Electronic Logbook and Electronic Data Verification Module to enhance the standards of High Seas Fisheries Management process of Sri Lanka

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ABSTRACT

Department of Fisheries and Aquatic Resources had introduced logbooks to collect spatial and location wise catch data since 2012. Logbooks on board for high seas fishing vessels is obligatory requirement of IOTC resolutions and managing logbook data is a crucial part of managing IUU fishing. Logbooks and log book data were decisively combined with the high seas fisheries management process of Sri Lanka under the road map to revoke EU fish export ban. Accordingly a systematic approach to develop a database was also initiated in 2015. Logbook data has been seen as a source of fisheries data since it became widely recorded and compiled. However, the logbook information has been continuously argued as unreliable and not verified as accurate in many fisheries management systems. There was no cost effective alternative in Sri Lanka to validate accuracy of fisheries logbooks until VMS is introduced in late 2015. The coupling of logbook and VMS data has already proven powerful for describing the spatial distribution of the marine biota habitat at a much finer spatial or temporal resolution. The VMS and logbook data analysis involves extracting VMS pings from cruise track records that matches with fishing activities. More than 40 % of logbook records were found with correct geographical locations with 0.3 degree precision in year 2015. However 09% of the log data were considered as "cannot be verified" under the data verification programme for catch certification for fish and fishery product export. The reason of none verifications were mostly observed as due to the incorrect location data. This scenario is also negatively influenced for the spatial and grid-wise catch data generation process. On the other hand record precise data in paper log book on board is a challenging practice under the harsh conditions at sea heightened by artisanal nature of the vessels.

Considering all the above concerns it was proposed to introduce a unique electronic log book system provide facilities with the fishermen to record catch data using a user friendly frontend. The electronic logbook would ultimately build up the management support and the interactivity

between all stakeholders. This project supposes a GPS enable mobile-based electronic logbook which automatically gathers all the boat route details and the catch details. The data recording will be done throughout the voyage and the data transferring to the central data location will be done within the GSM range. A piolet project was carried out for a period of 06 month and it was found that the system is capable of reducing the man power required for log data management and verification, enhance the quality of log data enabling Sri Lankan authorities to submit eminence spatial and temporal catch data and most importantly to address the requirement of managing IUU fisheries through a system, compatible with the unique fisheries culture of Sri Lanka. It was also found that e-log book also provides solution to fulfil the scientific observer requirements in artisanal fisheries vessels of Sri Lankan high seas fishing fleet (below 24m in length).

Acknowledgement

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Introduction

1.1 Fisheries sector of Sri Lanka

Sri Lanka is an island, situated in the Indian Ocean between 6 – 100 N latitude and 80 – 820 E Longitudes. This island has approximately 1700 km long coastline and sovereign power for the 21,500 km2 territorial sea and an Exclusive Economic zone (EEZ) of 517,000 km2 (MFAR, 2015). Therefore fisheries industry significantly contributes to the food security and the foreign exchange earnings of Sri Lanka. The fisheries sector plays an indispensable role in the economy of Sri Lanka contributing around 2.5% to the GDP (MFARD, 2015). However the figure really not highlight the significant contribution of the fisheries sector as a livelihood component which provides direct and indirect employment to around 550,000 people.

The Fisheries Sector generated 34,797 SLR Million (US$231.9Mn) export earnings in 2014 contributing 2%to the total export earnings of the country. The country exports mainly tuna, shrimps, lobsters, crabs, bêche-de-mer, shark fins, ornamental fish and verity of other frozen fish. The main markets are EU, Japan, USA, Singapore, China and Hong Kong.

Total fishing fleet of Sri Lanka accounts for about 65,000 boats (MFARD, 2015) and about 93% of the boats are considered as costal operated boats. About 03% of the boats go fishing beyond the EZZ for high seas (MFARD, 2015). Except for a small number of large commercial operators with modern facilities, the fisheries sector in Sri Lanka comprises mostly small scale operators. The poorest industry workers are the fishermen who use small traditional boats, fish workers, small scale vendors and low-paid workers of associated, often labour-intensive industries.

The majority of livelihood based fishers of Sri Lanka has no connection and facilities to link with the export market and conduct fisheries at small scale for multi-species using and multi-gears depending on the fish availability and the seasonal changes of the pattern of monsoons. Boat owners of these boats are often traditional fishermen who depend on their indigenous knowledge for fishing and thus having less idea of the latest available technology. Therefore unique strategies has to be adopted when introducing technologies related to fisheries managements. As an example establishment of VMS system for high seas boats took about 05 years.

1.2 The paper log book

Department of Fisheries and Aquatic Resources (DFAR) had introduced paper logbooks to collect spatial and location wise catch data since 2012. Logbooks on board for high seas fishing vessels is obligatory requirement of IOTC resolutions and managing logbook data is a crucial part of managing IUU fishing. Logbooks and log book data were decisively combined with the high seas fisheries management process of Sri Lanka under the road map to revoke EU fish export ban. Accordingly a systematic approach to develop a database was also initiated in 2015. Logbook data has been seen as a source of fisheries data since it became widely recorded and compiled. However, the logbook information has been continuously argued as unreliable and not verified as accurate in many fisheries management systems. There was no cost effective alternative in Sri Lanka to validate accuracy of fisheries logbooks until VMS is introduced in late 2015. The coupling of logbook and VMS data has already proven powerful for describing the spatial distribution of the marine biota habitat at a much finer spatial or temporal resolution. The VMS and logbook data analysis involves extracting VMS pings from cruise track records that matches with fishing activities. More than 40 % of logbook records were found with correct geographical locations with 0.3 degree precision in year 2015 (Gunasekara and Rajapaksha. 2016). Most of the errors were identified from the boats operated within EEZ as these boast possess minimum facilities to carryout systematic processes like log book data recording. 09% of the log data were considered as “cannot be verified” under the data verification programme for catch certification for fish and fishery product export. The reason of none verifications were mostly observed as due to the incorrect location data. This scenario is also negatively influenced for the spatial and grid-wise catch data generation process. On the other hand record precise data in paper log book on board is a challenging practice under the harsh conditions at sea heightened by artisanal nature of the vessels.

1.3 Requirement of the electronic log book

Considering all the above concerns, it was proposed to introduce a unique electronic log book system provide facilities with the fishermen to record catch data using a user friendly frontend. Requirement of such electronic log book can be characterised under two categories, international reporting requirements and requirements to make the system compatible with the capabilities of local fishermen. Electronic logbooks require manual data entry, in contrast to vessel position reports, where the data are automatically generated (FAO, 2004). Electronic log system can also

use for strengthening of the current management systems. The benefits of electronic logbooks include reducing illegible entries, reducing data entry errors at the FMC, securing and verifying authorized data entries, timely submission of catch and other information in relation to management requirements, increased efficiency, reduction of costs of data entry, timely verification from other data sources (FAO, 2004). On the other hand, electronic logbook should facilitate fishermen to enter catch data in a simplify format. Most effective way of minimizing the errors of entering data is to use symbols and pictures. Reduce the amount of typing done during the data entering was also identified as a critical requirement. Cost plays huge role when introducing systems in developing countries. Therefore reduction of maintenance cost and cost for the power requirement was also a key concerned areas.

2.0 Methodology

2.1 Applications

Replacing the paper log book with an electronic log book is a complex process in a unique sector like Sri Lankan fisheries sector. However it was decided to hire University of Colombo (School of Computing) of Sri Lanka to provide a unique solution in order to fulfil the above mentioned requirements and future needs. The electronic logbook would ultimately build up the management support and the interactivity between all stakeholders. The system proposed by university of Colombo in collaboration with the Department of Fisheries is capable of gathering the catch data based on the location automatically detected by an electronic tablet. The project supposes a GPS enable mobile-based electronic logbook which automatically gathers all the boat route details and the catch details. The data recording done throughout the voyage and the data transferring to the central data location will be done within the GSM range.

Tablet based mobile application provided to the skipper to maintain their catch data, equipment/ crew details and full fill other several requirements. The welcome navigation window is presented in Figure 1(a).This interface will allow user to interact with seven different tasks; departure, catch report, arrival, equipment, map, other reports and settings. User is given an attractive and simple interface to enter the catch details as presented in figures from Figure 1(b) to Figure 1(d). Ultimately this entered data will be used to generate the catch reports.

The electronic logbook has the GPS support and automatically detects the geographical location. During the entire voyage, application records the position, orientation, acceleration and other required information in a given frequency. The skipper should enter the Catch details. However, the relevant catching locations are automatically recorded by the application.

Figure 1:
(a) Welcome Window (Front end)
(b) Starting Menu of catch reporting programme
(c) Reporting menu (Tunas)
(d) Reporting menu (Bill fish)

Fisheries Inspector (FI) who is responsible for certifying the catches is also given a mobile-based application to interact with the system. The FI has to check the fishing gears/ equipment, information of fishing crew at the departure of the vessel. At the time of arrival FI has to check the recorded catch details, physically available stocks and the other relevant matters. The FI application facilities to these activities. Coast guard officer who are doing the verification of fishing gears and crew details have access to the system to verify the data entered by FI at the at the point of departure (harbour mouth).

2.2 Data Transmission Process

Once the vessel completed the voyage and reach to the GSM coverage, all recorded voyage information will be sent to the central location. At this level, automated catch verification will be done. Predefined guideline will be used to this process and verification results will be automatically sent to selected parties. Data handling and transmission Process of the system is given in Table: 1.

Table : 1 Data handling and transmission Process

Location of the vessel	GSM range	User level	Types of data to be feed
At departure	Within GSM range *(Automatic data transfer)*	Fisheries Inspector	Fishing gear equipment details Boat compliance details , Crew details Departure details
		Coast guard	Verification of fishing gears and crew details
At sea (within EEZ or High seas)	Out of GSM Range *(Data transferred when the boat reach in to GSM range)*	Fishermen (Skipper)	Catch details (Fish type, weight and number of pieces)
At arrival	Within GSM range *(Automatic data transfer)*	Fisheries Inspector	Catch verification (verified cruse details can be viewed, varication report will be generate)
		Owner	View boats cruse and catch details (forward catch details to the exporter)
		DFAR	Cross check boats cruse Automatic verification with VMS data Issue verification report to catch certification

Fisheries officers who are involving duties related to the departure handling, inspections and log data certification have access at various level for the FI application. Some information related to the vessels operated within the harbours were also transferred to Harbour Manager though a web based application as well. Access to DFAR at head office level is also given through a web based application (desktop interface) for the staff of District Fisheries office (Administration), VMS centre, High Seas Fisheries Unit (verification/ reconciliation of data) and Quality control unit (for catch certification). Owners of the boats can view the catch and cruise details and forward the same to selected exporters as a part of their marketing process. Data Flow of the elog book system of the system is given in Figure 2 and the action diagram of the system is given in Figure 3.

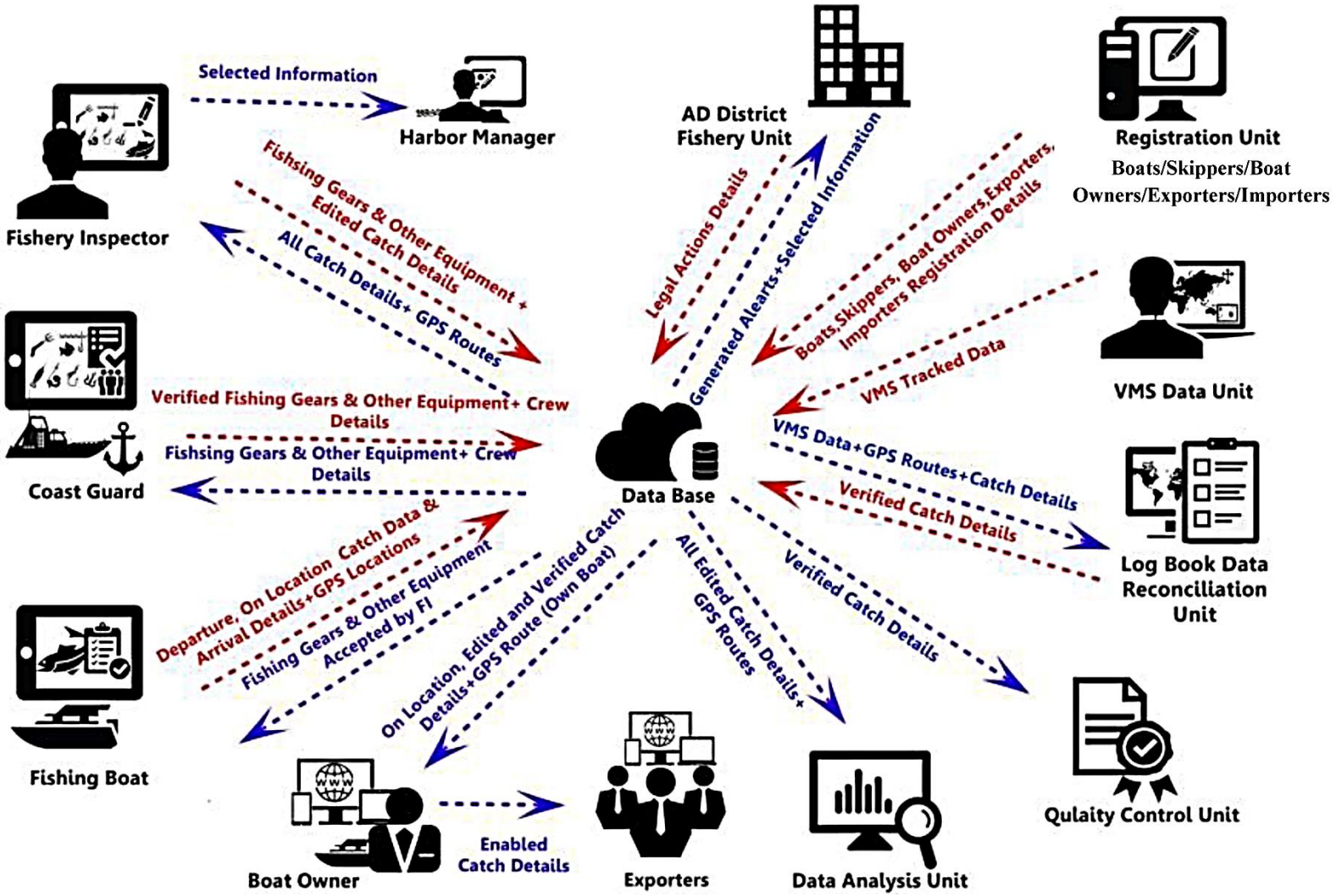

Figure 2: Data Flow of the elog book system

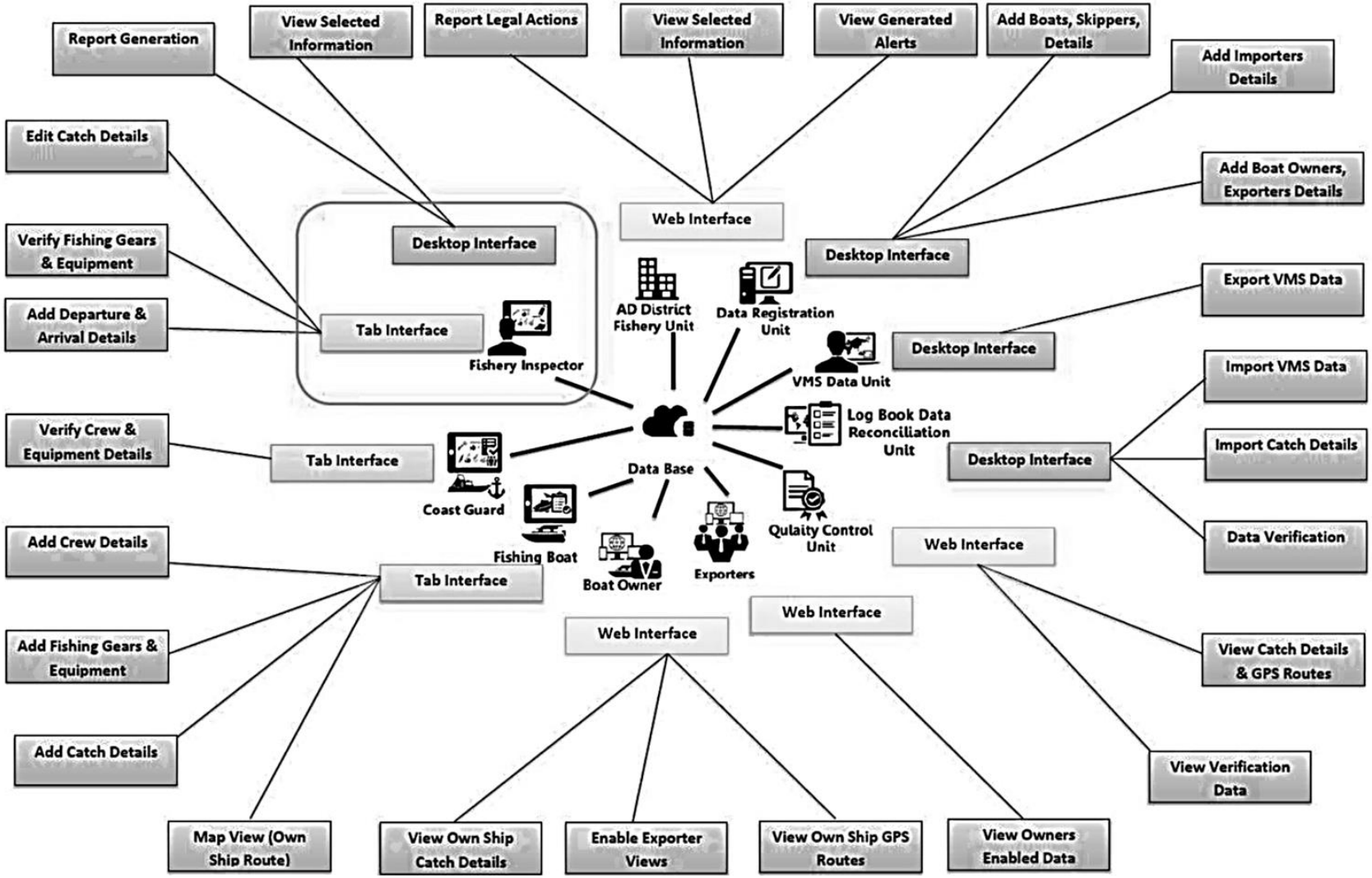

Figure 3: Action diagram for the elog book system

The Front end of the fishermen's application and FI application was built though Arnold system, while the web applications for DFAR and Owners is a PHP application. Data base is built in My SQL environment.

3.0 The piolet project and the Results

A piolet project was carried out for a period of 08 month (Table: 2). Accordingly, 31successful trips were tested with e-log book tablets. All errors identified during the piolet stages were corrected and it is expected to run the finalized system for over 03 month before launching the system officially. Results of a selected trip is provided in Figure 4 (a) to 4 (f) as an example.

Table 2: Results of the Piolet Trip

Stage	Number of Trips	Number of successful trips	Reason for unsuccessful attempts
I	12	7 (58%)	Departure allocation errors and Skipper registration errors
II	8	7 (88%)	GPS location grabbing failures
III	11	11 (100%)	NA
IV	6	6 (100%)	NA
Total	37	31	

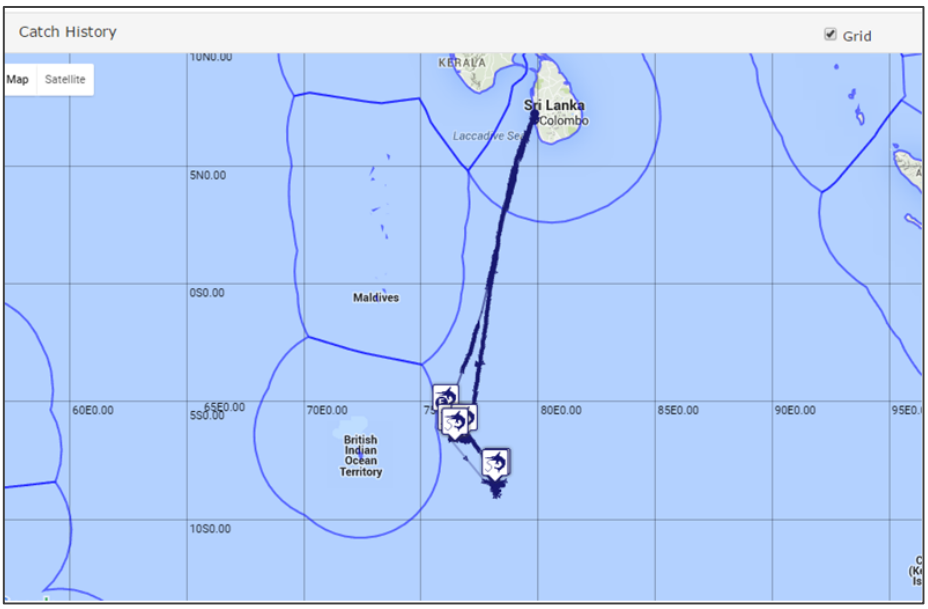

Figure 4 (a) Track details of the selected boat (IMUL-A-517-CHW)

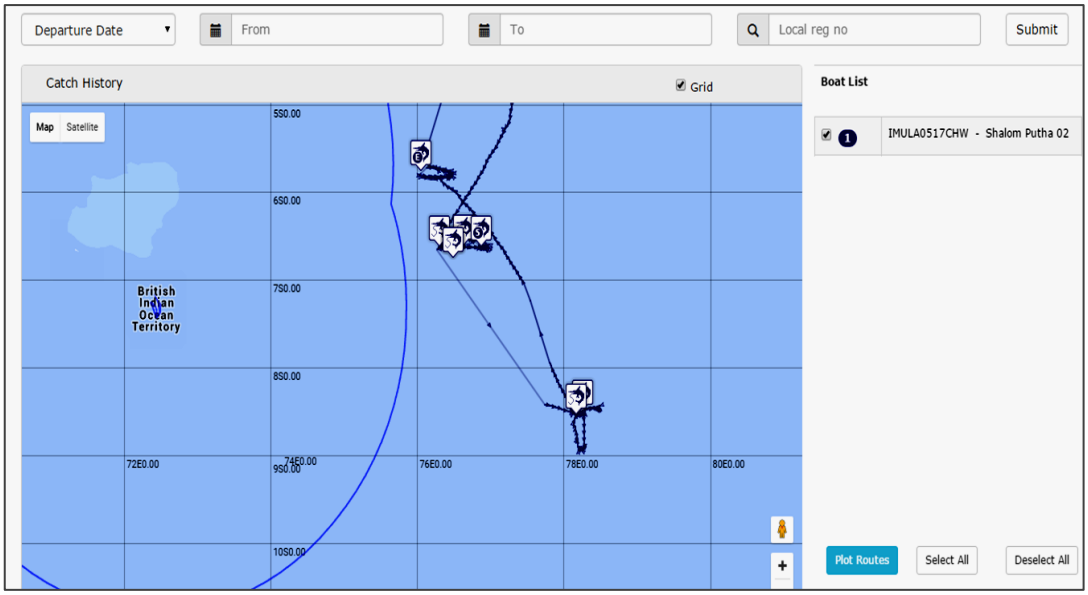

Figure 4 (b) E-Log Catch Details (Extracted from the details of IMUL-A-517-CHW):

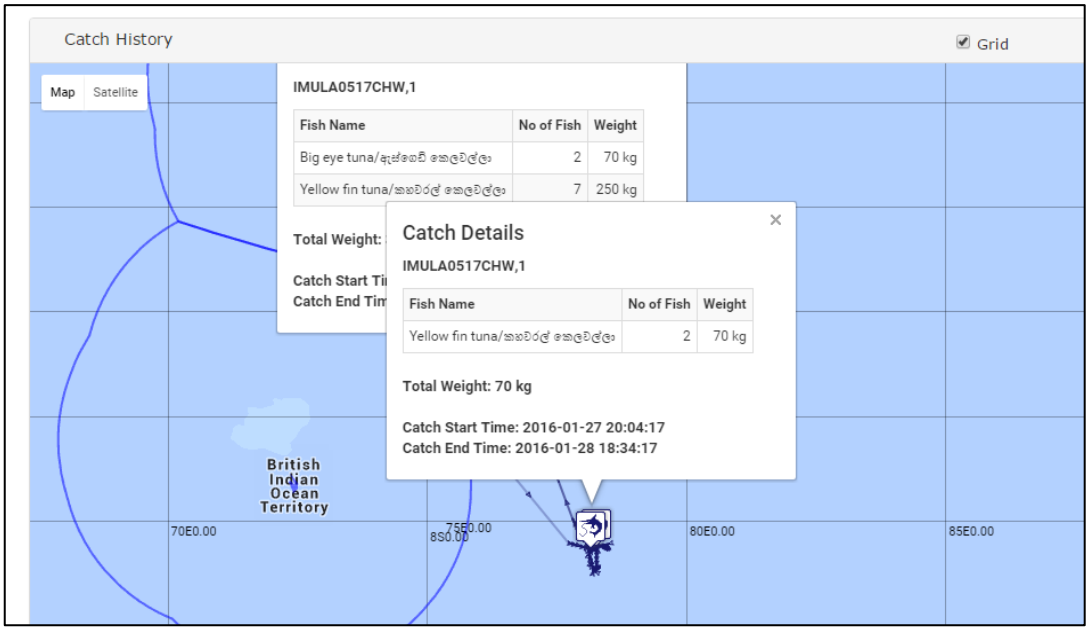

Figure 4 (c): E-Log Catch Details Zoomed view (Extracted from the details of IMUL-A-517-CHW)

Voyage Details - IMULA0517CHW

Voyage Details	
Departure Date:	2016-01-08
Departure Time:	15:59:32
Departure Port:	Dikkowita
Arrival Date:	2016-02-08
Arrival Time:	10:56:36
Arrival Port:	Dikkowita

Fish Name	Amount	Weight
Skipjack tuna/බලයා	2	9kg
Big eye tuna/ඇස්මහඩි කෙලවල්ලා	14	480kg
Yellow fin tuna/කහවරල් කෙලවල්ලා	48	1900kg
Blue Marlin/නිල් කොජ්ජරා	1	50kg

Total Catch Weight: 2439 kg

Close

Figure 4 (d): Trip Details and Total Catch Details (Extracted from the details of IMUL-A-517-CHW):

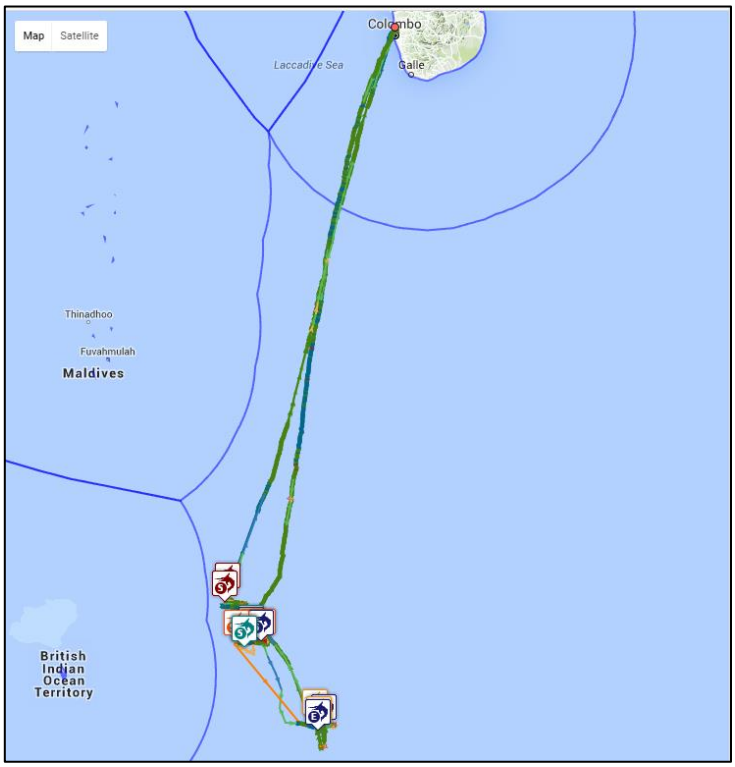

Figure 4 (e): Overlapping of the E- Log Track (Blue) and VMS Track (Green) Prior to the Verification

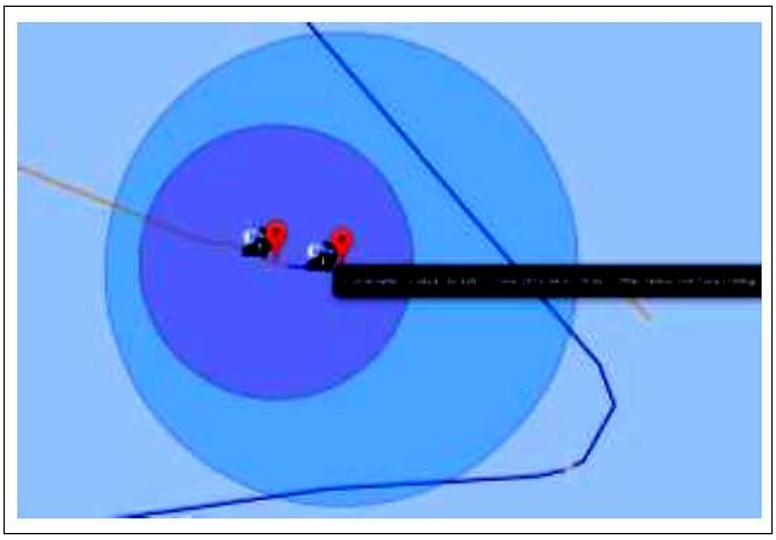

Figure 4 (f): Argument for verifying though overlapping elog track data based on the speed and cause of track data of VMS cruise details.

Through the given interface, authorized officer is given privilege to verify whether the vessel route and the catch locations are in the acceptable neighbourhood or there is any violation or abnormal behavior.

4.0 Discussion

4.1 Possibility of identifying IUU Violations via e log details

An analysis was done on the system to identify weather the system is capable of identifying all possible types of IUU violations as per the guidance given by Beke & Blomeyer (2014) and it was found that the system covers all possible IUU identifications related to the cacth data reporting.

Table 3: Possibility of identifying IUU Violations via e log details

Types of IUU Violations identified by Beke & Blomeyer, 2014	Supported by e-log system
Fished without a valid license, authorization or permit issued by the flag State or the relevant coastal State	Not Applicable
Not fulfilled its obligations to record and report catch or catch-related data, including data to be transmitted by satellite vessel monitoring system	Yes
Fished in a closed area, during a closed season, without or after attainment of a quota or beyond a closed depth	Yes

Engaged in directed fishing for a stock which is subject to a moratorium or for which fishing is prohibited	Yes
Used prohibited or non-compliant fishing gear	Yes
Falsified or concealed its markings, identity or registration	Not applicable
Concealed, tampered with or disposed of evidence relating to an investigation	Yes
Obstructed the work of officials in the exercise of their duties in inspecting for compliance with the applicable conservation and management measures; or the work of observers in the exercise of their duties of observing compliance with the applicable community rules	Not applicable
Taken on board, transshipped or landed undersized fish in contravention of the legislation in force	Yes (if coupled with VMS)
Transshipped or participated in joint fishing operations with, supported or resupplied other fishing vessels identified as having engaged in IUU fishing under this regulation, in particular those included in the Community IUU vessel list or in the IUU vessel list of a regional fisheries management organization	Yes (if coupled with VMS)
Carried out fishing activities in the area of a regional fisheries management organization in a manner inconsistent with or in contravention of the conservation and management measures of that organization and is flagged to a State not party to that organization, or not cooperating with that organization as established by that organization	Yes
No nationality and is therefore a stateless vessel, in accordance with international law	Yes
Catch certification scheme	Yes

4.2 Benefits

The salient features of the system are cost effectiveness and user does not get locked into a vendor specific proprietary solution. Development and maintenance cost of the proposed solution is a fraction of similar product in the market. Commercial products will only permit limited customization but in the proposed solution any additional features can be incorporated.

Summarized benefits of a home grown solution would be as follows;

1. Usage of the solution would be increased due to its cut-rate.
2. Localization of the software would enhance the usability and user friendliness.
3. Third party does not handle the gathered sensitive data.
4. Build home grown expertise/technologies.

5. Can be introduced to other countries and generate foreign income.
6. Valuing indigenous solutions would be appreciated by the society.
7. Reduce illegal, unreported and unregulated fishing (IUU), which caused the EU fishing ban.
8. Proper fishing monitoring would gain the trust of the authorities/ organizations.
9. Reduce environment damages and usage of harmful equipment/techniques.
10. With the proper monitoring illegal activities such as border crossing, smuggling and drug trafficking could be observed other than fishery activities.
11. Imposing proper actions after analyzing gathered data would heighten productivity and efficiency.
12. Gathered data on country's fishing vessels would be extra storage for further census.

4.3 Conclusions

It was found that the system is capable of reducing the man power required for log data management and verification, enhance the quality of log data enabling Sri Lankan authorities to submit eminence spatial and temporal catch data and most importantly to address the requirement of managing IUU fisheries through a system, compatible with the unique fisheries culture of Sri Lanka.

It is planned to implement the system among high seas fishing fleet of Sri Lanka within next three years. It is also proposed to add an application to the system allowing the operator to add details of bycatches and discards. . It was also found that e-log book is capable of providing solution to fulfil the scientific observer requirements in artisanal fisheries vessels of Sri Lankan high seas fishing fleet (below 24m in length).

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