, length, interest in results and intrusion of privacy are commonly mentioned as reasons for non-response or non-compliance. Consequently the question of why and when incentives become useful is explained using the theory of reasoned action as illustrated by the studies of Ajzen & Fishbein (1980) and Fishbein & Ajzen (1975) the decision on a course of action is determined by how much the profitability of the act outweigh the costs.

Singer, (2010) argues that monetary incentives are predominantly convenient in reaching to the sample respondents who previously were interested in responding or compliance. However, he emphasizes that monetary incentives should be a last option for any study. Mann et al., (2008) suggested in their study that parents receiving incentives were more likely than those receiving no incentives to comply since parents receiving incentives responded more quickly to the study. Findings by Beydoun et al., (2006) also revealed that combining prepaid and promised incentives produced greater responses in comparison to promised incentives only.

In contrast, Cobanoglu & Cobanoglu (2003); Deutskens et al. (2004); Göritz (2006b) and Marcus et al. (2007) argued that incentives did not markedly increase response rates. Bosnjak & Tuten (2003) found that the incentive arm had a considerably higher response as compared to the non-incentive arm. Göritz (2006a) also suggests that incentive may not be cost-effective. Dirmaier et al. (2007); Teisl et al (2005); Petrolia & Bhattacharjee (2009); Curtin et al. (2007); and Cantor et al. (2008) found no effect of incentives on nonresponse.

## **2.11 Conclusion**

This chapter has reviewed literature on defecation practices in general and approaches to end open defecation in particular. It also reviewed the validity, reliability, cost effectiveness, cost minimization and feasibility of the two survey tools in terms of data collection. Furthermore, it reviewed literature on the two-way SMS text messaging using mobile phones as defecation practice survey tools as compared to that of paper. The chapter further discussed the global sanitation policies and challenges of global sanitation monitoring and M & E approaches. Finally, the methodological approach to sanitation data collection in general was also examined.

In reviewing the literature, there were some gaps identified, which this study seeks to fill. The identified gaps in literature and what the study seeks to fill are as follows:

- There was paucity of empirical studies on the determination of validity alone. Most studies on validity combined evaluations of validity and reliability. As such, this study will determine validity alone by comparing the construct validities of the two M & E survey tools.
- Similarly, there were no of empirical studies on the determination of reliability alone. Most studies on reliability combined evaluations of validity and reliability. As such, this study will determine reliability alone by using the test-retest method.
- Though there were varied methods in the use of mobile phone as an M & E survey tool, there was no literature the use of mobile phone SMS text messages in sanitation. Hence, this study will provide the opportunity to use mobile phone technology for sanitation data collection.
- Again, no literature was identified on the comparison of cost between the paper based and mobile phone as M & E survey tools. Thus, this study will compare the cost between the paper based and mobile phone technology survey tools.
- In spite of the assertions from various studies on challenges with the use of paper based survey tool, no study emphasized the strategies to mitigate the limitations. Rather, these studies compared the paper based M & E survey tool against other M & E survey tools. Similarly, this study will test the paper based M & E survey tool against the mobile phone M & E survey tool.

- Although there was review on cost-effectiveness, the study adapts the cost-minimisation principle as the type of economic evaluation since there were no measurements prior to the intervention to be compared to an effect after the introduction of the intervention.



## CHAPTER THREE

### 3.0 METHODS

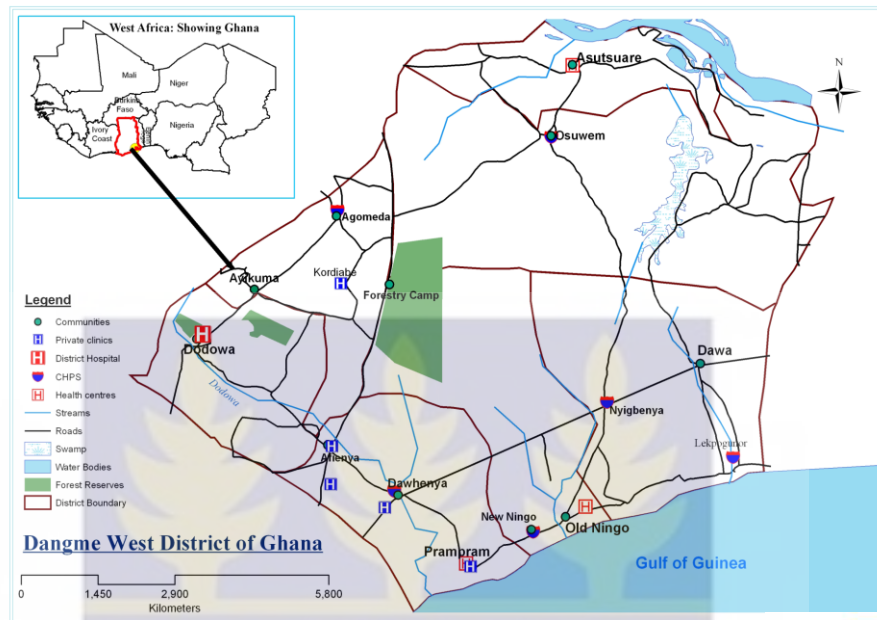
Chapter three outlines the study area, study design, study population, study variables, sampling procedures, data collection tools used, data quality control, data analysis, ethical considerations and limitations of the study.

### 3.1 Study area

The Ningo-Prampram District located in the Greater Accra Region of Ghana is mainly rural although it is rapidly urbanising. Formerly named the Dangme-West District, it lies between 5°45' South and 6°05' North, and longitude 0°05' East and 0°20' West and has a total land cover of 1442 km<sup>2</sup> as shown as in Figure 3. The major rainy season is from April to June and the minor season from August to November. The district is divided into four health sub districts that are Shai (Dodowa), Great Ningo, (formerly Old Ningo), Prampram and Osudoku (DHRC, 2009). The district's population is estimated to be 122,836 in 2010 at an annual growth rate of 2.1 based on the 2000 population census (DHRC, 2011). DHRC (2011) approximates the population to 123,000 with 22,360 households within 13,496 houses in the district's 376 communities. The average size of a household is 4.8 and about 38% of household heads are female with 13% of the population between 0-4 years old (DHRC, 2011).

***Ethnicity and religion:*** Predominantly, its ethnicity is the Dangme ethnic group although there are the Ewe, the Akan, the Sisala, the Dagomba and a minority population from other ethnic groups. Over 80% of the inhabitants are Christian with the rest ascribing to Islamic, Traditionalist, and Spiritualist beliefs (DHRC, 2011).

**Figure 3: The study site map of Dangme - West District of Ghana (2009)**



Source: Dodowa Health Research Centre, 2009.

**Social infrastructure:** There are main highways, which connect the Ningo-Prampram to Accra, Akosombo, and Aflao-Lome. However, there are some major roads, which are untarred. Travel is often by foot, bicycle, or commercial buses when available. In the rainy season, the roads linking the villages become inaccessible. The District Assembly serves as the local government authority in collaboration with the health administration, which is the District Health Directorate (DHDSS, 2011). Each of the sub-districts has a health centre with six community clinics located in various parts of the district. The district currently has a hospital and nine CHPS zones. About 30% of the communities in the district have electricity. There are no fixed telephone lines and

mobile phone use is predominant. The main economic activities and occupation are subsistence farming, fishing petty trading and artisan work (DHDSS, 2011).

***Education and literacy:*** Over 50% of persons above 15 years were illiterate in 2005. The Ningo-Prampram District Directorate of Education manages 79 primary schools with 3,307 pupils, 55 Junior Secondary Schools with 5,215 attendees and 2,399 students attending the three local Senior Secondary Schools. There are currently 35 public pre-schools and 50 private pre-schools in the district (DHDSS, 2011).

***Water and sanitation:*** The Community Water and Sanitation Agency (CWSA) is collaborating with DANIDA in the provision of toilet facilities in the majority of these schools. However the lack of water in certain communities is a barrier to the practice of good hygiene. The District has identified the inadequate supply of potable water and poor drainage and unsanitary conditions, as priority needs to improve the living conditions of the people (DHDSS, 2011). The district relies mainly on groundwater supplies pumped through boreholes to inhabitants though about 34% of the district population has no access to potable water and only 6% receive pipe borne water. The sanitation situation within the district reflects the rural peri-urban paradigm with 26% of households equipped with pit latrines or flush toilets. The majority relies on public trench latrines or the Kumasi Ventilated Improved Pit Latrine (KVIP) (DHDSS, 2011).

### **3.2 Study design**

The study was a comparative, prospective cohort study. The study compared the defecation practices of respondents using mobile phone Short Message Service (SMS) as against paper

based survey for monitoring sanitation. The study also compared the validity, reliability, cost, effectiveness, cost-effectiveness cost minimization and feasibility of using mobile phone SMS as against the paper based survey.

### **3.3 Study population**

The study population was made up of mobile phone users aged 18 years or more. The study population was also captured in the DHDSS 2011 and available throughout this study period. The DHDSS 2011 was based on a baseline survey conducted in 2011 in the then Dangbe West District (DHDSS, 2011). This population was used as the sampling frame of the study. The inclusion criteria were household representatives who had access to mobile phones on daily basis, were 18 years and above, resident in Prampram and were willing to participate. All household representatives who did not have access to mobile phones were excluded.

### **3.4 Study variables**

The dependent variable of the study was defecation practices of the respondents for both M & E survey tools. This was in terms of using either an improved or unimproved toilet facility in Prampram in the Ningo-Prampram District. The independent variables examined for their effect on defecation practices were sex, age and socio-economic status (i.e. in terms of household assets quintiles).

### **3.5 Sampling**

#### **3.5.1 Sample size determination**

All sample size calculations were done based on an assumed expected frequency of 50% response rate (by default) and worst assumed expected frequency of 40%.

##### ***3.5.1.1 The mobile phone SMS sample***

The household population with mobile phones in Prampram in the Ningo-Prampram District as at 2011 was 4195 (DHDSS, 2011). A baseline survey on defecation practices in 2011 showed that most respondents (61%) practiced open defecation whilst a few (11%) used public VIPs (Spencer, 2012). Assuming a 10% difference between the cohorts (61% and 71% open defecation) to be a real difference, which is not caused by random variation (chance): a sample size of 352 was calculated with a power of 80% and a significance level of 5% using Epi Info Statcal software. A 30% allowance was also made for non-response considering the fact that the mobile phone M & E survey tool was new. This gave a rounded sample size of 458 household representatives, which were randomly selected and used as study units. The randomly selected 458 household representatives were randomly divided into two equal cohorts: 229 household representatives were assigned to the mobile phone SMS cohort and the other 229 to the paper based cohort as described in 3.5.1.2.

##### ***3.5.1.2 Paper based sample***

There were three paper based samples for the study. The first was across all four quarters of the study, the second was at the end of the first quarter whilst the third was at the completion of the fourth quarter (a quarter being a three month period).

*First paper based sample:* Similar to section 3.5.1.1, a set of 229 randomly selected household representatives were grouped in the paper based cohort. The same questions in the mobile phone SMS questionnaire were presented on this paper based questionnaire.

*Second paper based sample:* For reasons of non-response, a second paper survey was conducted. At end of the first quarter, a total of 190 non-responses in the mobile phone SMS cohort were obtained. Using this as a sampling frame and assuming an expected frequency of 50% and a worst expected frequency of 40%, a sample size of 128 was calculated with a power of 80% and a significance level of 5% using Epi Info software. A 10% allowance was also made for non-response, giving a rounded sample size of 140 household representatives.

*Third paper based sample:* The third paper based survey was to answer for reasons of non-response, acceptability, ease of use and challenges encountered with the two survey tools. This study was conducted after the fourth quarter. Out of the selected 458 household representatives, a total of 445 had used both survey tools. Assuming an expected frequency of 50% and a worst expected frequency of 40%, a sample size of 207 was calculated with a power of 80% and a significance level of 5% using Epi Info software. A 10% allowance was also made for non-response, giving a rounded sample size of 227. The household representatives were then randomly selected.

### ***3.5.1.3 Focus group discussions***

A total of 32 focus group discussions (FGDs) were conducted throughout the study. Sixteen formative FGDs were conducted before the start of the study. The second set of sixteen FGDs

was at the end of the fourth quarter to find out reasons for their non-response to mobile phone M & E survey tool.

*Before the study:* A field guide and assistant was also used in the selection of household representatives at the community level all for FGDs. A total of sixteen focus group discussions (FGDs) were held with household representatives in each of the four communities. Each FGD lasted between forty-five minutes to one hour, and the number of household representatives ranged from 8-12 people. For each community, 4 different FGDs were held. The categories were young males between 18-30 years, young females between 18-30 years, adult males 30 years or more and adult females 30 years or more.

*At the end of the study:* At the end of the fourth quarter, 16 more FGDs (4 per field site) were conducted with the selected community members who had used both tools to answer for reasons of non-response, acceptability, ease of use and challenges encountered with the two survey tools. For each community, four different FGDs were held. The categories were young males between 18-30 years, young females between 18-30 years, adult males above 30 years and adult females 30 years and above. Each FGD lasted between forty-five minutes to one hour, and the number of household representatives ranged from 6-12 people. A digital recorder was used to capture all the discussions.

#### ***3.5.1.4 In-depth interviews***

A total of 45 in-depth interviews (IDIs) were conducted. Key Informant Interviews were conducted with one traditional or opinion leader in each community and the District

Environmental and Sanitation Officer. Forty of the IDIs were done during the second quarter. This was to answer for reasons of non-response within the first quarter.

*Before the study:* Five IDIs were conducted prior to the start of the study. Four of these IDIs were conducted with key opinion leaders in each of the four communities and one with the District Environmental and Sanitation Officer. This was done using a structured and unstructured interview guide. All key informants were purposively selected.

*During the study:* At end of the first quarter, a total of 190 non-respondents in the mobile phone SMS cohort was obtained. Using this as a sampling frame and assuming an expected frequency of 50% and a worst expected frequency of 40%, a sample size of 128 was calculated with a power of 80% and a significance level of 5% using Epi Info software. A 10% allowance was also made for non-response, giving a rounded sample size of 140. However, only 40 non-respondents were interviewed. Ten adult men 30 years or more; 10 adult women 30 years or more; 10 young men 18-30 years and 10 young women 18-30years were selected for the interviews. All interviews were recorded on a tape recorded after written and verbal permission had been sought and respondents had given their consent.

#### ***3.5.1.5 On-site observations***

A total of 40 observations were carried out within the study. These observations were carried out between the hours of 5am to 7am. For purposes of determining the practice of open defecation in all 4 communities households were divided into the four communities using the DHDSS 2011 round update as sampling frames. Five households from each community were randomly

selected also by balloting with replacement. This was in addition to each of the 5 households previously selected for the survey from each community at the start of the study for observations of open defecation. Thus a total of 40 households were selected for the observations. To strengthen the validity of the data, there were 3 observations of selected households in communities within the study area on a randomly selected day once every month. A checklist was used to note open defecation in each of the 4 communities selected. Photographs were taken of relevant open defecation sites. Again notes were taken while observing and field notes later documented.

### **3.5.2 Sampling procedure**

There were various sampling procedures for the mobile phone SMS survey, paper based survey, FGDs, IDIs and observations.

#### ***3.5.2.1 Mobile phone SMS sampling***

Multistage sampling was done in three phases for the mobile phone SMS survey, namely phases 1, 2 and 3 as shown in Figure 4.

*Phase one:* First, based on the results obtained from the DHRA (2011) data for Prampram, 4195 households were calculated using the inclusion criteria. Next, 458 households in Prampram were stratified into 4 communities of Olowe, Kley, Upper East and Upper West using their proportions in terms of their population sizes.

*Phase two:* This was followed with the random selection by balloting with replacement of the 458 household representatives; which were randomized into either the paper based survey or mobile phone SMS survey in each of the four communities. Randomization was done by using the Microsoft Excel. The randomization process was done by enlisting all respondents in Microsoft Excel. The first cell of the second column was highlighted and '= RAND ( )' typed in and then the 'enter' button clicked.

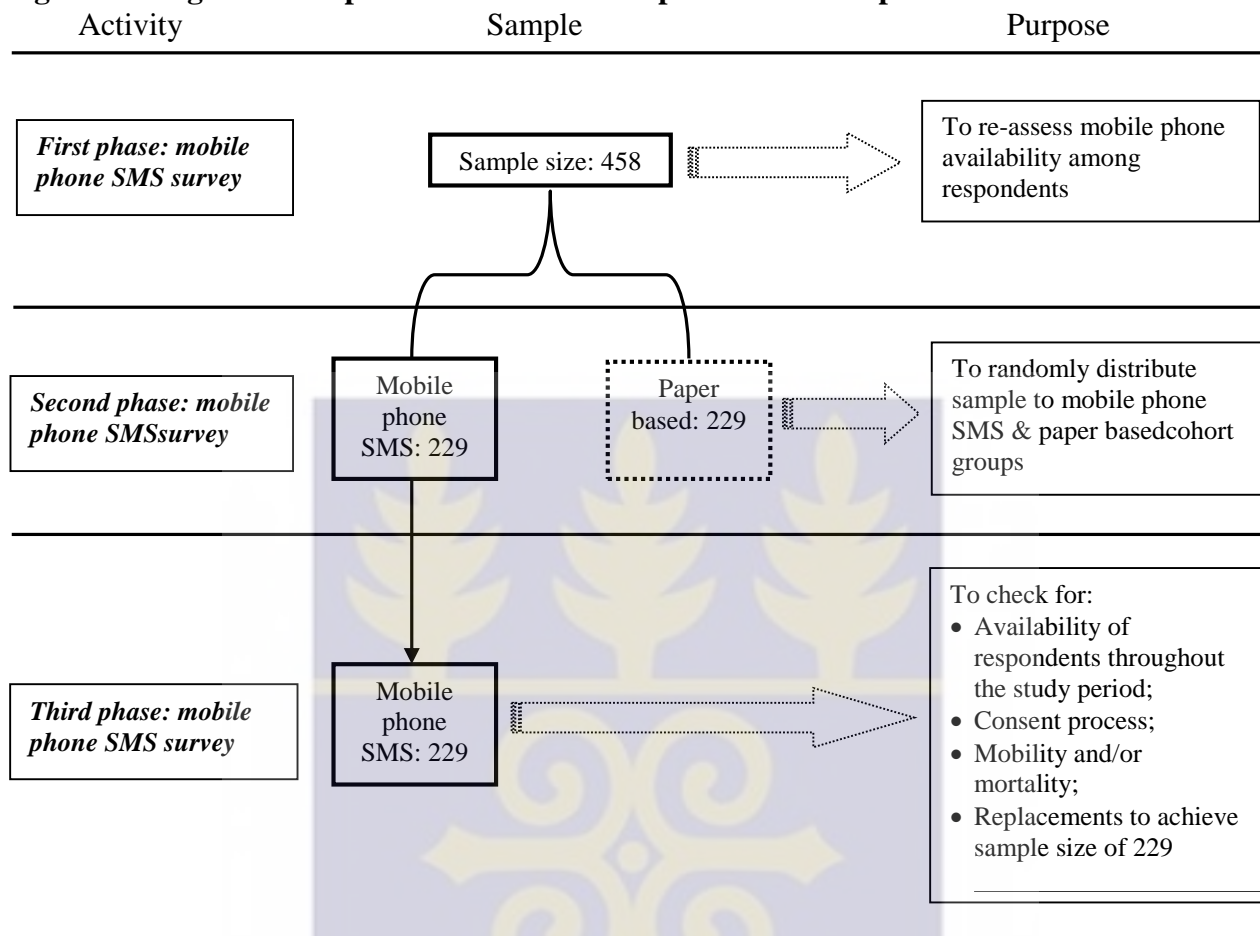
Next, a number appeared in the first cell of the second column and then dragged from the corner to the last cell still in the second column. A data icon that popped up and finally the icon 'sort' was in the last column for the mobile phone number. Thus a total of 229 household representatives were selected for each paper based and mobile phone SMS survey for all four-study quarters.

*Phase three:* To make up for the sample size, a visit was made to all the selected 229 mobile phone cohort households, prior to study. This was to (1) enquire if they still had access to the mobile phone, (2) confirm whether they were resident in the community and (3) to confirm their availability throughout the study. Household representatives who did not have access to the mobile phone on a daily basis were excluded from the study. New household members were then recruited to make up the sample size in cases where selected household representatives had no (1) mobile phone, (2) had moved and (3) had died. Those who agreed to take part in the survey consented by completing and signing consent forms. Their mobile phone numbers to which they have access were collected and recorded. Finally, the name, sex and age of the household representatives were crosschecked and confirmed using the DHDSS 2011 data.

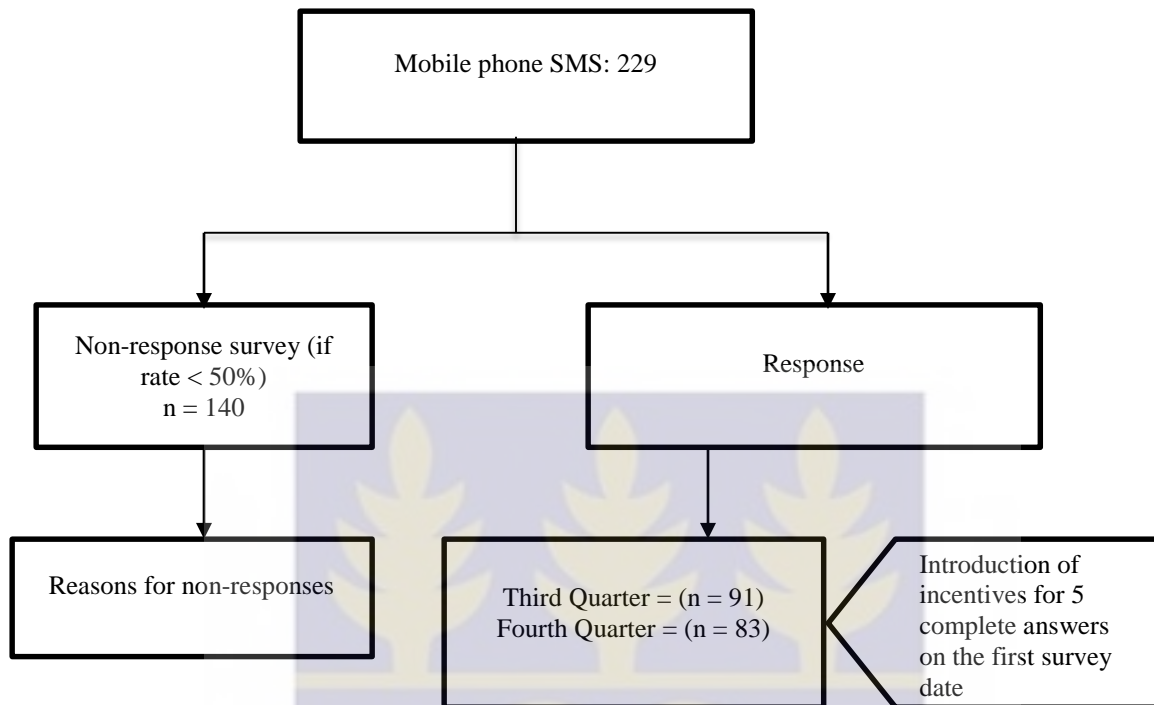
Respondents who answered all questions were coded as 01. The survey for the quarter was completed when all 5 questions were answered (Appendix 5). Otherwise the selected respondent is given another opportunity to complete all 5 questions on a second or third date within the same quarter. In cases where respondents did not respond or partially responded to the 5 questions on all 3 dates, a code of 02 was assigned. This implied non-response for the quarter. A code of 03 was assigned for all for all responses, which failed due to technical problems on the mobile software. All questions were to be answered by 11:59 pm on the same day. No further action was taken after the third SMS attempt for that quarter.

In the mobile phone SMS survey, three contact dates in each quarter were randomly assigned for each respondent. Three dates were assigned on the assumption that a non-response on the first date meant another opportunity on the second date. Similarly, a non-response on the second date meant that the respondent needed be contacted again on the third randomly chosen date. For each respondent, contact was terminated for that quarter when there was either a response to the survey or a non-response after three attempts. The randomisation into the two cohort arms was repeated for every test quarter. In addition, the subsequent assigning of survey visit days for all respondents was also repeated for every quarter. This was in an effort to addressing the major objective of comparing the two survey methods.

**Figure 4: Diagrammatic presentation of mobile phone SMS samples**



Incentives for the mobile phone SMS cohort were manually done by reimbursing the respondents with phone credits. A first incentive package of one Ghana Cedi (GHS 1.00) phone credit was introduced for all respondents in this cohort only. This was for all the four study quarters. Under the mobile phone SMS survey, another survey for non-response was conducted for scenarios of a 50% non-response or more; followed by the use of incentives as shown in Figure 5. In addition, a second incentive package of five Ghana Cedis (GHS 5.00) in phone credits was introduced. This was only in the third and fourth quarters. The second incentive package was given to mobile phone respondents who completed all 5 questions on time. Data were collected on all days of the week.

**Figure 5: Diagrammatic presentation of mobile phone survey process**

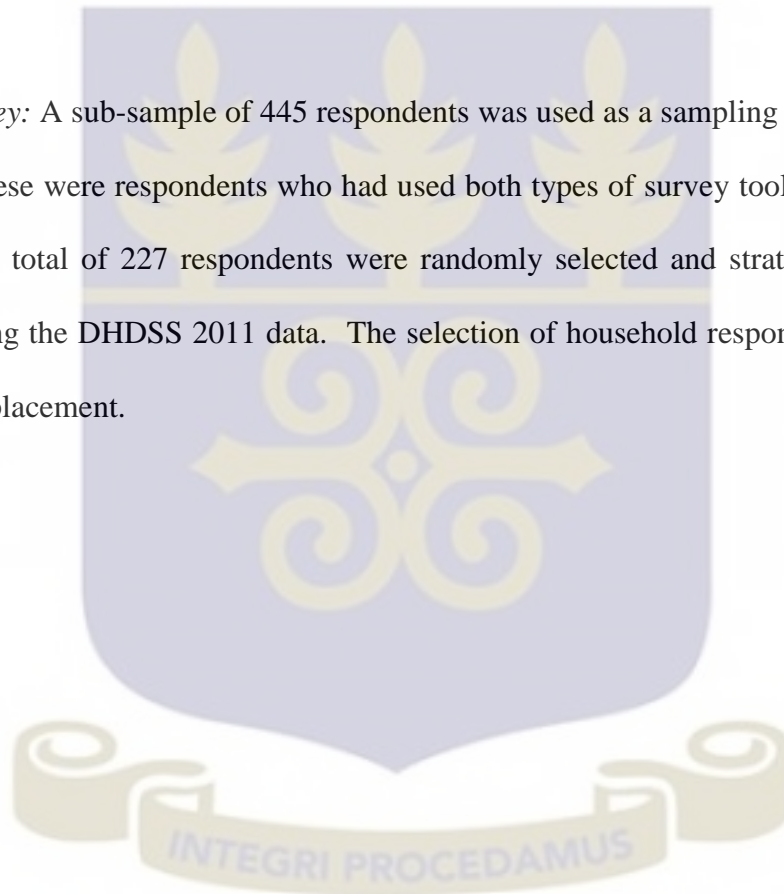
### 3.5.2.2 The Paper based sample

There were broadly three different paper based surveys as shown in Figure 6. The sampling procedures were as follows:

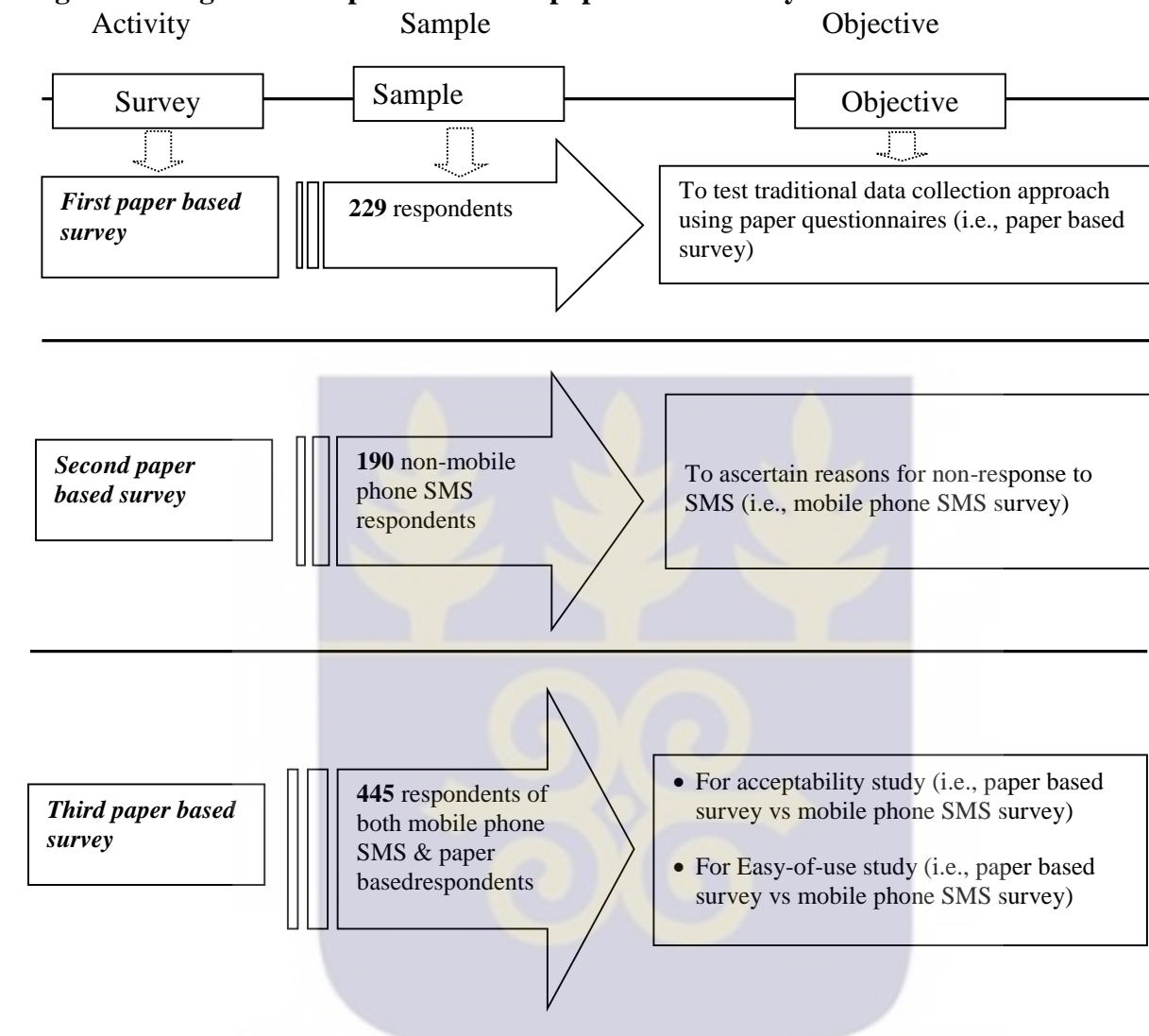
*First paper based survey:* Similar to the mobile phone sampling method, the entire process in section 3.6.2.1 was repeated for the first paper based sample. However, contrary to the mobile phone SMS survey, no incentives were given in this survey. The mobile phone numbers of the paper cohort although not needed for the first quarter were still collected and recorded. This was because randomisation for participation in either cohort arms was repeated for each new quarter.

*Second paper survey:* Out of 229 respondents for the mobile phone M &E survey tool 190 did not respond. Thus, a sub-sample of 190 non-respondents was used as a sampling frame for the second paper survey. These were non-respondents at the end of the first quarter. A total of 140 household representatives were randomly selected and stratified into the 4 communities using the DHS 2011 round update. The selection of household respondents was by balloting with replacement.

*Third paper survey:* A sub-sample of 445 respondents was used as a sampling frame for the third paper survey. These were respondents who had used both types of survey tools at the end of the fourth quarter. A total of 227 respondents were randomly selected and stratified into the four communities using the DHS 2011 data. The selection of household respondents was also by balloting with replacement.



**Figure 6: Diagrammatic presentation of paper based survey**



### 3.5.2.3 Focus group discussions

A stratified sub-sample household representatives were used for the 32 FGDs. Households were stratified into the four communities using the DHDSS 2011 data as sampling frames.

For each community, four different FGDs were held. The FGDs comprised of young males between 18-30 years, young females between 18-30 years, adult males 30 years or more and

adult females 30 years or more. The selection of household respondents was randomly done by balloting with replacement.

#### ***3.5.2.4 In-depth interviews***

The first set of in-depth interviews was conducted with one traditional or opinion leader in each community. Another in-depth interview was conducted with the District Environmental and Sanitation Officer. All key informants were purposively selected. For the third set of IDI multistage sampling was done. Out of the total of 190 non-respondents obtained in the mobile phone SMS cohort as a sampling frame, a rounded sample size of 140 household representatives was calculated. However, only 40 non-respondents were interviewed. The 40 non-respondents were made up of 10 adult men 30 years or more; 10 adult women 30 years or more; 10 young men 18-30 years and 10 young women 18-30 years. The randomly selected stratified into the 4 communities using the DHDSS 2011 data. The randomly selected household representatives was also by balloting with replacement

#### ***3.5.2.5 On-site observations***

A stratified sub-sample of household representatives was used. Households were stratified into the 4 communities using the DHDSS 2011 survey results as sampling frames. For purposes of determining the practice of open defecation in all four communities, five households from each community were randomly selected also by balloting with replacement. This was in addition to each of the five households previously selected for the survey from each community. Thus a total of forty households were selected for the observations. To strengthen the validity of the data,

there were three observations of selected households in communities within the study area on a randomly selected day once every month.

### **3.6 Data collection tools**

Qualitative and quantitative methods were used for the data collection. For the quantitative methods, structured questionnaires were administered to collect data. Semi-structured questionnaires, interview guides and checklists were used for the qualitative methods.

#### **3.6.1 Mobile phone SMS questionnaire**

The SMS questionnaire was presented on a mobile software platform. For the mobile phone platform, the SMS data collection system was hosted on a VPS (Virtual Private Server). The SMS application used a two-way SMS gateway to send SMS texts. In addition, the two-way gateway received replied texts and forwarded them to the platform. The SMS application also compared the option selected by replying person to the set of given answers. Finally, the application collated all results of SMS text messages. The platform used the two-way approach of sending and receiving text messages. The mobile phone tool could only accept a maximum of 160 characters, hence only 5 questions could be framed. As such, this informed the paper based questions.

It was assumed that household representatives who could neither read nor write were aided by other household members similar to the paper tool where data collectors could aid the respondents. The platform contained the most current demographic characteristics of the selected respondents as reported from the most recent DHS update (i.e. name, age, sex, socio-economic

status, educational status, household ID, house number, individual ID, community code, occupation, ethnicity, religion and phone number). All dates were in the DDMMYY format.

The questions via SMS were in the following areas (1) demographic characteristics (name, sex and age), (2) defecation preferences; and (3) hand-washing practices. The study used the two-way SMS approach to collect data. Response to the survey was coded as in Appendix 5.

### **3.6.2 Paper based questionnaire**

There were three paper based questionnaires for the study. The first had similar questions to that of the mobile phone (Appendix 6). The second was only on reasons for non-response in the mobile phone cohort after the first quarter (Appendix 7). The third was for reasons of non-response, acceptability, ease of use and challenges encountered with the two survey tools. All dates in the paper were in the DDMMYY format (Appendix 8).

### **3.6.3 Semi-structured questionnaire**

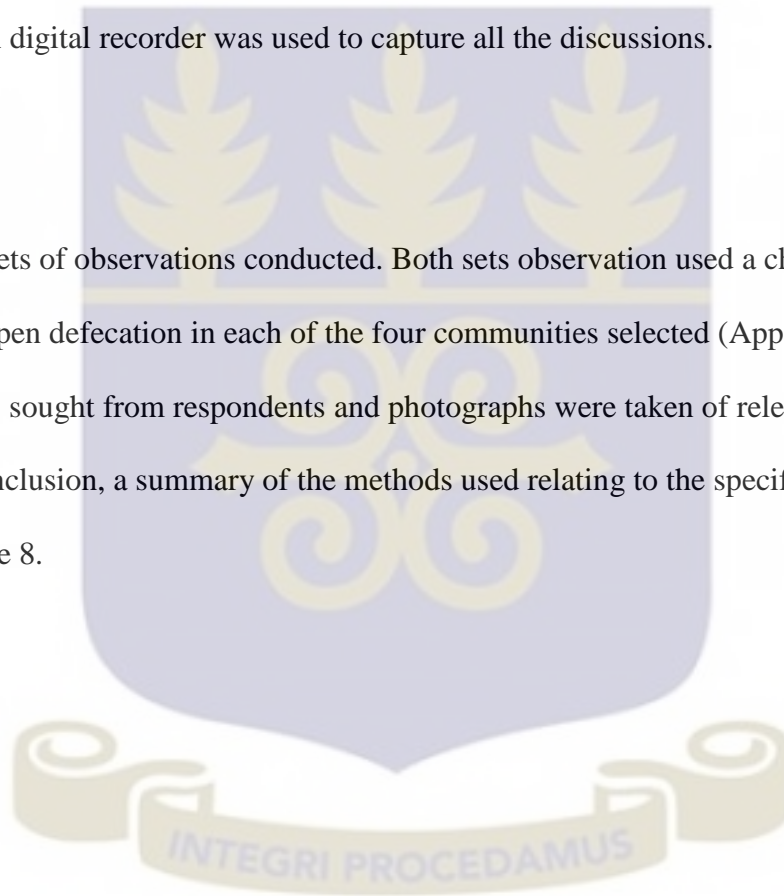
Semi-structured questionnaires were used for the FGDs. There were two sets of FGDs. The first set had questions on whether the household representatives were willing to use their personal mobile phones for the study (Appendix 9). The second was for reasons of non-response, acceptability, ease of use and challenges encountered with the two survey tools (Appendix 10). A digital recorder was used to capture all the discussions.

### **3.6.4 In-depth interview guide**

Interview guides (IDIs) were used for all the key informant interviews. There were three sets of IDIs. The first set were IDIs with traditional and opinion leaders on the feasibility of the study (Appendix 11). The second was with District Sanitation Officer on the general sanitation (Appendix 12). Finally, the third set of IDIs was with household representatives on reasons of non-response, acceptability, ease of use and challenges encountered with the two survey tools (Appendix 13). A digital recorder was used to capture all the discussions.

### **3.6.5 Checklist**

There were two sets of observations conducted. Both sets observation used a checklist to note all observations of open defecation in each of the four communities selected (Appendix 14). As well, consent was sought from respondents and photographs were taken of relevant sites of open defecation. In conclusion, a summary of the methods used relating to the specific objectives is presented in Table 8.



**Table 8: Specific objectives and the various methods used**

Specific Objective	Data Source: Methods and techniques used
1. To compare the validity of the mobile phone survey and traditional paper based defecation practice surveys tools in Prampram in the Ningo-Prampram District.	Survey using structured questionnaire on mobile phone and paper. There was the need to assess by comparisons of responses of same participants to same questions with an interval of three months and compare to the specified practices by JMP.
2. To compare the reliability of the mobile phone and traditional paper based defecation practice surveys tools in Prampram in the Ningo-Prampram District.	Survey using structured questionnaire on mobile phone and paper. Reliability was to be assessed by comparing responses of the mobile phone SMS using same questions and same population as that of the paper based survey tool.
3. To determine the effectiveness of the mobile phone and traditional paper based defecation practice surveys tools in Prampram in the Ningo-Prampram District.	Survey using structured questionnaire on mobile phone and paper. Desktop review. Focus group discussions. The results from specific objective 4 was used in determining whether the mobile phone survey comparatively was cheaper, easier to use, could be sustained and thus the opportunities in the target population.
4. To compare the feasibility of the mobile phone survey and traditional paper based defecation practice surveys tools in Prampram in the Ningo-Prampram District.	Survey using structured questionnaire on mobile phone and paper. Desktop review. Focus group discussions. Feasibility was assessed by comparing cost, ease of administration, acceptability and response rate of same participants to same questions.
5. To estimate the cost of the mobile phone and traditional paper based defecation practice surveys tools in Prampram in the Ningo-Prampram District.	Records of all costs for both paper and mobile phone defecation practices survey tools will be compared. Cost was to be determined using all records on cost during fieldwork for both surveys and compared.

### 3.7 Period of study

The summary of the study period is shown in Table 9. The first quarter was for the mobile phone survey and was conducted from May 17th, 2013 to June 30th 2013. The second quarter was conducted from July 1st to September 30th, 2013, whilst the third ran from October 1st to December 31st, 2013. Finally the fourth quarter was from January 1st to March 31st 2014. Concurrent with the mobile phone SMS survey, the first quarter for the first paper based survey was conducted from May 17th 2013 through to June 30th 2013. The second quarter was conducted from July 1st to September 30th, whilst the third was to run from October 1st to December 31st, 2013. Finally, the fourth quarter run from January 1st to March 31st 2014. In addition, a second paper based survey was conducted from July 1st 2013 to September 30th 2013. The third paper survey was run from April 15th 2014 to June 30th 2014.

The first 16 FGDs was from February 1st 2013 to March 31st 2013 whilst the second set of sixteen run from April 15th 2014 to June 30th 2014. For IDIs, the first 5 were from February 1st 2013 to March 31st 2013. The second set 40 IDIs run from July 1st 2013 to September 30th 2013. Finally, the first 20 observations were from February 1st 2013 to March 31st 2013 whilst the second set of 20 run from May 17th 2014 to March 31st 2014.

**Table 9: Period of study**

No.	Study type	Start date	End Date
<b>1</b>	<b><i>Mobile phone survey:</i></b>	<b><i>May 17<sup>th</sup> 2013</i></b>	<b><i>March 31<sup>st</sup> 2014</i></b>
	First quarter	May 17 <sup>th</sup> 2013	June 30 <sup>th</sup> 2013
	Second quarter	July 1 <sup>st</sup> 2013	September 30 <sup>th</sup> 2013
	Third quarter	October 1 <sup>st</sup> 2013	December 31 <sup>st</sup> 2013
	Fourth quarter	January 1 <sup>st</sup> 2014	March 31 <sup>st</sup> 2014
<b>2</b>	<b><i>First Paper survey:</i></b>	<b><i>May 17<sup>th</sup> 2013</i></b>	<b><i>March 31<sup>st</sup> 2014</i></b>
	First quarter	May 17 <sup>th</sup> 2013	June 30 <sup>th</sup> 2013
	Second quarter	July 1 <sup>st</sup> 2013	September 30 <sup>th</sup> 2013
	Third quarter	October 1 <sup>st</sup> 2013	December 31 <sup>st</sup> 2013
	Fourth quarter	January 1 <sup>st</sup> 2014	March 31 <sup>st</sup> 2014
<b>3</b>	<b><i>Second Paper survey:</i></b>	<b><i>July 1<sup>st</sup> 2013</i></b>	<b><i>September 30<sup>th</sup> 2013</i></b>
<b>4</b>	<b><i>Third Paper survey:</i></b>	<b><i>April 15<sup>th</sup> 2014</i></b>	<b><i>June 30<sup>th</sup> 2014</i></b>
<b>5</b>	<b><i>First sixteen FGDs</i></b>	<b><i>February 1<sup>st</sup> 2013</i></b>	<b><i>March 31<sup>st</sup> 2013</i></b>
<b>6</b>	<b><i>Second sixteen FGDs</i></b>	<b><i>April 15<sup>th</sup> 2014</i></b>	<b><i>June 30<sup>th</sup> 2014</i></b>
<b>7</b>	<b><i>First five IDIs</i></b>	<b><i>February 1<sup>st</sup> 2013</i></b>	<b><i>March 31<sup>st</sup> 2013</i></b>
<b>8</b>	<b><i>Second forty IDIs</i></b>	<b><i>July 1<sup>st</sup> 2013</i></b>	<b><i>September 30<sup>th</sup> 2013</i></b>
<b>9</b>	<b><i>First twenty observations</i></b>	<b><i>February 1<sup>st</sup> 2013</i></b>	<b><i>March 31<sup>th</sup> 2013</i></b>
<b>10</b>	<b><i>Second twenty observations</i></b>	<b><i>May 17<sup>th</sup> 2013</i></b>	<b><i>March 31<sup>th</sup> 2014</i></b>

### 3.8 Data quality control

The data control methods were in three parts of the (1) training, (2) data entry and checks and (3) pre-test.

*Training:* Prior to the study, there was a three-day orientation and training involving both M & E survey tools for the research assistants who assisted in the study. The training provided in-depth information on the study and expectations from them as a means to eliminate or reduce researcher bias. Trainers with experience in research facilitated these trainings. Household

representatives also received a short training on the definitions on defecation practices good hand-washing practices. These definitions had been determined through qualitative interviews with toilet users prior to launching the study.

*Pre-test of data collection tool:* A trial survey using the mobile phone SMS questionnaire and a trial FGD, were conducted using respondents from Old Ningo in the same district. The pre-test and FGD sessions were conducted to assess the suitability of the instruments with regard to duration, language appropriateness, and clarity of the questions. The pre-test also helped to rephrase some of the questions. The pre-test was repeated after a week with the same respondents. The responses from the same population were comparable for consistency.

*Data entry and checks:* To ensure compliance, the researcher monitored all field workers. For the paper based questionnaires were authenticated by ensuring the appropriateness and correctness of the data collected from the respondents. This was done by asking the respondents of their understanding of the questions to ensure that they matched with the objectives of the study. The daily editing of completed questionnaires and forms was to ensure that all errors and inconsistencies had been dealt with.

Data cleaning was ensured by cross-checking respondent's identifications against the "Paper based Cohort File". Data were cleaned by ensuring that filled-in paper questionnaires were numbered appropriately. The questionnaires were crosschecked and edited for completeness and clarity in readiness for data entry and analysis. The process was repeated daily after the close of work. Each interviewer's name was on each questionnaire, to make verification and clarification

possible, where necessary. Data were double entered by two trained data entry clerks so as to limit researcher bias. In terms of the mobile phone SMS questionnaires, data cleansing were done by cross-checking respondent's identifications against the "mobile phone SMS Cohort File". Data were cleaned daily after the end of the survey.

For both mobile phone SMS and paper based surveys, cross-checking was done to verify whether communities were correctly assigned. In both surveys, duplicate records and errors in household IDs and Community Codes were crosschecked. In addition, inaccurate and incomplete names, dates, date of births, codes, and household IDs were also crosschecked. The interview date format was also crosschecked to match with the DD/MM/YY format. Crosschecking was also done to make sure that each respondent answered each set of questions only once in each quarter.

### **3.9 Data analysis**

At the end of each study period, the data collected via each survey method were analyzed and compared. For all four quarters, quarterly data were combined into a single dataset. Analysis included a comparison of the validity, reliability, feasibility, cost, effectiveness and cost minimization of the mobile phone SMS survey tool as compared to that of the paper based survey tool.

#### **3.9.1 Quantitative data analysis**

Quantitative data analysis was based on the broad areas of validity, reliability, cost, effectiveness and feasibility. All quantitative data analysis were done using the both Epi Info version 3.4.1 and

SPSS version 17.0. Costing for both M & E survey tools was done from the household perspective. Cost minimization was also computed for the two M & E survey tools.

*Validity estimation:* Validity was assessed by estimating the construct validity for both M & E survey tools. This was done through confirmatory factor analysis where the factorial validity was assumed to be acceptable if the goodness of fit statistics ranged from 2 to 5. The confirmatory fit index and the goodness of fit indexes was also assumed to be acceptable for values greater than 0.9 but less than 0.05 for the root mean square error of approximation. The Cronbach's alpha may generally test for the construct validity of a variable or a tool. In addition, the Cronbach's alpha tested for the construct validity of the two M & E survey tools as shown in Table 10. This was on the assumption that the same questions were presented on both tools and therefore, any differences in their validity was as a result of the construct of the two tools. Cronbach's alpha was estimated for the validity of test scores for all four quarters for both M & E survey tools and the results compared. Alpha values of 0.6 to 0.9 were acceptable. It was also assumed that the M & E survey tool was valid if there was close agreement over repeated tests; given that the variables being measured remains unchanged. This was also done using an independent t-test. The coefficient of the correlation was also used to determine the effect of age, sex, occupation and level of education on defecation practices. The various values for the weighted Kappa were also determined for both M & E survey tools.

**Table 10: Comparison of Cronbach's alpha for all four quarters for both tools**

Validity			
Quarter	Cronbach's Alpha (CA)		T-test level of significance for differences in their means
	Paper	Mobile phone SMS	
1	CA <sub>p</sub> for first quarter	CA <sub>s</sub> for first quarter	Level of significance
2	CA <sub>p</sub> for second quarter	CA <sub>s</sub> for second quarter	Level of significance
3	CA <sub>p</sub> for third quarter	CA <sub>s</sub> for third quarter	Level of significance
4	CA <sub>p</sub> for fourth quarter	CA <sub>s</sub> for fourth quarter	Level of significance

*Reliability estimation:* Reliability indicators were the degree of timeliness and completeness of responses for each M & E survey tool. Reliability of the two M & E survey tools was measured using the timeliness and completeness of the responses. The Bonferroni's test was used to test for the differences in means between the two M & E survey tools in relation to their timeliness and completeness. Complete responses on the first date were the expected standard for timeliness. Thus, as a measure of timeliness, a completed set of responses on the first date assigned, was given a weight of three; the second date had a weight of two and the third date had a weight of one as shown in Table 11. Finally, a score of zero was recorded for non-response in the quarter. The mean weighted average scores for each M & E survey tool was then ranged into a 4-point scale as in Table 12. An independent t-test was used to determine any statistical significant differences in means in relation to the degree of timeliness between the four different quarters for each M & E survey tool. In addition, the various response rate proportions for all three dates across all four quarters were also compared.

**Table 11: Timeliness weights assigned for various response dates**

No.	Completed Responses (Timeliness)	Weights assigned
1	First date in a specific quarter	3
2	Second date in a specific quarter	2
3	Third date in a specific quarter	1
4	No response in a specific quarter	0

**Table 12: Mean weighted average scale against the various scores**

No.	Scale	Mean Weighted Average Score
1	Very Good	75 - 100
2	Good	50 - 74
3	Fairly Good	25 - 49
4	Poor	0 - 24

For completeness of responses, all five completed responses was the expected standard. Thus for a set of five responses completed, a weight of five was assigned. For four, three and two responses; weights of four, three and two were allotted respectively. A weight of one was given for only one correct response completed. Finally, a score of zero was assigned for non-response in the quarter as shown in Table 13. The mean weighted average scores for each survey tool in each quarter was calculated and this was categorized into a 4-point scale as indicated in Table 12. Independent t-tests were used to determine if there were any statistical significant differences in means in relation to the degree of completeness between the four different quarters for each M & E survey tool. The various response rate proportions for completeness in all five questions across all four quarters were compared.

**Table 13: Completeness weights assigned for response**

No.	Completed Responses (Accuracy)	Weights assigned
1	All 5 responses completed	5
2	Only 4 responses completed	4
3	Only 3 responses completed	3
4	Only 2 responses completed	2
5	Only 1 response completed	1
6	No response	0

For reliability, a total of twelve respondents were selected as indicated in Table 14. Four selected respondents who were in the mobile phone group during all four quarters were grouped as one.

Another four respondents in the paper group for all four quarters were grouped as two. Finally, four more respondents who were in the paper group for two quarters and in the mobile phone group for the other two quarters were grouped as three. The survey tool with largest number of consistent responses was determined from the mean weighted average. Independent t-tests were used to determine statistical significant differences in means in relation to the degree of consistency between the four different quarters for each M & E survey tool. The various response rate proportions for consistency in all five questions across all four quarters were also compared.

**Table 14: Weights assigned for consistency across the four quarters**

	Responses (Consistency)	Weights (Group 1)	Weights (Group 2)	Weights (Group 3)
1	Consistency in response for all 5 questions in 4 quarters	4	4	4
2	Consistency in response for all 5 questions for 3 quarters	3	3	3
3	Consistency in response for all 5 questions for 2 quarters	2	2	2
4	Consistency in response for all 5 questions for 1 quarter	1	1	1
5	No Consistency	0	0	0

*Acceptability and ease of use indicators:* Table 15 shows acceptability, privacy and confidentiality levels, which were determined by calculating the proportion of the sub-sample group who preferred either the mobile survey tool or the paper survey tool.

*Feasibility:* Feasibility was determined by comparing the estimated proportions of users of improved toilet facilities across the four quarters for both survey tools. In addition, the estimated proportions of survey tool users in terms of preference to its acceptability and privacy were determined.

**Table 15: Effectiveness analysis**

No.	Item	Type of Indicator	Effectiveness Indicators
1	Acceptability	Secondary	Number of respondents who accepted the mobile phone SMS tool as appropriate for defecation data collection
2	Privacy	Secondary	Number of respondents who indicated that the mobile phone SMS tool provided privacy for defecation data collection
3	Ease of use	Secondary	Number of respondents who indicated that the mobile phone SMS tool was easy to use for defecation data collection

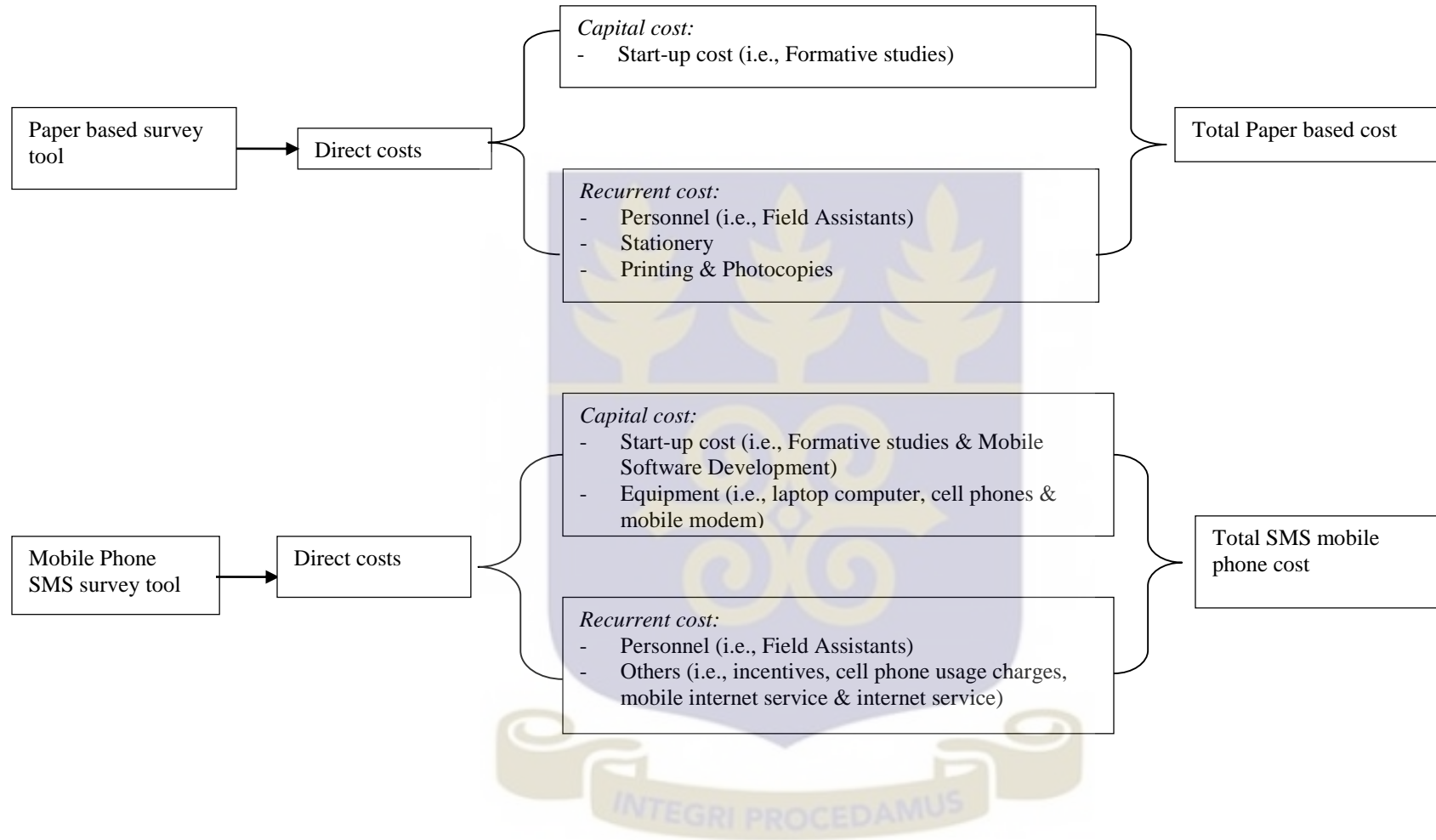
*Cost analysis:* The total cost of the two M & E survey tools were determined and compared. Costing was done from the societal perspective, which considered costs from both the provider and household perspectives. The study assessed financial costs only. Financial costing was done to estimate the actual cost of the surveys. The direct costs were broadly the capital and recurrent components as in Figure 7. Capital costs included costs incurred on items with life of more than one year (e.g. the mobile software, digital camera, the laptop computers, mobile phones, photocopier, external hard-drive and internet modem). Annualized capital cost was calculated for each activity. Capital costs were determined using a discount rate of 3% (Gold et al., 1996). Recurrent costs included cost of items with useful life of less than one year (e. g. stationery and personnel). The time of field assistants involved in training and other activities were valued using their gross monthly salaries (inclusive of social security) and summed up by activity. Finally, the total cost was estimated as a summation of capital and recurrent cost for each year for each survey tool.

The total financial costs were calculated as the sum of the recurrent cost and the capital cost for both tools. In this study, the total financial and economic costs were similar since there were no significant differences in the indirect and intangible costs. The cost information was based on the entire study period from 2012 to 2015. Research costs were also excluded. The total cost for

each M & E survey tool was calculated in Ghana Cedis. The calculation of total cost was done in Microsoft Excel. Cost in Ghana Cedis was converted into 2013 US\$ using average interbank exchange rate of 2.067 for 2013 (Interbank Currency Exchange, 2013).



**Figure 7: Diagrammatic presentation of cost minimization analysis**



*Cost Minimization analysis:* For each of the two M & E survey tools, their economic costs were estimated. In the context of this study, estimated direct costs are associated with both the paper based M & E survey tool and the mobile phone M & E survey tool on defecation practices. In this way, the optimal choice is that which can be based on the lowest cost. In this study, the paper based M & E survey tool is the base case for analysis and the mobile phone SMS M & E survey tool the intervention. Cost in Ghana Cedis was converted into 2013 US\$ using average interbank exchange rate of 2.067 for 2013 (Interbank Currency Exchange, 2013).

*Sensitivity analysis:* First, a one-way sensitivity analysis was performed by comparing costs at discounts rates of 3% and 6% using actual estimates of changes in cost. This was used as the standard level of comparison. Next, a multi-way sensitivity analysis was also performed, by assuming four scenarios of 25%, 50%, 75% and 100% estimated increases in mobile phone SMS responses all at discount rates of 3% and 6%.

### **3.9.2 Qualitative data**

The various responses to the different question were grouped into themes and subthemes. The transcribed material was categorized and analyzed using codes and themes based on the specific objectives. Compilation, tabulation and analysis of data from FGDs, IDIs and observations were done manually into broad and sub-themes. Thus there was triangulation of both the qualitative and quantitative data.

*Focus group discussions:* The interviews, quotations and field notes were transcribed into Microsoft word files also typed and saved as word documents. The results were presented on the

overall themes that emerged based from the study objectives. Transcribed responses were grouped into the following themes, (1) feasibility of sanitation data collection using the mobile phone SMS technology, (2) reasons for non-response in the mobile phone SMS group, (3) level of acceptability of both M & E survey tool (4) ease of use of both survey tools and (5) level of privacy of both M & E survey tools.

*In-depth interviews:* Again, all interviews and quotations were transcribed into Microsoft word files transcripts and notes were also typed and saved as word documents. Transcribed interviews were grouped according to the study objectives. The emerging themes were developed into the following codes, (1) general status of sanitation data collection at the community level (2) general status of sanitation data collection at the district level, (3) feasibility of sanitation data collection using the mobile phone SMS technology, (4) reasons for non-response in the mobile phone SMS group, (5) level of acceptability of both M & E survey tool (6) ease of use of both survey tools and (7) level of privacy of both M & E survey tools.

*Observations:* All observations, quotations and field notes were also typed and saved as word documents. The broad themes were mainly on open defecation. Photographs of relevant sites for open defecation were analyzed based on the study objectives. Items on the checklist were crosschecked to match the broad themes of open defecation.

### **3.10 Ethical considerations of the study**

The ethical issues of the study covered:

*Ethical clearance:* Ethical clearance was obtained from the Ethical Review Committee of the Ghana Health Service (Ethical Clearance - ID NO: GHS-ERC 01/11/2012) and Institutional Review

Board for the Dodowa Health Research Centre (Ethical Clearance – DHRC – IRB CPN 14/09/12 revd.2012) (Appendix 16 and 17).

*Approval:* Approval was sought from respondents to use their personal mobile phones without remuneration. This was prior to their recruitment for the study. In addition, the District Sanitation Officers and Assemblypersons were informed of the study and approval of their participation for the study was sought. For approval (1) verbal permission was sought from the Traditional rulers and Assembly persons of the selected local communities, stating clearly the objectives of the study, what would be involved and its significance, before data collection commenced; and (2) written permission was sought from the Ningo-Prampram District Assembly and the Ministry of Local Government, stating clearly the objectives of the study, what was involved and its significance, before proceeding.

*Selection of respondents:* Respondents were selected from all four communities in the study area were based on the 2011 baseline survey from DHRC, their daily accessibility to a mobile phone among adults. Selected respondents were then randomised into either the paper based group or the mobile SMS phone group. This was repeated every quarter.

*Risk/benefits of the study:* There were no known risk/benefits in the study.

*Privacy/ confidentiality:* Privacy of respondents was protected by safeguarding all data collected. Data were coded and used only for the purpose of the study. In addition, anonymity and

confidentiality were ensured by coding their mobile phone numbers to their household IDs, which already exist from the DHDSS 2011 baseline survey without asking names of respondents.

*Voluntary participation and compensation:* Respondents were informed that participation in the study was voluntary. Compensations in the form of phone credits were made for all mobile phone credits used in the SMS survey. Respondents who did not wish to participate in the study at any stage were allowed to do so

*Data storage and usage:* Data were captured from surveys, in-depth interviews, focus group discussions and observations. Duplicate copies were generated and used as a source of backup and labelled. Data were kept in a secured and locked desk drawer throughout the study until the results were analysed, written and presented. All data captured were also stored in a database generated for the trial and used for research purposes only. Unauthorized persons were not allowed access to the data.

*Informed consent:* Consent for all data collected was sought from all respondents (Appendices 1 to 4). The objectives of the study and possible outcomes were clarified to the respondents. Prior to the start of each survey, respondents were made to sign or thumbprint consent forms to show assent. A copy of the signed consent form was given to each respondent to keep.

*Conflict of interest:* There were no known conflicts of interest.

*Funding for the study:* The Danish Ministry of Foreign affairs funded the study and the knowledge is to help achieve the sanitation Target 10 on MDG 7 in Ghana.

### **3.11 Reliability and validity of results**

As the study covered an entire peri-urban community, conclusions from the study provide reliable and valid estimates and may be generalized to other similar peri-urban settings. However, results from such a study may not be generalized to urban or rural communities, since conditions in these settlements may vary.

### **3.12 Limitations of the study**

The study was bound by the following limitations:

1. The study sought to estimate the essential costs related to testing the two survey tools. It must be noted that not all costs were identified and measured. These measurements errors in the costs translated into the cost comparison.
2. The study assumed the use of improved toilet facilities and hand-washing practices only as a measure good defecation practices. The use of unimproved toilet facilities and failure to wash hands were considered as poor defecation practices.
3. To estimate the validity of the two survey tools, only the construct validity for the two M & E survey tools were used. This was on the assumption that both tools had the same questions.
4. The platform could accommodate a maximum of 160 characters and this limited the total number of questions on both M & E survey tools.

5. The study sought to estimate the reliability of the two survey tools. It must be noted that reliability was measured using only the estimated proportion of respondents whose responses were consistent across all four quarters.
6. The study could have had an unintended effect of change in sanitation practices among the participants under the assumption that alternative facilities were available and participants had a choice to use improved rather than unimproved facilities.
7. To estimate the feasibility of the two survey tools, only the estimated proportion of respondents who accepted and indicated that the mobile phone SMS survey tool provided privacy and was easy to use for defecation data collection were measured.
8. Given that in 2005, over 50% of persons above 15 years were illiterates. This could have affected response rates for both M & E survey tools since the questions required literacy levels for comprehension and consequent use of the tools.

### **3.13 Conclusion**

Chapter three outlined the methods used in this study. These included the study area, study design, study population, study variables, sampling procedures, data collection tools used, data quality control, data analysis, ethical considerations and limitations of the study. In spite of the outlined limitations, the strength of this study included the development and the pilot testing of mobile phone software for sending and receiving SMS text messages.

## CHAPTER FOUR

### 4.0 RESULTS

This chapter covers the results of the study, which consists of the comparison of the validity, reliability, feasibility, cost, effectiveness and cost minimization of the mobile phone SMS M & E survey tool as compared to that of the paper based survey tool.

#### 4.1 Socio-demographic profile of respondents

Table 16 shows the socio-demographic profile of the respondents for both M & E survey tools across all four quarters. A total of 455 household representatives, made up 178 (39.1%) males and 277 (60.9%) females, were selected from Prampram in the Ningo-Prampram district for the study. About 162 (36%) of respondents were between the ages of 18-29 years. The group distribution showed that respondents aged 50 years or more made up only 92 (20.2%) of the sample. The results also revealed that 344 (75.6%) of respondents were employed and only 10 (2.2%) used improved facilities as specified by the JMP such as pour-flush toilet.

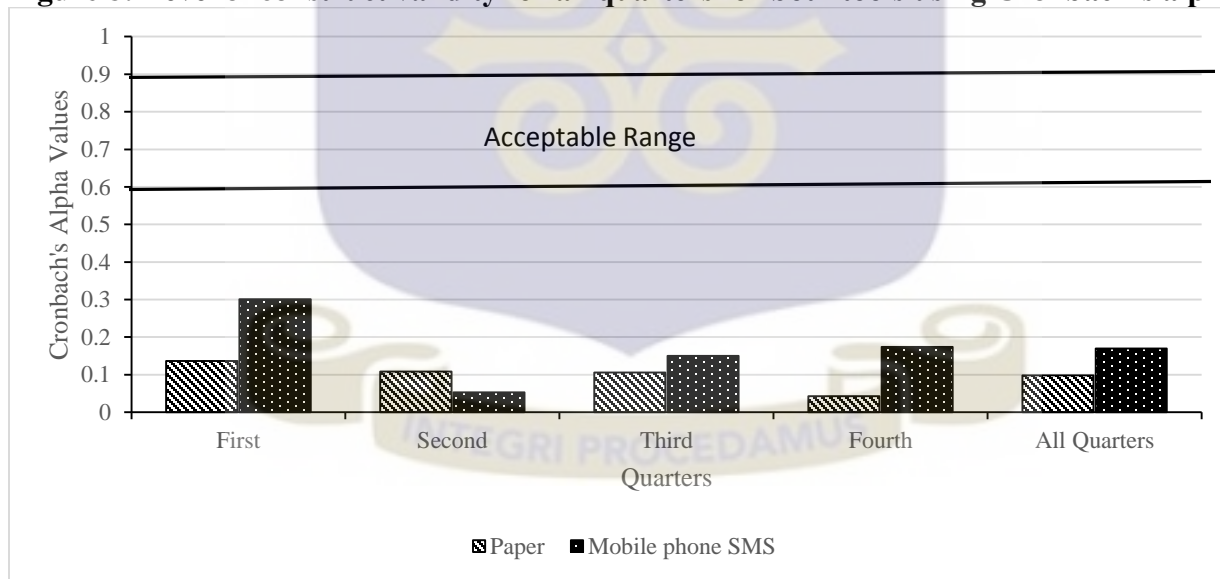
**Table 16: Background characteristics of respondents for both M & E survey tools**

<b>Characteristics</b>	<b>Frequency</b>	<b>%</b>
<b>Sex:</b>		
Female	277	60.9
Male	178	39.1
<b>Age (years):</b>		
18-29	162	35.6
30-39	134	29.5
40-49	67	14.7
50 and above	92	20.2
<b>Occupation of Respondents:</b>		
Unemployed	111	24.4
Employed	344	75.6
<b>Defecation Practices:</b>		
Improved Toilet Facilities Users	10	2.2
Unimproved Toilet Facilities Users	445	97.8

## 4.2 Validity

Figure 8 shows the level of construct validity for both M & E survey tools in terms of their Cronbach alpha measurements. The mobile phone SMS M & E survey tool recorded the highest Cronbach alpha value of 0.174 in the fourth quarter whilst the lowest value of 0.043 was for the paper based M & E survey tool in the same quarter. Thus across all four quarters, the mobile phone SMS M & E survey tool was comparatively more valid than the paper tool except in the second quarter. However, an independent t-test showed that there was no significant difference in the means of the Cronbach alpha values between the two M & E survey tools ( $p = 0.267$ ). From the results, all Cronbach alpha values were less than 0.6 to 0.9, which was the assumed acceptable range as indicated in Figure 8.

**Figure 8: Level of construct validity for all quarters for both tools using Cronbach's alpha**



There was no significant correlation of defecation practices with the age of the respondent (OR = 1.256,  $p = 0.427$ ), sex (OR = 2.471,  $p = 0.167$ ) or occupation (OR = 0.595,  $p = 0.476$ ) for both tools. The various values for the weighted Kappa and their level of agreement for both M & E

survey tools were determined as shown in Table 17. The results showed the highest level of agreement of 47.9% between the first and third quarter for the two tools with the least level of agreement of 38.0% between the second and fourth quarter. An independent t-test for the differences in means for Kappa values between the two M & E survey tools showed that there was no significant difference ( $p$ -value = 0.203) between the two tools. Thus the validity of the two M & E survey tools showed no acceptable levels of agreement in terms of their construct validity.

**Table 17: Level of construct validity for all four quarters for both tools using Kappa values**

Quarters	Levels of agreement between quarters (%)	Kappa values for both tools	P values
First and second	43.1	0.074	0.017
First and third	47.9	0.161	0.000
First and fourth	38.9	0.008	0.416
Second and third	41.5	0.064	0.031
Second and fourth	38.0	0.002	0.480
Third and fourth	39.8	0.031	0.183

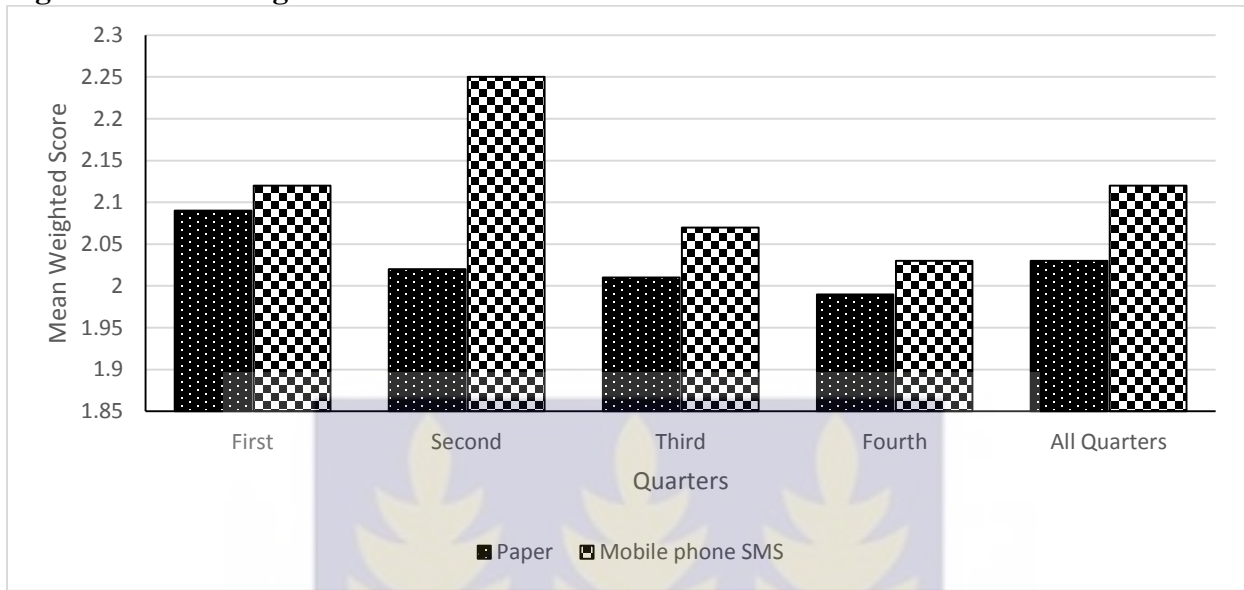
### 4.3 Reliability

Figures 9 and 10 respectively compare the reliability of the two M & E survey tools by measuring their degree of timeliness and degree of completeness. Reliability was highest for the mobile phone SMS M & E survey tool in terms of the mean weighted scores for timeliness during the second quarter (2.25); and lowest for the paper based tool during the fourth quarter (1.99) as shown in Figure 9. Reliability of the two M & E survey tools was measured using the

timeliness and completeness of the responses. Complete responses on the first date were the expected standard for timeliness. Thus, a measure of timeliness, a completed set of responses on the first date assigned was given a weight of three, the second date had a weight of two and the third date had a weight of one. Finally, a score of zero was recorded for non-response in the quarter. The mean weighted average scores for each M & E survey tool was then ranged into a 4-point scale. The Bonferroni's test was used to test for the statistical significant differences in means between the two M & E survey tools in relation to their timeliness and completeness across the four different quarters. In addition, the various response rate proportions for all three dates across all four quarters were also compared.

Reliability was also highest for the mobile phone SMS M & E survey tool in terms of the mean weighted scores for completeness of responses during the second quarter (2.31); and lowest for the mobile phone SMS M & E tool during the fourth quarter (1.99) as reported in Figure 10. The mobile phone SMS M & E tool showed a comparatively higher reliability by the measure of the degree of timeliness and completeness of responses across all four quarters than the paper based tool. However, the Bonferroni's test showed that there were no significant differences in means between the two survey tools in relation to their degree of timeliness ( $p = 0.138$ ) and completeness ( $p = 0.076$ ) for all four quarters.

**Figure 9: Mean weighted scores for timeliness**



**Figure 10: Mean weighted score for completeness in responses**

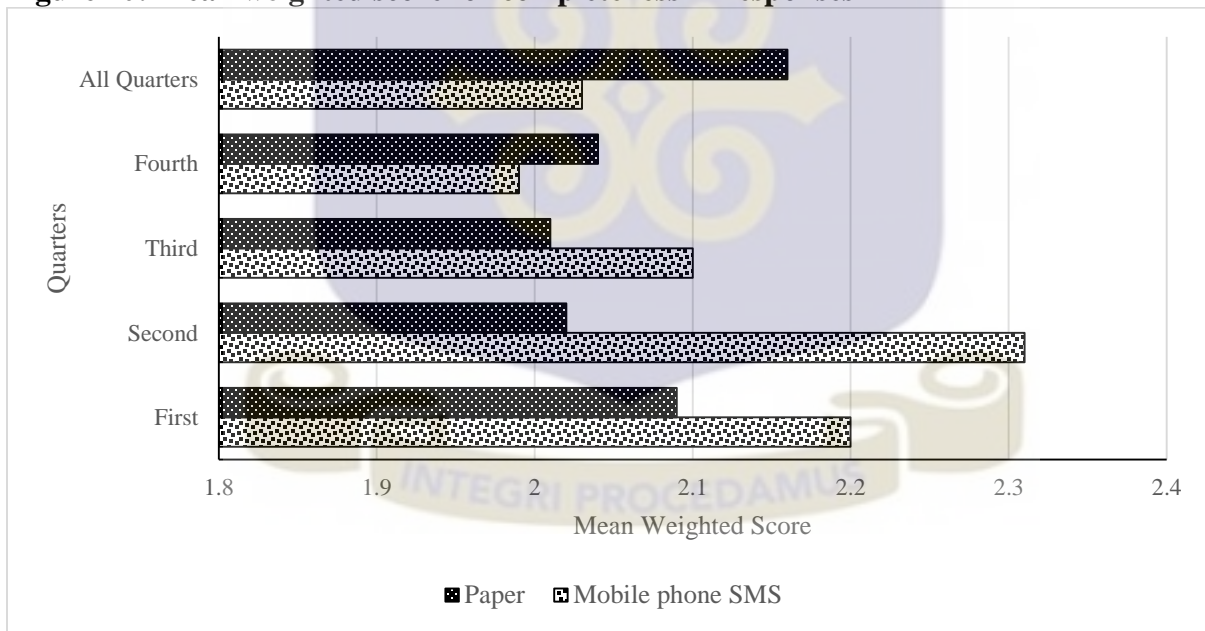


Table 18 indicates the degree of completeness of responses for both survey tools. The highest complete response rates were in the fourth quarter for both the paper based survey tool 220 (96.1%) and that for the mobile phone SMS survey tool 44 (19.2%). The lowest complete

response rates for the paper based M & E survey tool was during the first and fourth quarter 2 (0.9%) and 6 (2.6%) for mobile phone SMS survey tool during the second quarter. Table 19 further disaggregates the response rate by their ages and sexes. Thus the reliability of the two M & E survey tools showed no acceptable levels. In addition none of the selected 12 respondents showed any consistency in all five questions across all four quarters.

**Table 18: Response rate for all three dates across all four quarters**

Quarter	First date		Second date		Third date	
	Paper n = 229	SMS n = 229	Paper n = 229	SMS n = 229	Paper n = 229	SMS n = 229
First	2 (0.9)	7 (3.1)	25 (10.9)	9 (3.9)	194 (84.8)	21 (9.2)
Second	1 (0.4)	6 (2.6)	32 (15.3)	11 (4.8)	186 (81.2)	42 (18.3)
Third	35 (15.3)	26 (11.4)	58 (25.3)	22 (9.6)	135 (59.0)	43 (18.8)
Fourth	2 (0.9)	10 (4.4)	5 (2.2)	29 (12.7)	220 (96.1)	44 (19.2)



**Table 19: Comparison of all responses by the various age groups and sex for both tools**

Quarter	Age groups in years	Sex	1 <sup>st</sup> date		2 <sup>nd</sup> date		3 <sup>rd</sup> date		Total	
			Complete responses		Complete responses		Complete responses			
			Paper n = 229	SMS n = 229	Paper n = 229	SMS n = 229	Paper n = 229	SMS n = 229	Paper n = 229	SMS n = 229
First	18-29	M	0	1	5	1	26	3	31	5
		F	1	2	8	1	42	4	51	7
	30-39	M	0	1	2	1	21	5	23	7
		F	0	1	2	3	40	1	42	5
	40-49	M	0	1	1	0	15	2	16	3
		F	0	0	2	1	16	2	18	3
	50 +	M	0	0	0	0	10	2	10	2
		F	1	1	5	2	24	2	30	5
<b>Total</b>			<b>2 (0.9%)</b>	<b>7 (3.1%)</b>	<b>25 (10.9%)</b>	<b>9 (3.9%)</b>	<b>194 (84.8%)</b>	<b>21 (9.2%)</b>	<b>221 (97.0%)</b>	<b>37 (16.2 %)</b>
Second	18-29	M	0	0	4	2	21	10	25	12
		F	1	2	6	5	31	11	38	18
	30-39	M	0	2	7	1	26	4	33	7
		F	0	0	3	1	41	6	44	7
	40-49	M	0	1	3	0	10	2	13	3
		F	0	0	3	2	18	3	21	5
	50+	M	0	0	3	0	15	2	18	2
		F	0	1	3	0	24	4	27	5
<b>Total</b>			<b>1 (0.4%)</b>	<b>6 (2.6%)</b>	<b>32 (14.0%)</b>	<b>11 (4.8%)</b>	<b>186 (81.2%)</b>	<b>42 (18.3%)</b>	<b>219 (96.0%)</b>	<b>59 (25.8%)</b>
Third	18-29	M	2	5	10	3	19	7	31	15
		F	8	3	12	5	26	13	46	21
	30-39	M	1	7	4	3	15	5	20	15
		F	7	8	10	2	20	6	37	16
	40-49	M	7	0	3	4	8	2	18	6
		F	2	1	3	3	15	1	20	5
	50+	M	1	0	5	2	9	4	15	6
		F	7	2	11	0	23	5	41	7
<b>Total</b>			<b>35 (15.3%)</b>	<b>26 (11.4%)</b>	<b>58 (25.3%)</b>	<b>22 (9.6%)</b>	<b>135 (59.0%)</b>	<b>43 (18.8%)</b>	<b>228 (99.6%)</b>	<b>91 (39.7%)</b>

Fourth	18-29	M	1	2	3	4	23	12	27	18
		F	0	1	1	4	57	8	58	13
	30-39	M	0	0	0	6	26	5	26	11
		F	0	3	1	7	39	4	40	14
	40-49	M	0	2	0	4	12	2	12	8
		F	0	0	0	0	17	4	17	4
	50+	M	0	0	0	2	13	4	13	6
		F	1	2	0	2	33	5	34	9
<b>Total</b>			<b>2 (0.9%)</b>	<b>10 (4.4%)</b>	<b>5 (2.2%)</b>	<b>29 (12.7%)</b>	<b>220 (96.1%)</b>	<b>44 (19.2%)</b>	<b>227 (99.1%)</b>	<b>83 (36.2%)</b>



#### 4.4 Effectiveness

##### *Primary indicators*

Table 20 shows the different effectiveness indicators for the two M & E survey tools for all four quarters. Out of a total of 916 respondents across all four quarters, the number of users of improved toilet facilities for the paper based tool were 20 (2.2%) for the paper based survey M & E survey tool whilst that of the mobile phone SMS tool were only 4 (0.4%). However, a total 872 (95.2%) and 264 (28.8%) respondents indicated their use of unimproved toilet facilities using the paper based and mobile phone SMS survey tools respectively. From the results, the number of respondents who used improved toilet facilities, washed hands and answered by the paper based tool were 8 (0.9%) whilst users of improved toilet facilities, washed hands and answered by the mobile phone SMS tool was only 4 (0.4%). Users of unimproved toilet facilities, who washed hands and answered by the paper based tool were 340 (37.1%) with 144 (15.7%) being users of unimproved toilet facilities, who washed hands and answered by the mobile phone SMS tool.

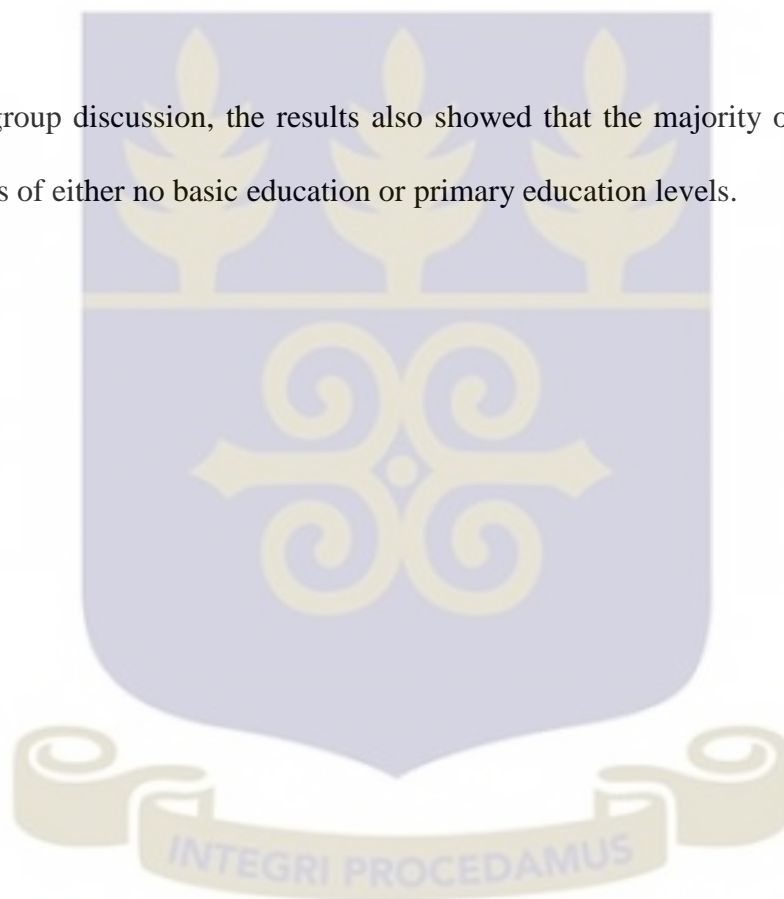
##### *Secondary indicators*

A total of respondents who answered all 5 questions by the paper tool were 896 (97.8%) whilst 264 (28.8%) answered all 5 questions by the mobile phone SMS tool. As a measure of timeliness using the paper based tool, a total of 20 (2.2%), 40 (4.4%) and 120 (13.1%) respondents answered on the first, second and third survey dates respectively. For the mobile phone SMS tool, only 40 (4.4%), 70 (7.6%) and 148 (16.2%) respondents completed responses on the first, second and third survey dates respectively. The low mobile phone SMS response rate is supported by qualitative quotes from the focus group discussions in the following statements:

*“There are many problems with the mobile phone. Credits, lights off, low battery and network problems. But the paper does not have these. The paper is better.”* (FGD, Young men, Kley)

*“Low battery is a big issue because I share my charger with my friend.”* (FGD, Adult men, Lower West)

From the focus group discussion, the results also showed that the majority of respondents had low literacy levels of either no basic education or primary education levels.



**Table 20: Effectiveness indicators**

	<b>Item</b>	<b>Effectiveness indicators</b>	<b>Paper (%) n = 916</b>	<b>SMS (%) n = 916</b>
Primary Indicators	Improved Defecation Practice rate	Number of reported users of improved toilet facilities	20 (2.2)	1 (.1)
		Number of reported users of unimproved toilet facilities	872 (95.2)	264 (28.8)
		Number of respondents who used improved toilet facilities and wash hands after defecation	8 (0.9)	4 (0.4)
		Number of respondents who used improved toilet facilities and did not wash hands after defecation	4 (0.4)	0 (0)
		Number of respondents who used unimproved toilet facilities and wash hands after defecation	340 (37.1)	144 (15.7)
		Number of respondents who used unimproved toilet facilities and did not wash hands after defecation	224 (26.6)	36 (3.9)
Secondary Indicators	Completeness of questionnaire	Number of respondents who answered all 5 questions	896 (97.8)	264 (28.8)
		Number of respondents who did not answer all 5 questions	20 (2.2)	644 (70.3)
	Timeliness of responses	Number of respondents who answered all 5 questions on Day 1	40 (4.4)	40 (4.4)
		Number of respondents who answered all 5 questions on Day 2	120 (13.1)	70 (7.6)
		Number of respondents who answered all 5 questions on Day 3	736 (80.3)	148 (16.2)

Table 21 also shows the different effectiveness indicators for the two M & E survey tools. Across all four quarters, the highest users of improved toilet facilities were only 24 (2.6%) for the paper based survey tool (in the third quarter) and 17 (1.8%) washed hands after using the toilet facility. Respondents for the mobile phone SMS M & E survey tool (in the second quarter) who used improved toilet facilities and also washed hands after the toilet facility use was 12 (1.3%). The highest number of unimproved toilet facilities 888 (96.9%) was in the third quarter with only 503 (55%) indicating hand washing after toilet facility use for the paper based survey tool respondents. The highest proportion of respondents who answered all five questions in terms of completeness and timeliness on the first survey date for both M & E survey tools were all in the third quarter. For the mobile phone SMS M & E survey tool, the highest proportion of respondents who answered all five questions in terms of completeness and timeliness on the first survey date was 346 (37.7%) and 105 (11.4%) respectively; whilst that for the paper based tool were 912 (99.5%) and 140 (15.3%) respectively. Unimproved toilet facilities included public toilets, and open defecation practices in open places such as the beaches and around public toilets as shown in Figure 11. In the same quarter, 364 (39.7%) of respondents for the mobile phone SMS tool formed the highest users of unimproved toilet facilities; out of which 225 (24.5%) washed hands after toilet facility use. As a measure of timeliness, only 140 (15.3%) of respondents for the paper based survey tool in the third quarter completed responses on the first survey date; with only 105 (11.4%) completing responses on the first survey date in the same quarter. Generally, the paper based tool was more effective than the mobile phone SMS tool in terms of response rate.

**Table 21:** Effectiveness indicators across all four quarters

Item	Effectiveness indicators	Response rates (%) per quarter							
		Paper				SMS			
		1st n = 229	2nd n = 229	3rd n = 229	4th n = 229	1st n = 229	2nd n = 229	3rd n = 229	4th n = 229
Improved Defecation Practice rate	Proportion of respondents who used improved toilet facilities	1.8	1.8	2.6	2.6	0.4	1.3	0	0.4
	Proportion of respondents who used unimproved toilet facilities	94.3	94.0	96.9	96.5	15.7	24.5	39.7	35.8
	Proportion of respondents who used improved toilet facilities and washed hands after defecation	0.9	0.4	1.8	0.9	0.4	1.3	0.9	0
	Proportion of respondents who used improved toilet facilities and did not washed hands after defecation	0.4	0.4	0.9	0.4	0	0	0	0.4
	Proportion of respondents who used unimproved toilet facilities and washed hands after defecation	55.0	30.1	17.5	45.4	10.0	13.1	24.5	15.3
	Proportion of respondents who used unimproved toilet facilities and did not washed hands after defecation	39.7	28.4	9.6	19.7	6.1	4.4	3.9	0.9
Completeness of questionnaire	Proportion of respondents who answered all 5 questions	96.5	95.6	99.5	99.1	16.2	25.8	37.7	36.2
	Proportion of respondents who did not answer all 5 questions	3.5	4.4	0.4	0.9	83.8	74.2	60.3	63.8
Timeliness of responses	Proportion of respondents who answered all 5 questions on Day 1	0.9	0.4	15.3	0.9	3.1	2.6	11.4	0.4
	Proportion of respondents who answered all 5 questions on Day 2	10.9	14.0	25.3	2.2	3.9	4.8	9.6	12.7
	Proportion of respondents who answered all 5 questions on Day 3	84.7	81.2	59.0	96.1	9.2	18.3	18.8	19.2

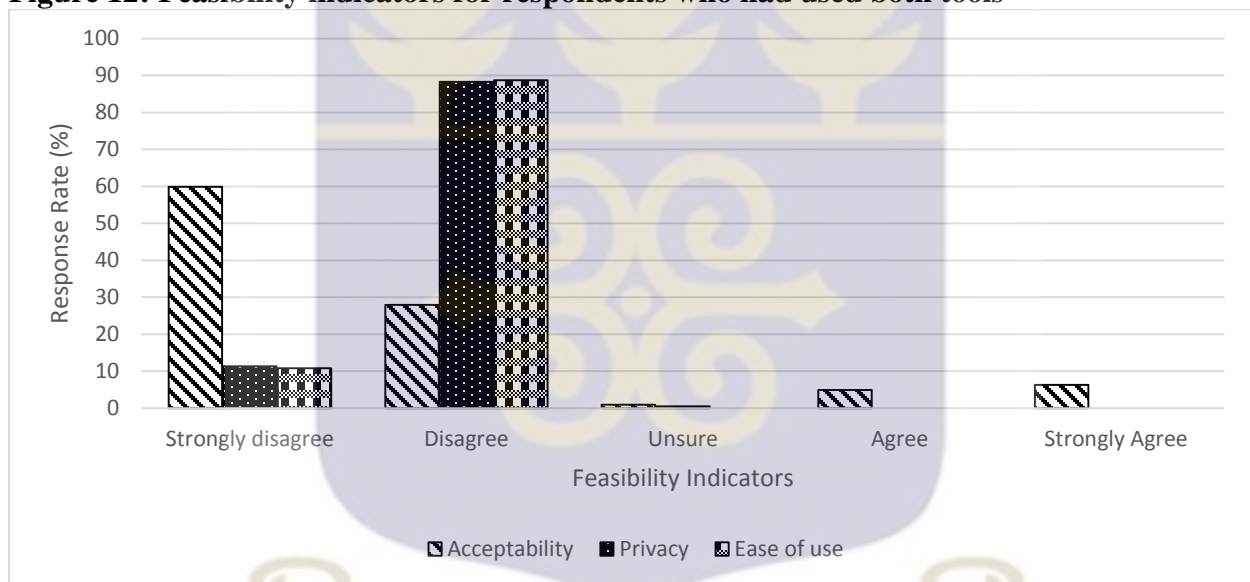
**Figure 11: Open defecation practice at the beach and around a public toilet.**



#### 4.5 Feasibility

Feasibility was determined by comparing the estimated proportions of survey tool users in terms of preference to its acceptability and privacy as shown in Figure 12. Respondents who answered that the mobile phone SMS M & E survey tool was acceptable, offered privacy and was easy to use as compared to the paper based tool were 58 (6.3%), 5 (0.5%) and 5 (0.5%) respectively as shown in Figure 12.

**Figure 12: Feasibility indicators for respondents who had used both tools**



#### *Acceptability*

From Figure 12, the paper based M & E survey tool was more acceptable as compared to the mobile phone M & E survey tool. Although sanitation data collection with the mobile phone SMS M & E survey tool was feasible, there were several challenges such as issues of literacy, the unavailability of network services, phone credit, phone sharing, low battery, incentives, forgetfulness and unavailability of electricity resulting in their inability to charge their mobile

phones. These reasons were given in answer to why respondents preferred the paper based M & E tool to the mobile phone SMS tool and also why there were non-responses when using the mobile phone SMS tool. Among the various age groups, adults between the ages of 18-29 years gave reasons of mobile phone credits challenges 92 (40.5%), poor network services 49 (21.4%), illiteracy 22 (9.5%) and unavailability of electricity or power outages 22 (9.5%). For respondents between the ages of 30-39 years, 60 (26.3%) attributed their non-response to illiteracy, 30 (13.2%) to poor network services, another 30 (13.2%) to issues of mobile phone credits and 30 (13.2%) to the unavailability of electricity or power outages. Reasons for non-response in the 40-49 age group were poor network services 10 (4.2%), illiteracy 66 (29.2%), inadequate of mobile phone credits 47 (20.8%) and unavailability of electricity or power outages 19 (8.3%). Respondents who were 50 years or more answered that illiteracy 119 (52.6%), poor network services 10 (4.2%) and issues of mobile phone credits 19 (8.3%) were their reasons for non-response to the mobile phone tool.

Among the male respondents, their reasons of non-response were poor network services 44 (19.4%), illiteracy 62 (27.4%), mobile phone credits 51 (22.6%) and unavailability of electricity or power outages 33 (14.5%). However, female respondents answered that poor network services 24 (10.7%), illiteracy 65 (28.6%), mobile phone credits 49 (21.4%), poor communication from the field 3 (1.4%) and unavailability of electricity or power outages 27 (12.1%) were mainly their reasons for non-response and thus their preference for the paper based survey tool as against the mobile phone SMS M & E survey tool.

Figures 13 and 14 also show the reasons for non-response during the first quarter for the mobile phone SMS M & E survey tool. Respondents' qualitative comments reinforced these reasons

and indicated that the majority preferred the paper based M & E survey tool in terms of the level of acceptability, privacy and ease of use. This was predominant in both male and female respondents who were 30 years or more in all four communities, although there were a few quotes by the younger respondents between 18-29 years. The majority of respondents 30 years or more who were both males and females in all four communities explained these themes as:

*“Paper is easier and better. For me I can’t read so I have to let the children do it. And they will use the opportunity to use my phone and use my credits. So I prefer to keep my phone to myself and talk to my children overseas when they call. For that one I can do it myself.”* (FGD, Adult men, Lower East).

Some of the challenges mainly related to difficulty in answering the text messages from the mobile phone SMS survey tool included issues of literacy, the unavailability network services and electricity resulting in their inability to charge their mobile phones. These reasons for the non-response to the mobile phone SMS M &E survey tool are from statements by respondents during focus group discussions across the various age groups, sexes and communities:

*“A lot of people have not been to school before, so we will need somebody to always help us to do it. We have not been to school before, so always, somebody has to help us. It will not be easy for those who have not been to school before. People will say give them money to buy credit to send the text messages.”* (FGD, Young men, Kley)

*“The lights off is sometimes from morning till evening so it affects charging your battery.”* (FGD, Young men, Lower West)

*“Sometimes the power, this “dumsor dumsor” problem makes the charging a problem.”*

(FGD, Adult men, Kley)

*“The network is not good at all. Sometimes it is unavailable for three days. All the networks, Vodafone, MTN, TIGO, all.”* (FGD, Young men, Olowe)

*“The lights-off can worry me sometimes. Because if I don’t charge it and the lights go off and the message come at that time then I cannot do it until the lights come back.”* (FGD, Adult men, Kley)

In contrast, the minority of younger male and female respondents 18 years or more but less than 30 years were of the opinion that the mobile phone SMS M &E survey tool was more acceptable, easier to use and offered a greater level of privacy and asserted that:

*“At any time you can reply to the questions if you are using the mobile phones. Even if you are busy you can do it later.”* (FGD, Young women, Lower East)

#### *Ease of use*

From the results, the paper based survey M & E survey tool was easier to use. The reasons given indicated why respondents preferred the paper based M & E tool preferred to the mobile phone SMS tool and also why there were non-responses when using the mobile phone SMS tool. Reasons ascribed to non-response included difficulty in the use of the mobile phone M & E survey tool as compared to the paper based tool. Among the various age groups, adults between the ages of 18-29 years gave reasons of difficulty using the mobile phone SMS M & E survey tool 27 (11.9%), and challenges with survey tool administration. For respondents between the

ages of 30-39 years, 60 (26.3%) attributed their non-response to illiteracy and another 60 (26.3%) to difficulty in the use of the mobile phone SMS tool. Reasons for non-response in the 40-49 age group were difficulty in the use of the mobile phone tool 47 (20.8%) and issues of survey tool administration 38 (16.7%). Respondents 50 years or more answered that difficulty in the use of the mobile phone tool 57 (25.0%) and issues of survey tool administration 25 (11.1%) were their reasons for non-response to the mobile phone tool.

Among the male respondents, their reason of non-response was difficulty in the use of the mobile phone tool 33 (14.5%). However, female respondents answered that difficulty in the use of the mobile phone tool 47 (20.7%) and issues of survey tool administration 2 (0.7%) were their main challenges leading to non-response. The following quotes support these findings:

*“I think the paper one is easier, because I don’t need any person to write a message for me. So the paper is better.”* (FGD, Adult men, Olowe)

*“The paper one is easier. It does not have many problems. The people ask the questions and we answer them. You have finished.”* (FGD, Young men, Lower East)

However, other respondents were of the opinion that the mobile phone SMS M & E tool was easier to use than the paper tool and clarified their reasons from the following quotes:

*“You can send your own private thing with the mobile phone and nobody will know what you did.”* (FGD, Young women, Kley)

### *Privacy*

From the results, the paper based M & E survey tool comparatively offered more privacy. Even though sanitation data collection with the mobile phone SMS M & E survey tool was feasible, there were some challenges such as mobile phone sharing. Among the various age groups, adults

between the ages of 18-29 years gave reasons of mobile phone sharing for their non-response 11 (4.8%), whilst respondents between the ages of 30-39 years, attributed their non-response to the same reason of mobile phone sharing 6 (2.6%) as shown in Figures 13 and 14. Respondents 50 years or more 6 (2.8%) answered that mobile phone sharing was a reason for non-response. Among the male respondents, 10 (4.3%) answered that mobile phone sharing was their reason for non-response.

Furthermore, the ensuing quotations support these findings on privacy:

*“We have many friends who can easily pick your phone, check your messages, and get to know your private information.”* (FGD, Young women, Lower East)

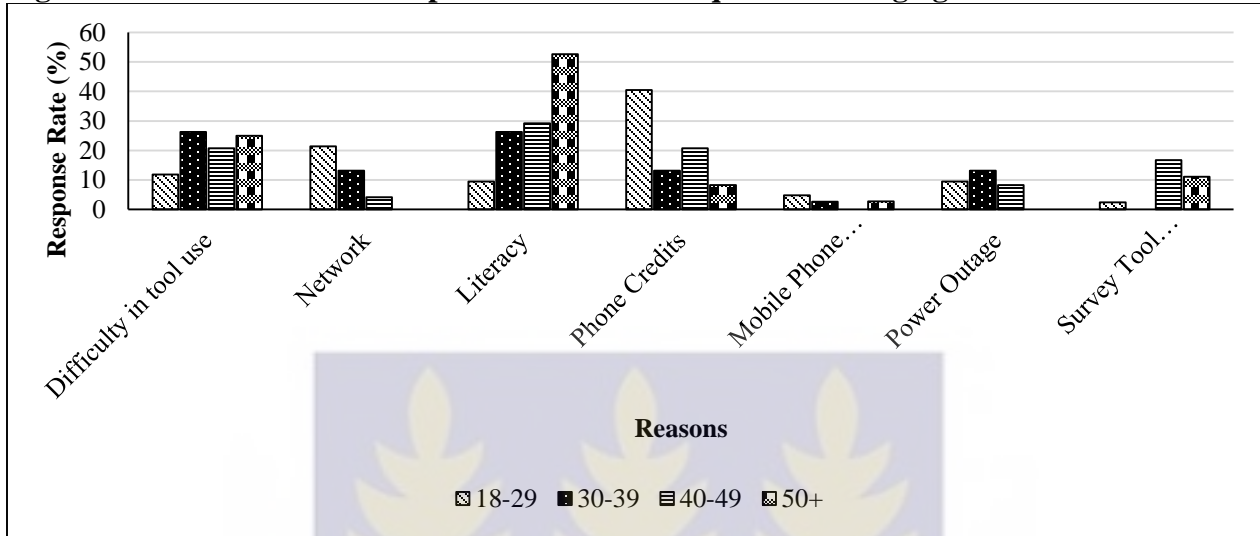
*“It would be generally good to delete the SMS after reading. But this is only toilet and sanitation issue so it does not really matter if someone else sees the text message.”* (FGD, Young women, Lower West)

*“I share my phone with my family. Any member of the family can use my phone.”* (FGD with adult women in Kley)

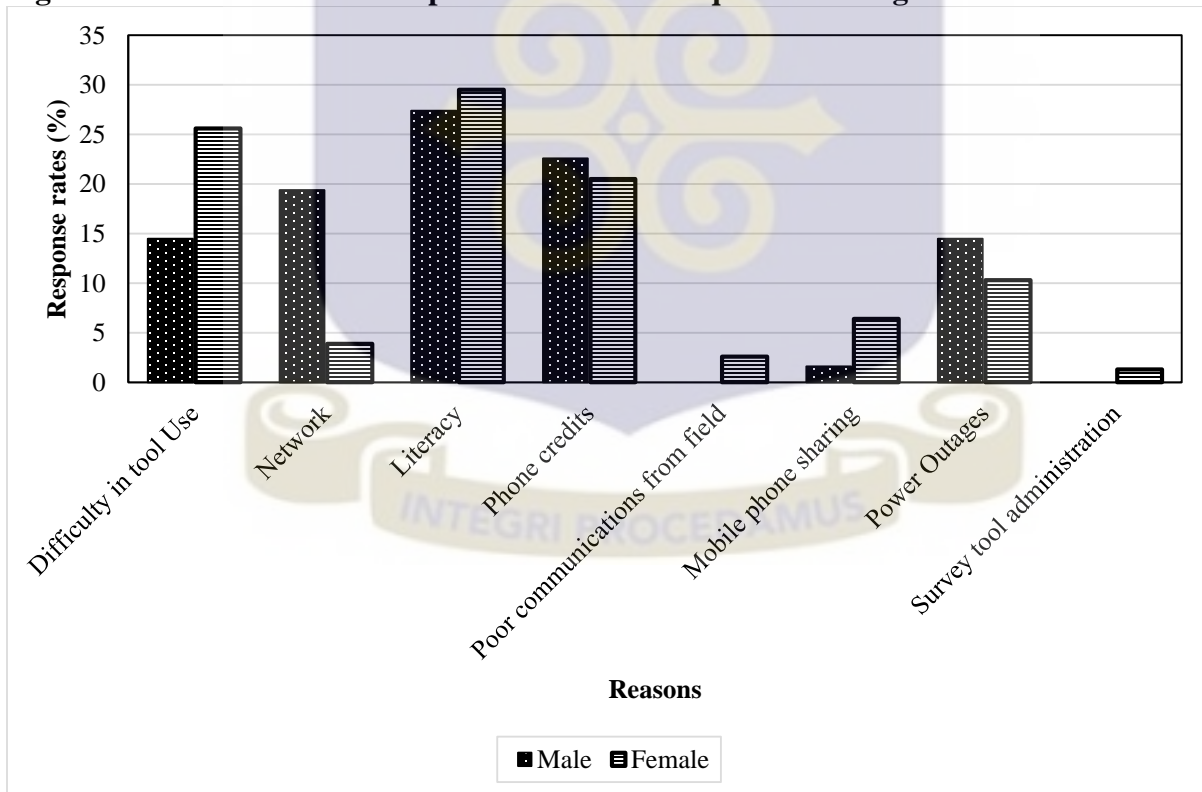
*“I do not want to burden myself with handling a phone. I have to always remember to charge it, buy credit and also keep it safe and not lose it. So the children use it a lot more than I do.”*

(FGD with adult men in Olowe)

**Figure 13: Reasons for non-response after the first quarter among age**



**Figure 14: Reasons for non-response after the first quarter among sex**



Thus, the mobile phone SMS M & E survey tool, although feasible was not acceptable, not easy to use and offered a low level of privacy as compared to the paper based tool.

#### **4.6 Cost analysis**

##### *Capital cost*

There was no capital cost for the paper based M & E survey tool as compared to that for the mobile phone tool, which amounted to GHS15,808.95 (US\$7,648.26). In this study, the start-up cost was included in the capital cost. The start-up cost for the paper based M & E survey tool was GHS7605.53 (US\$3,679.50) with that of the mobile phone SMS tool totaling GHS 11,228.01 (US\$5,432.03). As indicated in Figure 15, the capital cost for the paper based tool constituted 10% of the total cost, which includes the start-up cost. For the mobile phone SMS tool, the capital cost accounted for 70% of its total cost which also includes the start-up cost.

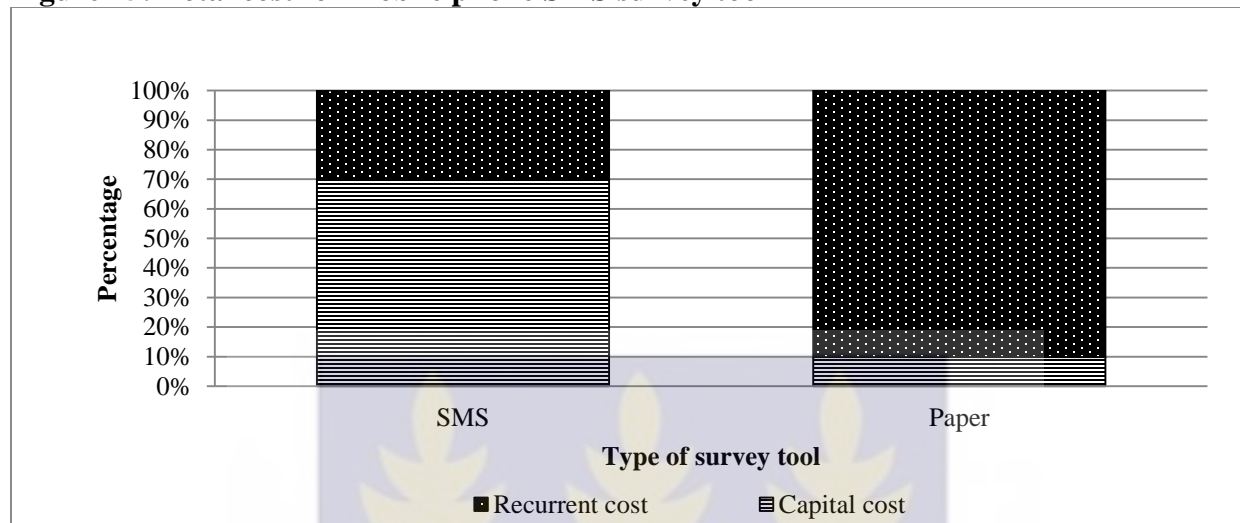
##### *Recurrent cost*

As shown in Figure 15, recurrent cost for the paper based tool constituted 90% of the total cost whilst that for the mobile phone SMS tool accounted for 30% of the total cost.

##### *Total cost*

The total cost of the paper based M & E survey tool was GHS 77,090.37 (US\$ 37,295.78) whilst that for the mobile phone tool amounted to GHS 38,748.58 (US\$ 18,746.29). Generally, the total cost of the paper based M & E survey tool was higher than that of mobile phone tool.

**Figure 15: Total cost for mobile phone SMS survey tool**



**4.7 Comparative cost of paper-based and mobile phone SMS tools**

Table 22 compared the direct costs, which were the capital, recurrent and total cost of the two M & E survey tools. Using the paper based M & E survey tool as the base case, the capital cost of the mobile phone SMS M & E survey tool was 355.5% compared to that of the paper based M & E survey tool, giving a difference 255.5% of the total capital cost. For recurrent cost, the mobile phone SMS M & E survey tool, which was 16.9% with a difference of 83.1% of the total recurrent cost. Total cost for the mobile phone SMS M & E survey tool was 50.3% with a difference of 49.7% of the total cost incurred for each tool.

In all four scenarios of 25%, 50%, 75% and 100%, the estimated increases in mobile phone SMS responses all at a capital cost discounted at rates of 3% and 6%, did not enhance the cost of mobile phone SMS M & E survey tool. In comparing the costs of the two tools, the reported users of improved toilet facilities; and cost per respondents who used improved toilet facilities and washed hands with soap after defecation can be interpreted as potentially acceptable

scenarios; whilst the cost per respondents who answered all five questions on the first date can be interpreted as acceptable.

**Table 22: Comparative cost of paper-based and mobile phone SMS tools**

Items	Capital cost		Recurrent cost		Total cost	
	(GHS)	%	(GHS)	%	(GHS)	%
Paper-based tool	7,605.59	0.0	69,484.84	0.00	77,090.43	0.0
Mobile phone SMS tool	27,036.96	355.5	11,711.61	16.9	38,748.57	50.3
Differences	-19,431.37	-255.5	57,773.23	83.1	38,341.86	49.7
Interpretation	Mobile phone SMS more expensive		Paper-based more expensive		Mobile phone SMS less expensive	

#### 4.8 Conclusion

In conclusion, the validity of the two M & E survey tools showed no acceptable levels of agreement in terms of their construct validity. The reliability of the two M & E survey tools showed no acceptable levels. Generally, the paper based tool was more effective than the mobile phone SMS tool in terms of response rate. The mobile phone SMS M & E survey tool, although feasible was not acceptable, not easy to use and offered a low level of privacy as compared to the paper based tool. Generally, comparatively, the total cost of the paper based M & E survey tool was higher than that of mobile phone M & E survey tool.

## CHAPTER FIVE

### 5.0 DISCUSSION

This chapter discusses results of the study. The chapter is divided into six main sections and compares the validity, reliability, effectiveness, feasibility, cost and cost minimization of the paper based and mobile phone M & E survey tools.

#### 5.1 Validity

From the results of this study, the validity of the two M & E survey tools show no acceptable validity in terms of their construct validity. Although the mobile phone SMS M & E survey tool was comparatively more valid than the paper tool in most of the quarters, an independent t-test showed that there was no significant difference in the means of the Cronbach's alpha values between the two M & E survey tools. In addition, Cronbach alpha values for both M & E survey tools were not within the assumed acceptable range of between 0.6 and 0.9 and therefore are not valid. Several studies emphasize that the validity of any tool or instrument should necessarily be within an acceptable range for its recognition in terms of measurability, and has been further addressed by findings from several studies (Bjertnaesa et al., 2010; Londoño & Schulz, 2014; Benito et al., 2013; Blackman et al., 2013).

On the basis of a maximum of only 160 characters, which the platform could accommodate, the construct validity could have been negatively affected. The opportunity to add more characters could have improved the construct of both M & E survey tools.

Further findings from this study also indicate that there is no significant correlation of defecation practices with the age of the respondent (OR = 1.256,  $p = 0.427$ ), sex (OR = 2.471,  $p = 0.167$ ) or occupation (OR = 0.595,  $p = 0.476$ ) for both tools. Therefore good defecation practices had no basis of correlation in terms of age, sex and occupation. Good defecation practices as a variable is, therefore, not dependent on these sociodemographic characteristics.

The results of this study also showed that the highest value for the weighted Kappa and their level of agreement for both M & E survey tools ranged from 47.9% to 38.0% across all quarters. An independent t-test for the differences in means for Kappa values between the two M & E survey tools showed that there was no significant difference ( $p$ -value = 0.2026) between the two tools. This is in contrast to findings from studies by Evenson et al. (2008) who observed acceptable validity values ( $\kappa = .80$ ) and moderate agreement following a retest ( $\kappa = .60$ , 95% CI = 0.52-0.67) for the tool under study. Equally, Telford et al. (2004) observed high agreement (85.7% to 95.6%) between two different tools. Bernabe-Ortiz et al. (2008) also reported a good agreement (86%) between data collected with paper format and handheld computers was 86%. Categorical variables agreement was between 70.5% and 98.5% (Kappa: 0.43–0.86) while numeric variables agreement was between 57.1% and 79.8% (Spearman: 0.76–0.95). In addition, Whitford et al., (2012) and Johansen & Wedderkopp (2010) also found that the text-messaging tool had excellent agreement compared to that for telephone for collecting information.

The low levels of agreement could have been from the high non-response rates on the basis that the use of improved toilet facilities and hand-washing practices were the only indicators for

sanitation. The inclusion of other good defecation practice indicators such as availability and accessibility of acceptable defecation disposal sites, number of people sharing the same toilet facilities, the use of improved public toilets, the affordability of using public toilet and other relevant good defecation practice indicators could be considered.

## **5.2 Reliability**

The results from this study shows that the reliability was generally higher for the mobile phone SMS M & E survey tool than for the paper based M & E tool. The mobile phone SMS M & E tool showed a comparatively higher reliability by the measure of the degree of timeliness and completeness of responses across all four quarters than the paper based M & E tool. Yet, the Bonferroni's test showed that there were no significant differences in means between the two survey tools in relation to their degree of timeliness ( $p = 0.1377$ ) and completeness ( $p = 0.0761$ ) for all four quarters. This is consistent with the findings from studies as reported by Braham et al., (2004) who compared two sets of data collection tools and concluded that there was no significant difference in data collected by the two tools.

The increased response rates in the fourth quarter may be attributed to increased mobile phone credit as incentives during the third and fourth quarters. Although the response rates were higher for the paper based M & E tool for most quarters, the use of the paper M & E tool may not be appropriate since the mobile phone SMS M & E tool indicated a higher level of timeliness and completeness of responses in the second quarter. It is implied that the mobile phone SMS M & E tool could be further improved. In contrast to the findings in this study, Vallejo et al. (2007) report on the comparison of the online and paper based versions of the same tool. Vallejo et al.

(2007) found that both tools had an equivalent high consistency for reliability and response rates for the paper based tools were higher than online ones. The study concluded that even when an online test has shown acceptable reliability and validity values, the use of normative data from paper based M & E tools may not be appropriate. Lim et al., (2008, 2010) also compared response rates, timeliness, completeness of data and acceptability by randomizing participants into one of three groups of SMS, online or paper (by post). An online survey was conducted at the end of three months to compare retrospective data collected and found that although the SMS tool was a convenient and timely data collection tool, the online tool was preferable to most respondents and more likely to be complete. The finding in this study is in contrast to studies by Frennered et al., (2010) and Brussoni et al., (2013) which showed acceptable limits for reliability. Frennered et al. (2010) asserted that the computerized touch-screen tools virtually eliminate missing values and show good reliability compared to paper forms. Ly & Golberg, (2014) argue that in validating a newly developed tool the assessment of its reliability is important. This is supported by findings from the studies of Mendoza et al., (2010) who tested a paper M & E tool and affirmed that the reliability levels of the tool was acceptable.

The low response rates for the paper tool for the fourth quarter could be as a result of research fatigue due to the presence other SUSA Work Packages in Prampram, which were using the same study population.

Generally, for the mobile phone SMS M & E survey tool, respondents assigned several reasons as some of the challenges encountered. Some of the reasons were mobile phone sharing, low literacy level, power outages, no mobile phone credit and poor network services. These reasons

could have contributed to the low levels of completeness and timeliness of responses. For paper based M & E survey tool, general apathy towards research, research fatigue, absence of respondents during visits by field assistants and the sensitive nature of the subject matter could have contributed to the low levels timeliness of responses. These combined factors for both mobile phone and paper based M & E survey tools could have contributed to the low levels of reliability of both M & E survey tools.

### **5.3 Acceptability and ease of use**

The results from this study indicated that, out of a total of 916 respondents across all four quarters, the number of users of improved toilet facilities for the mobile phone SMS M & E tool were only 4 (0.5%) whilst that of the paper based M & E tool were 20 (2.2%). However, a total 896 (97.8%) and 264 (28.9%) respondents indicated their use of unimproved toilet facilities using the paper based M & E and mobile phone SMS M & E tools respectively also throughout all four quarters. From the results, the number of respondents who used improved toilet facilities, washed hands and captured by the paper based M & E tool were 8 (1.0%) whilst users of improved toilet facilities, who washed hands and answered by the mobile phone SMS M & E tool were only 4 (0.5%) for all four quarters. Users of unimproved toilet facilities, who washed hands and captured by the paper based M & E tool were 340 (37.0%) with 144 (15.7%) being users of unimproved toilet facilities, who washed hands and captured by the mobile phone SMS M & E tool during all the four quarters. The study results are consistent with those of other studies conducted which indicated that rates of hand washing with soap range from zero to 34 % (Steiner-Aseidu et al., 2011; Afroza, 2007; GHW 1, 2008; Dykes, 2008; Scott et al, 2003). The result findings also shows that open defecation is still a challenge in the Ningo Prampram district

of the Greater- Accra district of Ghana; and confirms the JMP's report that Ghana currently has a total open defecation rate of 19%, an urban open defecation rate of 7% and a rural open defecation rate of 33% (WHO & UNICEF, 2014). According to another report, most urban and peri-urban households in Ghana use public latrines while a larger proportion of rural households defecate in the open (JMP, 2013).

The total number of respondents who answered all 5 questions by the paper based M & E tool were 896 (97.8%) whilst 264 (28.9%) answered all 5 questions by the mobile phone SMS M & E tool. As a measure of timeliness using the paper based tool, a total of 20 (2.2%), 40 (4.4%) and 120 (13.1%) respondents, answered on the first, second and third survey dates respectively. For the mobile phone SMS M & E tool, only 40 (4.4%), 71 (7.7%) and 148 (16.4%) respondents completed responses on the first, second and third survey dates respectively. The low mobile phone SMS response rate is supported by quotes from the focus group discussions in the following statements:

*“There are many problems with the mobile phone. Credits, lights off, low battery and network problems. But the paper does not have these. The paper is better.”* (FGD with young men in Kley).

*“This is an embarrsing issue, concerning toilet, so I feel shy about it. (FGD with young women in Olowe).*

*“Low battery is a big issue because I share my charger with my friend.”* (FGD with adult men in Lower West).

Similar to findings from this study, several studies have indicated that low response rate of a survey sample leads to non-response error, which has been identified as one of the challenges when using text messaging for data gathering (Moller et al., 2012; Kew, 2010; Bexelius et al., 2009, Roberts & Gorman, 2009; Cocosila et al., 2008; Anhoj & Moldrup, 2004). In these studies text messaging response rates ranged between averages of 14% to 100% is dependent on several factors including finding operational mobile phone numbers, appropriate introduction to the aims of the study, benefits to respondents, and respondents' awareness of the study. According to findings from studies by Bexelius et al., (2009), randomly selected mobile phone numbers from the Swedish population registry achieved a response rate of 14% whilst that of Kew (2010) had a response rate of 100%. These response rates were also dependent on the literacy levels of this sampled population.

Li et al. (2013), argue that respondents are more likely to complete the text messaging survey when they respond to the first text message question and thus the need to explore how the response rate can be increased. In addition, levels of literacy and occupation (Kew, 2010; Haberer et al. 2010), the exact time of the day (Schembre & Yuen., 2011; Brick et al., 2007) and the level of convenience of the tool in use (Roberts & Gorman., 2009; O'Toole et al., 2008) were associated with response rates.

From the results, although there were no incentives for the paper based M & E respondents, the highest rates for completeness (99.5%) and timeliness (15.3%) of responses were recorded. This occurred in the third quarter. This is in confirmation with several studies have argued that non-response bias is highly unaffected by a growing non-response rate (Abraham et al., 2009;

Groves, 2006; Merkle & Edelman, 2002; Keeter, 2000; Curtin et al., 2000). This is supported by findings from the studies of Dirmaier et al. (2007); Teisl et al., (2005); Petrolia & Bhattacharjee (2009); Curtin et al., (2007); and Cantor et al. (2008); that there are no effects of incentives on nonresponse. Singer, (2010) discusses that monetary incentives may be convenient but should be a last option for any study; since this may be not be cost-effective (Görizt, 2006a).

Respondents gave varied reasons as difficulties in the usage of both mobile phone and paper based M & E survey tools. These reasons included issues with privacy, acceptability and ease of use of the M & E survey tools. Other related reasons such as mobile phone sharing, low literacy level, power outages, no mobile phone credit, poor network services, general apathy towards research, research fatigue, absence of respondents during visits by field assistants and the sensitive nature of the subject matter also contributed to difficulties in using both M & E survey tools. All these diverse reasons could have contributed to the low response rates for the mobile phone M & E survey tool. Although, the response rates for the paper based M & E survey tool was relatively higher than the mobile phone SMS M & E survey tool, but for the reasons outlined above, the response rates could have been much higher.

Again, respondents overwhelmingly indicated their preference for the paper based M & E survey tool. In spite of the difficulties associated with the paper based M & E survey tools and the benefits linked with the mobile phone SMS M & E survey tool, the field assistant factor gave the respondents some assistance in responding to the questionnaire. Also, the presence of the field assistant made it difficult for the respondents to ignore responding to the questionnaire. As such, respondents were at ease dealing with a 'human' than merely responding to some message by an

unknown mechanism such as the mobile phone platform. Besides, the field assistants used the language of the respondents, thus eliminating the low literacy level issue. Hence, the face-to-face factor played a key role in the effectiveness of the paper based M & E survey tool.

#### **5.4 Feasibility**

The low response rate could be explained by several factors such as unavailability of electricity and poor network services. From the results, the paper based M & E tool was comparatively more acceptable, easier to use and offered more privacy. In addition, although sanitation data collection with the mobile phone SMS M & E tool was feasible, there were several challenges such as issues of low literacy, the unavailability network services, phone credit, phone sharing, low battery, incentives, forgetfulness and unavailability of electricity resulting in their inability to charge their mobile phones.

From the responses, the older respondents were of lower literacy levels and had challenges texting messages on their phones. This was coupled with unavailability of electricity and poor network services as compared to the younger respondents. Other respondents had challenges in the use of the SMS mobile phone tool. Mobile phone sharing was also a challenge for older respondents.

In contrast to findings from this study, Heinonen et al., (2012) argue that it is essential that respondents find any data collection tool easy to use and also not encounter network challenges. Heinonen et al., (2012) concludes that these factors could affect the sustainability of such new technologies on larger scales of data collection. Hays et al., (2001) support the arguments of

Heinonen et al., (2012) by indicating that there could be high non-response rates for mobile phone tools, varying according to the population, the subject matter and study length. Fenton et al. (2001) and Gillmore et al. (2001) also suggested that study results are often challenged by fatigue and habituation effects. Maumbe & Okello (2013) reason that respondent's privacy, confidentiality, widespread availability, low cost of mobile phone technology, literacy and cell phone use practices should also be important factors to consider preceding the use of mobile phone technology in data collection. This is to promote acceptance and effectiveness, which may determine the level of sustainability for such a technology in the context of data collection (Maumbe & Okello, 2013).

Tomlinson et al., (2009) test and explore the feasibility of mobile technology, in terms of data loss and uploading challenges, which offers mobile phones as a feasible method of data collection requiring further exploration. Similar to findings by Crankshaw et al., (2010) the results from this study show that use of mobile phone text messaging for intervention purposes is feasible and may be further investigated. Other findings by Zhang et al., (2012) show that although household survey data collection is predominantly paper based, mobile phone text messaging may have advantages over paper, but little evidence exists on how they compare. Furthermore, Zhang et al. (2012) and Whitford et al. (2012) conclude that mobile phone technology has the potential to produce quality data.

In spite of respondents' general preference for the paper based M & E survey tool, critical factors such as cost, the practicability and the possibility of the use of the mobile phone for data collection meant that the use of mobile phone as an M & E survey tool for sanitation data

collection is feasible in a peri-urban setting. This is a crucial issue not only in sanitation data collection alone, but also in using mobile phone as a data collection tool in research in general in developing countries. It is expected that improvements in technology, experience with use of mobile phone in research by both researchers and respondents and the suitability of mobile phone as a data collection tool for a particular researches may have positive effects on the validity, reliability, effectiveness and cost of using mobile phone as a data collection tool.

### **5.5 Cost analysis**

The Millennium Development Goals (MDGs) represent a transformed determination to resolve the numerous challenges of human development (WHO & UNICEF, 2010b). For the sanitation sector, the goal is to halve the proportion of people without sustained access to safe drinking water and basic sanitation by 2015 (JMP, 2010). However, while enormous investments have been made, there is limited information on whether the resulting facilities are still in effective use in addition to the development of good hygiene habits (WHO & UNICEF, 2012). It is only from such reliable sanitation information that assessment of the usefulness of these goals in terms of health and poverty reduction can be made; since the evaluation of access alone is not sufficient (Boot & Cairncross 1993, Jenkins & Scott, 2007). Therefore, sanitation experts have identified the prospective of these phones, as tools to enhance services, by collecting and sharing information at a low cost, rapidly, reliably and directly to or from the underprivileged and vulnerable populations who greatly need these services (Thomson et al., 2012a).

## 5.6 Cost minimization

Although the capital cost of the mobile phone SMS M & E survey tool was about four times the capital cost of the paper based M & E survey tool, the recurrent cost of the paper based M & E survey is about six times that of the mobile phone SMS M & E survey tool. The low capital cost of the paper based M & E survey tool can be attributed to the zero startup cost as against GHS11,228.01 (US\$5,432.03) for the startup cost for mobile phone SMS M & E survey tool. The relatively high startup cost of the mobile phone SMS M & E survey tool is compensated for by a very low recurrent expenditure because there are minimal costs associated with the sending and receiving of the SMS text messages. In this study, even though in the third and fourth quarters respondents were given incentives in the form of mobile phone credit as compensation for using their units to respond to the questions, the amount involved is still lower than engaging the services of field assistants to facilitate the implementation of the paper based M & E survey tool. The major cost component for the entire study was the engagement of the field assistants, thus making the paper based M & E survey tool relatively more expensive than the mobile phone SMS M & E survey tool. This reflects in the resultant total cost where the paper based M & E survey tool is twice that of the mobile phone SMS M & E survey tool.

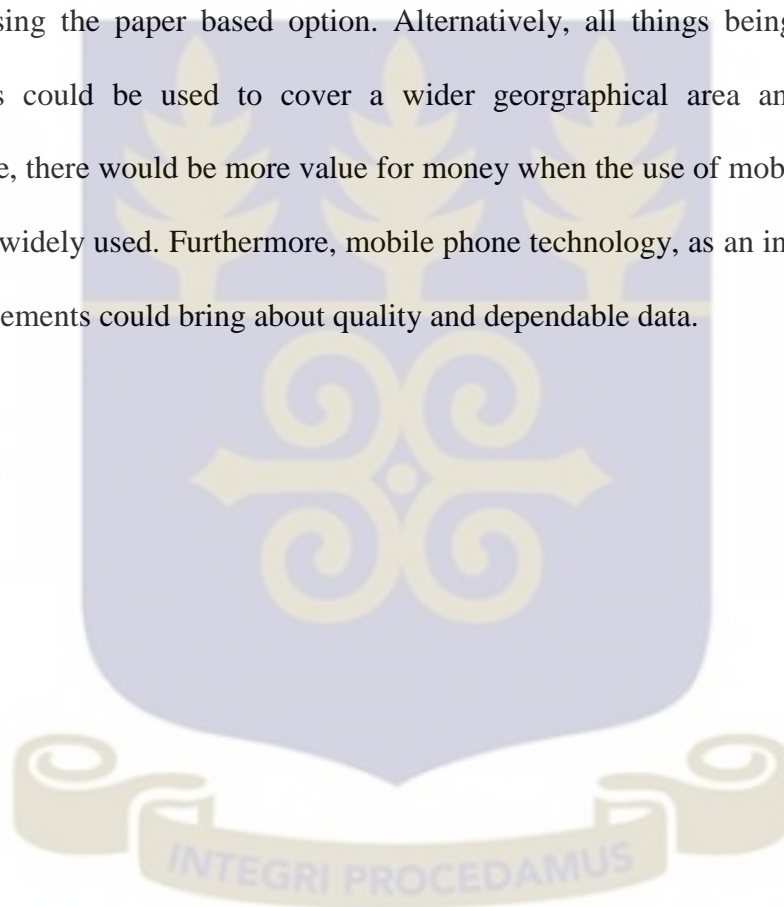
Similar to findings by Prydz (2013), this study indicates that implementation of research with low direct costs of materials is feasible. In contrast to Rascati (2009) this showed that respondents incurred cost. However, the cost of service delivery as a whole was difficult to estimate. Similar to the findings from this study, Heerden et al., (2014) consider the limitations of human resource, as a useful important aspect of the study and include the target population themselves, which needs a multidimensional and sustained approach. The whole aim of

acceptability, determination of the cost minimization, and evaluation of the sustainability of the peer-reviewed programs can be achieved. Mobile phone technology could offer one practical approach for increasing reliability of gathering data.

In the findings from studies by Riensch & Beswick (1990) and Newby and Hill (2003) it is feasible for the inexpensive alternative to the desired outcome. Overwhelmingly, the response rates on defecation practices and hand-washing using the paper based M & E tool were generally higher than that of the mobile phone SMS M & E tool making the mobile phone SMS M & E tool the less effective of the two tools.

In conclusion, all indicators showed that the paper based M & E tool was cheaper than the mobile phone SMS M & E tool. The cost of newly developed mobile phone SMS M & E tool is important in determining whether it may be scaled up or have more resources channeled into its further improvement. Nevertheless, the decision to scale up or not is also dependent on other factors, such as the essence policymakers place on sanitation data reliability, accuracy and timeliness in a continuous context. It is worth noting that our study was undertaken in a peri-urban setting and thus the findings may not be applicable to urban settings. Furthermore, under the prevailing resource constraints the cost of all interventions is especially important (JMP & UNICEF, 2012). There are, however, very few studies with hard data on the costs and effectiveness of survey tools in the sanitation sector; and even fewer studies have compared the cost minimization of different survey tools and approaches.

Given that the cost of paper based M & E survey tool is twice the cost of the mobile phone M & E survey tool, there is the clear indication that mobile phone as a survey tool is feasible and that sponsors and researchers should consider exploring the option of researching ways of improving the mobile phone tool as a survey tool. The mobile phone as a cheaper alternative also implies that, all things being equal, funders and researchers would require relatively less funds to the same research using the paper based option. Alternatively, all things being equal, the same amount of funds could be used to cover a wider geographical area and or cover more population. Hence, there would be more value for money when the use of mobile phone as a data collection tool is widely used. Furthermore, mobile phone technology, as an intervention, aiming at peri-urban settlements could bring about quality and dependable data.



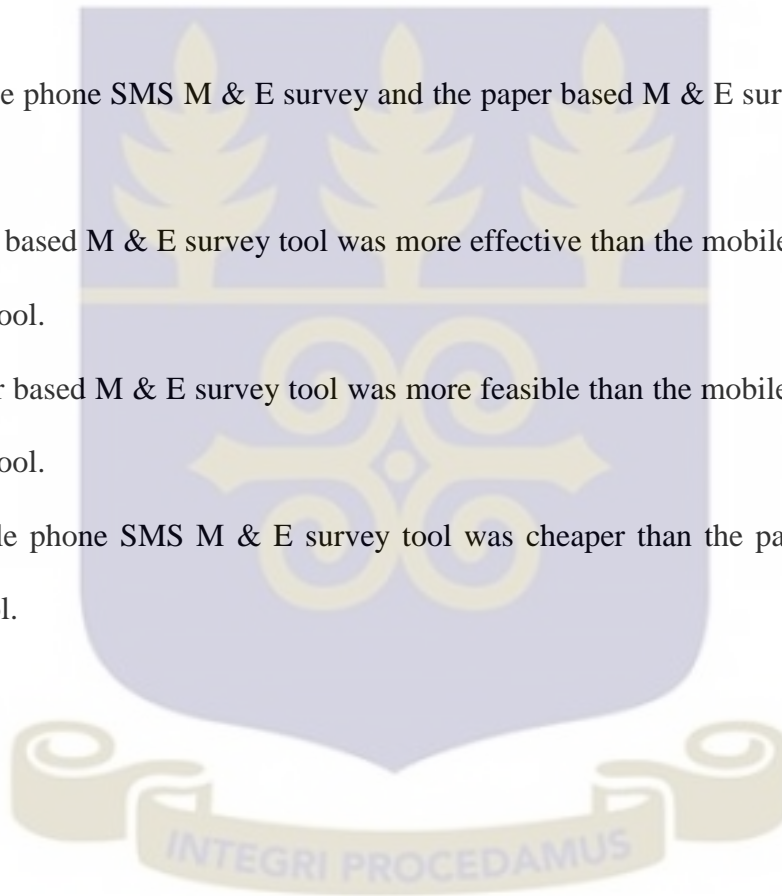
## CHAPTER SIX

### 6.0 CONCLUSION AND RECOMMENDATIONS

#### Key findings

The key findings of the study are:

1. The mobile phone SMS M & E survey and the paper based M & E survey tools were not valid.
2. The mobile phone SMS M & E survey and the paper based M & E survey tools were not reliable.
3. The paper based M & E survey tool was more effective than the mobile phone SMS M & E survey tool.
4. The paper based M & E survey tool was more feasible than the mobile phone SMS M & E survey tool.
5. The mobile phone SMS M & E survey tool was cheaper than the paper based M & E survey tool.



Although there were no significant differences in means between the two M & E survey tools in relation to their degree of timeliness and completeness of responses for all four quarters, the mobile phone SMS survey tool promises to be timely and reliable in terms of completeness of responses. In this sample and for these questions, there were no significant differences in the reliability and validity for both survey tools. Overwhelmingly, the response rates on defecation practices and hand-washing using the paper based M & E survey tool were generally higher than that of the mobile phone SMS M & E survey tool making it the less effective of the two M & E survey tools. Although the mobile phone SMS M & E survey tool was acceptable to respondents who used both M & E tools, its total costs were lower than the paper based M & E survey tool. The indicators showed that the mobile phone SMS M & E tool was cheaper. This mobile phone solution has the potential to be scaled up in an extensive way for teams and studies of almost any size. The mobile phone technology, combined with the continuous improvement that mobile phones offer over the paper, in terms of data loss and uploading difficulties, make mobile phones a feasible method of data collection that needs to be further explored.

## **6.1 Conclusions**

In the context of the various factors considered in this study, the following conclusions have been drawn:

1. In conclusion, although both M & E survey tools are statistically insignificant in their estimated validities and reliabilities, the mobile phone SMS M & E survey tool for sanitation data collection is relatively more valid, more reliable and cheaper. However, the paper based tool is more effective and feasible. As such, the paper based tool is the

better sanitation data collection M & E survey tool in the context of Prampram, a peri-urban settlement.

2. In many ways, the advent of the mobile phone technology could intensify and broaden the sanitation data collection in the face of paper based tool challenges. Furthermore, the mobile phone technology, as an intervention, aiming at peri-urban settlements could bring about potential quality and dependable data as specified by the JMP in the future.
3. Data collection is an aspect of Public Health surveillance, which includes the continuous, systematic, collection, analysis and interpretation of health related data needed for the planning, implementation and evaluation of Public Health practice. Work Package Six looked at one of such new innovative insights so as to inform policy and plans in support of community health efforts by mobilizing community partnership in diagnosing, identifying and solving health problems.

## **6.2 Recommendations**

The following recommendations are made from the study:

1. The format of the questions on the mobile phone SMS M & E survey should be improved by the use of sanitation pictorial mobile phone technology for data collection to ensure a higher levels acceptability and ease of use. Stakeholders could further examine the use the pictorial mobile phone technology for data collection as a guide for low-literacy populations.
2. As the issue of defecation practices is often a sensitive and an unpleasant subject to discuss in public, estimated validities and reliabilities could have been negatively affected. Hence, there is the need for further research in other settings to support these

findings. Therefore, findings from the study would serve as a baseline research to help improve knowledge on validity, reliability and cost minimization of the tools.

3. With appropriate education and sensitization, the mobile phone SMS M & E tool can be used as a more effective, feasible and cost-effective tool than the traditional paper based tool in relation to sanitation data collection. This should be achieved by orientation of the target groups at the onset of the study.



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**APPENDIX 1: INFORMED CONSENT FORM FOR LITERATE RESPONDENTS IN  
THE HOUSEHOLD SURVEY**

**Monitoring and Evaluation Tools for Sanitation: A Comparative Study of Mobile Phone and Traditional Paper Based Survey of Defecation Practices in the Ningo-Prampram District of Ghana**

I am Sarah Van-Ess, a PhD student at the University of Ghana affiliated with the Dodowa Research Centre in the Ningo-Prampram District and this is my team. I am conducting a study about sanitation in your community. This study is on monitoring and evaluation tools for sanitation and will compare the mobile phone SMS technology and traditional paper based survey of defecation practices in the Ningo-Prampram District of Ghana. The information collected from this study will be useful in comparing the reliability and validity of both types of survey tools at the community and district level for any future water and sanitation projects.

For the next 45 minutes, I would like to ask you to contribute to the study by answering certain questions about your defecation practices. I would also like to say that some of the questions are sanitation related and may be embarrassing and may cause uneasiness. All efforts will be made to reduce any embarrassment and you can cease to participate in the study at any time. All information provided during participation in the study will be kept confidential and none of the personal information obtained which could identify you will be used in any report. There will be no cost to you for participation and your participation is entirely voluntary.

You will not be paid any money or receive any payment before, during, or after the study. Your participation in the study, will contribute to efforts for more reliable, dependable and continuous sanitation data collection and generation relating to improving health in the community and the information will help in planning future sanitation projects. Study results and findings may be shared with and used by your community as a whole, other researchers, health staff, local government officials, and other stakeholders at the district, national and international levels and may be published in internationally.

This study will use non-participatory observation of the surrounding environment requiring the researcher to observe their surroundings as people go about their normal activities in order to gather data. You will clearly need to understand that if you agree to participate, the researcher will observe you and may take photographs and make audio and videos recordings with your permission and all images and voices of persons will be duly protected by ensuring that they will not be recognised and not be used publicly; and securely kept under lock and key. These observations made by the researcher may be recorded as field notes, recorded on a digital recorder and later transcribed. There may be the need for you to use your mobile phone to answer some of the questions in a Short Messaging Service (SMS) Text form. Thorough privacy will be ensured and no reference will be made to your identity. Any digital media coverage will be recorded in a manner to ensure your privacy. All the electronic data will be kept for at least 2 years for the purpose all required publications.

If there are any times that you do not feel comfortable either in having the researcher accompanying you or answering any questions, or do not understand what is being asked or how

particular observations will be used in the research, please let the researcher know and clarify any issues.

All questions are permitted and for any concerns or issues regarding the study please contact

Dr. Margaret Gyapong  
Dodowa Health Research Centre  
P.O.BOX 1  
Dodowa  
Tel: 0244 573138

Dr Moses Aikins  
University of Ghana  
Legon  
Accra  
Tel 0244 433743

If you have read and understood all the above statement and voluntarily agree to participate at no cost please make the following statement and sign that:

“The content and purpose of the study has been read to me and I have been assured of confidentiality of my responses. I have had the opportunity to ask questions. I agree to participate voluntarily in this study and give my consent to the publication of findings. I also grant permission that following recording methods to be used video recording and photograph(s) may be used. Any additional conditions for my participation in this research has been discussed and noted.”

Signature/Thumb print of participant \_\_\_\_\_

Date: \_\_\_\_\_

I, Sarah Van-Ess confirm that all clarifications have been made to the participant who has been given the opportunity to ask questions about the study, and all the questions asked by him/her have been answered correctly to the best of my ability. As a respondent, I have read and understood that the participation is void of intimidation and any act of involuntary nature. Total consent by the participant is voluntary.

Name of Researcher/Field Assistant \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

Place of interview \_\_\_\_\_



## **APPENDIX 2: INFORMED CONSENT FORM FOR ILLITERATE RESPONDENTS IN THE HOUSEHOLD SURVEY**

### **Monitoring and Evaluation Tools for Sanitation: A Comparative Study of Mobile Phone and Traditional Paper Based Survey of Defecation Practices in the Ningo-Prampram District of Ghana**

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For the next 45 minutes, I would like to ask you to contribute to the study by answering certain questions about your defecation practices. I would also like to say that some of the questions are sanitation related and may be embarrassing and may cause uneasiness. All efforts will be made to reduce any embarrassment and you can cease to participate in the study at any time. All information provided during participation in the study will be kept confidential and none of the personal information obtained which could identify you will be used in any report. There will be no cost to you for participation and your participation is entirely voluntary.

You will not be paid any money or receive any payment before, during, or after the study. Your participation in the study, will contribute to efforts for more reliable, dependable and continuous sanitation data collection and generation relating to improving health in the community and the information will help in planning future sanitation projects. Study results and findings may be shared with and used by your community as a whole, other researchers, health staff, local government officials, and other stakeholders at the district, national and international levels and may be published internationally.

This study will use non-participatory observation of the surrounding environment requiring the researcher to observe their surroundings as people go about their normal activities in order to gather data. You will clearly need to understand that if you agree to participate, the researcher will observe you and may take photographs and make audio and videos recordings with your permission. These observations made by the researcher may be recorded as field notes, recorded on a digital recorder and later transcribed. There may be the need for you to use your mobile phone to help to answer some of the questions in a Short Messaging Service (SMS) Text form. The assistance of the interpreter will be employed at your convenience. Thorough privacy will be ensured and no reference will be made to your identity. Any digital media coverage will be recorded in a manner to ensure your privacy. All the electronic data will be kept for at least 2 years for the purpose all required publications.

If there are any times that you do not feel comfortable either in having the researcher accompanying you or answering any questions, or do not understand what is being asked or how

particular observations will be used in the research, please let the researcher know and clarify any issues through the interpreter.

All questions are permitted and for any concerns or issues regarding the study please contact

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If you have understood all the above translations and voluntarily agree to participate at no cost please make the following statement through the interpreter and thumbprint to indicate that:

“The content and purpose of the study has been read and translated to me and I have been assured of confidentiality of my responses. I have had the opportunity to ask questions. I agree to participate voluntarily in this study and give my consent to the publication of findings. I also grant permission that following recording methods to be used video recording and photograph(s) may be used. Any additional conditions for my participation in this research has been discussed and noted.”

Signature/Thumb print of participant \_\_\_\_\_

Date: \_\_\_\_\_

I, Sarah Van-Ess confirm that all clarifications have been made to the participant who has been given the opportunity to ask questions about the study, and all the questions asked by him/her have been answered correctly to the best of my ability. As a respondent, I have read and understood that the participation is void of intimidation and any act of involuntary nature. Total consent by the participant is voluntary.

Name of Researcher/Field Assistant \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

Place of interview \_\_\_\_\_



**APPENDIX 3: INFORMED CONSENT FORM FOR RESPONDENTS IN THE IN-  
DEPTH INTERVIEW**

**Monitoring and Evaluation Tools for Sanitation: A Comparative Study of Mobile Phone and Traditional Paper Based Survey of Defecation Practices in the Ningo-Prampram District of Ghana**

I am Sarah Van-Ess, a PhD student at the University of Ghana affiliated with the Dodowa Research Centre in the Ningo-Prampram District and this is my team. I am conducting a study about sanitation in your community. This study is on monitoring and evaluation tools for sanitation and will compare the mobile phone SMS technology and traditional paper based survey of defecation practices in the Ningo-Prampram District of Ghana. The information collected from this study will be useful in comparing the reliability and validity of both types of survey tools at the community and district level for any future water and sanitation projects.

For the next 45 minutes, I would like to ask you to contribute to the study by answering certain questions about your defecation practices. I would also like to say that some of the questions are sanitation related and may be embarrassing and may cause uneasiness. All efforts will be made to reduce any embarrassment and you can cease to participate in the study at any time. All information provided during participation in the study will be kept confidential and none of the personal information obtained which could identify you will be used in any report. There will be no cost to you for participation and your participation is entirely voluntary.

You will not be paid any money or receive any payment before, during, or after the study. Your participation in the study, will contribute to efforts for more reliable, dependable and continuous sanitation data collection and generation relating to improving health in the community and the information will help in planning future sanitation projects. Study results and findings may be shared with and used by your community as a whole, other researchers, health staff, local government officials, and other stakeholders at the district, national and international levels and may be published in internationally.

This study will use non-participatory observation of the surrounding environment requiring the researcher to observe their surroundings as people go about their normal activities in order to gather data. You will clearly need to understand that if you agree to participate, the researcher will observe you and may take photographs and make audio and videos recordings with your permission. These observations made by the researcher may be recorded as field notes, recorded on a digital recorder and later transcribed. There may be the need for you to use your mobile phone to answer some of the questions in a Short Messaging Service (SMS) Text form. Thorough privacy will be ensured and no reference will be made to your identity. Any digital media coverage will be recorded in a manner to ensure your privacy. All the electronic data will be kept for at least 2 years for the purpose all required publications.

If there are any times that you do not feel comfortable either in having the researcher accompanying you or answering any questions, or do not understand what is being asked or how particular observations will be used in the research, please let the researcher know and clarify any issues.

All questions are permitted and for any concerns or issues regarding the study please contact

Dr. Margaret Gyapong  
Dodowa Health Research Centre  
P.O.BOX 1  
Dodowa  
Tel: 0244 573138

Dr Moses Aikins  
University of Ghana  
Legon  
Accra  
Tel 0244 433743

If you have read and understood all the above statement and voluntarily agree to participate at no cost please make the following statement and sign that:

“The content and purpose of the study has been read to me and I have been assured of confidentiality of my responses. I have had the opportunity to ask questions. I agree to participate voluntarily in this study and give my consent to the publication of findings. I also grant permission that following recording methods to be used video recording and photograph(s) may be used. Any additional conditions for my participation in this research has been discussed and noted.”

Signature/Thumb print of participant \_\_\_\_\_

Date: \_\_\_\_\_

I, Sarah Van-Ess confirm that all clarifications have been made to the participant who has been given the opportunity to ask questions about the study, and all the questions asked by him/her have been answered correctly to the best of my ability. As a respondent, I have read and understood that the participation is void of intimidation and any act of involuntary nature. Total consent by the participant is voluntary.

Name of Researcher/Field Assistant \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

Place of interview \_\_\_\_\_



## **APPENDIX 4: INFORMED CONSENT FORM FOR RESPONDENTS IN THE FOCUS**

### **GROUP DISCUSSIONS**

#### **Monitoring and Evaluation Tools for Sanitation: A Comparative Study of Mobile Phone and Traditional Paper Based Survey of Defecation Practices in the Ningo-Prampram District of Ghana**

I am Sarah Van-Ess, a PhD student at the University of Ghana affiliated with the Dodowa Research Centre in the Ningo-Prampram District and this is my team. I am conducting a study about sanitation in your community. This study is on monitoring and evaluation tools for sanitation and will compare the mobile phone SMS technology and traditional paper based survey of defecation practices in the Ningo-Prampram District of Ghana. The information collected from this study will be useful in comparing the reliability and validity of both types of survey tools at the community and district level for any future water and sanitation projects.

For the next 45 minutes, I would like to ask you to contribute to the study by answering certain questions about your defecation practices. I would also like to say that some of the questions are sanitation related and may be embarrassing and may cause uneasiness. All efforts will be made to reduce any embarrassment and you can cease to participate in the study at any time. All information provided during participation in the study will be kept confidential and none of the personal information obtained which could identify you will be used in any report. There will be no cost to you for participation and your participation is entirely voluntary.

You will not be paid any money or receive any payment before, during, or after the study. Your participation in the study, will contribute to efforts for more reliable, dependable and continuous sanitation data collection and generation relating to improving health in the community and the information will help in planning future sanitation projects. Study results and findings may be shared with and used by your community as a whole, other researchers, health staff, local government officials, and other stakeholders at the district, national and international levels and may be published in internationally.

This study will use non-participatory observation of the surrounding environment requiring the researcher to observe their surroundings as people go about their normal activities in order to gather data. You will clearly need to understand that if you agree to participate, the researcher will observe you and may take photographs and make audio and videos recordings with your permission. These observations made by the researcher may be recorded as field notes, recorded on a digital recorder and later transcribed. There may be the need for you to use your mobile phone to answer some of the questions in a Short Messaging Service (SMS) Text form. Thorough privacy will be ensured and no reference will be made to your identity. Any digital media coverage will be recorded in a manner to ensure your privacy. All the electronic data will be kept for at least 2 years for the purpose all required publications.

If there are any times that you do not feel comfortable either in having the researcher accompanying you or answering any questions, or do not understand what is being asked or how particular observations will be used in the research, please let the researcher know and clarify any issues.

All questions are permitted and for any concerns or issues regarding the study please contact

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University of Ghana  
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If you have read and understood all the above statement and voluntarily agree to participate at no cost please make the following statement and sign that:

“The content and purpose of the study has been read to me and I have been assured of confidentiality of my responses. I have had the opportunity to ask questions. I agree to participate voluntarily in this study and give my consent to the publication of findings. I also grant permission that following recording methods to be used video recording and photograph(s) may be used. Any additional conditions for my participation in this research has been discussed and noted.”

Signature/Thumb print of participant \_\_\_\_\_

Date: \_\_\_\_\_

I, Sarah Van-Ess confirm that all clarifications have been made to the participant who has been given the opportunity to ask questions about the study, and all the questions asked by him/her have been answered correctly to the best of my ability. As a respondent, I have read and understood that the participation is void of intimidation and any act of involuntary nature. Total consent by the participant is voluntary.

Name of Researcher/Field Assistant \_\_\_\_\_

Signature \_\_\_\_\_ Date \_\_\_\_\_

Place of interview \_\_\_\_\_



**APPENDIX 5: STRUCTURED QUESTIONNAIRE FOR THE MOBILE PHONE**

**SURVEY TOOL**

Thank you for joining this study. My name is Sarah Van-Ess. In about 45 minutes we want to find what your choices in terms your opinion of the use of the Mobile phone as a Monitoring and evaluation survey tool. All answers are welcome; we just want to know your opinion. You can say what you want, and what you say will not be quoted individually. All information will be kept confidential.

The main themes for the interview are on monitoring and evaluation tools for sanitation and will compare the mobile phone SMS technology and traditional paper based survey of defecation practices in the Ningo-Prampram District of Ghana. The information collected from this study will be useful in comparing the reliability and validity of both types of survey tools at the community and district level for any future water and sanitation projects.

I seek your permission to record, take pictures or video this interview and assure you that it will only be used for the research purpose and will not be released to any authority.

If you agree to participate in the study, please sign this (consent form) document for me. You are all encouraged to participate in the discussion.

.....

Code

Interview Date           (dd/mm/yyyy)

Household ID

Participant's Unique ID

.....

Q1. What is your age?

A. 18-29  B. 30-39  C. 40-49  D. 50 and Older

Q2. What is your Sex?

A. Male  B. Female

Q3. Where did you last go to toilet?

A. Beach

B. Bush

C. Public KVIP D

D. Shared House Toilet

E. Private Toilet

F. Other

Q4. During your last toilet did you use a plastic bag?

A. Yes  B. No  C. Do not Remember

Q5. After your last toilet, did you wash your hands with soap?

A. Yes  B. No  C. Do not Remember



**APPENDIX 6: STRUCTURED QUESTIONNAIRE FOR THE PAPER SURVEY TOOL**

Thank you for joining this study. My name is Sarah Van-Ess. In about 45 minutes we want to find what your choices in terms your opinion of the use of the Mobile phone as a Monitoring and evaluation survey tool. All answers are welcome; we just want to know your opinion. You can say what you want, and what you say will not be quoted individually. All information will be kept confidential.

The main themes for the interview are on monitoring and evaluation tools for sanitation and will compare the mobile phone SMS technology and traditional paper based survey of defecation practices in the Ningo-Prampram District of Ghana. The information collected from this study will be useful in comparing the reliability and validity of both types of survey tools at the community and district level for any future water and sanitation projects.

I seek your permission to record, take pictures or video this interview and assure you that it will only be used for the research purpose and will not be released to any authority.

If you agree to participate in the study, please sign this (consent form) document for me. You are all encouraged to participate in the discussion.

.....

Code

Interview Date         (dd/mm/yyyy)

Household ID

Participant's Unique ID

.....

Q1. What is your age?

A. 18-29  B. 30-39  C. 40-49  D. 50 and Older

Q2. What is your Sex?

A. Male  B. Female

Q3. Where did you last go to toilet?

A. Beach

B. Bush

C. Public KVIP D

D. Shared House Toilet

E. Private Toilet

F. Other

Q4. During your last toilet did you use a plastic bag?

A. Yes  B. No  C. Do not Remember

Q5. After your last toilet, did you wash your hands with soap?

A. Yes  B. No  C. Do not Remember



**APPENDIX 7: STRUCTURED QUESTIONNAIRE FOR NON-RESPONSE**

Thank you for joining this study. My name is Sarah. In about 45 minutes we want to find what your choices in terms your opinion of the use of the Mobile phone as a Monitoring and evaluation survey tool. All answers are welcome; we just want to know your opinion. You can say what you want, and what you say will not be quoted individually. All information will be kept confidential.

The main themes for the interview are on monitoring and evaluation tools for sanitation and will compare the mobile phone SMS technology and traditional paper based survey of defecation practices in the Ningo-Prampram District of Ghana. The information collected from this study will be useful in comparing the reliability and validity of both types of survey tools at the community and district level for any future water and sanitation projects.

I seek your permission to record, take pictures or video this interview and assure you that it will only be used for the research purpose and will not be released to any authority.

If you agree to participate in the study, please sign this (consent form) document for me. You are all encouraged to participate in the discussion.

.....

Code

Interview Date           (dd/mm/yyyy)

Household ID

Participant's Unique ID

.....

Q1. What is your age?

A. 18-29  B. 30-39  C. 40-49  D. 50 and Older

Q2. What is your Sex?

A. Male  B. Female

Q3. In your opinion, are there reasons why you could not respond to the mobile phone survey tools?

A. Yes  B. No  C. Do not Remember

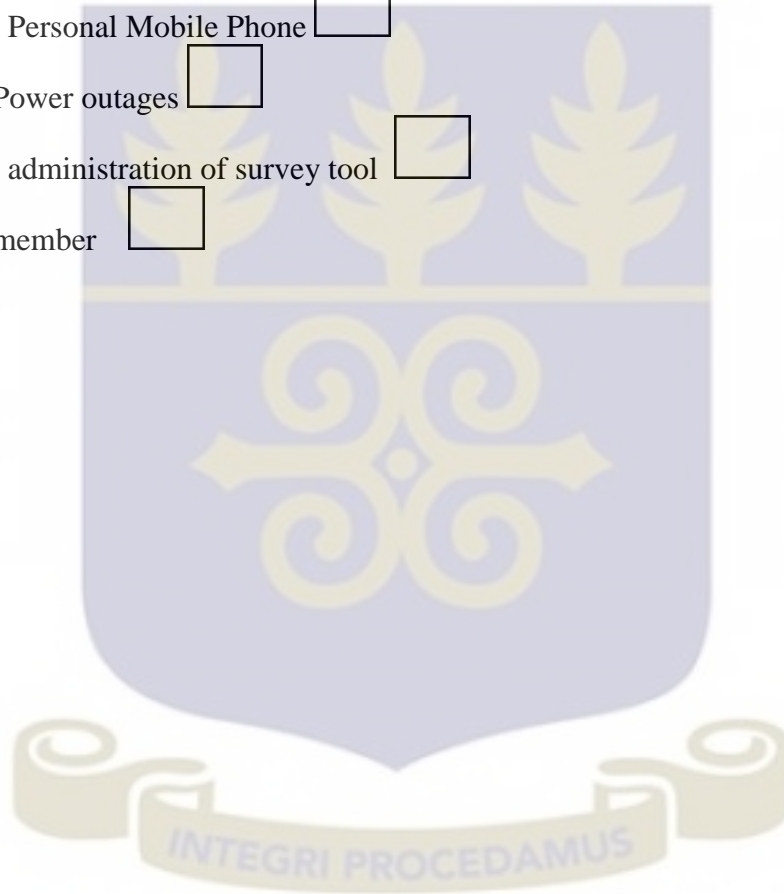
Q4. Could please indicate which of these options best support your non-response to the mobile phone survey?

A. Difficulty in the use of the survey tool

B. Issues of Privacy

C. Issues of Confidentiality

- D. Issues of Convenience
- E. Issues of Network Availability
- F. Issues of Literacy
- G. Issues of Mobile Phone Credit
- H. Issues of poor communication from field workers
- I. Issues of Personal Mobile Phone
- J. Issues of Power outages
- K. Issues of administration of survey tool
- L. Do not remember



**APPENDIX 8: STRUCTURED QUESTIONNAIRE FOR BOTH MOBILE PHONE AND PAPER SURVEY TOOLS ON ACCEPTABILITY, PRIVACY AND EASE OF USE**

Structured Questionnaire (after the study) for youth, aged, women, men, literate and illiterate respondents in both the mobile phone survey and traditional paper based survey tool groups.

Thank you for joining this study. My name is Sarah Van-Ess. In about 45 minutes we want to find what your choices in terms your opinion of the use of the mobile phone as a monitoring and evaluation survey tool. All answers are welcome; we just want to know your opinion. You can say what you want, and what you say will be confidential. All information will be kept confidential.

The main themes for the interview are on monitoring and evaluation tools for sanitation and will compare the mobile phone SMS technology and traditional paper based survey of defecation practices in the Ningo-Prampram District of Ghana. The information collected from this study will be used to inform any district level for any future water and sanitation projects.

I seek your permission to record, take pictures or video this interview and assure you that it will only be used for the research purpose and will not be released to any authority.

If you agree to participate in the study, please sign or thumbprint this (consent form) document for me. You are all encouraged to participate in the discussion.

	<b>Questions</b>	<b>Response</b>
	Respondents ID	<input type="text"/>
	<b>Demographic Information</b>	
1.	Age in years (above 18 years)	<input type="text"/>
2.	Sex 1. Male 2. Female	<input type="checkbox"/>
3.	Education Level 1. Tertiary 2. Secondary 3. Primary 4. None	<input type="checkbox"/>
	<b>Acceptability</b>	
4.	In your opinion, the mobile phone was more acceptable for collecting data on defecation practices than the paper tool. 1. Strongly disagree 2. Disagree	<input type="checkbox"/>



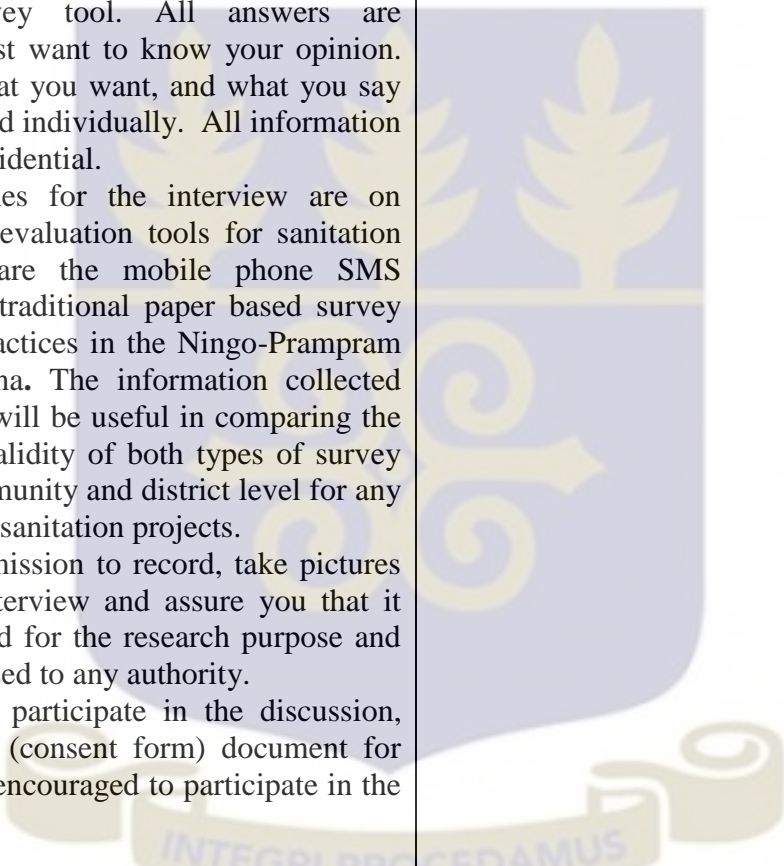


	<ol style="list-style-type: none"> <li>3. Uncomfortable to discuss with unfamiliar persons</li> <li>4. “Private affair “ subject</li> <li>5. Shyness</li> <li>6. Difficult to discuss subject with opposite sex</li> <li>7. Tired of defecation practice surveys</li> <li>8. Other, please specify .....</li> <li>9. Do not know</li> </ol>																															
10.	<p>In your opinion, you are willing to discuss issues of your defecation practices with anyone.</p> <ol style="list-style-type: none"> <li>1. Strongly disagree</li> <li>2. Disagree</li> <li>3. Unsure</li> <li>4. Agree</li> <li>5. Strongly agree</li> </ol>	<input type="checkbox"/>																														
11.	<p>Could please indicate which of these options supports your answer in question 10 above? (Choose all that apply)</p> <ol style="list-style-type: none"> <li>1. To improve sanitation in the community</li> <li>2. To talk about challenges of sanitation</li> <li>3. Embarrassing subject</li> <li>4. Culturally unacceptable / Taboo subject</li> <li>5. Uncomfortable to discuss with unfamiliar persons</li> <li>6. “Private affair “ subject</li> <li>7. Shyness</li> <li>8. Difficult to discuss subject with opposite sex</li> <li>9. Tired of defecation surveys</li> <li>10. Other, please specify ..... .....</li> <li>11. Do not know</li> </ol>	<table style="width: 100%; border: none;"> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> </table>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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12.	<p>In your opinion, which time would you prefer to discuss issues of your defecation practices?</p> <ol style="list-style-type: none"> <li>1. Morning</li> <li>2. Afternoon</li> <li>3. Evening</li> <li>4. Anytime</li> <li>5. Do not know</li> </ol>	<input type="checkbox"/>																														
13.	<p>Could please indicate which of these options supports your answer in question 12 above? (Choose all that apply)</p> <ol style="list-style-type: none"> <li>1. Privacy</li> <li>2. Confidentiality</li> <li>3. Convenience</li> <li>4. Mobile connectivity</li> <li>5. Literacy</li> <li>6. Shortage of mobile phone credit</li> <li>7. Sharing of personal mobile phone</li> <li>8. Ability to charge mobile phones</li> <li>9. Other, please specify .....</li> <li>10. Do not know</li> </ol>	<table style="width: 100%; border-collapse: collapse;"> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> <tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr> </table>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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<p><b>Thank you for your time.</b></p>																																

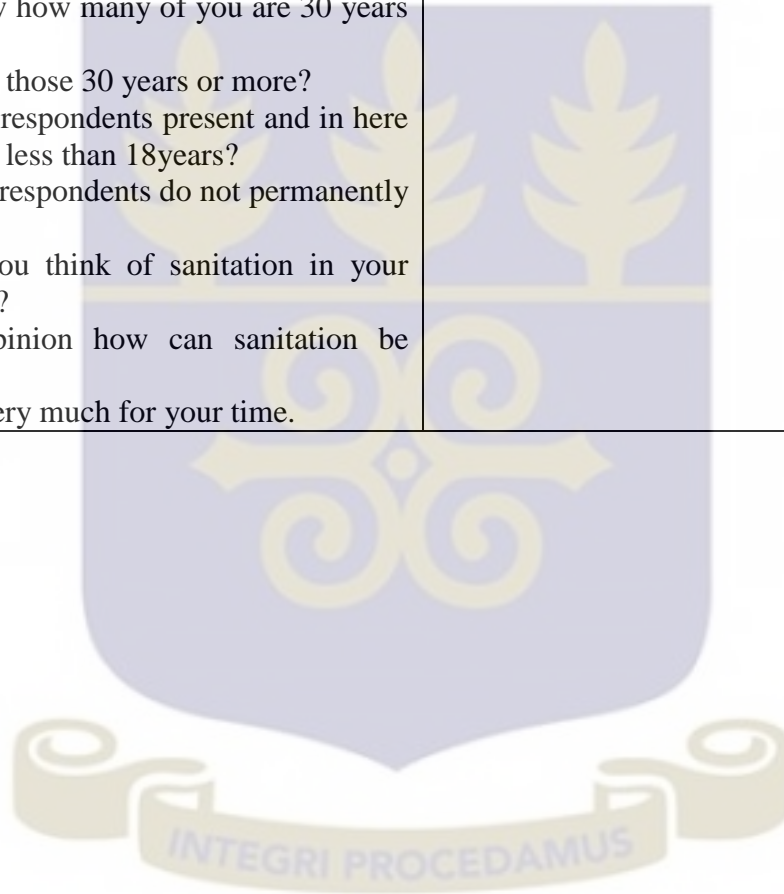
**APPENDIX 9: FOCUS GROUP DISCUSSION GUIDE BEFORE STUDY**

Focus Group Discussion Guide (prior to the study) for Youth, Aged, Women and Men in both the mobile phone survey and traditional paper based survey tool groups.

<b>Focus Group Discussion with Community members.</b>	<b>Interviewer Instructions</b>
<p>Thank you for joining this discussion. My name is Sarah. In about 45 minutes we want to find what your choices in terms your opinion of the use of the Mobile phone as a Monitoring and evaluation survey tool. All answers are welcome; we just want to know your opinion. You can say what you want, and what you say will not be quoted individually. All information will be kept confidential.</p> <p>The main themes for the interview are on monitoring and evaluation tools for sanitation and will compare the mobile phone SMS technology and traditional paper based survey of defecation practices in the Ningo-Prampram District of Ghana. The information collected from this study will be useful in comparing the reliability and validity of both types of survey tools at the community and district level for any future water and sanitation projects.</p> <p>I seek your permission to record, take pictures or video this interview and assure you that it will only be used for the research purpose and will not be released to any authority.</p> <p>If you agree to participate in the discussion, please sign this (consent form) document for me. You are all encouraged to participate in the discussion.</p>	<p>Introduction (To explain objectives and establish ground rules)</p> 
<p>Please tell us your name and something you like about yourself. I'll start. As I said, my name is Sarah Van-Ess, a student from Legon and this is my team. This discussion is voluntary and will not yield any monetary rewards. Please let me know if you do not wish to continue in the discussion.</p>	<p>Get respondents to introduce themselves and establish rapport</p>
<ol style="list-style-type: none"> <li>1. In your opinion, is the mobile phone useful or not?</li> <li>2. Can you tell me some of its advantages and</li> </ol>	<p>Probe to find out if more than 75%</p>


<p>disadvantages?</p> <ol style="list-style-type: none"> <li>3. In your opinion, do about 75% of members of this community have mobile phones? Could please give reasons for your answer?</li> <li>4. Presently in this discussion, how many of you have mobile phones? May I please see your hands up if you do?</li> <li>5. If yes, which groups of people often use their mobile phones regularly at all times of the day? Please explain your answer.</li> <li>6. What are some of the issues with constant and regular use of your mobile phones?</li> <li>7. Are there some times and situations when you are not able to use these mobile phone? Could you please further elaborate on your answer?</li> <li>8. What do you think about network availability in your community?</li> <li>9. Which network is common in your opinion? Please explain your answer with examples.</li> <li>10. In your own opinion, to what extent are you able to use the mobile phone which you own? Please explain your answer.</li> <li>11. How often do you use your mobile phone to send SMS texts?</li> <li>12. If not, why?</li> <li>13. How often do you receive SMS texts on your phone?</li> <li>14. If never, could you please explain your answer?</li> <li>15. I would need a volunteer to demonstrate this.</li> <li>16. What specific types of mobile phones do you own? Could you name them?</li> <li>17. What specific times do you use your mobile phones in the course of the day?</li> <li>18. Do you enjoy using your mobile phone?</li> <li>19. If I need you to send me an SMS text message, will you be able to do so?</li> <li>20. To what extent are you still willing to send me a text if it is about your choice of facility the last time you defecated?</li> <li>21. What about at all times during the day, whether you are home or not?</li> </ol>	<p>of respondents have at least one mobile phone.</p> <p>Probe to know about regular network availability and the most common</p> <p>Probe to find out if respondents can read, send and receive SMS text messages.</p> <p>About three respondents will demonstrate the SMS text messaging process and others will be asked to comment, until there is the certainty that they all know what they are talking about.</p>
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22. Will you all be willing to give genuine answers just as on a paper survey?
  23. To what extent are you willing to use your mobile phone to answer survey questions on defecation through an SMS text?
  24. What are some of the problem you think this SMS exercise could have?
  25. How many of you have ever participated in such an exercise?
  26. If yes, when and where was this?
  27. May I know how many of you are 30 years or less?
  28. What about those 30 years or more?
  29. How many respondents present and in here with us, are less than 18years?
  30. How many respondents do not permanently live here?
  31. What do you think of sanitation in your community?
  32. In your opinion how can sanitation be improved?
- Thank you very much for your time.

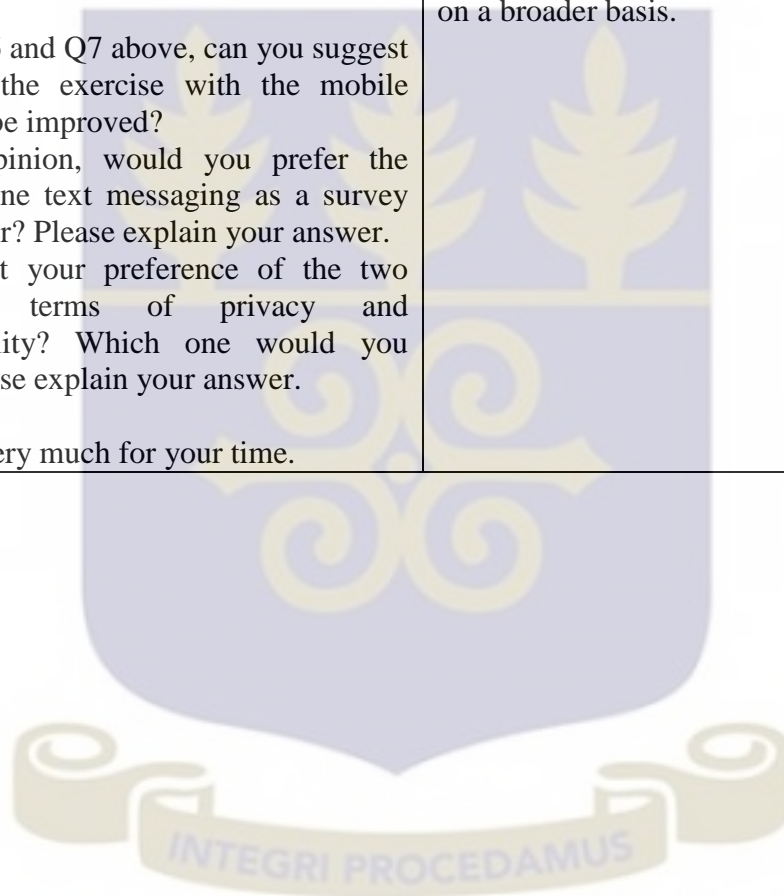


**APPENDIX 10: FOCUS GROUP DISCUSSION GUIDE AFTER STUDY**

Focus Group Discussion Guide (after the study) for Youth, Aged, Women and Men in the mobile phone group only.

<p>Focus Group Discussion with Community members.</p>	<p>Interviewer Instructions</p>
<p>Thank you for joining this discussion. My name is Sarah. In about 45 minutes we want to find what your choices in terms your opinion of the use of the Mobile phone as a Monitoring and evaluation survey tool. All answers are welcome; we just want to know your opinion. You can say what you want, and what you say will not be quoted individually. All information will be kept confidential.</p> <p>The main themes for the interview are on monitoring and evaluation tools for sanitation and will compare the mobile phone SMS technology and traditional paper based survey of defecation practices in the Ningo-Prampram District of Ghana. The information collected from this study will be useful in comparing the reliability and validity of both types of survey tools at the community and district level for any future water and sanitation projects.</p> <p>I seek your permission to record, take pictures or video this interview and assure you that it will only be used for the research purpose and will not be released to any authority.</p> <p>If you agree to participate in the discussion, please sign this (consent form) document for me. You are all encouraged to participate in the discussion.</p>	<p>Introduction (To explain objectives and establish ground rules)</p> 
<p>Please tell us your name Please let me know if you do not wish to continue in the discussion.</p>	<p>Get respondents to introduce themselves and establish rapport</p>
<ol style="list-style-type: none"> <li>1. In your opinion, has the mobile phone useful or not as compared to the traditional paper based one?</li> <li>2. In your opinion, were there any challenges during the study?</li> <li>3. Can you tell me some of these challenges and elaborate on them?</li> <li>4. What about the benefits of the mobile phone as a survey tool? Please explain your answer.</li> </ol>	<p>Probe to find out the types of challenges.</p>

<p>5. Do you think the mobile phone as a survey tool in determining defeaction practices should be encouraged regularly at all times of the day? Please explain your answer.</p> <p>6. In your opinion do you think the exercise should be repeated in the following year? Please give reasons.</p> <p>7. If yes to Q6 above, do you think the exercise should be extended to other neighbouring communities? Please explain.</p> <p>8. If yes to Q6 and Q7 above, can you suggest any ways the exercise with the mobile phone can be improved?</p> <p>9. In your opinion, would you prefer the mobile phone text messaging as a survey tool to paper? Please explain your answer.</p> <p>10. What about your preference of the two tools in terms of privacy and confidentiality? Which one would you chose? Please explain your answer.</p> <p>Thank you very much for your time.</p>	<p>Probe to know the proportion that find the mobile phone usage a better option and compare to those who do not.</p> <p>Probe to know if the mobile phone use as a survey tool in the sanitation sector has a potential of being done on a broader basis.</p>
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## APPENDIX 11: INTERVIEW GUIDE

In-depth interview with Community traditional or Opinion Leaders.

Thank you for joining this discussion. My name is Sarah. In about 45 minutes we want to find what your choices in terms your opinion of the use of the Mobile phone as a Monitoring and evaluation survey tool. All answers are welcome; we just want to know your opinion. You can say what you want, and what you say will not be quoted individually. All information will be kept confidential.

The main themes for the interview are on monitoring and evaluation tools for sanitation and will compare the mobile phone SMS technology and traditional paper based survey of defecation practices in the Ningo-Prampram District of Ghana. The information collected from this study will be useful in comparing the reliability and validity of both types of survey tools at the community and district level for any future water and sanitation projects.

I seek your permission to record, take pictures or video this interview and assure you that it will only be used for the research purpose and will not be released to any authority.

If you agree to participate in the discussion, please sign this (consent form) document for me. You are all encouraged to participate in the discussion.

1. How does the community as a whole relate to the general issue of sanitation?
2. How long have you been in this community?
3. Which groups are mainly responsible for as far as sanitation in this community?
4. Who bears the responsibility of sanitation data collection in the community?
5. What about the district?
6. What are some of the issues concerning sanitation?
7. How often is the sanitation data generated in the district?
8. Can you explain how data is generated at the community level?
9. Are there certain agencies or groups to do this?
10. If yes, what are they and what are their roles?
11. How long have these agencies been in the community or district?
12. If yes, is it at the community or district level?
13. Are there any challenges with sanitation data generation at the community level?
14. Do these agencies share this community sanitation data?
15. If yes, with whom do they share with?
16. How often do you share this data?
17. What are some of the highlights of the sanitation data captured?
18. What is your general opinion of sanitation in your community?
19. Which type of sanitation facility is mostly available?
20. Which type is mostly used?
21. Do you have any suggestions to improve on sanitation data generation?

Thank you.

## APPENDIX 12: INTERVIEW GUIDE

In-depth interview with District Officer- in- Charge of Sanitation or a Representative.

Thank you for joining this discussion. My name is Sarah. In about 45 minutes we want to find what your choices in terms your opinion of the use of the Mobile phone as a Monitoring and evaluation survey tool. All answers are welcome; we just want to know your opinion. You can say what you want, and what you say will not be quoted individually. All information will be kept confidential.

The main themes for the interview are on monitoring and evaluation tools for sanitation and will compare the mobile phone SMS technology and traditional paper based survey of defecation practices in the Ningo-Prampram District of Ghana. The information collected from this study will be useful in comparing the reliability and validity of both types of survey tools at the community and district level for any future water and sanitation projects.

I seek your permission to record, take pictures or video this interview and assure you that it will only be used for the research purpose and will not be released to any authority.

If you agree to participate in the discussion, please sign this (consent form) document for me. You are all encouraged to participate in the discussion.

1. Can you tell me what office you hold?
2. How does your office relate to sanitation in the community?
3. How long have you held this office?
4. Have you always worked in this community?
5. What about the Ningo-Prampram District, have you always worked here?
6. What are your main roles and responsibilities as far as sanitation is concerned?
7. Who bears the responsibility of sanitation data collection in the community?
8. What about the district?
9. Is there a Policy to guide sanitation data collection at both the community and district level?
10. May I see a copy if there is one here and how is it titled?
11. What are some of the issues concerning sanitation?
12. How often is the sanitation data generated in the district?
13. Can you explain how data is generated at the community level?
14. What about the district level?
15. Do you partner with certain agencies or groups to do this?
16. If yes, what are they and what are their roles?
17. How long have they been in the community or district?
18. If yes, is it at the community or district level?
19. Are there any challenges with sanitation data generation at the community level?
20. What about at the district level?
21. Do you have supervisors?
22. Who are they and where are they located?
23. What exactly is their role in terms of sanitation data generation?
24. What about the District Assembly, what is their role?
25. How often do you generate this sanitation data at both the community and district level?
26. Is it consistent with the Policy?

27. Do you use this community sanitation data?
28. How do you use it?
29. Do share this community sanitation data?
30. If yes, with whom do you share with?
31. How often do you share this data?
32. What are some of the highlights of the sanitation data captured?
33. What is your general opinion of sanitation in your community?
34. Which type of sanitation facility is mostly available?
35. Which type is mostly used?
36. Do you have any suggestions to improve on sanitation data generation?

Thank you.



**APPENDIX 13: IN-DEPTH INTERVIEW GUIDE AFTER STUDY FOR NON-RESPONSE**

In-depth Interview Guide (after the study) in the mobile phone cohort who did not respond to the SMS text during the sanitation survey.

<p>In-depth Interview Discussions with Community members who did not respond fully to SMS texts.</p>	<p>Interviewer Instructions</p>
<p>Thank you for granting this discussion. My name is Sarah. In about 45 minutes we want to find what your choices in terms your opinion of the use of the Mobile phone as a Monitoring and evaluation survey tool and why there were non-responses. All answers are welcome; we just want to know your opinion. You can say what you want, and what you say will not be quoted individually. All information will be kept confidential.</p> <p>The main themes for the interview are on monitoring and evaluation tools for sanitation and will compare the mobile phone technology and traditional paper based survey of defecation practices in the Ningo-Prampram District of Ghana. The information collected from this study will be useful in finding out why there was a non-response.</p> <p>I seek your permission to record, take pictures or video this interview and assure you that it will only be used for the research purpose and will not be released to any authority.</p> <p>If you agree to participate in the discussion, please sign this (consent form) document for me. You are all encouraged to participate in the discussion.</p>	<p>Introduction (To explain objectives and establish ground rules)</p>
<p>Please tell us your name Please let me know if you do not wish to continue in the discussion.</p>	<p>Get respondents to introduce themselves and establish rapport</p>
<p>1. In your opinion, has the Prampram community been involved in survey exercises in</p>	

<p>the past?</p> <ul style="list-style-type: none"> <li>a. If yes             <ul style="list-style-type: none"> <li>i. what kinds of survey questions have you been asked?</li> <li>ii. How was the survey administered?</li> <li>iii. How do you feel participating in these surveys?</li> <li>iv. Are there topics that you think are important to survey the community about? What topics are important? Why?</li> </ul> </li> </ul> <p>2a. Can you please tell me your mobile phone number?</p> <p>b. Could you please tell me if you have had any education?</p> <p>c. If answer is no to QU 2b, may I please know if this is the reason for non-response.</p> <p>d. If yes, may I please know your highest level of education?</p> <p>e. There has recently been a testing of new ways of delivering surveys to community residents. One of these ways is to delivery short surveys via SMS to mobile phones. You were randomly selected to receive these SMS a few times a year as part of our test.</p> <p>f. In your opinion, do you recall receiving any SMS questions about your toilet practices?</p> <p>g. May I please know what you thought when you first received the SMS?</p> <p>h. Could you please share whether it clear to you who the SMS was coming from?</p> <p>i. Was it clear to you why you were receiving the survey? Could you please explain your answer?</p>	<p>Probe to find out their overall position with regards to surveying. Do they feel positively or negatively about the practice?</p> <p>Probe to find out the mobile phone number of the non-responder to make sure it is exactly the one on file to exclude the possibility that the SMS survey went to another phone/person.</p> <p>Probe for a check on literacy. If the person cannot read then it may be wise not to ask additional questions, but simply probe if this is the reason for non-response</p>
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j. In your opinion, was it clear to you what the SMS was about? If yes, what do you think the SMS survey was about? Could you please explain your answer?

k. If no, could you please discuss why was not it clear?

l. Did you receive any information about the SMS survey before it arrived on your phone?

m. We are interested in knowing why some people decide not to reply fully to the SMS survey, but did so partially. Would you mind sharing with me the reasons why you did not fully reply to the SMS survey questions?

3. Do you ever share your phone with others in the household? Is it possible that another person had the phone when the SMS survey was sent to you?

a. Do you ever run out of credits before having the opportunity to recharge?

b. If yes to QU 3a above, how often does this happen?

c. Does your battery ever fall before you can recharge it?

d. If yes to QU 3c above, how often does this happen?

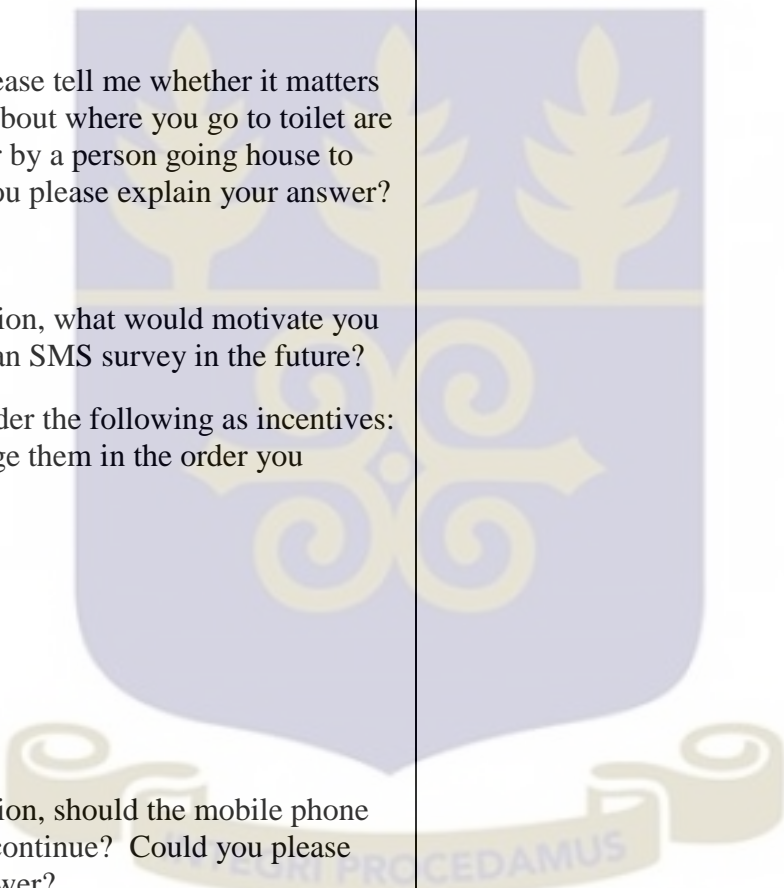
e. Have you had any issues or challenges in phone ownership in recent months?

f. If yes to QU 3e above, when was this?

g. Do you ever change phone numbers or switch networks as in “porting”?

h. Do you receive lots of SMS advertisements? What do you think about these?

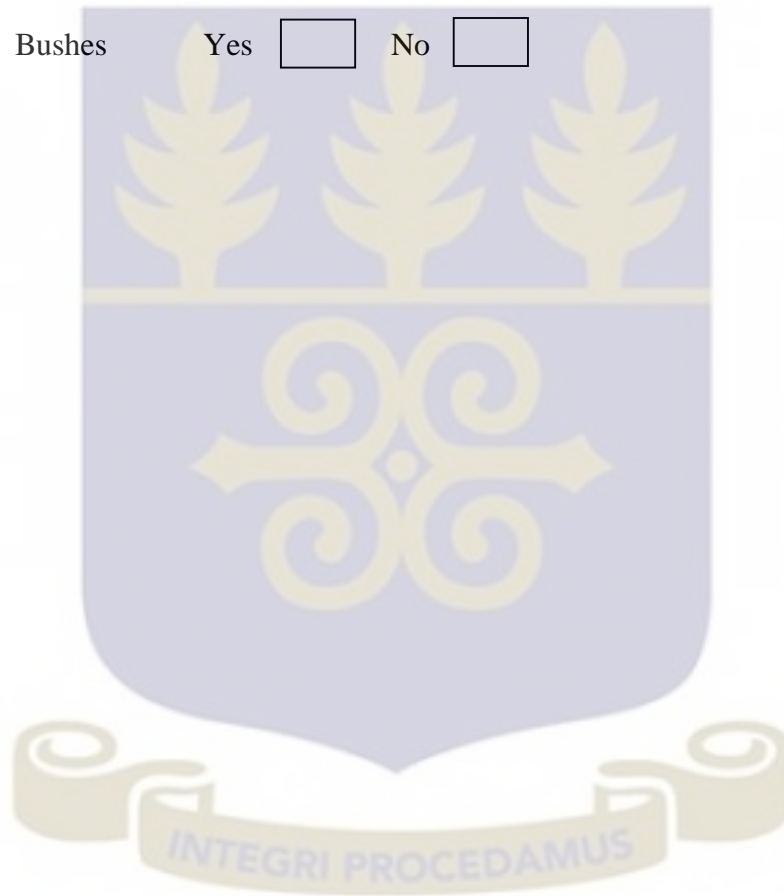
i. Are you ever without phone network

<p>coverage?</p> <p>j. If yes to QU 3i above, could you please tell me when this happened?</p> <p>k. In your opinion, how do you feel about being asked questions about going to the toilet?</p> <p>l. In your opinion, do you think sanitation surveys are important in the Prampram community?</p> <p>m. Could you please tell me whether it matters if the questions about where you go to toilet are asked by SMS or by a person going house to house? Could you please explain your answer?</p> <p>4. In your opinion, what would motivate you to participate in an SMS survey in the future?</p> <p>a. Please consider the following as incentives: Could you arrange them in the order you prefer?</p> <p>i. Phone Credits</p> <p>ii. Money</p> <p>iii. Soap</p> <p>b. In your opinion, should the mobile phone SMS surveying continue? Could you please explain your answer?</p> <p>c. Could you please share how would you improve the SMS survey in the future?</p> <p>Thank you very much for your time.</p>	 The logo of the University of Ghana is a watermark in the background of the right column. It features a shield with a yellow tree and a yellow cross, with a yellow banner below it containing the Latin motto 'VERUM PROCEDEMUS'. The shield is set against a light blue background.
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**APPENDIX 14: OBSERVATIONAL CHECKLIST**

Evidence of Open Defecation around:

- a. Houses      Yes  No
- b. Public toilets    Yes  No
- c. Beaches      Yes  No
- d. Bushes      Yes  No



## APPENDIX 15: LETTER TO STAKEHOLDERS

Letter to District/National Sanitation Officers and Stakeholders such as Officials of Ghana Statistical Service, Demographic Health Survey and Community Water and Sanitation and Environmental Health Departments.

Dear Sir/Madam,

I am a student of the School of Public Health, Legon, pursuing a PhD Public health degree. As part of the program, I am undertaking a study on Mobile Phone Technology as a Monitoring and Evaluation tool In Ghana's Sanitation Sector.

This study is on monitoring and evaluation survey tools for sanitation and will compare the mobile phone technology and traditional paper based survey of defecation practices in the Ningo-Prampram District of Ghana. The information collected from this study will be useful in comparing the reliability and validity of both types of survey tools at the community and district level for any future water and sanitation projects.

The study seeks to compare evaluate the reliability of Mobile Technology in addressing continuous data sanitation data generation challenges at the community level. I would be grateful if assistance is granted for the exercise.

Thank you.

Yours sincerely,

Mrs. Sarah Effuwah Van-Ess.




## APPENDIX 16: ETHICAL CLEARANCE FROM THE GHANA HEALTH SERVICE

**GHANA HEALTH SERVICE ETHICAL REVIEW COMMITTEE**

*In case of reply the number and date of this Letter should be quoted.*

My Ref. :GHS-ERC: 3  
Your Ref. No.

  
Your Health - Our Concern

Research & Development Division  
Ghana Health Service  
P. O. Box MB 190  
Accra  
Tel: +233-0302-681109  
Fax + 233-0302-685424  
Email: [Hannah.Frimpong@ghsmail.org](mailto:Hannah.Frimpong@ghsmail.org)  
September 17, 2012

**SARA VAN BELLE, Principal Investigator**  
London School of Hygiene and Tropical Medicine  
London

**ETHICAL APPROVAL FOR IMPLEMENTATION OF AMMENDMENT TO APPROVED PROTOCOL**  
**RE-Request for approval to change study sites**  
**RE: Protocol Title: "Accountability in Sexual and reproductive health: the influence of INGOs on district decision-making in Ghana: ID NO: GHS-ERC: 08/05/2012"**

Reference is made to your letter dated September 17, 2012, requesting permission to change originally approved study sites of the above-mentioned Protocol.

Please be informed that the Committee has reviewed the request and is satisfied with the explanation thereof concerning the selection of the study sites. We therefore wish to inform you that approval is hereby given for you to change the original study sites from "Ho Municipal District" to "South Tongu district, Volta Regio, and Ayawaso East, Accra."


This approval requires that you submit periodic review of the protocol to the Committee and a final full review to the Ethical Review Committee (ERC) on completion of the study. The ERC may observe or cause to be observed procedures and records of the study during and after implementation.

Please note that any modification of the project must be submitted to the ERC for review and approval before its implementation.

You are also required to report all serious adverse events related to this study to the ERC within seven days verbally and fourteen days in writing.

You are requested to submit a final report on the study to assure the ERC that the project was implemented as per approved protocol. You are also to inform the ERC and your mother organization before any publication of the research findings.

Please always quote the protocol identification number in all future correspondence in relation to this protocol

SIGNED.....  
  
PROFESSOR FRED BINKA  
(GHS-ERC CHAIRMAN)

Cc: The Director, Research & Development Division, Ghana Health Service, Accra

1

## APPENDIX 17: ETHICAL CLEARANCE FROM DODOWA HEALTH RESEARCH CENTRE

*In case of reply the number and date of this letter should be quoted.*

My Ref. : DHRC/IRB/12/01/

Your Ref. No.

9<sup>th</sup> November 2012

Sarah Van Ess  
School of Public Health  
University of Ghana

Dear Madam,

**ETHICAL CLEARANCE**

DHRC-IRB CPN14/09/12 revd.2012

**Title of Protocol: Monitoring and Evaluation Tools for Sanitation: A comparative Study of Mobile Phone and Traditional Paper Based Survey of Defecation Practices in the Dangme West District of Ghana**

Principal Investigator: Sarah Van Ess


Upon addressing the comments raised, the IRB has approved your proposal. Upon addressing the comments raised after the initial review on 9<sup>th</sup> October 2012 and subsequent reviews thereafter, the IRB has approved your proposal.

Please note that the final report must be submitted to the board at the completion of the study. Your research records may be audited at any time during or after the implementation.

Any modification of this research project must be submitted to DHRC-IRB for review and approval prior to implementation.



Please report all serious adverse events from this study to DHRC-IRB within seven days verbally and fourteen days in writing.

This certificate is valid till 9<sup>th</sup> October 2013. You are to submit annual reports for continuing review.

Signature of Chairperson: 

Dr. Evelyn Korkor Ansah  
DHRC-IRB, Chairperson

Cc: Dr. Margaret Gyapong  
Director, DHRC



INTEGRI PROCEDA

**APPENDIX 18: PUBLICATION: IS THE MOBILE PHONE TECHNOLOGY FEASIBLE FOR EFFECTIVE MONITORING OF DEFECATION PRACTICES IN GHANA? THE CASE OF A PERI-URBAN DISTRICT IN GHANA**

