Improving Data Collection Mechanism and Identification of Marine Wildlife CITES-Listed Bycatch Species Though E-log and Artificial Technologies in Pakistan

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Abstract:

Pakistan is an important coastal country in the Indian Ocean. The gillnet is a popular fishing gear used to target tuna and tuna-like species in inshore and offshore waters by small-scale fishing boats. The data collection and reporting have been developed from the onboard tuna fishing vessels for the target and bycatch species. However, the small-scale coastal gillnetters have not focused on their catches and bycatch species. The Crew-based observer program replicated in small-scale coastal fisheries for data collection and reporting. An E-log was developed to improve the data collection and reporting mechanism from onboard and landing areas for the species of concern from the area of interest of IOTC. The e-log has also been developed to determine the gear efficacy by monitoring the data collection and reporting. The small-scale gillnetters catch some bycatch species underreported due to the challenges in identifying the bycatch CITES-listed species to their species level. A developed prototype has successfully shown great accuracy for detecting the underwater CITES-listed species. Further investigation and development are required to test the AI technology to identify CITES-listed species and improve the data collection at the field level.

Keywords: Small scale fisheries, data collection, observers, onboard sampling, port sampling, e-log, gear efficacy, target catch, CITES-Listed species, artificial technology.

Introduction

Pakistan is an essential coastal country for gillnet fisheries in the Indian Ocean. (Moazzam, 2012). Seven hundred nine tuna gillnet vessels are operating in neritic and oceanic waters in the Exclusive Economic Zone (EEZ) of Pakistan (Khan, 2020). the tuna gillnet fleets are wooden boats that range in size from 10 to 15 meters and 15 to 20 meters overall length (Moazzam, 2012) The tuna gillnet fishing vessels use nylon and polyamide gillnet that varies from 4.83 km to 20 km, and breadth ranges from 8 to 20 meters while the stretched mesh size range from 13 cm to 17 cm (Moazzam, 2012) (Shahid, 2012) (Khan, 2020). tuna gillnet vessels more than 10 to 20 meters operating more in the offshore waters; however, wooden boats range from 7 to 11 meters and the gillnet size ranging between 3 to 5 km and stretched mesh sizes ranging from 5 to 14 cm, do operate within the coastal waters. (Khan, 2020) these boats do not primarily target tuna species, catch demersal and pelagic species, including Spanish mackerel, catfish, queenfish, croakers, barracuda, seabreams (Khan, 2020). there are around 3,800 gillnetters and 815 pelagic gillnet vessels that operate in the IOTC areas of competence (Kazmi, et al., 2019).

Among the eight reported tuna species, yellowfin (*Thunnus abacares*), longtail ((*Thunnus tonggol)*, skipjack tuna (*Katsuwonus pelamis*), kawakawa (*Euthynnus affinis*), and frigate tuna (*Auxis thazard thazard*), which are caught in commercial quantities (Moazzam, 2012) (Shahid, 2012). the catches and bycatch of tuna and other tuna-like large pelagic contribute around 48,320 tons where the landing of all pelagic species constitute 51.53% by tuna species; yellowfin being the dominating species included for 24.61%, tuna-nei by 28.17%, frigate by 27.90%, longtail by 11.87%, kawakawa by 4.52% and skipjack by 2.88%. the other large pelagic / seerfishs constitute around 9.17%, 9.17% dolphinfish, and 25.77% billfishes. (Khan, 2020)

In addition to targeting tuna species in offshore deep water, the accidental catches of the tuna gillnet vessels consisted of the commercially important large pelagic that includes Indo-Pacific sailfish (*Istiophorus platypterus*), black marlin *Makaria indica*), striped marlin (*Tetrapturus audax*), dolphinfish (*Coryphaena hippurus*), threshers (*Alopias superciliosus*) and mako (*Isurus oxyrinchus*) (Moazzam, 2012). the accidental catches of CITES-listed species include thresher shark (*Alopias superciliosus*), silky shark (*Carcharhinus falciformis*), and other sharks and rays (Moazzam, 2012). the accidental catches of the commercially important tuna-like fishes in neritic tuna include Talang queenfish (*Scomberoides commersonianus*), Kingfish (*Scomberomorus commerson*), Barracuda (*Sphyraena sp.*), Dolphinfish (*Coryphaena hippurus*), (Moazzam, 2012). the catches of the neritic tuna from the small scale coastal and semi coastal fisheries are unavailable, and it's estimated to be around 20% contribution to the total landing of tuna species in Pakistan (Khan, 2020)

The gillnet gear is popular yet considered the main factor for the entanglement/ mortality of the accidental/ non-targeted catches the highly migratory marine flagship/ priority megafauna species (Moazzam, 2012) (Shahid, 2012). These large pelagic megafaunas (shark and rays, marine turtles, and marine cetaceans) are Endangered, Threatened, and Protected (ETP), and CITES-listed species do have their important ecological roles within the marine ecosystem (Moazzam, 2012) (Shahid, 2012). The ecological impacts of gillnets remain unknown on flagship megafauna species, apart from studies undertaken in Pakistan. The ecological implications of the use of this non-selective fishing gears result in entanglement/ mortality of more than 12,000 dolphins in and around 28,000 sea turtles in 2013 are reduced to entanglement and mortality to only 183 dolphins and entanglement of only 1,369 marine turtles and mortality reduced to nil, respectively (Khan, 2020). These megafauna species, particularly elasmobranch, are k-selected and vulnerable due to their slow growth rate, late maturity and low reproductive rates, and the low rate of rebounding their populations.

Additionally, many elasmobranch populations declined due to overfishing, and small numbers of annual bycatch may be sufficient to cause population declines or extirpations. Limited research has been conducted in small-scale coastal and industrial open-ocean fisheries. However, some bycatch is known to occur in most fisheries, and it could be the leading cause of the decline of some populations of coastal elasmobranchs. The red list of IUCN assessed 420 sharks and rays species. Around 154 species are " threatened" or at risk of extinction in the wild; 68 species are critically endangered (172% increase), and 97 are endangered (126% increase), including 7 out of 8 hammerhead species (family Sphyrna), critically endangered oceanic whitetip shark (*Carcharhinus longimanus*)and giant manta ray (*Mobula birostris*) (Harriet Brooker; Matthias Fiechter, 2020) (Dr. Andy Cornish, 2021). the adopted for the conservation and management measure for elasmobranch species of interest of IOTC and the collection and exchange of the fisheries data are emphasized by the following resolutions:

- IOTC Resolution 10/02 Mandatory statistical requirement for IOTC Members and Cooperating Non-Contracting Parties (CPC's);
- IOTC Resolution 13/03 On the recording of catch and effort data by fishing vessels in the IOTC Area of Competence,
- IOTC Resolution 05/03 Relating to the establishment of an IOTC Programme of Inspection in Port,
- IOTC Resolution 05/05 Concerning the conservation of sharks caught in association with fisheries managed by IOTC.

- IOTC Resolution 13/06 On A Scientific And Management Framework on the conservation of shark species caught in association with IOTC managed fisheries.
- IOTC Resolution 12/09 On the conservation of THRESHER SHARKS (family Alopiidae) caught in
- association with fisheries in the IOTC area of competence:
- IOTC Resolution 13/05 On the conservation of WHALE SHARKS (Rhincodon typus)
- IOTC Resolution 12/04 On MARINE TURTLES
- IOTC Resolution 13/04 On the conservation of CETACEANS
- IOTC Resolution 11/04 On a Regional OBSERVER SCHEME

All the marine megafauna species of IOTC of interest are also projected by the following federal and provincial governments of Pakistan:

- Pakistan Trade Control of Wild Fauna and Flora Act 2012, CITES laws of Pakistan
- Notification NO.5(3)SO(Fish)L&F/16/092, 2016 under Government of Sindh,
- Notification Mo.SO(Coord)Fish/2-1/2013/3148-58, 2016, under Government of Balochistan
- Balochistan Wildlife Protection, Preservation, Conservation and Management Bill No. 15 of 2014 vide No. PAB/ Legis: V(15)2014, Government of Balochistan.
- Clause 5(c) of Pakistan Fish Inspection and Quality Control Rules, 1998 notified vide S.R.O. No.739(I)/9

Under the acts mentioned above and national laws, the elasmobranch families are declared CITES-listed species and protected (Khan, 2020). It includes Rhicodontidae, Alopiidae, Caracharinidae (*Carcharhinus falciformis* (Muler & Henle, 1839), *Carcharhinus longimanus* (Poey, 1861)), Sphyrnidae, Pristidae, Myliobatidae, Rhinidae, and Rhinobatidae or Rhynchobatidae. in addition, all the marine turtles and marine cetaceans are also protected by wildlife protect bill 2014 (Khan, 2020).

However, the catches of the neritic tuna from the small-scale coastal and semi coastal fisheries are unavailable, and it is estimated to be around 20% contribution to the total landing of tuna species in Pakistan (Khan, 2020). The information of the historical changes and the magnitude of the accidental catches, species composition, and the annual statistical landings were not recorded separately for shark rays (Moazzam, 2012) (Shahid, 2012) (Shahid, Khan, Nawaz, Dimmlich, & Kiszka, 2015). With the concern of information gaps and poor understanding of the quantified rates of the entanglement of the bycatch and tuna catches, there is a need to strengthen data collection mechanisms as 80% of catch data is estimated (Kazmi, et al., 2019). at the regional level, the accidental catches of the bycatch species in the tuna gillnet fisheries are underreported or not reported systemically. The underreporting of the non-targeted species (mobulids) caused information limitation for not identifying and reporting to species level (Shahid, Khan, Nawaz, Dimmlich, & Kiszka, 2015) (Shahid, et al., 2018). the gaps in the information on poorly documentation of the CTIES-List bycatch and important bycatch species of IOTC is mainly considered due to the misidentification to the bycatch species has eventually caused issues and challenges for the fisheries management to quantify the bycatch categories to species levels (Shahid, et al., 2018). The CMMs of bycatch species of concern lack coherence and inconsistency in the data collection requirement (Martin & Shahid, 2021). the CMMS needs improvement for the data collection, reporting, and monitoring for bycatch, discards, and safe releases. (Martin & Shahid, 2021). The need for improved data collection mechanism for data quality/ standardization is required on species-level identification through alternative tools and emerging technologies such as machine learning and artificial intelligence to identify the most effective sampling strategies (Secretariat, 2019) (Secretariat, 2020).

Methodology and results

Improving the data collection mechanism for the improved coverage and nominal catches in IOTC Area of Competence for species of interest of IOTC

the monitoring mechanism has been established by replicating crew-based observer program in small scale coastal fisheries (Moazzam & Khan, 2018) (Razzaque, et al., 2020). The fishermen were also taken on board to monitor the gear efficacy in small-scale fisheries while promoting targeted fisheries in small-scale fisheries. The longline was considered an experimental vessel during the trials, and the gillnet was considered a control vessel.

a) *Onboard data collection:* The fishermen from both longline and gillnet vessels were trained to collect the prescribed datasheet/ log from their fishing operations from 2018 to date. The fishermen trained for the onboard data collection on the target catch, bycatch of commercially important fisheries, non-targeted bycatch species, safe handling, and released. The fishermen also trained for the onboard sampling of the specimens for their total number and size frequencies of at least three to five specimens of each fish group. The fishermen provided photographic evidence for the species ID of fish catches (target, non-target yet retained and discarded species) and sighting the marine birds, cetaceans, and other oceanographic phenomena during their fishing operations (Figure - 1). The trials of longline and gillnet were carried out in 2019 with two fishing vessels that have increased to 7 boats. The observers' fishing trips consist of a maximum of 12 fishing trips where the data recoded consistently with n=1594 fishing sets (Graph-1). The data collected from both longline and gillnet consisted of 22 fish categories. It includes eel, grunts, snappers, pompano, crackers, barracuda, demersal shark species, groupers, queenfish, cobia, emperor, crab, rays, threadfins, Spanish mackerel, scads, longtail tuna, squids, hairtails, seabream, and (1) green turtle (Graph-2). The comparison of each trip's total expenses and total income were also recorded (Graph-3).
b) *Port sampling:* two fishermen trained for the data collection of random sampling on the landed fish species daily from the landing areas during the landing fish timings. The fishermen were trained to collect information on the landed fish species and random sampling for their length size frequencies and per kg prices of the sampled fish, respectively. These fishermen were also responsible for collecting information from the fisheries' middlemen and processors/ exporters (Figure 2). Two community-based fishermen took on board as observers to monitor the landing areas at Ibrahim Haidari and Rehri Goth. These observers monitor the landing areas from 2019 to 2021. the number of the samplings from landing areas was n=6,293 (Graph-4) with coverage of the sampling boats from two landing areas (Graph-5). The number of crew engaged in a different type of fishing was also recorded (Graph-6). During the sampling, 15 different types of the gillnet were recorded for catching of the 24 categories of fishes that includes barracuda, blue crabs, catfish, cobia, croakers, Eel, Groupers, grunts, hairtail, ladyfish, longtail tuna, mullets, pomfrets, queenfish, rays, scads, seabreams, demersal sharks, shrimps, snappers, Spanish mackerel, squids, threadfin and tongue soles) (Graph-7). The fish rates, overall expenses, and income of the sampled boats from landing areas were also investigated (Graph-8).

All the collected data from the board fishermen were validated from the datasheets with the photographs and the data collected from the fishermen on port sampling for accurate identification of the target catch, non-target yet commercially important species, non-target bycatch species, discards, safe releases, area-based fishing, and fishing effort. The information collected from onboard sampling, landing areas sampling, and market investigation will be analyzed.

To improve data collection, reduce human efforts and resources, an e-log mobile application has been developed recently for the data collection i) from onboard fishermen and the ii) landing areas, and iii) market/ processors. The e-log can be used on the android smartphones at the movement. the e-log covers the information of the administration data, boat configuration, gear configuration, fishing operations, biological sampling for total number and estimated weight of the retained/ discard/ released fish catches and bycatch species as well as the length-frequency catch species. It also includes recording the information of the involved economics while calculating the expenses of each fishing trip, sold fish prices for each fish, and overall catch sales and net income of the fishing trips (Figure 3).

Improved data collection mechanism for data quality/ standardization required on species-level identification through alternative tools and emerging technologies such as machine learning and artificial intelligence:

In 2018, WWF-Pakistan collaborated with Oxford University to better use the emerging AI/ machine learning technology for strengthening species data collection and identification. The idea of piloting the AI/Machine learning technology could help identify marine species accurately and no-invasively to strengthen the data collection from onboard and port areas. The prototype, which then would be a developed mobile application, would mainly focus on establishing a systematic data collection, monitoring, and verification mechanism for the accidental catches of CITES-listed species, including shark and rays, marine turtles, and cetaceans, and other ETP marine species from small scale fisheries. The application would also be focused on the capacity building of fishers and fisheries managers for identification and reporting of the species to improve the fisheries management, particularly for the ETP CTIES- listed and IOTC species of interest in the Indian ocean.

Prototype: The mobile application prototype has already been developed using underwater shark images. The prototype tool was developed to combine the images' deep-learning machine learning by convolution neural network technique recognition technology (Figure-4) and big real-world datasets to detect the species based on their unique identification characteristics (Figure-5). The database of the porotype contains images from the internet of the underwater shark species. The database includes 4400 images of the shark species: blue shark, great white shark, lemon shark, nurse shark, tiger shark, whale shark, and whitetip shark species. More than 500 images of each shark species were in the prototype's database. The developed prototype has shown the significant performance of detecting and identifying all shark species in the database with up to 90% accuracy (Graph- 9).

Next steps:

after successful pilots of the prototype with underwater images of the shark, WWF-Pakistan will be developing the mobile-based application in collaboration with stakeholders and partners to establish a systematic data collection and monitoring and verification of sharks and rays bycatch data from coastal and offshore fisheries. To help develop a comprehensive strategy for improving CITES-listed shark and rays species in Pakistan for capacity building, orientation, and adoption.

The development of the mobile application contains the main components are as under:

a) **Funding for piloting the AI mobile application:** The consortium of fisheries and technology experts will be taken on board to develop the application. The financing of the application development is the main constrain for testing the AI for the data collection and detection of the CITES-List from the field.
b) **Application development:** the mobile-based application will be developed using machine learning/ Artificial intelligence technology. The application will be customized to be used on tablets/ smartphones, where the collected data will be accessed and reviewed on the

application's web portal. The application will use a systematic workflow for the development of the application. The mobile application will follow two primary interfaces for the detection, identification, data collection, and reporting form a) onboard fishers during their fishing operations and b) landing areas for the fisheries managers/ scientific communities (Figure-6).

c) **Data collection and database:** field visits will collect at least 12 CITES-listed shark species. The collected shark specimens will be further analyzed for managing the 'real' images in the biological laboratory. The real images of shark specimens will be at least 100 to 300 real images of each shark specimen for the application's machine learning. The collected real images of the sharks in the laboratory will ultimately support the development of the database for the application. The real images of the shark will eventually strengthen the application for the detection and identification of the species through machine learning.

d) **Testing of the prototype:** based on the sharks' collected real images among other marine wildlife species, the developed mobile application will test the prototype in the field by onboard fishermen/ observers and fisheries managers from landing areas. The tested prototype will be designed while following the scan-and-record approach based on the species' unique characteristics for the detection, and it will also collect geo-tagged information among the critical information (Figure-7). It will help identify gaps to further strengthen the data collection application and report for the shark species under consultative processes between fisheries and mobile application developer teams.

WWF and its partners will lunch the use of the developed mobile application. The mobile application will be designed restricted to be used by providing a subscription to the clients that include but are not limited to the coastal states, fisheries managers, NGOs, scientific communities. The information collected from the mobile application will be used to identify errors, anomalies, and gaps to understand the species better and support the data collection for the stock assessment of species of concern while moving towards fisheries improved managed in the region. The amount generated by the application's subscription members will be used to maintain the mobile application and upgrade with the latest technology and datasets.

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a) *Preliminary Analysis of onboard sampling*

Figure 1: The datasheet used for the data collection and reporting from onboard fishermen of longline vessels and gillnet vessels.

Onboard Data sheet									
Date	Data provider	Observer Name	Departure of port		Arrival of port		Fishing trip		
			(DD/MM/YY)	Area	(DD/MM/YY)	Area	Fishing trip day	Total fishing days	non fishing days

Boat Configuration									
Captain Name	Boat Name	Boat type	Boat length (m)	Registration No.	Total no of crew	Qty of Ice blocks	Water Quantity	Diesel (liter)	fishing Area

Fishing Method	Gear Type	Gear Configuration				Floaters			
	gillnet/ longline	Length (Km)	Width (m)	Mesh Size (mm)	Net Color	Float type	Total No. of Floaters	Length	Floater spacing

Hooks				Anchor				Bait	
Total Used	Hooks No.	Hooks Spacing (Meter)	Hooks Lost	Type of Anchor	Anchor spacing	weight of anchor (kg)	Quantity of Anchor	Bait used	Total weight of Bait (kg)

Set Net	Date	Time	Depth of water (m)	Temp (DC)	Turbidity (m)	Latitude	Longitude
Start							
End							

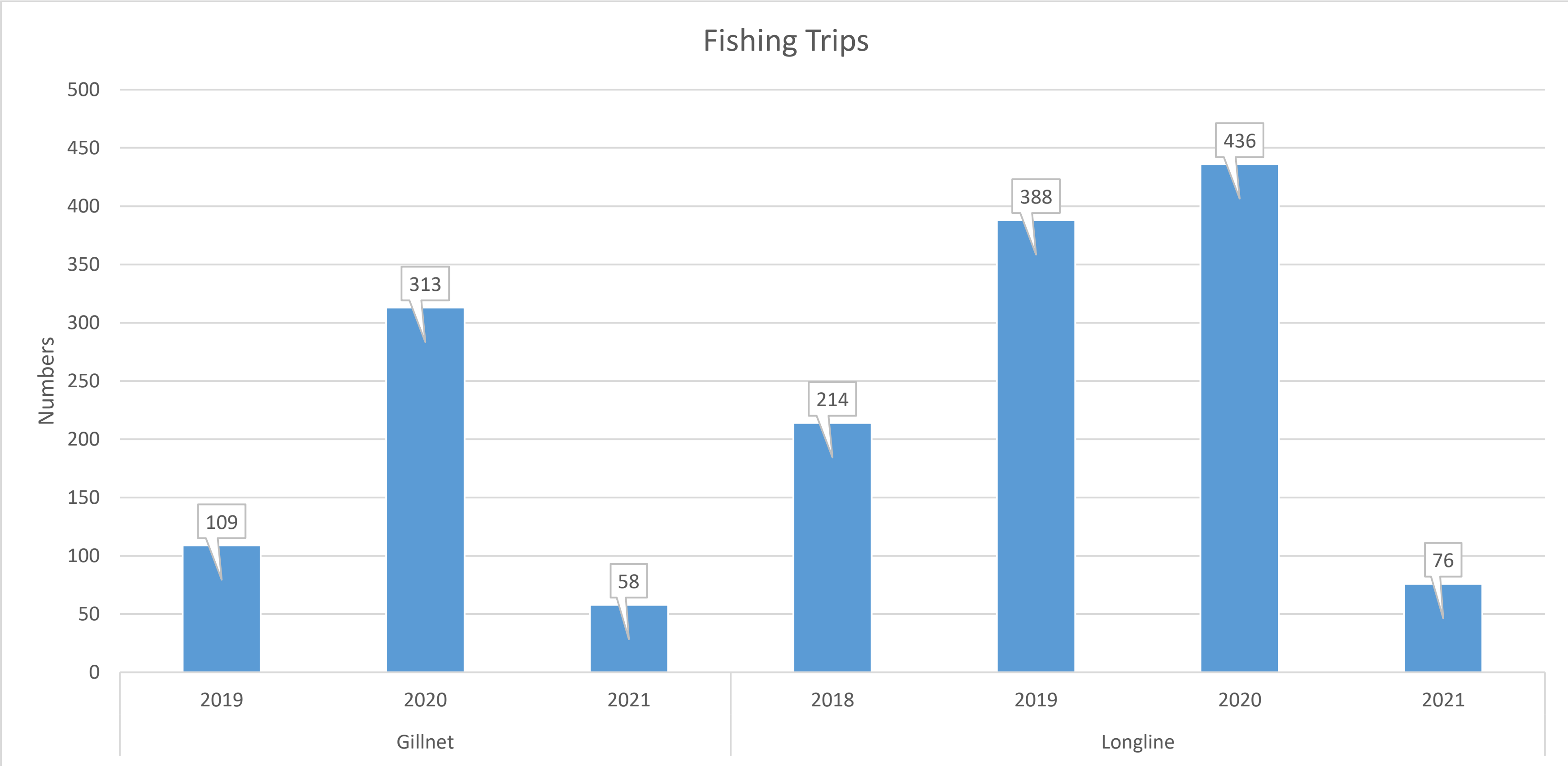
Haul Net	Date	Time	Depth of water (m)	Temp (DC)	Turbidity (m)	Latitude	Longitude
Start							
End							

Catch composition			Length of Fish (cm)					Status			
Target Species	Quantity	Weight (kg)	1	2	3	4	5	Retain	Discarded	Released Alive	Released dead

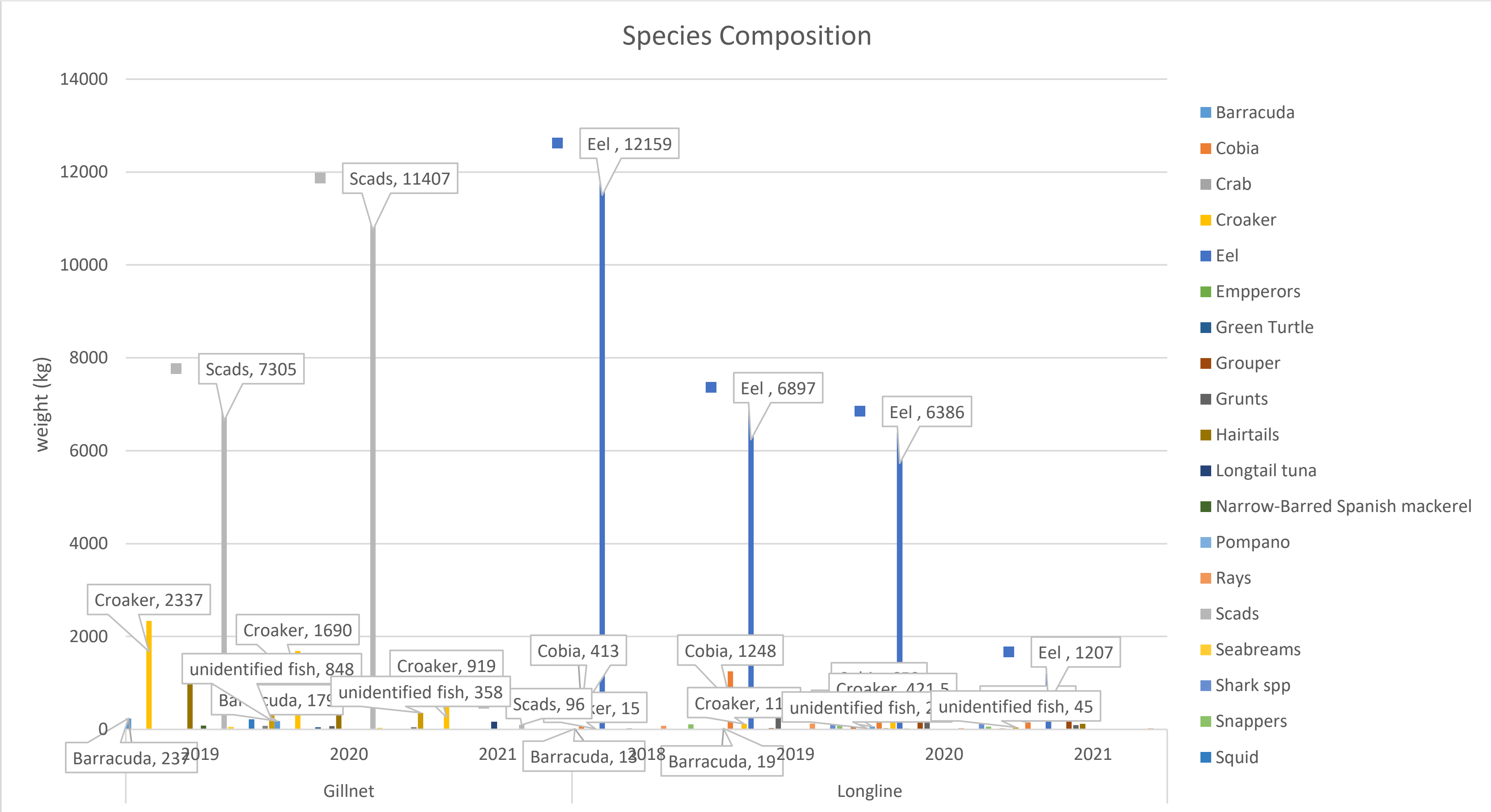
Port arrival		
Target Species	Total kg	Total price/kg

Total expenses/ trip (PKR)	Total income/ trip (PKR)

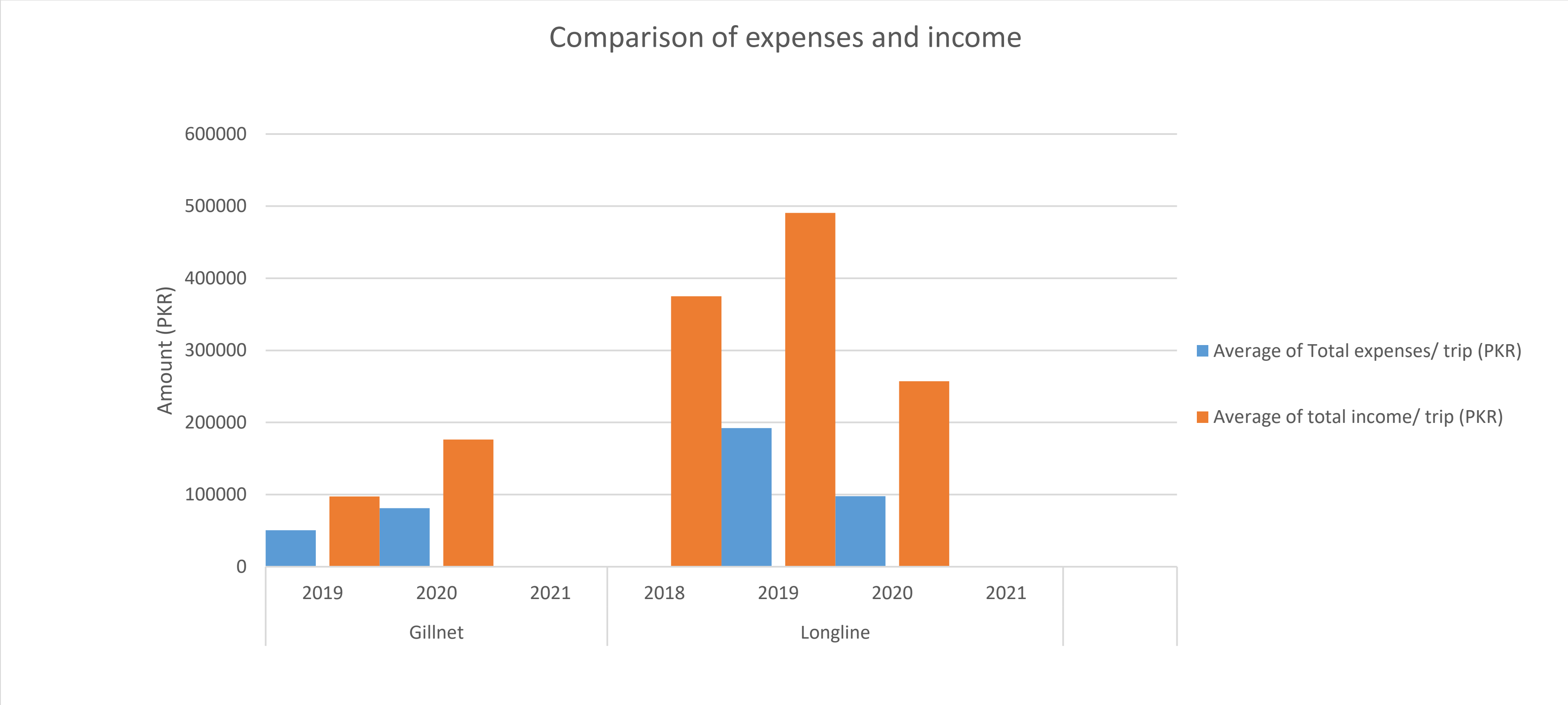
Graph 1: fishing trip of longline and gillnet vessels.



Graph 2: species composition reported during onboard data collection and monitoring from longline and gillnet vessels.



Graph 3: Comparison of the expenses and income of longline and gillnet vessels.



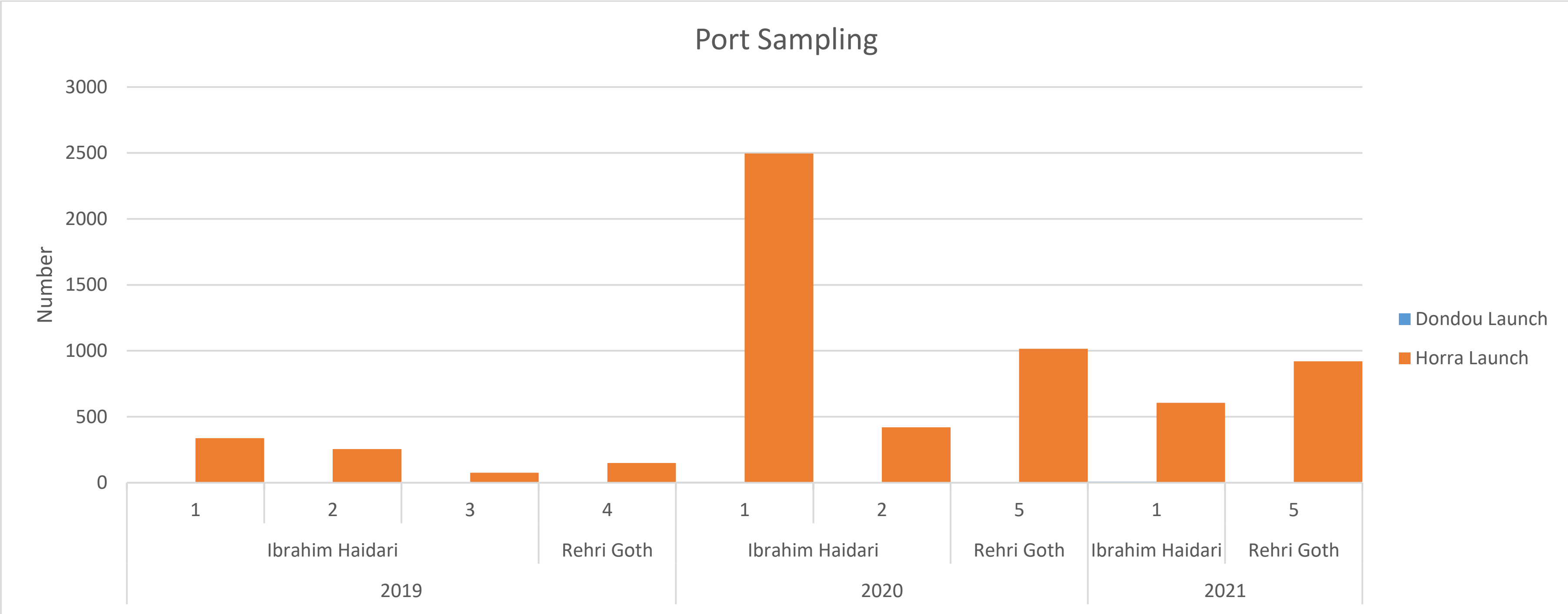
b) Preliminary Analysis of port (landing) sampling

.Figure 2: datasheet used for the data collection and reporting from the landing areas.

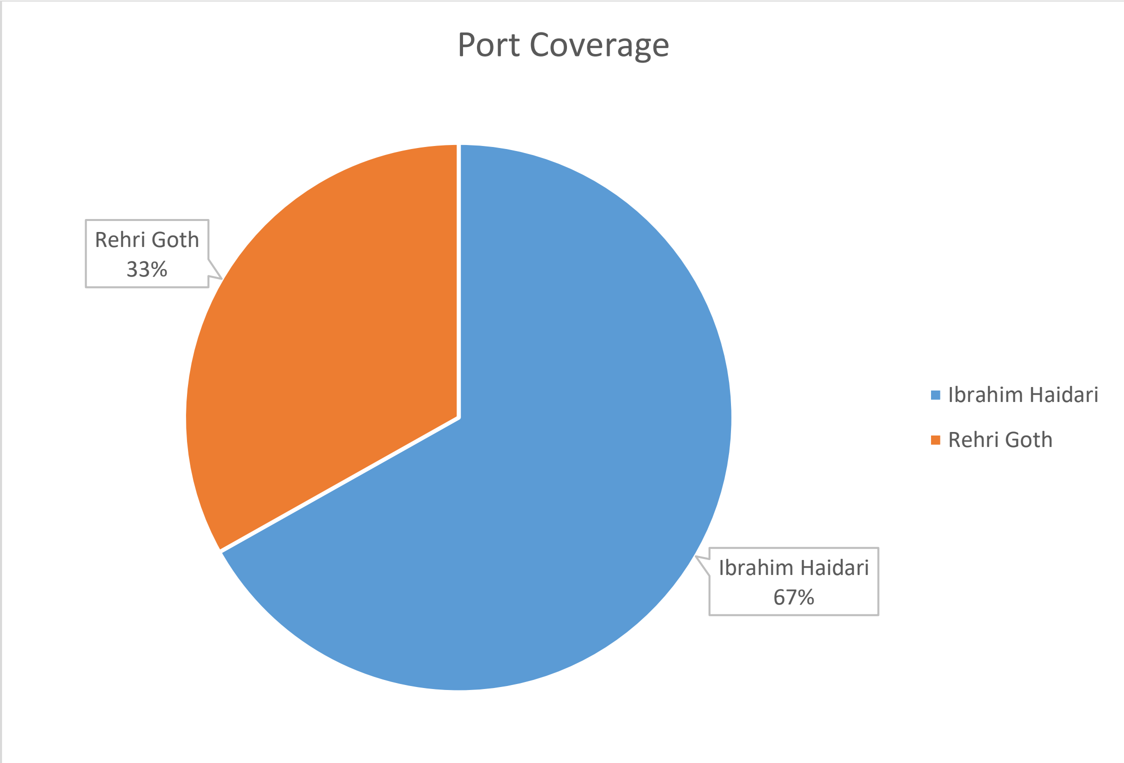
Port Sampling Data Sheet											
Data recorder	**Data provider**	**Date of Data Collection**	**Departure port**	**Arrival port**	**Name of captain**	**Name of boat**	**Registration number**	**Type of Boat**	**No of ice (blocks)**	**Water (liter)**	**Deiseal (Liter)**
Gear Configuration					**Fishing**						
Gear Type Gillnet/Longline	**Length (Km)**	**Width (m)**	**Width (m)**	**net Colour**	**Number of crew**	**Total no.of fishing days**	**Total no.of non fishing days**	**Fishing area**	**Fishing method**	**Total expense (PKR)**	**Total catch price (PKR)**

Catch Composition				**Fish Measurement**									
Fish name	**Qty**	**Weight**	**Price per kg (PKR)**	**1**		**2**		**3**		**4**		**5**	
				length Cm	**width cm**	**length Cm**	**width cm**	**length Cm**	**width cm**	**length Cm**	**width cm**	**length Cm**	**width cm**

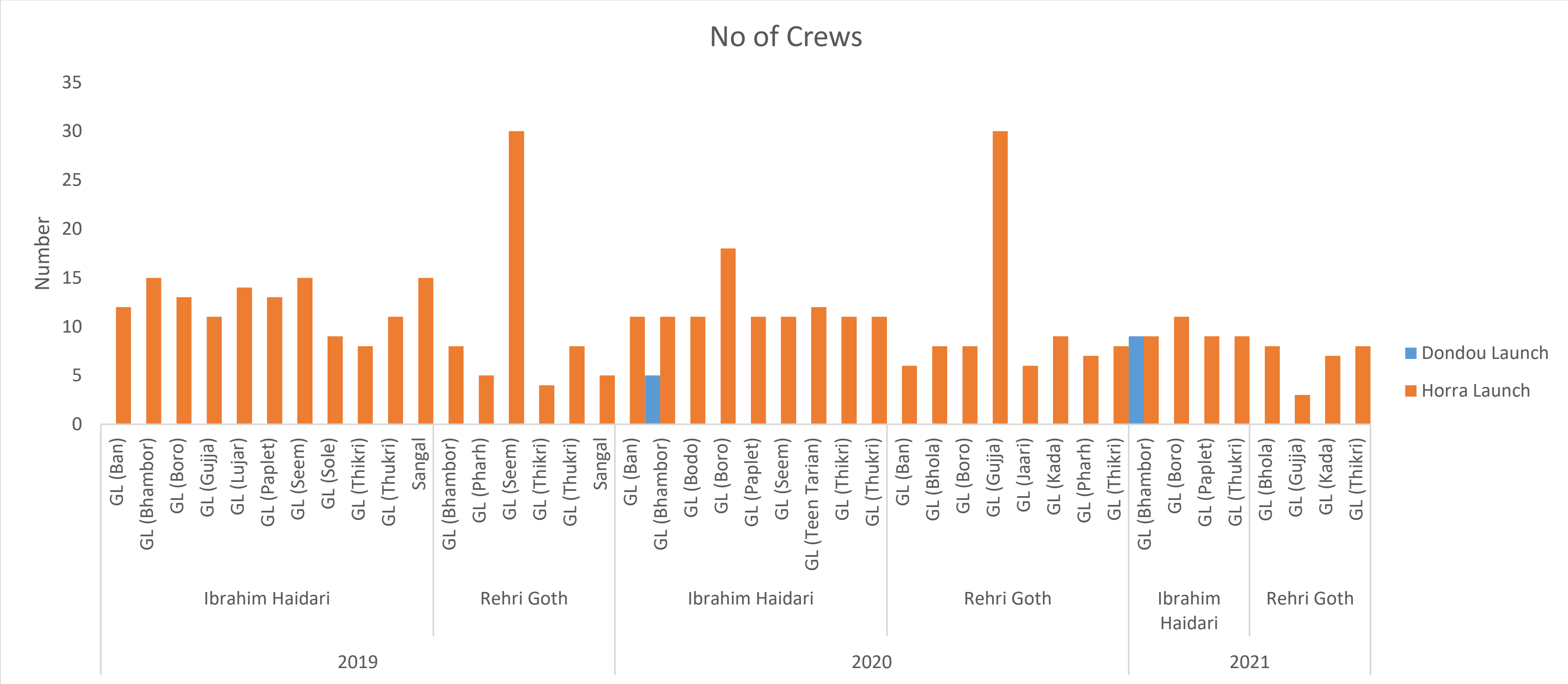
Graph 4: the frequency of the observers collected data from landing areas.



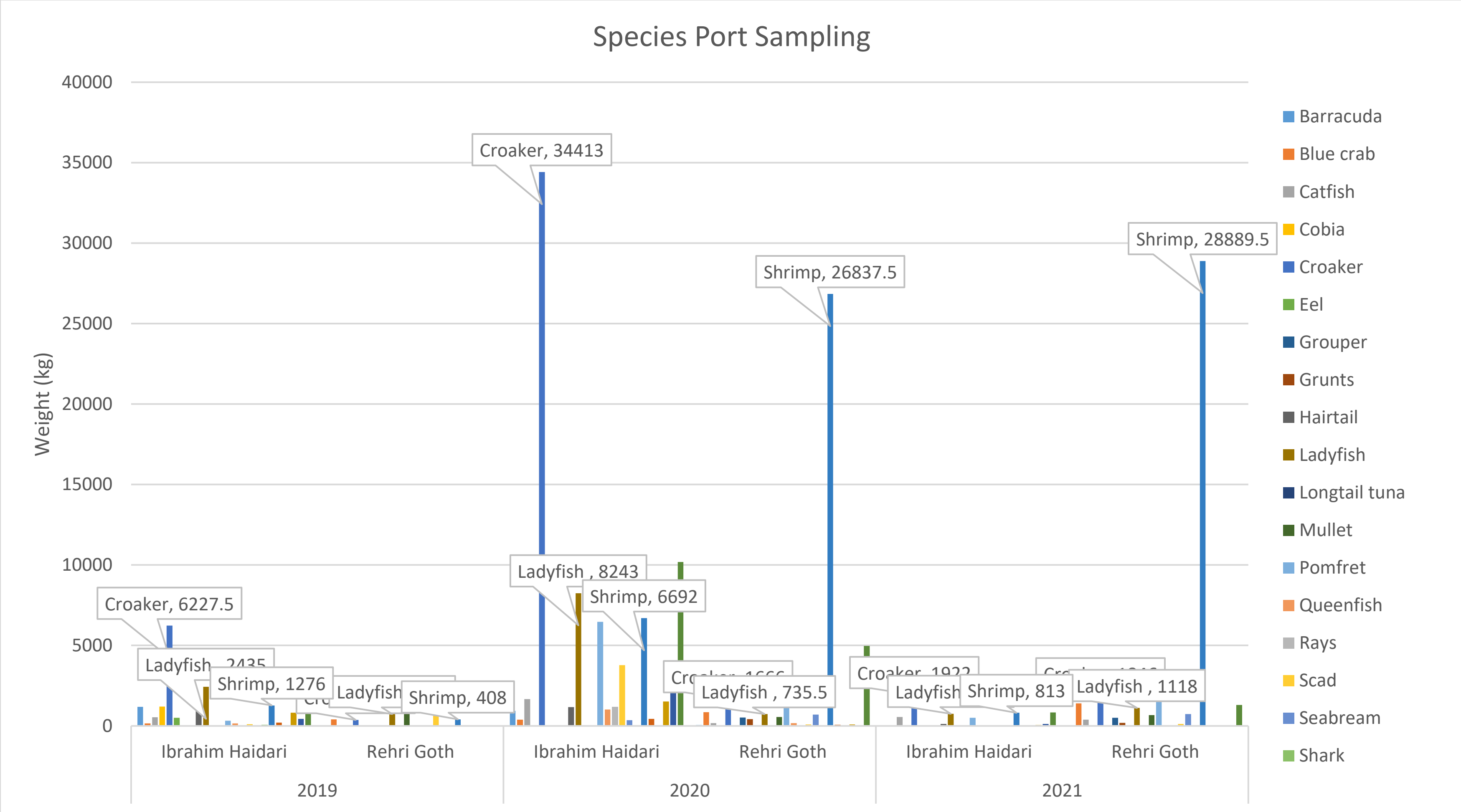
Graph 5: the area coverage of the landing areas from the sampling.



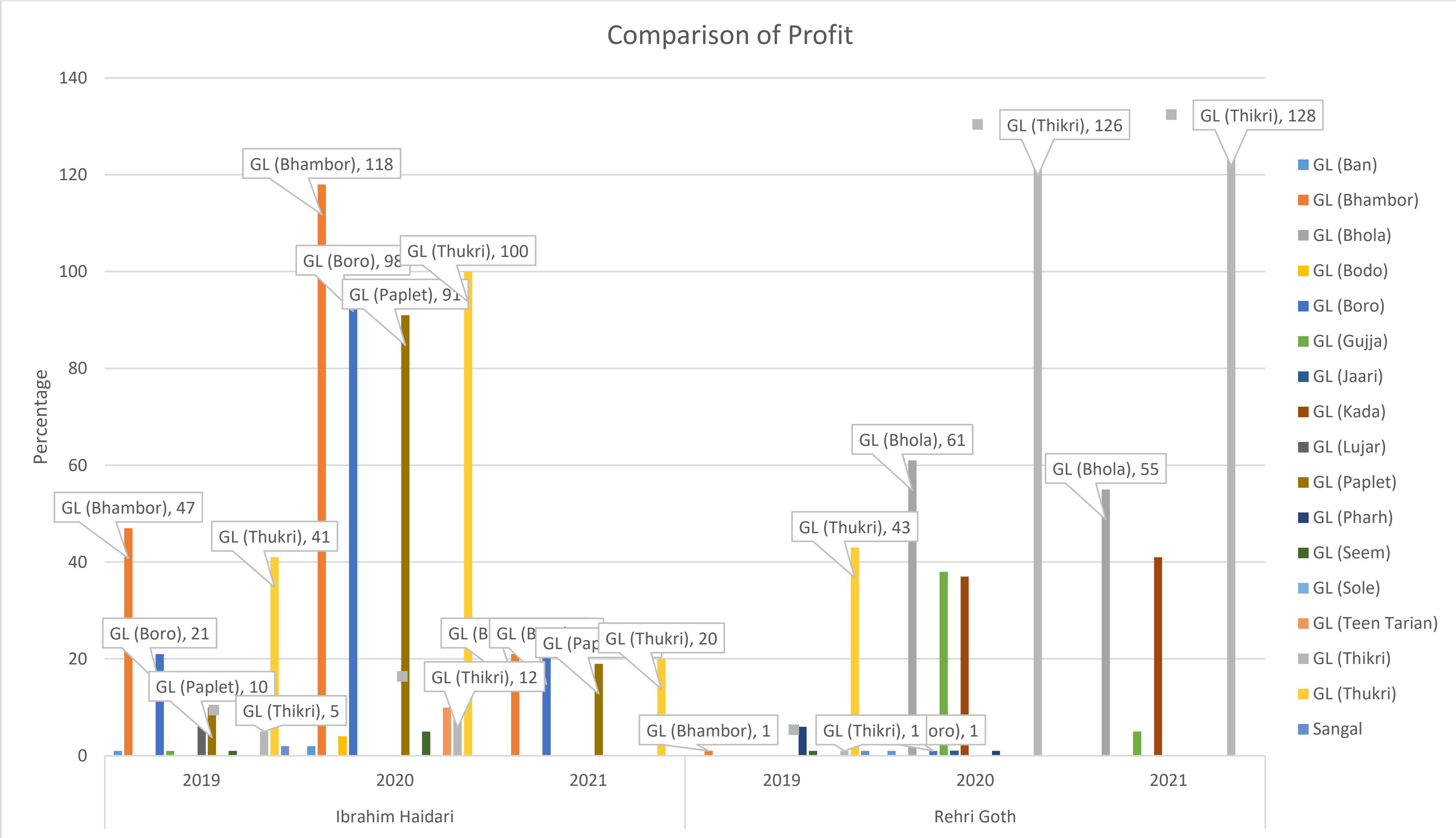
Graph 6: The number of the crews used by the boats from both villages.



Graph 7: The species composition recorded from different boat types from the landing areas.

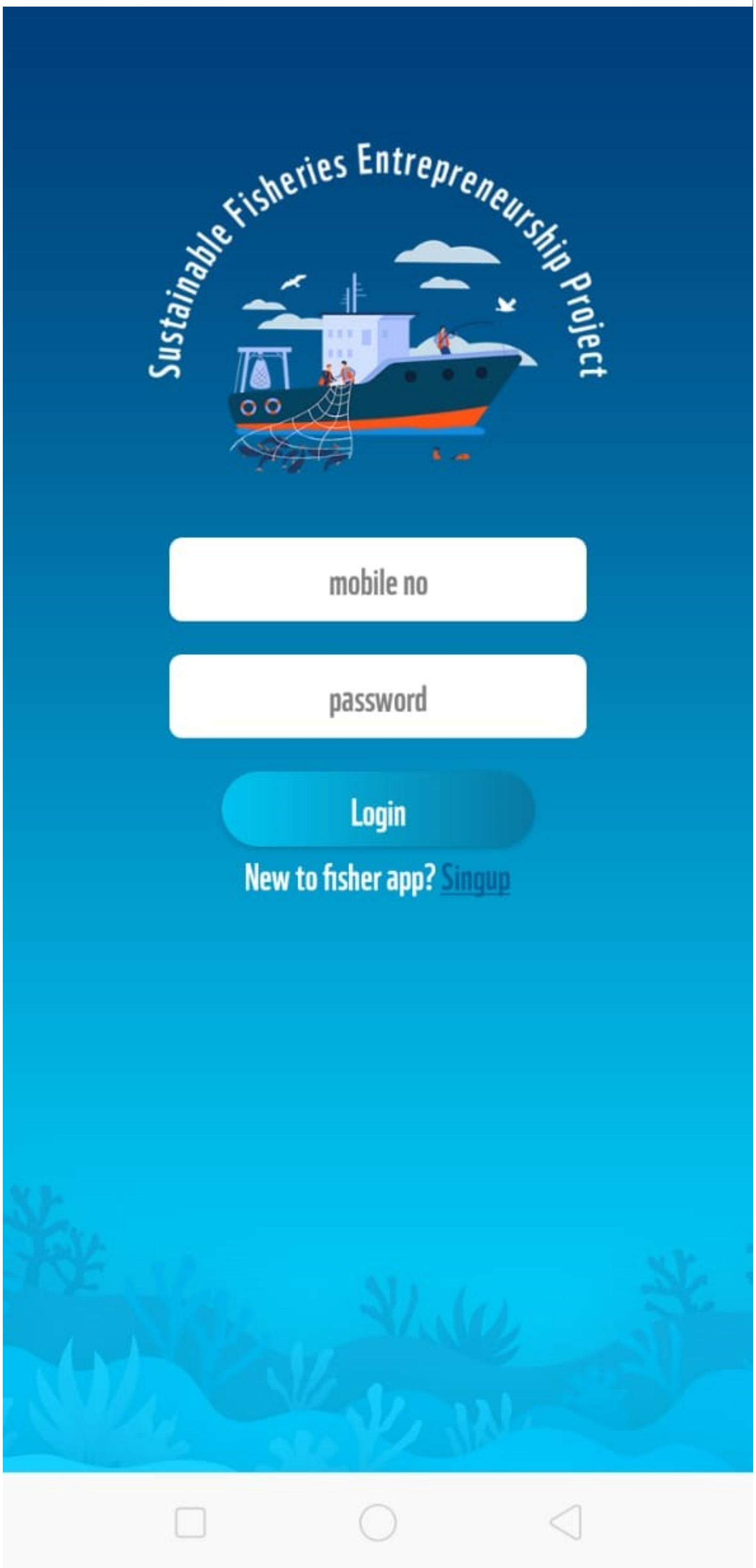


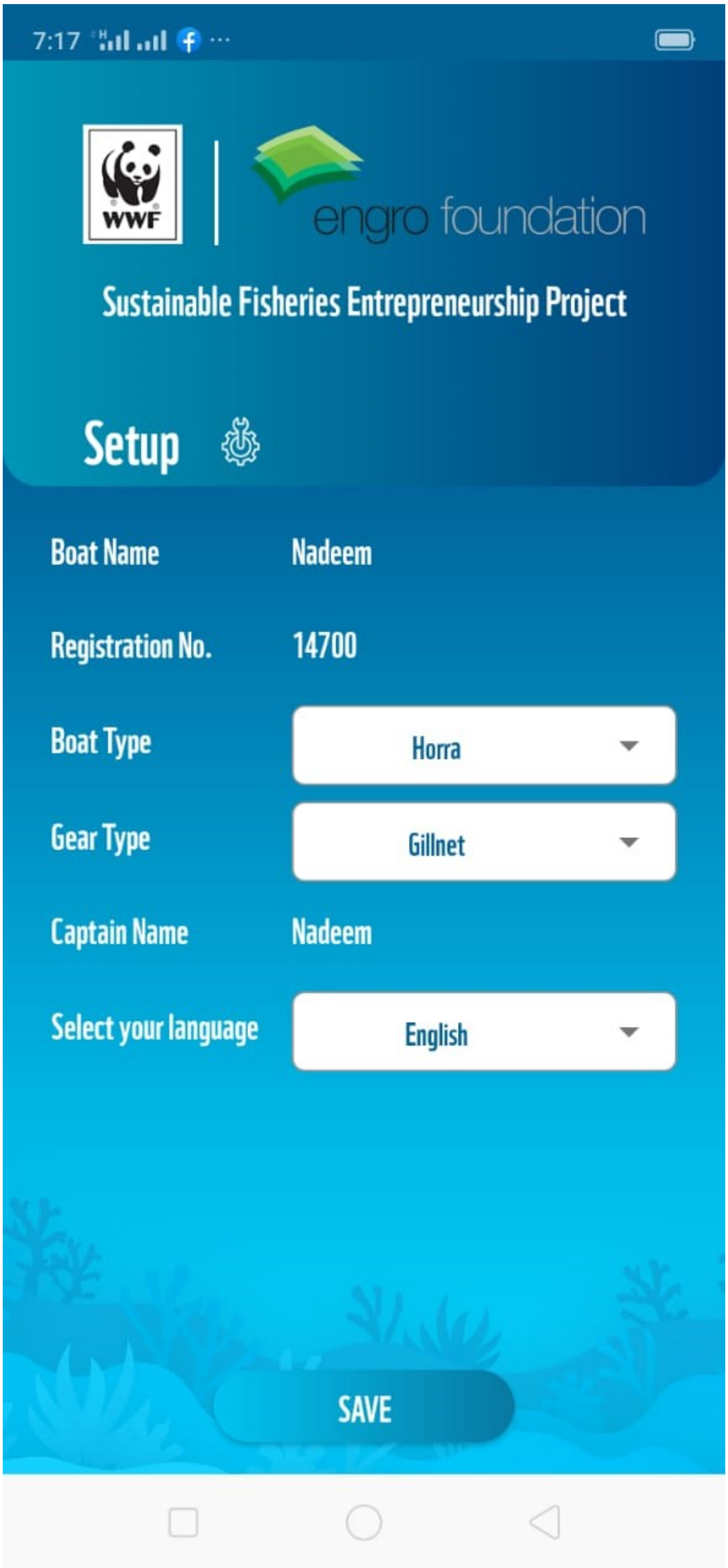
Graph 8: The comparison of the profit of the boats using different gears and landing their catches in villages-based landing areas.



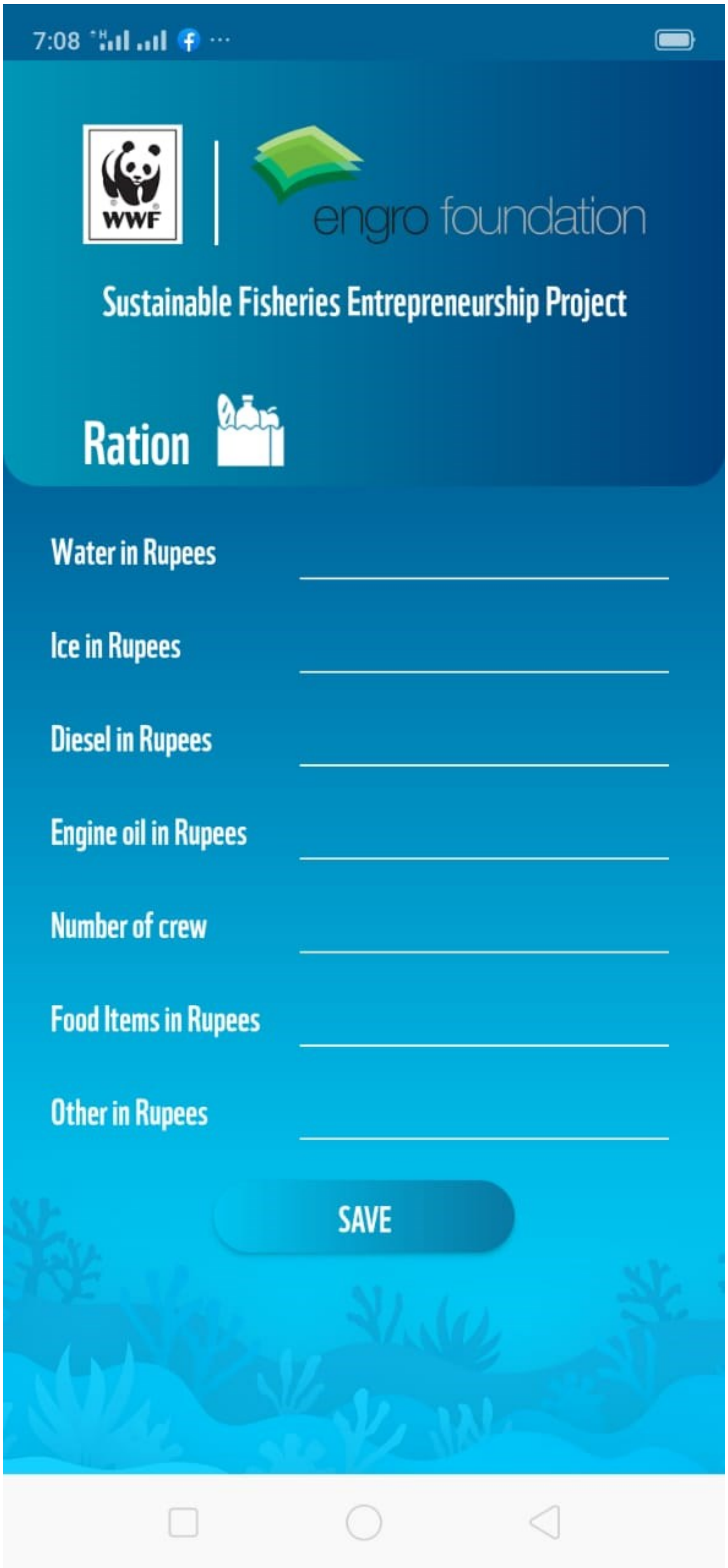
E-log for the data collection & reporting from small scale fisheries

Figure 3: -log for the on board data collection & reporting from small scale fisheries



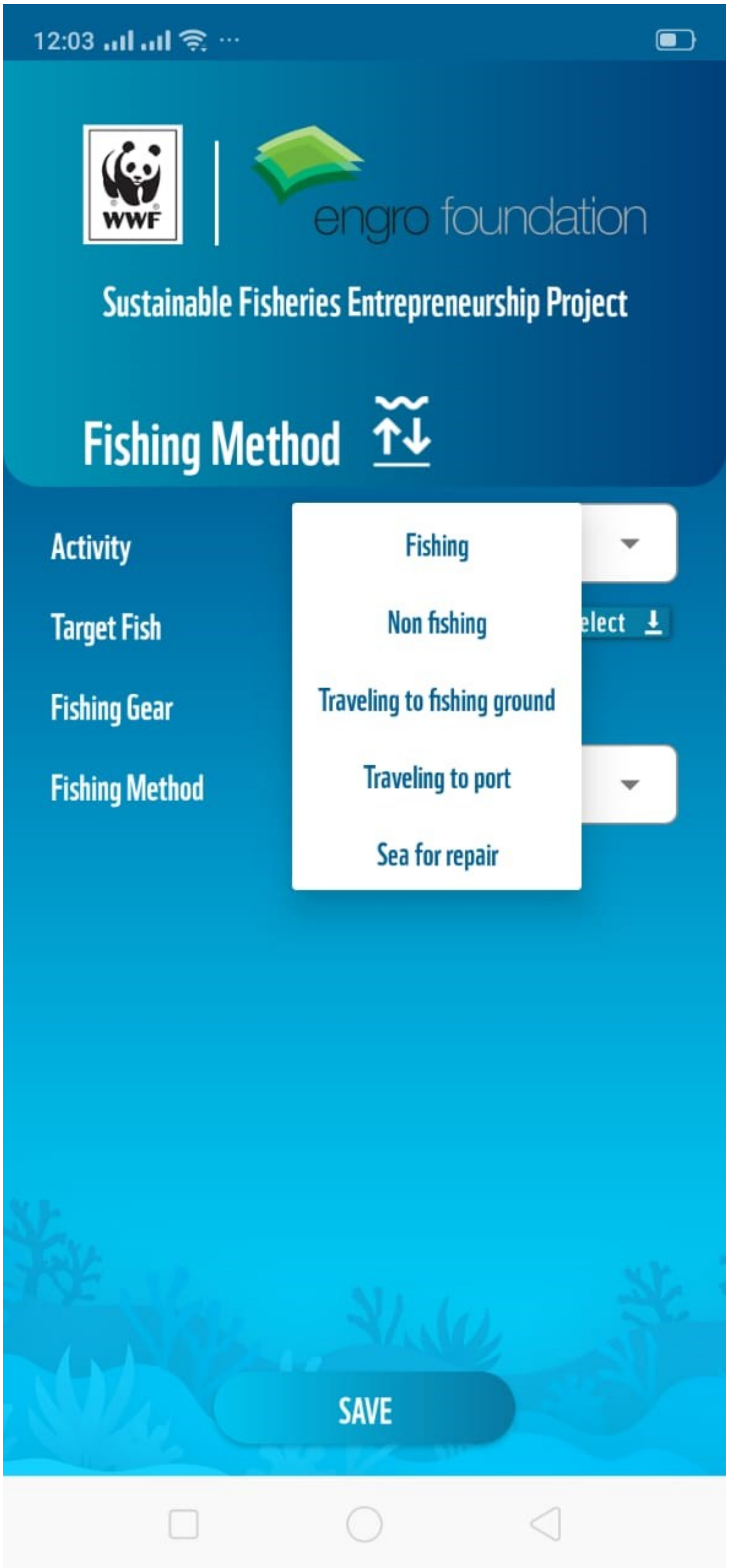

7:17
engro foundation
Sustainable Fisheries Entrepreneurship Project
Setup
Boat Name
Nadeem
Registration No.
14700
Boat Type
Horra
Gear Type
Gillnet
Captain Name
Nadeem
Select your language
English
SAVE

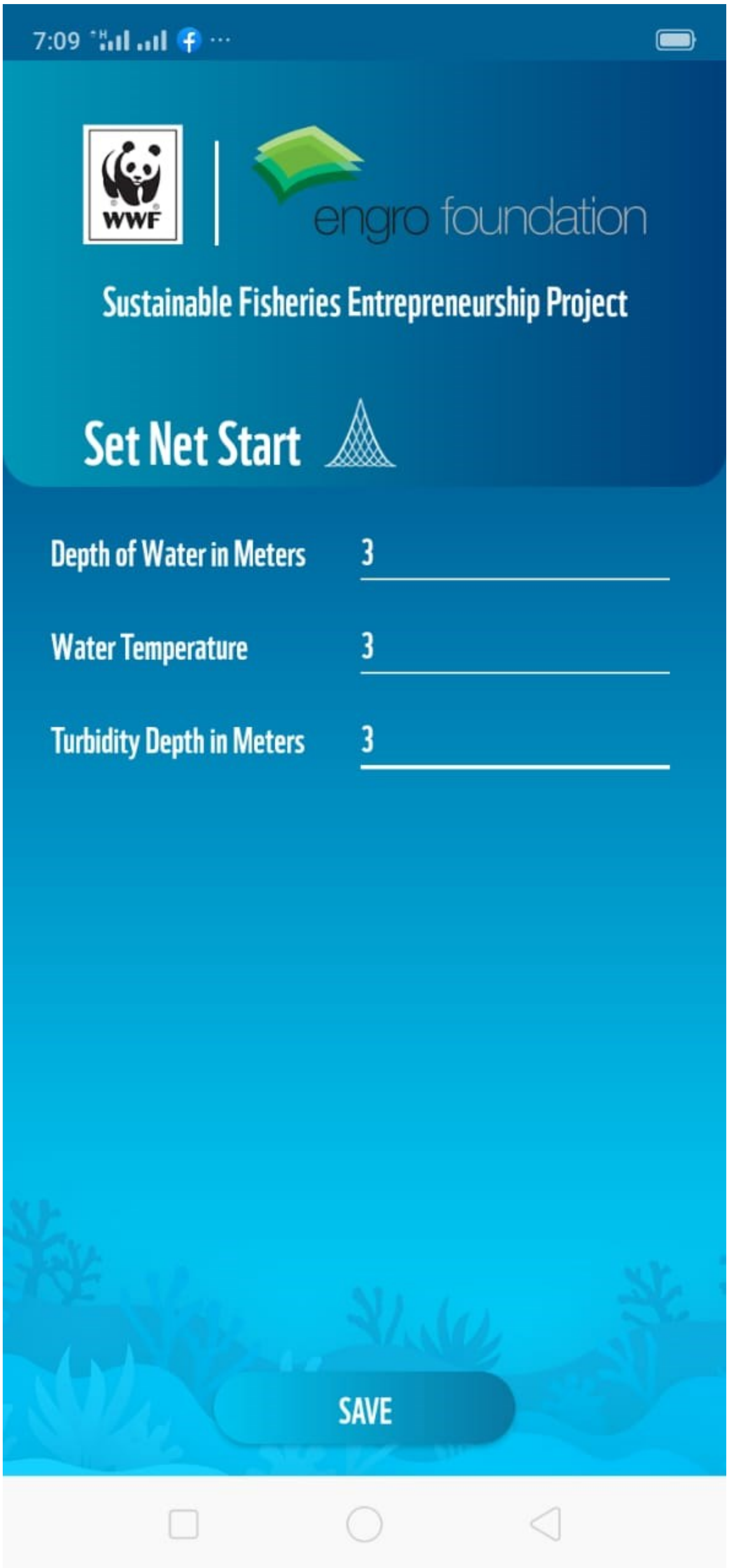

3:00
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Name: Nadeem
Reg no: 14700
Boat type: Horra
Boat Name: Horra
Fishing
Departure
Equipment
Fishing Operations
Fish Catch

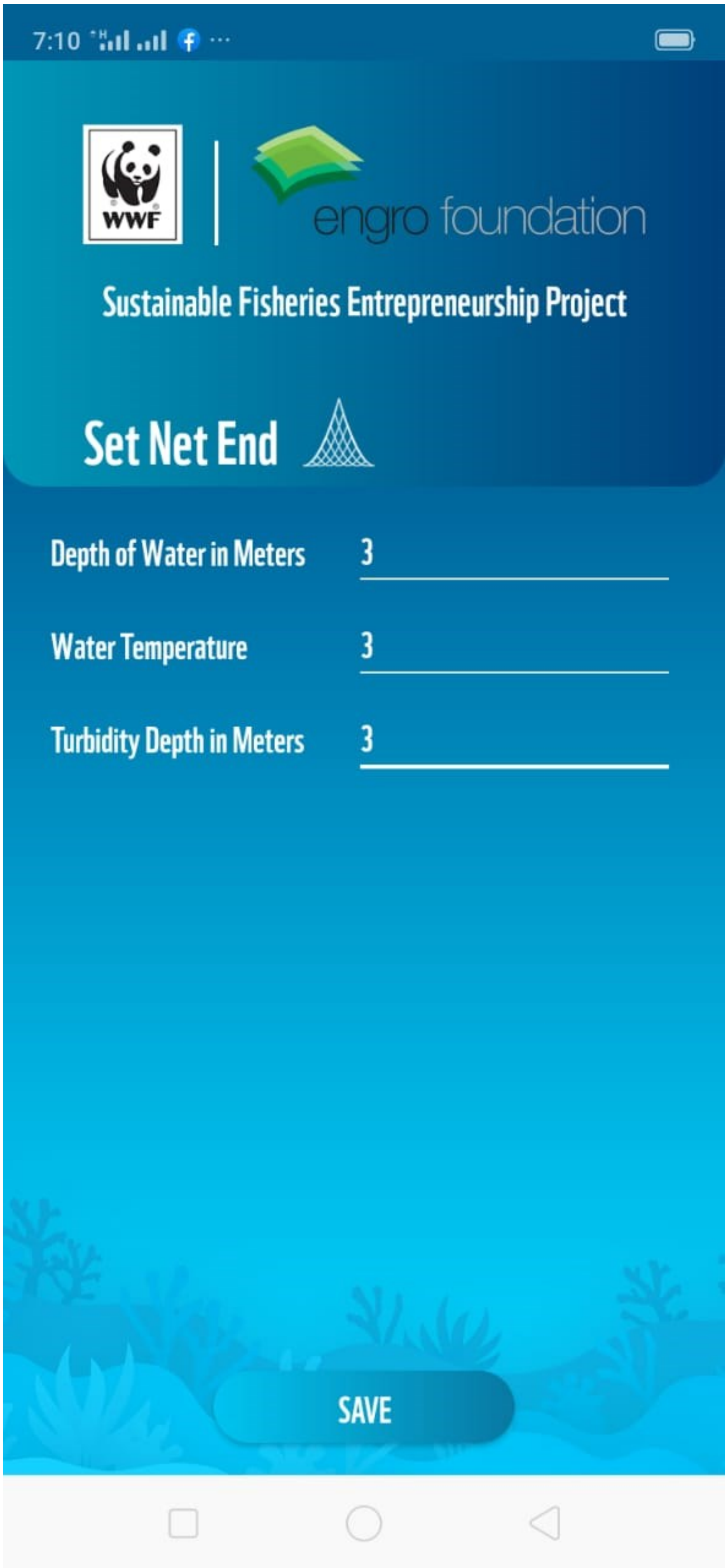

7:08
engro foundation
Sustainable Fisheries Entrepreneurship Project
Ration
Water in Rupees
Ice in Rupees
Diesel in Rupees
Engine oil in Rupees
Number of crew
Food Items in Rupees
Other in Rupees
SAVE

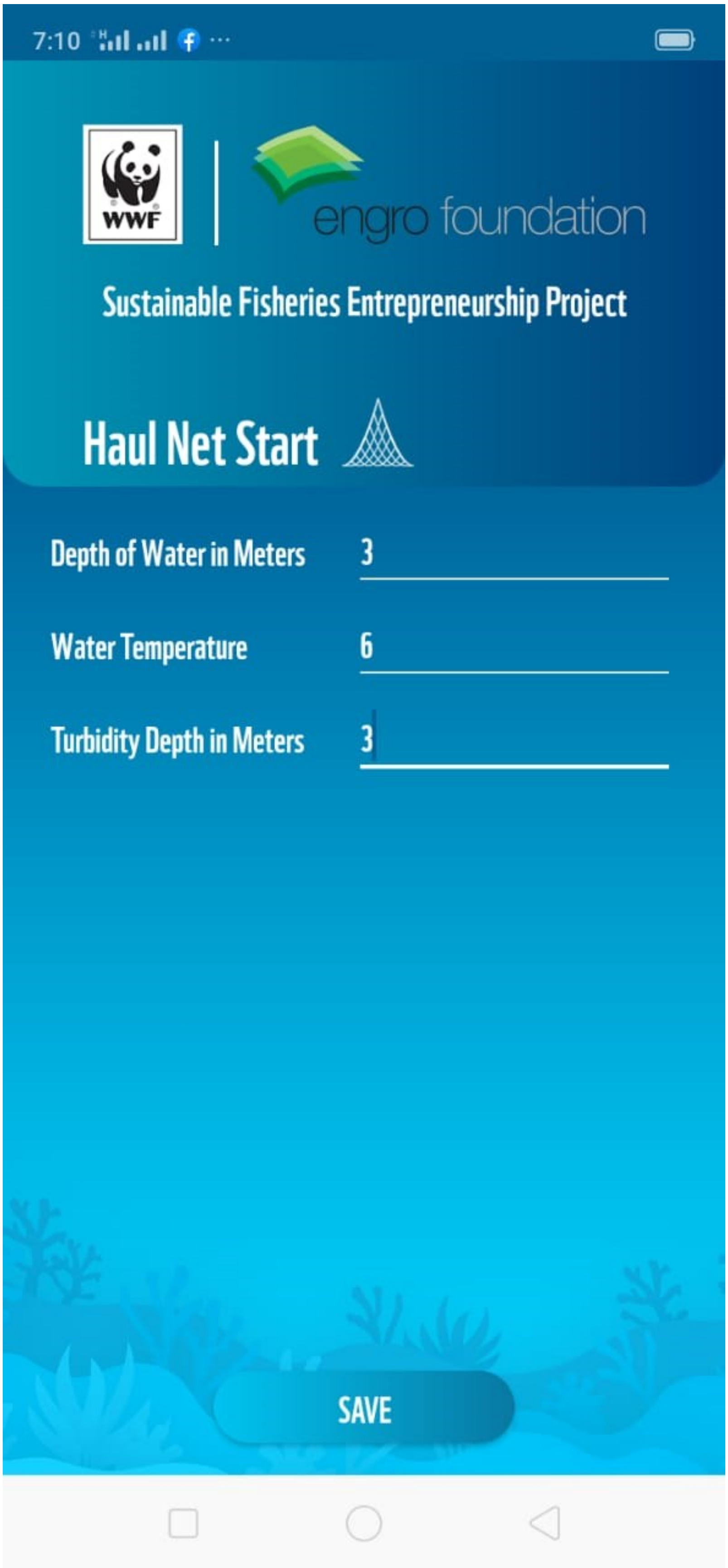

7:08
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Gillnet
Gear Configuration
Length of Net in Km
1
Width in meters
3
Length of one panel in Km
200
Color of net
Green
Mesh size in mm
50
Type of float
Malta
Number of floats
100
Floats spacing in meters
6
Weight of sinkers in Kg
10
SAVE


7:09
engro foundation
WWF
Sustainable Fisheries Entrepreneurship Project
Name: Nadeem
Reg no: 14700
Boat type: Horra
Boat Name: Horra
Fishing
Departure
Equipment
Fishing Operations
Fish Catch


12:03
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Fishing Method
Activity
Target Fish
Fishing Gear
Fishing Method
Fishing
Non fishing
Traveling to fishing ground
Traveling to port
Sea for repair
SAVE


7:09
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Set Net Start
Depth of Water in Meters
3
Water Temperature
3
Turbidity Depth in Meters
3
SAVE


7:10
engro foundation
WWF
Sustainable Fisheries Entrepreneurship Project
Set Net End
Depth of Water in Meters
3
Water Temperature
3
Turbidity Depth in Meters
3
SAVE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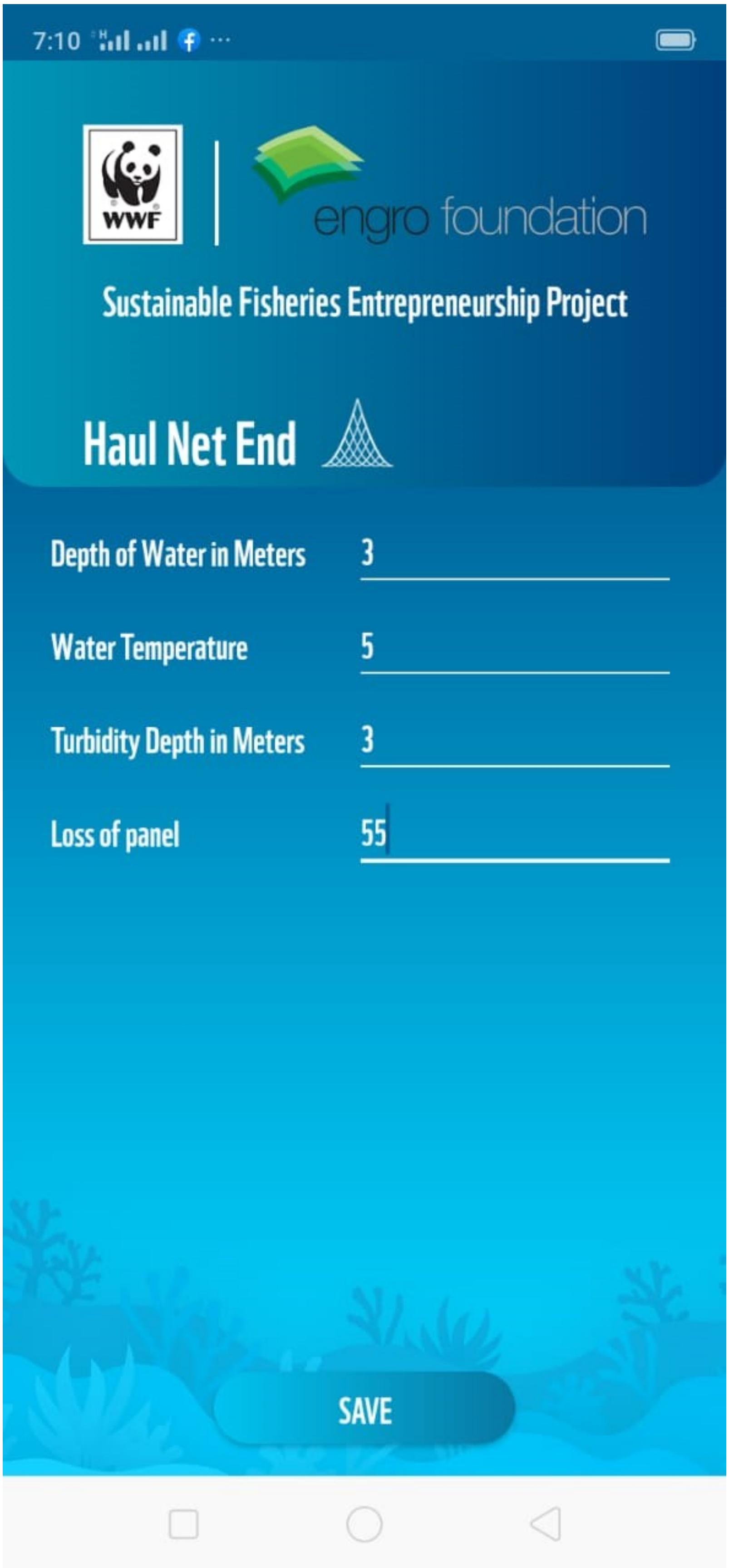
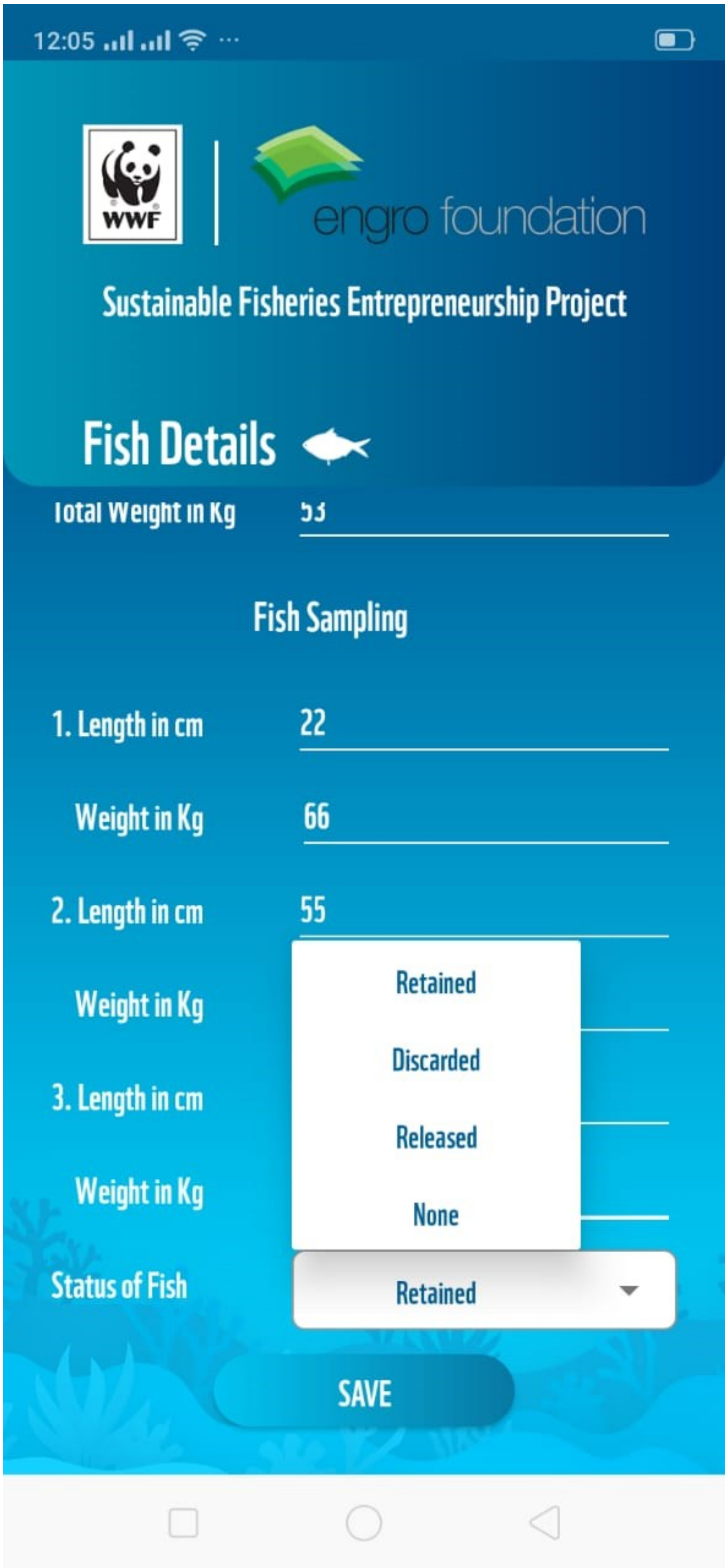
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Haul Net Start
Depth of Water in Meters
3
Water Temperature
6
Turbidity Depth in Meters
3
SAVE

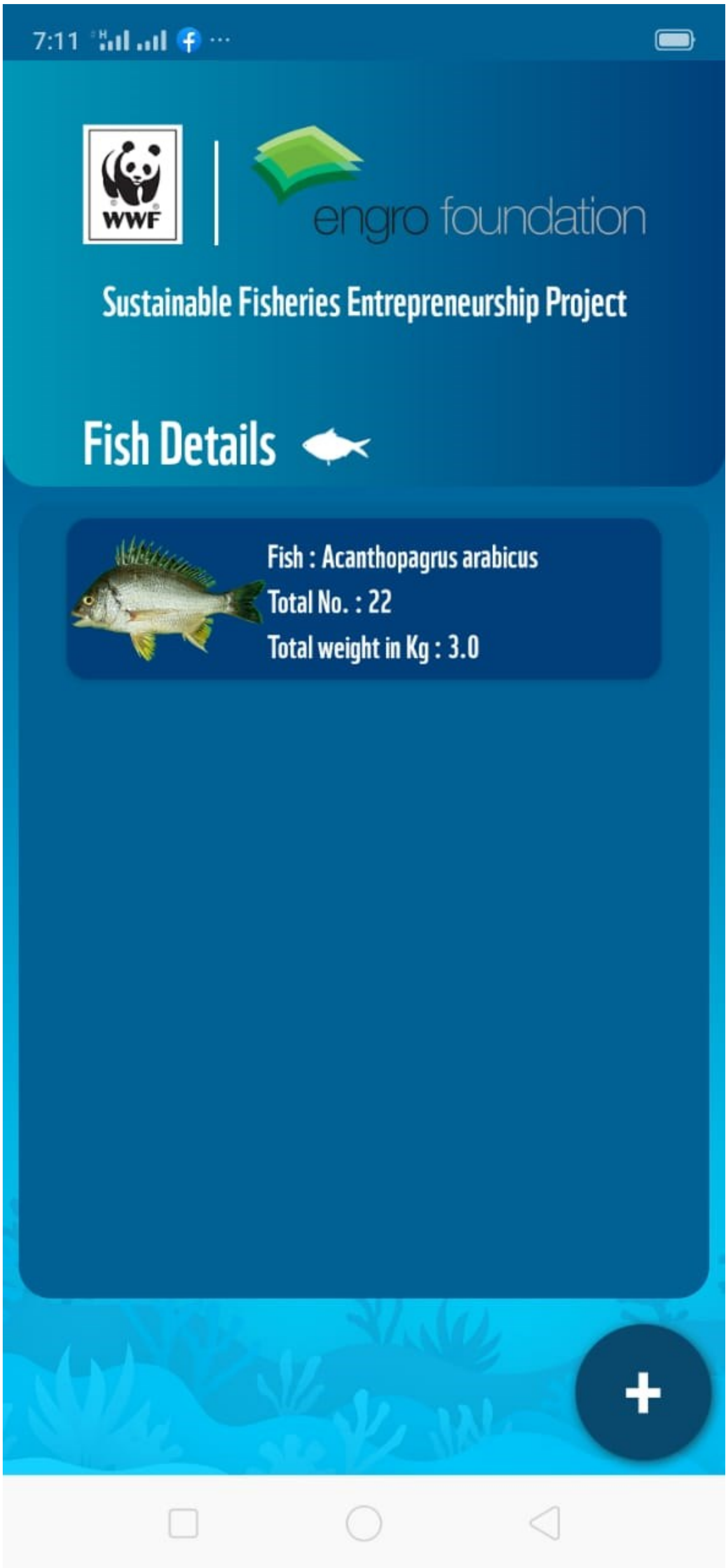

7:10
engro foundation
Sustainable Fisheries Entrepreneurship Project
Haul Net End
Depth of Water in Meters
3
Water Temperature
5
Turbidity Depth in Meters
3
Loss of panel
55
SAVE

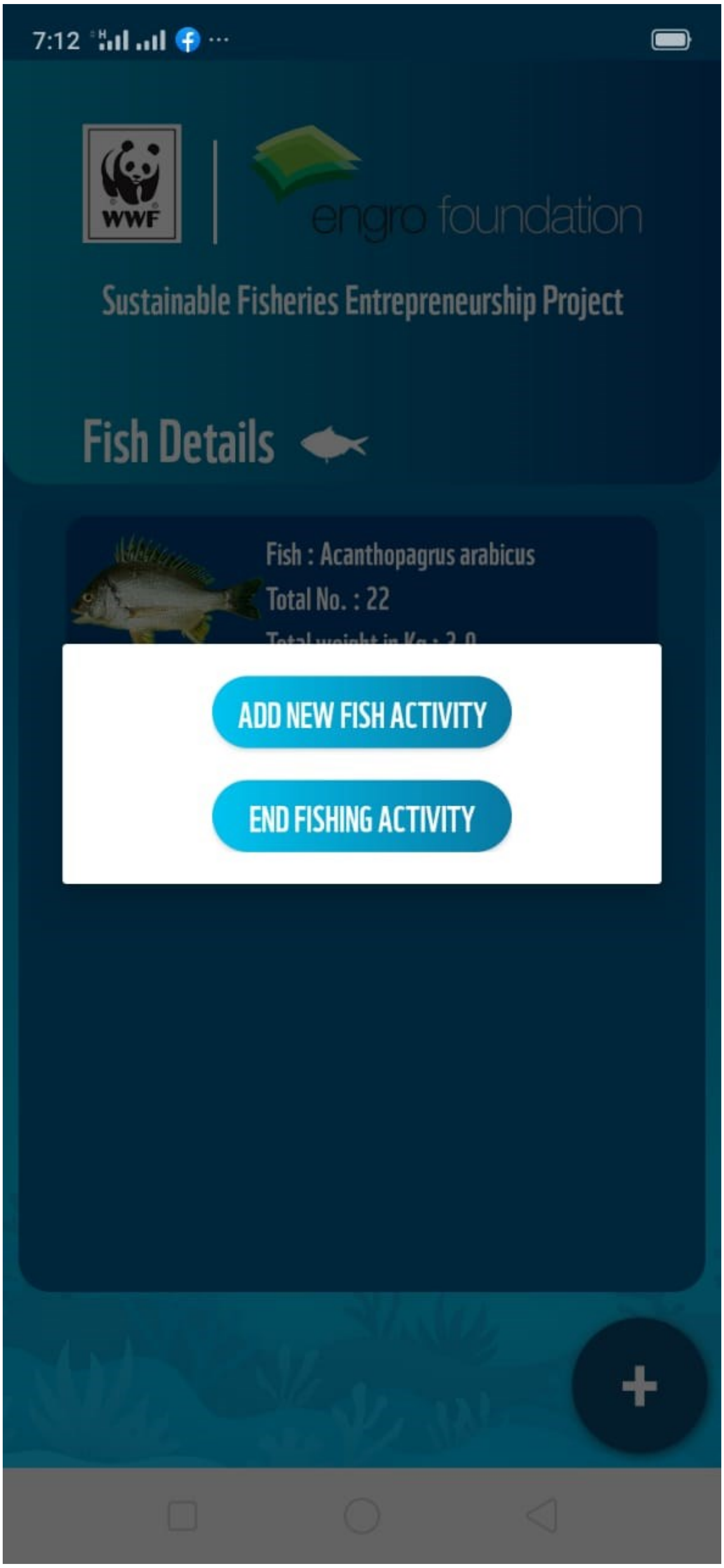

7:10
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Name: Nadeem
Reg no: 14700
Boat type: Horra
Boat Name: Horra
Fishing
Departure
Equipment
Fishing Operations
Fish Catch


7:11
engro foundation
Sustainable Fisheries Entrepreneurship Project
Fish Details
Ablennes hians
Acanthopagrus arabicus
Alectis indica
Amphioctopus marginatus
Anadontostoma chacunda
Argyrops spinifer


7:11
engro foundation
Sustainable Fisheries Entrepreneurship Project
Fish Details
Fish group
Acanthopagrus arabicus
Select
Total number
22
Total Weight in Kg
3
Fish Sampling
1. Length in cm
2
Weight in Kg
2
2. Length in cm
3
Weight in Kg
1
3. Length in cm
6
Weight in Kg
2

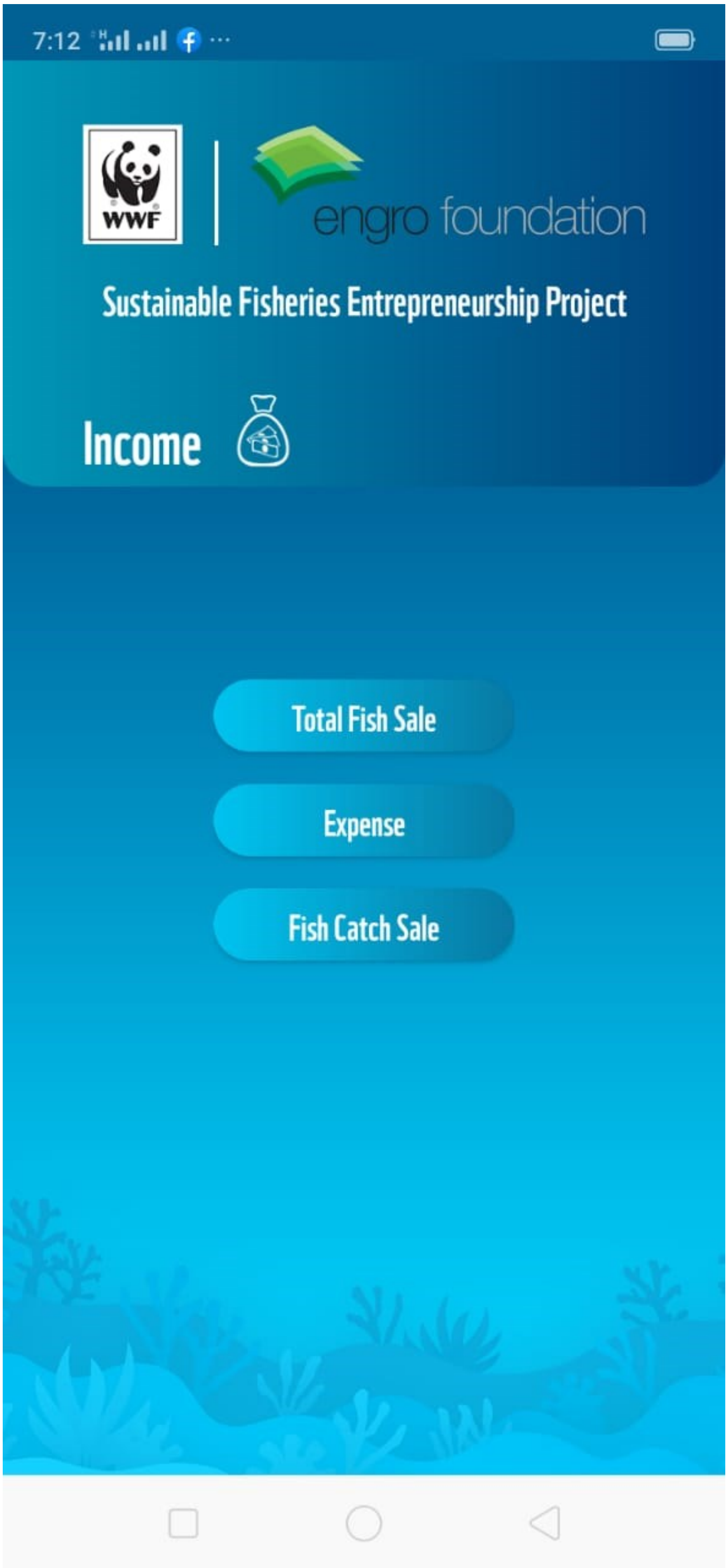

12:05
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Fish Details
Total Weight in Kg
53
Fish Sampling
1. Length in cm
22
Weight in Kg
66
2. Length in cm
55
Weight in Kg
3. Length in cm
Weight in Kg
Retained
Discarded
Released
None
Status of Fish
Retained
SAVE


7:11
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Fish Details
Fish : Acanthopagrus arabicus
Total No. : 22
Total weight in Kg : 3.0

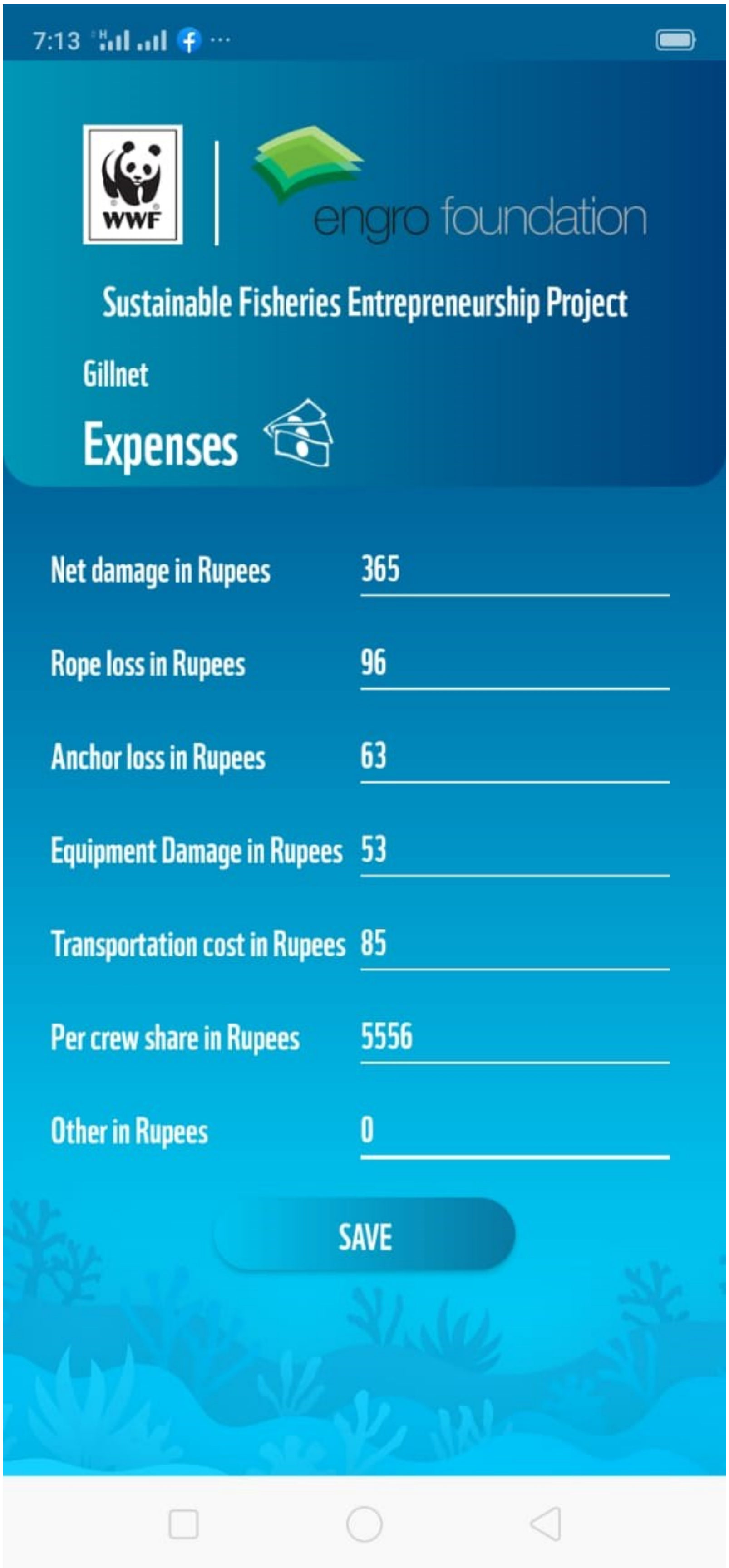

7:12
Sustainable Fisheries Entrepreneurship Project
Fish Details
Fish : Acanthopagrus arabicus
Total No. : 22
ADD NEW FISH ACTIVITY
END FISHING ACTIVITY

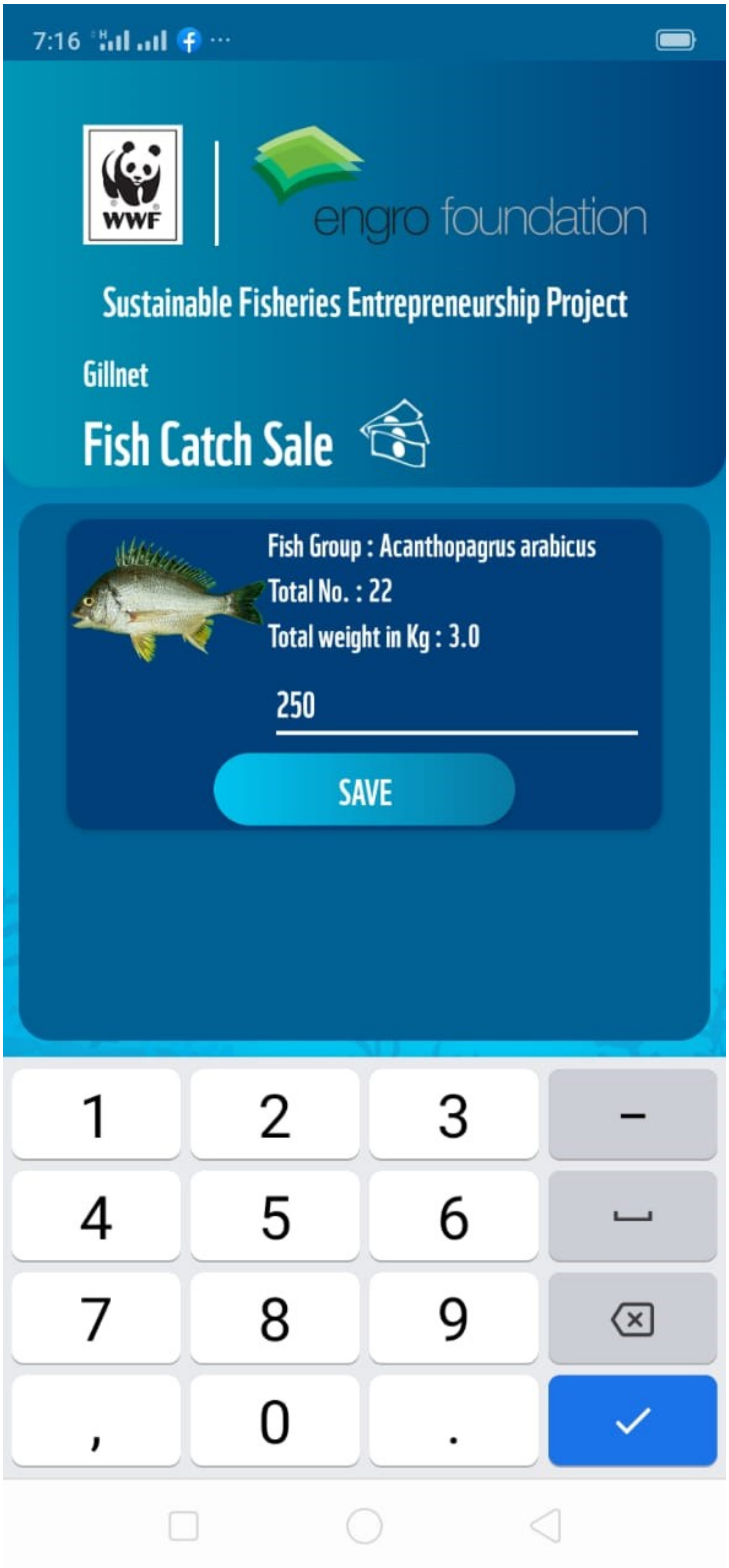

7:12
engro foundation
Sustainable Fisheries Entrepreneurship Project
Name: Nadeem
Reg no: 14700
Boat type: Horra
Boat Name: Horra
Fishing
Departure
Equipment
Fishing Operations
Fish Catch
Arrival
Income


7:12
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Name: Nadeem
Reg no: 14700
Boat type: Horra
Boat Name: Horra
Fishing
Departure
Equipment
Fishing Operations
Fish Catch
Arrival
Income


7:12
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Income
Total Fish Sale
Expense
Fish Catch Sale


7:13
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Gillnet
Total Fish Sale
Total Sale in Rupees
2560000
SAVE


7:13
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Gillnet
Expenses
Net damage in Rupees 365
Rope loss in Rupees 96
Anchor loss in Rupees 63
Equipment Damage in Rupees 53
Transportation cost in Rupees 85
Per crew share in Rupees 5556
Other in Rupees 0
SAVE


7:16
engro foundation
Sustainable Fisheries Entrepreneurship Project
Gillnet
Fish Catch Sale
Fish Group : Acanthopagrus arabicus
Total No. : 22
Total weight in Kg : 3.0
250
SAVE
1
2
3
4
5
6
7
8
9
0


7:16
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Name: Nadeem
Reg no: 14700
Boat type: Horra
Boat Name: Horra
Fishing
Fishing Operations
Fish Catch
Arrival
Income
Trip Summary
Settings


7:17
WWF
engro foundation
Sustainable Fisheries Entrepreneurship Project
Trip Summary
Trip number 2
Trip duration (Days) -5
Food cost (PKR) 6
Water cost (PKR) 3
Diesel cost (PKR) 6
Ice cost (PKR) 6
Net damage cost (PKR) 365
Ropes loss (PKR) 96
Anchor loss (PKR) 63
Equipment damage cost (PKR) 53
Others cost (PKR) 0
Total crew share (PKR) 33336
Total fish rates of the trip (PKR) 0
Total fish sale at harbor (PKR) 0
Total Expenses (PKR) 33934
Net Income (PKR) -33934

Improved data collection mechanism for data quality/ standardization required on species-level identification through alternative tools and emerging technologies such as machine learning and artificial intelligence

Figure 4: The convolution neural network technique is used to detect the species by AI machine learning.

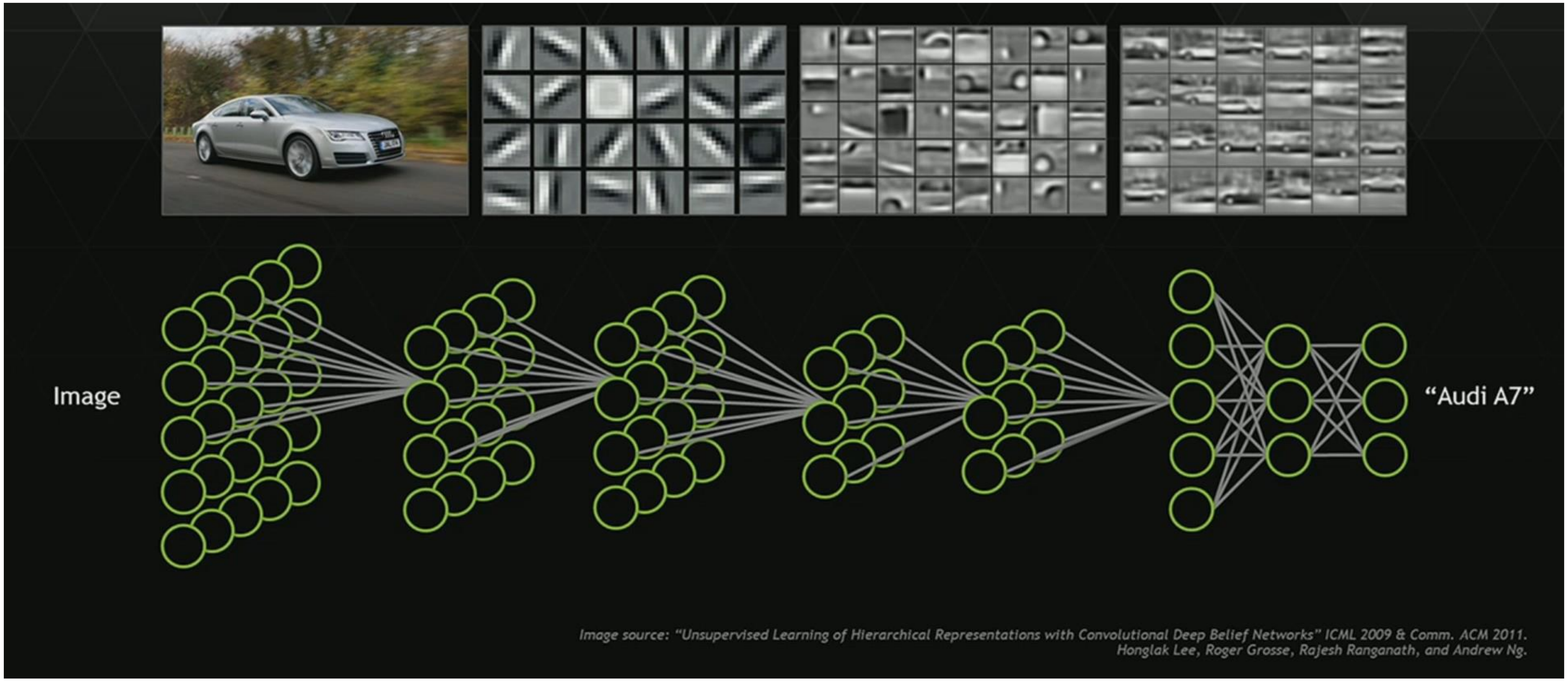


Figure 5:: AI Prototype machine learning used underwater images of the shark to detect the unique characteristics.

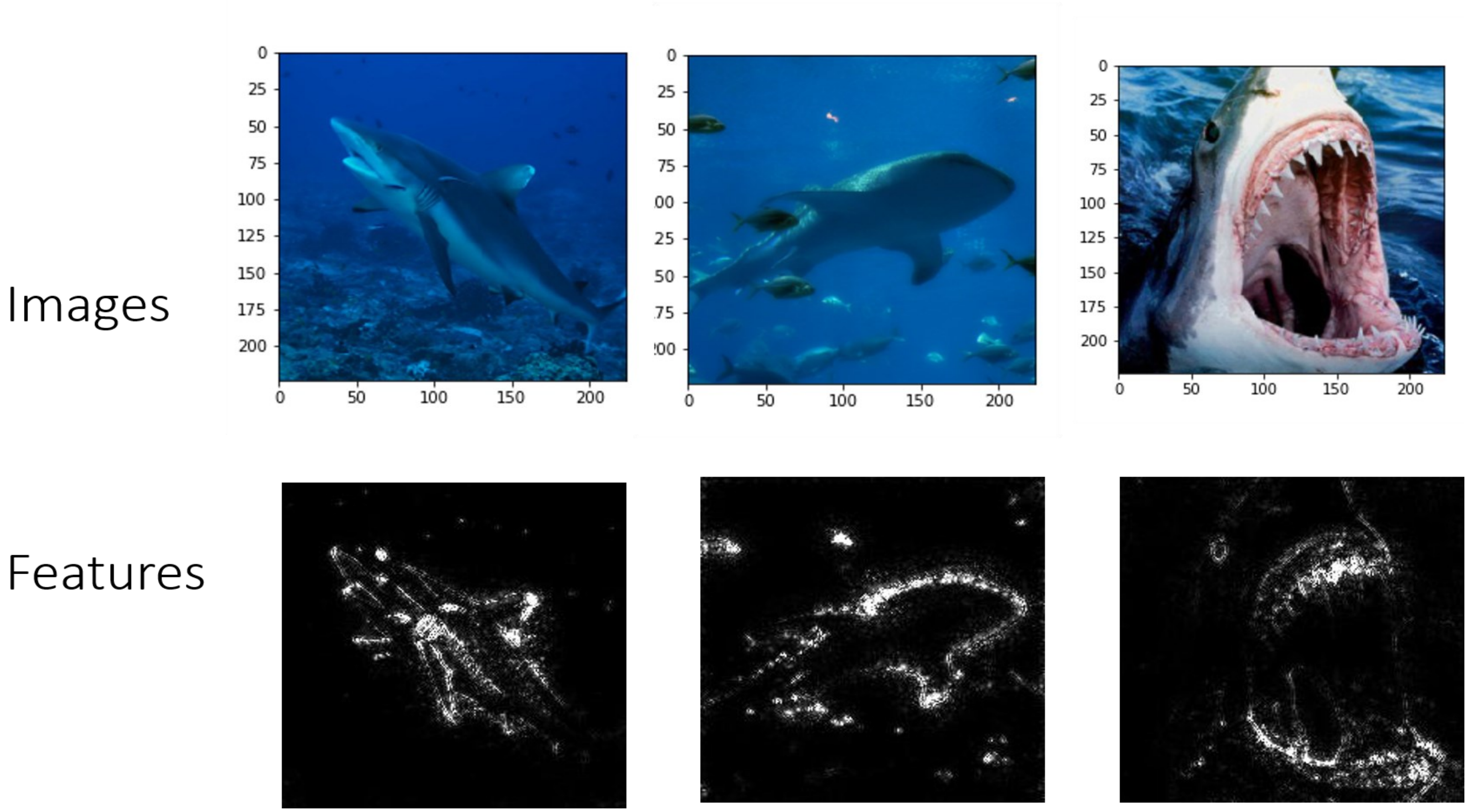
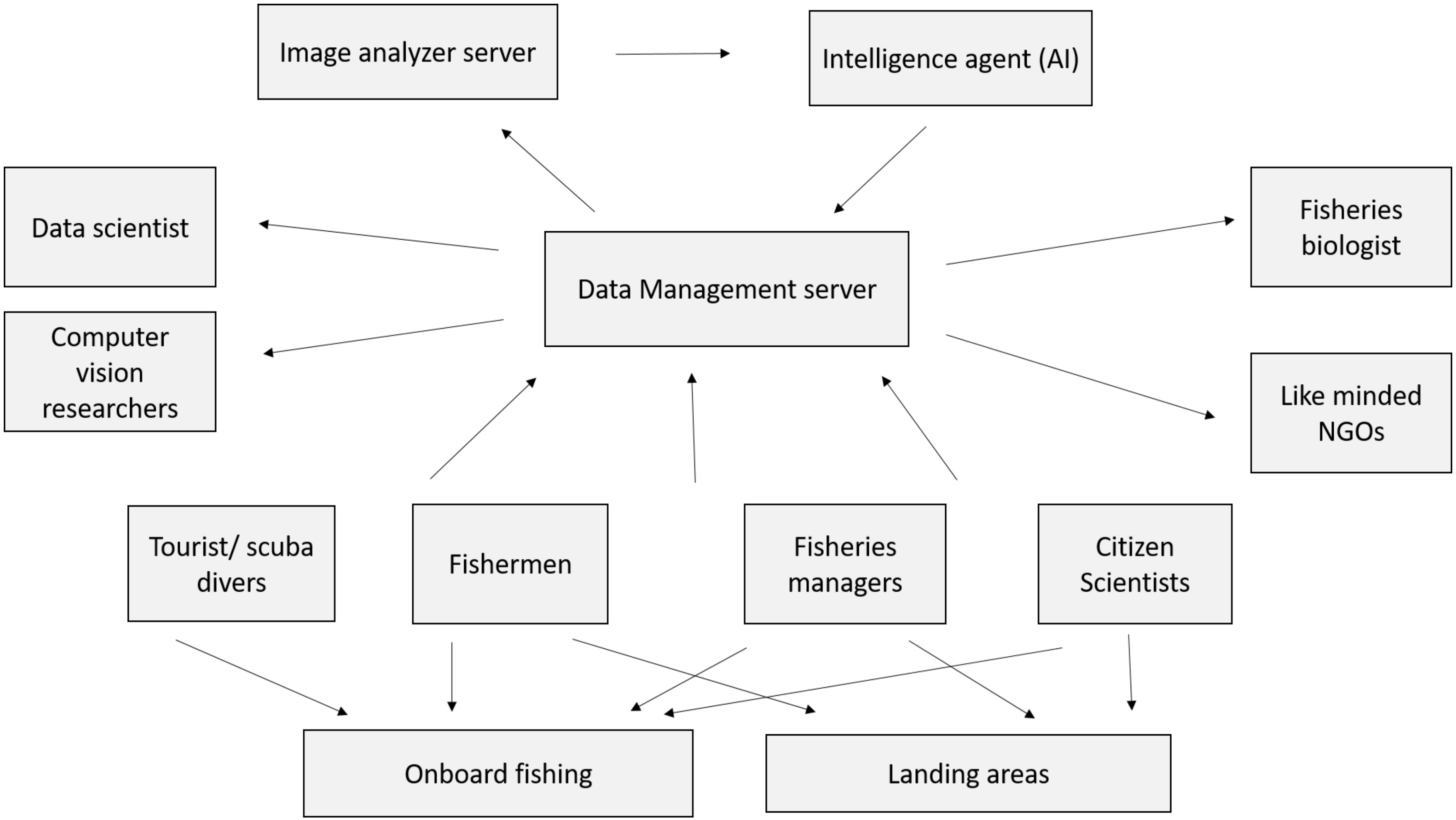


Figure 6: Ecosystem of the workflow of the AL application for the detection and processing of the species.



Graph 9: Prototype detected underwater shark species up to 90% of the species included in the database.

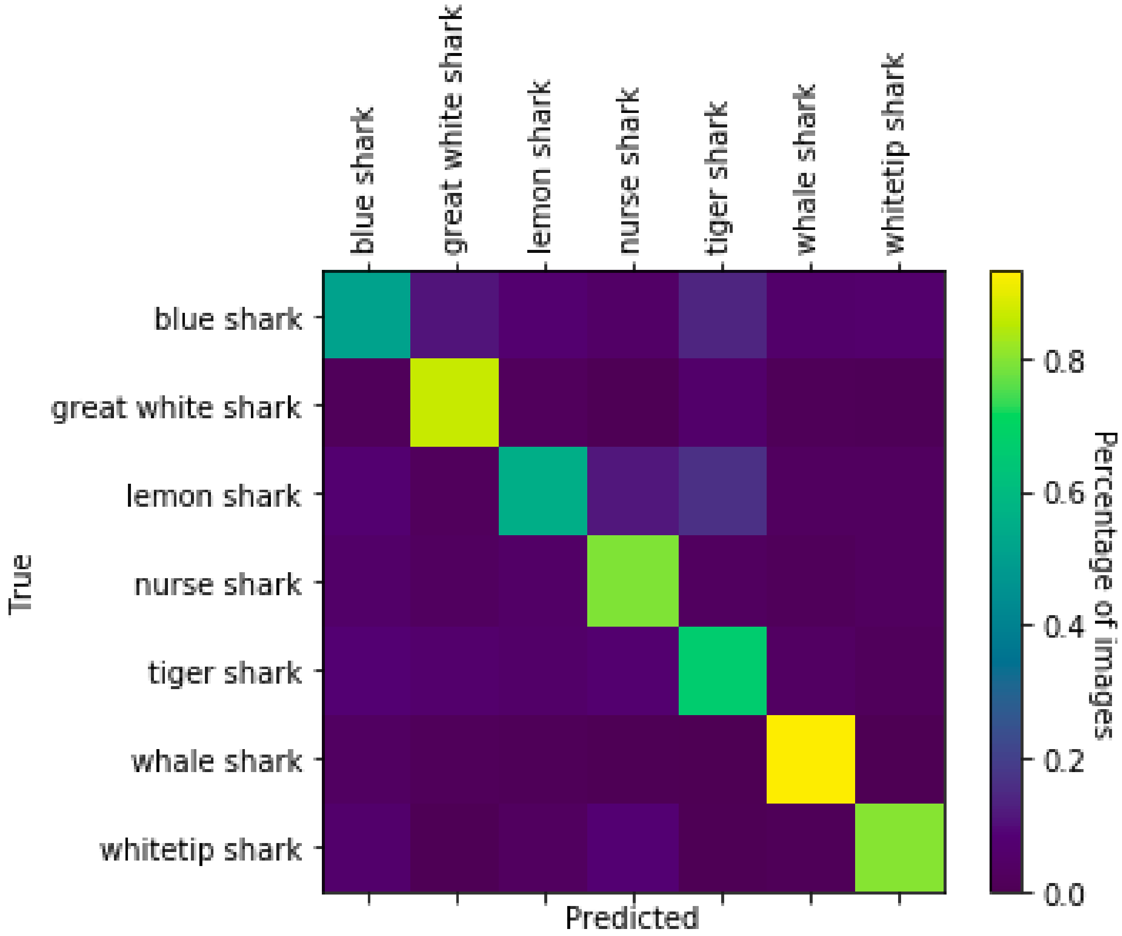
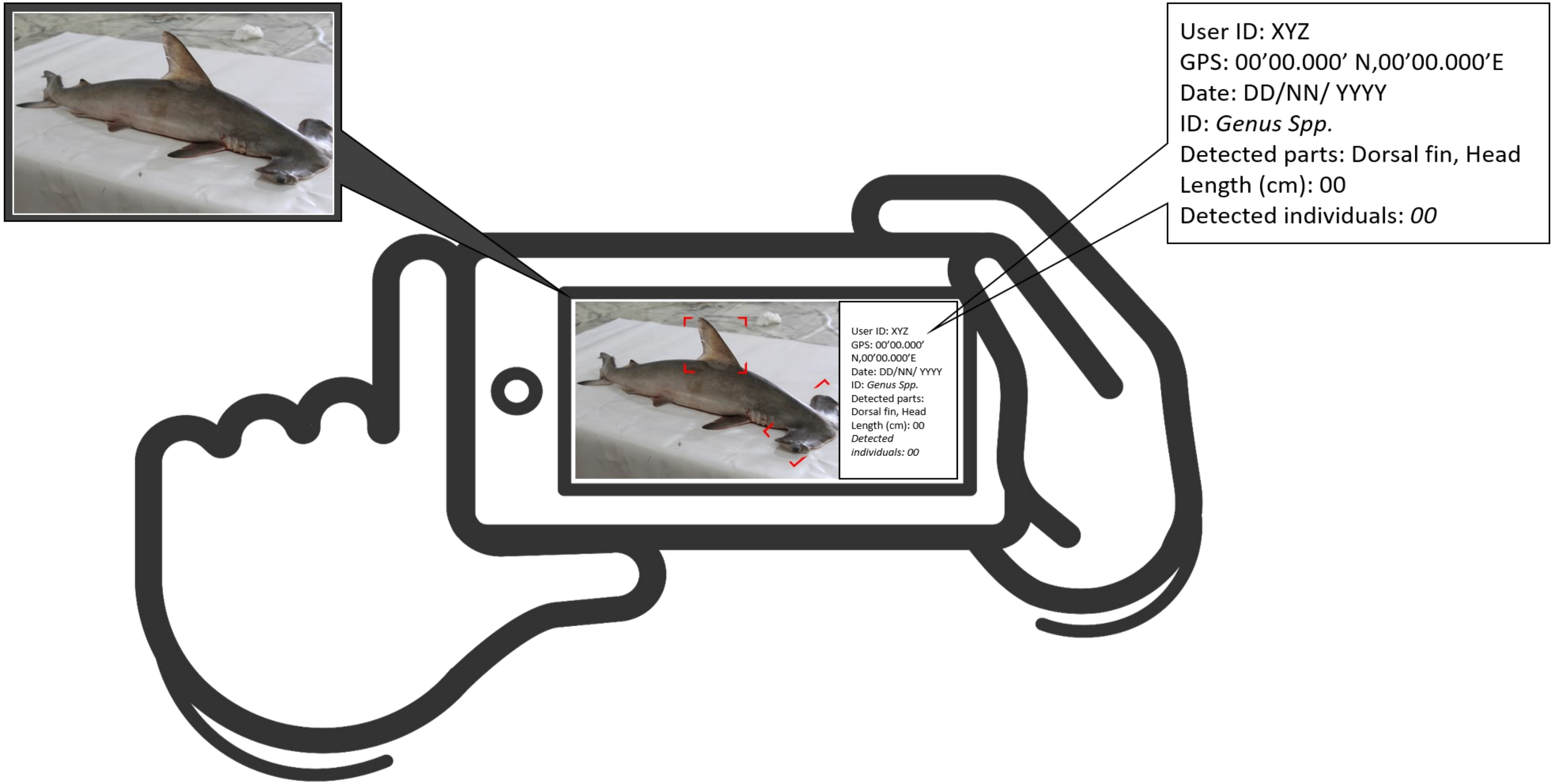


Figure 7: the typical interface of the AI-based mobile application for identification and data collection of species



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