

# Modernised Annual Frame Survey Data Collection System in the Small-Scale Fisheries in Lake Malawi, Malawi

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## Abstract

Malawi is endowed with a diverse natural resource base that includes fisheries resources in the major waterbodies such as Lakes Malawi, Chilwa, Malombe and Chiuta; and the Shire River System. The management and conservation of the fisheries resources are championed by the Department of Fisheries. One of the critical areas of fisheries management involves the management of fishing effort in the country. In pursuit of this endeavour, the Department of Fisheries conducts Annual Frame Surveys in all the major water bodies. These surveys also known as the annual census of the basic fishing effort indicators provide a basis for the fishing effort management. The fishing effort indicators are categorised as fishers (comprising gear owners and fishing crew members) who are the food producers within the food chain. The food producers use fishing units which are recorded as numbers and types of fishing crafts, and numbers and types of fishing gears. The 2024 Annual Frame Survey indicates some significant changes to the fishing effort indicators. A total of 79,668 fishers were recorded indicating an increase of 17% from 66,435 fishers recorded in 2023. Out of this, 13,928 were gear owners and 65,740 crew members, representing 25% and 19%, respective increase from the 2023 survey. Most of the fishers were found in Mangochi district (17,474) followed by Nkhotakota district (10,379) with the least number of fishers was registered in Dedza district (1,010). This situation demonstrates an increase in the levels of direct employment and community participation in the country's fishing sector. The current survey recorded a total of 21,530 fishing crafts representing an increase of 12% from

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the 19,299 recorded in 2023. The recorded fishing crafts mainly comprised dugout canoes (55%), planked canoes (19%), planked boats without engines (11%) and planked boats with outboard engines (15%). Most of these fishing crafts are in Mangochi (4,899) followed by Karonga (3,310), Nkhatabay (3,236), Nkhotakota (2,656) and Salima (2,056) thereby respectively contributing 23%, 15%, 15%, 12% and 10% to the total number of crafts. The increase in the number of fishing crafts demonstrates increased investment in terms of ownership and utilisation of fishing equipment and accessories in the country. At district level, the numbers of fish producers and their fishing units have increased except for Mangochi district. For instance, the numbers of fishers in Nkhotakota, Karonga and Nkhata Bay have increased by 57%, 28% and 27%, respectively. In Mangochi district, the number of fishers and fishing crafts have declined by 7.2% and 6.6%, respectively. Mangochi further reported a drop in the legal gillnets as well as beach seines from the previous survey results. These declines are a result of most fishers migrating to Lake Chiuta in Machinga and Lake Chilwa in Zomba. The proliferation of illegal fishing gears and fishing methods cannot be overemphasized in most of the fishing districts. For instance, the utilisation of mosquito nets and monofilament gillnets has become common in virtually all the fishing districts in the country with increasing trends. The utilisation of illegal fishing gears needs to be stopped by the districts so that fishing effort is maintained within acceptable and sustainable levels.

**Keywords:** Fishing effort, Monofilament, livelihoods, illegal fishing, fisheries management

## 1 Introduction

Malawi is greatly gifted with the most freshwater fish diversity worldwide mainly found in the five main water bodies namely Lakes Malawi, Malombe, Chilwa and Chiuta, and the Shire River System [1] [2]. Despite the uniqueness, Malawi fisheries resources are facing sustainable threats from anthropogenic, climatic and environmental factors [3]. Respondingly, the Department of Fisheries conducts various programs that aim at conserving, managing, and utilising the resources, and this is done to ensure the sustainability of the fisheries resources. One of the tools used in managing the fisheries resources is the Annual Frame Survey for the small-scale fisheries. Annual frame survey is an annual census of fishers and their fishing units. Specific, this is a tool for quantifying and describing the elements of fishing effort namely the number and type of fishers, fishing crafts and gears [4].

The Annual Frame Survey is carried out in September every year when most of the landing sites in the country are accessible by land and when fishing activities are down scaled for fishing gear maintenance [4]. The survey involves visiting and taking records of all villages and landing sites to gather information on location and distribution patterns of the fisheries statistics. Traditionally, Annual Frame Surveys have been paper-based and this has been the case since 1993. As it is widely reported paper-based data collection approaches has numerous challenges ranging from untimely submissions, error prone to space limitations. In an effort to migrate to the digital world, the 2024 Annual Frame Survey used a mobile app to collect the data following a successful pilot in the 2022 Annual Frame Survey.

The Annual Frame Surveys are important in that the recorded information helps to identify primary and secondary sampling sites, and appropriate sampling strata for the catch assessment surveys (CAS) and the Malawi Traditional Fisheries assessment (MTF) [4]. Information relating to the total numbers of sampling units is also used to raise sampled catch rates in the estimation of total catch at different spatial scales. Changes in the number and composition of fishers, fishing gears

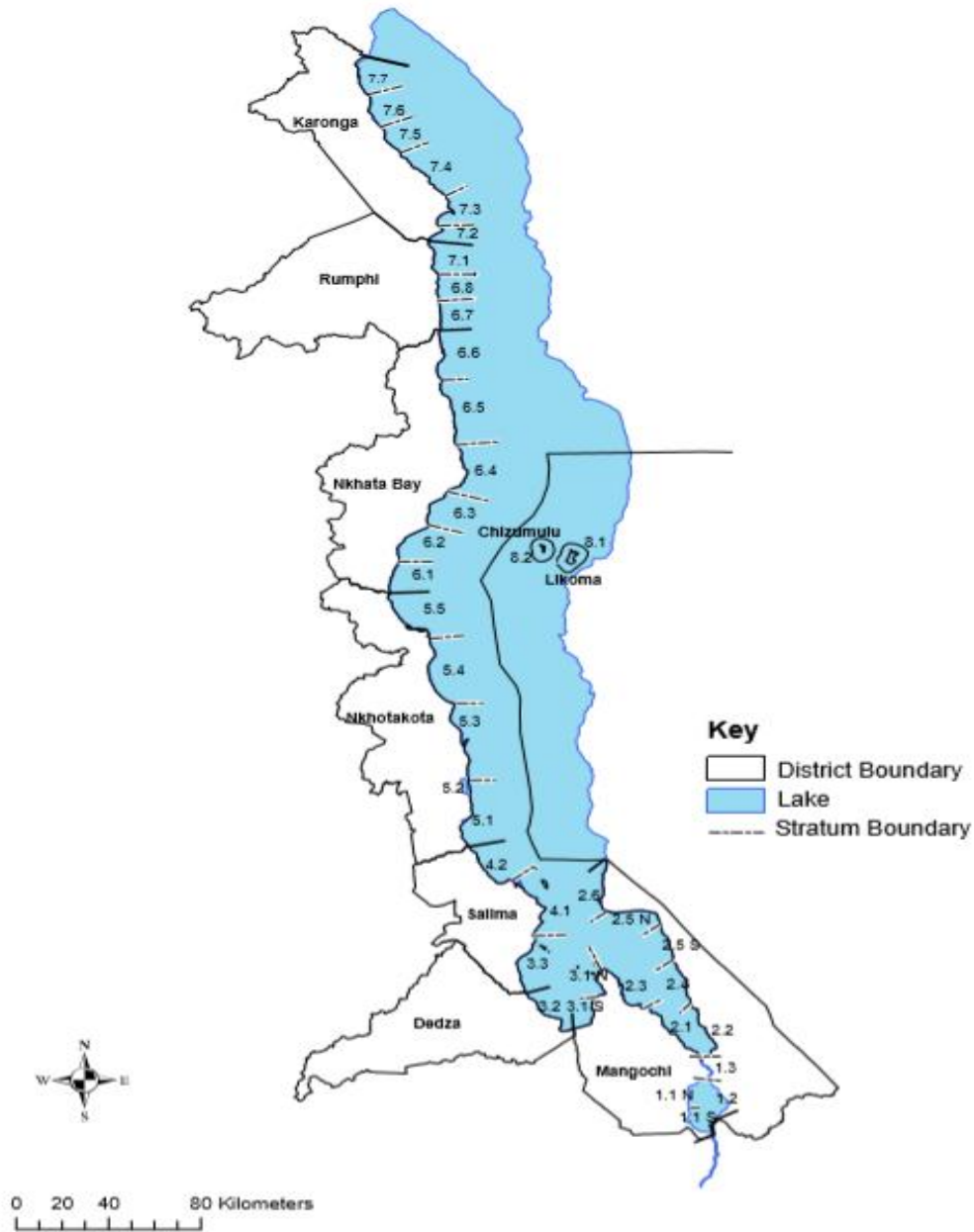
and fishing crafts are also tracked besides providing gender profiles in the capture fisheries activities. Economically, annual frame survey products are used to set district revenue collection targets through provision of estimated revenue from licenseable fishing gears.

The overall objective of the 2024 Annual Frame Survey was to provide basic fisheries information on the status and trends of elements of small-scale fishing effort for Malawi's major water bodies. Specifically, the surveys are conducted to provide up-to-date statistics on the numbers and types of fishers, fishing crafts and fishing gears; to determine distribution of gear owners by gender and age; to obtain socio-economic information that aid in fisheries development planning and to track changes in fishing methods/materials/effort characteristics.

## **2 Materials and Methods**

### **2.1 Study Study**

The study was conducted in all thirteen (13) fisheries districts in Malawi. Fig. 1 shows the district covered in Lake Malawi, Lake Malombe and the Shire River.



**Fig. 1** Map showing minor strata in Lake Malawi, Lake Malombe and the Upper Shire River

## 2.2 Preparations

Controlling Officers in all Districts were informed of the planned activity. The required number of personnel and associated resources for supervisors, enumeration and support staff were verified with responsible District Fisheries Officers (DFOs) and heads of research stations. The DFOs were further asked to provide the status of mobile phones or tablets for all the potential data recorders. Institutions working with fisheries offices were formally informed of the planned frame survey a month before the exercise. The enumerators were drawn from District Fisheries Offices. As per tradition unless otherwise decided by the respective DFO, the enumerators were allocated to their respective strata in which they were familiar with

### 2.3 Data collection protocols

The survey used the existing stratification of major and minor strata of the main water bodies in Malawi. For administration purposes, each District is demarcated based on the size of the fishing area. Lake Malombe has two minor strata 1.1 and 1.2, the Upper Shire River has one stratum, 1.3, Lake Malawi has 2.1 to 8.2 (Fig. 1), Lake Chilwa has 9.1 to 9.7, Lake Chiuta has 10.1 and 10.2 while the Shire Valley has 11.1 through 11.7.

### 2.4 Orientation on the collection tools

A mobile app, KoboCollect App was adopted and used in digitalizing the data collection forms in all the districts. Besides adding new information, all the parameters that were in the paper forms were transferred to the mobile app. All DFOs and their enumerators in all thirteen districts were assisted during an orientation training on how to access the form and its usage. The supervisors had coherent information to train enumerators at a central and convenient place that was decided upon by the responsible DFOs. The enumerators were taken through the form to collect reliable data and ensure unambiguous data recording. It was also demonstrated during the orientation on how to capture GPS position at every interview point in addition to taking pictures where necessary. A dry run at a nearest landing sites was arranged to see how the questions were flowing within a particular time.

### 2.5 Data Collection

To ensure consistency and avoid double counting due to migration, the survey was restricted to a maximum of 6 days. The collection of data was mainly by taking measurements, interviews and observation. Data was recorded by filling in the digital form in the mobile tablets/phones upon retrieving it from the server. Supervisors were mainly officers from the research institutions of the DoF and made spot checks for the verification of comprehensiveness and accuracy of the data being collected. At the end of each day, all the collected data was being sent to the server through internet connectivity.

### 2.6 Data retrieval

Once the data was being populated in the server, technical officers at Monkey Bay Capture Fisheries Centre were continuously checking for the data accuracy and consistency and provided instant feedback. The data were analysed using the Microsoft Excel 2016 and Sigmaplot software packages. A pivot-table analysis was used to summarise the data by water bodies and districts. Data summary was presented in the form of summary tables and graphs at national and district levels.

### 2.7 Ethical considerations

A written consent was obtained from each participant at the start of the interviews (questionnaire administration). Respondents were read an informed consent which clearly stated the following:

- a. the purpose of the study,
- b. what participation in the survey would involve?
- c. how confidentiality would be maintained,
- d. the right to refuse to participate in the survey or to withdraw from the survey without any penalty,
- e. the benefits of participating in the survey.

### **3 Results**

#### **3.1 Number and distribution of respondents**

Table 1 shows the number and distribution of respondents. The survey covered 394 group village headmen belonging to eighty-nine (89) Traditional Authorities scattered across Lakes Malawi, Malombe, Chiuta, Chilwa, Upper Shire, and Lower Shire Rivers. A total of 795 landing sites were registered in the current survey against 779 reported in 2023. A total of 743 beach village committees (BVCs) were reported to be active in the 2024 Annual Frame Survey against 703 registered in 2023 survey. From a total of 13,928 respondents, 1,201 indicated to be residents from other landing sites other than where they were found, representing an 8.6% non-residence rate. These non-residents were mostly found in the districts of Nkhotakota, Mangochi, and Machinga.

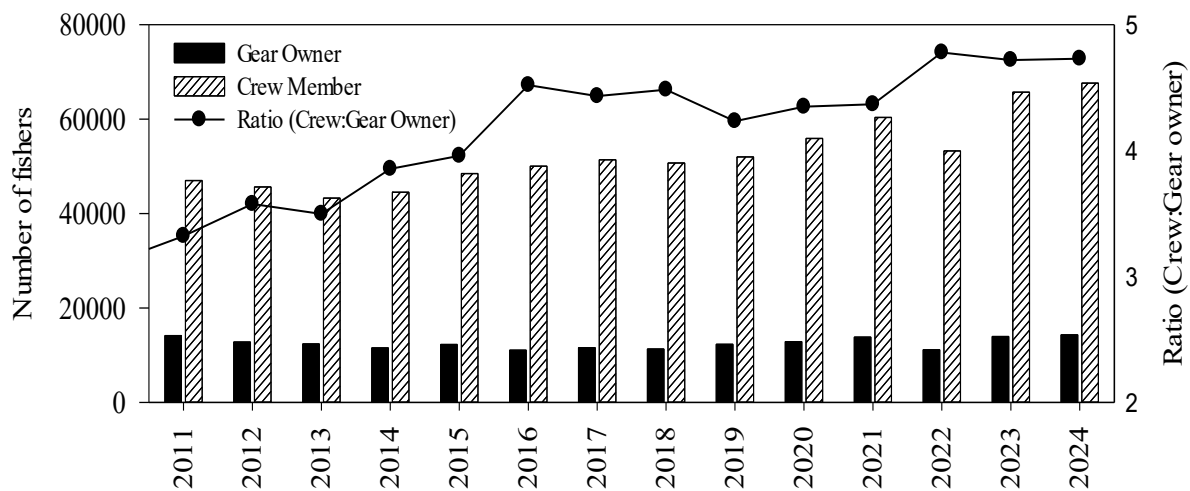
Table 1: Summary of results for the 2024 Annual Frame Survey by District and water body

Category	Parameter	Lake Malawi								Lake Malombe	Upper Shire River	Lake Chilwa			Lake Chiuta	Lower Shire River		Grand Total
		Dedza	Karonga	Likoma	Mangochi	Nkhata Bay	Nkhotakota	Rumphi	Salima	Mangochi	Mangochi	Machinga	Phalombe	Zomba	Machinga	Chikwawa	Nsanje	
Fishers	Male Gear Owners	225	1,660	569	2,317	1,897	1,736	471	977	393	143	351	236	462	406	794	1,283	13,920
	Female Gear Owners	1	76	27	96	47	33	20	11	2	2	4	9	1	45	9	383	
	Male Crew	1,014	6,515	4,328	17,588	8,131	8,768	2,582	4,789	3,870	797	1,921	947	2,057	374	1,096	2,085	66,862
	Female Crew	33	41	41	38	28	255	51	67	15	6	13	3	51	50	53	45	790
	Number of Gear owners (<18)	1	17		23	27	13		3	1	3	3	1	5	2	6	41	146
	Number of Gear owners (18-35)	109	577	162	963	498	670	51	332	158	34	120	73	200	267	330	483	5,027
	Number of Gear owners (>35)	116	1,142	434	1,427	1,419	1,086	440	653	236	108	232	162	266	138	503	768	9,130
	Number of Crew (<18)	53	1,066	31	1,847	685	732	70	345	185	26	14	5	39	6	30	218	5,352
	Number of Crew (18-35)	738	3,396	2,438	11,229	4,360	6,021	1,491	2,750	2,482	501	1,125	463	1,320	232	491	1,007	40,044
Number of Crew (>35)	256	2,094	1,900	4,550	3,114	2,270	1,072	1,761	1,218	276	795	482	749	186	628	905	22,256	
<b>Total number of fishers</b>	<b>1,273</b>	<b>8,292</b>	<b>4,965</b>	<b>20,039</b>	<b>10,103</b>	<b>10,792</b>	<b>3,124</b>	<b>5,844</b>	<b>4,280</b>	<b>948</b>	<b>2,289</b>	<b>1,186</b>	<b>2,579</b>	<b>831</b>	<b>1,988</b>	<b>3,422</b>	<b>81,955</b>	
Fishing Crafts	Boat with engine	5	259	368	994	803	557	236	268									3,490
	Boat without engine	104	110	127	667	40	135	59	206	364	102	145	75	242	1	32	52	2,461
	Planked canoe	5	984	271	592	451	846	476	78	47	3	100	59	164	66	95	101	4,338
	Dugout canoe	166	1,926	308	3,417	2,610	1,320	560	1,277	84	46	83	76	74	137	134	565	12,783
	<b>Total number of Fishing Crafts</b>	<b>280</b>	<b>3,279</b>	<b>1,074</b>	<b>5,670</b>	<b>3,904</b>	<b>2,858</b>	<b>1,331</b>	<b>1,829</b>	<b>495</b>	<b>151</b>	<b>328</b>	<b>210</b>	<b>480</b>	<b>204</b>	<b>261</b>	<b>718</b>	<b>23,072</b>
Gillnets	Gillnet	349	103	436	2,896	405	348	390	421		450	1	41	177	3,278			9,294
	Ngongongo	805		10	187	760	176	385	238		85	1		96				2,742
	Chikwekwe			606			585	2	12	35								1,240
	Monofilament	3,559	7,493	1,113	16,473	12,186	13,523	1,290	11,329	2,310	97	1,382	28	1,366	3,141	610	369	75,289
	<b>Total number of gillnets</b>	<b>4,713</b>	<b>7,596</b>	<b>1,559</b>	<b>20,162</b>	<b>13,351</b>	<b>14,631</b>	<b>2,067</b>	<b>11,999</b>	<b>2,345</b>	<b>632</b>	<b>1,384</b>	<b>69</b>	<b>1,639</b>	<b>6,419</b>	<b>617</b>	<b>441</b>	<b>88,644</b>
Hooks and Lines	Longline	140	347	759	3,344	1,906	1,088	205	1,387	35	-	155	44	634	115	222	195	10,576
	Handline	11	325	136	714	179	289	15	102	1			30	5	1	96	70	1,974
	Chomanga				21		7					3	32	35	31	30	243	402
	<b>Total number of hooks and line</b>	<b>151</b>	<b>672</b>	<b>895</b>	<b>4,079</b>	<b>2,085</b>	<b>1,384</b>	<b>220</b>	<b>1,489</b>	<b>36</b>	<b>-</b>	<b>158</b>	<b>106</b>	<b>674</b>	<b>147</b>	<b>348</b>	<b>508</b>	<b>12,951</b>
Open-water Seines	Chitimira	3	987	542	1,217	1,040	694	444	248									5,175
	Nkacha	19			30		6		9	213	36							313
	Matemba seine	3			3		15					167	92	190	1			471
	<b>Total number of open water seine</b>	<b>25</b>	<b>987</b>	<b>542</b>	<b>1,250</b>	<b>1,040</b>	<b>715</b>	<b>444</b>	<b>257</b>	<b>213</b>	<b>36</b>	<b>167</b>	<b>92</b>	<b>190</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>5,959</b>
Beach Seines	Kambuzi seine	3	3	1	4		31		16	1	1							60
	Kandwindwi	6			47		22		19	19								113
	Chambo seine/Wogo	2	13		58	2	1	3	1	1	37							118
	Mosquito net	8			56		97		2	7	7	5		3		4	69	258
	Usipa seine	5		1	17	4	5	1	28		1							62
	<b>Total number of beach seines</b>	<b>24</b>	<b>16</b>	<b>2</b>	<b>182</b>	<b>6</b>	<b>156</b>	<b>4</b>	<b>66</b>	<b>28</b>	<b>46</b>	<b>5</b>	<b>-</b>	<b>3</b>	<b>-</b>	<b>4</b>	<b>69</b>	<b>611</b>
Fish Traps	Fish trap	8	512	1	81	15	342	20	186	838	946	6,032	2,932	10,215	10,709	5,139	4,159	42,135
	<b>Total number of fish traps</b>	<b>8</b>	<b>512</b>	<b>1</b>	<b>81</b>	<b>15</b>	<b>342</b>	<b>20</b>	<b>186</b>	<b>838</b>	<b>946</b>	<b>6,032</b>	<b>2,932</b>	<b>10,215</b>	<b>10,709</b>	<b>5,139</b>	<b>4,159</b>	<b>42,135</b>
Others	Kokota															7	72	79
	Scoop net				1		1								2	41	11	56
	Cast net															142	121	263
	Spear							1									13	14
	Batting															56	73	129

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### 3.2 Number and distribution of fishers

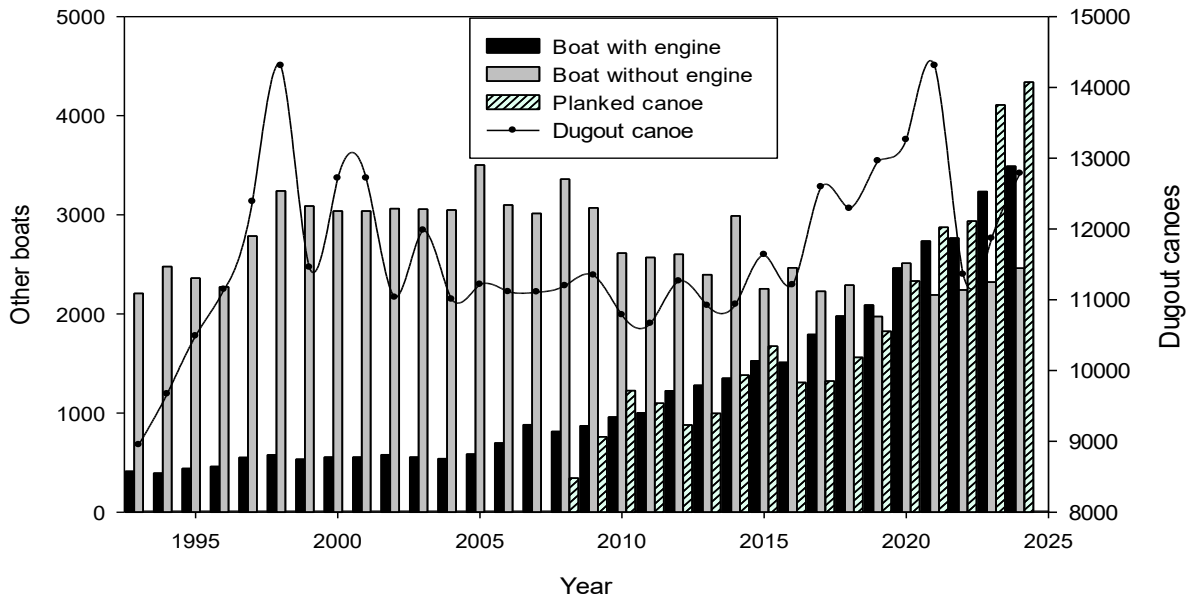
Fig. 2 shows the trend of the number of fishers. Countrywide, the number of fishers (gear owners and crew members) was 81,955 of which gear owners has increased by 25% from 11,151 to 13,928 while the number of crew members has increased by 19% from 55,284 to 65,740 between 2023 and 2024. Most of the fishers were found in Mangochi district (17,474) followed by Nkhotakota district (10,379) with the least number of fishers was registered in Dedza district (1,010) (Table 1). Male fishers continue to dominate the fishery with a contribution of 98% during the 2024 frame survey (Table 1 and Fig 2). In terms of gear ownership by sex, a total of 384 female gear owners were recorded in the current survey representing a 30% increase from those recorded in the 2023 survey (296). The number of female crew members has also increased by 133% from 422 in 2023 to 982 in 2024. The number of crew members was dominated by an active age group of 18 – 35 years contributing 60% to the total while those below 18 years contributed 7%. Crew members above 35 years contributed 33% to the total. The number of gear owners and crew members shows an increasing trend of 26% and 31%, respectively between 2016 and 2024. The ratio of crew members to gear owners over time shows an increasing trend since early 2000 and currently, it is estimated at 5 crew members to 1 gear owner.



**Fig. 2** Trend in the number of fishers from 2011 to 2024

### 3.3 Number and composition of fishing crafts

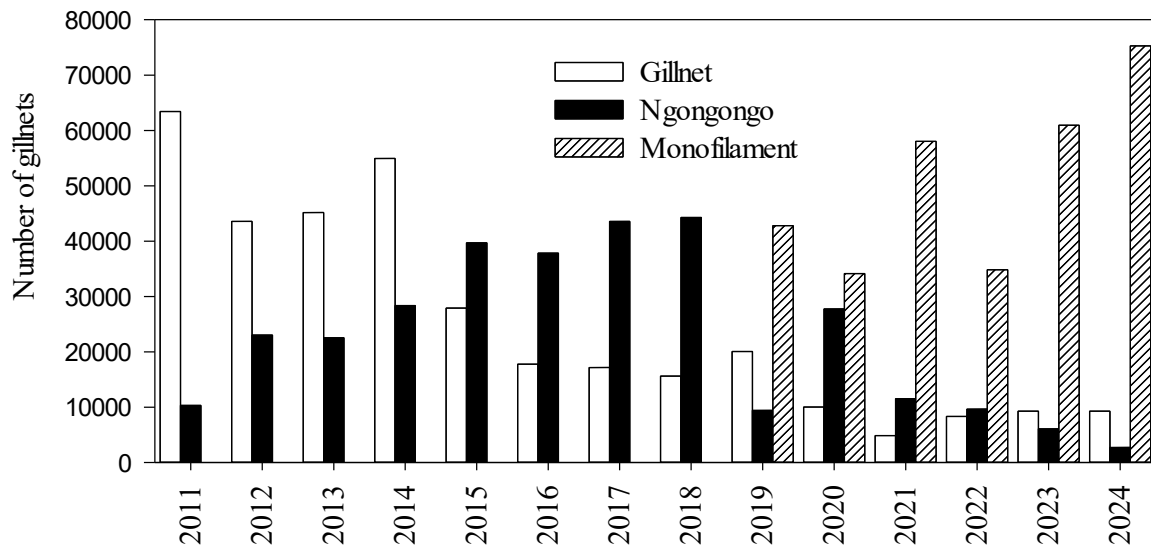
The number of boats with engines and planked canoes has increased by 11% and 40%, respectively while the number of boats without engines and dugout canoes has increased by 3.5% and 4.5%, respectively between 2023 and 2024 (Fig. 3). At district level, most of these fishing crafts are in Mangochi (4,899) followed by Karonga (3,310), Nkhatabay (3,236), Nkhotakota (2,656) and Salima 2,056) thereby respectively contributing 23%, 15%, 15%, 12% and 10% to the total number of crafts (Table 1). The number of boats with engines has been increasing since 2011 and between 2016 and 2024, an increase of 114% has been observed. On the other hand, the number of boats without engines does not show a definite pattern although between 2016 and 2024, a decline of 6% is observed. The number of dugout canoes has remained relatively stable unlike the number of planked canoes that have been increasing since 2011. Between 2016 and 2024, the number of dugout canoes and planked canoes increased by 6% and 213%, respectively.



**Fig. 3** Trend in the number of boats and canoes from 2011 to 2024

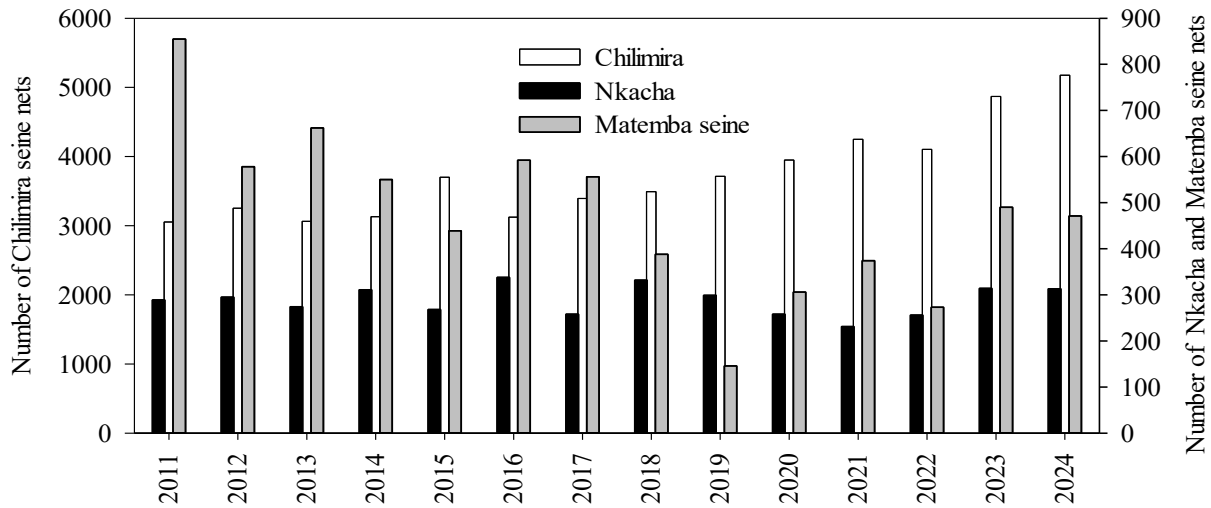
### 3.4 Number and composition of Gillnets

The fishery categorises gillnets as ‘legal’ gillnets, undermeshed gillnets (Ngongongo) and monofilament gillnets. The number of legal gillnets has continued to decline from an average of 50,000 (between 2011 and 2014) to 10,000 in the present years (2023 and 2024). Similarly, the under-meshed gillnets are also showing a declining trend. These gillnets are being replaced by monofilament gillnets with a total of 62,000 recorded in 2024 (Fig. 4).



**Fig. 4** Trend in the number of legal and illegal gillnets from 2011 to 2024

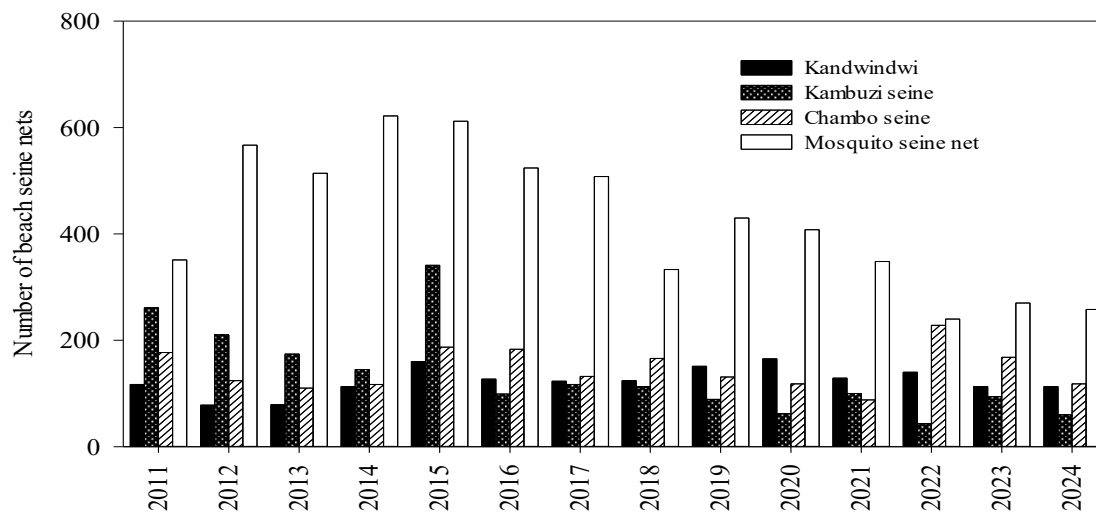
In Malawi, open water seine nets are locally identified as Chilimira, Nkacha and Matemba seine nets. Chilimira seine nets have increased by 19% while Nkacha and Matemba seine nets have increased by 23% and 79% respectively between 2023 and 2024 (Table 1 and Fig. 5). The number of Chilimira seine nets has continued to increase and between 2016 and 2024, an increase of 56% was registered. On the other hand, Nkacha and Matemba seine nets show a declining trend over the same period with 7% and 17%, respectively.



**Fig. 5** Number of open water seine nets from 2011 to 2024

### 3.5 Number and composition of beach seine nets

Fig. 6 shows the trend in the number of beach seine nets. Beach seines are Kandwindwi, Kambuzi, Chambo and Mosquito net. Kandwindwi and Chambo seine have declined by 19% and 26%, respectively while Kambuzi seine net, and Usipa/Mosquito net have increased by 118% and 13%, respectively between 2023 and 2024.



**Fig. 6** Trend in the number of beach seine nets from 2011 to 2024

## 4 Discussion

This report provides a summary of the 2024 Annual Frame Survey information collected in the five major water bodies in Malawi. The report further compares the effort indicators over 14 years. The distribution of boats, fishing gear and fishers in an area is an indicator of the fishing intensity. There have been major changes in the fisheries between 2011 - 2024 period. The report has noted drops in the number of fishers, fishing crafts and their gears in many districts. An unusual picture has also been noted in Machinga, particularly in Lake Chilwa where a substantial number of Nkacha nets was reported. This increase supports the claim of migration from Lake Malombe in Mangochi where enforcement activities have been enhanced. Correspondingly, there has been a drop in the number of fishing effort indicators in Mangochi and Zomba.

As previously expected by the 2024 report, very improved results have been reported. The current survey also witnessed a complete migration from a paper-based to an electronic data collection system. The benefits of using electronic data collection systems over papers have been widely reported [5,6, 7]. It is also expected that all districts will adopt the new method of data collection for improved data quality and speedy processing of the data for timely reporting.

## 5 Conclusion

In conclusion, the 2024 frame survey has revealed a mixture of increases and decreases in the fishing effort indicators. This calls for district-specific fisheries management interventions which are well-placed with the decentralisation initiatives. The results provide a better picture of the fisheries sector both at the national and district level. For the second time running, the use of electronic data capture through the mobile app has proven to be more effective than conventional paper-based data collection. The Department of Fisheries should therefore consider scaling up the approach to all fisheries data collection systems in Malawi.

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