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The Emergence of Mobile-governance in Bangladesh

In What Extent, Mobile-governance Services are Facilitating Flexible & Sustainable 'Government to Public' (G2P) Communication?

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Acknowledgements

During my research on Applied Research on Sustainable Consumption and Production (ARSCP), one of the partial requirements of the MSc. Environmental Management and Policy program, I have first though about this thesis. The topic in my ARSCP research, 'by Swedish Public Agencies' view on Virtual Meetings (VMs)', inspired me to think about the same technology might be useful in developing country's context from different perspective. When visited Bangladesh for the last time, in Dhaka (the capital) the devastating traffic condition, waiting hours in the traffic jam and air pollution made me realize about alternative solutions of the problem, rather than traffic control and high tax on importing vehicles. This problem was also there in Bangladesh two years before, when I used to reside there. But studying here in the institute International Institute for Industrial and Environmental Economics (IIIEE) and the academic knowledge I gained, inspired me to think about the solutions of this problem from different dimensions. At first, I thought of 'Virtual Meetings' instead of travel might be an interesting alternative in Bangladesh. And furthermore the current political condition and government's 'Digital Bangladesh' strategy on promoting e-governance is quite positive for the initiatives. Talking with one of my friends Ashraf Abir, (CEO, MCC) I came to know the fact, that for Bangladesh 'A mobile phone serves more than a computer' for its higher penetration rate than computer, considering its price, energy consumption, affordability and flexibility. Taking this advantage government of Bangladesh initiated many projects on providing mobile governance services in several sectors since last two years (2009 to till now). Focusing on that, I started the research on this interesting topic, to have an overview of the emerging new governance (m-governance service) in Bangladesh from sustainability point of view. My first gratitude goes to the institute IIIEE and all the teachers, staffs and my fellow mates from 'batch 15 and 16' to being supportive to me academically and mentally all the time. Specially, I want to thank Håkan Rodhe for liking my idea and inspire me to do the thesis. Following that, my gratitude goes to Mårten Karlsson my supervisor and Peter Arnfalk, my co-supervisor, helping me to present my thoughts through this research and putting it in written format. I want to give my special thanks to Mårten Karlsson for his valuable feedback. Without their motivation and advices the thesis could not be finished.

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Abstract

As a developing country, government of Bangladesh took many initiatives using ICT to improve public service in the platform of e-governance. Currently, m-governance is leveraging the e-governance by a wide range of government initiated services in the context of Public Private Partnership (PPP). Mobile-governance services are designed, based on mobile sms, IVR system and interactive applications. The thesis will discuss the service platform for Educational and Agricultural Sector which are influenced by different actors, factors and indicators in the context of Bangladesh. However, the research also checked the sustainability nature of the m-governance services in the study. Five surveys and many interviews were conducted to answer the research question, and the results are analyzed in a mix of theoretical and conceptual frameworks. Analysis showed that m-governance (mobile-governance) system in Agricultural Sector seemed more complex than Educational Sector in terms of service penetration, measuring sustainability, perceived satisfaction and communication network. However, individual behavior towards technology from user's side, rebound affect, other subjectivity i.e. 'a mobile has different function', and negative environmental impact from WEEE from mobile handset disposals were noted but not considered in the case. The analysis evaluated, Agricultural Sector did not fulfilled the nature of sustainability (environmental concern was immeasurable) in m-governance service in communication, but showed flexibility, and in Educational Sector the service evidenced communication flexibility and sustainability (environmental concern somewhat fulfilled). Analyzing the current situation and reality, the government and policy makers are suggested to have proper plan, increase transparency, and encourage public participation in every m-governance service project. Besides that, policy level intervention needed for 'price setting' for agricultural product. However, government should target more potential receivers in both sectors. In general for sustainability, government of Bangladesh is recommended to start thinking about the WEEE disposals form mobile handset, which has long term environmental and health impact.

Keywords: ICT, m-governance service, government, Agricultural Sector, Educational Sector, public, Public Private Partnership (PPP), Bangladesh.

Executive Summary

Background

The research was conducted on the background of government of Bangladesh's recent (2009 to till now) initiatives on m-governance (mobile-governance) service, supplementing e-governance, supporting one of the government's Millennium Development Goals (MDGs). The initiative falls under government's development strategy on 'Access to Information' (A2I), transition towards 'Digital Bangladesh' by 2025. This thesis will focus on m-governance services in the enabling environment of Public Private Partnership (PPP) only in Educational and Agricultural Sector. The actors involved in the service platform are different ministries of government, telecom companies, content developer (for agricultural sector), and several national and internal NGOs. The significance of the background can be, higher penetration rate and diffusion of mobile phone in the country (76.434 million subscribers, 2010), many government initiated projects (some in planning and some in implementation phase), current government's tax, vat and other regulation favoring ICT and some recent success results.

Problem Statement and Objectives

To facilitate the public, many technology options are already being utilized in Bangladesh by several government agencies, but they are more interested to establish a long term partnership with the private sector, called Public Private Partnership (PPP) for a sustainable solution. The higher mobile penetration and limited use of computers (to city people and educated users) encouraged government to choose mobile as a media for providing public service (governance) to general people. Less energy consumption and high adaptability of cell phone made an environment to work on m-governance. The services are specially designed to reduce travel and information cost from the public services keeping the current traffic condition in agenda. In both Educational and Agricultural sector, government focused on communication flexibility and sustainability in the services provided. The thesis will present an overview whether government is successful in its motive or not, by a reality check (through survey and analysis). Thereafter, discussions, suggestions and recommendation will be presented for the current and future project.

The research purpose directs the following **objectives**-

- Addressing policy makers the 'challenges and opportunities'; and 'success and hindrance' factors in the m-governance services platform from the studied cases.
- Check with public opinion & feedback from the studied cases and analyze with reality.
- Identify & test the 'sustainability nature' of m-governance service in the studied cases.

Research Question

Based on the study done and the objective of conducting the research, the following research question was made-

"The present and future 'success factors and hindrance' behind implementing the m-governance service (in Educational and Agricultural Sector) to facilitate flexible and sustainable communication system among government and public"

Research Scopes

The research will be focusing only on the Public Private Partnership (PPP) initiatives of Bangladesh's government, focusing on the m-governance services in Educational and Agricultural Sector. The research has been scoped to the m-governance services that deal with mobile phones excluding other ICT tools, i.e. computer. To calculate the carbon footprint from distance traveled by sample population, a simple carbon calculator tool was used, considered every person in the survey traveled by midsized motor vehicle. While calculating figures subjective factors and 'rebound effect' was not considered, which could interrupt the part of the research result and analysis. However, individual behavior towards selecting travel vehicle might have influence on the result, which was not taken in to consideration because of its indefinable measurement. Furthermore, as a broad issue negative environmental impact from WEEE disposals from mobile handset was not considered in the study.

Case Studies

To answer the research question within the research scope five surveys were conducted for this thesis paper. The surveys were based on the current projects in the Educational and Agricultural Sector. Ministry of Agriculture of Bangladesh implemented this two projects showed in the cases, where 'case 1' is a projects on Agricultural Market Information System (AMIS), proposed to facilitate sustainable and flexible communication by ensuring 'information right'. Thereafter, 'case 2' deals with the project on Digital Cane Procurement System, called 'E-Purjee' initiated by Ministry of Agriculture incorporation with Bangladesh Sugar and Food Corporation (BSFIC) and UNDP. Both of the cases falls under the government Millennium Development Goal (MDG) strategy on Access to Information (A2I). 'Case 1' deals information collection and dissemination (agriculture related product, price, fertilizers, pesticides, technology, financing) with m-governance service provided by the Mobile Operators through sms, IVR system. The information is mainly stored, transmitted and shared through the Union Information Center (UIC) and sometimes directly with mobile operators (in case of general information). In 'case 1' six farmers were interviewed during the survey to get their feedback on the AMIS system. Project discussed in 'case 2' involves in providing sms based sugarcane procurement system to the farmers, developed by the involved authorities, transmitted and ordered by the sugar mills around the country. There are 15 sugar mills in the country; among them five sugar mills have 30,000 members (farmers) who are involved in the system (2011). The project is now in expanding stage to target more farmers to be included in the system. Only one farmer was interviewed to get the feedback in 'case 2'. Details of the two cases are given in the 'section 3.1.1 and 3.1.2' in 'chapter 3'. Three cases are discussed on Educational Sector in 'section 3.2.1, 3.2.2 and 3.2.3' in 'chapter 3'. 'Cases three' is based on a project on Shahjalal University of Science and Technology (SUST), in Sylhet district, 'case 4' is on Bangladesh University Engineering and Technology (BUET), in Dhaka district and 'case 5' is on the 19 colleges of Dhaka district (name of the colleges are in Appendix 1-2). All of the cases in the Educational Sector are based on m-governance services, provided for the students, includes sms based application registration for admission, fee payment and admission test result system. Interestingly, 'Teletalk' a government owned mobile operator company is the partner for providing the service together with Dhaka Education Board and the Educational Institutes. The service ensures receiving and providing information from both sides in the communication network.

According to the government of Bangladesh, all of the five cases (projects) discussed in the thesis, aimed to provide sustainable and flexible communication among the m-governance service receivers. This initiative considered as government's development initiatives to facilitate limited income group to reduce their information cost, ensure information

authenticity, avoid corruption, reduce hassle and reduce environmental impact from unnecessary travel. The results of the cases are given below.

Findings and Results

The overall feedback gathered from the interviewees is shown below in the table. The detail result with findings discussed under 'section 3.1 and 3.2' in chapter three, only important results are shown here. Appendix- 3 and 4 shows the collected data and results.

Table: Findings and results for the studied five cases

	Case 1 (Ag. S)	Case 2 (Ag. S)	Case 3 (Ed. S)	Case 4 (Ed. S)	Case 5 (Ed. S)
Projects Name	AMIS	E-Purjee	SUST	BUET	19 Colleges
Number of Interviewee	6	1	50	20	30
Satisfied and Happy with the service?	Happy, not Satisfied	Happy, not fully satisfied	Happy and satisfied	Happy and satisfied	Happy and satisfied
Problem faced in the service	Information authenticity and execution of product price according to information	Understanding the system	72% said 'no problem', 20% management problem	80% said 'no problem', 15% management problem	83.34% said 'no problem', 6.66% management, 6.66% said Technical
Distance saved from travel	Undefined and immeasurable	Might be defined if all farmers are included	97.1 km (Apprx)	1431.6 km (Apprx)	8,911 km (Apprx.)
Reduced Carbon Footprint	Undefined and immeasurable	Might be defined if all farmers are included	0.05 Tons CO2 eq for an average day for communication	0.7 Tons CO2 eq for an average day for communication	4.11 Tons CO2 eq for an average day for communication
Overall Comments	50% said good and 50% was skeptical	Positive Feedback (one farmer)	Excellent 86%, Good 14%	Excellent 30%, Good 60%, Average 5%	Excellent 10%, Good 60%, Average 23.34%
Sustainability in the service, proved?	Social- Yes Economical- No Environmental- No	Social- Yes Economical- Yes Environmental- Not for this thesis, further research needed	Social- Yes Economical- Yes Environmental – Somewhat yes (not considering rebound affect and subjectivity)	Social- Yes Economical- Yes Environmental – Somewhat yes (not considering rebound affect and subjectivity)	Social- Yes Economical- Yes Environmental – Somewhat yes (not considering rebound affect and subjectivity)

Methods/ Frameworks Used for Analysis

For analysis, two frameworks have been used in the paper, i.e. PESTLE Analysis and Conceptual Framework, discussed in 'chapter 4'. Beside that various literatures has been analyzed and interpreted with the findings got from the interviewees. The theoretical framework, PESTLE analysis used as a tool for strategic analysis of the effecting factors (political, economical, social, technological, legal and environmental) in the m-governance service platform. The tool also made comparison of the strengths and weakness of the Agricultural and Educational Sector based on the challenges and opportunities faced by both sector. The conceptual framework (Figure 4-1) has been developed to give reader a clear view of the m-governance platform, in the enabling environment of Private Public Partnership (PPP). Besides that, the framework shows the actors involved in the m-governance system, and how they are influenced by 'direct and indirect' factors, resulting in environmental impacts from suppliers and users side. A literature analysis has been shown discussing the sustainability in individual behavior.

Analyses

The analysis part in 'chapter 5' discussed the results and findings achieved from the five case studies under the proposed theoretical and conceptual framework. Demonstrating that, the chapter will identify the challenges and opportunities faced in terms of m-governance by both sectors. There will be an illustration on the success and failure of m-governance service in both sectors in promoting communication sustainability. The result from the surveys will be interpreted with the sustainability perspective of the m-governance service.

In the **Agricultural Sector** (AS), the analysis was made based on the scope of the communication network existing in the m-governance service platform. The number of service receiver group is very big and considered to be illiterate. As a result m-governance is relatively hard to penetrate among the farmers. Lack of policy level intervention in setting the product price and corruption by middle man, has been evident in **'case one'**. It happened because the farmers were not directly involved in setting the price of their product. The purpose of the project was to give the farmers 'best price' for their product through providing information from market. On the other hand, farmers got general information about use of pesticides, fertilizers and seeds. The m-governance service environment in Agricultural Sector is very complex and the government has five working years to prove their credibility, at least in an acceptable level, which holds the success of the project. In **'case two'** farmers were directly involved in information dissemination with sugar mills. Farmers participated in the decision making, training, and inspiring other farmers to be included in the system. The farmers became members (30,000 in five sugar mills) and registered in the database system with their information. Evaluation and surveys can be conducted considering listed farmers for better understanding of the current situation and prepare for the future development. In the AS farmers' age and years of mobile usage, behavioral patter in terms of technology use seemed variable. In both cases 'case 1 and 2' farmers were very skeptical deciding on 'use of mobile phone saved their travel', that is because of the complex socio-economic system. Considering the fact, environmental factors considered by the Agricultural Sector are one of the future big challenges in m-governance service.

However, in the **Educational Sector** (ES), the situation is different from AS in terms of providing m-governance service. Although the number of service receivers are big, but not as AS. Furthermore, m-governance service penetration is easier in this sector because there was an established collaboration among government and the educational institutions seen and educational institutes have their sovereign right in operation. So, there is no third party interference to decrease the efficiency of the system. Overall comments from the three cases (case 3, 4 and 5) are same and positive. Among the two cases, 'case 3 and 4' are based on university admission and 'case 5' based on college admission. Differences in individual behavior in choosing vehicle; and considering 'motor vehicle' instead of walking and biking in Dhaka city, has been seen in two cases (**case 4 and 5**). In this case, saved travel by those people does not justify the communication sustainability as they considered personal safety and health issues (from air pollution). This fact might manipulate the result, but if macro level survey is done considering the variables, this fact can be omitted. Educational institution outside Dhaka, such as SUST, discussed in **'case 3'** saved more travel distance because students from different districts came for admission. Where in terms of the other two cases (case 4 and 5), most of the students are locals. This indicates that m-governance will be more helpful for the students studying in different institutes outside Dhaka. High income group and improved life style (mainly in Dhaka), does not realize the m-governance service impact in a sustainability sense, which has been seen in the 'case 4' and 'case 5'. However, all the three cases in ES, determines that m-governance is reducing the students' travel at least in a micro level.

This is true for both of the sector that the energy usage for different functions cannot be distinguished with the amount of energy used for m-governance service. That is why it is difficult to identify the benefit of m-governance service from technology side. This also links the 'rebound affect'. These facts have been noted, but not considered in the calculations in any case in this thesis, to avoid complexity.

Conclusions

In the context of Bangladesh, both the success and hindrance of the m-governance service widely depends on the political, social, economical and technological factors. Among them, political instability has the highest influence as most of the projects are directly linked with different ministries of government. Wide communication networks established by the mobile companies and higher mobile penetration rate in Bangladesh considered as the success, where mismanagement in the communication networks may causes hindrance. Analyzing the current situation and studying the cases, success has been seen mostly in the case of Educational Sector rather than in Agricultural Sector. Mismanagement, lack of literacy, communication gap for the middle man, lack of government's intervention in price regulation for agricultural product and corruption backing behind the Agricultural Sector, holding back the success in the Agricultural Sector. However, m-governance service penetration is easier in Educational Sector because students are literate and are communicated directly (no middle man in the communication network). In the Agricultural Sector, in Case 1 and Case 2, farmers seemed to be happy with the m-governance service but not satisfied fully. They agreed that the service gave them communication flexibility but they are skeptical agreeing on the sustainability issue. They said the service gave them social benefit, somewhat economical benefit, but they do not think it reduced their travel significantly. In terms of Educational Sector the service gave the students socio-economic benefits and in a rough estimation, reduced environmental impacts replacing travels (in a total of 10439.4 km (approx.) and 4.86 Tons (approx.) CO2 eq for a typical day of communication by road) from 100 sample students studied in the three cases. Although there are some subjective matters which is difficult to measure and 'rebound affects' are there, still it concludes on the favor of the statement 'mobile communication by m-governance services replaces travel and environmental impact' in Educational Sector. For Agricultural Sector the statement seemed not true and complex to define. However, public participation, individual sustainable behavior needed for successful implementation of m-governance.

Recommendations

The recommendations drawn from the study are following – Firstly, proper planning, management, transparency and public participation required before starting any project of m-governance. Whether there is a change in government, but the project must continue. Secondly, the government and policy makers need to have a policy level intervention among the small and big actors involved in the m-governance service (mainly in agricultural sector). Thirdly, Education Sector should unite the rest of the school, colleges and private universities into single m-government service system for smoother operations. Fourthly, more research and development needed in on the innovation of content development (local language text, images and logics for farmers) for better understandability. Finally, Bangladesh government should increase their concern about the long term negative environmental and health impact caused by disposal of WEEE from mobile phones. This can be suggested that, WEEE 'containing valuable components' extracted from the product, might be interested by the developed countries. In exchange Bangladesh can expect technology and skill of transfer from their country and can get rid of the WEEE.

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Currency Conversion Rate

$1 USD = 70 BDT (Rate taken from www.xe.com in August 15th)

Abbreviations

A2I	Access to Information
AMIS	Agricultural Market Information System
ARSCP	Applied Research in Sustainable Consumption and Production
BBS	Bangladesh Bureau of Statistics
BRTC	Bangladesh Road Transport Commission
BSS	Bangladesh Shangbad Shangstha
BTRC	Bangladesh Telecommunication Regulatory Commission
BTU	British Thermal Unit
CDA	Cane Development Assistant
DAM	Department of Agricultural Marketing
E-governance	Electronic Governance Communication
G2P	Government to Public Communication
ICT	Information Communication Technology
IVR	Interactive Voice Response
M-governance	Mobile Governance
NGOs	Non-Governmental Organizations
PPP	Public Private Partnership
UISC	Union Information Service Center
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNDP	United Nations Development Programs

Glossaries

'Banglalink Jigyasha'	A sms based application service by Banglalink Telicoom Company called 'Agri-Quiries'
'Banglalink Krishibazaar'	Banglalink Telicoom Company's IVR service called Banglalink 'Agri-Market'
Digital Bangladesh	ICT derived development initiatives in Bangladesh (establishment of e-governance)
E-Government	E-Government involves activity using Information and Communication Technology (ICT) by the public sector organizations to facilitate cost effective, flexible, and better service to the general public.
E-Purjee	Digital Cane Procurement System
'Hridoye Mati O Manush'	An agribase TV program, cosponsored and hosted by Channel I, a private channel in Bangladesh

M-Governance	Is called Mobile-Governance. It is a similar word of 'm-government' holding same meaning in some countries. Basically in India, Bangladesh, China, Africa, Indonesia, Pakistan and some other Asian countries usually use the term m-governance instead of m-government, which is a sub-domain and complementary of 'e-government' mainly deals with development projects using mobile phone as ICT tool, i.e. poverty reduction, increase literacy and access to information for the public within affordable price and flexibility.
Polly Tathya Kendra	Village Information Center
Rikshaw	A three wheel non-motor vehicle, maximum two persons can sit in the seats behind and the driver pull the cart by paddling in front

1 Introduction

1.1 Background

The Telecom Industry all over the world has changed incredibly in the last two decades. The key diffusion took place in the wireless and mobile sector in a fast pace changing people towards interaction and adoption of mobile phones. The significant contribution from the mobile sector accounted for the wide range of service provided to the customer. Along with that the technology is designing and facilitating both the developed and developing world to improve their political, economical, social and environmental condition. Although the diffusion taking place in developed country is not same as developing country, but both considers positive change in the countries overall condition. Telecom industry considered as one of the important contributors of world economy estimated 3% of the global economy with a subscriber of more than 4 billion. The substantial growth in the telecom and wireless sector is expected to rise by double digit because of emerging market penetration and recovery in world's economy (Market Research Report, 2010). In some cases developing countries like Bangladesh are in initial stages of advancement comparing to other countries in same region but this transition is expected to take the country's overall socio-economic and environmental condition towards positive direction. In 2011 Bangladesh Telecommunication Regulatory Commission (BTRC) reported 76.434 million subscribers where in 2010 Pakistan reported their subscribers to cross 100 million by 2013, which is a tremendous evolution. The exponential growth in transitional and economical impact of telecom sector in Bangladesh (in last 5 to 10 years) has almost same as Ready Made Garments (RMGs) has in the country's economy. Four major players in the market including one government company kept a positive impact on the county's economy and creating employment, providing tax to government and changing people's quality of life style. Some major telecom industries like Grameenphone (Telenor), Banglalink (Orascom) and Robi (Airtel) are introduced themselves through Foreign Direct Investment (FDI) and later became trend setters and key players in the market (The News Today, 2010). From last 3 years, these major players with the governments company (Teletalk) being working together to execute the present government's new Millennium Development Goal (MDG) strategies for the vital development sector (Agriculture, Land Administration, Health, Education, Social Safety Nets, Disaster Management, Commerce, Law, Civil service and so on). The strategy includes Public Private Partnership (PPP) by enhancing e-governance, which will identify the modalities where the private sector can invest and earn revenue by providing public service (Digital Bangladesh, 2009). Inclusion of Information and Communication Technology is the key goal in the strategy. Following that many private public partnership government and donor funded projects have been initiated in different public sectors like- Ministry of Agriculture, Ministry of Health, Ministry of Education, Ministry of commerce and more in last two years. The main objective of the strategies were to create awareness about use of Information Communication Technology (ICT) tools among public, information dissemination by reaching the public in mass level in less time, establishing sustainable communication by reducing travel cost, travel time, and protecting environment. In terms of Bangladesh among the usage of ICT tools by general people mobile penetration is higher than computer and other ICT tools because of the cultural, behavioral and socio-economic condition of this country. In last five years a significant dispersion of mobile phone usage has been seen in the rural areas. Mainly prominent mobile companies are working desperately to reach as many as subscribers possible, because in Bangladesh a major part of the population lives in rural area. As a win-win situation they are increasing their revenue and developing communication through interlinking the urban-rural context, which results increase in quality

of life more in urban areas and somewhat in the rural areas in the initial stages. More or less the main benefit goes to the public, which is allowing them travel less and spend less for travel by flexible communication system (discussed in the cases in chapter 3). So far, no survey and research has been done in Bangladesh in macro level to determine the 'positive or negative' impact of sustainable communication on environment, but some micro level research conducted for this thesis, has been discussed in chapter three to demonstrate reduced environmental impact from energy usage and traffic congestions by m-governance[1] service.

1.2 What is M-Governance (Mobile Governance)?

M-governance called 'Mobile Governance', is a sub-domain and complementary of e-governance that helps to extend the governance to reach mass level population in the developing world (Rameesh Kailasm, 2010). It establishes communication network among, government, public, private and other actors in a nation. M-governance mainly facilitate government to public (G2P) and public to government (P2G) communication for better public service in terms of information transmission and dissemination. Establishing the infrastructure of mobile governance does contain several actors where government plays the vital role. Beside that in many cases, in developing world private organizations, national international Non-Governmental Organizations (NGOs) and foreign donors are involved for financing and providing technical support. A common phenomenon in m-governance is a huge database server. This database server mainly store data for two way transmission. These data from both public and government side are controlled and secured in the data base server on government's sanctuary. The m-governance services are provided through three modes of mobile communication -Interactive Voice Response (IVR), signaling and disseminating data through using a wide range of mobile application system. A general question could be drawn, why it is called m-governance, where it could be identified as mobile facilities? In some developed country this services may not be considered as m-governance because of the social, economical and technological advancement of those countries. People of technologically and economically developed countries are using the mobile service by paying the mobile companies. Beside that they are also using other expensive ICT tools very flexibly which could give them same service as a mobile could do. The service demand usually comes from the customers' side, where the demand for these expensive ICT tool is less in developing country like Bangladesh. In terms of developing countries whose economical condition is below poverty line (less literate population, less affordability to use expensive ICT tools), those countries are providing the mobile facilities in a term of m-governance (Bangladesh, India, Malaysia, Thailand, Pakistan etc) (UNDP, 2007). Although there is a demand for those facilities, but the demand cannot trigger the buying capacity as still ICT tools are considered as luxury product in poor developing countries. Behind m-governance service, government is mainly involved in funding and spending for establishing the infrastructure. In this case, some time government finance through nations fund or by foreign donor's fund depending on projects' nature and situation. All in all m-governance is for facilitating a country's development through helping the general public to improve their life style, creating information awareness (education, job,

[1]M-governance is a similar word to m-government holding same meaning in some countries. Basically in India, Bangladesh, China, Africa, Indonesia, Pakistan and some other Asian countries usually use the term m-governance instead of m-government, which is a sub-domain and complementary of e-government mainly deals with development projects using mobile phone as ICT tool, i.e. poverty reduction, increase literacy and access to information for the public within affordable price and flexibility (mEmpoerment 2010, Rameesh Kailasm 2010 and International Telecommunication Union 2011).

business, environment, health, banking etc), increase public participation in national decision, and flexible sustainable communication system.

Before discussing the m-governance service in the Educational and Agricultural Sector, it is important to have a an idea how m-governance get importance in Bangladesh, and why government is more motivated to implement m-governance in a large scale as a development initiative than e-governance comparing to other neighbor countries. Section 1.3 in this chapter will discuss how m-governance got more popularity than e-governance and later established as a supplementary of e-governance.

1.3 Transition from E-Governance to M-governance

Evaluation of e-governance was initiated in the late of 1990s by establishing infrastructures. The PPP took place in the second phase of development of the e-government (Bangladesh Enterprise Institute, 2010). In the same time emergence of m-governance took place in end of the second phase of the e-government. Later in third phase m-governance integrated with different services to assist e-governance in the long run. Most of the m-governance services are diversified and developed in collaboration with different private organizations. Among them, mobile companies played a vital role. In some cases international and national NGOs are also facilitating the PPP services by technology transfer, providing skilled human resource and free consultancy. The discussion on this framework will be limited to educational and agricultural sector in Bangladesh. Figure 1 shows the evaluation of e-government along with m-governance in Bangladesh (Bangladesh Enterprise Institute, 2010). The increase and decrease in the subscribers will settle down the production (importing) cost and finally decide the supply side (as input) to the PPP environment of m-governance.

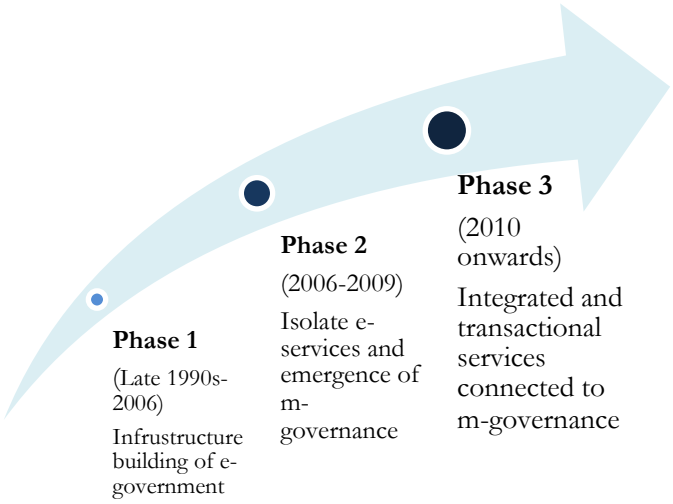

Figure 1-1 Evaluation of e-Government and m-Governance in Bangladesh
Source: Bangladesh Enterprise Institute July 2010, Page 13

M-governance works as a complimentary to e-governance rather replacement. It is widening the reach of e-governance by disseminating ICT. M-governance became popular in Bangladesh because it provides service 'anytime, anywhere' to the public, where computer is less portable than mobile and needs internet connection or network. Furthermore, in all Asian countries, including Bangladesh, India, Pakistan mobile services are cheaper and reachable to the remote people (Kailasam, 2011). Furthermore, the technological infrastructure in Bangladesh supported m-governance to penetrate more, which triggered the government to supplement m-governance service with e-governance.

1.4 Overview of m-governance in different sectors of Bangladesh

The Prime Minister of current government in the 9th parliamentary election 2008 came up with the proposal to transform the country as 'Digital Bangladesh' by 2021. This idea attracted general people to envision the country going towards development even though the vigor of the scope of such strategy was vague to the mass people (Gurumia, 2011). In the beginning (2008-2009) government mainly focused on the e-governance emphasizing more on broadband establishment, Union Information Service Centers (UISC) and increasing computer literacy in both urban and rural areas. Later government focused more on m-governance projects as mobile penetration is much higher than internet and computer use among general people. Besides that, government wanted to utilize the advantage of massive number of mobile subscribers in the country and the set established technological infrastructure by mobile phone companies that covers even remote networks. According to United Nations Educational, Scientific and Cultural Organization (UNESCO), e-governance facilitate the public sector to disseminate information, service delivery, public participation in decision making and make themselves transparent and accountable to the general public (Gurumia, 2011). This description falls under the current government's strategy for both e-governance and m-governance. These initiatives were followed up by Access to Information (A2I) program in 2007 that was designed to leverage ICT in public service delivery with necessary capacity of stakeholders to promote ICT for development (Digital Bangladesh, 2010). The first two years of government's target, the initiatives took place in union level in different district targeting remote areas through tele-networks. Furthermore, UISC, community radio, different TV programs initiated to help the mass poor people to get good service in general health issue, maternal health related information, agricultural issue, legal and human right issues. UNDP helped in designing and operating those programs by providing technology, human resource and experts and fund in some special projects. In last two years (2009 and 2010) the demand for m-governance service from the public side also increased that triggered government's initiatives to plan and implement various projects.

The government of Bangladesh apprehended that the adoption of mobile phone by the country people is relatively high and they started developing mobile applications enhancing better communication among general public with the government's different public sector. Public response in using and adoption of those services were noticeable that opened the new horizon for development through mobile phone from government side. These initiatives are called as mobile governance (m-governance) that linked PPP for the development of public sector. Beside the goal of making 'Digital Bangladesh by 2021' the main objective of m-governance can be specified as, i) reduced number of face-to-face interaction between the service provider and recipient, ii) service delivery in less costly, less travel and less time consuming means, iii) extend the service availability by 24/7 (Digital Bangladesh, 2010). In Bangladesh government initiated m-governance in almost all the public sectors but importance were given to education, agriculture, health and public safety as priority according to the country's present socio-economic condition. Among them, Educational Sector and Agricultural Sector considered as the most important sectors, where m-governance can bring positive changes. Some of the government's main initiatives of m-governance are discussed below. The in-depth case discussion will be followed by 'chapter 3' and analyses section in 'chapter 5'.

1.4.1 M-governance in Agricultural Sector (m-Agriculture)

Believing the demand, possibility and scope of work in the agricultural area adequate work has not been done so far. It is estimated that still a big number of population need to be reached to deliver the m-services. In Bangladesh 70% (112 million) of the total population

(160 million, BSS, 2009) are involved in agricultural activity defined as farmer. Among the farmers 69.9% of the farmers use mobile phone, 91.4% take help for friends and family and 78.9% use television as a communication media to get information about agricultural activity and farming (Kashem, 2010). TV media became more popular because of various initiatives taken by Shykh Seraj, media personality and agricultural journalist, thorough his TV program 'Hridoye Mati O Manush' from 2004 (The Daily Star, 2008). He highlighted the problem of poor farmers in case basis all over from all district from Bangladesh and tried to solve their problem transmitting their voice to the relative sector by his weekly 'two hour' program. It established the link and enhanced communication with the farmers and the Ministry of Agriculture. Having the farmers' data base on agricultural activity from him, government's initiatives on m-governance became more flexible and reachable to good number of farmers.

Government of Bangladesh came up with many initiatives in last three years which showed positive vive among the farmers on having flexible communication. Furthermore, farmers are being acquainted with new applications of mobile phones to get information about their program. Major mobile phone companies like Grameenphone, Banglalink and Teletalk are deliberately working in developing agriculture related application, IVR and sms based services for the farmers. One of the prominent Banglalink Telecom Company initiatives is 'Farmers Call Center' called 'Jigyasha' (queries) that helps the farmers by information. It works like a call center linked with community information center that has information about the agricultural product. A customer need to pay $0.285 USD (2 BDT) per minute for calling the help line. The process of the help line is shown in Appendix 2-1. 'Banglalink Krishi Jigyasha' service together with Soil Resource Development Institute (SRDI), a research organization under the Ministry of Agriculture, Government of Bangladesh initiated 'Digital Fertilizer Recommendation System' on July 2009, which is covering farmers of 30 sub-districts from 459 around Bangladesh (Banglalink Jigyasha, 2011). Other popular service by Banglalink is 'Banglalink Krishibazar' which is based on IVR system, enabling the sellers & buyers to upload or search the details of their desired Agro products , prices, and sellers or buyers locations and contact information through voice recording. Similar kind of service is given by Grameenphone 'CellBazar' and some other mobile companies based on sms service (Banglalink Krishibazaar, 2011). Government of Bangladesh working in line with the mobile service providers to reach remote level farmers. As most of the farmers are not literate about technology, an easy way of communication system by mobile phones are being developed by the Content Development (CD) organizations like- D-Net, BRAC, Proshika, Katalyst, US AID, UNDP, UNICEF and UNFPA. They design the application in an easy understandable way for the farmers by using local language text, images, and logics in the mobile phone application.

With that content development government initiated many projects to ensure information right and flexible communication, among them Agricultural Market Information System (AMIS) is one of recent initiatives. Department of Agricultural Market (DAM) of Ministry of Agriculture facilitated the project with the help of Swedish International Development Cooperation Agency (SIDA), Swedish Program for ICT in Developing Regions (SPIDER), BRAC University and Soft-ED Limited (AMIS, 2008 and SPIDER 2008). The details of the project will be discussed in the case study in 'chapter three'. Other than that in 2010 implementation of 'e-purjee,' a mobile based procurement system from the sugar-mil,l for sugarcane growers has changed the farmers' life magnificently. It is estimated that around 3000 farmers were trained and educated to use the digital procurement system all over in Bangladesh. The service includes sms based procurement order send to the sugarcane producers which was held manually by paper procurement before with the help of Cane Development Assistant (CDA). This system enables the registers sugarcane grower to receive

the order directly by sms through their mobile phone instead of travelling to CDA offices to receive the paper order. This initiative by government reduced time, travel and hassle at least from 3000 sugarcane producers side and flexible system with improved communication directly with the sugar mills. Details of the project will be discussed in the Case Study and Analyses section, in 'chapter three' and 'chapter four'.

1.4.2 M-governance in Educational Sector (m-Education)

Bangladesh government has provided sizable development in the education related mobile service sector in last three years (2009 to 2011). Although the initiatives are scattered in case, but are highest in number comparing with other initiatives in other sectors (Saleh, 2010). The number of service recipient in terms of mobile governance is relatively high comparing to other sector because majority of the service takers are youth in age (18 to 30 years), educated and have mobile phone literacy. The services get popularity mostly in administrative activities by the education institute governed by the Ministry of Education, which ensures the students communication flexibility, reduced cost and travel of getting the service. Mainly the mobile governance projects in this sector are undertaken by the government owned mobile company Teletalk. Most of the projects are related with delivering exam results, application procedure in various universities, administrative service and education related information delivery via mobile phone, by connecting with central board's education database. Some projects include collection of application fees from the mobile account of Teletalk – the government service provider (Ifty Islam, 2010). In Bangladesh 19 colleges are active with this governance to help the students all over the country. A pilot mobile based admission procedure was initiated by Shahjalal University of Science and Technology (SUST) in 2009 that has generated good response triggering government directives to implement this for all universities in the country. From 2010-2011 sessions all public universities implemented mobile based admission, fees and result system following government's directive. Detail case study for SUST admission procedure and college admission procedure will be discussed in the Case Study and Analysis section (chapter three and chapter four). Besides the trigger from government side, many national and international organizations like US AID, The World Bank, D-Net are working on facilitating mobile governance by initiating teachers training (on providing digital and interactive education), distance learning (through wireless connection in computer & mobile phone, community radio, television), content development for mobile and computer based adult learning, e-book and so forth. Following government recent development strategy (discussed in the chapter 1.1) the initiatives were designed in a motive to reduce travel and travel cost replacing by flexible communication (A2I, 2009).

1.4.3 M-governance in other sectors

Several m-governance services are active like- m-governance in health sector, mobile banking, mobile ticketing, mobile bill pay system, disaster management information through mobile phone, income tax information by sms etc, but they are not as effective and efficient like the discussed one here in the paper. Among these services many are in initial stages and not mature in infrastructure. Comparing to other sector m-governance in health sector has been advanced. Considering the current population of Bangladesh delivering the health service to the mass public became the utmost challenge for government. Main hindrance takes place when giving the service to the poor people of remote level. All the good doctors and facilitated services are available in the city area. In Bangladesh 26 doctors are assigned for per 100,000 person. This cause very long queue, less efficient service, and might cause death of a patient (The Fred Hollow Foundation, 2011).

Considering the current situation, this is the sector required never ending service to fulfill public's requirement, comparing other sectors. Mobile-governance is providing backlog of service deliveries by making it efficient and effective to the receiver (Saleh, 2010, p3). In a sense it is very complicated to establish proper health related help line service by mobile phones because it involves the doctors and health inspectors' to diagnose the patient by face to face interaction and scrutinizing the infected area of the patient which needs to be felt. As a result mobile based health governance has been provided for the information regarding medication and primary cure for basic level illness. Moreover, it is being a popular service for the village poor people who get ill frequently (for water, sanitation, bacterial and virus related problem) and cannot buy medicine neither afford doctors for illness. To reach them government first initiated their operation with 'Polly Tattha Kendro' -village information center where people have to go and know about health information along with other information. D-Net as a partner developed the system in 2005 with technical support and skilled human resource (D-Net, 2005).

Later government along with mobile telecom companies like Grameenphone, Banglalink, Robi, Teletalk came up with sms based and IVR system to deliver health related information to the registered user to facilitate lower income and marginalized people. Among them Grameenphone help line was the first to initiate with this service as Corporate Social Responsibility (CSR) activity by their call centers. Government followed the procedure of 'Grameenphone' and interlinked system with the community information center for better flexibility. Like Grameenphone initiated polio vaccination reminder sms service with the help of World Health Organization (WHO) in 2007 (Telenor Group, 2007), recently signed project on Mobile Alliance for Maternal Action (MAMA) with D-Net-MCC and other international partners like US AID, Johnson & Johnson. MAMA project is in initial stage and will be implemented as pilot project in four districts in the country including the capital. The project is based on IVR and sms based system which will provide the pregnant mother with monthly reminder and information about safe pregnancy during the whole pregnancy period (Priyo, 2011). Ministry of Health and Family Welfare directing the initiatives by involving 80 hospitals all over from Bangladesh (MCC, 2011). Beside that Banglalink, Teletalk and Robi have their individual 'Health line' service which gives general information about medication and information about health institute for basic illness.

1.5 Overview of Traffic Condition in Bangladesh

The capital of Bangladesh Dhaka can be represented as the overall traffic condition of major four cities (Chittagong, Sylhet, Rajshahi, and Barisal) in the country. As a densely populated (6.5 million) mega city in Bangladesh with an area of 815 km2 the daily life in Dhaka is a hectic for citizens for various reasons. Moreover, cities like Dhaka and other metropolitans consist of massive number of vehicles which is more than its road length. Problem of traffic jam mainly seen in the city area because of population density and migration towards city. Job locations, business and government's offices are mostly centralized in the city area which requires people to come in the city almost every day. According to Bangladesh Road Transportation Authority (BRTA) report in 2010, the total number of registered vehicle (motor car, jeep, taxi, bus, minibus, truck, auto-rikshaw/tempo, motor cycles and others) was 1,504897 in Bangladesh and 603166 in Dhaka city (BRTA, 2011). Beside that more than 700000 rikshaw (non-motor vehicle) with 75000 holding legal registration number are playing in the roads of Dhaka. They are the main reason behind the traffic clogs (Saifulah, 2009). A report showed in 2006, the transportation road has been extended to 270,722 km with a 5,073 km paved road which is not enough for functioning huge number of vehicle (Ahmed, 2010, p57). The study also showed that freight traffic and passenger traffic are estimated to increase 17% and 7% respectively from 2008 to 2025 (Ahmed, 2010, p55). Result of traffic

clog causing severe air emission by various CO2 or equivalent pollutant species such as carbon monoxide (CO), hydrocarbons (HC), photochemical oxidants e.g., ozone (O_3), nitrogen oxides (NO_x), particulate matter (PM), and lead (Pb) (Karim et. al., 1997). The summary of emission in Dhaka city (2010) from each pollutant presented in a study (Randall, 2011, p45) are shown below –

Table 1-1 Air Emission from Transportation in Dhaka City 2010

	Transport Sector (Million Tons)		
	2010	2030 (est)	Difference
PM2.5	1.36	1.29	-5%
PM10	1.50	1.47	-2%
SO2	2.50	3.84	+53%
NO2	9.38	18.90	+102%
GHGs (CO2 eqv.)	0.97	1.66	+71%

The source also published NOx emissions in 2010 were 30000 tons in Dhaka, subjected to the Industrial (combustion/power plants) and Transport sectors (Randall, 2011, p5). High concentration of lead (Pb) 463 nanograms/m³found in the ambient air of Dhaka city caused by pollutants from gasoline, paints, ceramics, batteries etc released in the environment (Mahmood, 2011, p129). According to the World Bank's recent report these pollutants in the air causing death of 15000 people each year in the country (Mahmood, 2011). On the other hand Dhaka-based Accident Research Center showed in a recent study yearly death of 12,000 people (on an average) in road accidents in Bangladesh (Ahramonile, 2011). Moreover, transport sector in Bangladesh is the second largest energy (petroleum, gas) consumer of 218.29 trillion BTU from 2003 to 2004 where the nation's aggregate demand for energy (2008) is 700 trillion BTU (Ahmed, 2010, p59). The current situation shows Bangladesh is running out of gas reserve as well as the demand increase 10% every year (Ahmed, 2010, p59). The previous and current government has been working for handling the traffic condition and pollution caused by it, but increasing population and demand for transportation making all the effort futile. As new highways cannot be made as many as required because of old infrastructure and economic condition of the country, furthermore country area cannot be expanded; government has no other way but to think alternative way to reduce travel by alternative means of communication. This horrible traffic condition not only causing harm in environment and human health, but also causing negative impact in National Trade Balance. Report shows that 3.5 million ton (worth of $1.12 billion USD) of petroleum fuel was imported in 2003 consisting 1.94% of country's Gross Domestic Product (GDP) (Ahmed, 2010, p59). Realizing the facts and figures the current government came up with new strategy, emphasizing more on ICT to reduce transportation along with other problems. Now it is a big challenge for government to prove the credibility of the new strategy, whether it saves the country from various problems, bring some positive results or keep remain the problem same as it was with changed direction!

1.6 Scope of Sustainable Communication Network Existing in the M-governance Service Platform

Before defining the 'sustainability' in the communication networks in m-governance service platform, it is important to demonstrate the scope of networks in both sectors. Figure 1-2 and 1-3 shows the possible communication networks among different actors in the m-governance service platform.

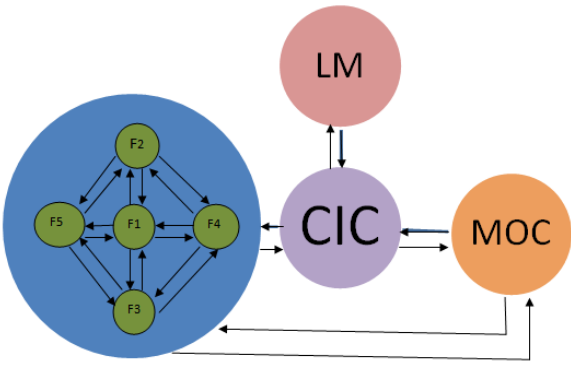

Figure 1-2 (CN) Agricultural Sector

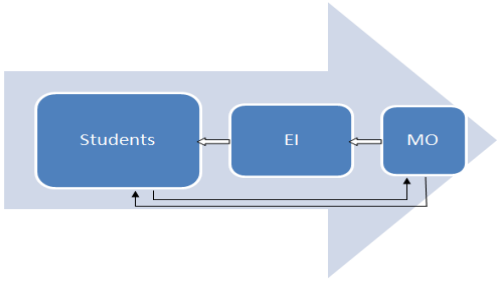

Figure 1-3 (CN) Educational Sector

F= Farmers, CIC = Community Information Center, LM = Local Market, MO = Mobile Operator Companies, EI = Educational Institute, CN= Communication Network

In both the figures 'communication network' defined by (CN) and shown by arrows in black color. In Figure 2-1, round shaped images denotes the actors involved in the Agricultural Sector. And in Figure 2-2, square shaped figures denote actors involved in Educational Sector.

This conceptual figure models are drawn on the basis of current system practiced and present in the m-governance environment for both sector. In reality the communication take places through this imagined network. In Figure 2-1 it shows that, direct communication network is there within farmers and the Mobile Operator Companies (MOC), on the other hand there is another communication network which has been bridged by the Community Information Centers (CIC). On the other side, CIC also has communication network with the local market for updating daily market information about agricultural product. Farmers among them shares information through mobile based application, which is considered as another communication network. The entire communication takes place transferring information from both side (service provider and receiver). In Educational Sector this is not the same case. The communication network is bit simple than the other sector. The two way communication network is there among the Educational Institutes (EI), students and Mobile Operators (MO). Usually it does not require any third party involvement in terms of providing the service. This is quite visible that the network established involving m-governance services in the Agricultural Sector is much wider than the communication network in the Educational Sector. This can initially draw a conclusion that the scope of sustainable communication network is higher in Agricultural Sector. But this is not the case in reality, establishing sustainability in the communication network is challenging in this sector for various reasons. However, the system in Agricultural Sector is very complex and influenced by many relevant and irrelevant factors (discussed in analysis) which cannot be determined and defined in many cases. In terms of fulfilling the sustainability requirement in the new flexible communication system (m-governance service) provided by government, both the sector does not perform in a satisfactory level. In both cases environmental concerns as a sustainability measure are bit shaky, and particularly in agricultural sector this is quite impossible to identify the environmental positive or negative impact caused by the m-governance services.

2 Problem Statement & Research Question

2.1 Problem Definition and Justification

From past decades telecommunication has been contributing a massive increase in the economic growth of Bangladesh. Behind that, the growth in mobile industry and higher penetration of mobile phones in the rural areas, as well as extended service to the user has turned the success factor of transferring the technology to the masses (Islam, 2010). And obviously this created a well structured channel for public agencies to flexible their communication through mobile governance, to the general people through extended cell phone service. As part of government's new agenda to build a Digital Bangladesh in 2009, the government of Bangladesh has identified mobile phone as one of the affordable, flexible and feasible medium of electronic service delivery to the citizens (Digital Bangladesh, 2009). Many technology options are already being utilized by several government agencies, but currently they more like to establish a long term partnership with the private sector, called Public Private Partnership (PPP) for a sustainable solution (Hossain, 2010). On the other hand the usage of computer is only popular in the city area and limited only to the educated user. Taking the opportunity of high mobile phone penetration the government of Bangladesh came up with various m-governance services in many of the public sectors. Concerning the overall traffic condition in the country (mainly in the city area), the services are specially designed to reduce travel (A2I, 2009). The implementation level of these kinds of services is remarkably high since 2008 (present government in power in 2008). This paper will discuss the success and hindrance factors playing behind the implementation of those services. Besides that, the paper will also test the sustainability measures in terms of communication (according to government's promise in the PPP strategy) on those provided services.

The study has been done on a motive to help government, private companies and other actors involved in providing m-governance service, to realize the factors behind the success and failure of their initiated projects. The outcome of the paper expected to provide an empirical feedback from the consumers' side who are receiving the m-governance services. However, it is also expected to give a clear view of the studied areas, where future development can take places through the collaboration of government and private sector.

2.2 Objectives and research question

This research is motivated by the current technology being used in information and communication dissemination in developing countries focusing on Bangladesh. Furthermore, the paper will illustrate its total implementation, challenges and opportunities, and finally the potentials in future. However, the spotlight will be on the m-governance services (one of the new paradigm of ICT in Bangladesh). To fulfill the thesis the following objectives were made-

- To get a practical view of current m-governance practice in Bangladesh, by identifying the success factors and hindrance of some current government projects facilitated by government, and addressing the policymakers to improve their initiatives.
- Check with public opinion and feedback from some projects. To have a general idea about their opinion, are they satisfied and happy with the m-governance service?
- Identify whether m-governance service can support sustainable communication and reduce environmental impact.

In order to fulfill the research objectives five surveys was done in between June to August and many interviews were taken from different officials. To support the objective, a theoretical and conceptual framework was developed and literatures were reviewed to analyze and interpret the survey results. The final analysis was made answering the research questions from a critical point of view.

On the light of the research context, the following research question was made-

"What are the present and future 'success factors and hindrance' behind implementing the m-governance service in Bangladesh, (in Educational and Agricultural Sector) to facilitate flexible and sustainable communication system among government and public?"

To explain the research question the following sub-questions were made-

1. Whether m-governance service fulfills the three pillars for sustainability in communication?
2. Whether public feedback on m-governance service supports the statement 'm-governance mobile base service replacing travel'?
3. If it reduces travel, whether the amount of reduction in travel and environmental impact can be identifiable and definable?
4. If it does not, whether there is any scope to reduce environmental impact from analyzing the system?

2.3 Research Methodology

The research conducted on the basis of empirical analysis in a zest of some quantitative survey result. Foremost, the methodology was derived by the data collected by interviews, survey, literature reviews and so on. To fulfill the answer of the research question almost 100 person were interviewed (open ended questionnaire) and surveyed through close ended questionnaire. The result from the surveys and interviews were processed through theoretical framework and assessed through literature reviews; to get a critical analysis result of the political, social and economical situation from the country's context.

2.3.1 Methods of Data Collection

The data were collected considering the availability, data quality and authenticity of the sources. Most of the **primary data** are gathered from interviews of the actors directly indirectly involved in the m-governance system. Among them government officials from Educational and Agricultural Sectors, officials from private sectors (Telecom Companies, Content Developers and NGOs), Educational institutes involved in providing m-governance services are the main. Other big sources of primary data being collected by questionnaire survey from the farmers (open ended) and from the students (close ended). The questionnaire was designed according to the research question with a simple format. The questionnaires for the farmers were made in local language 'Bengali' for better understandability. The **secondary data** were accumulated from literature analysis, peer reviews, newspaper, websites, LOVISA and from other online journals. Important secondary data provided by different government officials and private partners (mainly MCC), through paper based and online information (online company's research report, documents, presentations, publication, annual report, video footage and so on).

2.3.2 Methods of Data Analysis

A theoretical framework was developed in the context of the situation and collected data. PESTLE Analysis used as a theoretical framework for analyzing the current and future condition, strength and hindrance of the m-governance service system in the Educational and Agricultural sector in Bangladesh. PESTLE stands for Political, Economical, Social, Technological, Legal and Environmental analysis of a studied organization, product or services. It is considered as a strategic tool that can analyze the 'macro and micro' external environmental factors for given product or service (Renewal Associates, 2003). Details of the PESTLE analysis has been discussed in chapter four, 'section 4.1'. Beside that the framework, describes and analyze how the whole process works, what factors influence the system and what are the possible environmental impact from the m-governance system. Literature reviews were also interpreted with the analysis by benchmarking with good practices in the m-governance system with other countries. The final outcomes of the analysis will also interpret the result with the reality of the current situation in Bangladesh, by testing the sustainability pattern of government's claimed sustainability solution in the m-governance service.

2.4 Scopes and Limitations

The research will be focusing on the Public Private Partnership (PPP) initiatives of Bangladesh's government, focusing on the m-governance services only. In the m-governance service environment, some of the projects consider use of computers. Discussion on the use of other ICT tools in a project was not considered for the simplicity of the analysis. Only government initiated projects in Educational and Agricultural sectors were considered in the study for analysis. The scope of the communication network for this study, for both sectors has been discussed in 'chapter one, in 'section 1.6'. As the study includes interviews and surveys from different places of Bangladesh, no geographical boundary was set for the research. The study background was considered in the context of whole Bangladesh. To calculate the carbon footprint from distance traveled (in kilometers) a simple tool (carbon footprint calculator software from website) was used considered every person (considered in the calculation) traveled by midsized motor vehicle. The travel was considered as a typical day of road communication. Many subjective factors that influence replace of travel by mobile based communication, are noted but not considered fro the calculation in this paper. Rebound effect is one of them, which can interrupt the part of the research result and analysis. For example, travel replaced by mobile communication may be used for another relevant or irrelevant purpose and use of mobile phones for different purposes (excluding use for m-governance service) cannot be measured (energy consumption of m-governance service cannot be distinguished). These facts were not considered for its subjectivity and indefinable nature in many cases.

The research required surveys and interviews for its credibility, within short time it was very difficult to arrange. Biasness might work in answering the questionnaire by the interviewee; this was also noticed while taking interviews. For example, as the m-governance is quite new service and people are very excited about it, they might overlook the negative side and answered only focusing on the positive side of it. Lack of proper knowledge in perceiving the service also can be the reason for biasness. In some cases people behaviors cannot define some of the answers in the survey questionnaire, and it also differs in the context of urban and rural area. For example, some of the interviewees in city are using car to travel even one kilometer where in villages farmers prefer to walk two kilometers if it requires. Similarly, mobile phone is a common phenomenon in city area and cost per sms is very cheap for them, where in rural area still some farmers consider mobile phone as luxurious product.

During data collection this socio-economic differences were not considered. Use of internet in mobile phones was not considered as a service requirement in m-governance service. As a result, internet use in mobile phone was not considered as influencing factor for the surveys. Moreover, people use mobile phones for other purposes, which may overlap with the service, was not accounted in the study.

2.5 Target Audience

The main target group for this thesis paper is the Educational and Agricultural Sector of Government of Bangladesh and Telecom Companies (currently active or interested in providing m-governance service). This research can work as feedback and evaluation paper for both of the group to perform better service in future projects and made necessary steps to correct errors in the current projects. However, this thesis paper was made to be delivered in the end of the masters program 'Msc. Environmental Management and policy' as a partial requirement of the program, that is why it is expected to be a focal point for the academic audience who already involved in similar research. Furthermore, I have conducted this research inspired by my previous Applied Research in Sustainable Consumption and Production (ARSCP) research study, which was based on 'How virtual meetings enhance sustainable communication by replacing travel' in Swedish Public Agencies. The audience interested in Swedish Public Agencies could be interested to have a view on the context of developing countries' initiatives. This can open the door for further research on 'technology and innovation transfer' from Sweden to other developing countries. Actors involved in providing m-governance service could be interested to find their weakness and bottleneck through this paper and make improvement for future projects.

2.6 Disposition

After the introductory 'chapter one' and problem statement with research question in 'second chapter', the paper follow through case study in the 'third chapter' describing five cases with survey findings. 'Chapter four' discusses the theoretical framework and literature analysis on the light of Bangladesh's context. Thereafter, based on the case and framework, analysis has been drawn in the 'fifth chapter' following by discussion. The last and 'sixth chapter' includes conclusion addressing the answers of the research questions. However, all the chapters' content represents the overview of the work done in the research.

3 Case Studies

3.1 Mobile Phone Usage in Agricultural Sector

Country like Bangladesh is widely depending on its agricultural product to fulfill at least the partial food demand for its 160 million (approx) people (BBS, 2009). Among the population there are 29 million households, where 15 million households are owner and associated with agricultural farmhouse (BBS, 2009). According to recent survey at least one person in a three member family has mobile phone access, which means many farmers (at least 7.829 million that is 69.9% of total farmers, discussed in chapter one) have access to mobile phones. As a developing country Bangladesh needs a lot more to add towards the technological development of agricultural sector. Indicating that, in 2007 ICT Development index ranked Bangladesh 130 out of 154 for using ICT means. Although it doesn't sounds interesting, but penetration rate of mobile phone use in Bangladesh seemed outstanding than other ICT means (PC, Internet etc) (ITU 2009 and BTRC 2010).

Among the electronic technology mobile phone technology is the dominating one in the rural vicinity as well. The adoption of cellular technology is relatively higher even to the poor farmers because of the linkage of society and technology, and according to that farmers shape their lifestyle (Dey, 2008, p1). Farms are relatively small here in this country and farmers are disheveled with various problems like crop sharing, tenancy, money lending with their trader and land owner (Dey, 2008, p1). Most of the farmers do not get right price from the middle man who sell their crop to the retailer. They even do not know they are being cheated by their product price, as most of the time they do have less idea about the market price. Furthermore, they have limited access to the latest information about seed, fertilizers, and pesticides that is being used in the land. Unfortunately, they even do not have appropriate health care information for using those ingredients in the land. So it is clearly seen there is a communication gap functioning and letting the farmers backward from their right to have information.

Bangladesh government's recent developing strategy 'making digital Bangladesh' also includes use of mobile technology (application, service) for flexible and sometime direct communication between the farmers and agricultural ministry, to help the farmers with information. The main operation of the ministry of Agriculture is centered in the metropolitan city and the number of community hub that works as representatives of the ministry, are very less in number that cannot cover an entire village. At a sense it also works as sustainable communication among government and farmers by minimizing cost, travel and hassle to get information. Farmers can get information through mobile phone text message and automated voice service (IVR). The services are provided by the mobile phone companies with the help of the ministry and content/application developer. From government side the investment is considered as for development project. Mainly the content developer and the mobile phone companies get certain amount of finance from government's project fund. In addition, mobile phone companies get revenue from the usage of their capacity as service by the farmers.

3.1.1 Case 1: Agricultural Market Information System in Bangladesh- Scopes and Challenges

Under Bangladesh Ministry of Agriculture a two year (2007 to 2009) project on Agricultural Market Information System (AMIS) has been completed in cooperation with Department of Agricultural Marketing (DAM), to facilitate the poor small farmers of Bangladesh by providing correct information about their products in the market for better functioning,

through ensuring information right. The system provided agricultural information through combining sms bases mobile service, mobile IVR service and local information staff. Örebro University of Sweden, as a partner funded the feasibility survey in the country with a sample of 50 villages of 13 districts (1050 farmers) along with the stakeholders in 2007 before planning the AMIS to be in action (AMIS, 2008). The other partners were Swedish International Development Cooperation Agency (SIDA), Swedish Program for ICT in Developing Regions (SPIDER), BRAC University and Soft-ED Limited (AMIS, 2008 and SPIDER 2008). The project went through much critical process and ended making a platform for the small farmers to receive authentic information about their product price and attributes.

3.1.1.1 Projects Description

The project was designed for data collection and dissemination for the poor small farmers for ensuring the right information about their product. The project was inspired and initiated after a tasted survey by BRAC University, finding the demand for correct information for agricultural product by a huge number of farmers. AMIS focused on mobile phone to provide the service (information) to the farmers in minimum cost with the help of telecom companies. An established infrastructure of 'Grameen Village Phone' project of Grameenphone (user of 122,000 poor villagers) helped AMIS a lot to initial stage of the project. The project deals with sample of 13 districts (210 mobile phone users of 1050 farmers) in the country (AMIS 2008). The farmers in the sample districts use mobile connection from different operators. The whole system works combining the database sms server, IVR system and mobile phone sms system. Market investigators gather price information about agricultural products (50 items initially) from the growers and from day level market, and text the information through message to store in the database sms server. Farmers requiring the price information of particular product send sms request in the database and get replied through sms again. Farmers are able to use IVR system to share information about their product (AMIS, 2008). Considering low literacy rate of understanding the mobile screen and text capacity by the farmers, the system used simplifying messaging system using images and signs (AMIS, 2008). In this way the system allows the farmers to become well adopted by the process and to make them aware of their product's price.

3.1.1.2 Purpose of the Project

The main purpose of the project was to improve technological development and ensure information authenticity in agricultural sector. The development was to guarantee proper collection and dissemination of agricultural market information to the poor farmers using cheap, flexible and sustainable means of communication (SPIDER, 2008). Before the service took place, the poor farmer had to travel long distance and spend a lot of time to gather daily market information (mainly price) for their grown product. They also had to travel other villages to share information and check price of similar product. This project aimed significant reduction in travel and time spent by the farmers for collecting and sharing information. The project also aimed to facilitate the existing system of the Ministry of agriculture by extending it with new flexible technology (Department of Agricultural Marketing, 2011). It was also designed to establish strong network among the Ministry of Agriculture, Local Market Organizers and the other actors involved (farmers, traders, retailers, market investigators) to develop the platform for full implementation of the system. All the data, analysis and results were supposed to report directly to the government of Bangladesh (SPIDER, 2008).

3.1.1.3 Why Mobile Phones for the Farmers?

According to BTRC June 2011, the number of total mobile subscribers in Bangladesh is 76.434 million where the number of computer user is around 3 million (2010) (BTRC 2011, IWS 2010 and Wiki 2010). A previous project of Food Agricultural Organization (FAO) with Department of Agricultural Marketing (DAM) had worked for similar service using PCs as communication tool. For the information service they established 20 computers in 20 districts with dial-up connection which facilitated data collection and entry through computer terminals (AMIS, 2008). However, due to lack of literacy and computer maintenance at the district levels, data collection and dissemination became a bottleneck in the whole system. Moreover, the power (electricity) distribution system in the villages and voltage fluctuation creates disruption in computer usage.

The surveys in AMIS (2008 to 2009) showed, among 210 farmers a major part use Grameenphone as service provider and used Nokia as handset. Both the connection (prepaid) and handset is relatively cheap and provided good service to the farmers (Islam et. al., 2011, p6). Especially for the farmers, during that time Grameenphone sold a special package of Nokia handset (flexible software installed for the farmers) with the connection and sim card with a discounted price. However, other telecom companies like 'Banglalink' and 'Robi' later took some of the market share in the rural area. Beside that power consumption of a mobile phone is low comparing with other ICT devices and that made the device popular and user friendly even to the ignorant. In addition, the mobile phone diffusion and adoption level seen as very high even among the farmers because of the social and individual context. Islam and Grönlund (Islam et. al., 2011, p6) discussed various reasons for mobile adoption in their paper. One of the important reasons denotes the feature of mobile phone in terms of service. With the phone they can connect with their family and relatives besides getting agricultural information. Villagers even keep in touch with their neighbors using mobile phones. As a result the diffusion of mobile phone became high. As a wonderful device perceived by the farmer it reduces time, reduces travel both for collecting and sharing information. A mobile phone usage has an individual behavioral impact in this country which could be significantly differentiated from western world. Among the poor people if one person gives a miss call to another person it means the person giving miss call is in shortage of mobile credit. The perceived person will call back in that case. It could not be that much flexible for other devices. But this behavioral action the farmers created mutual understanding among themselves which is very unique.

3.1.1.4 Farmers' Interview feedback on the AMIS project

The survey conducted by Islam and Grönlund represented that around 80% of the 1050 farmers would go to another market to sell their product if they get information about better market which gives more price to their product. And 60% of them said they would like to use mobile phones to collect and share information about their product price (AMIS, 2008). It shows that there is potential demand for the rest 840 farmers to use mobile phones for the service. Considering the demand fact a new survey has been conducted in June 2011 for this research paper taking 10 farmers as a sample from the 210 farmers, from three districts among 13 districts (50 villages), to get feedback from the sample farmers. The sample 5 villages have been taken randomly from the 3 districts. The sample contains at least 5 villages from 3 different districts.

The farmers were interviewed in their local language by using mobile communication from Sweden. The questionnaire was mainly designed in such a way to get their feedback and opinion on AMIS project and how the project reduced their information cost and travel.

They were asked about increased reliability by implementing sustainable communication (among government and farmers) through using mobile service to get agricultural market information. Among the sample 10 farmers, finally six farmers could give their feedback. The interviews are shown in Appendix 3. Most of them are vegetable growers. Beside that some of them grow rice, sugarcane and involved in aqua culture. Among the farmers two of them were relatively young (below age 30) and seemed enthusiast to learn more. Most of the farmer said they are happy with using mobile phone as a technology for flexible communication but only four of them said they are satisfied with the AMIS service. Rest of the two farmers said mobile is working as communication tool for both agricultural activity and business but not helping in getting correct price information about their product. Young aged people seemed very enthusiast than middle aged farmer. They want to learn more and want access to the information more. Some wants to learn computer and internet to enhance their knowledge in the field. Most of the farmers are using mobile phones at least for 5 years. One of the farmers is using mobile phone for 16 years for different purpose. People using other mobile subscribers other than Grameenphone connection, thinks 'Grameenphone' provides the best service in all case in agricultural information. They think 'Grameenphone' has the widest reach to all level of farmers and they can interlink the farmers' activity by mobile based information sharing system. Most of the farmers are not happy with the middle man setting the price for their product. They think there is a local politics going on regarding setting the market price of the product and an internal business syndicate working behind that. The middle man does not agree with the deserved price of the farmers as there is no rule to enforce them to do that. Every famer said, on an average another 20 farmers are involved in receiving m-governance service in the locality and they are also facing same problem.

All the farmers agreed that after m-governance came in action they came to know important information about their product which reduced their travel, time, cost and hassle, but the service could be better. They also agreed everyday they had to travel many kilometers (maximum 8km, minimum 1km) by road and by river before, for seeking information, which they do not do now. According to their feedback, mobile based m-governance service reduced their travel but they are unable to quantify that as they are using mobile phones for years on a daily basis for agricultural and other reason.

3.1.1.5 Findings

According to one of the researchers of the project Sirajul M. Islam of Örebro University , "AMIS in Bangladesh unable to fulfill the farmers requirement as they deserve, the politics of the middle man (who sell farmers product to the retailer) and local politicians for defending their benefits (monetary) making the whole system malfunctioning" (Islam, 2011). This has been realized while interviewing the farmers. Among the six farmers four of them mentioned about the problem of corruption. This malfunction in the system weakens government initiatives and purpose of the project. This may reduce the credibility of the project and discourage the new farmers to strive for the service. On the other hand still farmers prefer face-to-face interaction in some cases as the information they get is not authentic and trustable. Ultimately they are not benefitted with the service, which will lead them to travel local market. This practice may increase the total travel (kilometers per farmer) again. The satisfaction of the farmers also depends on which mobile operators' services they are using. 'Grameenphone' as first and 'Banglalink' as second proved as the best in providing service in the AMIS case. Although farmers are being benefitted in terms of communication but ultimately the AMIS project could not show success in its result as it was expected.

3.1.2 Case 2: Digital Cane Procurement and Development System (E-Purjee)

The Digital Cane Procurement System is a m-governance system initiated by government, called 'E-Purjee' in Bangladesh's context. This system kept a magnificent change in communication system among the poor sugarcane producer with the sugar mills. The project was initiated by government in 2009 to fulfill government's 'Access to Information (A2I)' strategy (Digital Bangladesh, 2010). In the initial stage, two pilot projects took place in two sugar mills, one in Faridpur and another in Mobarakganj district. After the successful accomplishment of the pilot projects, government added the rest 13 sugar mills under the service in 2010. Bangladesh Sugar and Food Corporation (BSFIC) administered and managed the m-governance service along with UNDP (Digital Bangladesh, 2010). UNDP provided financial and technical assistance to execute the project successfully. Government officials from Bangladesh Sugar and Food Industry Corporation (BSFIC) instigated advertisements (leaflets, banners, posters) in the village locality and knocked house-to-house to create awareness about the new system (Digital Bangladesh, 2010).

3.1.2.1 Project Descriptions

After the success of the first two pilot projects, necessary infrastructures and installments were established in the rest 13 sugar mills. Different workshops, seminars, training (ToT) were held to inspire workers and farmers to be habituated with the system. Related software and hardware were installed for supporting the system. Fifteen servers have been installed in 15 mills with other logistics (computers, printers, internet and scanner) to facilitate the service. Government officials (computer operators) from A2I and a Content Developer Company designed the software for this service. At first the farmers were divided into units, centers and zones under each sugar mills. In 15 sugar mills the total number of units are 1371, each mills holds 80 to 120 units and around 100 to 200 farmers are allocated in each unit, two or three units together combine a center or a zone (Digital Bangladesh, 2010). A center performs the administrative work of its own, and responsible for their units. The Cane Development Assistant (CDA) is being assigned to control the whole e-purjee system under government's supervision. Before in the traditional system, farmers had to send notice to the sugar mills, that they are ready with sugarcanes. Getting the notification the sugar mills then send the procurement order to the farmers and notifying the local union office, where farmers had to wait a long (3 to 4 days) to get the paper procurement. This previous system was time consuming, farmers and mill owners both had to face loss for the chance of sugarcane be putrid during this time. The sugarcane losses it's juice content if it takes more than one day to harvest. That produces loss for the both parties.

This new digital system (mobile base procurement system) sends procurement directly to the member farmers using mobile sms where no middleman involvement is required. This is an automated sms process generated from sugar mills while the raw material is finished. For that purpose, three operators being assigned to execute procurement related operations in a mill (Digital Bangladesh, 2010). In the beginning of the project the CDA member trained the trainers (farmers' leaders) to receive and send sugarcane procurement information using mobile sms system. They were trained how to interpret the sms got from sugar mills and what action they should take after getting information through sms. BSFIC and other government officials from A2I organized this training session for 3,000 members (including farmers) of the 15 sugar mills. The members were divided in to two teams and each 1,500 members in one team trained around 0.15 million farmers through group meetings in their locality (Digital Bangladesh, 2010).

3.1.2.2 Project Purpose

The purpose of the project was to ensure the farmers information right and communication flexibility system in the sugarcane procurement system to benefit the poor farmer. The project was designed on the light of government's A2I strategy (A2I, 2009) to fulfill the e-government development targets by implementing flexible m-governance services. Open workshops and seminars were held to inspire new farmers from other districts who were beginner to the system. Prominent personalities, high officials from BSFIC, some parliament members, sugarcane growers, CDA, and leaders from the farmers' side were present in the workshop to encourage the new farmers involved in the system. The farmers from the two pilot projects shared their views on e-purjee system, discussed the comparison of the previous traditional procurement system and their good and bad experiences with the new system (Digital Bangladesh, 2010). In that seminar government officials discussed their purpose of the initiatives along with the significance of government's strategy of A2I.

3.1.2.3 Farmers' Interview Feedback on E-Purjee Project

There was a survey on farmers feedback on the 'e-purjee' system which was published in Bangladesh government's website named 'Success Story: A sms changed our life' (Digital Bangladesh, A success story, 2010). The feedback is concluded based on the survey result. According to the farmers from Faridpur district, where the first pilot project of 'e-purjee' took place; this system has reduced half of their sufferings from the traditional procurement system. All most all the farmers were involved with the traditional system since 1976. During the traditional system they could deliver the sugarcanes after they get the paper based procurement order in the crushing season from the sugar mills through the union office. After their delivery they get their money when the sugarcane crushing season is over. Now they do not have to worry and run union offices (Center in charge offices) for getting the procurement order and also getting their money. In both cases they are contacted through sms. They had to face problem before as the paper procurement mentions only three days validity for sugarcane which could not be possible to maintain by the farmers on due time. After the validity time the sugarcane may become dry and the mills may not want to buy it as raw materials. Furthermore, farmers used to get the order though neighbors, other farmers or they have to travel miles to get the order from the office. Sometimes even if they travel to take the order or receive money, they find the order was not received by the office authority. So, there was always a communication gap and unnecessary hassle. Farmers seemed to be very happy now with the new system and think it as a revolutionary change after the liberation war (1972) of Bangladesh, for the sugarcane growers and the mill owners. According to the farmers this service not only gave them communication flexibility but also provided information about interest free agricultural loan, fertilizers, pesticides, and fundamentals about irrigation. If a sugarcane grower is asked to express their feedback in one sentence, on the digital cane procurement system, they would say 'A sms changed our life!' It is one of the statements said by 58 years old sugarcane grower Mr. Shahidul Islam from Faridpur (Digital Bangladesh, A success story, 2010).

3.1.2.4 Findings

The survey covered 15 sugar mills in 2010, and 3000 members (in 2010) were taking the service. Right now (2011) five sugar mills having 30,000 members (farmers) from five mills from the following district- Shyampur, Mohimaganj, Panchagarh, Thakurgaon and Setabganj (Rangpur division) are having the service (The New Nation, 2011). The estimated total amount of mills including members from the rest 10 mills will be more. The average possible reduction in travel replaced by mobile sms for this digital cane procurement system can be achieved, if statistical data for the total number of involved farmers could be gathered by any

macro level survey. For this more research and development in this sector is required. This system encouraged more farmers to adapt the system as the sugar recovery rate has increased by 7.5% in 2011 (The New Nation, 2011). Moreover, the digital cane procurement system encouraged other farmers to grow sugarcane beside rice production. Presently, sugarcane farmers do not complain for corruption, hassles, and problems of information authenticity. Overall the system proved as successful implementation of m-governance and accepted by a big number of farmers.

3.2 Mobile Phone Usage in Education Sector

The motto for Bangladesh in terms of literacy is 'Education for all'. To achieve that motto Bangladesh acknowledged many challenges. Inclusion of ICT for providing better service in education sector is one of the recent prominent initiatives. Among the ICT tools community Radio (CR), use of mobile phones, online based education through pc service are the significant initiatives. According to United Nations Educational, Scientific and Cultural Organization (UNESCO) listing of prioritized country for literacy effort, 35 countries in the world have a literacy rate of below 50% and illiterate population more than 10 million. Bangladesh falls under on those countries with an adult literacy rate of 48.8% (2008) (UNESCO, 2010, p1-3).

As a democratic country emerging education sector is one of the vital priorities of the MDGs of Bangladeshi government. Beside that the country's government considers education as the interior strategy to alleviate poverty and assist development. In the '2010-2011' annual budget Bangladesh government allocated around $25.7 (1795.9 billion BDT) billion USD in the education sector which is amounted as double in the budget than any other sector, mentioned by the Finance Minister of the country. Some of the budget already has been allocated in the primary education programs middle of 2010(Dhaka News, 2010). The digital Bangladesh goal of 2009 mainly emphasizes on ensuring quality education, transparency, efficiency and effectiveness at all level of educational administration from ministry to teacher level through using ICT tools. It also gave importance on public (students, parents and teachers) participations on developing six strategic areas for development (Appendix 1-1). For smoother operation teachers are trained as ICT professional according to the content they are going to use for teaching the students. The most recent and significantly effective service can be considered as the citizen service using ICT tools (mainly mobile phone and internet based PC) related to education (AIP, 2010). It is considered as significant, as an enormous number of students are involved in the service relating admission and getting result from school, colleges and universities. For example: this year (2011) around 1.315 million students attended the Secondary School Certificate (SSC) examination from all 11 boards and 779,441 students attended the Higher Secondary Certificate (HSC) examination. And they got their result through sms system via mobile phone, using Teletalk connection (a mobile service operator in Bangladesh) (Noboaalo, 2011 & All time BD News 2011). Not only that, they are also getting their result through mobile phone and PCs (using internet). The students (around 1.1 million students) passed from SSC this year (2011) got admitted for HSC in different colleges around Bangladesh (ShopnoBaz, 2011). Among the colleges 19 (Appendix 1-2) of them (approved by Education Board) processed the initial admission application process using mobile based sms system.

Furthermore, different public universities already implemented similar system for admission procedure and published result to ensure better flexibility, and less travel (admission related) by the students. In the initial stage the education board administrated this service coordinating with the partner organizations- Ministry of Education, mobile phone service providers, mobile phone software developer or content developer and educational institute.

In terms of special cases they involve national or international NGOs for help. These services are mostly sector development oriented and triggered by the government and also funded by government allocated budget (Digital Bangladesh, 2010). Beside that from the customers' side they pay a very little amount of money to get the service and that goes as revenue to the mobile service provider.

3.2.1 Case 3: SMS Based Automated Registration of Admission Test for Shahjalal University of Science and Technology (SUST)

To initiate with Paperless Admission System as a strategic MDGs for digital Bangladesh, government of Bangladesh and Shahjalal University of Science and Technology with other partner organizations introduced totally new system of registration of admission test initially as pilot project. The system was mainly designed in 2010 concentrating on reduced travel cost and hassle free admission procedure, addressing those candidates who just passed their HSC or equivalent examination. This smart system includes registration, application fee payment and result publication procedure using sms through mobile phones (E-Content and ICT for Development Award, 2010). In general, students usually come from different place and location around Bangladesh to fill up the application and attach their academic documents on spot for the admission procedure. But this system reduced the travel and hassle of the students significantly (both coming for application procedure and coming for the result).

3.2.1.1 Project Description

The whole project is mainly funded by government. Beside Ministry of Education other organizations D.Net-MCC worked for content and communication platform development, where MCC is a subsidiary company of D.Net. MCC developed the total application and content with the help of the Computer Science and Engineering (CSE) department of SUST and Teletalk mobile operator company. As the project was initiated as pilot project, the university involved Content Developer for ensuring better service and technology. Teletalk Company gets lump-sum money for providing the sms service capacity to the service user. The whole process promised to give at least 5 admission related services for the university candidates using the ICT tools, where three of them has been provided from mobile sms service and two of them through online using PC (SUST, 2010). The three sms services are registration for the admission test, paying the application fee and knowing the admission test result. In the whole admission process, the candidates required only one time to go to the institute for admission test. Last year (2010) the system showed successful system implementation with students' satisfaction. Students were happy with the new system as it saved time, and travel cost significantly (showed in survey findings). The technical process work through following way (E-Content and ICT for Development Award, 2010) –

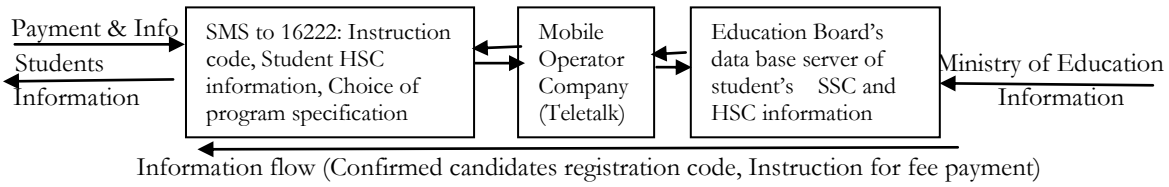

Figure 3-1 Registration for admission test (Step 1)

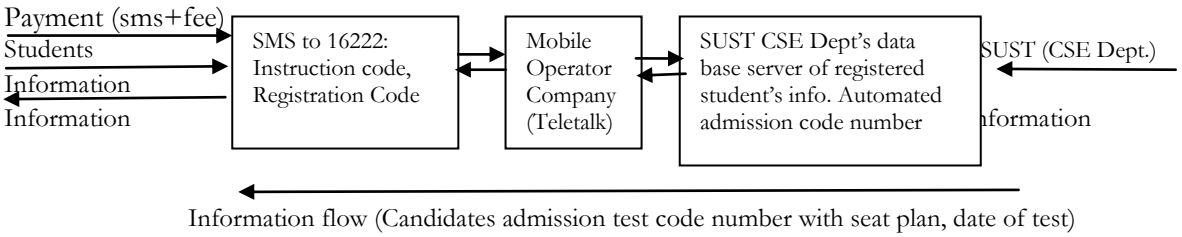

Figure 3-2 Registration Fee payment (Step 2)

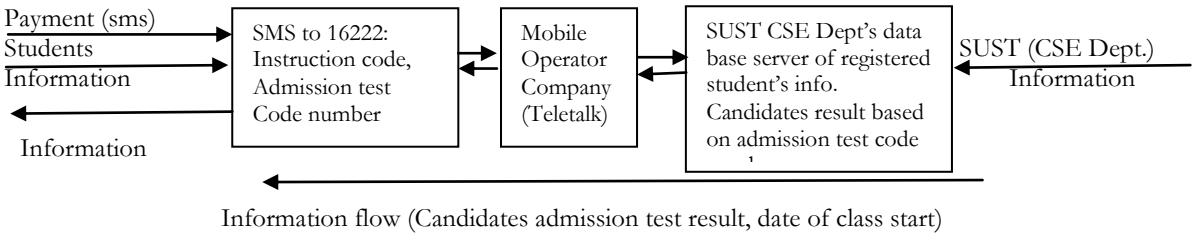

Figure 3-3 Getting the admission test results (Step 3)

The above technical process described in an easy understandable format excluding the detail IT mechanism. All the information about HSC and SSC college name/board code, program code in SUST, instruction code and all other relevant codes for applying for the admission and getting result through sms, are communicated with the candidates and interested group through newspaper and SUST university website. The seat plan, results of the admission test and other relevant information can be obtained online from university website by inputting candidate's registration code and admission code number. This whole process requires the candidates to go to the university only one time for admission test. The candidates require sending sms at least three to four times for the whole process. This is a 24/7 service and only candidates of teletalk connection holder can send sms. Teletalk deduct $0.00822 USD (0.575 BDT) including Value Added Tax (VAT) per sms (Teletalk Bangladesh Ltd, 2011) which is very cheap relatively travelling to the university several time. Beside that this initiative considered as environmental friendly sustainable communication both by the university and government. Although it reduces carbon footprint in a trivial level from transportation by the candidates but this worked as benchmark and case in point for other private and public universities to take similar initiatives.

3.2.1.2 Students Adaptability with Mobile Phones

Having a mobile phone is a very common phenomenon for the students in Bangladesh. Mobile operator companies' market segmentation, campaign and advertisement motive mainly focus on youth generation that is visible from the newspaper, radio and television commercials. The mobile operators services are such even a primary level student can operate mobile phones. Beside that most mobile operators provide 'Bengali Language Text' software in the mobile set if the customer buys it as package with the connection. Students usually prefer to take that offer, as mobile sets are relatively cheap if it is included in the package. Some mobile operators give installment options to buy mobile with connections for students like the western country do. According to the education journal of Bangladesh 2010 the number of students already enrolled in the primary education in 2008 was 1.61 million

(Ahmed et. al. 2010, p11) where the adult literacy rate is 48.8% (UNESCO, 2010, p1-3) that is around (48.8% of 160 million) 7.808 million (2008) of students (Indexmundi, 2010). In general according to BTRC June 2011 report the number of mobile subscribers in Bangladesh is 76.434 million (BTRC, 2011). The number of mobile subscriber as student is not available as statistics but it can be assumed that a good number of people from 76.434 million mobile users are students from the literacy perspective. Students come from different locations and studying in different universities in Bangladesh in many district, stay temporary in that place for study purpose. Those students use mobile phones mainly for communication purpose as they are not eligible to get LAN line telephone connection. From the above figure it can be expected that the mobile phone use among students will increase proportionally by the increase in literacy rate (both primary and adult), through expanded infrastructure beyond urban area, and more government and private level mobile governance initiatives in educational sector.

3.2.1.3 Survey Findings on SUST Admission

A recent survey has been done in July 2011 in SUST with a sample of 50 students (randomly taken), to get the students' feedback on the sms based admission system. Beside that interviews were taken from the employees of the university who were and still directly involved in the project. Among them Mr. Jafar Iqbal, head of CSC department (a prominent writer and film director) was main. The survey result reflected the following feedback from the students. The detail of the result also showed in Appendix 4-1 B. The sample 50 students were interviewed randomly with a 'close ended' questionnaire. The survey was done in Sylhet, one of the four major cities in Bangladesh as the university located in Sylhet. The survey was conducted by a university teacher Ms. Zyeda Sharmeen of SUST, who worked as a research representative for collecting data from the students. The result from the students received as electronic scanned copy through email from the paper version of the questionnaire. The questionnaire is also show in Appendix 4-1 A. The purpose of the survey is to take students' overall feedback on the system. Beside that special focus kept on how much distance in kilometer they saved, using the m-governance service during the admission procedure. Moreover, total kilometer of distance saved by the sample 50 students calculated approximately 8, 934 km for a typical day of road communication. It will be 8,911 (8,934-28) km excluding the travel by rikshaw and walking. Travelling with rikshaw and walking does not have any environmental impact. For this reason this amount of distance has been deducted from the total distance saved. Total carbon footprint saved by 50 students was approximately 4.11 CO2 eq Tons for a typical day of road communication (Appendix 4-1 B). For the distance the student's saved in total time 12, 104 minutes (approx). It will be 11,874 (12,104-230) minutes (approx.) excluding rikshaw journey and walking. The amount of money saved in total of approximately BDT 32,272 BDT 31,500 (32,272-772), $450 USD excluding rikshaw and walking distance.

Among the students 74% used bus, 10% private car, and 16% used rikshaw while going for the admission test, which they do once instead of twice during the admission procedure. 72% students said they do not face any problem, 20% faced management problem and 8% faced technical problem and no one faced any administration problem. The students' feedback on the overall system denotes 86% said the service is excellent and 14% said the service good and no one disliked the system. 96% students like to see the further development, 2% was bit skeptical and 2% did not want any development.

3.2.2 Case 4: SMS Based Undergraduate Admission Process in Bangladesh University of Engineering and Technology (BUET)

According to Teletalk (Mobile service provider) annual report (2009-2010) a total of 26 universities (22 public and 4 private universities) for the first time held their admission process through the sms system in 2010. Using the Teletalk sms service in total of 630, 000 students admitted on those universities through using sms service. The number of students' admission through this system expected to increase by 10 million by next academic year (2011-2012). The services included registration for the admission application, application fee payment and receiving admission result through using sms (Teletalk, 2010). BUET as a public university falls under those listed universities who gave the sms based admission service. According to BUET 7,450 students applied through online and sms based admission process in the 2010-2011 session and 965 students got admitted in different department. In the whole process students submitted their application online, paid application fee through sms service, get heir admit card, money receipt and their result through sms or online. According to them the admission process was very flexible and successfully accomplished without any major problems (Coordinator of Undergraduate Admission BUET, 2011)

3.2.2.1 Project Description and Technical Process

BUET developed the admission process with the help of its Computer Science and Engineering Department students and Teletalk mobile service operator. Besides that, Ministry of Education mainly funded the project along with other universities. BUET is located in Dhaka, capital of the country and targeted students mainly live in Dhaka, as they have limited accommodation for students. Assuming that most of the students have access to the internet they designed three of the steps- submission of application, getting money receipt and getting admit card using online service. This initiative is also for acquainted the students with the online system. The technical process work through following way (BUET 2010)-

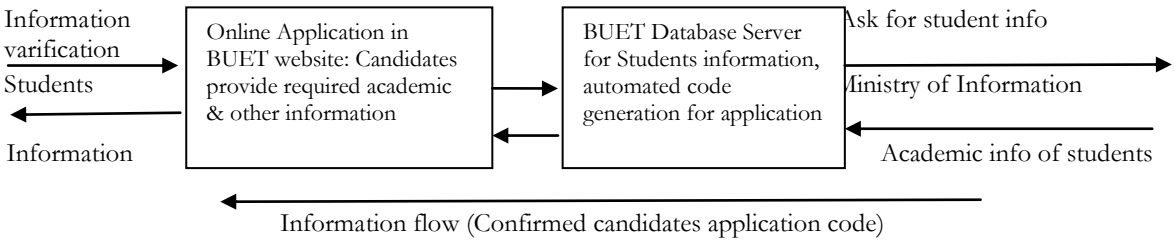

Figure 3-4 Online Application Submission (Step 1)

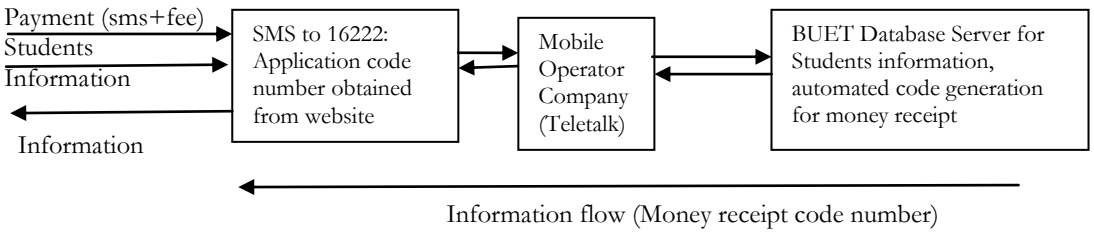

Figure 3-5 Registration Fee payment (Step 2)

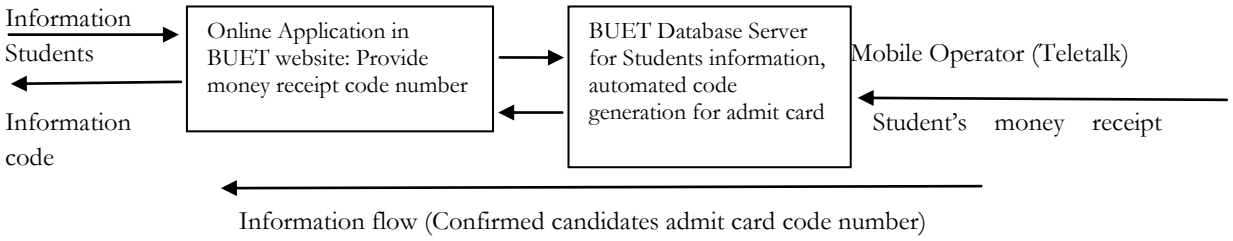

Figure 3-6 Getting the Admit Card (Step 3)

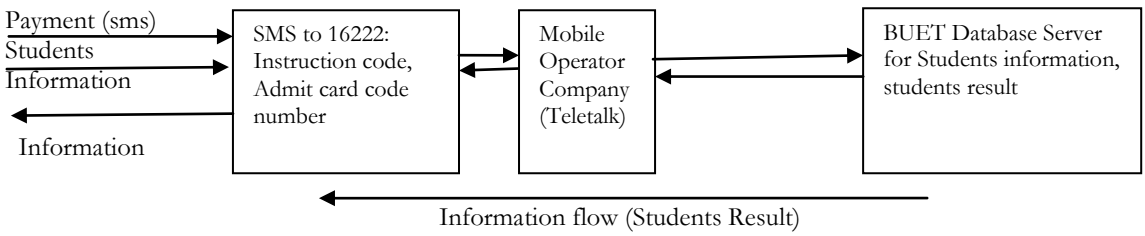

Figure 3-7 Getting the admission test result (Step 4)

There are three steps in admission process which can be done both using mobile sms service and taking information online from university website. It depends on students' flexibility. Students are informed about the application procedure for admission though communication media- newspaper, television and website with required information. For using the sms service the students are required to pay a lump-sum amount of sms charge which is same as discussed in Case 3. It is very clear that 7,450 candidates from different parts of the country of 2010-2011 sessions have saved their time and travel cost by using the online and sms service for application. The whole application procedure required the students' attendance only on the admission test day. According to the authority in BUET, they did not find any major difficulties to communicate with the students as students were always welcome to contact them for any queries.

3.2.2.2 Survey Findings of BUET Admission

As discussed earlier in Case-3, the students of Bangladesh are very much acquainted with mobile phone operations. It has been observed through their response in this innovative admission process. A survey was done for this paper in the beginning of August 2011 to get the students' feedback on this online and sms based admission process taking a sample of 20 students from the 965 students who got admitted (7450 candidates applied for admission test). The students' responses on the new admission system from '2010-2011' session are showed in Appendix 4-2 B. The survey was conducted by a research representative on behalf of me for this thesis, who is a university graduate student from Dhaka. The survey questionnaire is shown in Appendix 4-2 A. This case is also focused on the students' overall feedback and the travel (amount of distance) they saved during the admission procedure. Moreover, total kilometer of distance saved by the sample 20 students is approximately 1, 436 km for a typical day of road communication. It will be 1431.6 (1,436-5.1) km excluding the travel by rikshaw and walking. Travelling with rikshaw and walking does not have any environmental impact. For this reason this amount of distance has been deducted from the total distance saved. Total carbon footprint saved by 20 students was approximately 0.7 CO2 eq Tons for a typical day of road communication (Appendix 4-2 B). For the distance the

student's saved in total time approximately 3,266 minutes. It will be 3,210 (3,266-56) minutes excluding rikshaw journey and walking. The amount of money saved in total of BDT 6,300 (approx.), BDT 6,200 (6,300-100), and $88.572 USD excluding rikshaw and walking distance.

Among the students 20% used bus, 70% private car, and 10% used rikshaw while going for the admission test, which they do once instead of twice during the admission procedure. 80% students said they did not face any problem, 5% faced management problem and 15% faced technical problem. The students' feedback on the overall system denotes 10% said the service is excellent and 30% said the service was good, 60% said average, 5% was neutral in their comment, and 3.34% disliked the system. 73.34% students like to see the further development, and 5% was bit skeptical about further development in m-governance.

3.2.3 Case 5: SMS Based Application for Admission in Higher Secondary Certificate (HSC)

This project is another initiative from government to facilitate m-governance for students' flexibility. The last two years student got their SSC and HSC result online and by sms. Sms based college admission is the first time in Bangladesh. This year (2011) 1.082543 million students passed from SSC and got admitted for HSC in different colleges around Bangladesh (ShopnoBaz, 2011). The education board initiated this system for '2011-2012' batch in 2011 for the HSC applicant. Considering the number of students using the service expected to provide communication flexibility in a massive level. Although adaptation of this system might become a question, but it highly depends on the management and administration of the educational institute. The initial steps of the application procedure of HSC admission test, government approved 19 colleges (Appendix 1-2). The colleges processed the initial admission application process using mobile phone sms system. The number of colleges is expected to increase. Only 'Teletalk' subscribers will be able to get the service. People who do not use Teletalk connection can take help to send sms from other Teletalk user (Dhaka Education Board, 2011).

3.2.3.1Project Description and Technical Process

After successful establishment of the sms based admission system in the public universities, government of Bangladesh for the first time implemented the system in the 19 colleges this year. At the beginning of the project government planned to observe the response, after that government planned to implement in the rest of colleges. All of the 19 colleges are located in Dhaka city (Dhaka Education Board, 2011). The technical process of the project is similar to the SUST admission system. It considers two steps applying for each program. The first step considers the registration procedure and in the second step application fees will be deducted. The students are provided necessary codes for schools, programs, category through daily newspaper few months before the admission procedure. Students use those codes according to their information while applying for the admission. The students required to go to the institute only one time while admissions test. The receipt and admission code is enough to recognize them in the admission hall. The students already have their photos with education board information server. In this way the authority can recognize them through their photo. The whole technical process can work through in the following way (Prio, 2011) –

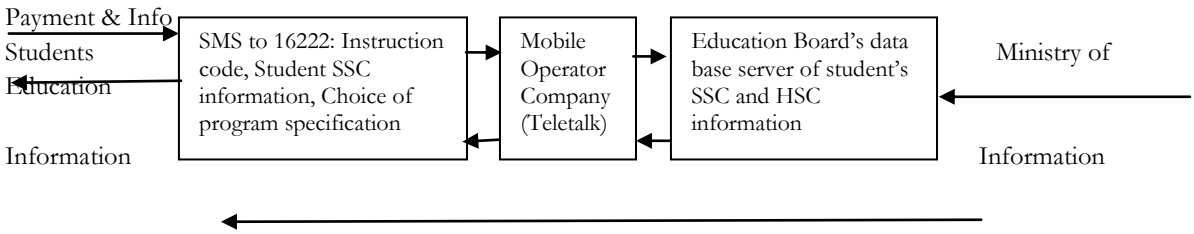

Figure 3-8 Registration for admission test (Step 1)

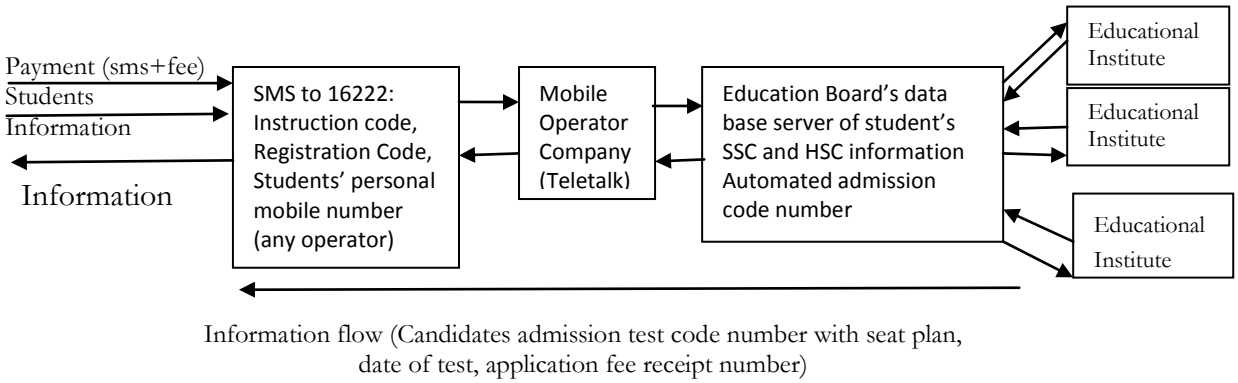

Figure 3-9 Registration Fee payment (Step 2)

If the student uses Teletalk connection from another person, it will not create any problem to contact them when required, as they provide their own mobile numbers through sms while processing for the application fee. The whole system does not take external help or interference for processing. Individual educational institutes (19 colleges) have a information network with the Education Board, where they provide and receive information request for the student candidates.

3.2.3.2Survey Findings on HSC Admission

The survey was done for this paper in the mid of august with the help of a research representative in Dhaka. As the m-governance service was valid for 19 colleges in the Dhaka city only, it was easy to conduct the interviews on spot in those colleges. For time shortage 30 students from three colleges are taken as a sample study. The three colleges are Virarunnisa Noon College, Government Science College and Motijheel Ideal College. The colleges are selected from different area location of Dhaka city to keep bias less distance. The students are chosen randomly for interview. The questionnaire designed as 'close ended' like the other survey discussed. The questionnaire is shown in Appendix 4-3 A. Like the previous two cases, this case also focused on the students' overall feedback and the travel (amount of distance) they saved during the admission procedure. Moreover, total kilometer of distance saved by the sample 30 students was approximately 104.5 km for a typical day of road communication. It would be 97.1 (104.5-7.4) km excluding the travel by rikshaw and walking. Travelling with rikshaw and walking does not have any environmental impact. For this reason this amount of distance has been deducted from the total distance saved. Total carbon footprint saved by 30 students was approximately 0.05 CO2 eq Tons for a typical day of road communication (Appendix 4-3 B). For the distance the student's saved in total time 3,266 minutes (approx.). It would be 844 (956-112) minutes excluding rikshaw journey and walking. The total travel distance saved by the students was relatively small to calculate the

money saved from travel. For this case amount of money saved did not take into consideration.

Among the students 20% used bus, 60% private car, 4% used rikshaw and 2% walking while going for the admission test, which they do once instead of twice during the admission procedure. 83.34% students said they did not face any problem, 6.66% faced management problem, 6.66% faced technical problem and 3.31% faced administration problem. The students' feedback on the overall system denotes- 10% said the service is excellent, 60% said the service was good, 23.34% said average, 3.34% was neutral in their comment, and 3.34% disliked the system. 73.34% students liked to see the further development, 20% was bit skeptical and 6.66% did not want any further development in the service.

4 Theoretical and Conceptual Frameworks

In this chapter, a mix of theoretical and conceptual framework will be discussed based on the current condition of the m-governance service in the context of Bangladesh. In section 4.1 a theoretical framework, 'PESTLE Analysis' has been discussed to identify the factors influencing m-governance service environment in both Educational and Agricultural Sector. The PESTLE analysis tool also made a tentative comparison of m-governance service in the both sector pointing out the strengthening and weakening factors. The factors in the PESTLE analysis were determined by interviewing the involved authorities, actors, government officials and though literature analysis. From the conceptual framework in section 4.2 the reader will be able to understand the current and future conditions of m-governance in both Educational and Agricultural sector, based on the data gathered from the field work. The data and information gathered from the interviews helped to develop the conceptual framework for the whole system. A critical analysis of different actors, influencing factors and their communication networks will be given on the light of collected data through survey and interviews.

4.1 PESTLE Analysis: Framework for Explaining the M-governance Service in Agricultural and Environmental Sectors

Many researchers used PESTLE as a strategic analyzing tool to illustrate market environment (economic growth, market potentiality, business condition, government regulation) through different environmental and ecological factors related to the product and services. The initials stand for Political, Economic, Social, Technological, Legal and Environmental scanning from strategic management perspective (RapidBI, 2007). As a 'macro environmental analysis' and 'environmental scanning for change' in the 1980s, many authors including Brown, Fahey, Narayanan, Morrison, Renfro, Boucher, Mecca and Porter included variations in classifications for case basis implementation in a variety of orders: PEST, PESTLE, STEEPLE etc where PEST proved its popularity because of its format (RapidBI, 2007). In the beginning of the first decade of 21st century PESTLE analysis became more interesting instrument for analyzing the widespread rise in 'green businesses' (BPMGeek, 2011). In this paper 'PASTLE Analysis' is used as a strategic tool for evaluating government's initiatives on m-governance in 'Agricultural' and 'Educational' sector depending on several criteria which is considered as 'macro-environmental' factors (both internal and external) influencing the success and failure of the initiatives in both sectors in the context of Bangladesh. The rationale behind the use of this tool to analyze government's different projects in terms of service considering wide spread economic and social environment through strategic thinking. Beside that it will help the government and other actors to identify the future potentiality and difficulties ex-ante so that improvement can take place on those areas and action can be taken now to minimize the hurdles (Haughey, 2011). Table-2 below shows some listing of the factors and its 'positive' and 'negative' (direct or indirect) influence or impact on m-government services over the two (Agricultural and Environmental) sectors. Based on time convenience and simplicity some important factors have been taken for detail discussion which relates with both sectors and have strong influence on strengthen and wakening the sectors. Explanations on the information provided in Table-2 are given below.

4.1.1 Political Factors

All most all the government funded m-governance services in Bangladesh are strongly influenced by ruling government. In terms of Bangladesh it counts more because of the unstable political condition. The People Republic of Bangladesh has five years of

parliamentary democratic government with an elected parliament (Bangladesh, Wikipedia 2011). As Agricultural and Educational sector in the country considered as the most important sectors that has scope for development, any party running government usually gives their best effort to facilitate service on those sectors. Although their motive is same (development), different parties come in power with their own priority of project implementation depending on their own interests. As a result with the change of government (every 5 years), the country failed to establish a long sustainable strategy for public development projects (Bangladesh, Wikipedia 2011). The current governments projects on different sectors with a strategic name 'Digital Bangladesh' may not be followed by another parliamentary government (if opposition party comes in power) after election in 2014 (National Web Portal of Bangladesh, 2011).

But it can be anticipated that in the Educational Sector, the established infrastructures of m-governance services (discussed in the 'Introduction' part) will not be affected if other party comes in power. The rationale behind this anticipation is that, a number of students and teachers of school, colleges and universities are involved in it and this built-in infrastructure (in most cases) did not depend on the other factors i.e. funding and technological backups. The school, colleges and universities have their sovereign right to keep any system that is good for their students and teachers. On the other hand, the infrastructure of this project is not similar to Agricultural Sector. The main service receivers in agriculture sector are farmers who are literally not much educated and familiar with ICT tools. To facilitate the m-governance services other actors like NGOs, Content Developers and Telecom companies have to collaborate. The scope of development is immense for the farmers (70% of the population) and continuous development is needed to deliver the perceived services. In some cases, foreign donations and a large amount of government's fund used for making these services flexible, easily understandable and reachable to maximum number of farmers. If the ruling government changes in future, the current projects discussed in 'case one' and 'case two' may not complete in Agriculture Sector, which is evident by past experience showing discontinuation of most government development projects with the change of ruling government. On the other hand market regulations does not affect educational sector in large extent because of sovereign nature of the educational institute, but in agricultural sector, market regulation mostly influenced by political parties (members of political party) in their locality through middleman who sets the product price. If the government and political figures are corrupted and do not regulate agricultural product price, farmers will not get the best price for their product. Change in market regulation and political instability may have both positive and negative impact in the agricultural sector. The current m-governance services (described in the 'Introduction' part) directed to help the farmers to get proper price and information about their product through increasing transparency in market regulation.

Table 4-1 Factors influencing M-governance service in Education & Agricultural sector in Bangladesh

Factors	Sub-Factors	M-governance services in Educational Sector (Impact)	M-governance services in Agricultural Sector (Impact)
Political	Political Stability	+	-
	Government's Attitude	+	+
	Market Regulation	+	?
Economic	Country's Economic Condition	0	+/-
	Global Economic Condition	0	+/-
	Government Spending	+	+/-
Social	Income Distribution (Spending)	0	+/-
	Change in Life Style (Adaptability)	+	+
	Attitude towards work, business, F&F	+	+
	Education	+	+
	Safety	+	+
Technological	Government Research Initiatives	+	+/-
	Rate of Technology Transfer and Innovation	+	+
	(Service) Link with other ICT Tools	+	+
	Energy Use and Cost (Providing Service)	0	+/-
	Communication Flexibility	+	+
Legal	Current Tax/VAT Policies	+/-	+/-
	Government's Directives & Regulations	+/-	+/-
	International Law	+/-	+/-
	Health & Safety Law	0	0
Environmental (Ecological & Environmental)	Direct Aspects (Climate change, usage)	?	-
	Indirect Aspects (alternative options)	+	+
	Rebound Aspects	-	-

(+) = The factors have **Positive** impact or influence over the M-governance services or vice-versa
(-) = The factors have **Negative** impact or influence over the M-governance services or vice-versa
(+/-) = The factors have **Positive or Negative** impact or influence over the M-governance services or vice-versa depends on the changed situation
(0) = The factors have **No** impact or influence over the M-governance services or vice-versa
(?) = The factors have **Undefined** impact or influence over the M-governance services or vice-versa

4.1.2 Economical Factors

Any country with positive economic growth makes the path easier for government to spend more on development projects. As a developing country Bangladesh is not exceptional. Furthermore, economic growth is an important factor for continuous development of many sector. Increase in Gross Domestic Product (GDP), exports and foreign reserve are the key indicators of country's economic growth. In that sense the first two indicators (GDP and exports) are directly related with the agricultural sector of the country. As a result change in economic growth will not have much impact in the educational sector where in agricultural sector it denotes significant change. If farmer get more flexible m-governance services in agricultural sector, it is expected that it will increase their agricultural productivity. More educated youth, those are now unemployed, will be diverted towards smart agricultural activities and farming business. This may increase GDP by increasing gross national production, which in turns increase in gross national exports. On the other hand, change in global economy does not have much impact on education, but of course trigger the change in agricultural sector. Global economy has significant impact on m-governance in agriculture sector since many of these projects are run by donor money. If the projects become closed in

the middle, the whole motive of the projects will be jeopardized. Discontinuation may result achieved success to be failure again. International fluctuation in oil price has direct (positive or negative) impact in transporting agricultural product within and outside the country. M-governance services at least can reduce the transportation by replacing with mobile based service that deals with information collection about the agricultural product. Unfavorable economic conditions in the country like Bangladesh, will lead people to spend more on their basic needs rather than on luxury product. On the other side, government spending will be more on importing food products to feed the country people than spending for development projects. Increase of government spending in educational m-governance services will obviously be a plus point for the service receiver, but if the spending is stopped that might not affect the sector crucially. The reason can be drawn, as the infrastructure that has been already working within the educational system is more stable and fixed compared to Agricultural Sector.

4.1.3 Social Factors

In social context the m-governance service receiver are the public, which is facilitated by different public organizations. Public income level and their spending do not affect the educational sector in terms of providing m-governance service. As the school, colleges and universities are mostly located in the city area; people are willing to pay 2 BDT ($0.0286 USD) per sms to get information rather than going to the educational institute which incurs travel cost (considering the case discussed in chapter 3). The people live in the city are relatively well incomer and afford this little amount of service fee. So, change in income or spending does not have much influence on m-governance service by government. On the other hand in agricultural sector, from the farmer's side if there is change in their income (during less harvest, crops destroyed due to natural disaster) they will spend less. Some of the farmer who are still reluctant to the technology use, may not like the service as they are very poor and fighting daily to ensure two times meal at least. In that sense increase in the price of technology use, (increase in price of sms) will discourage them to use that. They may prefer to walk for kilometers to get information or use other ways rather getting information through mobile phones. The main difference is the way of life style in urban and rural life. However, Kas Kalba discussed in his paper the mobile adoption rate varies country to country, the adoption rate is higher in small-households rather than larger households. The comparison can be drawn even with Eastern Europe to Latin America, China to India and Indonesia to Bangladesh. In some cases the adoption rate depends on the age of the service receiver but it doesn't affect the broad range of perceived value by m-governance (Kalba, 2008, p661).

According to a research, the mobile penetration in Bangladesh was 27.7% in the first quarter of 2008 while India had 21.9% and Malaysia was leading with 89% in Asia. Comparing to India Bangladesh is very small country but comparing to Malaysia Bangladesh is still lagging in mobile penetration (Moman, 2010). As a similar size like Malaysia, Bangladesh can at least follow the strategy taken by Malaysia in terms fastening of mobile penetration. However recent study showed Bangladesh is going towards positive trends (38% in 2010) in mobile adoption rate which is positive for implementing m-governance in both educational and agricultural sector (Islam, 2008, p25). The whole process triggers the change in public life style, towards better quality of living. It is changing the way of interaction among friends & family, in working environment and business activities. In both sector m-governance is keeping positive change in getting service reducing public bothering. Increase in literacy will accelerate the adoptability of m-governance in both education and agricultural sector. Educated people are likely to understand the technology more easily. On the other hand m-governance services in both sector are likely to motivate reducing travel and face-to-face

interaction for information diffusion, which will ultimately help people to have less accidents (reduce probability) and ensure safety in Bangladesh's perspective. On the other hand projects of m-governance in both sectors, ensure the public information safety in the information data bank regulated by 'Access to information' and 'Consumer Privacy Law' in Bangladesh.

4.1.4 Technological Factors

As the m-governance service system is set upon government's development strategy the research initiatives in technological advancement can bring differences in both educational and agricultural sector. The current government initiatives in both sectors discussed in the 'Introduction' part likely to bring positive impact in the overall governance system. Specially, we could see positive effects in the 'E-Purjee' project in agricultural sector and 'Admission, result and application fee payment in educational institutes by sms' in the 'Case' section. If there is no initiative taken for research from government side, private sector will not be triggered to participate in providing the m-governance service for political interference. In that sense educational sector may not be affected much but the agricultural sector will lag behind in output because the country is widely depending on food feed from the agricultural sector and there is a lack of research and development in the sector. The same goes with the rate of technology transfer and innovation in educational and agricultural sector. It will usually take a longer time to execute technological transfer and to bring innovation in the Agricultural Sector than it will in the Educational Sector. The reason behind that again denotes the literacy rate among the farmers.

As m-governance deals with service related with mobile phones, the link with other ICT tools (TV, computer with internet, radio etc) with it will enhance the usage horizon. In Bangladesh some of the m-governance services in educational sector involve use of computers directly by the user and in agricultural sector information investigators in the community information centers use computers to link mobile service used by the farmers. More the link among ICT tools get stronger more the service options will be wider. To penetrate m-governance further in agricultural sector, more community information centers needed to be established to flexible the operations among the farmers. This will need more investments and involves energy use and cost of establishments. Comparing to that the cost of providing the service and energy use in terms of educational sector is quite negligible. In most of the government commenced m-governance service in educational sector collaborated with education board and the educational institute. Mobile phone use is the most flexible way for communication that has been discussed in 'Chapter 1' and 'Chapter 3. If the mobile operator companies comes up with more communication flexibility, i.e. voice triggered service in future that will definitely add on the whole service in both sectors.

4.1.5 Legal Factors

As the present government's strategy is in favor of the m-governance service, the Tax/VAT policies are much flexible in terms of service providers and user side. Government of Bangladesh is planning to reduce the broadband wholesale price (for the broadband line providers, both individual and mobile companies) for fastest broadband penetration in public which will likely to reduce the total tax amount levied to mobile operator companies. For ensuring push in digital Bangladesh government enacted in the fiscal (2010-2011 budgets) regulatory form to cut in the 'SIM Card' tax to encourage usage of m-governance (Islam, 2010). On the other hand strong regulations and directives may discourage the mobile companies to coordinate in PPP and force them to increase their service price which may cut the number of service users. For example, there is not much clarity in Telecom companies'

license renewal process; the 3G license cost issue is still uncertain to the mobile company user, and so on (Islam, 2010). It is very clear that government's flexibility in market regulation and directives (in affordable level) will encourage the telecom sector to act for the development of the general public. In some cases Global Events in the Telecom Sector (Foreign ownership rules, transparency, price, internet connection etc) may directly affect (positively or negatively) the mobile sector which may affect educational and agricultural sectors (Mamontovas et. al., 2008). The affect will be significant as the service provided as PPP coordinating with the telecom companies. This is affective for Bangladesh as two of the major telecom companies; Grameenphone (Telenor) and Banglalink (Orascom Group) are foreign companies and are major market share holders in this sector.

There is another side of international law regarding end of life after usage activity (electrical and electronic waste) of electronic devices including mobile phones. In the international Basel Convention on 'Transboundary movement of hazardous waste and their disposal' various methods are discussed for disposal and recovery of the Waste Electrical and Electronic Equipment (WEEE) in Annex IV. For Example, recycled or processed material from WEEE for reclaiming metal, organic and inorganic substance use are considered as waste. Components used without farther processing are not considered as waste. The convention also provided list (list A and B) for hazardous and non-hazardous WEEE where hazardous has serious impact on environment and health. This is applicable in all e-waste including mobile phones. Although Bangladesh and many developing countries signed and ratified the convention in 1993 (Basel Convention, 1992), but do not have obligation to manage them by the law. The convention does not follow management of WEEE in a country, but to prescribe the control mechanism of the transboundary movement of hazardous WEEE. Most of the international trade involving electrical and electronic equipment (EEE) is done by declaring it as the shipments of second hand products to avoid being subject to the control mechanism of the Basel Convention. In addition, even if a country has ratified and been active in implementing the convention, it does not automatically follow that it will make a progress on the management of WEEE, which required in WEEE directive for the EU member states (Panate Manomaivibool, 2011). In Annex VIII hazardous WEEE showed the following circumstances (International ICT Policies and Strategies, 2011):

> *A1180: Waste electrical and electronic assemblies or scrap containing components such as accumulators and other batteries included in List A, mercury-switches, glass from cathode-ray tubes and other activated glass, and PCB-capacitors, or contaminated with Annex I constituents (for example, cadmium, mercury, lead, polychlorinated biphenyl) to an extent that they possess any of the characteristics contained in Annexure III. (Basel Convention, 2005, p55)*

Although mobile phone does not contain all of the hazardous substance, but some low quality mobile phones have batteries which contains hazardous components. In case of Bangladesh this regulations does not work well, as the country shows different scenarios and interest on transboundary WEEE. Mostaem Billah, showed in his research that Bangladesh imports WEEE from Singapore and China, as a developing country they have big secondary market for this products (mainly computers and mobile phones). In this situation international regulation does not have much influence on penetration in mobile phone use, but the boom in usage may trigger the government to take initiatives in future to handle the disposal of WEEE including mobile phones (Billah, 2008). The current government enforced new laws on restrict mobile phone use while driving to avert road accidents in the middle of 2011. This law is enforced to all the motor vehicle under health and safety law (Bdnews24.com, 2011). This law does not have much impact on the use of mobile phone in

educational and agricultural sector. But extensive use may harm in user's health in long term which does not considers the usage for m-governance.

4.1.6 Environmental Factors

Two major environmental impacts (external and internal) can be considered from the m-governance service. In terms of **direct** impact, the service deals with energy consumption of mobile phones in use phase and disposal of mobile phones at the end of product life cycle, it may affect both agricultural and educational sector in providing m-governance service in long term. In educational sector the affects cannot be calculated and seemed undefined, as a mobile consume very modest energy in use phase and mobile phone disposal is not a legal issue in Bangladesh's perspective, where in the EU directive on WEEE was levied on EU countries has discussed the proper ways to handle the hazardous waste from EEE. Strict rules and regulation has been pointed for the 'first ten' equipment in Annex IA where mobile phones falls under in number three (WEEE Directive, 2003). Being lucky in one sense, Bangladesh do not have to follow those regulations, besides get benefit from the privilege to import WEEE from other countries (mainly developed). At the initial stage of development the affect occurs less from the m-governance from educational sector but more from agricultural sector. The agricultural sector involves more partners, additional ICT tools (computer and internet); and information unit (community information hub) which may cause growing amount of WEEE and also considers additional energy consumption. From energy consumption side it may affect the m-governance service negatively in the agricultural sector.

In terms of **indirect** impact for example, use of mobile phones may reduce the use of other ICT tools in Bangladesh's context like TV, computers in some extent. This may reduce the environmental burden, as people will limit using other ICT tools for gathering information which may save energy. For example, the educational and agricultural information services, discussed in the cases in 'chapter 3', people could get it through using television or computers which is now replaced by mobile phone service. A television and a computer consume more energy than a mobile phone. On the other hand as people seeming travelling less, that saves energy (fuel) and cost, this is positive for reducing environmental burdens and protecting health form polluted air in traffic congestions. Finally, **rebound** environmental impacts can also make the m-governance service questionable in many senses. This is indefinable because the people replacing travel using mobile phones for acquiring information may use their time and money for other purpose (or traveling somewhere else), which can decrease the credibility of the m-governance service. These potential changes in activities by public are impossible to measure and interpreted with the result. For simplicity purpose and time limitations the dimensions of rebound effects in both the sector are not conferred in this paper.

4.2 Conceptual Framework: Critical Analysis of Government's enabling M-governance Service Platform for Educational and Agricultural Sector

The conceptual framework has been developed for this paper considering the PPP working for developing m-governance service for general public. In the enabling platform of m-governance service there are two main actors (public and private) collaborating to achieve one designated goal. Among the partners in the private sector Telecom Companies (mobile service providers) are the key actors, beside that 'Content Developers' plays an important role mainly developing m-governance services in the agricultural sector. The framework also showed direct and indirect factors influencing the PPP environment. The framework also

represents the supply side of the service with product from producers' side and possible environmental impact from it, before service being processed in the PPP environment. On the other side it represents the demand for service from consumer side along with possible environmental impact from use phase of mobile phones while using the m-governance services. Before starting with the PPP in process government had to work on the establishment of the infrastructure of the technology at least for three to four years. During that time government had to ensure proper supply of ICT tools (mobile phones) which is shown in the supply side of the diagram in figure 6. The **supply** from producer's side of mobile phones triggered by different micro and macro level aspects. Government's flexible policies in importing mobile handsets played a great role in IT infrastructure development. For example, in 2002 Bangladesh government reduced import duty by 37.5% on mobile handsets (Total Telecom, 2002). If the import duty increases in future it may discourage poor people to buy mobile phones. In Bangladesh still it is considered as luxurious product by mass people. On the other hand if other ICT tools delivering similar function like mobile phone exist in the market it may detain some of the market share of mobile phones, which may affect the supply side of mobile handset. Bangladesh does not produce mobile handset; at best some cheap mobile handsets are assembled here from Chinese parts. In that sense production cost means import cost of handsets and its parts. If the import cost increase mobile operators will be unable to provide cheap mobile handset with connection to the mass people, and vice-versa.

As discussed earlier in the paper mobile penetration rate is positive in Bangladesh, it is good news for government to deliver m-governance service to be accepted by mass generation. Global technology transfer is always favorable for any ICT environment of any developing country. Government of Bangladesh is planning to adopt modern technology like internet connection and video conferencing in mobile phone used by the mass generation to improve the service more. This technology is already there, but in limited access. It is expected to add a new paradigm in the development of ICT in Bangladesh (Telenor, 2008). The telecom company industry size is one of the biggest after Ready Made Garments (RMG) in Bangladesh. In 2007 Grameenphone reported mobile sector in Bangladesh added a total of 371.43 million (BDT 260 billion) to the economy, representing 6.2% of total GDP. This is accounted as very favorable input for providing m-governance service (Telenor, 2008). Industry size also relates with innovation and R&D. Big industries are most likely to invest more of R&D which is applicable for Bangladesh mobile sector. Grameenphone's 'Village Phone Program' considered as the amazing innovation during the 21st century that ensured mobile phone access to a mass number of poor people in rural area and reason to change their life style (Telenor, 2008). Figure 4-1 shows the conceptual framework of enabling m-governance service platform in Educational and Agricultural Sector, the involved actors, factors influencing the actors and possible environmental impacts from the whole system.

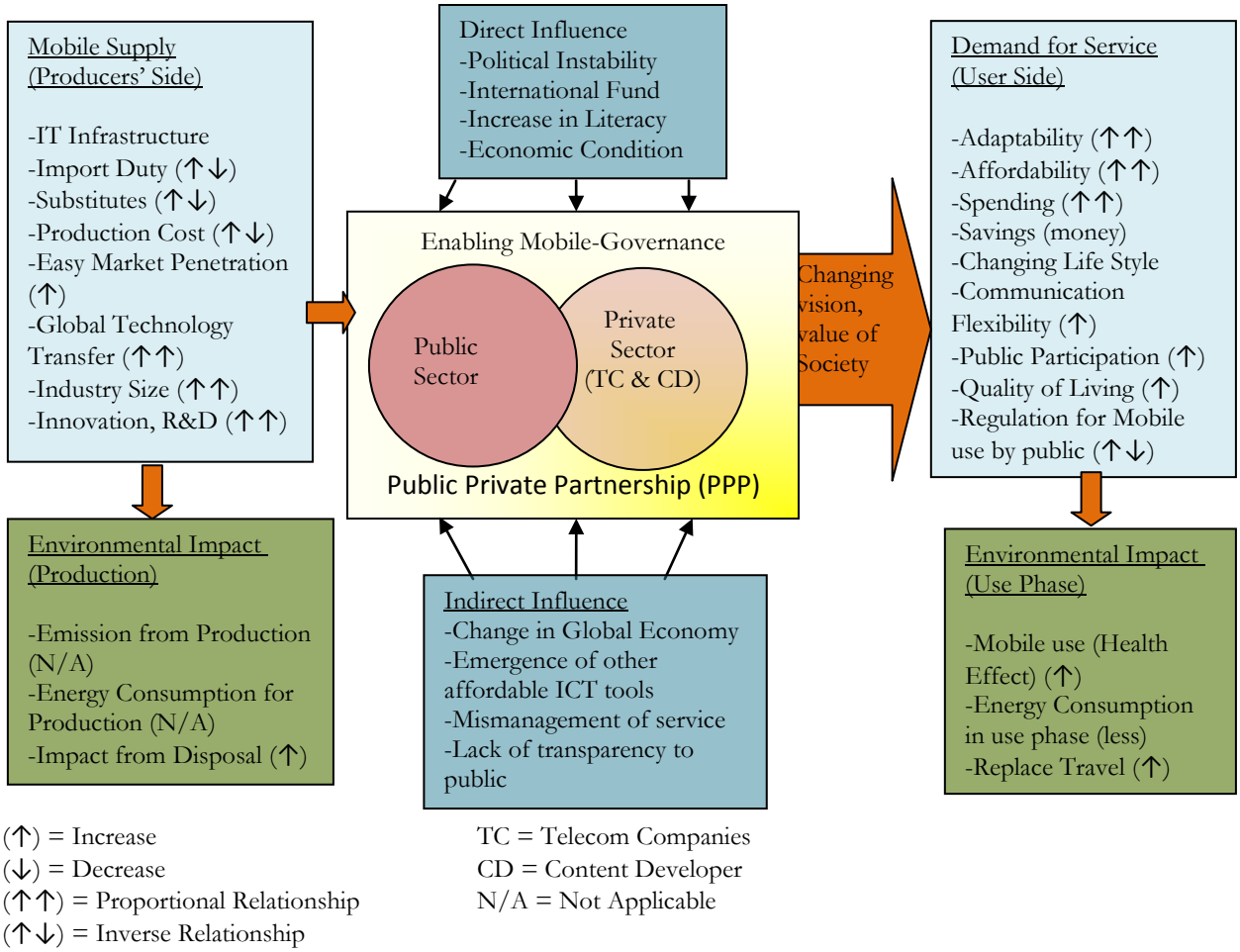

Figure 4-1 Conceptual Framework of enabling m-governance service platform, influencing development in socio-economic context, facilitating business environment (in ICT) and keeping positive/ negative environmental impact through Public Private Partnership (PPP) in Bangladesh

The '**Direct' and 'Indirect'** factors that are influencing the m-governance environment are already discussed before in the theoretical framework for m-governance service in Education and Agricultural Sector. The main patterns collaborating in the PPP are government, mobile operator companies and content development organization (mainly for the farmers, discussed in 'case one and two'). Input from the supply side processed and result in various m-governance services. Political stability and country's economic condition have the **direct** influence on performing m-governance service in a wide level. In Bangladesh political stability is a questionable issue. According to the political history, Bangladesh had several changes (ups and downs) in the political situations with the change in government. Beside that corruption of every ruling party became the foremost repulsive affair in every sector which may cause lose in public's trust and credibility in government's development initiatives. In Bangladesh if opposition party comes in power, the usually discontinue the previous project and start new projects with new strategy and new agendas. As a result, number of incomplete projects is hanging and some of the project stopped and lost credibility for being unattained. On the other hand a good economic condition is the prerequisite for continuous development initiatives for good governance that will include more foreign investment, increase in literacy and so on. **Indirect** influences like affordable substitutes to mobile phone, lack of public transparency and mismanagement in m-governance service can be a hurdle for m-governance service to perform. It will reduce

public's acceptability of the service whether they afford it or not. A similar picture we saw in the m-governance service in the agricultural sector (Case one and two). Although there is a law on 'right to get information', still farmers have been cheated by the middle man in terms of their product price.

In the **demand** side only demand for m-governance service has been considered for the simplicity of the framework. Various factors controlling the demand for m-governance services already discussed in the theoretical framework. However, the most influencing factors lied on the adaptability, affordability and communication flexibility in the m-governance service. The increasing number of mobile penetration in Bangladesh (discussed earlier in cases) proved well adaptability and affordability of the mass public. In both educational and agricultural sector, the number of mobile subscribers is increasing (discussed earlier in the cases). This is still debatable whether increase in communication flexibility (through mobile governance) replaces travels or not. But if the answer is yes, this will keep a remarkable change in the country's social, economic and environmental condition.

Two possible **environmental impacts** have been drawn from the m-governance service in this analysis. It is easier to define environmental impact from a product life cycle rather than a service. For time, text limitation and simplicity purpose it was not possible to show the technical part (calculation) of every possible environmental impact throughout the service life cycle. Furthermore, a service involves many factors and undefined objects which may formulate the result (on environmental impact) subjective. In a traditional case, environmental impact from the **producer's side** will be considered as emission from production and energy consumption for production (types of energy used for production). In this study both the cases are not applicable, because Bangladesh does not produce mobile handset or mobile parts, so the environmental impact from these activities was not considered in this case. However, these facts were noted in the thesis but not included in the calculations to avoid complexity. The major environmental impact comes from the disposal of the mobile handset which is huge in volume. Bangladesh not only disposes mobile phones, they also import second hand mobile phones from other countries in a cheaper price for their secondary market. The demand for cheap mobile handsets in the secondary market is so high (discussed earlier in theoretical framework) that government is unlikely to take any initiatives to enforce any WEEE disposal regulation. One reason could be policy makers do not perceive this as an urgent issue in the country. It is also possible to speculate that they might want to protect the businesses evolving around reuse and recycling of WEEE, despite them being illegal. But the increasing amount of WEEE might create climate change issue in the near future in Bangladesh.

As government initiated m-governance services is in infant stage (two to three years) the negative environmental impacts form **user's side** has not became a big issue. As a first impression, mobile consume very less energy in use phase than any other ICT tools (computers & television), and this is less likely to have negative environmental impact. Question of disposal comes again, what the consumer does with the mobile handsets in the end of life of the product? Or they do with the old mobile phones if they buy a new one? No research, investigation and survey have been done so far to identify that. The reason behind that is the government of Bangladesh is reluctant to think about environmental impact from WEEE in the long run. Furthermore, government of poor country like Bangladesh, and other private organizations are happy expanding ICT in a wider level, for country's development and means of revenue (in case of mobile operator companies). As a result public are not legally bided to draw attention on the disposal of their mobile handset. In a positive point of view, which the government tried to focus more in m-governance, 'mobile

communication replaces travels'. This statement is very subjective at a sense, but in the initial level from a bird's point of view, this seems to be true. In a macro-level this is impossible to calculate and analyze the interpretation of the fact. But in project level (sector wise) government's initiatives can draw a tentative result analysis. In that case transparency in government's projects is one of the important factors. In terms of direct impact on health and safety, usage of mobile phones may cause long term harm but indirectly reduced travel (replaced by mobile phones) and helped people to inhale less polluted air (from traffic conditions) which is also very subjective to analyze. In this paper, few cases (government's projects) showed the tentative reduction in environmental impact through using different variables.

4.4 Emerging Sustainability Behavior by Sustainable Communication

In this paper m-governance services are introduced as government claimed sustainability activity for the country. Before evaluating government's service, let's define what 'sustainability' is and what 'sustainability behavior' is. There is no perfect definition for 'sustainability' available, and factors involved with it is so wide that some time it becomes difficult to explain sustainability. However, the word 'sustainability' came from 'sustainable development' discussed in the World's first Earth Summit in Rio in 1992 (Global Footprint, 2009). The 'sustainability' definition was considered as –

"'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Bruntland Report for the World Commission on Environment and Development (1992)"

Furthermore, sustainability is based on three pillars. A service considering its sustainability must fulfill the three pillars', 'Economic, Social and Environmental'. The presence of this pillars and efficiency in performing the needs for present, without compromising the future generation to meet their own need will be called sustainability (Yada, 2011). On the other hand 'Sustainability Behavior' can be perceived differently by different group. An environmentalist would search for developing environmental aspects in sustainability, an economist will consider the cost efficiencies and externality issues, a sociologist will concentrate on the human development issues, and a natural scientist would focus more on technological issues. Well, only an integrated aspect can define 'sustainability behavior' considering technical, environmental, social and environmental issue. From past decades, the use of mobile as an ICT tool in daily life, proved to be a tool to be encouraging 'sustainability behavior'. Different mobile software applications promoting mobile based service (m-governance) becoming popular both in developed and developing countries (Bijan Aryana & Casper Boks, 2010, p3). Some of the applications, for example, m-governance service by government in Bangladesh, are expecting by the people to cut their ecological footprint, travel cost and motivate them to change their behavior towards environment and society. In developed country like Sweden, these application like; online banking, online smart transportation information system, mobile ticketing, internet based health system and internet based education have changed the quality of life. In developing countries like Bangladesh, a simple phenomenon 'missed call' can help the people to communicate without increasing their variable cost. This does not require system occupancy and people do not have to pay for it (Bijan Aryana & Casper Boks, 2010, p4-5). This is likely to indicate, a big number of people are there to receive mobile services within affordable price range. In this situation m-governance services in Bangladesh is likely to be a revelation in near future, if the services are consistent with its flexibility, sustainability pattern and shows transparency. Otherwise government will lose its credibility for the development initiatives, which also associates good amount of government's spending.

5 Analyses and Discussions

The section will present the analysis of gathered data, interviews and related literatures. The analysis will illustrate the success and failure of m-governance service in both sectors in promoting communication sustainability, based on sustainability's definition. Furthermore, this chapter will also demonstrate the results and findings from the cases and discuss the challenges and opportunities faced in terms of m-governance by both sectors. One of the objectives of the survey done in the cases was to see, whether the people of Bangladesh are happy and satisfied with the m-governance service, and what might be the potentials among the public to reduce environmental impacts by taking these services. In this section the result from the surveys will also interpret the sustainability perspective of the m-governance service in the studied cases.

5.1 Challenges and Opportunities in M-governance Service

Analyzing the theoretical framework, literature reviews and critical views from the enabling m-governance platform in Bangladesh, a tentative picture can be drawn. Considering the m-governance service in **Agricultural Sector**, the number of service receiver is very big in amount and scattered in different location in the country. The number of actors involved in delivering the services is relatively more than other sectors. Coordination among the actors seems to be strong from outside, but doesn't look same in reality. Outcome from the survey showed the lack of transparency, misinterpretation of information and decrease in credibility in the system. However, corruption in the system has been identified by most interviewees and also denotes the political instability. As discussed in the theoretical framework, political factors are mostly influential in terms of m-governance service, as government is directly involved in it. This fact also realized during the survey interpreting farmer's reaction on the m-governance service (Case 1). In that case, the farmers seemed happy, but not satisfied. The problem occurs mainly in the price setting of the product. As farmers are not directly involved in price setting of their product, even do not belong to any community, they have been cheated year after years. No such rules, regulations and directives came from government side to stop the business syndicates to control the market price of the agricultural product. Although government came up with development strategy in providing good service to the farmers, ultimately malfunctions in the system reduced their credibility. Resulted, farmers are not getting their deserved price of their product and general people are buying the product relatively in triple price from the market (farmers' outcome while interview). To control this situation is a big challenge for government. However, other services like information regarding farming and agricultural activities are helping the farmer a lot in terms of communication. Some farmers think, the services reduced their travel in a significant level, where some were very skeptical to say that. It cannot be concluded in this situation because, the m-governance service environment in Agricultural Sector is very complex and the government has five working years to prove their credibility, at least in an acceptable level. Other influencing factor like technological diffusion of mobile phones to the public is ahead in terms of its adaptability, affordability and flexibility in communication.

From the second case (E-Pujee) these fact has been proven widely. Comparing to 'Case 1' (AMIS project) 'Case 2' had higher acceptability and credibility in communication flexibility and dissemination of authentic information. The reasons adhere behind the difference in the political, economical and technological factors. In 'Case 2' farmers are directly involved and participated in the development of the digital cane procurement services, and the service involves production of only one product 'Sugar', which made the initiative successful. The number of famers benefitted by this service are listed and registered in the system, which is a

good opportunity for government to target farther development in the system. Evaluation and surveys can be conducted considering all the involved farmers for better understanding the current situation and prepare for the future development. In 'Case 1' it will be difficult to gather a structured evaluation of m-governance service from the farmers. The interviews showed variation in their response considering the information they need. Even farmers' age and years of mobile usage is a considering factor in variation in opinion. Farmer's behavioral patter is also different in terms of technology use.

Considering the fact, environmental factors considered by the Agricultural Sector are one of the future big challenges in m-governance service. Foremost, positive environmental impact can be considered as the most visible phenomenon by this service. In reality, travels and face-to-face meetings are being replaced the m-governance service. The amount of replacements and factors affecting the replacement cannot be determined easily. This is called 'rebound effect'. Person receiving m-governance service are using mobile phones not only for this purpose, he/she might use it for other communication reason (friends, family, business etc). On the other hand energy used by mobile phones cannot be distinguished by 'amount of energy used for m-governance service'. Therefore, people replacing travel by using m-governance service for agricultural activities, may use that time to travel another place for another business for better income. Interestingly, the negative environmental impact from disposal of mobile phone is nowhere in the context of Bangladesh. If calculation take place for both positive and negative environmental impact, the result may become very deplorable for Bangladesh's government. Ultimately, even though communication flexibility can be seen all over in the Agricultural Sector, but determining the environmental impact is still indefinable in terms m-governance service.

In the field of **Educational Sector** m-governance service plays a different role, as the number of targeted service receivers and number of provided services are relatively smaller than Agricultural Sector. Still the numbers of service receivers are big, considering the fact 65% of the population in country falls under the age of 25 (The News Today, 2010). This indicates that this number of population can be included in the m-governance service, if they all can be educated in educational institutions. A big proportion is already involved in primary and secondary education considering the facts and figures in Chapter 1. Very interestingly, use of internet is very much accepted by the teenage students and around 90% of the internet users in the country use internet from their mobile phones (The News Today, 2010). This could be a good opportunity for government of Bangladesh to introduce mass level internet use in the m-governance service platform. Analysis drawn from the theoretical framework; social, technological and environmental factors are the most influential phenomenon in terms of m-governance service in Educational Sectors.

One good side of the m-governance service in this sector is that, there is an established collaboration among government and the educational institutions. Furthermore, the educational institutes have their sovereign right; as a result thirds party's interference has been seen less. Technological factors, encourages people to focus more on change in choices and fashion, rather than necessity. The students will more likely buy a mobile phones with different attributes and features (music, camera, radio, internet), rather concentrating just on the m-governance service. The energy usage for different functions cannot be distinguished with the amount of energy used for m-governance service. That is why it is difficult to identify the benefit of m-governance service from the technology side. This also links the rebound effect, like the agricultural sector. In terms of social factors, differences in individual behavior have been observed in the three cases (Case 3, 4 and 5). At a sense individual behavior is different among the city people and rural people. However, more difference has

been noticed in the people live in the mega cities. Two of the cases (Case 4 and 5) based on Dhaka city, showed different illustrations of people's behavior in terms of choosing vehicle. Most of the people choose motor vehicles (either private car or bus) in their selection to travel, instead of taking bike, rikshaw or walk. In this sense, they think they have saved the carbon foot print from the travel (distance in km), by using m-governance service, which they would have done with using the motor vehicle. In a critical point of view, a person can easily travel one or two kilometer by walking or by taking rikshaw which does not cost a lot, neither occur any emission. Analyzing the fact, it can be imagined that the students in the metropolitan city focus more on safety and traffic congestions instead of environmental concern. In a sense government's m-governance services discussed in the three cases in educational sector is benefitting the students. The findings from the case studies showed that, although the sms based admission system is quite new to the students, most of the students cordially accepted it and satisfied with the service. University students have been more benefitted than the school and colleges, because people come from different places and location appearing for the admission in universities. This has been noticed that, educational institutes located in Dhaka (mainly considered in the case) focuses student, who lives in Dhaka city and near location. On the other hand, in other city (Case 3, Sylhet) people come from different directions of the country and are more benefitted economically and environmentally by the m-governance service. People lives in Dhaka are generally high income group and improved life style, does not realize the m-governance service impact in a sustainability sense.

However, it has been determined from all the cases (Case 3, 4, 5) that m-governance is reducing the students' travel at least in a micro level. Even though rebound effect is there (discussed earlier in Agricultural Sector), still it is possible by the government to calculate the reduced environmental impact from the use of m-governance service in the Educational Sector. This may take few years of farther research, considering the rebound affects. The higher penetration of mobile phones in Bangladesh may cause negative environmental impact (WEEE disposals) and challenges (in terms of international regulation) in the long run, but right now this is not the big concern of Bangladesh's government.

5.3 Discussion

Last few years government of Bangladesh tried to work heart and soul to work towards the 'Digital Bangladesh' strategy introduced in 2008 when the government came in power. It's been three years now, and much development initiatives have been seen in different sectors (discussed in Capter1, 3 and 4). If the situation analyzed critically, a clear analysis can be portrayed (studying the cases) that three years are not enough for both planning and implementation phase of government's projects in various sector. The lack of planning before implementation has been realized in different projects, which caused malfunctioning and decreased the credibility of many projects. Furthermore, the initiatives are moving far from the sustainability measure (mainly in environmental and social context). Although concerns for better environment and environmental impact from 'Green House Gas' emissions by transportation are not a major concern in Bangladesh, but increase in air quality is one of the challenges faced by the government. So far, government of Bangladesh did not find any concrete solution to improve the air quality. All parties holding government, usually debate in international climate change conferences, presenting them as climate change victim by developed world's industrialization. As a non-OECD developing country (Bangladesh), they seek fund for development initiatives, but they overlook their own created problems which is affecting them most (air pollution from traffic). Well, Bangladesh is competing well now in mobile related developing initiatives with the neighbor countries, like India, Pakistan, Malaysia and China. The initiatives needed to be credible to mass generation and should not

be displaced from its main motive. For example, recently introduced mobile ticketing for bus service in Sweden increased flexibility and convenience among the public. Swedish, Road and Transport Agency of Skåne Region had a motive to give flexibility to the public discouraging use of cash in the bus fair. On the other hand it ensured safety for the bus drivers not handling the cash (Gemalto, 2011 and Skånetrafiken, 2011). A similar service may not serve a lot to Bangladesh's perspective In Bangladesh economic (cost) facility and environmental friendliness in a social context (mass level) should be the main motive for any m-governance initiative rather giving the public flexibility. Most of the studied cases discussed in the paper showed the communication flexibility and some aspects of economic flexibility in few areas (mainly in city area), but environmental measures could not be measured fully. Well, this is the high time for the country to increase their concern for environment and public health caused by it.

6 Conclusions and Recommendations

6.1 Conclusions

This chapter wraps up the final conclusion from the above discussion and analysis. To answer the research question, the paper discussed (in the framework, analysis and discussion part) various success and hindrance factors affecting the m-governance service in Bangladesh. In the context of Bangladesh, both the success and hindrance of the m-governance service widely depends on the political, social, economical and technological factors. Among them, political factors have the immense influence over the service as most of the projects are directly linked with different ministries of government. And change in political situation may change the strategies taken by the particular ministries. Analyzing the current situation and studying the cases, success has been seen mostly in the case of Educational Sector rather than in Agricultural Sector. The main reason behind that, the size of the Agricultural Sector is big and most of the service receivers are illiterate. However, the overall technological advancement and built infrastructure (built by the mobile companies, ICT and Content Developer Organizations) are the success factor for the m-governance platform, but proper management and administration of the communication network is a big challenge, which is evident by the situation seen in 'Case 1'. Although there is a law in Bangladesh called 'Right to information', although farmers are getting the right information but they failed to execute it in their product price. A mobile has different functions (calling friends and family, neighbor, radio, camera, internet) and people from all levels use mobile phones for various purposes, not only for m-governance. In the same time if an affordable ICT tool, with similar functions like mobile, takes place in the market share, it might be a problem for government to continue operations with mobile phones. So there is a risk of interruption in providing m-governance service, if people switch mobile phones with substitutes. One important difference found in the study denotes that, in the m-governance service system farmers are not communicated directly, where in the Educational Sector students are communicated directly. Because of this existing problem (middle man in the communication) farmers are not getting full benefit from the m-governance service. This is one of the reasons, actors in m-governance platform find easier to establish and penetrate services in Educational Sector than in Agricultural Sector. Considering the feedback from the farmers' side, in 'Case 1' showed negative feedback on the overall m-governance service. They are happy with the flexible communication but not satisfied with the information execution and transparency of the AMIS project. 'Case 2' in this paper, showed somewhat positive feedback from the farmers' side in terms of communication flexibility and information dissemination. Well, in both cases farmers are happy with communication flexibility, they partially agreed with economic benefit from m-governance but they did not agree with the fact, mobile communication replaces travels.

The three cases discussed in the Educational Sectors, mostly provided same feedback. The students along with the university authority seemed happy and satisfied with the service. The survey results showed a rough estimation of saved travel and reduced carbon footprint, which indicates that, it is possible to calculate the estimated environmental impact from travel distance saved by mobile governance. If all the population could be considered for the survey more accurate result could be drawn excluding the 'rebound affect' discussed in the analyses part. In this paper 'Case 3' (50 students), 'Case 4' (20 students) and 'Case 5' (30 students) showed reduced distance and carbon footprint respectively 8,911 km (4.11 Tons CO2 eq/day) 1,431.6 km (0.7 Tons CO2 eq/day) and 97.1 km (0.05 Tons CO2 eq/day). Although there are some subjective matters which is difficult to measure (energy use for only m-governance service by a mobile phone) and 'rebound affects' (travel saved by m-

governance used for another purpose that increase environmental impact) are there, still it concludes in favor of the statement 'mobile communication by m-governance services replaces travel and reduce environmental impact' for Educational Sector. For Agricultural Sector the statement seemed not true and complex to define.

However, m-governance service is fully based on public private partnership (PPP), so 'sustainable behavior' (discussed in section 4.3) from public side also required for the successful implementation of the service. Not only from government and private actors' side, individual behaviors (in a particular socio-economic condition) also can change the sustainability pattern of any project, which has been evident in the cases (some people prefer to travel by car for one kilometer, where some prefers to walk). Finally, in the concluding remarks it can be said that m-governance services in all the studied cases managed to fulfill the social and economical parts of the 'sustainability pillar' but partially fulfilled the environmental concern part. As the 'negative environmental impact' from mobile phone disposal was not concerned in the case context, the environmental concern for the 'sustainability pillar' seemed uncertain. Still, the data interpretation, analysis and current situations denoted that m-governance reduced environmental impact, at least for the Educational Sector.

6.2 Recommendations

Government of Bangladesh working with the m-governance services since 2009 with the other partners in the platform. Among the actors government is the important actor and still needs to do a lot of ground work to improve the system. The services are for the public and it is called 'Public and Private Partnership', keeping this in mind government and other actors involved in providing the service, should increase transparency and encourage public participation while taking decisions in the field. However, this practice has not been realized in any case in a practical point of view. The government and policy makers need to have a policy level intervention among the small and big actors working in the m-governance service platform. Specially, regulation and interference needed in the Agricultural Sector to ensure the 'best price' for selling the farmers' product to the middleman. Government should ensure no 'business syndicate' regulating the agricultural product price, and no corruption is taking place to cheat the farmers. In terms of Educational Sector, only 19 colleges have implemented the m-governance service in Dhaka city, there are many schools and colleges in Bangladesh. So, government needs to bring all the school and colleges in the m-governance system, so that communication flexibility and sustainability take places in a significant level. For this, continuation of the project is necessary, even if the ruling government changes. More research and development is needed in this field, to improve the service and make it reachable to a maximum number of receivers. For that, development in flexible and innovative technology (text in local language, images of products or commodities or instructions, logics, IVR in local language, easy mobile operating function) for the illiterate mobile users will be helpful for mass level penetration. Last but not the least; government should start thinking about the disposal of the WEEE generated from mobile phones, which has environmental and health impact in the long run. For this, government can come up with directives or regulation that will deal with the recycling of the WEEE disposals. Technology and skill transfer from the developed world like- Sweden, Denmark, Germany, Netherlands can be helpful in this case. The developed country might be interested transferring or establishing the technology and skill in Bangladesh, if the WEEE 'containing valuable components' extracted from the product, can be exchanged with them!

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Appendixes

Appendix 1

Appendix 1-1

The Goals of Digital Bangladesh for Education

1. Ensuring a productive 21st-century-ready workforce

2. Improving curriculum, pedagogy and teacher's capacity building to ensure quality education for all

3. Ensuring transparency, efficiency and effectiveness at all levels of educational administration

4. Securing accountability to real stakeholder namely the students and parents and enabling the citizens to participate in policy making

Focus on 6 strategic areas to focus on Education:

1. Improving Teaching/Learning using ICTs – General and TVET

2. ICT Literacy for Students

3. Professional Development of Teachers using ICT

4. Education related Citizen Services

5. ICT in Education Administration 6. ICT Infrastructure and Delivery channels

Source: http://www.digitalbangladesh.gov.bd/documents/Education.pdf

Appendix 1-2

Dhaka Education Board

Rules and Regulation of HSC admission for the session 2010-2011

No: 1036, Date: 29.05.2011

Part of the Notice 3.2: about admission and Fees (Translated to English):

For HSC Examination 19 colleges must take their admission application (initial application registration) through using sms system. The colleges are: DHAKA COLLEGE,

GOVT. BANGLA COLLEGE, GOVT. SCIENCE COLLEGE, GOVT. KABI NAZRUL COLLEGE, BEGUM BADRUNNESSA GOVT. GIRLS' COLLEGE, GOVT. SHAHID SOHRAWARDI COLLEGE, GOVT. BHAWAL BADRE ALAM COLLEGE, GOVT. TONGI COLLEGE, GOVT. TOLARAM COLLEGE, RAJUK UTTARA MODEL COLLEGE, TEJGAON COLLEGE, DHAKA CITY COLLEGE, DHAKA COMMERCE COLLEGE,

VIQARUNNISA NOON COLLEGE, IDEAL SCHOOL AND COLLEGE, MOTIJHEEL, RESIDENTIAL MODEL COLLEGE, BIR SHRESHTHA NOOR MOHAMMAD RIFLES PUBLIC SCHOOL AND COLLEGE, LALMATIA MOHILA COLLEGE, DHAKA IMPERIAL COLLEGE. More information regarding sms system application for admission can be found in Dhaka Education Board website www.dhakaeducationboard.gov.bd

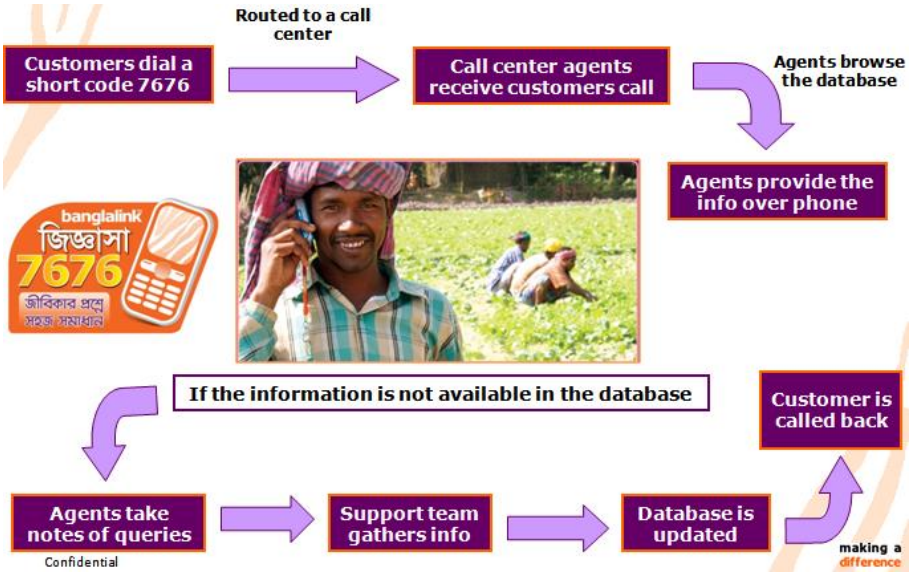
Source: http://www.dhakaeducationboard.gov.bd/wp-content/uploads/order/college/adm%20circu.pdf

Appendix 2

Appendix 2-1

Banglalink Jigyasha

How the sms based system works-

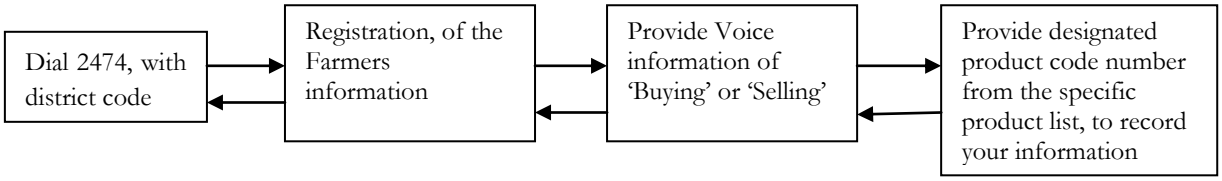


Source: Document provided by Banglalink official through personal communication

Appendix 2-2

Banglalink Krishi Bazar

How the IVR (Integrated Voice Recording) system works-



Source: Relevant Document provided by Banglalink official through personal communication

Appendix 3

Farmers Interview

Interviewee 1 (Positive)

Mr. Abdul Baten is 28 years old vegetable farmer from Gazipur District (Sonmania village). He has been using mobile phone (Grameenphone connection) for 8 years. His main activity is to grow vegetable and also deliver them to the nearest market on placed order. He was inspired by his father to be a vegetable farmer. He also sells seasonal vegetables in the retail local market in some extent. According to him it is a very good idea to get information through mobile phones and it became much easier in terms of agricultural market information. Most information he gets from the government community information booth through mobile phone. He mentioned that market investigators collect information and bring them in the community information center and he finds up-to-date information about all agricultural products he grows. As he works as a supplier in other market he needs mobile phones to communicate for fixing the day-to-day transportation. It is a daily activity for him and without mobile phone it would not possible to manage transportation for shipment on spot and might be delayed supply by three or four days. Finally that would jeopardize his business as vegetable is a non-durable product. He thinks still he doesn't get the right market price of the product. He finds there might be a manipulation or lack of authenticity in terms of product price information. Otherwise other services like use and sources of buying pesticides and fertilizers are very impressive. Through mobile phone they also get information about micro credit banks that provides loan for agriculture, although he is not using that service. Grameenphone mobile service in line with community information center has helped him and other 16 farmers from the same village. He thinks it is the best service as it saves time, money and reduces a huge amount of travel cost. He said his father had to travel almost 7 km every day to travel other villages and sometime to the nearest big cities to learn and get information about growing vegetable and knowing market price of those products, which is now easily being done though mobile phones within few minutes by spending very negligible amount of money ($.03 USD, 2 BDT). He usually used bus as transportation for travelling and that was costly for him on a daily basis. He wishes for more mobile related service from government side which specially informs them about new information, technological development and innovation about growing and marketing agricultural product.

Interviewee 2 (Skeptical)

Mr. Al Mamun is a 38 years old vegetable grower from Chandpur district (Boraikandi Village). He is using mobile phones for five years for agricultural activities. According to him almost 20 to 30 farmers in his locality are using mobile phone service for growing vegetables and farming. He is specialized in growing pesticides free vegetable in his locality. Currently he is using the mobile connection from 'Robi' (Telecommunication Company). Mr. Mamun thinks mobile phone is not giving expected service in terms of getting correct price for the product as he expected. But he got help in instructions about pesticides and fertilizer use for growing vegetable. Moreover, mobile phone is helping him mostly communicating people for his business purpose. Years before while there were no mobile connections he used to take agricultural information through direct face-to-face communication or by using land line. The local market is not far (1.5 kilometer) from his business place, so he could also walk or take rikshaw for travel. Like all other farmers he had to travel everyday to the local market for product information. He assures that usage of mobile phone made hassle free

communication but he is skeptical about saying that mobile phone replaced his travel for business and increase information efficiency. His overall comments on m-governance service are not optimistic. He still prefers to travel rather than taking information through using mobile phone service as the information is not transparent and authentic to him.

Interviewee 3 (positive)

Mr. Abul Hossain is a young (22 age) farmer from Gajipur District (Mirjanagar village), involved in rice production and vegetable growing. From the beginning he is the subscriber of Grameenphone mobile operator and using it for five years. Around 15 persons are using mobile phone service for the same purpose in his locality. The m-governance service is helping him in every kind of agricultural activity including information regarding fertilizer, pesticides, product price, new technology, new product, innovation in agriculture and so on. Currently he is getting this kind of help from different service provided by Grameenphone. Among them 'Cell Bazaar' service helping him to know the product price, on the other hand 'Help Line' giving them diversified services including product price, health related information cased by pesticides and fertilizers and particular market for specific product. According to him grameen phone is the best subscribers in the country and can help more if they provide flexibility in learning and using internet through mobile phones. He used to go to local bazaar for information when there were no such mobile services. It would take a long to go there using any type of transportation. He had to walk for eight kilometers to get agricultural information before. It was not affordable for him to go by motor vehicle. He would be happier if government take initiatives to teach young farmers to use internet and computer use so that they can enhance their knowledge according to their business need. In this century he cannot think without mobile phone even for agricultural activities. He strongly agrees that now-days use of mobile phones replacing travels for getting agricultural information.

Interviewee 4 (Skeptical)

Mr. Abdus Sattar is a 28 years old farmer from Chandpur District (Ekhlaspur Village). He is involved in growing rice and vegetables and aqua culture. For this diversified activity he is using mobile phones for three years. Currently he is a subscriber of 'Robi' connection. Almost 25 to 30 farmers in his locality are using mobile phone services for various purposes. He did not get much response from the mobile service he uses. According to him although he does not have to use river transportation (around 3 kilometers) anymore for receiving agricultural information but still the information he gets cannot be considered as authentic. In terms of price regulation of the product he grows it is still controlled by local politician. If he gets information using mobile service to reduce hassle ultimately the middle man does not agree with that price as there is no rule to enforce them to do that. He thinks government level interruption is necessary to control the market price. Sometime he needs to contact his collogues in the main city Dhaka, where mobile plays an important role for communication. Although he doesn't believe mobile phone replace travel in a significant level but he thinks using mobile phone service is important considering all of its purpose.

Interviewee 5 (Skeptical)

Mr. Manjur Dali is a 40 years old farmer from Chandpur district (Mathavanga village). He is using 'Banglalink' mobile phone connection for seven months for agricultural information purpose, but he thinks 'Grameenphone' provides the best service in agricultural information. He is involved in growing vegetable, sugarcane and fruits. Mobile phone services give him

the privilege to get connected with other farmers and community information center. Around 15 to 20 farmers are using mobile phones for the same purpose. But the product price information provided by them he doesn't consider as authentic. He thinks for local party's manipulation the price cannot be regulated properly. The maximum help he got from using mobile service is the information about various seed and location to buy it. Furthermore, he is getting communication flexibility and can also contact parties in the city area. Before he had to walk one kilometer daily to know the market condition which is not necessary now-days. He thinks mobile phone is very important and affordable tool right now for business, agriculture and communication purpose. He hopes governments keep transparency for what governance it provides to sustain its credibility.

Interviewee 6 (Positive)

Mr. Tajuddin is a 32 years old vegetable and rice grower from Chandpur district (Ekhlaspur Village). He is using mobile phone for 16 years for agricultural activity. He thinks in every 100 farmers in the village at least five person use mobile phone services for agricultural purpose. Although he is using 'Robi' as mobile connection this days but he thinks 'Grameenphone' is the best in providing agricultural information by its mobile based services. He is also involved in rural development planning and community information center for providing them with agricultural information. He used to use river transportation (1.5 kilometer distance) for visiting local market to know agricultural information when he was not introduced to mobile phones. He thinks mobile based services reduced the hassle for communication. He thinks mobile based information is worthy to provide information regarding pesticides and fertilizer use and their affect on health and crops but not market price for the agricultural product. He is also involved in agricultural business where mobile plays an important role in communication. He believes government's future development in mobile based service development will be able to reduce travel time and cost significantly.

Appendix 4

Survey questionnaire and results of Case 3, 4 & 5

Appendix 4-1 A

Questionnaire (Questionnaire for Students)

Mobile Governance in Bangladeshi Educational Sector

Shahjalal University of Science and Technology (SUST)

Project Name: Paperless Admission Process (PAP)

1. Your residence, while admission process in SUST? City, location
_____

2. What is the approximate distance from SUST to your residence? Within –

3. Within Sylhet City, mention km_____ outside the city, mention km _____

4. What was the mode of transportation from your residence to SUST you used while admission exam?

Bus Train Private Car Rickshaw Cycle

5. How did you like the Paperless Admission Process in SUST?

Excellent Good Average Neutral Bad

6. What is the significant benefit you got from the service?
_____

7. What was the significant problem you faced while PAP? (mention, if more than one)

Administrative Technical Management if other _____

8. What is the main difference between paperless admissions than paper based admission to you?

Saves time Less travel Saves Travel cost Hassle free did't find any difference

9. Approximately how much money you saved from travel cost accepting PAP while first time admission?

Amount _____BDT didn't save any money

10. Do you think more mobile based application should be developed in educational sector? Yes/No/Maybe

Appendix 4-1 B

Case 3: SMS Based Automated Registration of Admission Test for Shahjalal University of Science and Technology (SUST)

Table: Student's Survey Feedback on SMS based Admission System in SUST

(N)#	Distance (km)	Time (T*4) min	Transport	Problem Faced	Overall Comments	Further Development	Money Spent (BDT)
1	68	280	B	NP	E	Y	350
2	2	25	R	NP	E	Y	12
3	5	35	B	NP	E	Y	100
4	6	40	PC	NP	E	Y	1200
5	5	35	B	NP	E	Y	1000
6	3	28	B	NP	E	Y	100
7	10	60	B	NP	E	Y	1000
8	350	400	B	T	E	N	2000
9	1	20	R	T	E	Y	100
10	345	400	B	NP	E	Y	1500
11	4	32	R	NP	E	Y	100
12	300	360	B	NP	E	Y	1200
13	120	300	B	NP	E	Y	400
14	500	550	B	NP	G	Y	1500
15	330	380	B	NP	G	Y	1200
16	380	400	B	NP	E	Y	1200
17	300	360	B	NP	G	MB	1500
18	300	360	B	NP	E	Y	1200
19	3	28	R	NP	E	Y	100
20	7	40	PC	NP	G	Y	300
21	400	500	PC	NP	E	Y	1200
22	380	400	B	NP	E	Y	1200
23	500	550	B	NP	E	Y	1200
24	7	40	B	NP	E	Y	200
25	115	290	B	NP	E	Y	500
26	170	320	B	M	E	Y	450
27	350	400	B	M	E	Y	500
28	325	370	B	NP	E	Y	700
29	472	500	B	M	E	Y	500
30	300	360	B	M	E	y	300
31	52	280	B	NP	E	Y	300
32	15	110	B	NP	E	Y	100
33	3	28	R	NP	E	Y	60
34	52	280	B	NP	E	Y	300
35	600	600	B	NP	E	Y	1200

36	350	400	B	M	G	Y	1200
37	770	660	B	M	E	Y	2000
38	25	170	B	NP	E	Y	100
39	255	330	PC	M	E	Y	700
40	7	40	B	T	E	Y	300
41	300	360	B	M	E	Y	400
42	8	42	R	NP	E	Y	100
43	5	35	R	NP	E	Y	100
44	3	28	B	T	E	Y	300
45	331	360	B	M	E	Y	1000
46	20	150	B	NP	E	Y	300
47	3	28	B	NP	E	Y	200
48	68	280	B	NP	G	Y	400
49	2	20	R	NP	G	Y	100
50	7	40	PC	M	E	Y	300
Total	8934	12104					32272

PC = Private Car (10%)= 5
B = Bus (74%)= 37
R = Rikshaw (16%)= 8
W = Walking (0%)= 0

E= Excillent (86%)= 43
G= Good (14%)= 7
A= Avg. (0%)= 0
N= Neutral (0%)= 0
B= Bad (0%)= 0

NP= No Problem (72%)= 36
A= Administrative (0%)= 0
M= Management (20%)= 10
T= Technical (8%)= 4

Yes (96%)= 48
May Be (2%)=1
No (2%)= 1

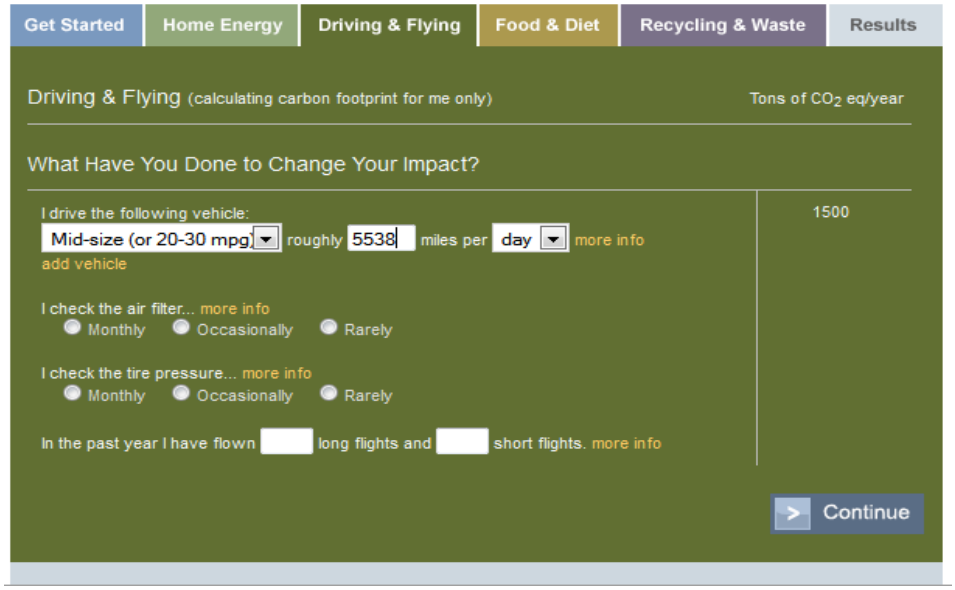
Distance Calculations:

Total Saved Distance (Excluding rikshaw & walking), (8,934-28) = 8,911 km (Approx.) in a typical day of communication by road

1 kilometer = 0.6214 Miles *(Source: http://taylormade.com.au/billspages/conversion_table.html)*

8,911 km = (8,911*0.6214) = 5537.2954 = 5538 Miles

Carbon Calculation:



Source: http://www.nature.org/greenliving/carboncalculator/index.htm

Total CO2 equivalent saved from 5538 Miles is 1500 Tons/year, 1500/365 = 4.10958 = 4.11 Tons (Approx.) in a typical day of communication by road

Appendix 4-2 A

Questionnaire (Questionnaire for Students)

Mobile Governance in Bangladeshi Educational Sector

Bangladesh University of Engineering and Technology (BUET)
Project Name: Sms based application fee payment system

1. Your residence, while admission process in BUET? City, location _____
2. What is the approximate distance from SUST to your residence? Within –

   Within Sylhet City, mention km_____ outside the city, mention km _____
3. What was the mode of transportation from your residence to BUET you used while admission exam?

   Bus Train Private Car Rickshaw Cycle
4. How you did like the sms based application fee payment system in BUET?

   Excellent Good Average Neutral Bad
5. What is the significant benefit you got from the service?

   _____
6. What was the significant problem you faced while sms paying? (mention, if more than one)

   Administrative Technical Management if other _____
7. According to you what is the main difference between normal payment and sms based fee payment?

   Saves time Less travel Saves Travel cost Hassle free did't find any difference
8. Approximately how much money you saved from travel cost by paying fee through sms while admission?

   Amount _____BDT didn't save any money
9. Do you think more mobile based application should be developed in educational sector? Yes/No/Maybe

Appendix 4-2 B

Case 4: SMS Based Undergraduate Admission Process in Bangladesh University of Engineering and Technology (BUET)

Table: Students Feedback on the Survey in BUET Admission

(N)#	Distance (Km)	Time (T*4) min	Transport	Problem Faced	Overall Comments	Further Development	Money Spent (BDT)
1	2.6	7*4 = 28	PC	NP	G	MB	300
2	14.1	27*4 = 108	PC	NP	G	Y	700
3	14.1	27*4 = 109	PC	NP	E	Y	300
4	5.1	14*4 = 56	R	M	G	Y	100
5	14.1	27*4 = 109	PC	NP	E	Y	250
6	200	240*4 =96 0	PC	NP	E	Y	700
7	5.1	14*4 = 56	R	NP	G	Y	100
8	3	7*4 = 28	PC	NP	N	Y	100
9	3.7	11*4 = 44	B	NP	G	Y	100
10	4.2	12*2 = 48	PC	NP	A	MB	150
11	10.1	21*4 = 84	PC	NP	E	Y	300
12	1.5	6*4 = 24	PC	T	G	Y	300
13	4.3	12*4 = 48	B	NP	G	Y	100
14	3	7*4 = 28	PC	NP	G	Y	300
15	3	7*4 = 28	PC	NP	E	Y	500
16	9.4	22*4 = 88	B	NP	G	Y	200
17	3.4	10*4 = 40	PC	NP	E	Y	300
18	470	600	PC	T	G	Y	700
19	300	360	PC	T	G	Y	400
20	366	420	B	NP	G	Y	400
Total	1436.7	3266					6300

PC = Private Car (70%)= 14	E= Excillent (30%)= 6	NP= No Problem (80%)= 16	Yes (90%%)= 18
B = Bus (20%)= 4	G= Good (60%)= 12	A= Administrative (0%)= 0	May Be (10%)=2
R = Rikshaw (10%)= 2	A= Avg. (5%)= 1	M= Management (5%)= 1	No (0%)= 0
W = Walking (0%)= 0	N= Neutral (5%)= 1	T= Technical (15%)= 3	
	B= Bad (3.34%)= 0		

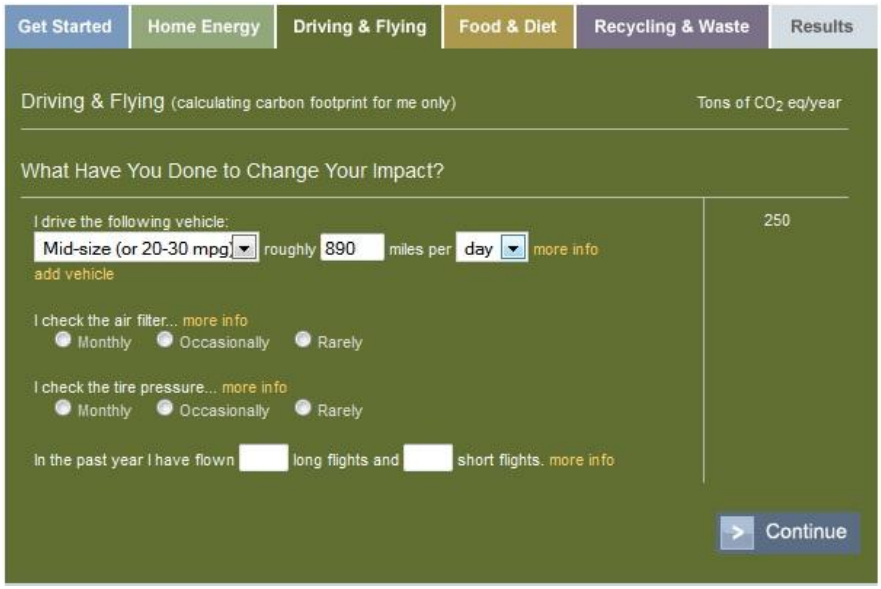
Distance Calculations:

Total Saved Distance (Excluding rikshaw & walking), (1,436-5.1) = 1431.6 km (Approx.) in a typical day of communication by road

1 kilometer = 0.6214 Miles *(Source: http://taylormade.com.au/billspages/conversion_table.html)*

1431.6 km = (1431.6*0.6214) =889.59624 =890 Miles

Carbon Calculation:



Source: http://www.nature.org/greenliving/carboncalculator/index.htm

Total CO2 equivalent saved from 890 miles, 250 Tons/year, 250/365 = 0.68493 = 0.7 Tons (Approx.) in a typical day of communication by road

Appendix 4-3 A

Questionnaire 2 (Questionnaire for Students)
Mobile Governance in Bangladeshi Educational Sector
College Name: _____
Project Name: Registration for college admission by sms

1. Your residence, while admission process in you college? City, location _____
2. What is the approximate distance from your college to your residence? Within –

   Within City, mention km_____ outside the city, mention km _____
3. What was the mode of transportation you used while admission exam?

   Bus Train Private Car Rickshaw Cycle walking
4. How did you like the mobile sms system for the registration for admission in your college?

   Excellent Good Average Neutral Bad
5. What is the significant benefit you got from the service?_____
6. What was the significant problem you faced in the system? (mention, if more than one)

   Administrative Technical Management if other _____
7. What is the main difference you found between the previous and current system? The current one -

   Saves time Less travel Saves Travel cost Hassle free did't find any difference
8. Approximately how much money you saved from travel cost while registering through sms for admission?

   Amount _____BDT didn't save any money
9. Do you think more mobile based application should be developed in educational

   sector? Yes/No/Maybe

Appendix 4-3 B

Case 5: SMS Based Application for Admission in Higher Secondary Certificate (HSC)

Table: Students' feedback on the survey on HSC admission

(N)#	Colleges	Distance (km)	Time (T*4) min	Transport	Problem Faced	Overall Comments	Farther Development
1	VNC	2.3	6*4 = 24	PC	T	G	Yes
2	VNC	2.6	7*4 = 28	R	NP	G	Yes
3	VNC	2	5*4 = 20	PC	NP	A	Yes
4	VNC	1.6	4*4 = 16	R	M	G	May be
5	VNC	0.5	3*4 = 12	W	NP	A	Yes
6	VNC	1.3	5*4 = 20	R	NP	G	Yes
7	VNC	2.3	6*4 = 24	PC	NP	A	May be
8	VNC	0.6	3*4 = 12	W	NP	G	Yes
9	VNC	16.6	25*4 = 100	PC	NP	G	Yes
10	VNC	1.9	6*4 = 24	PC	NP	A	May be
11	VNC	12.5	20*4 = 80	PC	NP	G	Yes
12	GSC	1.8	5*4 = 20	PC	NP	G	Yes
13	GSC	5.5	14*4 = 56	B	NP	E	Yes
14	GSC	5.8	13*4 = 52	PC	NP	G	Yes
15	GSC	2.5	7*4 = 28	B	NP	G	Yes
16	GSC	4	10*4 = 40	B	NP	E	Yes
17	GSC	1.8	5*4 = 20	PC	NP	G	Yes
18	GSC	2.9	7*4 = 28	PC	NP	G	Yes
19	GSC	2.2	6*4 = 24	PC	NP	A	May be
20	GSC	3.1	8*4 = 32	PC	NP	G	May be
21	GSC	1.5	4*4 = 16	B	NP	A	Yes
22	MIC	3.8	9*4 = 36	PC	T	G	Yes
23	MIC	2.9	8*4 = 32	PC	NP	A	May be
24	MIC	5.4	14*4 = 56	B	NP	E	Yes
25	MIC	3.1	8*4 = 32	PC	NP	G	Yes
26	MIC	1.5	4*4 = 16	PC	NP	A	Yes
27	MIC	0.8	3*4 = 12	R	NP	G	No
28	MIC	1.9	5*4 = 20	PC	A	N	No
29	MIC	2.3	6*4 = 24	B	M	B	No
30	MIC	7.5	13*4 = 52	PC	NP	G	Yes
Total		104.5	956				

Specification: VNC = Viqarunnisa Noon College GSC = Government Science College MIC = Motijheel Ideal College	PC = Private Car (60%)= 18 B = Bus (20%)= 6 R = Rikshaw (13.4%)= 4 W = Walking (6.6%)= 2	Yes (73.34%)= 22 May Be (20%)= 6 No (6.66)= 2

NP= No Problem (83.34%)= 25	E= Excillent (10%)= 3
A= Administrative (3.34%)= 1	G= Good (60%)= 18
M= Management (6.66%)= 2	A= Avg. (23.34%)= 7
T= Technical (6.66)= 2	N= Neutral (3.34%)= 1
	B= Bad (3.34%)= 1

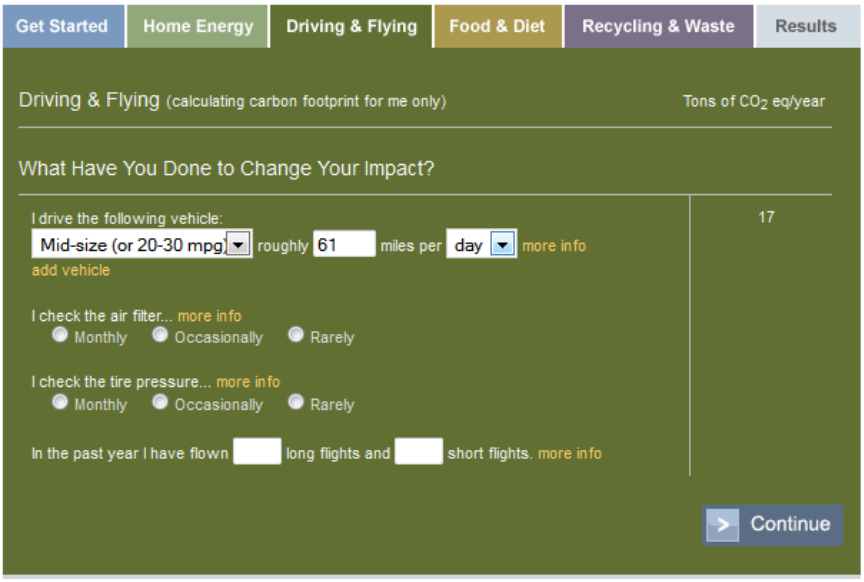
Distance Calculations:

Total Saved Distance (Excluding rikshaw & walking), (104.5-7.4) = 97.1 km (Approx.) in a typical day of communication by road

1 kilometer = 0.6214 Miles *(Source: http://taylormade.com.au/billspages/conversion_table.html)*

97.1 km = (97.1*0.6214) = 60.33794 = 61 Miles

Carbon Calculation:



Source: http://www.nature.org/greenliving/carboncalculator/index.htm

Total CO2 equivalent saved from 61 Miles is 17 Tons/year, 17/365 = 0.04657 = 0.05 Tons (Approx.) in a typical day of communication by road