

EFFECTS OF MOBILE PHONE USE ON ARTISANAL FISHING MARKET EFFICIENCY AND LIVELIHOODS IN GHANA¹

Mahamadu Salia

Institute of Statistical, Social and Economic Research
University of Ghana, Legon, Ghana
basamadu12@yahoo.com

Nicholas N.N. Nsowah-Nuamah

Rector
Kumasi Polytechnic
Kumasi, Ghana
n3n_nuamah@yahoo.com

William F. Steel

Adjunct Professor
Institute of Statistical, Social and Economic Research
University of Ghana, Legon, Ghana
wsteel@alumni.williams.edu

ABSTRACT

This article assesses the effects of mobile phone use on the artisanal fishing industry in the Effutu Municipality of Ghana. It contributes to the growing literature on how mobile telephony can help overcome market inefficiencies in developing countries due to imperfect information. The study shows how mobile phone use among fishermen has enhanced the efficiency of input and output markets for artisanal fishing and improved their businesses relations and livelihoods. The 'before and after' approach was used, based on interviews with fishermen and other supply chain actors on ways in which fishermen bought inputs and sold fish, and their perceptions of the effects of the mobile phone. The results indicate that market efficiencies improved and price variations reduced as a result of better availability of up-to-date information. Use of mobile phones enabled fishermen to improve their incomes, expand their markets, feel more secure at sea, and remain in closer touch with both families and other fishermen.

Keywords: Mobile phone, Fishing, Market efficiency, Imperfect information, Technology

1. INTRODUCTION

Mobile telephony over the past decade has grown rapidly in developing countries. Almost 70 per cent of the world's mobile phone subscribers are in the developing world. Reasonable pricing and easy access have helped make this technology a potential tool for generating economic opportunities and social networking, even in rural areas (e-agriculture.org, 2009). According to Donner (cited in Rashid and Elder, 2009) the reasons for this explosive growth include sense of security to users, good leapfrogging technology, the requirement of only basic literacy, extra features (besides voice communication) such as text messaging and data transfer, which can be used for education, commerce, advertising, even banking; increasing competition (especially where open to private investment) and innovative payment methods (e.g., pre-paid, unit transfer) that make them increasingly affordable to the lower quintile of the population. This study shows how mobile phone use among artisanal fishermen in Ghana

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has enhanced the efficiency of input and output markets and improved their businesses relations and livelihoods.

2. FRAMEWORK AND METHODOLOGY

In developed countries markets function efficiently because the prices of goods and services are known or can be accessed cheaply, widely, and readily (Eggleston et al. 2002, cited in Davis and Ochieng, 2006). On the other hand, in rural Africa markets function inefficiently because information flow on the prices of goods and services is largely difficult and mal-distributed, especially among artisanal fishermen and smallholder farmers. This condition in rural Africa is attributable to lack of cheap, timely, and readily accessible information, poor information delivery mechanisms and infrastructure, and a private sector attitude that typically views smallholders as commercially unattractive (Phlips, 1988; Eggleston et al., 2002).

2.1 Role of Information in Overcoming Market Inefficiencies

Many studies have concluded that access to telecommunications has a fairly strong impact on growth and economic development, as well as poverty reduction. Recently, some studies have focused on the relationship between access to telecoms and economic well-being of the poorer segments of society in several countries at the micro-level, as does this study (Abraham, 2006; Aker, 2008; Galperin and Mariscal, 2007; Jensen, 2007). In theory, lowered transaction costs, inter alia through faster access to more accurate information, should help the poor to increase their incomes directly or indirectly through the more productive use of the time saved by placing a call. While empirical evidence of such impacts at a generalized level is sparse, studies do show concrete empirical evidence of the benefits at this micro-level in specific markets or for certain groups of people. Mobile phone ownership has boomed throughout Sub-Saharan Africa, accounting for about 9% of subscriptions worldwide, with “Africa and Asia-Pacific the main drivers of growth, accounting for 80% of global net additions in the first half of [2010]” (engineeringnews online 2010). Nevertheless, there have been few reliable studies on the social and economic implications of mobile phone use in African countries.

The use of mobile phones can correct market inefficiencies through affordable access to information. The Palliathya help line in Bangladesh is a successful example in this direction. Palliathya (cited in Bhavnani et al. 2008) uses mobile phones to increase access to information on the part of men and women living in Bangladesh's rural areas, as well as to stimulate economic opportunities for underprivileged women. The Palliathya initiative concluded that “*the helpline services: (a) prevent exploitation by middlemen; (b) provide employment opportunities (particularly for rural women); (c) reduce information gaps; (d) save cost and time; and (e) strengthen access of service providers to rural people.*”

This initiative uses face-to-face contact, together with ICT, to empower women economically, as well as to share community-relevant information on education, emergency situations, markets, weather, etc. The Palliathya case shows that lack of relevant and timely information is a major bottleneck to rural development. Overall, these cases demonstrate the importance of information for the functioning of markets and that well-functioning markets have a positive impact on welfare.

Aker (2008) studied grain traders in Niger and concluded that “*mobile phones reduce grain price dispersion by a minimum of 6.4%*”. The study provided evidence that mobile phones reduce grain price dispersion across markets and reduce intra-annual price variation. This means that mobile phones have a maximum impact and ability to level price dispersion when the markets are far away from each other and with poor road network quality. According to Aker this effect becomes larger as a higher percentage of markets have mobile

phone coverage because traders reduce their search costs, as grain traders operating in markets with mobile phones coverage search over a greater number of markets and sell in more markets. In summary, it implies that mobile phones improved consumer and trader welfare.

2.2 Implications of Mobile Phone Use in Fishing

The introduction of mobile telephony in fishing has been seen as a boon to artisanal fishermen, by giving them access to information on alternative prices from different buyers at different markets, as well as on locations of shoals at different points in the sea. Jensen's (2007) study of fishermen in Kerala state in India argues that mobile phone use by fishermen was associated with a great reduction in price dispersion, elimination of waste, and almost near-perfect adherence to the Law of One Price:

Both consumer and producer welfare increased: waste (6% of the fish were unsold before cell phones) has been eliminated; fishermen's profits are up 8% and consumer prices are down 4%, directly driving a 20 rupee/person/month consumer surplus, the equivalent of a 2% increase in per-capita GDP from this one market alone.

Similarly, Abraham (2007) reported the results of a series of focus groups discussions conducted at 12 locations in Kerala, India, and interviews with nearly 200 local people associated with the fishing industry. He concluded that “*with the widespread use of mobile phones, fishermen are able to respond quickly to market demand and prevent wastage*”. He asserts that mobile phones enable fishermen to respond quickly to market demand and reduce or prevent wastage of catch, which was a common phenomenon before the adoption of phones. At the marketing end, mobile phones help coordinate supply and demand, and merchants and transporters are able to take advantage of the free flow of price information by catering to demand in undersupplied markets. There is also far less wastage of time and resources in all segments of the fishing community. Fishermen spend less time idling on shore and at sea, whereas owners and agents go to the landing centres only when they receive information (via mobile phones) that their boats are about to dock. He finds that with the widespread use of mobile phones, markets become more efficient as risk and uncertainty were reduced. There is greater market integration and price dispersion, and price fluctuations are reduced.

Newspapers have recently reported that African fishermen are a part of these new users (BBC News, The Economist and Washington Post, cited in Myhr and Nordström, 2006). Preliminary investigations for the present study in the Winneba Municipality of the Central Region of Ghana found pervasive use of mobile phones at sea by fishermen in the community.. This is reasonable given the nature of their occupation. Fishermen often spend a lot of time away from families and away from their customers. Furthermore, fishermen are vulnerable out at sea, where a broken engine in rough weather can be a life threatening experience. Fortunately, the wireless nature of the mobile phone has availed itself for fishermen to place and receive calls while on the water. But has this new access to communication improved their wellbeing? reduced their vulnerability? transformed their businesses for the better? Has the mobile phone helped coordinate supply and demand in respect of marketing? Are the fishermen satisfied with the quality of the services rendered by mobile phone service providers?

This article investigates the effects of mobile phone use on the artisanal fishing industry in the Effutu municipality of Ghana. The underlying theory is that lack of access to accurate information (e.g., on input availability or prices, or on weather conditions), or asymmetries in the availability of information (e.g., on the prices that buyers are willing to pay for fish at different locations), impede efficient operation of markets and raise the costs and time required to manage risk and uncertainty (Phlips, 1988). Questions were designed to

elicit how mobile phones helped fishermen to access better information and whether this resulted in any changes in behavior and welfare. Specifically the study:

- i. Assesses the role of mobile phone usage in the supply of inputs and sale of fish by fishermen in Winneba;
- ii. Determines how mobile phone use facilitates the flow of information among fishermen and their business partners;
- iii. Examines the extent to which mobile phone use levels price variation of fish along the landing sites in Winneba and beyond;
- iv. Assesses use of mobile phones to reduce vulnerability;
- v. Evaluates whether or not fishermen are satisfied with mobile phone use;
- vi. Identifies the challenges that face mobile phone use in fishing.

2.3 Study Area

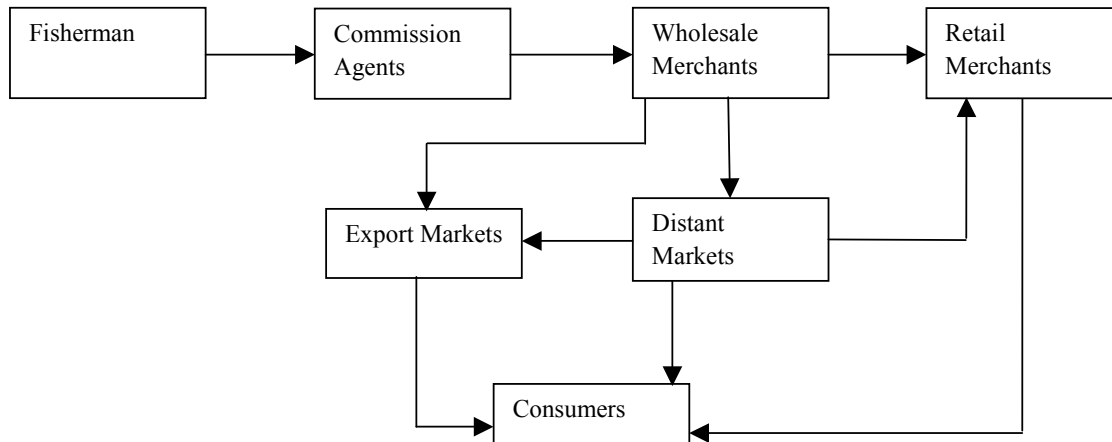
The Effutu Municipality is one of the nineteen administrative districts in the Central Region. It was carved out from the Awutu-Effutu-Senya (AES) District Assembly in the year 2007 with Winneba as its capital and a total population of 46,494 (54% females). The main economic activities of the Municipality are fishing and commerce. As a recently-created Municipality, independent statistics on household income and expenditures are not available. Nevertheless, the average annual income for the AES District was GH¢ 694 with average annual expenditures of GH¢ 1246; average household size was 8.²

2.4 Methodology

According to Cracknell (2000), many researchers have confirmed that controls rarely work satisfactorily. Therefore, the obvious direct method is the 'before and after' approach, which simply compares the situation at the time of the assessment with what it was before the intervention (i.e. mobile phone use) started. Cracknell (2000), however, cautioned that although this approach is used to carry out many assessments, it still suffers from a major defect. That is, if the intervention under study has spanned over a period of several years, a number of changes might have taken place during the life of the intervention, whose effects might incorrectly be attributed to the intervention. Hence, if a control is not used, it is desirable to use published statistics and other available information about trends related to the project under study, if possible to the region of intervention (Cracknell, 2000).

Given the lack of a suitable control group (due to the pervasive use of mobile phones) and the absence of systematic statistics on artisanal fishing markets, the research had to rely on the 'before and after' approach, coupled with a conceptualized structure of the fish market in Effutu Municipality. A stylized representation of the supply chain expressed in Figure 1 enabled the research to examine very closely how fishermen use the mobile phone to carry out their business and the impact it exerts on the artisanal fishing industry in Ghana.

² GLSS5 data for 2005/06 (exchange rate approximately GH¢ 0.95/\$).

Figure 1: Conceptual Framework of the Fish Marketing Chain in Ghana

Source: Abraham Reuben (2006)

Fresh fish is a highly perishable commodity which, in principle, requires the shortest possible supply chain with as little involvement of intermediaries as possible (Figure 1). In reality, the catch goes through a complex distribution chain from the producer/fishermen to the end consumer. The owners of the canoes hire fishermen to man their canoes. In some cases, the fishermen or fishermen's co-operative could themselves be the owners. In most of the cases, the canoe also has an investment from the commission agent, who thereby ensures control over the sale of the catch. On landing the catch, the commission agents auction the fish to both retail and wholesale merchants, who then sell the fish to consumers either directly, in the case of retail merchants, or through other retail merchants, in the case of wholesale merchants. The agents then pay the owners after subtracting between 5–10% of the total value as their commission. The owners pay for the variable costs of the trip, including ownership fee and split whatever remains among the fishermen.

The 342 registered canoes in the Effutu Municipality composed the sampling frame for the survey, of which 240 canoes were selected, representing 70% of the registered canoes. All the canoes were given numbers, which were put into a container, mixed, and drawn one-by-one with replacement until the required number was reached. A structured questionnaire based on similar studies (Abraham 2006, Jensen 2007, Myhr and Nordström 2006) was then administered to the 240 selected fishermen by staff of the Fisheries Department in the Municipality, trained in the survey data collecting process. This was supplemented by unstructured in-depth interviews with three executive members of the local association members, three chief fishermen and three experienced fishermen, who were purposively selected from the three landing sites.

The data was analysed with SPSS to provide summaries of frequencies and percentages. Nonparametric statistics was used to test for statistical significance of the difference in the number of landing sites visited before and after the introduction of mobile phone. Principal components analysis was also used to determine the specific factors which influenced the fishermen to obtain mobile phones

3. SAMPLE CHARACTERISTICS

3.1 Sex and Age Distribution

All of the 240 fishermen interviewed were males, consistent with the researcher's preliminary observation that all those involved in canoe fishing and going to sea were males. Table 1

shows the age distribution of fishermen by age bracket, with 76% falling between 30 and 49 years of age.

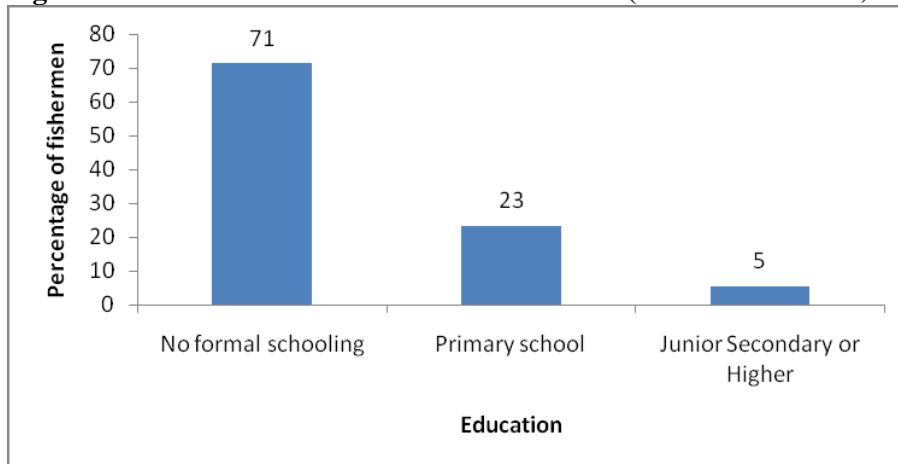
Table 1: Age Distribution of Fishermen (Source: Field data, 2009)

Age-group (years)	Frequency	Percent	Cumulative
15-29	16	6.7	6.7
30-39	77	32.1	38.8
40-49	105	43.8	82.9
50-59	40	16.7	99.2
60+	2	0.8	100.0
Total	240	100	

3.2 Educational Attainment

Of the 240 fishermen, 95% had only primary education or no formal schooling at all (Figure 2), and only 1.2% of these could read and write. These findings are consistent with the high illiteracy rate in the country, as indicated by the Population and Housing census of 2000. Despite functional illiteracy, respondents indicated no difficulty using mobile phones.

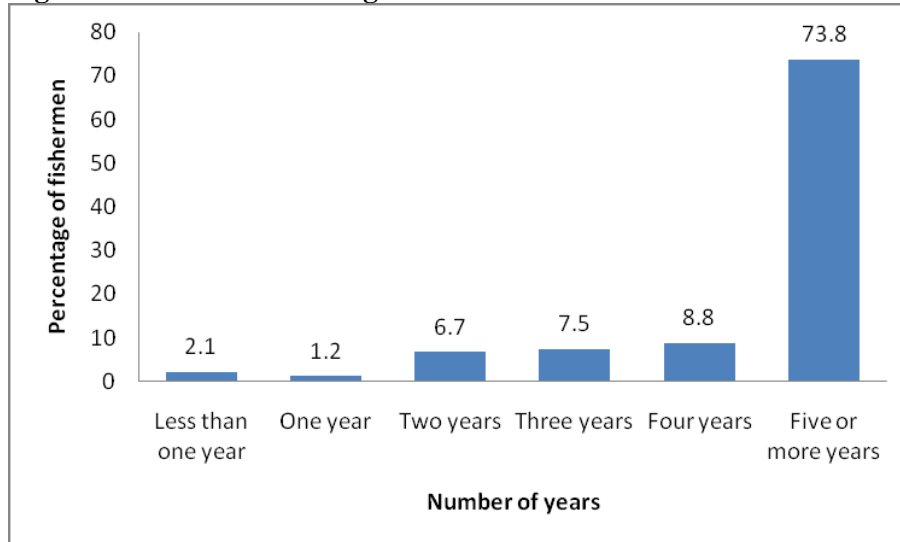
Figure 2: Educational Attainment of Fishermen (Source: Field data, 2009)



3.3 Duration in Fishing Business

Fishermen had substantial experience in fishing, with 90% in the business for three or more years (Figure 3).

Figure3: Duration in Fishing Business



Source: Field data, 2009

3.4 Secondary Occupation

The majority of the fishermen had no job apart from fishing; less than a quarter were also engaged in other occupations such as carpentry, petty trading, farming, lumbering and carpentry (see Table 2).

Table 2: Secondary Occupation of Fishermen

	Frequency	Percent
Carpentry	27	11.2
Trading	12	5.0
Farming	10	4.2
Lumbering	7	2.9
No other job	184	76.7
Total	240	100

Source: Field data, 2009

4. FINDINGS

4.1 Purchase of Inputs Before and After Mobile Phones

Fishermen were asked to indicate how they ordered inputs such as premix fuel, ice blocks, mending twine, bait, and kerosene/diesel before and after they acquired mobile phones. The dominant mode before mobile phones (74.3%) was to walk or travel to the source of the input to order the supply, while 19.8% indicated that they contracted local agents to order the inputs for them and 5.9% engaged their relatives to purchase or order the supplies on their behalf. After the introduction of mobile phone into the municipality, the share who walked or travelled to the sales point of the inputs fell to 44.2%, while 31.5% used mobile phones to arrange the purchases of inputs from their suppliers.

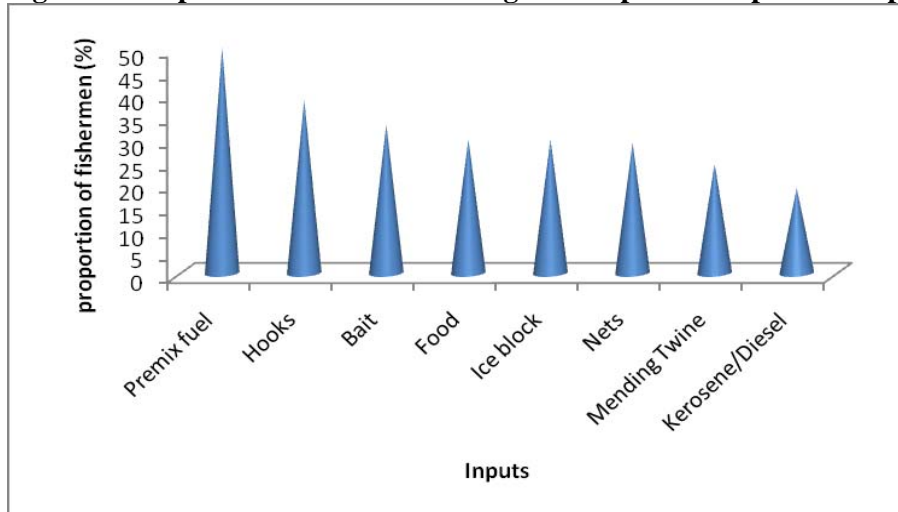
Table 3: Ways Fishermen Purchase Inputs Before and After Mobile Phone Acquisition

Ways of Purchasing Inputs	Before (%)	After (%)
Walk/travel to source of inputs to buy	74.3	44.2
Contract local agent (middleman) to buy inputs	19.8	18.4
Others help me to buy inputs (e.g. relatives, friends)	5.9	5.9
Arrange by mobile phone to buy inputs	---	31.5
Total	100	100

Source: Field data, 2009

The 31.5% of fishermen who indicated that they used mobile phones to arrange purchase of inputs were further broken down by the types of inputs they used the mobile phone to purchase. Half used their phones to purchase premix fuel, and hooks, bait, food, ice blocks and nets were also frequently purchased over the phone (Figure 4). The improved efficiency in input purchase made possible by mobile phones is illustrated by the following comment by one of the canoe owners:

“...these days the phone has saved me from walking about unnecessarily either to the fuel station or to find out anything about my job. Sometimes I call the fuel station to see if there is fuel. I also used to buy my net from one supplier in Accra, but now I just call him to supply any time I need some”.

Figure 4: Proportion of fishermen using mobile phones to purchase specific inputs

Source: Field data, 2009. Multiple responses were permitted.

4.2 How Mobile Phones Facilitate the Flow of Information

In a multiple response question, fishermen were asked to indicate the ways in which mobile phone use has facilitated the flow of information in the fishing business. Three-quarters of the fishermen indicated that the mobile phone has enabled them to stay in touch both with their suppliers and with their customers, and two-thirds found new customers via the phone (Table 4). Getting price information from other markets was important for 70.8% of mobile phone users, while 37.8% reported that it helped them to cut out middlemen in their business.

Table 4: How Mobile Phones Facilitate the Flow of Information.

Information Flow	Responses	
	N	Percent
Stay in touch with suppliers	182	75.8
Stay in touch with customers	180	75.0
Get price information from other markets	170	70.8
Give access to new customers	160	66.6
It helps me cut out middlemen	91	37.9

Source: Field data, 2009. Multiple responses were permitted.

4.3 Ways Fishermen Sell their Catch before and after Possession of Mobile Phone

With respect to the way fishermen sold their catches before the advent of mobile phones, 70.8% said that they sold to customers at the landing sites, while 21.2% gave their catches to their wives to sell, and 7.9% contracted local agents to sell their catches (Table 5).

Table 5: Ways of Selling Catch Before and after Possession of Mobile Phone

Channel	Before (%)	After (%)
Auction to customers	78.3	23.3
Give to wives	17.5	43.8
Contract agents to sell	4.2	--
Arrange by mobile phone to sell to customers	--	32.9
Total	100	100

Source: Field data, 2009

Direct auction to customers at the landing site fell sharply to 23.3% after introduction of mobile phones, while 32.9% said they arranged by mobile phone to sell their catches to their customers either before or after they have arrived at landing sites (Table 5). Interestingly, the proportion of fishermen allowing their wives sell their catches rose to 43.8%. Statistical comparison of the distributions before and after mobile phone (chi-square test) indicates that the change in modality was significant ($\chi^2_{(df=2, N=240)} = 225.10, p < 0.05$). Box 1 confirms that fishermen perceive positive changes in how they sell their catches to customers due to improvement in mobile phone technology.

4.4 Number of Landing Sites Visited Before and After Mobile Phone

The number of landing sites/markets visited by a fisherman per month before the availability of mobile phones in the municipality was sought. Of the 240 fishermen, 48.3% indicated that they visited only one landing site per month before the introduction of mobile phones (that is fishermen' own local landing sites); 30.0% visited two landing sites; and only 21.7% visited three or more landing sites (Figure 5). However, after the introduction of mobile phones, only 12.9% visited just one landing site a month to sell their catches, while 70% visited three or more landing sites (more than triple the previous share). Wilconxon Sign Rank test indicated that the differences in the number of landing sites visited before and after the availability of mobile phone was statistically significant at $Z=10.074, p < 0.05$.

Box 1: Changes in How Fishermen Communicate with Buyers

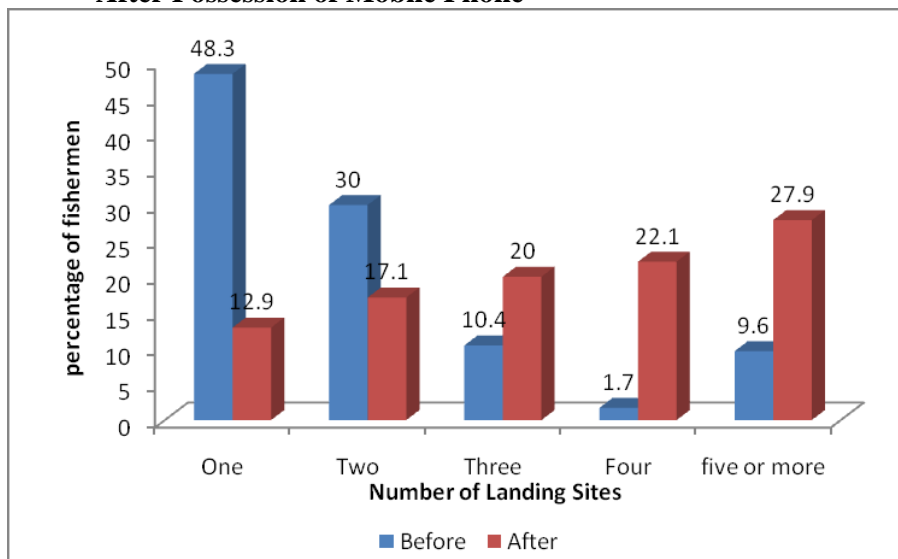
One canoe owner interviewed noted changes in the way he contacts his colleague fishermen and customers before his canoe arrives from sea:

At sea my other colleagues just communicate with me when they make a catch. I will therefore call all my customers through the mobile phone to inform them that the fishermen have made some catch, the type of fish, and the time they will arrive and the price per crate/bucket so they should get ready to meet me. Some will buy the quantities they want on the phone but most of them will come to the landing sites to wait for the fishermen.

Another fisherman responded as follows when he was asked: “in what ways has the mobile phone been beneficial to you in the fishing business?”

Our fishing activities are not limited to only Sempa (Effutu), we can travel as far as to the shores of Sekondi, Takoradi, Elmina, Winneba, Accra, Tema and even Ada searching for the fish. [If] we got a good catch, we can't travel back to Sempa (market area) [because of] the distance involved.... with our mobile phones we are able to communicate with our customers (fish mongers) along these shores to meet us at our destination point for the catch, making our journey back home easier. I will say that mobile phones help us communicate effectively with fish mongers for easy marketing.

Figure 5: Number of Landing Sites Visited in a Month Before and After Possession of Mobile Phone



Source: Field data, 2009

The main reasons why fishermen visited multiple landing sites are shown in Table 6. Obtaining the best price was the primary motivation for 66.2% of the fishermen, and 15.0% similarly said they were looking for more buyers. Less than 5% gave reasons other than prices, buyers and financing, e.g., problems with their outboard motors. These results indicate that, indeed, the mobile phones were facilitating fishermen to seek better prices and more buyers by visiting more landing sites.

Table 6: Reasons for Visiting Landing/Marketing Sites

	Frequency	Percent
Best prices at the landing sites	159	66.2
More customers are at the landing sites	36	15.0
Financiers are at the landing sites	34	14.2
Emergencies	11	4.6
Total	240	100.0

Source: Field data, 2009

4.5 Influence of Mobile Phone on Price Differentials among Landing/Marketing Sites

The fishermen were asked to state whether or not mobile phone use has influenced price variation by leveling prices among the various landing/marketing sites in the municipality. While 45% did not perceive any impact on price differentials, 48% said that mobile phones have had some influence (large or small) on price differentials among the landing sites (Table 7; statistically significant at $X^2_{(df=3, N=240)} = 76.03, p < 0.05$).

Table 7: Influence of Mobile Phone on Price Leveling among Landing/Marketing Sites

	Frequency	Percent
No influence	110	45.8
Small influence	61	25.4
Large influence	54	22.5
Not applicable	15	6.3
Total	240	100

Source: Field data, 2009

The conclusion that mobile phones have tended to reduce price differentials is borne out by the following interview with one fisherman:

“We also find out prices at the other marketing/landing sites and compare them to prices at our landing site and try to sell at the same price. The phones have helped in the fair distribution of fish among the marketing/landing sites. This is because during bumper harvests, we use the phones to find out the markets with less or no fish in order that we land there”.

4.6 Perceptions on Specific Benefits of Mobile Phones

A principal component analysis with varimax rotation was conducted to determine the specific factors which influenced the fishermen to obtain mobile phones. Four factors were identified based on four constructs: **cost reduction factors**, **safety factors**, **coordination factors** and **market expansion factors**. The **cost reduction factors** load most strongly on three items, with loadings ranging from 0.76 to 0.79 and 27.9% of variance explained (first column of Table 8). The **safety factors**, composed of three items with loadings ranging from 0.76 to 0.80, explained 14.5% of the variance (second column). The **coordination factors**, comprising two items with loadings spanning from 0.75 to 0.79, explained 9.0% of the variance (third column). Finally, **market expansion factors**, made up of two items with loadings ranging from 0.79 to 0.81, explained 8.1% of variance (fourth column). While most of these factors are economic, the safety factors reveal the importance of mobile phones in

Table 8: Principal Components Analysis Showing Perceived Benefits of Mobile Phone

Benefits of Mobile Phones	Component Loadings				Communalities
	1 Cost	2 Safety	3 Coordination	4 Market	
Help me to reduce wastage of fish	0.79				0.82
Help reduced transaction cost	0.77				0.76
Reduced price differences among landing sites	0.76				0.65
Help quickly in case of emergencies		0.80			0.67
Receive weather information		0.79			0.74
Better access to family information		0.76			0.81
Better coordination with other fishermen			0.79		0.69
Information on location of shoals			0.75		0.79
Help me to find new customers				0.81	0.70
Help me to find better market prices				0.79	0.70
Eigenvalues	4.75	2.46	1.53	1.38	
% of variance explained	27.9	14.5	8.98	8.10	

Note: Loadings less than 0.5 are omitted

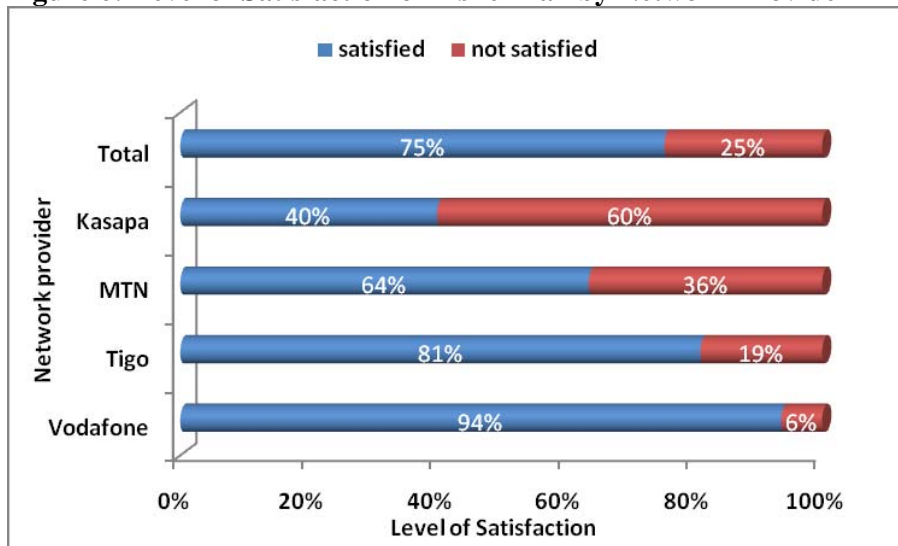
Source: Field data, 2009

reducing the risks of going to sea through better weather information and ability to contact others in case of emergencies, as well as to maintain contact with their families.

4.7 Perception of Quality of Services

Fishermen's satisfaction with the quality of services rendered by the network operators was sought. Overall, three-quarters of fishermen were satisfied, one-quarter not satisfied (figure 6). The highest degree of satisfaction was with Vodafone (93.6%) and Tigo (81.1%); Kasapa was the least satisfactory (60% not satisfied). A chi-square test for relatedness between network provider and level of satisfaction indicated that differences between providers were significant ($X^2_{(df=3, N=240)} = 23.38, p < 0.05$), though data were not available to compare to the national values.

Figure 6: Level of Satisfaction of Fisherman by Network Provider



Note: Responses on a 4-point scale have been grouped.

Source: Field data, 2009.

The fishermen were asked to indicate their level of satisfaction or dissatisfaction on specific aspects of services of mobile networks. The overall satisfaction rate by this measure was only 58%, and more than 70% of fishermen expressed dissatisfaction with costs, customer support, network coverage and dropped calls (Table 9).

Table 9: Determinants of Quality of Service

Service Aspects	Satisfaction			
	Yes	No	% satisfied	% not satisfied
Overall mobile phone service	140	100	58.3	41.7
Overall costs of calls from mobile phone	51	189	21.3	78.8
Quality of customer service and support	52	188	21.7	78.3
Network coverage both on land and sea	66	174	27.5	72.5
Dropped calls (i.e. cut off in middle of call)	70	170	29.2	70.8
Congestion (i.e. inability to access network)	86	154	35.8	64.2
Cost of calling others network	136	104	56.7	43.3

Note: Responses on a 4-point scale have been grouped.

Source: Field data, 2009

4.8 Specific Challenges Faced in the Use of Mobile Phone

When asked about the biggest challenges of using mobile phones at sea, the overwhelming concerns were with limited network coverage and the risk of dropping phones into the sea (95-100% of fishermen; Table 10). The cost (73%) and the tendency of the phones to rust (68%) were also seen as important drawbacks. During the interviews, one fisherman stated the challenges as follows:

The first and foremost is the limited network coverage (“out of coverage area”) causing us not to communicate effectively with our colleagues even when there is a problem//breakdown. Secondly, contact of the phone with the waves and salty water renders it ineffective. Also, phones may/do fall into the water on several occasions.

Table 10: Specific Challenges Faced in the Use of Mobile Phone

	Responses	
	N	Percent
Not much network coverage	240	100.0%
Mobile phone sometimes fall into the sea	229	95.4%
Mobile phones are expensive	174	72.5%
Mobile phone easily rust	164	68.3%
Mobile phones are attractive to thieves	77	32
Total	240	100

Source: Field data, 2009. Multiple responses were permitted.

5. CONCLUSIONS

5.1 Role of Mobile Phone in Inputs Supply and Fish Selling

The findings indicate that fishermen use their mobile phones as “umbilical cords” which connect them to their suppliers, buyers and families, including while at sea. Fishermen now are much more likely to purchase inputs via mobile phones through an arrangement with their suppliers instead of having to walk to the suppliers’ shops to purchase the inputs, as before. This reduces transaction costs and the risk of supplies not being available, and enables just-in-time purchases. As many as two-thirds of the fishermen are in touch with their customers and their suppliers continuously, seven days a week. Over 20% have used the phone to get access to new customers. This frequent interaction helps to build trust and confidence in their businesses.

The study suggested that the availability of mobile phone has facilitated information flow among fishermen in many ways. With respect to the selling of fish, the study observed a shift in the way fishermen sell their catches, with about a third now selling their catches through mobile phone arrangements to customers instead of the traditional form of selling through face-to-face auctioning at their home landing sites. This arrangement was found to have helped about 12% of the fishermen to bypass middlemen and sell straight to their customers. These findings support the conclusions of Boadi and Shaik (2008) and Morowczynski and Miscione (2008) that mobile phones have helped small businesses to bypass middlemen and obtain better prices.

In particular, the study found that 22% of the fishermen used the phone specifically to access price information from the various markets/landing sites, and the evidence showed a significant increase in the number of landing sites visited monthly after the advent of mobile phones. Buyers likewise call sellers to find out about catches and how much of each species,

even while the canoes are at sea. This includes new buyers who come to the landing sites to obtain the mobile phone numbers of fishermen, thus empowering the fishermen to choose from alternative buyers and obtain the best prices. About 48% of fishermen agreed that the result has been reduced price differentials between sites/markets, consistent with the finding by Abraham (2006) that mobile phones have reduced price dispersion and fluctuation among fishing markets in India.

5.2 Perceptions of the Main Benefits of Mobile Phones

The survey found four major categories of reasons fishermen gave for using mobile phones: cost reducing factors, safety factors, coordination factors, and market expansion factors.

Ways in which the mobile phone has helped them to reduce costs include reduction in the quantity of fish spoilage (by selling catches even while at sea); reduced time consumed in search of a good price; and lower quantity of fuel consumed and time used in search of fish (through communication among fishermen as to where shoals are located). Reduction in price differentials among the landing sites provides evidence of more efficient markets due to better information, which previously was very difficult to come by as fish could be sold at one landing or marketing site without any knowledge of prices at other landing sites.

Safety factors refer in particular to the usefulness of the phone in times of emergencies such as engine breakdowns, as well as access to bad weather information from other fishermen. Better access to information on their families during fishing hours was also a benefit, permitting information to be relayed to their families in case of mishap and improving their peace of mind and confidence as they conduct their business.

Coordination factors include the ability to be in constant touch with colleague fishermen before, during and after fishing. For instance, the crew leader uses the phone to call all crew members (some of whom may stay a distance away from the sea) to arrange fishing expeditions, and to make alternative arrangements in cases where crewmembers are indisposed. Fishermen also inform colleagues on the location of shoals, or ask for help in finding lost nets.

Finally, the fishermen stated that the mobile phone has helped them to expand their markets by finding new customers and the best prices, both within and outside their local landing sites. In effect, the mobile phone has helped the fishermen to make informed decisions on who, where and how much to sell their catches.

5.3 Challenges and Suggestions

While fishermen were generally satisfied with mobile phone services, there were very different perceptions of the various networks, and some dissatisfaction with network coverage at sea, customer support, and dropped calls, as well as cost. One challenge is that the phones easily fall into the sea water (which some fishermen address through the insertion of corks on their phones) and are susceptible to rusting due to the salinity of the sea. The principal recommendation by fishermen to improve the usefulness of mobile phones would be to expand the reach of network coverage beyond 20-25km at sea. They would also like phones to be cheaper and more resistant to salt water.

5.4 Implications and Further Research

The study confirms that a modern technological innovation (mobile telephony) can be made accessible to a largely illiterate, low-income population with positive effects on their ability to manage their business profitably and to cope with risks. One area of further work to enhance these effects would be development of applications suitable for artisanal fisherman, such as readily accessible reports on local weather conditions and prices, or reporting illegal trawling operations. Given that cell phone towers cannot be located at sea, improving

coverage will depend on the providers developing technologies to extend the signal farther, or locating more towers close to the sea. Since it was not feasible in this study to obtain direct data on prices before and after introduction of mobile phones, further research to investigate the impact of mobile telephony on artisanal fishing (or other occupations with variable prices) in other countries could usefully be done on a randomized experimental basis with tracking of prices before and after provision of mobile phones to those selected.

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Appendix: MOBILE PHONE USE AND THE ARTISANAL FISHING INDUSTRY

The questionnaire is being used to find out mobile phone use and the artisanal fishing industry. Your responses will be used purely for academic purpose; hence confidentiality and anonymity are assured.

INSTRUCTIONS:

Please read the following questions carefully – Tick [✓] appropriate answer(s) in the boxes provided and specified where necessary. Thank you

Entry number

GENERAL SURVEY DATA

- 1 Date of interview.....
- 2 Name of interviewer.....
- 3 Name of supervisor.....
- 4 Name of landing site.....
- 5 Name of crew leader.....
- 6 Name of canoe.....
- 7 Name of district.....
- 8 Name of mobile phone service provider of crew leader.....
- 9 Mobile phone number of crew leader.....

RESPONDENT DATA

- 1 Approximate age of respondent
- 2 Gender: (*tick appropriate box*)

Male []	Female []
----------	------------
- 3 What is the highest level of Education that you have achieved?
(*Tick one box indicating the highest level of education mentioned*)

No formal schooling	[]	GO TO Q.4
Primary school	[]	
Junior secondary	[]	
Senior secondary	[]	
Post secondary e.g. diploma, degree	[]	

Only if they have had no formal schooling ask question 4

- 4 Do you know how to read and write?

Yes	[]
No	[]

OBJECTIVE 1 : assess the role of mobile phone use in the input supply, harvesting and trading of fish by fishermen.

0. For how long have you used a mobile phone at sea?

Less than 1 year
1 year but less than 2
2 years but less than 3

3 years or more
 Used to take phone but no longer do
 Have never taken mobile phone to sea

1. Which of these groups of people do you use your mobile phone to call? (Tick as many as apply).
 - Other fishermen
 - Business partners e.g. owners, agents, customers
 - Family members
 - Friends
 - Executive members of association
 - Other(s)(specify).....

2. Has mobile phone use helped to coordinate input supply in your fishing business?
 - Yes
 - No

3. Which of this/these input(s) do you use your mobile phone to coordinate their supply? (Tick as many as apply)
 - Premix fuel
 - Food
 - Ice block
 - Kerosene/Diesel
 - Mending twine
 - Nets
 - Hooks
 - Baits
 - Lead
 - Other(s)(specify).....
 - None of the above

4. Before mobile phone use, how did you coordinate the supply of all the activities ticked above in question (3)
 - Premix fuel
 - Food
 - Ice block
 - Kerosene/Diesel
 - Mending twine
 - Nets
 - Hooks
 - Baits
 - Lead

5. Has mobile phone use reduced the time you take to prepare for sea?
 - Yes
 - No

6. If yes, by what percentage proportion has the time reduced?
 - Below 10%
 - 11-30%

- 31-50%
- Above 50%

Harvesting of Fish

7. Do you use the mobile phone at sea during fishing?
- Yes
- No
8. During the last [three] months, how many times did you use the mobile phone at sea during fishing for the following? (Enter number of times, or "0")
- To contact engineer to repair outboard motor engine
- To contact premix fuel seller
- To contact meteorologist for weather and tide information
- To contact other fishermen when shoals are located
- To contact landing/marketing sites for best selling price
- To report poachers on local fishing grounds
- To contact other fishermen to help find lost net
- To contact fishermen for information e.g. health condition
- To contact friends for information
- To contact executive members of union
- Other(s)(specify).....
9. Indicate the extent to which you
- To contact engineer to repair outboard motor engine
- To contact premix fuel seller
- To contact meteorologist for weather and tide information
- To contact other fishermen when shoals are located
- To contact landing/marketing sites for best selling price
- To report poachers on local fishing grounds
- To contact other fishermen to help find lost net
- To contact fishermen for information e.g. health condition
- To contact friends for information
- To contact executive members of union
- Other(s)(specify).....
10. How frequently do you use the mobile phone at sea?
- Anytime I go to sea
- Sometimes at sea
- Not at all
11. Do you face problems at sea during fishing?
- Yes
- No
12. If yes, what are some of the problems you face at sea?
- Engine breakdown
- Fuel shortage
- All ice melting before returning period
- Taken ill
- Food shortage

Canoe leakage
 Other(s)(specify)

13. How do you call the attention of others about your problem?

Use mobile phones to contact others
 Sail to other fishermen to inform them at sea
 Wave a white shirt or flag
 Shout for help from nearby canoe
 Does not communicate the problem to anyone
 Other(s) (specify).....

14. If your answer in question (7) is mobile phone, what do you do in parts of the sea without network coverage?

Move to areas where there is network coverage
 Sail to other fishermen to inform them
 Wave a white shirt/flag
 Other(s) (specify).....

Fish Trading

Has mobile phone changed the procedure of selling fish at landing/marketing sites?

Yes
 No

If yes, how has that changed?.....

If no, why?.....

Do customers (market women) contact you on the mobile phone to found out catch?

Yes
 No

Do you arrange to sell fish to customers through the mobile phone while at sea?

Yes
 No

If no, why?.....

Do you contact customers on mobile phone to sell your catch?

Yes
 No

OBJECTIVE 2. Determine the extent to which mobile phone use facilitates the flow of information among fishermen and traders.

1. During the last [month? Week?] how many times did you communicate with customer(s)?

Face-to-face
 By Mobile phone

2. Do you have a record of the customers' mobile phone number(s)?

Yes
 No

3. How well do you know the customer(s)?

- Not well
 Somewhat
 Very well
4. Is the relationship strictly business?
 Yes
 No
5. Where does your most important customer /buyer live?
 In neighborhood
 Some part of city
 Elsewhere
6. How would you say mobile phone use has facilitated the flow of information in your fishing business? (Tick as many as apply)
 It makes me stay in touch with my customers
 It makes me stay in touch with my suppliers
 It gives me access to new customers
7. Which of the following mobile phone numbers are on your mobile phone?(tick as many as apply)
 Input suppliers e.g. ice block providers, premix seller
 Buyers e.g. retailers, wholesalers.
 Canoe owners
 Local fishing union executives
8. How often do you communicate on your phone with the following groups?(read and apply the appropriate code in the appropriate box)
 Code: 1=very regularly, 2=regularly, 3=no opinion, 4=not regularly, 5=not very regularly
 Input suppliers
 Buyers (retailers, wholesalers, consumers)
 Canoe owners
 Local fishing union executives
9. Mobile phone use has improved the level of information flow in your fishing business?
10. What proportional percentage has mobile phone use improved the level of information flow in your fishing business?
- | | Strongly disagree | Disagree | Neutral | Agree | Strongly disagree |
|-------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Input suppliers | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| Buyers (e.g. retailers) | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| Canoe owners | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
| Local union executives | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |

OBJECTIVE 3: To assess the level of satisfaction of mobile phone services to fishermen

- 1 Which mobile service do you use in your fishing business?
- | | |
|----------|--------------------------|
| Kasapa | <input type="checkbox"/> |
| MTN | <input type="checkbox"/> |
| Glo | <input type="checkbox"/> |
| Zain | <input type="checkbox"/> |
| ONEtouch | <input type="checkbox"/> |
| Tigo | <input type="checkbox"/> |
- 2 How satisfied are you with the mobile phone suppliers on the following attributes?
Not at all satisfied Not very Satisfied Fairly Satisfied Satisfied
- | | |
|--|--------------------------|
| Overall mobile phone service | <input type="checkbox"/> |
| Value for money for overall package | <input type="checkbox"/> |
| Overall cost of calls from your mobiles | <input type="checkbox"/> |
| Amount it costs for others to call your mobile | <input type="checkbox"/> |
| Dropped calls i.e. cut off in middle o call | <input type="checkbox"/> |
| Congestion i.e. ability to assess network | <input type="checkbox"/> |
| The cost of calling other mobile networks | <input type="checkbox"/> |
| The quality of customer service and support | <input type="checkbox"/> |
- 3 The level of call service changes for using your mobile phone?
- | | |
|----------------------|--------------------------|
| Very satisfied | <input type="checkbox"/> |
| Fairly satisfied | <input type="checkbox"/> |
| Not very satisfied | <input type="checkbox"/> |
| Not at all satisfied | <input type="checkbox"/> |
- 4 How often if at all, do you use mobile phone for;
- | | Business purposes? | Social/personal purposes? |
|------------|--------------------------|---------------------------|
| Frequently | <input type="checkbox"/> | <input type="checkbox"/> |
| Sometimes | <input type="checkbox"/> | <input type="checkbox"/> |
| Rarely | <input type="checkbox"/> | <input type="checkbox"/> |
| Never | <input type="checkbox"/> | <input type="checkbox"/> |
- 5 Do you encourage other fishermen to use mobile phone during fishing?
- | | |
|-----|--------------------------|
| Yes | <input type="checkbox"/> |
| No | <input type="checkbox"/> |
- 6 If yes, what is the level of encouragement?
- | | |
|--------------------|--------------------------|
| Strongly encourage | <input type="checkbox"/> |
| Slightly encourage | <input type="checkbox"/> |
- 7 Which of the following do you use to pay for your mobile phone service?
- | | |
|---|--------------------------|
| Pre-paid (i.e. after paying one off fee for the phone, top up is bought as and when required) | <input type="checkbox"/> |
| Monthly subscription contact (line rental and call charges are paid each month) | <input type="checkbox"/> |

All in package (i.e. line rental paid in advance and calls either billed monthly or paid by vouchers)

- 8 How much do you spend on your mobile phone per month?
- Below GHc10
- Ghc10-GHc15
- GHc16-GHc20
- GHc21-GHc25
- Above GHc25
- 9 Which of the following services do you want your mobile service providers to provide the fishermen?
- To provide coverage to all offshore waters
- Develop some specific fisheries-related applications e.g. market pricing, security and other alerts, location management
- Develop insurance and banking applications e.g. money transfer
- Other(s).....

OBJECTIVE 4: To determine the extent to which mobile phone use reduces price variation of fish along the landing sites in Winneba and beyond.

- 1 Before you started to use mobile phone in your canoe, how many landing/marketing sites did you visit in a month to sell your catch?
- One
- Two
- Three
- Four
- Five or more
- 2 If the answer in question (1) is two or more, name the landing or marketing sites and their locations.
- 3 Since the year you started to use mobile phone in your canoe, on the average a month, how many landing sites do you visit?
- One
- Two
- Three
- Four
- Five or more
- 4 If the answer in question (3) is two or more, name the landing sites and their location.
- 5 What informs you to go to the other landing or marketing sites apart from your local landing or marketing sites?(tick one box)
- Best prices at these landing /marketing sites
- More customers at these landing/marketing sites
- Wife/wives are at these landing/marketing sites
- Financiers are at these landing/marketing sites
- To get new customers at these landing sites
- Other(s)(specify).....

6 The landing/marketing sites you visited, were there different prices among them?
 Yes
 No

7 If no, why.....

OBJECTIVE 5: Assess the extent to which mobile phone use improves income and wellbeing and reduces vulnerability of fishermen in Winneba and beyond.

1 Indicate the extent to which mobile phone use has influenced each of the following benefits for you over the last two (2) years

	<i>Not Applicable</i>	<i>No Influence</i>	<i>Small Influence</i>	<i>Medium Influence</i>	<i>Large Influence</i>
New customers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Better prices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduced costs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increased sales/income	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quicker turnover	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Help quickly in cases of emergencies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Have received information quickly about family members	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Have been able to arrange activities on preparation to go sea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Receive information on locations of shoals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Better coordination with other fishermen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Better access to family health information while at sea	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Legal requirements	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Increased awareness of legal rights eg territorial boundaries	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Improved love life	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Metrological information eg information on weather	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Information regarding premix fuel	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

- 2 What proportional impact (%) has using the mobile phone had on?
 Impact on income (earnings)
 Impact on time saved
 Impact on savings (reduced costs)

- 3 How helpful has your investment in the use of a mobile phone been regarding the following?
(Read item and place appropriate code in appropriate box and indicate reason for response if positive)
Code: 1=very helpful, 2=helpful, 3=no opinion, 4=unhelpful, 5=very unhelpful

	Very Helpful	Helpful	No Opinion	Unhelpful	Very Unhelpful
For economic Activities	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
For social communication	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
For knowledge	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

4 What proportional impact in (%) has using mobile phone had on?

	Can't tell	Net loss	No change	Small increase (6-10%)	Medium increase	Large (>10%)
Income (earnings)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Time saved	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Costs	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	Can't Tell	Net increase	No change	Small decrease (6-10%)	Medium decrease	Large decrease (> 10%)

OBJECTIVE 6: To find out some of the challenges facing fishermen in mobile phone use

2 Which of these challenges do you face as fisherman in the use of mobile phone?

(Tick as many as apply)

- Mobile phone can sometimes fall into the sea
- Mobile phone battery while at sea
- Poor network coverage
- Mobile phones are attractive to thieves
- Large amount of investment deployed into mobile phone acquisition
- Repeated recharging of the mobile phone is money consuming
- Mobile phone reduces the free capital accessible to fishermen in harsh times
- None of the above