**TAFIRI**

**Technical report**

**For**

**Analysis of fisheries data collected from RUMAKI**

**2014-2018**

**To**

**WWF Tanzania**

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1. Executive Summary

The collection and analysis of fishery data and information is a costly and timely exercise. To be relevant and cost-effective, fishery data and information collection systems must have a clear set of objectives and appropriate strategies to collect data, which should be based on priorities and requirements of data users. However, chronic problems of insufficient human and financial resources allocated for data collection often resulted in poor quality of information that further led to non- or limited use of statistics for fishery management and policy development. Consequently only dwindling support was given to systematic improvement of national fishery data and information collection systems. There is an urgent need to terminate this vicious cycle of problems. Previous budget allocated by the Government for data collection during CAS should be more than enough if re-allocated to the used in the improved eCAS data collection system.

# Background

Tanzania coastal marine fisheries is largely dominated by artisanal fishers (Sobo, 2004), catches are used for subsistence purpose while few species are traded for internal and external markets (Hamidu, 2012). The fishery contributes to social economic development of the coastal community and beyond (Hamidu, 2012), However, proper management of the fishery resource is yet to be realized (Berachi, 2003; Hamidu, 2012; Jacquet and Zeller, 2007).

It is widely recognized that knowledge of the status and trends of capture fisheries, including socio-economic aspects, is a key to sound policy-development, better decision-making and responsible fisheries management. For the fisheries to contribute to food security it is important that information related to a particular stock or entire fisheries is available on an instant basis. Fisheries information can be used to validate the policy in place and track the performance of fisheries management. Therefore, the importance of fisheries data collection can not be overemphasized.

Management measures for small-scale fisheries must also account for strategies to collect and analyse data (Robertson et al 2018). In many data-poor countries, full stock assessment is hardly conducted, scientists are forced to use data poor methods to come up with estimated stock status which in many cases does not reflect the actual situation. For instance, landings of coastal fish species in Tanzania are chronically under-reported (landings are at least 1.7 times higher than actual reported landing) and catch rates appear to only be maintained by a continual increase in effort (Jacquet and Zeller, 2007, Bush et al., 2017). Improvement in data collection systems is therefore essential to insure proper management of the fisheries resource.

Countries in coastal East Africa have taken up a scheme to decentralized management of the fisheries. The countries have introduced fisheries co-management systems as an approach to manage coastal and marine resources. It is in this context, more accurate and timely information should reach out to relevant stakeholders and result in a better informed decision at all levels. In Tanzania, the system was introduced in the year 2003, it entails establishments of community-based co-management groups commonly known as BMUs (Beach Management Units; Sobo, 2012). Since the inception of the BMUs, the government, in collaboration with the World Wildlife Fund (WWF) has established more than 204 BMUs along the coast (Kanyange et al., 2014). One of the major tasks of these BMUs is to participate in fisheries data collection, particularly data related to the Catch Assessment Survey (CAS). The outputs of the CAS are estimation of the total fish production by weight and value, catch per unit effort, and to conduct stock assessments.

It was anticipated that participation of BMUs in the data collection would improve coverage and timely collection of the fisheries data. This has been true but challenges are inevitable. One o f the challenges is related to the systems itself, the use of hard copies. BMUs had to collect and send back filled forms to the centralized (statistics) offices for compilation and analysis. This process involved a number of human resources and is time consuming. However, feedback to the community has been a high mountain to climb. Following the introduction of smart mobile phones, it was thought, the use of mobile applications in fisheries data collection will facilitate instant submission of catch data to a centralized database, reduce backlog and cost related to the transportation of hard copies and finally facilitate timely feedback to the communities and other stakeholders. In this context, WWF and Tanzania Fisheries Research Institute (TAFIRI) have been working to realize this concept in the RUMAKI seascape.

In the year 2016, TAFIRI in collaboration with WWF conducted a pilot study on the use of mobile application in fisheries data collection (e-CAS). The initiative started with selected 5 BMUs, selected members were trained on the use of mobile application in fisheries data collection. Initial analysis suggested the proof of concept was possible. It is at this time more species of tuna and tuna like were recorded for the first time. As of today the initiative has been rolled out to all coastal districts landing sites and endorsed by the government.

Monitoring and evaluation of the mobile data collection system has been a work in progress over the years. The monitoring program is meant to fine tune the application, quality check and provide recommendation to different stakeholders. At this end, WWF has assigned TAFIRI to undertake analysis of e-CAS and CAS fisheries data collected from 2014 to 2018 in order to better inform policy and decision making for improved management of small-scale fisheries resources. Specific tasks under the current agreement are:

1. To review the status of stock healthiness in the RUMAKI districts based on the data collected from 2014 to 2018.
2. Compare stock healthiness between RUMAKI and the rest of the coastal districts outside the RUMAKI area.
3. To provide recommendations on the quality of e-CAS fisheries data.
4. To assess reappearance of fish species in the study area and its link to conservation initiatives.
5. To prepare a brief summary of the findings for local artisanal fisher communities
6. To develop a statistical fact sheet based on the findings
7. To develop a manual for e CAS mobile system
8. To prepare documentation for a stakeholders’ workshop.

The current report is prepared based on the above agreements particularly number 1-4, other derivables (5-8) will be submitted as independent documents.

# Methodology

## Approach

It is important to note that the current assignment is desktop based and did not involve field visits. The fisheries annual statistics reports from 2014 to 2018 were the source of data. The Department of Fisheries publishes these reports annually and available upon request from the department. In addition, we retrieved e-CAS, an online platform for storing fisheries data in Tanzania mainland. , this particular data span from 2016-2019. The database is currently hosted by the Department of Fisheries and periodically updated by TAFIRI.

For the purpose of this report the RUMAKI area comprises the districts of Kibiti, Mafia, Kilwa, Kigamboni and Mtwara Rural. These are located in the southern coast of Dar es salaam. Non-RUMAKI area comprise all other remaining coastal districts, from the northern end it includes , Mkinga, Mheza, Pangani, Bagamoyo, Kinondoni, Ilala and Mkuranga; from the southern end the districts of Mtwara urban, Lindi rural and urban.

## Data collection

The current assignment used the official Catch Assessment Survey (CAS) data spanning from the year 2014 to 2018. In addition, we also extracted data collected by BMUs members from the RUMAKI districts, this additional data span from 2016-2019. The database is currently hosted by the Department of Fisheries and available online upon permission.

Prior to the analysis, we conducted data cleaning and quality check up, this exercise removed all data points that were either wrongly recorded, duplicate or name of species/genus were missing/misspelled. Afterwards, we checked for major fisheries groups that have appeared consistently over the years. There is no single species that has appeared in the data set consistently from 2014 to 2018. Therefore, the dataset was grouped according to major six fishery groups with few common representative species where available. The groups/priority fisheries are, Octopus, Small pelagic, Tuna and tuna-like, Reef fishes, Elasmobranch and Prawns. These groups were adopted from priority fisheries under the SWIOFish Project.

Table 1. Category of priority fish species pooled from the database and Annual statistics reports.

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| **Category** | **Species** | **Category** | **Species** |
| OCTOPUS | Octopus cyanea | REEF FISH | Red snapper |
| SMALL PELAGIC SPECIES | Amblygaster sirm | Serranidae |
| Sardine | Carrotomus carolinus |
| Mackerel | Lutjanus spp |
| Dussumieria acuta | Lethrinus |
| TUNA AND TUNA LIKE SPECIES | Auxis thazard | ELASMOBRANCH | Carcharhinus spp |
| Euthynnus affinis | Rhynchobatus spp |
| Istiophorus platypterus | Himantura uarnak |
| Katsuwonus pelamis | Maculabatis ambigua |
| Scomberomorus spp | Manta alfredi |

**3. Results and Discussion**

The results and discussion section is based on the five priority fishery groups presented above. First, we are providing a general picture on areas with high and low catches along the coast. Second, we zoom in into specific group performance in each coastal district.

**3.1. Status of stock healthiness in RUMAKI and Non-RUMAKI districts.**

The status of healthiness for RUMAKI and Non RUMAKI (districts which were not involved in the RUMAKI-FISHCOM project) was assessed based on the data from CAS spanning from 2014 to 2018 and additional data from the eCAS spanning from 2016 to 2019 respectively. To meet the specific objectives of the study spatial maps of catch variation (Figure 1-5) for the five priority fishery categories (Table1) quantifying the amount of fish landing were developed.

**3.1.1 Spatial variation of fisheries total catch in the RUMAKI and non- RUMAKI districts.**

**Octopus cyanea**

There is only one species of octopus in Tanzania (Reference) Table 1. The average total annual catch for the octopus fishery was found to be (xx-xx tones per year) in the non-RUMAKI and (xx-xx tones per year) in the RUMAKI districts. The spatial maps indicate the districts of Ilala and xx have highest catches while Temeke/Mkuranga and xx have lowest catches in the non and RUMAKI areas respectively (Figure 1). The possible explanation for Ilala to have the highest catch could be due to the reason that the country's main marine fisheries market (The Ferry Market) is located in Ilala. The market receives a batch of fish from other parts of the country particularly from the southern coast. Therefore, apart from Ilala being a landing site it also serves as the main market to other fishers and fish traders from other parts of the country. On the other hand, the lowest catches noted at Temeke and Mtwara could be related to the limited seascape for these districts and close proximity to the main ferry market for the case of Temeke. Rufiji is exceptional, the large part of its fishing ground is dominated by mudflats and continuous influx of fresh waters from the delta. This habitat is known to be favourable for prawn fishing.

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**Figure 1: Average annual catch for Octopus fishery in the (a) RUMAKI and (b) non-RUMAKI coastal districts.**

**Tuna and tuna like species**

The average total annual catch for the tuna and tuna like species was found to be (xx-xx tones per year) in the non-RUMAKI and (xx-xx tones per year) in the RUMAKI districts. The spatial maps indicate the districts of Ilala and xx have highest catches while Muheza, Pangani and Mkuranga and xx have lowest catches in the non and RUMAKI areas respectively (Figure 2). Total volume of tuna caught globally on an annual basis is around 4.3 million tonnes. Japan, the EU,Taiwan, Indonesia, Philippines and Korea are the six main catching nations. In coastal east Africa, catches are very low, in most cases from industrial fishing. Little is known about the catch from artisanal fisheries, recently countries have started to focus on this important fishery. However, data related to artisanal tuna and tuna like species is hardly known, the current data collection systems in Tanzania is an initiative addressing this challenge. The initiative has managed to separate tuna from other fish species but effort is needed to collect error free data at species level as required by the Indian Ocean Tuna Commision (IOTC).

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**Figure** **2**: **Average annual catch for tuna and tuna like species in the RUMAKI and non-RUMAKI coastal districts.**

**Small pelagics**

The average total annual catch for the small pelagic is (xx-xx tones per year) in the non-RUMAKI and (xx-xx tones per year) in the RUMAKI districts. The spatial maps indicate the districts of Kindondoni and Mkuranga have highest catches, this is true for Kilwa and Mtwara in the RUMAKI area. Pangani and Temeke and Rufiji have lowest catches in the non and RUMAKI areas respectively (Figure 3). The small and medium pelagic fishery mainly consists of sardines (Clupeidae), anchovies (Engraulidae),scads (Carangidae) and mackerel ([Scombridae](https://en.wikipedia.org/wiki/Scombridae)) and . This group is the main target for artisanal fishers. Data related to small pelagic is scarce and in most cases underestimated. This is due to the nature of the fishery itself, landing is usually packed in boxes or buckets and sold in bulk, makes the estimation difficult. A dedicated effort is needed to make sure data related to small pelagic is accurately collected, more important during the peak season in NEM (calm sea with favorable temperature and nutrients (abdellaoui et al 2017)).

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**Figure 3: Average annual catch for small pelagic species in the RUMAKI and non-RUMAKI coastal districts.**

**Reef species**

The spatial map showing catch (MT) variation for Reef fishery among the Non RUMAKI area is shown in figure 4. Pangani ranked highest, followed by Mkinga and Kinondoni. Muheza and Bagamoyo ranked least.

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**Figure 4: Average annual catch for reef species in the RUMAKI and non-RUMAKI coastal districts.**

**3.1.2 Catch trend comparison of stock healthiness between FISHCOM area and the rest of the district**

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**Figure 8.** Mean catches and standard error for the four common fisheries group in RUMAKI and non RUMAKI area (2014 to 2018)

**3.2.1 Catch Trends for priority fisheries stock in the RUMAKI**

The current findings indicate there is a decrease in total catch from artisanal fishers in the RUMAKI districts for all major fisheries groups with exception of small pelagic (Figure 5a). This is based on the data collected by BMUs members at different landing sites from 2016-2019. The direct reasons linked to this trend could not be established, as environment data, catch and effort and other parameters are not part of the general fisheries data collection. Potential reasons could be due to the environmental variability and specifically increased in sea surface temperature (SST). TAFIRI is independently monitoring change in environmental conditions for the entire coast, findings suggest from 2016 to 2019 there has been a change in sea surface water temperature annual anomaly of 1.7oC and particularly in 2017 (Fig. 5a and b). The other reason could be anthropogenic, specifically dynamite fishing, but this is yet to be linked/confirmed.

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**Figure 5.** (a) Trends of Mean catches for the five common fish group in RUMAKI area from 2016 to 2019 (b) Sea surface Temperature annual anomaly in Tanzanian waters between 2014 to 2018

**3.2.2 Total catch for priority fisheries groups in RUMAKI districts**

Catch trends of the major fishery groups in the RUMAKI area are shown in Figure 6. Despite the general trend of decreased fish catch in the RUMAKI districts, a detailed analysis for each district indicates some fisheries categories seem to be doing better in some places between 2016 to 2019. For instance, octopus and tuna species catches show an increase in Kigamboni, likewise, reef fish and octopus in Mtwara rural. More importantly, there is some consistency in the data collection for Kibiti, Kigamboni, Kilwa and Mafia districts (Fig 6a&b). This is good news. Though, this is not yet to the standard that will assist a full stocks assessment but it is a good starting point. The data points gaps in Mtwara and Kibiti indicate the inconsistency in the data collection. Both Kigamboni and Mtwara picked up a year later after the piloting phase, but Kigamboni has kept the momentum going.

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**Figure 6:- Catch trend of major fish groups in the RUMAKI districts.**

**3.2.3 Total catch for priority fisheries groups in RUMAKI districts**

The finding from this study indicates the major fisheries categories supporting livelihood of artisanal fishers in the FISHCOM area in the order of magnitude is Reef fisheries, Octopus Fisheries, Elasmobranch fisheries, Small pelagics, and Tuna and tuna like fisheries. The second major fishery in FISHCOM is Octopus as observed in Temeke, Kilwa, Mtwara Rural and Mafia. Interestingly Elasmobranch ranked third, observed in Mtwara rural, Temeke, Kilwa and Rufiji. The fourth fishery is a small pelagic group, contributing the highest in Kilwa and to less extent in Mafia, and Temeke . Tuna fishery ranked fifth observed to be caught in Temeke and Kilwa

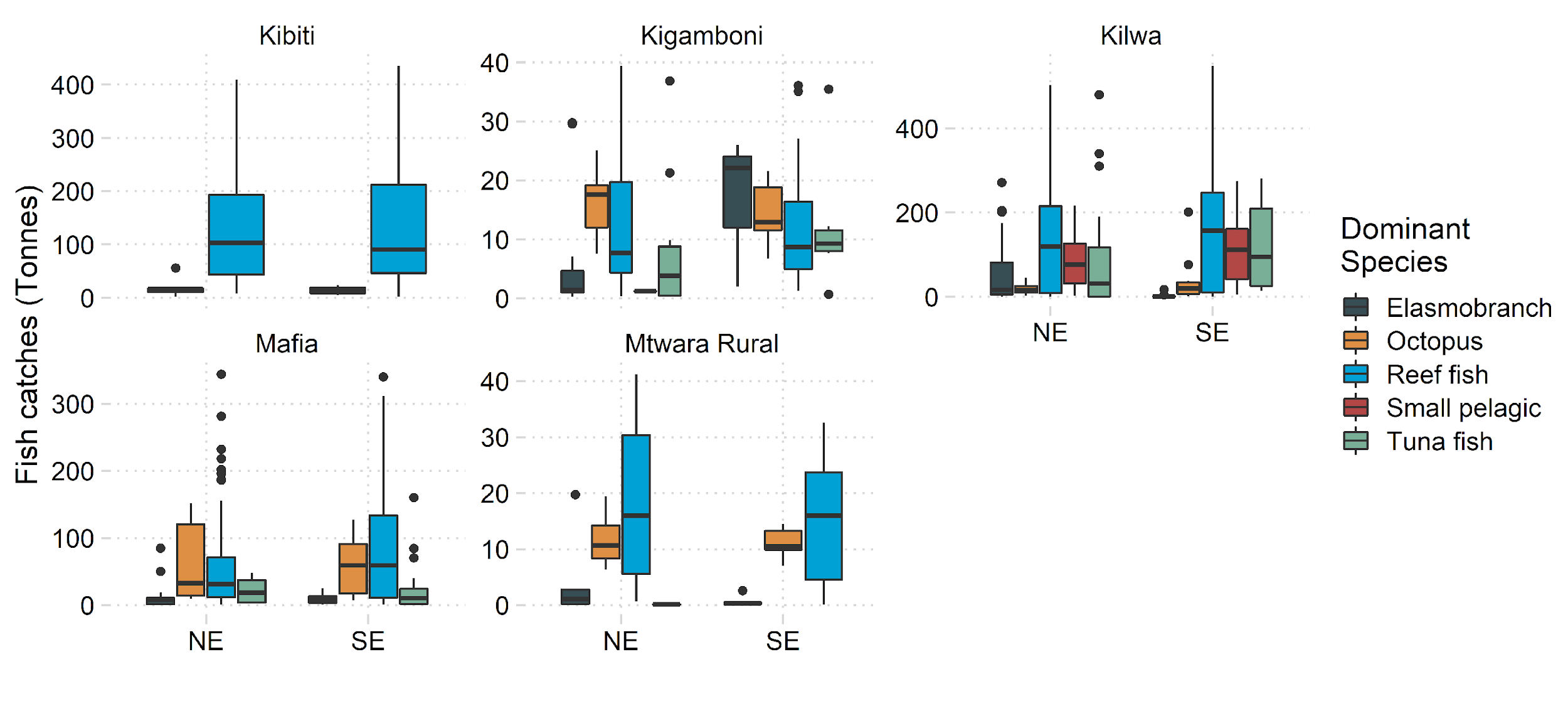
Kilwa and Temeke have all five fisheries; Mafia and Mtwara four fisheries;and Rufiji two fisheries.

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**3.2.2 Seasonal variation of the total catch for priority fisheries in RUMAKI**

The use of eCAS helped analysis of the seasonal/ monthly fisheries catch variation of the major fisheries among Rumaki (Figure 7). Analysis of the monthly catch variation did not produce good results necessitating pooling data into the seasonal, North East (NE) and South East (SE)Monsoon. Yet not clear differences in catch variation could be observed in all fisheries categories. The possible explanation is that the dataset was not enough to show such variation. More data needs to be collected for such an analysis to run. In the previous database in the CAS such seasonal comparison in catch variation among sites could not be performed.



**Figure 7:-** Seasonal (NE and South East SE Monsoon) variation in catch (Mt) composition of dominant priority fisheries groups among RUMAKI sites from 2016-2019.

**Output 3. Recommendation on the quality of e CAS fisheries data.**

For the purpose of improving fisheries data collection system, the following are set of recommendation that this report suggest will improve the process and hence facilitate management of the artisanal fisheries:

* The Department of Fisheries (DoF) in collaboration with TAFIRI should consider identifying representative species for all priority (major) fisheries groups and consistency follow up the data collection on the identified species.
* The DoF, should consider adapting and upscaling the eCAS as the main data collection tool. Promote timely preparation of fishery statistics through the application of databases. This should go along with timely sharing of the statistics with relevant stakeholders.
* Promote capacity development in the area of data collection, processing, analysis, interpretation and reporting.
* Periodic strategic planning/system review of marine fisheries, data collection should be in position to answer some of the management questions at any time.
* Promotion and adoption of statistical systems for small-scale coastal fisheries.
* The DoF in collaboration with other stakeholders should explore ways to develop and implement multi-sectoral indicators analysis as an approach to monitor the stock, such indicators could include socioeconomics and livelihood data, this can be incorporated in the current data collection and analysis.
* A major limiting factor in the formulation and implementation of action plan and management strategy for sustainability of the priority fisheries is the lack of comprehensive data for a sufficiently long period which form the basis of proper status assessment of the fisheries stocks.
* The data such as availability of fish species diversity, catch, effort, landing, trade and market value are needed, the knowledge base requires a lot of improvements.
* The central and the state governments should facilitate efficient data collection and research by allocating adequate funds.
* Conservation and sustainable management of the priority fisheries need to address the food and livelihood issues of the fishing communities in the country,

**Output 4. Fish species reappearance in the study area and its link to conservation**

Previous information recorded on the CAS forms was able to record fish species to family level. The new version of eCAS has a room to record fish species catches to a species level. This is a major improvement, it does not only facilitate mandatory reporting to national and regional fisheries organizations but further allow analysis of appearance/disappearance of endangered and other species of ecological importance. During the current analysis, we have noted re-appearance of the elasmobranch group in the database with a relatively good resolution. Interestingly Some species of shark and rays are captured in the database to the genus level, though more effort for identification of the elasmobranch to species level is needed.

**Conclusion**

The collection and analysis of fishery data and information is a costly and timely exercise. To be relevant and cost-effective, fishery data and information collection systems must have a clear set of objectives and appropriate strategies to collect data, which should be based on priorities and requirements of data users. However, chronic problems of insufficient human and financial resources allocated for data collection often resulted in poor quality of information that further led to non- or limited use of statistics for fishery management and policy development. Consequently only dwindling support was given to systematic improvement of national fishery data and information collection systems. There is an urgent need to terminate this vicious cycle of problems. Previous budget allocated by the Government for data collection during CAS should be more than enough if re-allocated to the used in the improved eCAS data collection system.

**Annexes**.

**Output 5 A brief suitable for local artisanal fisher communities Developed**

**Activity 5.1** Literature review,

**Activity 5.2** Identification of policy **issues** from analysed data

issues

* elasmobranch species appears
* seasonal variation in catch composition can be traced down on monthly basis
* Ilala seems to have more catch but in reality catch come from other districts
* budget allocation for data collection should be beared by the Central government or local government?

**Activity 5.3** Development of first draft of the brief suitable for local fishers

**Activity 5.4** Production of the final brief document after incorporation of input **from** stakeholder meeting

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