Original Article

Fisheries-based Determinants of Fisherfolks' and their Influence on Access to Impact-based Weather Forecasting in Suba-North sub-County, Homabay County, Kenya

Owuor' John Ochieng[1], Michael Omondi Owiso[1], Dominic Kniventon[2] & Barack Omondi Calvince[1]*

[1] Maseno University, P. O. Box 333-40100 Maseno, Kenya.
[2] University of Sussex, Falmer, Brighton BN1 9RH, UK.
[*] Author for Correspondence ORCID ID: https://orcid.org/0000-0001-9940-0394; Email: joochieng@maseno.ac.ke

ABSTRACT

Lake Victoria, the world's largest freshwater fishery, supports the livelihoods of 4 to 5.6 million economically vulnerable people, with many living on less than $1.25 a day. However, the Lake also witnesses a staggering annual drowning toll of 1,500 to 5,000 fatalities, with two-thirds attributed to storms. Recognising the need for an effective advisory and warning system known as impact-based forecasting (IBF), the HIGHWAY-WISER Project commenced in 2017, focusing on 10 East African beaches, including those in Kenya. Despite its significance, this donor-funded initiative remains relatively unknown and under-researched. This study investigates how fisheries-based factors affect access to IBF in the Lake Victoria region. Data collection involves two key stakeholder groups: policymakers and implementers from the Kenya Meteorological Department (KMD) and the fisherfolk community, segmented across six beaches. A combination of proportional stratified and simple random sampling yields a sample size of 422 fisherfolk who complete semi-closed questionnaires. Additionally, 30 policymakers and beach management unit (BMU) members are purposively selected as key informants and interviewed. The study reveals that fisheries-based determinants significantly influence IBF access among fisherfolk. These determinants encompass BMU politics and leadership, social networks, the adoption of flags and noticeboards, exposure to storms, boat size, energy sources for propulsion, fisherfolk experience, and timing of fishing activities. To enhance awareness and accessibility, the study recommends greater involvement of community-based organisations and increased training on IBF for fisheries decision-making contexts. This research underscores the importance of further exploration into fisheries-based factors as pivotal determinants of IBF access. It illuminates how these understudied variables factor into the decision-making processes of fisherfolk regarding whether to embark on fishing expeditions, irrespective of the presence or absence of IBF at their respective beaches. Such insights can inform more effective strategies for improving IBF access within this vital socioeconomic context.

INTRODUCTION

Lake Victoria sustains the most significant freshwater fishery globally, yielding an impressive 1 million tons of fish annually and providing employment opportunities for a staggering 200,000 individuals who contribute to supporting the livelihoods of an extensive population of at least 4 million people (African Great Lakes Information Platform, 2023). The population within the basin is experiencing rapid growth, expanding at a substantial annual rate of 3.5 per cent, which places it among the highest population growth rates globally. Unfortunately, except for Kenya, the countries situated within the basin are plagued by extreme poverty, with the majority of their populace surviving on meagre incomes of less than $1.25 per day, indicating their low socioeconomic status and challenging living conditions, but also the critical value of the Lake Victoria resource to livelihoods of a majority poor population depending directly on it (*Ibid*).

However, the capacity of the Lake to continue to support such a huge livelihood is under threat, most especially due to extreme weather events resulting from climate change. Lake Victoria is notorious for being one of the most perilous water bodies globally, primarily due to the hazardous weather conditions that frequently occur over the Lake. While earlier studies approximated a significant number of annual drowning fatalities, ranging from 3,000 to 5,000, and the accuracy of these figures remains questionable due to limited recorded data, the truth is that extreme weather events are an existing threat to the lives, livelihoods, and property of the over 5.6 million dependents on the Lake (Roberts et al., 2022). Though there is evidence that the numbers have been declining over time as more recent research conducted by Watkiss et al. (2020) confirms that though a lower estimated annual death toll of approximately 1,500 is estimated, a huge chunk of this, about two-thirds are linked to adverse weather conditions (1,000 deaths). According to surveys carried out among the Lake's inhabitants, it is evident that the majority of these tragic drownings affect fishermen and small-boat travellers. Key factors contributing to boat capsizing incidents involve stormy weather, lightning, strong winds, waves, and boat overloading, as documented by Tushemereirwe et al. (2017) and corroborated by others (Kobusingyea et al., 2017; Whitworth et al., 2019).

Following these two sets of stories about the Lake - of benefits and threats –a striking concern for development researchers is how the dangers emanating from extreme weather events can be sustainably mitigated to not only save lives but also lay measures for sustainable enhancement and protection of livelihoods of the over 5.6 million Lake Victoria dependants. Very recent research (Roberts et al., 2022) worries that despite the significant loss of life caused by severe weather events, Lake Victoria Basin (LVB) has not yet implemented an effective advisory and warning system to protect the population that heavily relies on the Lake for their livelihoods. It was upon the recognition of this critical gap, argues the scholars, that the World Meteorological Organization (WMO) initiated a 3.5-year project known as the High Impact Weather Lake System (HIGHWAY). This ran from September 2017 to March 2021 (*Ibid*). The primary objective of this project was to enhance resilience and mitigate the loss of life and property damage in East Africa (EA) by promoting the increased utilisation of impact-based weather information – information that shows weather information consumers the magnitude of the dangers and impeding weather event would have to enable them to make rational decisions as to whether they go to the Lake or postpone.

This vital initiative was made possible through funding from the U.K. Foreign, Commonwealth and Development Office (FCDO) under the Weather and Climate Information Services for Africa (WISER) program. Throughout the course of the project, four significant activities were undertaken to establish a pilot regional Early Warning System (EWS) specifically designed for Lake Victoria Basin, expanding upon previous efforts in the region. The focus of this comprehensive endeavour was to develop a robust advisory and warning system that could effectively disseminate critical weather information to the population dependent on Lake Victoria for their livelihoods. The ultimate aim was to improve the region's preparedness and response to high-impact weather events, thereby reducing the devastating consequences such

events can inflict on human lives and property. By integrating weather information into decision-making processes, the project sought to enhance the capacity of the communities around Lake Victoria to cope with adverse weather conditions and safeguard their well-being and economic stability. In Kenya, 10 beaches were lucky to be selected for the pilot, namely Luanda Nyamasare, Koguna, Tabla, Kisui, Remba Island, Ringiti Island, Nyandiwa, Nyagina, Koguna, and Kiumba.

It is against this backdrop that this study was undertaken. Following the fact that no studies have neither evaluated the impact nor the influence of the IBF on access, the study asked the question: Has the project improved access to IBF among fisherfolk? The study therefore, aimed to examine the extent to which the project had increased uptake of impact-based forecasting (IBF) among fisherfolk. Specifically, it examined the basic (through cross-tabulation) relationship between fisheries-based factors such as fishing experience, size of the boat, type of fishing, energy used for boat propelling (fishing context factors) and time of fishing and access to IBF.

MATERIALS AND METHODS

The Study Design

This study employed a case study design to examine the influence of fisheries-based factors on access to impact-based weather forecasting in the Suba North sub-county in Homa Bay County, Kenya. Both quantitative and qualitative data collection and analysis techniques were employed.

Area of Study

This study was conducted between December 2022 and April 2023 in Suba-North Sub-County, Homa Bay County. Homa Bay County is located in South Western Kenya along Lake Victoria, where it borders Kisumu and Siaya counties to the North, Kisii and Nyamira counties to the East, Migori County to the South, and Lake Victoria and the Republic of Uganda to the West. Homa Bay County lies between latitudes $0°15$ South and

0° 52 South and between longitudes 34° East and 35° East and covers an area of 4267.1 km square inclusive of water surface which covers an area of 1,227 km square (HBCIDP, 2014).

Fishing remains a predominant economic activity in the county, with at least 200,000 directly involved and between 4 million and 5.6 million depending on it for their livelihoods (African Great Lakes Information Platform, 2023; Roberts, 2022). The main types of fish harvested include Nile perch, tilapia, and Silver Cyprinid (Omena). According to the 2010 framework survey, the county had a catch of 12,000 tonnes valued at Kshs 9 billion. The county has 151 landing beaches managed by 133 beach management units (BMUs), the majority (61) of which are in Suba North. In the year 2012, 76,710 tons of fish were harvested worth Kshs 7 billion. Of these, Nile perch contributed Kshs. 5 billion, and clarias contributed 1.7 billion. The reasons for choosing the Suba-North sub-county were that the Kenya Meteorological Department and HIGHWAY Project have been piloting impact-based weather forecasting or marine impact-based weather forecasting in Suba North Sub-county, Homa Bay County only among fishing communities since 2017.

Sampling Techniques and Data Collection Methods

The study used a semi-closed questionnaire, participants of which were recruited through simple random, stratified, and proportionate sampling techniques. A simple random sampling technique was used to sample six beaches out of 10 beaches where IBF was piloted, leading to the selection of Remba Island, Ringiti Island, Kiumba in Rusinga Island, Lwanda-Nyamasare, Tabla, and Koguna from the mainland. The sampled beaches have a total population of 5,760 (Lake Victoria Organization Regional Frame Survey Report RFSR, 2015), out of which 422 were sampled based on Fisher et al. (1991) formula for selecting a sample from a finite population. A stratified sampling technique was then used to choose individual fisherfolk based on how intensive they engage in fishing; thus, boat owners, crew members, transporters, fishmongers, and auxiliary service providers formed the strata. Proportionate sampling was then applied to select elements within each stratum; thus, 40 percent were crewmen because they form the majority of fisherfolk, 20% were boat owners, 24% were fishmongers, 8% were transporters, and 8% were auxiliary service providers.

Qualitative data was also collected through focus group discussion (FGD) based on participants' knowledge of IBF identified during semi-structured surveys and reinforced by snowballing to identify more participants in each landing beach based on their roles, experience, and gender. Limited by the principle of saturation, a total of 6 FGDs and 30 in-depth interviews were conducted in this study based on the principle of saturation (Creswell, 1998; Stake, 2000; Marshall et al., 2013). The sequential technique of mixed methods design came in handy as gaps realised during the survey were noted and informed data collection at FGDs and Key Informant Interviews (KIIs). Other than primary data, secondary data were also used and were retrieved from desktop and library reviews of existing relevant institutional and academic works.

Data Analysis

The process of quantitative data analysis involved cleaning, sorting, checking for outliers, and recoding (previously open-ended questions with more than 5% similarity) data from filled questionnaires before entry and analysis using the Statistical Package for Social Science (SPSS) v.26 to through descriptive statistics in terms of frequency tables and cross-tabulation. On the other hand, Qualitative analysis went simultaneously with the collection of FGDs and KIIs initially through memoing and thematic sorting of transcribed data, and at the end through systematic thematic sorting, sub-thematic sorting, description, and interpretation of different possible meanings.

RESULTS

This section presents the findings of the study. The study examined the influence of fisheries-based determinants of IBF access among fisherfolk in the Suba-North sub-county. The factors included the landing sites, fisher folk categorisations, boat size, form of energy used to propel boats, type of fish targeted, and years of fishing experience.

Fishing Landing Sites and Access to Impact-based Weather Forecasting

Fishing landing sites are fishing settlements along the Lakeshore where fisherfolk trade fish and other items, as well as locations of parking for boats before and after fishing. They are usually near the Lakes' shores. Although there are several landing sites on Lake Victoria, this study was carried out at six landing sites, which were part of the HIGHWAY pilot. The Island beaches included Remba, which is one of the largest and most wealthy landing sites as it is surrounded by the deepest part of Lake Victoria, where Nile perch is fished mainly for international trade, followed by Ringiti and Kiumba landing sites in Rusinga Island. These landing sites play a major in the local economy as fishing is the main economic activity. The mainland landing sites included Koguna, which is one the largest mainland landing sites in Homa Bay County. The second is Lwanda Nyamasare, which is situated along Mbita-Homa Bay road and Tabla, which is well known for Omena fishing, supplying most parts of Homa Bay and exported to Nairobi for human and animal consumption. The influence of landing sites was tested by cross-tabulating indicators for landing site (name of site) with the type of information one has access to. The result is summarised in *Table 1*

Table 1: Access to weather information by landing sites

Name of landing sites	Access to IBF		Access to traditional weather information		Access to None	
	F	%	F	%	F	%
Remba	51	38.3	43	32.3	39	29.3
Ringiti	33	34	32	33	32	33
Koguna	28	42	22	33	16	24
Lwanda Nyamasare	9	27	10	30	14	42
Tabla	7	31	3	14	12	55
Kiumba	12	46	3	11.5	11	42
TOTAL	140	37	113	30	124	33

Source: Field data

The findings from the table above revealed that 37% of the fisherfolk were accessing IBF, whereas 30% accessed traditional weather forecasts, and 33% were not accessing any weather information. Access to IBF also varies according to landing sites. IBF is most accessible in Kiumba 46% and Koguna 42%. The study revealed that 38% of fisher folk in Remba also access IBF and in Ringiti, 34%, Tabla 31% and 27% in Lwanda Nyamasare. The differences in access to IBF could be explained in a number of ways. One factor that explains the level of accessibility to IBF in the leading sites is leadership commitment to hoisting marine weather flags and weather notice boards provided by the HIGHWAY WISER project to the beaches.

For example, during the FGDs and KIIs in Kuimba and Koguna, the participants indicated that they accessed IBF by observing the marine weather flag hoisted on their beaches. At Lwanda Nyamasare, the KII participants hinted that leadership only hoisted marine weather flags when they were privy to information on the coming of visitors to landing sites. In Remba and Ringiti, the participants observed that marine weather flags were in use for only about three months due to a lack of leadership committed to the ideas. Key informant interviewee at Remba highlighted other reasons for low access at the site, namely:

"We only saw the BMU raise it for 2-3 months after they were brought here. But also, the project only trained two men; they have never come back, and I think the flags and boards are also too old if they exist. Sincerely most people here are very aged fishermen; they can tell the rain will rain through their ears. You cannot imagine, but that is true. They cannot afford to believe in so-called IBF" [Experienced fishing crew and a net-mender as well, 11th December 2022].

A key informant from Ringiti voiced almost similar sentiments and called for action on several issues not going well while discussing the low access levels of IBF:

"You say they trained people. I do not know about that. The BMU is not interested in science and are themselves boat owners or friends of the Oria (Somali boat owners who to a great extent, run the fishing economy); hence, they cannot even tell someone the truth about whether. When it used to work – the IBF they could lie to enable people to go into the Lake" [KII Participant and a Woman Boat Owner, 2022].

Category of Fisherfolk and Access to Impact-based Weather Forecasting

This study established five typologies of fisherfolk depending on their roles in the fishing economy. The crews are the labourers hired to carry out fishing activities or work in their own boats (usually small boats). They are the most vulnerable as they face the events on the Lake directly – risking both their lives and livelihoods. On average, each boat usually has about 3-5 crews that often work in shifts. The second category is fishmongers, mostly composed of women but also a few men who trade in fish. The third category is the boat and gear owners, who are also the key decision-makers in terms of who goes or not to the Lake, thus controlling the fishing economy. They hire crews to work in their boats and, from time to time, as we found out in Remba, can force their labourers into the Lake despite impending extreme storms. The fourth group are the auxiliary service providers. Most of these groups engage in the fishing economy as service providers in their respective landing sites. They provide different services such as net mending, boat repairs, selling food items, and running shops. The fifth category is the transporters. This group transports fish and people between the island and the mainland, within Kenya and without Kenya. They are important in the promotion of commerce among the landing sites. All these five categories require weather information to carry out their activities. The cross-tab below reveals that access varies from one category to another.

Table 2: Fisherfolk access to weather information by category of Fisherfolk.

Fisher folk categorisation	Access to IBF		Access to the traditional weather forecast		Access to both IBF and Tradition		not access any weather information	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Crews	43	27	44	28	15	10	55	35
boat owners	23	31	18	24	8	11	25	34
Fishmongers	36	40	25	28	6	7	22	25
auxiliary service providers	7	22	10	31	2	6	13	41
Transporters	4	15	7	27	5	19	10	38

Source: Field Data (2023).

The crews are the category of fisher folk that encounter extreme weather on the Lake. This is because they intensively engage in primary fishing activities – that is, going into the Lakes and conducting the actual fish extraction. 28% of them had access to traditional weather information, while 27% had access to IBF, 11% of them had access to both traditional and impact-based forecasts, and the rest did not have access to any type of information. This low level of access, despite the expectation that crews would lead on this front, was due to varying reasons. In Rigiti

and Remba, where fishing is largely commercialised and on a large scale for export into European countries, it was largely because of a lack of autonomy on the part of crews, as their "Tarijis' (bosses) had the final say. One Ringiti crew narrated during an FGD:

> "When you have eaten your Tajiri's [boat owner's] food, it is like a 'bomb' because he forces you to risk your life because she/he needs to recover his garamah [the food's expense]. The boat owners do not care if the IBF shows there would be danger or not" (Fishing Crew, 20th Dec 2023)

Looking at boat owners (*Table 2* above), 24% of them have access to traditional weather information, while 34% indicated a lack of access to any weather information, 31% have access to IBF, and 11% have access to both traditional and IBF. Boat owners play a critical in decision making whether crews need to go fishing or not. Their access to weather information is very important in the fishing industry. They also fund preparations for fishing expeditions. Boat owners' access to IBF is vital in making decisions that can avert weather risks and save livelihoods. However, it appears that the boat owner's access to IBF does not translate into access by their employees (crews). Obviously, for commercial reasons, the boat owners get the IBF and hoard it from the crews so that they can continue to the Lake and fish for them. Also, their relatively higher access compared to crews shows that they are always on land compared to crews who, like birds in the air, are in the water almost all the time extracting fish – denying them the time to access such information.

The study established that fishmongers were leading in access to IBF (40%). This category, particularly those in the Omena business, needs weather information to aid in fish processing. Fishmongers are engaged in fish processing, which depends on weather conditions, and their business is sensitive to weather conditions. Most activities that fishmongers are involved in are onshore, and they face the danger of extreme weather through losses that accrue in their business. One Omena monger emphasised how keen they are with timely communicated IBF and ridiculing other actors for hiding this needed information from them.

> "We are always thought to be secondary actors in the fishing economy. But this is a wrong perspective. We need the information to decide whether to buy Omena or not. If we know it will rain, we do not risk buying Omena for consumption; we just buy it for animal feed. Most of the time, fishers and boat owners do not want us to know the truth; they can hand the wring flag just for us to buy when it rains" [Omena-monger, Tabla beach during an FGD, 7th Dec 2022].

The study also established that only 22% of the auxiliary service providers (ASP) have access to IBF. The auxiliary service providers are another category of fisherfolk affected by weather conditions indirectly. They engage in onshore services such as boat construction and repair, net mending, shop-keeping, and food kiosks. Their business is indirectly affected by weather conditions through its effects on fishing activities. By observation, two main reasons can account for this state among the ASP. First, their services are off the shore areas and far away from MBU offices. They neither have the time to see the flags and boards through which IBF are communicated nor can they see when these are hung around the BMU offices as is the norm in Suba-North. Secondly, those who, for example, do hotel services and so need fish perceive themselves as not concerned with IBF or secondary to its impacts.

Lastly, the study found that only 15% of the transporters had access to IBF. Two main reasons can explain this state. First is the view that transporters are not part of the fishing economy. This perspective was a cross-cutting one across beaches and transporters interviewed and surveyed.

> *The transporters are the heart of the fishing economy, but we are so detached from the developments here, such as IBF. For example,*

none of our members was trained, and our employers/boat owners do not care about IBF warnings (Key Informant Interview with a Fish Transporter at Ringiti Island, January 2023).

Secondly, based on observations we made in the field, transporters are a generally safe category. They use engine-powered boats and are the largest of all sizes. Actually, we learned during the survey period that boat human transport was safer between Mbita town and Ringiti or Remba than modern modes such as water bus, owing to their relative stability. This way, transporters and especially their employers are not so much bothered about accessing and using IBF as other categories, especially using small-sized boats and non-engine powered.

Boat Size, Means of Boat Power, and Access to Impact-based Weather Forecasting

Boat size is one of the factors that may influence fisherfolk's interest in weather information. The small boat sizes are the riskiest during stormy weather (Thiery et al., 2017) and a major cause of fatalities in Lake Victoria (Roberts et al., 2022). This is because they have a small surface area to volume ratio, are lighter and are often manually powered. This makes them very vulnerable to serious storms and can easily cause the death of crews. Fisherfolk categorised boats into three different sizes: small, 3-4 meters long; medium, 5-6 meters; long and large, 9-13 meters. The boats were further classified as the source of energy to propel them. Under this classification, there were sailing boats powered by sails, peddled boats powered by human efforts, and motor engine boats powered by engines. The size of boats and source of energy could be one of the factors that may influence their quest for weather information. This assertion was tested through a cross-tabulation summary, which is shown in *Table 3*.

Table 3: Cross-tabulation of boat sizes and type of power and access to weather information

Size of Boats According to Length	Access to IBF		access to the traditional weather forecast		access to both IBF & Tradition		not access any weather information	
	F	%	F	%	F	%	F	%
3-4 meters small/human effort powered	35	29	31	26	8	7	46	39
5-8 meters medium sail powered	23	26	31	35	12	13	23	26
9–13-meter large motor engine powered	3	16	5	26	3	16	8	42

Source: Field Data (2023).

As *Table 3* above shows, the hypothesis that small-sized boats would likely access IBF more than large-sized boats is very proven right. As visible, the smallest size boats (3-4 metres) had the highest access at 29%, followed by the medium size (5-8 metres) with the access of 26%, and lastly by the largest (9-12) which only 16% had access. The medium-size boats that most engage in Nile perch and Omena fishing often involve deep lake fishing, and weather information is vital for them for safe fishing expeditions. It is worrying that 38% of them lack access to weather information. This could explain the frequent weather hazards among them. Most of them rely on wind direction and speed to sail to different points. Large-size boats are often stable and engine-powered and are involved in deep lake fishing. Most of them are used either for human transportation or Nile perch fishing. Weather information should be of interest to them because they face high risk during stormy events. This is because large boats are motor engine powered and large; they have a false consciousness of safety in the Lake and may be less interested in weather information.

Type of Fishing and Access to Impact-based Weather Forecasting

There are three main types of fish that are harvested in Lake Victoria: Tilapia, Omena, and Nile perch. Tilapia fishing takes place along the

Lakeshore, while Nile perch and Omena vary from medium range to deep lake fishing depending on the methods of fishing used. All fishing requires weather information to be safe. The study found that among those involved in Nile perch fishing, 34% have access to traditional weather information, whereas 31% have access to IBF, 8% have access to both traditional and IBF, and 27% do not have access to any weather information. Among the Omena fishers, 26% have access to traditional weather information, 30% have access to IBF, and 11% have access to both traditional and IBF. Whereas about 33% reported having no access to weather information. The high levels of access to IBF among Omena fishers are due to the fact that this type of fishing highly depends on the weather because Omena fishing and processing entirely rely on the prevailing weather conditions. Among Tilapia fishers, 17% have access to traditional weather information, 33% have access to IBF, and 50% have no access to weather information. This is because Tilapia fishing takes place close to shore; hence, tilapia fishers could promptly respond to weather changes.

Experience in Fishing and Access to Impact-based Weather Forecasting

Based on survey data, the study classified fisherfolks' experience in fishing into five categories, namely, less than one year, 1-2 years, 3-4 years, 5-6 years, and 7 years and above. The assumption tested here was that experience in fishing may influence access to weather information among fisherfolk. This is because those with a large span of experience in fishing may see themselves as experts in traditional weather predictions, hence seeing IBF as an opportunity cost.

The results of the study confirm this assumption affirmatively. It was found that those who have less than one year of experience in fishing tended to access both traditional and IBF in a nearly 50-50 way: 44% and 38%, respectively. Implying they were trying both types of information if at all access relates to use. 70% of those who had experience of 1-2 years accessed

traditional weather information, with only 23% accessing IBF. This showed that deed they had started catching up with traditional predictions ways and also that they were probably getting influenced by the fishing communities' sub-culture of traditionalism and opposition to modernist mechanisms such as IBF. This trend was true for the next level of experience (5-6 years), of whom a whopping 83% had access to traditional weather with only 17% accessing IBF. For those with 7 years of experience, nearly all had access to just traditional (93%). These findings show that the more experience one has in fishing, the less caring she-he becomes about IBF; hence, the less access is to be expected to IBF and, conversely, the more access (and perhaps use) of IBF.

DISCUSSIONS

This study examined the influence of fisheries-based determinants of access to impact-based weather forecasting (IBF) among fisherfolk from 6 beaches in the Suba North sub-county where the HIGHWAY-WISER Project had launched IBF in 2016. The project, up to the time the fieldwork for this study was undertaken, remained unevaluated scientifically and programmatically; hence, this study's insights are hoped to show, in part, what access to IBF so launched looks like. The information thus is key not just for future research on the subject in similar contexts but also to policymakers who perhaps sit in their offices imagining how the donor-driven project has had a huge impact, as reports a recent related but non-evaluative study (Roberts et al., 2022).

Five fisheries-based determinants were examined: Landing sites, category of fisherfolk, boat size and type of boat power, type of fishing and experience in fishing. The study established that the extent to which a landing site influences access of the fisherfolk at that space to IBF is largely but not entirely a function of the extent of commercialisation of fishing activities. In heavily commercialised fishing beaches such as the Islands of Remba and Ringiti, low access was recorded to areas - where commercialisation happens not as much relative to these two sites –

such as Koguna, Tabla and Kumba. Thus, there is a large way through which Marxist notions of relations of production, especially in the context of slave owners (read boat owners and crews), define power relations dynamics that are hugely asymmetrical against the crews who are like slaves for the boat owners (largely the minority *Somalis*) who don't care about IBF than they do care about the 100-200 Kenyan shillings they give to crews every day making them to snatch crews of the autonomies to decide to go fishing or not, and consequently force them into the Lakes, even leading to several deaths – or so did the study establish.

As regards the category of fisherfolk, an unexpected finding was that crews who are most vulnerable to storms only ranked third after fishmongers and slave-owners (read boat owners). The part explanation for this situation is already due to the scenario revealed in the foregoing paragraph. But beyond the notion of relations of production, there are two explanations: first, the boat owners hoard IBF information from their slaves as their priority is money, and crews are part of the objects of labour necessary to attaining their priority goal. Secondly, by the very nature that crews are almost always in the Lake extracting fish from which they learn only that which can sustain them for the next expedition, they have no time to pursue IBF. If anything, crews when on land and busy sleeping only to be woken up that it is time for the next expedition, as we observed and noted systematically using an observation protocol. These findings make more sense in the context of the burgeoning poverty levels that characterise Lake Victoria and its environs (Roberts et al., 2022). It is practical when one observes the 24-hour cycle toil of a common crewman. Stakeholders should intervene. Third and lastly, the fishmongers, though underrated within the traditional fishing industry as happens in the rural settings like the site for this study, turned out to be the most autonomous actors driving the local fishing market. This explains why they appeared to have the highest levels of access than all other categories. They (especially the Omena-mongers) are keen for this information

(IBF) to decide whether to buy their trading item for feed or for food depending on impending weather crews and boat owners from time to time attempt to do what boat owners to the fish mongers, they can only do so much as this category is an economically autonomous actors; deciding when and what quantity to buy and from whom – a capacity that makes them able to manipulate local prices.

The size of the boat and the type of engine used to power it determines the level of access. Biggest-sized boats, 9 – 12 m owners, were perceived to be having the lowest level of access. This is not only logically correct but also a consistent finding in light of the foregoing paragraphs. Bigger boats are largely commercial-purpose, and their owners only know about money. Moreover, the fact that they are engine-powered, bigger in size and stable makes IBF useless to most (if not all) of their owners). The type of fishing also influences access because the type of fish one extracts is a function of the extent/distance of the Lake he travels. Hence, tilapia fishers are only around the shore and are safer, reducing their need for IBF. Omena and especially Nile perch fisher have to go deeper into the Lake and hence have no option but to care about predictions IBF. Lastly, the years of experience in fishing influenced IBF access.

The more years one has fished in Lake Victoria, the more likely that he will be transformed into a traditionalist who, in the exact words of study participants, "can smell and hear rain and wind" and thus has no use for modern techniques such as IBF. This and the foregoing discussions point to the public and targeted awareness gaps that remain and the justification for the Kenyan Government to adopt and take seriously the, in our view, defunct, WMO-sponsored HIGHWAY-WISER Project. GoK can do this without adopting the task force approach, which has become common even to issues that require simple mechanisms for intervention, for this case, getting officers that facilitated the launch of the project in 2017 at the Kenya Meteorological Department (KMD) out of their comfortable offices to go the ground and see for themselves that very less has changed and very much needs to be done. Flags

and boards are old and/or destroyed/worn out. The trained are longer at their respective beaches and/or need refreshers, do not have WhatsApp cell phones to receive the IBF anymore or are simply disinterested. Beach politics has overtaken the modernisation euphoria, and fisherfolk are back to their traditional cost-free ways of knowing – and predicting weather. The Government of Kenya must do something.

Summarily, the foregoing findings attempted to fill three formations of research niches in the extant literature on the subject. Current studies (Thiery, 2017; Oloo, 2019; Roberts et al., 2022) suffer from clarity of the exact typologies of determinants and how those determinants influence uptake. It is unclear what exact determinants are being explored, and additionally, there is a trend toward emphasising the socioeconomic, demographic, and psychological determinants of uptake of modern weather information, leading to the (analytically) exclusion of other typologies of determinants (Ford et al., 2010; Inman et al., 2018; Meijer et al., 2015; Bironga, 2021; Nkuba, 2014). Secondly, extant literature is ambiguous in their studies of uptake of weather forecasting in so far as drawing the boundary between access, use, and impact and primary weather beneficiary perspectives is concerned (Inman et al., 2018; Meijer et al., 2015). Thirdly, a large chunk of extant works on modern weather information accords the fisherfolk in a peripheral position and places the farming folk at the centre of analysis (Zendeta, 2011; Anshuka, 2021; Roberts et al., 2022). Finally, a huge chunk of works that focus on fisherfolk still have been conducted among and/or for fisherfolk in the developed world.

Testing Statistical Significance of Fisheries-based factors associated with Access to Impact-based forecasting

Table 4 below shows the statistical tests for the foregoing discussions made in this paper. From the table, for the "**Category of Fisherfolk**", The Pearson Chi-Square value for the Category of Fisherfolk variable is 21.809, with 4 degrees of

freedom, and the p-value (Asymp. Sig.) is less than 0.001 ($p < 0.001$). This indicates a statistically significant association between the category of fisherfolk and access to impact-based forecasting. Concerning the "Landing **Beaches**", the Pearson Chi-Square value for the Beaches variable is 12.162, with 5 degrees of freedom, and the p-value (Asymp. Sig.) is less than 0.001 ($p < 0.001$). This also suggests a statistically significant association between the type of beaches and access to impact-based forecasting. On the third variable, "**Type of Boat**", The Pearson Chi-Square value for the Type of Boat variable is 22.480, with 3 degrees of freedom, and the p-value (Asymp. Sig.) is less than 0.001 ($p < 0.001$). This indicates a statistically significant association between the type of boat and access to impact-based forecasting. The variable of "**Size of Boat**", The Pearson Chi-Square value for the Size of Boat variable is 19.839, with 3 degrees of freedom, and the p-value (Asymp. Sig.) is less than 0.001 ($p < 0.001$). This suggests a statistically significant association between the size of the boat and access to impact-based forecasting. Lastly, for "**Years of Experience**", the Pearson Chi-Square value for the Years of Experience variable is 2.717, with 4 degrees of freedom, and the p-value (Asymp. Sig.) is 0.020 ($p = 0.020$). This indicates a statistically significant association between years of experience and access to impact-based forecasting, although the significance level is lower compared to the other variables, which is in line with the discussions made above.

In summary, all the variables in your analysis (Category of Fisherfolk, Beaches, Type of Boat, Size of Boat) show a statistically significant association with access to impact-based forecasting based on the Pearson Chi-Square test. The Years of Experience variable also shows a significant association but with a slightly higher p-value (0.020). These results provide evidence for the relationship between these factors and access to impact-based forecasting among fisherfolk.

Table 4: Actors associated with access to Impact-based forecasting

Variable	Value	Standard Deviation	Asymp. Sig. (2-sided)
Category of Fisherfolk	21.809[a]	4	.000
Beaches	12.162[a]	5	.000
Type of Boat	22.480[a]	3	.000
Size of Boat	19.839[a]	3	.000
Years of Experience	2.717[a]	4	.020

Source: Field Data (2023).

CONCLUSIONS

In conclusion, this study delved into the influence of fisheries-based factors on fisher folk's access to impact-based weather forecasting (IBF). The results unequivocally affirm that fisheries-based factors wield a significant sway over the accessibility of IBF by fisher folk. While extant research predominantly focuses on demographic characteristics and the methods of information delivery as key determinants of IBF accessibility, our study sheds light on the pivotal role of internal factors in explaining the variations in fisher folk's access to IBF. Consequently, any initiatives aimed at promoting fisher folk's access to IBF must duly account for these internal factors to enhance the adoption of contemporary weather information.

The study also highlights a critical issue: the prevalent preference among a majority of fisher folk for traditional weather forecasting methods, which adversely affects their utilisation of IBF. Recognising this preference is crucial, as it underscores the necessity for tailored strategies to bridge this gap in access. Failure to address this issue could impede efforts to develop effective coping and adaptation strategies designed to bolster the fortunes of the fishing community.

The value of IBF cannot be overstated. It empowers fisher folk to plan their management strategies and allocate resources in anticipation of weather-related events, enabling them to better cope with storms and adapt to extreme weather conditions. Therefore, it is imperative that IBF services are made accessible to all segments of the fishing population, ensuring a diverse reach that caters to the varied needs of fisher folk. This inclusivity is vital for enhancing their resilience and adaptability in the face of ever-changing weather patterns and associated challenges.

REFERENCES

African Great Lakes Information Platform, (2023) https://www.africangreatlakesinform.org

Anshuka, A., van Ogtrop, F. F., Sanderson, D., Thomas, E., & Neef, A. (2021). Vulnerabilities shape risk perception and influence adaptive strategies to hydro-meteorological hazards: A case study of Indo-Fijian farming communities. *International Journal of Disaster Risk Reduction*, *62*, 102401.

Bironga, C. (2021). Socioeconomic Factors That Determine Final Market Demand for Fish and Chevon Meat in Marsabit County (Doctoral dissertation, University of Nairobi).

Creswell, J.W. (1998). Qualitative Inquiry and Research Design: Choosing Among Five Traditions, Sage, Thousand Oaks, CA.

Ford, J. D., Pearce, T., Duerden, F., Furgal, C., & Smit, B. (2010). Climate change policy responses for Canada's Inuit population: The importance of and opportunities for adaptation. *Global Environmental Change*, *20*(1), 177-191.

HBCIDP (2014). Homa Bay County Integrated Development Plan 2013-2017. Government of Kenya.

Inman, A., Winter, M., Wheeler, R., Vrain, E., Lovett, A., Collins, A., ... & Cleasby, W.

(2018). An exploration of individual, social and material factors influencing water pollution mitigation behaviours within the farming community. *Land use policy*, *70*, 16-26.

Kobusingye, O., N. M. Tumwesigye, J. Magoola, L.Atuyambe, and O. Olange, 2017: Drowning among the lakeside fishing communities in Uganda: Results of a community survey. Int. J. Inj. Control Saf. Promot., 24, 363–370, https://doi. org/10.1080/17457300.2016.1200629

LVFO (2014). Regional status report on Lake Victoria 2012 frame surveys Report

Marshall, B., Cardon, P., Poddar, A. and Fontenot, R. (2013). "Does sample size matter in qualitative research?: A review of qualitative interviews in IS research", Journal of Computer Information Systems, Vol. 54 No. 1, pp. 11-22.

Meijer, S. S., Catacutan, D., Ajayi, O. C., Sileshi, G. W., & Nieuwenhuis, M. (2015). The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa. *International journal of agricultural sustainability*, *13*(1), 40-54.

Nkuba, M. R., Chanda, R., Mmopelwa, G., Kato, E., Najjingo Mangheni, M., Lesolle, D., & Mujuni, G. (2023). Effect of indigenous and scientific forecasts on pastoralists' climate change perceptions in the Rwenzori region, Western Uganda. *Climate and Development*, *15*(6), 522-534.

Oloo, P. (2019). Towards developing a sustainable early warning system for the Lake Victoria basin. Kisumu: WMO HIGHWAY Project Focal Point-Kenya

Roberts, R.D., Goodman, S.J., Wilson, J.N., Watkiss, P., Powell, R., Petersen, R.A., Bain, C., Faragher, J., Chang'a, L.B., Kapkwoma, J.K., Oloo, P.N., Sebeziga, J.N., Hartley, T.D., Mittermaier, M, Crona, L., & Virts K.S., (2022). Taking the HIGHWAY to Save Lives on Lake Victoria. https://doi.org/10.1175/BAMS-20-0290.1. American Meteorological Society.

Stake, R., E. (2000). "Case Studies", in Denzin, N.K. and Lincoln, Y.S. (Eds), Handbook of Qualitative Research, Sage, London, pp. 425-454.

Thiery W, Gudmundsson L, Bedka K, Semazzi F H, Lhermitte S, Willems P, Van Lipzig N P and Seneviratne S I 2017 Early warnings of hazardous thunderstorms over Lake Victoria Environ. Res. Lett. 12 074012

Tushemereirwe, R., D. Tuhebwe, M. A. Cooper, and F. M. D'ujanga, 2017: The most effective methods for delivering severe weather early warnings to fishermen on Lake Victoria. PLOS Curr., 22, 9.

Watkiss, P., R. Powell, R., Hunt, and F. Cimato, 2020: The Socioeconomic Benefits of the HIGHWAY project. Report, 89 pp., www.metoffice.gov.uk/binaries/ content/assets/metofficegovuk/pdf/business/i nternational/wiser/wiser0274_ highway_seb_report.pdf

Whitworth, H. S., and Coauthors, 2019 2019: Drowning among fishing communities on the Tanzanian shore of Lake Victoria: A mixed-methods study to examine incidence, risk factors and socioeconomic impact. BMJ Open, 9, e032428, https://doi.org/10.1136/bmjopen-2019-032428

Zendera, W. (2011). Access and utilisation of agro-meteorological information by smallholder farmers in Perkerra and Lari-Wendani irrigation schemes, Kenya (Doctoral dissertation, Egerton University).