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**•Open access challenges in attaining Sustainable Development Goals in Lake
Tanganyika: The Case Study of Kabonga in Burundi and Kagunga in Tanzania
Landing Sites**

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Outline of the presentation

1. Basic information about Lake Tanganyika and LTA
2. Introduction and Objective of the study
 - 1.1 Fisheries description
 - 1.2. Economic contribution and social implication of the fishery
3. Management of Fishery in open access
 - ❖ Management of the fishery
 - ❖ Input into management
 - ❖ Management measures
 - ❖ Monitoring and enforcement:
4. Contribution of fishery in open access to achieve sustainability
 - 3.1 Sustainable use of the resources
 - 3.2 Economic viability of the resources
5. Main challenges and way forward.
 - 4.1 challenges for the fishery
 - 4.2 Improvement of fishery sustainability in the future

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Basic information on Lake Tanganyika

Riparian Countries	Burundi, DR Congo, Tanzania & Zambia
Altitude (surface)	773 m
Surface area	32,600 km²
Volume	18,880 km³
Maximum depth	1,470 m
Average depth	570 m
Residence time	440 years
Drainage area	223,000 km ²
Population in drainage area	12.5 million
Population density in drainage area	45/km ²
	Length of lake 670 km
Length of shoreline	1,900 km
pH	8.6 – 9.2



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About Lake Tanganyika Authority (LTA)

- After several studies conducted 1990s in the lake, it was revealed that problems and challenges facing the lake resources including fisheries are transboundary. Fish species which are highly exploited are also transboundary.
- In 2000 the four countries reached a consensus on which actions should be taken so as to address the threats facing the lake and its inhabitants .
- In 2003 they adopted a Strategic Action Program (SAP), a Convention on Sustainable Management of Lake Tanganyika. was signed
- The convention was the legal and institutional framework to support the implementation of the developed SAP.
- In 2008 Lake Tanganyika Authority was established under Article 23 of the Convention as an executing agency to co-ordinate the implementation the Convention by the Contracting States
- The organs of the Authority are: the Conference of Ministers, the Management Committee and the Secretariat.

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Introduction

Objective of the case study

- Report from the fisheries framework survey (2011) reported that, species of economic importance, have declined sharply and conflicts have increased due to population increase which triggered uncontrolled exploitation and gear changes in the pursuit of more fish (TAFIRI 2016) as well as un-harmonized fisheries policies, processes and procedures.
- Most recently, the modified active gillnets of unlimited lengths which was nicknamed by data collectors of this study as ‘Abnormal Active gill net fremaya brush-kamatia chini’ net emerged in the lake.
- The objective of case study of the Kagunga Landing Site in Tanzania and its nearby Kabonga Landing Site in Burundi, was to explore bottlenecks arising from non-harmonized fisheries management laws, policies, and fisheries practices among fisheries in riparian states of Lake Tanganyika.
- The study was also revealed on how these problem hinders fisheries in open access attain sustainable development goals.



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1.1 Description of the fishery

- In 1990s , annual fish production potential in the four countries was estimated to vary in the range of 165,000 to 200,000 metric tonnes.
- Recently, It was reported that the yields fluctuated from 40 000 to 20t in Burundi and from 200,000 to 184 000t in Tanzania (Philippe, 2013).
- Fisheries is characterised into small and medium scale fishing
- predominated with the two different types but often overlapping fisheries:
 - a) Pelagic zone fisheries mainly target two species of sardine-like clupeids and four species of perch (table 1)
 - b) Littoral zone fisheries, target a wide diversity of species (LTA, 2016). (table 1)

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Table 1: Significant commercial species from Lake Tanganyika

Offshore (pelagic species)	Maximum length (mm)*	Type of Gears (2018)	Abundance (2014)
1. <i>Lates stappersii</i>	450	Lt, RN, MAGN, AP	Abundant
2. <i>Stolothrissa tanganicae</i>	102	Lt, RN, MAGN, AP	Abundant
3. <i>Limnothrissa miodon</i>	170	Lt, RN, MAGN, AP	Frequent
4. <i>Lates angustifrons</i>	2000	Lt, RN, MAGN, AP,HL	Infrequent
5. <i>Lates mariae</i>	750	Lt, RN, MAGN, AP,HL	Infrequent
6. <i>Lates microlepis</i>	850	Lt, RN, MAGN, AP,HL	Frequent
7. <i>Hydrocynus goliath</i>	2500+	BS, MAGN, RN	Rare
Nearshore (littoral) and marshes species			
	Maximum length (mm)*		Abundance (2014)
<i>Boulengerochromis microlepis</i>	800	BS, MAGN, RN,HL	Frequent
<i>Limnotilapia spp</i>	260	BS, MAGN, RN	Frequent
<i>Tylochromis polylepis</i>	435	BS, MAGN, RN	Frequent
<i>Bathybathes fasciatus</i>	397	BS, MAGN, RN	Frequent
<i>Bathybathes ferox</i>	362	BS, MAGN, RN	Frequent
<i>Chrysichthys graueri (catfish)</i>	360	BS, MAGN, RN	Frequent
<i>Clarias gariepinus (catfish)</i>	1700	BS, MAGN, RN,HL	Frequent
<i>Dinotopernis cunningtoni (catfish)</i>	Appppp	BS, MAGN, RN,HL	Rare (frequent in DRC)

LT- Lift net,
RN- Ring net,
Bs-Beach seine

AP-
MAGN-
HL-

Appppp
Modifies active abnormal gill net,
Hook line

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1.1 Description of the fishery

- The main two pelagic species include the sardine *Stolothrissa tanganyicae* and the perch *Lates stappersii* which represent 98% of the total landings of the offshore fishery and are commercially exploited (LTA, 2018; Philippe.P. & Tom.S, 2015).
- They provide between 25% and 40% of the animal protein consumed in the region with an annual value estimate of USD 700 million (Philip T., 2013).
- Sustainability of fisheries resources and the attendant business is however at pole due to increase in population and fishing capacity in the lake basin. Extraordinary increase of bad fishing practices such as illegal modified gill net (Fremaya brush-fremaya) makes the situation to be more worse.
- These gears tremendously catch massive juvenile of *Luciolates* species and Fries of sardine

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1.1 Description of fishery at the study areas:-

Most recently, the emergence of modified gillnets with unlimited lengths nicknamed by data collectors in this study as ‘Abnormal Active gill net fremaya brush-kamatia chini’ net (Locally known as Fremaya brush for Burundi and fremaya makila kamatia chini for Tanzania) has been reported in parts of the lake.

The practice was found to have tremendous adverse impact on sustainability of food and rights of other fisheries at Kabonga and Kagunga landing sites (Table: 4)

Additionally there is differences levels of compliance to regulations and policies following the prevailing situation in their respective countries

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1.1 Description of the fishery as the study area:-

Table 2: Information of fishing capacity at Kabonga and Kagunga sites

Gears type	No. of Engine	Measurements	Size of the Fish adult/juvenile/both	Numbers of fishing Gears			Number of boats			No. of Fishermen employed		
				KB	KT	Total	KB	KT	Total	KB	KT	Total
Catamaran Lift net	86	length: 40m Depth: 25 -35m,	Both	06 40	11 86	126	20	140	160	280	516	796
Planked net Ring	12	length: 35- 40m Depth: 25 -50m,	Both	0	7	07	20	28	48	60	84	144
Planked net abnormal Gill	20	length: 1000 - 3000m Depth: 25 -30m	Both	0	20	20	0	40	40	0	60	60
Appolo Appolo lift net	75	length: 30-40m Depth: 25 -50m,	Both	70	0	70	34	0	34	490	0	490
Gill net normal-passive	NA	length: 80-100m Depth: 1-1.5	Larger	30	20	50	60		60	60	0	60
Hooks-Passive	NA	30 -50 hooks/fisher	Larger	100	15	15		13	13	200	30	30
Total	193			125	128	243	134	221	355	930	690	970

NA= Non-motorised gear; KB= Kabonga landing site in Burundi, KT=Kagunga Landing site in Tanzania

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Modified Active Gill net- Freemaya



28m deep

2000m length



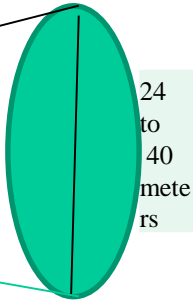
Catamaran for lift net



Lift net

25 Meters

24 to 40 meters



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1.1 Description of fishery Con-

Table 3

Number of Active Crafts and Units	KB-Kabonga		KT-Kagunga		Total (2018)	
	2011	2018	2011	2018	2011	2018
Population in the study areas	3.50%	22000	0.035	13000	35 000	36 000
Average number of fishers/landing site	168	930	111	690	279	1620
Average active Fishing vessels	68	42	134	221	202	42
Average active Fishing Units	51	40	125	128	176	168
		126 LN		20 MGN		
		one Lift net occupiest an Average area of 2514 m		One MGN occupiest an Average area of 56000m		

- Conflicts arises between these fishers operating different gears, targeting same fishing ground and same species. It was reported however that local fisheries institutions of Burundi and Tanzania, would resolve such antagonism whenever they arises.
- Leaders of fisher institutions could solve almost 90% of the antipathy. If parties failed to settle their confrontation, they appeal to the higher governments authorities in their respective areas.

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1.2 Economic contribution and social implications of the fishing activity

- In the region (2011) employed 100 000 fishermen, active vessels=31, 496
- In 2018 in the study area is directly and indirectly benefiting more than 35, 000 population (22 000 in KB and 13 000 in KT)

- Direct fishermen are 1620 (Source: FA questionnaire).
- Out of which 15% are owners
- 6% of owners were women

- 85% of 54 respondents are fishers who are earn between 26% to 50% of the total earnings which is divided equally according to the number of fishers on the particular gear.

- The remaining to 50% 74% is for the owners who were only 15% among the respondents.

- However, the sustainability of this fishery resources and its attendant business are at limit due to the **increase of illegal fishing (immature)**.

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1.2 Economic contribution cont-

- Out of 54, 88 to 92 are full time employed under fishery and only 12 and 8% from Kabonga and Kagunga respectively participate in other activities such as agriculture, and retails,
- It is not easy for fishermen to change and get acquitted to different activities. Only owners are readily able to diversify their activities
- In both sites, six species were mentioned to greatly contribute food and income to individuals, households and local governments,
- But economically the two sardine clupeids and contributed about 80% of the catch followed by *Late stapperssi*.
- Similar findings were observed in Kigoma, which is about 60km south of the study area. The study indicated that 70% and 25% of the catch was *sardine clupeids* and *Luciolates* respectively. Other spp amounted into only 5% (Kimerei 2006).
- The species are also transported by traders to the Eastern DR.Congo and other International markets such as Canada and Belgium (LTA, 2017).
- Other species such as *Lates*, Giant clupeid, Lake Tanganyika Sardine, and *Limnotilapia* are caught in littoral waters and are commonly sold at the local markets for households consumption.

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Economic contribution cont--

Consequence of the fishery

- Economic consequence - High rate of fishing juveniles lead to reduction of income.

How?

Table 4

Species	No if individual fish/ per box	Value /portion/BF	Total value per box (Assume one box contains 50 portions
		BIF/Tsh	
<i>L.stappersii</i> , immature	126 x 50 portions= 6300	1000/126 pieces	50 portions x 1000 = 50 000 BF
<i>L.stappersii</i> , at maturity/adult	250 pcs/box 6300 =25 boxes	3000/7pieces	(25boxesx250)/7pcs
			=892x3000=2.6M
Loss by selling immature			-2.55m

- Food security consequences – how?

Average fish consumption rate in LTA states is between 2 to 10 kg/prs/year

Species	No if individual fish/ portion	Required pieces to attain 10/kg	No.People benefitting from one box
<i>Luciolates</i> - immature	126pcs =1kg	1260 piece of fish	5 people
<i>Luciolates</i> - at maturity/adult 1 box = 6300fish/ 7= 900kg	7pc = 1kg	70 piece of fish	90 people
Social Loss by selling Immature			8 persons

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1.2 Social implication of the Fishery activity cont-

a) Competition for resource;

- Conflicts between fishers operating lift nets and those operating Modified abnormal gill nets (illegal) targeting same species at the same fishing ground.
- Modified gill nets occupies large space of the fishing ground (56 000msquire vs 2514 m squares of Lift nets)
- The MAG net collects all juveniles of *lates*

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1.2 Social implication of the Fishery activity cont-

- b) Conflict due to un-humanized regulatory fisheries frameworks and low compliance (closed season, illegality of gillnet
- KB closes its fishing season for about 10 days in each month during full moon to comply with its national regulation of closing fishing season and landing site.
 - Contrarily, Kagunga on the Tanzanian side of the lake does not practice the measures.
 - The disgust was that fishers in KB felt that their reserved fish were being harvested by their neighbours,
 - Secondly, those implementing closure season felt that their neighbours were getting more money during closer period while they are starving during.
 - 10 days closure is also still being questionable whether it can bear impact to fish recruitment.
 - There is therefore a need for research profile to find out to better planning for closure system.

Therefore harmonisation of management measures and other regulatory frameworks.

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- c) Post harvest resource waste lower level of food security in the region- malnutrition MAGN lead to **wastage of resources and lowers level of food security**
- o Fishery activities undertaken in the area if persist for a long time it may reduce economy contribution to the fishing community, social well being and food security in the area. Resource wastage occur in the following ways:-

Table 5: Loss caused by the fishing operation

Average fish consumption rate in LTA region 9 kg/prs/year			
Species	No if individual fish/portion	Required pieces to attain 10/kg	No. People benefit from one box
<i>Luciolates</i> - immature	126pcs = 1kg	1260 piece of fish	5 people
<i>Luciolates</i> - at maturity/adult 1 box = 6300fish/ 7= 900kg	7pc = 1kg	70 piece of fish	90 people
Social Loss by selling Immature			85 People

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2. Management of the fishery in Open access

- Fishery in this study area is transboundary resources and is under Multination with a single unified Convention on the Sustainable Management of Lake Tanganyika
- Article 2(a) and 7(1,2) insists that, the cooperation among states in planning and managing activities under the jurisdiction or control of a Contracting State which have a negative impact on the basin.
- The states also shall promote community participation in fisheries management and promote sustainable fisheries management on Lake Tanganyika

- However, the implementation is still minimal, .
- The study reveals that the fisher co management community participate in managing resources with several challenges;
 - Low cooperation among the member states and fishery institutions as well.
 - Activeness of the FI enforcement depends much on support from governments(They were more active at KB where they are supported than at KT)

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Management inputs:

- The convention, SAP, Draft of FFMP are Fisheries legal instruments allows community involvement by proposing opinions for decision making through meetings or their representatives.
- Their ideas/opinions are embraced by the government and thereafter to the regional level (LTA, 2012a).
- For example suggestion of banning the modified active 'fremaya-brush kamatia chini' in Burundi, originated from fishermen.
- However, there was a less involvement at KT compared with KB. Fishers in KT pointed out delay in feedback from their government after sending several information regarding fisheries challenges at their area.
- Generally idea of operating the destructive MAGN in the lake is not accepted by both fisheries communities of this case study.

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Management measures:

- There are management measures which are already being implemented by the individual countries while waiting for approval of the Regional Frameworks Fisheries Management Plan which has already been prepared under collaboration of LTA Secretariat and AU IBAR. Moreover some measures exist though at a low level in the sites are listed below:-

Table 6

Measures	Availability in National regulation (Yes/No)		Level of Compliance at site LOW/MEDIUM/HIGH	
	KB	KT	KB	KT
1. Regulation on restricting fishing gears characteristics,	Yes	Yes	Medium	Low
2. Mesh size restrictions	Yes	Yes	High	Low
3. Restricted areas/ closed areas e.g 50 meter from the shore & hours	Yes	Yes	Low	Low
4. Observation of lunar breaks for the pelagic fishery	Yes	Yes	Medium	Low
5. Closure season (particularly 10 days during full moon)	Yes	NO	High	NA
6. Control, surveillance, and enforcement eg banning illegal gears such as MAGN	Yes	Yes	Medium	Low
7. Restricts Breeding areas (only KB has identified breeding areas not KT)	Yes	NO	Medium	NA
8. Fishing Licensing- was mentioned even though it is more based on revenue collections by the government rather than fisheries resources management tool	Yes	Yes	NA	High

- The low level of measures application was noticed to be caused by open access nature of the fisheries with un-harmonised management measures, lack of surveillance facilities as well as community awareness.

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Monitoring and enforcement:

- Generally enforcement is engineered by governments entities with the involvement of fishers, local communities such as Fisheries federation for Burundi and Beach Management Unit for Tanzania.
- Strong involvement of the Local government Authorities and central governments was mentioned to be a success to regulation enforcement.
- RFMO is playing a key role of harmonizing fisheries policy and regulations, disseminating proper information related to promotion of proper fisheries management so as to rescue transboundary resources for sustainable regional livelihoods.
- On one site the degree of enforcement measures was a little bit more effective than another.
- At KT there were number of challenges, including lack of patrol boats. One strength noticed in KB sites is the strong involvement of other sectors. Both sites pointed out inadequate fund and lack of surveillance facilities.
- Using the FAO questionnaire, hazardous mentioned by respondents included storms and piracy. Both led to bankruptcy of fishers and removed them from fishing activities or either force them to resort to cheaper illegal gears for survival.
- Piracy occurs at night, where their gears taken away and some drowned into the lake.

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3.0 Contribution of the Open access approach to achieving Sustainability

3.1 Sustainable use of resources

- Open access of transboundary resources if emphasize harmonisation of management and enforce regulation it can promote sustainable use of the resources
- Previous research recognized that the hauled immature *L. stappersii* had 160mm length (Kimerei 2016), During this study Using FAO questionnaire, observation and other research findings, in almost 90% boxes landed, the *Lates* juveniles had 70mm length.
- With 90% of the catch composition contain 10% of sardine *Stolothrissa* (August, 2018)
- Ring operation at shallow water and Lift nets, operating during breeding season are also causing the same impact, as they cause destruction to fishery biodiversity by blocking fish recruitment system leading to total fishery collapse.
- Fishing operations of these modified gears, which involve of cruising the nets at the fishing ground and collecting immature are greatly impacting the fishery stock and they **can hardly lead to sustainability of fishery resources**

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3.2 Economic viability of the resource

- Generally, fishing efforts have increased six times in both Kabonga and Kagunga landing sites. There were 930 fishers in KB and 690 fishers in KT compared to that of 2011(186 and 111 respectively). Continue use of MAGN is accelerating immature fishing with low value product.

Table 7

Species	No if individual fish/ per box	Value /portion/BF	Total value per box (Assume one box contains 50 portions
		BIF/Tsh	
<i>Luciolates</i> , immature	126 x 50 portions = 6300	1000/126 pieces	50 portions x 1000 = 50 000 BF
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			=892x3000=2.6M
Loss by selling immature			-2.55 BF millions

- **Selling immature fish lowers economy of the community, reduce fish consumption rate and it can accelerate poverty to community.**
- Economically immature fishing at the open access transboundary fish with un harmonised fisheries management measures is not viable.

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4.1 Challenges for the fishery

- Un-harmonized fishery regulatory measures and standards among member states
- Low compliance to fisheries laws and regulations and inadequate enforcement, which lead to prevalence of immature fishing and marketing in the study area.
- Ineffective involvement of all stakeholders in the fisheries management process,
- Conflict between fishers due to resources competition.
- Limited scientific findings as well as other sources knowledge to guide and provide sound data to be used for decision making in the management plan. shortage of manpower, financial constraints, lack of awareness by the fisheries communities, and inadequacy in dissemination of proper information are among them.
- Keep on changing gears to catch immature fish hence leads to loss of pelagic & littoral fisheries --resources/reduction of fish, economy, social aspects
- Loss of aquatic biodiversity
- Habitat degradation, loss of ecosystem services
- Lack of alternative activities
- Population increase

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4.2 Improving fishery sustainability in the future

Sustainable use of the fisheries resources depends much on evidence from well collected data lead to proper decision making on management measures (because every day fisher defaulters seek to ploy with the regulations).

In order to increase the fishery's sustainability, sustainable use of the fisheries resources, economic viability of the fishery, and social equitability, the following is therefore suggested;

- Harmonize regulatory frameworks (eg control immature fish, closures, both spatial and temporal, minimum mesh sizes and size limits) where minimum legal lengths which our collaborators LVFO are implementing.
- Conduct training, awareness campaign against illegal practices and abolishes immature fish marketing.
- Immediate meetings involving all fisheries stakeholders is highly required to agree and propose management rules so as to rescue stock of the fishery as well as to improve economic wellbeing and food security of fishery community and regional at a larger.

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4.2 Improving fishery sustainability in the future

- The following interventions are needed for the fishery support attainment of SDGs:-
 - Conduct a research on a suitable mesh size of commercial exploited species in order to suggest appropriate mesh size to be used in the fishery (TAFIR, 2006)
 - Conduct a keen study on the economic loss from selling immature fish is urgently needed to show how much resources are wasted from individual perspectives, national and region as a whole, how negatively fish per capital consumption is reduced (currently is 2kg and 9kg/prs/year for Burundi and Tanzania- LTA,2016), disseminate the findings to fishers.
 - Support Lake mapping for sustainable use as well as diversify livelihood activities and approval of LTA aquaculture protocol which shall support, creation of alternative activities to fishery during closure system (through promotion of environmentally friendly cage culture)
 - Conduct Socio-economic study on the importance and contribution of the fishery resources of the Lake to communities' livelihood.
 - Establish legal slot size of the *L. stappersii* so as to rescue its stock, current there is none and when people are caught some politician are using it as an excuse for people continue to trade the immature fish.
 - Support fish monger women with savings schemes and communal cage culture.
- Research on proper months which relevancy with fish breeding and member states should institute closing seasons as per researchers' advice.

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THANKS

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