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Role of Mobile Phones in Creating Environmental Awareness Among Fishers in the Indus Delta of Pakistan

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ABSTRACT

Mobile phones changed the patterns of communication and flow of information in human society. This study assesses their importance in creating awareness about issues related to the natural environment and climate change, where responsiveness at a community is essential. It examines particularly the role of mobile phones in creating environmental awareness among fishers in the Indus Delta region of Pakistan. Mobile usage patterns, mobile phones as a source of environmental information and the use of social media for environmental discourse among the fishing communities are analysed. The results indicate that mobile communication is ranked as the fifth major source of information about environmental problems in the Indus Delta after personal observation, television, radio and newspapers. Although mobile phones offer high potential for receiving, accessing and reporting information about environmental issues through the use of social media, they are still not widely used for such purposes in these fishing communities.

KEYWORDS:

Environment, Climate Change, Communication, Usage, Radio, Television, Newspapers, Awareness Campaign, Social Media, Sustainability

INTRODUCTION

Ecological problems and climate change related-issues have emerged as major challenges for the global society and economy during the past few decades and people in different parts of the world, including fishing communities, are facing the consequences of climate change and environmental degradation (Senpati & Gupta, 2017) and are exposed to risk (Eckstein et al., 2019). In this context, information and awareness campaigns are regarded vital to raise concerns and create behavioral change to respond to the problems related to climate change (Chakraborty & Chakravarty, 2017).

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Information and communication technology (ICT) devices are providing fundamental support to these campaigns with ICT tools fast transforming interactions around the world (Shafiq et al., 2014; Ospina & Heeks, 2011). Accordingly, ICT tools are potentially instrumental in disseminating critical information related to climate change and engaging communities for sharing of experiences to develop viable adaptation and resilience strategies (Eakin et al., 2015).

Information systems are seen as playing a mediating role in tackling climate change responses and adaptation (Hasan et al., 2017). The rapid penetration of mobile phones in both rural and urban areas all around the globe has spectacularly changed the communication patterns. Mobile phones have become the most widely available and affordable tool of ICT, thus offering unprecedented solutions to the communication gaps and barriers, especially in rural areas (Singh et al., 2016). The devices are used for supporting environmental awareness campaigns in rural areas and development of a collective and participatory response to the climate change problems in far-flung rural areas (Ospina & Heeks, 2012). They also play a role in environmental education, particularly for rural communities (Banks & Burge, 2004).

In this context, the study aimed at assessing the role of mobile phones in creating environmental awareness among the fishers in the Indus Delta region of Pakistan. The Indus Delta is the 5th largest delta in the world covering approximately an area of 41,440km^2 (16,000 square miles) and providing habitat for many migratory birds and different species of fish (WWF, 2020). It comprises 17 major creeks and meets the sea across an area of 210 km (130 miles) (Chandio et al., 2011). However, the environmental degradation of the mangroves ecosystem of the Indus Delta, sea erosion and other ecological problems are resulting in depletion of its fish resources and other traditional sources of livelihood in the region (Amjad et al., 2016; Bux Mallah, 2013).

This paper analyses the role of mobile phones in the fishing communities with the Indus Delta in relation to accessing and using information about environmental problems in the region. We first offered a brief literature review as a background for the study followed be description of its methodology and its objectives. The findings from a survey of fishers in the Indus Delta conducted in 2019 are then discussed and some recommendations offered.

BACKGROUND

According to Kim et al. (2009), information and communication technology tools are playing a highly commendable role in creating awareness about environmental problems and tackling climate change. These tools are seen as strategically important to mitigate the impacts of climate change and maintain economic growth (Mickoleit, 2010). Particularly in the context of developing countries, ICT tools are expected to be used in tackling the gamut of environmental challenges, including climate change, solid waste management, air and water pollution, degradation of ecosystems and loss of biodiversity (Houghton, 2010). Informatics systems are also playing a key role in designing holistic and comprehensive policies for education to create awareness about the negative impacts of climate change, facilitate initiatives to respond to the challenges and inculcate environment friendly social behaviours (Alexandru et al., 2013). Mobile phones in particular are becoming a powerful tool not only for communication but also to access information. The diffusion of mobile phones as a new technology in the developing world has been very high, with analysis showing that the adoption rates are not connected to the levels of income (James, 2010). This has allowed countries such as Pakistan to achieve high penetration and growth for the use of mobile phones (James, 2010). These IT tools are positively contributing to rural development in terms of decreasing information asymmetry and closing the gap in the digital divide (Sylvester, 2016). Four decades after their first introduction, mobile phones have become pervasive and indispensable all over the world (Deloitte, 2017).

The communities living in rural areas of the developing world, including coastal communities, are increasingly using mobile phones for the fulfillment of their social communication and information needs as well as related to practising particular professions (Meng et al., 2014). Furthermore, the

mobile phones are being effectively used for community education, especially for creating awareness about climate change and environmental problems across the developed and developing world (Banks & Burge, 2004; Schaal & Lude, 2015). Early warnings through mobile phone are considered useful in saving lives during environmental disasters. Different mobile phone applications are not only useful for raising the awareness level of the communities about environmental problems but they are also helpful in data collection about impacts of climate change. The data collected through these applications can provide support to policymakers and researchers to deal with climate change emergencies and in drawing conclusions (Chakraborty & Chakravarty, 2017).

On the other hand, the lack of awareness among rural communities about ecological problems and climate change-related threats to their regions is considered as a one of the major hurdles in developing resilience in dealing with the situation and ICTs have emerged as powerful means of environmental communication (Mudombi, 2014). The use of information technology for transitioning to sustainability, including resolving environmental problems, achieving green growth and building community resilience, is considered vital in current and future initiatives to counter climate change impacts in Pakistan and other developing countries (Nizam et al., 2020; Asongu et al., 2019; Majeed, 2018). Mobile phones are an essential part of the new ICT opportunities.

Although there has already been some research interest in the potential role of ICTs in helping communities to tackle climate change-related challenges in developing countries, there is very limited evidence as to how coastal communities that are at the forefront of climate change use mobile phones. Given the ecological and social importance of the Indus Delta region for Pakistan, this study analyses the use of mobile phones by fishers as well as investigates what are the major sources of environmental information for these communities.

METHODOLOGY OF THE STUDY

The research objectives of the study are as follows:

- Assess the patterns of usage of mobile phones by fishers in the Indus Delta region of Pakistan;
- Identify the main sources of information for the fishing communities in this area related to climate change and environmental problems; and
- Understand the role of social media in creating awareness about environmental problems in the Indus Delta region.

Known as the vertebra of the Pakistan's economy and ecology (Ebrahim, 2020), the Indus Delta region is administratively covered by the Province of Sindh. The mighty Indus River flows towards the Arabian Sea forming "an extensive system of swamps, mudflats, creeks, estuaries, marshes and mangroves forests" (WWF, 2020, para. 1) which offer livelihood to millions of people. In addition to Karachi – a large transport hub for Pakistan, the two districts of Thatta (population 980,000 in 2017, City Population, n.d.) and Badin (population 1.8 million in 2017, City Population, n.d.) cover most of the coastal parts of the Indus Delta region. Fishing is an important source of livelihood in these two districts (Asian Development Bank, 2012). However, in recent years fish stocks have declined due to environmental degradation (The New Humanitarian, 2013). This study was conducted in Thatta and Badin, the two districts of the Province of Sindh which cover the Indus Delta (Place and see, 2022).

A cross-sectional survey was carried out in 2019 to collect data in Thatta and Badin. A close-ended questionnaire was developed in light of the research objectives of the study. The practicability of the research instrument was tested through a pilot study. In the absence of a complete database of the fishing communities living in the deltaic region, purposive sampling (Black, 2010) was used. Two hundred fishers living in different villages of the two districts (100 from each district) were purposively selected as respondents for this study. They were visited personally in the various villages of the sampled districts and the data was collected in a face-to-face situation from the respondents

with the survey administered by the research team. The collected data was analysed with the help of SPSS statistical software.

All participants were male as there is a clear gender division in the fishing sector (FAO, 2016). Men and women engage in different and often complimentary activities with fish-catching being a predominantly male occupation. As the impacts of climate change and environmental deterioration are manifested very prominently in the amounts of fish caught, it was important to have direct information from the male fishers. Moreover, women who contribute to this livelihood through activities, such as cleaning, processing and selling the fish, rarely identify as fishers (FAO, 2016). The results from the survey are presented and discussed in the section to follow. This survey was conducted prior to COVID-19. Although the pandemic influenced Pakistan's fishing communities with countrywide lockdowns and bans on exports to China due to virus contamination of shipments (Jain, 2021), it is unclear whether the gender roles in this sector were impacted. Evidence from Bangladesh shows that men continued to use fishing as their main household livelihood while women became more vulnerable to the impacts of the pandemic because of lower engagement in income-generation activities (Sultana et al., 2021). It is reasonable to assume that no major gender shifts occurred in the Indus Delta region.

FINDINGS AND DISCUSSION

It is important to understand the demographic profile of the survey sample before examining closely the use of mobile phones and information sources related to climate change and the natural environment. The communication gap and obstacles to be overcome are also discussed.

Demographic Profile of the Surveyed Fishers

The survey sample is representative of the total population of both districts of Thatta and Badin with a confidence interval of 9.8 at the 95% confidence level. Table 1 shows the demographic profile of the sample.

As already explained, all respondents to the survey were male fishers. They were contacted mainly at fish catching sites in the deltaic villages. Although there are women engaged in fisheries in Pakistan, according to previous research none of them is part of the direct harvesting activities (Shah, 2012). The majority of women form part of the post-harvesting operations, including peeling, cleaning and packing as well as making and repairing fishing nets. This gender division of labour was confirmed in our survey with all fishers found at the catching sites being male. All respondents belonged to native Sindhi speaking community in which members from our research team were fluent. The majority of the respondents, namely 85%, stated their marital status as married. Most of them, namely 70% were in the age group of up to 40 years with 20% belonging to the over 50 years age group and the remaining 10% being between 41 and 50 years of age. The overall educational level of the surveyed fishers was low with only 2% having completed a college or university degree, 69% being uneducated and 29% who have graduated from primary or high school.

Mobile Usage Patterns

Against this background, the use of mobile phones was quite revealing (see Table 2). The penetration of mobile phones among the fishing community of the Indus Delta is highly visible. There was not a single respondent who did not have a mobile phone. Moreover, they all owned their mobile phones. was not using a as the data in Table one mentions that all the respondents of this study were not only using mobile phone but they were having their own cell phone. However, the share of smart phones was very low at 4% while the remaining 96% were using simpler feature phones which are relatively cheaper and in addition to voice calling and messaging have a fixed set of functions that may include web browsing but do not allow the use of apps.

In relation to monthly mobile expenses (see Table 2), half of the respondents were spending up to 500 PK rupees for their mobile phone use whereas 29.5% were spending up to 1000 PK rupees.

Table 1. Demographic profile of the survey sample

Demographic Variables	Number	Percentage (%)
Gender		
Male	200	100.0
Female	0	0.0
Mother tongue		
Sindhi	200	100.0
Other	0	0.0
Marital status		
Married	173	86.5
Unmarried	27	13.5
Educational status		
Uneducated	137	68.5
Primary to High School	59	29.5
College & University	4	2.0
Age		
Up to 40 years	139	69.5
41 – 50 years	22	11.0
Above 50 years	39	19.5
District		
Badin	100	(50.0)
Thatta	100	(50.0)

Source: Primary data

Moreover, one fifth of the respondents belonged to the high spending category as they were found to be spending more than 1000 PK rupees for charges of their mobile phone use.

Sources of Information about Deltaic Environmental Degradation

One of the main issues explored in the study is the role of mobile phones in creating socio-environmental awareness among the fishing communities of the Indus Delta. We asked the respondents about the use of a different range of information sources (see Table 3). This allowed us to assess how important ICTs currently are as well as understand the use of other sources. The responses indicated that a great majority of the fishers, namely 80%, use personal observation as a source of environmental information about the Indus Delta which also indicates that the deterioration of its ecological state is visible and observable by the people who rely on it for their livelihoods. Personal observation was also the most commonly used source of information about the ecological condition of the Indus Delta.

Television was the second most commonly used source with 70% of the respondents answering affirmatively about drawing information about environmental problems this way (see Table 3). This is followed by radio as a third significant source of environmental information for 66% of the fishers. The use of newspapers and mobile phones were fourth and fifth with 42% and 41%, respectively which indicates that less than half of the fishers rely on such sources. Even less important were awareness campaigns by NGOs (25% of fishers use them) and the government (used by 19% of the participants).

Table 2. Use of mobile phones

Mobile usage variables	Number	Percentage (%)
Using a mobile phone		
Yes	200	100.0
No	0	0.0
Owning a mobile phone		
Yes	200	100.0
No	0	0.0
Mobile phone type		
Feature	192	96.0
Smart	8	4.0
Monthly mobile phone expenses		
Up to 500 Rs.	100	50.0
600 to 1000 Rs.	59	29.5
Above 1000 Rs.	41	20.5

Source: Primary data

Local opinion leaders were the least popular source of information about the environmental state of the Delta with only 18% of the fishers counting on them.

The fact that mobile phones are not a very popular source of information can be explained to a certain degree because of the fishers using basic feature types which allow to make and receive calls and messages (short-message service or SMS) but have limited web browsing and no specific apps. On the other hand, this also indicates that if the authorities or NGOs want to proactively disseminate information about the ecological condition of the Indus Delta, including environmental disasters or emergencies, they should only rely on messaging rather than on any specifically designed apps or websites.

We further investigated the correlation between the use of different information sources and age of the respondents to see whether there were any generational differences (see Table 4). It became

Table 3. Sources of information about environmental degradation in the Indus Delta

Source of information used	Yes (%)	No (%)
1. Radio	132 (66.0)	68 (34.0)
2. Television	139 (69.5)	61 (30.5)
3. Newspapers	83 (41.5)	117 (58.5)
4. Mobile phones	82 (41.0)	118 (59.0)
5. NGOs awareness campaigns	50 (25.0)	150 (75.0)
6. Governmental awareness campaigns	38 (19.0)	162 (81.0)
7. Local opinion leaders	35 (17.5)	165 (82.5)
8. Personal observation	160 (80.0)	40 (20.0)

Source: Primary data

Table 4. Survey respondents by information source and age

	Age categories		
Information source	**Up to 40 years**	**Above 40 years**	**Total**
Radio *			
Yes	83 (59.7)	49 (80.3)	132 (66.0)
No	56 (40.3)	12 (19.7)	68 (34.0)
Total	139 (100)	61 (100)	200 (100)
Television			
Yes	91 (65.5)	48 (78.7)	139 (69.5)
No	48 (34.5)	13 (21.3)	61 (30.5)
Total	139 (100)	61 (100)	200 (100)
Newspapers**			
Yes	67 (48.2)	16 (26.2)	83 (41.5)
No	72 (51.8)	45 (73.8)	117 (58.5)
Total	139 (100)	61 (100)	200 (100)
Mobile phone†**			
Yes	66 (47.5)	16 (26.2)	82 (41.0)
No	73 (52.5)	45 (73.8)	118 (59.0)
Total	139 (100)	61 (100)	200 (100)
NGOs awareness campaigns			
Yes	40 (28.8)	10 (16.4)	50 (25.0)
No	99 (71.2)	51 (83.6)	150 (75.0)
Total	139 (100)	61 (100)	200 (100)
Government awareness campaigns			
Yes	28 (20.1)	10 (16.4)	38 (19.0)
No	111 (79.9)	51 (83.6)	162 (81.0)
Total	139 (100)	61 (100)	200 (100)
Local opinion leaders††			
Yes	29 (20.9)	6 (9.8)	35 (17.5)
No	110 (79.1)	55 (90.2)	165 (82.5)
Total	139 (100)	61 (100)	200 (100)
Personal observation§			
Yes	104 (74.8)	56 (91.8)	160 (80.0)
No	35 (25.2)	5 (8.2)	40 (20.0)
Total	139 (100)	61 (100)	200 (100)

*χ^2 = 8.02, *p*.00, df = 1· **χ^2 = 8.43, *p*.00, df = 1; †χ^2 = 7.91, *p*.00, df = 2; ††χ^2 = 3.57, *p*.05, df = 1; §χ^2 = 7.64, *p*0.01, df = 1
Source: Primary data

clear that age impacted on the way fishers receive information about the environmental condition of the Indus Delta.

In the regard to those using personal observation – the most commonly used source, the proportion of those who were above 40 years old (92%) was higher than of those who were younger (75%). Similarly, the share of fishers who did not receive deltaic environmental information by personal observation was higher among those who were up to 40 years old (25%) than those who were older (8%). This was not unexpected as you need to be able to make comparisons between the past and the present and some environmental trends take longer to manifest.

There was also a generational difference in relation to the use of television as a source of information with the proportion of those who were above 40 years old (79%) being higher to those who were younger (66%). Again, among the fishers who did not receive deltaic environmental information by television the proportion of those who were up to 40 years old (34%) was bigger than those who were younger (21%).

Similar trends were observed in relation to radio. Among the fishers who received deltaic information by radio, the share of those above 40 years old (80%) was greater than those who were younger (60%) whereas among those who did not use this source, the proportion of people who were up to 40 years old (40%) was bigger than those who were older (20%).

Newspapers was the fourth most popular source of information. Interestingly, it appealed more to the younger fishers. Among those who received deltaic environmental information from the newspapers, the proportion of those who were up to 40 years old (48%) was greater than that for those who were older (26%). Similarly, among the fishers who did not receive deltaic environmental information from newspapers, the share of those who were above 40 years old (74%) was higher than those who were younger (52%). These patterns were similar in relation to the use of mobile phones. Among the fishers who received deltaic environmental information using their mobile phones, the proportion of those who were up to 40 years old (48%) was greater than those who were older (26%) and among those who did not use this source, the share of those who were above 40 years old (74%) was higher than those who were younger (52%).

Public awareness campaigns can play a significant part in creating environmental attitudes and to promoting and reinforcing positive changes (Borawska, 2017). In our study however neither campaigns organised by non-government organisations (NGOs) nor the government were seen as important sources of environmental information about the Indus Delta. It was however interesting to observe that younger people responded better to this source by comparison to older fishers. Among fishers who received deltaic environmental information through NGOs awareness campaigns, the proportion of those who were up to 40 years of age (29%) was bigger than those who were older (16%). Again, among fishers who did not receive deltaic environmental information through NGOs awareness campaigns, the proportion of those who were above 40 years old (84%) was greater than the those who were younger (71%). The same trend is manifested in relation to government awareness campaigns. Among the fishers who used this source, the share of younger people up to 40 years old (20%) was higher than that who were older (16%). Similarly, among those who do not use this source, the share of fishers above 40 years old (84%) was higher than those who were younger (80%).

Local opinion leaders are the least used source of information by the fishers. The opinion leaders have more influence among younger fishers with the share of those who use this source (21%) belonging to the group up to 40 years old compared to the smaller proportion of those who are older (10%). Again, among those fishers who did not receive deltaic environmental information from local opinion leaders, the proportion of those who were above 40 years old (90%) was bigger than the share of those who were younger (79%).

Table 5 reports the data about information sources and education in relation to receiving information about enviro-social issues of the Indus Delta. Firstly, it shows that the educated respondents were keener to receive environmental information on radio in contrast to the uneducated respondents. The same pattern was also found in the case of receiving information through television and personal observation. Understandably, newspapers were a source of information only for those who had some education. Secondly, although representing a much smaller share of the sample, fishers with college

Table 5. Surveyed respondents by information sources and education

Information Source	**Education Status**			
Radio	Uneducated (%)	Primary to High School (%)	College & University (%)	Total (%)
Yes	88 (64.2)	40 (67.8)	4 (100)	132 (66%)
No	49 (35.8)	19 (32.2)	0 (0.0)	68 (34%)
Total	**137 (100)**	**59 (100)**	**4 (100)**	**200 (100**
Television				
Yes	91 (66.4)	44 (74.6)	4 (100)	139 (69.5)
No	46 (33.6)	15 (25.4)	0 (0.0)	61 (30.5)
Total	**137 (100)**	**59 (100)**	**4 (100)**	**200 (100)**
Newspaper *				
Yes	0 (0)	37 (62.7)	4 (100)	41 (20.5)
No	137 (100)	22 (37.7)	0 (0.0)	159 (79.5)
Total	**137 (100)**	**59 (100)**	**4 (100)**	**200 (100)**
Mobile				
Yes	57 (41.6)	23 (39.0)	2 (50.0)	82 (41.0)
No	80 (58.4)	36 (61.0)	2 (50.0)	118 (59.0)
Total	**137 (100)**	**59 (100)**	**4 (100)**	**200 (100)**
Personal Observation				
Yes	105 (76.6)	51 (86.4)	4 (100)	160 (80.0)
No	32 (23.4)	8 (13.6)	0 (0.0)	40 (20.0)
Total	**137 (100)**	**59 (100)**	**4 (100)**	**200 (100)**

*χ^2 = 32.20, p.00, df = 2

or university degree were very much interested in receiving information about environmental issues through almost all possible channels, including radio, television, newspapers and personal observation. Overall, it appears that education plays a positive role in fishers' interest regarding environmental information with the exception of using mobile phones where the share of users was higher for uneducated than educated people. Notwithstanding this, less than half of the uneducated fishers (namely 42%) used their mobiles for this purpose.

Use of Social Media for Information about Environmental Degradation

Social media are playing a major role in creating environmental awareness and are widely used by different generations across the globe (Severo et al., 2019). The situation in the Indus Delta in Pakistan is very different. According to the survey data (see table 6), receiving information about environmental or social issues through the social media is very unusual among the fishing communities as only 4% (or 8 people) out of the total of 200 respondents having smart phones. The data related to the use of social media among the respondents having smart phones indicate that all such fishers do receive environmental-social information about from this source on a regular or occasional basis. When the frequency of such information received by these fishers is analysed, 6 out of the 8 respondents with smart phones do this on a regular basis while the remaining 2 do this only occasionally. Only 5 of the 8 respondents with smart phones use their mobiles to receive social media posts – 2 regularly and 3

occasionally. Another 5 respondents use their smart phones to receive social media videos about the Indus Delta – 4 regularly and 1 occasionally. In total, 3 out of 8 smart phone users stated that they never receive social media posts nor videos about the Delta on their mobiles. None of the 8 smart phone users read online articles about the Indus Delta on their mobiles. The overall social media activity of the fishers is similarly low with only 5 of the smart phone users stating that they share social media content – 2 on a regular basis and 3 occasionally, and 3 do not do this at all.

In response to the question related to information about the river flow downstream Kotri, the majority of the respondents in the overall sample, namely 76% (see Table 5) stated that they never received any such material on their mobile phone, including through messaging. Only 18% of the respondents acknowledged receiving regularly such information on the mobile phone, while 11% stated that they do this occasionally.

Communication Gap and Hurdles in the Use of Mobile Phones

The purpose of this section is to assess what gaps and hurdles exist in the usage of mobile phone by the fishers in the Indus Delta. A total of six possible reasons which can impede successful communication were listed in the survey questionnaire (see Table 7) which were on the assumption that the fishers were technically familiar with their mobile phones. The reasons from network coverage to battery recharging and mobile phone repairs to ease of communication with contacts and authorities. Only a small percentage from the survey respondents (namely 4%) reported problems with network coverage

Table 6. Use of social media for information about environmental degradation

Item	Always (%)	Sometimes (%)	No (%)	NA (%)
1. I receive Deltaic information on social media	6 (3.0)	2 (1.0)	0.0	192 (96.0)
2. I receive social media posts on my mobile phone	2 (1.0)	3 (1.5)	3 (1.5)	192 (96.0)
3. I receive videos about the Deltaic environment on social media	4 (2.0)	1 (0.5)	3 (1.5)	192 (96.0)
4. I read online articles about the Deltaic environment on my mobile phone	0 (0.0)	0 (0.0)	8 (0.0)	192 (96.0)
5. I share content related to Deltaic issues on social media through my mobile phone	2 (1.0)	3 (1.5)	3 (1.5)	192 (96.0)
6. I receive information about river flow on my mobile phone	36 (18.0)	11 (5.5)	153 (76.5)	0 (0.0)

Source: Primary data; note: NA– not applicable

Table 7. Communication gaps and hurdles in the use of mobile phones

Item	Always (%)	Sometimes (%)	No (%)
I receive clear mobile signals in my area	117 (58.5)	74 (37.0)	9 (4.5)
I face battery problems while working in the field	73 (36.5)	102 (51.0)	25 (12.5)
I face problems in recharging my batteries	75 (37.5)	105 (52.5)	20 (10.0)
I face difficulties due to lack of contacts	68 (34.0)	91 (45.5)	41 (20.5)
I face difficulties to have my mobile phone repaired if required	76 (38.0)	78 (39.0)	46 (23.0)
I feel hesitant to contact the authorities for advice or information on a mobile phone	81 (40.5)	27 (13.5)	92 (46.0)

Source: Primary data

in their area. The majority, namely 58%, were always satisfied with the clarity of the signal and 37% had problems occasionally. This shows that the overall quality of the mobile phone services in the area is acceptable.

According to the survey results, the biggest hurdle was related to contacting the authorities for advice or information on the mobile phone with 40% of the fishers feeling hesitant to do so. The second highest hurdle (38%) for the fishers was getting their mobile phone repaired when needed. This was followed by problems related to recharging the battery of the mobile phones (38%) and battery problems when working in the field (36%). The fishers also faced difficulties due to lack of contacts – 34% all the time and 46% occasionally.

Overall, the fishers seem to be facing some problems related to maintaining and recharging their mobile phones. Hence, their level of ICT use can be improved but the price of smart phones will remain a significant barrier to accessing the latest technologies. Finding ways of overcoming these barriers is important, particularly given the gradual deterioration of the Indus Delta that the fishers can record with direct observation.

CONCLUSION AND RECOMENDATIONS

The problem of climate change is expected to adversely affect the economies and traditional sources of livelihood in developing countries, including Pakistan. This country is already experiencing floods, droughts, water stress, degradation of ecosystems, and biodiversity loss due to climate change (Hussain et al., 2020). Pakistan's coastal areas and its fishing communities are considered highly vulnerable to the impacts of climate change. In this context, the Indus Delta region is facing serious environmental problems and the government of Pakistan has initiated several projects to protect the coastal communities from the negative impacts of climate change (Salik et al., 2015).

These measures include the project of mangroves rehabilitation under the Green Pakistan Initiative of the country's Prime Minister. The Indus Delta is the seventh mangroves area in the world (WWF, 2020) and its ecological importance goes beyond that for the country. Also, the Pakistan Navy has launched a campaign to plant 3 million mangrove plants in the coastal areas of the provinces of Sindh and Baluchistan to enhance the mangrove-covered area and protect the precious deltaic ecosystem (IUCN, 2018; Clean Green Pakistan, 2020). Awareness about environmental problems allows communities to take suitable measures to counter the harmful impact of climate change and create resilience among them (Abbasi & Nawaz, 2020). Government and environmental activists in Pakistan have been working on several initiatives to create awareness within society to understand the impacts of climate change and prepare for adaptation in a suitable manner. Within this context, there is a contribution that technology can make and this study explored the current and potential role of mobile phones in creating awareness among the fishers of the Indus Delta about the environmental problems of the region.

The findings of this study suggest that for the great majority of the fishers, their main source of information about the environmental problems of the region was their personal observation. Older fishers relied more on this source of information than their younger counterparts. Television and radio emerged as the second and third major source of information about the environmental issues for the fishing communities of the Indus Delta, however there was a clear generational difference with the older fishers relying more on these two ways of obtaining updates. Newspapers emerged as the fourth and mobile phones as the fifth major source of information about ecological problems in the Indus Delta, but the generational differences were in reverse with younger fishers relying more on these ways of receiving updates.

Overall, 41% of the respondents stated the use of mobile phones as a source of information about environmental problems of the Indus Delta besides other sources. Therefore, it is deduced from the results of the study that the mobile phone is not one of the three major ways of receiving updates about the environmental problems in the Indus Delta but has started to emerge as one of the top five

sources of information stated by a sizeable proportion of the respondents. An overwhelming majority of the fishers, namely 96%, use feature mobiles which limits their ability to access the full gamut of social media, apps, websites and other ICT applications. The higher interest in mobile phones by the younger generation of fishers indicates that this will potentially emerge as one of the main sources of environmental information and awareness for the region's fishing communities in the future. It can also potentially contribute towards better engagement with the enviro-social issues and solidarity between the fishers (Akel & Mohammad, 2019).

The study indicated that on average the aged fishers rely more on traditional mediums, namely television and radio, while younger fishers were more interested in newspapers for information about environmental problems of the Indus Delta. A possible explanation is the higher literacy rates among the young generation of the fishers.

Similarly, younger fishers were more receptive to deltaic environmental information generated through NGOs and government awareness campaigns than those who were older in age. It is understandable that younger people are more concerned about the future (Gatt, 2016). This indicates a higher level of engagement by the younger generation while older people relied more on their personal observation and experience. Finally, it was also deduced that on average the older fishers received deltaic environmental information more by personal observation than their younger counterparts. Such trends seem logical with the younger fishers are more oriented towards the latest sources of information about environmental affairs.

Social media played a very minor role in providing information for the fishing communities in the Indus Delta. The main reason is that only 8 people (4%) from the survey sample of 200 fishers had smart phones. As people who have smart phones use them to receive information about the Indus Delta, with the growth of adoption of such phones among the fishing communities, the importance of this source of information in creating environmental awareness will also increase. The study also indicated that the majority of fishers (76%) never received any information about the river flow towards downstream Kotri. This is another potential opportunity to improve the communication with the Indus Delta fishers.

The highest barrier in the use of mobile phone by the fishers of the Indus Delta was for seeking information by contacting any concerned authorities. This is partially due to these authorities having an authoritarian way of providing information that disempowers the public (Transparency International, 2018). People felt hesitant in doing this which again highlights another opportunity to improve communication. Steps can be taken to improve the fishers' access to officials and on their part, officials could be trained to talk with the fishers in a friendly and competent manner keeping in view the cultural sensitivities of the fishing communities. For example, environmental activists and officials from the concerned departments can organise awareness campaigns for the fishers to effectively use their mobile phones in relation to environmental issues in the Indus Delta.

Technical problems related to phone repair and battery maintenance were also highlighted. This can be resolved by offering support and investing in these communities to close the technological gap. Access to smart phones can significantly improve the level of communication. Even without upgrading the currently used mobile phones, the Pakistan Meteorological Department could initiate alerts to inform fishers about probable changing weather conditions onshore or offshore. Similarly, disaster management authorities can also develop mechanisms for more effective communication with the fishers through mobile phones during a pre-disaster, disaster and post-disaster situation through appropriate alerts. Cyclone warnings and sea storm mobile applications may also be launched by the provincial and national disaster management authorities to provide real-time information to the fishing communities.

As the study indicates, all fishing communities in the Indus Delta have mobile phones which have become a standard way of communication. There is however a lot of potential to extend the use of these mobile phones to better serve the fishers and their families who are at the forefront of many climatic and environmental changes that impact on their livelihoods.

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