

**Review of the Fisher Logbook Data Collection System and Fish Weighing Point  
System under the Lake Chilwa Basin Climate Change Adaptation Program  
(LCBCCAP)**

**A Progress Technical Report for WorldFish Center, Zomba, Malawi**

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## Acronyms

|      |   |
|------|---|
| BVCs | Beach Village committees                                |
| CAS  | Catch Assessment Surveys                                |
| DFO  | District Fisheries Officer                              |
| FAO  | Food and Agriculture Organisation of the United Nations |
| FRU  | Fisheries Research Unit                                 |
| MK   | Malawi Kwacha, a local currency                         |
| GoM  | Government of Malawi                                    |
| WFC  | WordFish Canter   |
| ZA   | Zomba   |

## **Summary**

Importance of the fisheries resources in Malawi cannot be overemphasized. Malawi is endowed with a number of water bodies which are the source of fish production. Among the significant water bodies, Lake Chilwa is one of the most productive ones in terms of fish production. The lake is virtually fished by small-scale fishers using basic fishing gears such as chomanga, gillnets, matemba seines, fish traps and longlines. The fisheries of the lake are conventionally monitored through a combination of annual frame survey (FS) and a monthly sample-based catch assessment survey (CAS). Due to enormous budgetary and logistical challenges associated with the conventional method, alternative fisheries monitoring systems are required.

Fisher logbooks and fish weighing point systems were therefore piloted in the Lake Chilwa Basin from January 2011 to June 2012, taking advantage of the deep rooted Participatory Fisheries Management (PFM) framework. The sampling schedules followed the hotspots of the Lake Chilwa Basin Climate Change and Adaptation Program (LCBCCAP) which covers the districts of Machinga, Phalombe and Zomba districts. The hotspots included two landing sites of Mposa/Mapira and Namanja in Machinga, Kachulu and Chisi Island in Zomba and Swang'oma in Phalombe.

The catch estimates for the lake between January 2011 and December 2011 based on CAS and logbook methods yielded annual production estimates of 7,346 and 15,716 metric tons, respectively. In both cases, Chambo and Matemba species dominated the catches. During the period, the fishers reported a total of MK92 million as gross income from the entire lake.

Records based on the Fish Weighing Point at Mposa landing site in Machinga district alone indicate some 380 metric tons which translated to MK162 million during the period between August 2011 and June 2012.

A small-meshed Matemba seine which becomes an illegal fishing gear during close season of the lake (January to February), were operated during the entire reference period. This therefore clearly shows that illegal, unreported and unregulated (IUU) fishing is still occurring in the lake. This is a serious management challenge.

Merits and demerits for each of the fish monitoring systems are further discussed in this report.

### **1.0 Introduction**

Lake Chilwa is the second largest lake in Malawi after Lake Malawi whose surface area is about 700 km<sup>2</sup> and is shallow lake with an average depth of 3 m, saline and not exceeding 6 m depth at peak water levels. Because of its shallowness, nutrient recycling is efficient, making the lake one of the most productive lakes in Africa (Chiotha 1996). In some years, the annual catch can approach 25,000 tons, but the average is around 13,000 tons. In 1979, fish production from the lake contributed approximately 43% to the national fish production, whereas in 1990 its contribution was 33%. This means that the lake has an important bearing on the nutritional requirements of Malawi's human population. Supply of fish to the local population and the fishing-related activities can, therefore, be some of the appropriate means through which food security and poverty eradication policy objectives of the Government of Malawi can be achieved.

The lake has no outlet and is bordered by extensive marches in the north and south. Water level changes are considerable between dry season (May-October) and wet season (November – to April). During dry season, crafts are moved several hundreds of meters offshore before they can find water deep enough to enable sailing. The lake is shared between Zomba, Machinga and Phalombe districts. In addition, it is a shared waterbody between Malawi and Mozambique.

The fisheries of the lake are based mainly on four main fish species categories that include Matemba (*Barbus paludinosus*), Makumba (*Oreochromis shiranus chilwae*), Mlamba (*Clarias gariepinus*) and others. Most these fish are landed while already processed. The main fishing gears for these species are gillnets longlines, matemba seine nets, and chomanga. Currently, there are over 5,000 fishers on the lake (GoM, 2010).

The fisheries of the lake are currently monitored through a set of conventional data collection systems i.e. catch assessment surveys (CAS) and annual frame survey (FS). The CAS, established by FAO in 1976 involves sampling fresh catches and fishing

effort at four statistically selected fishing sites by a recorder within a statistical area or Minor Stratum (MS). Records on sample based catch and effort are collected during the first 16 days of the month, spending four days at each selected landing site. The completed forms are sent to the District Fisheries Office (DFO) for processing and reporting. The annual Frame Survey (FS) is a complete enumeration of fishing effort upon which raising factors for up scaling sample based catch and effort generated through CAS are based.

At some point in time, use of fish weighing point system (WPS) was done to record fish catches from the lake. The WPS was established by Mr. Ratcliffe in 1970s in order to contain the problems associated with the conventional method. Weighing points were established at Phaloni, Kachulu (Zomba) and Mapila (Machinga). The weighing points constituted a scale with a metal rack enclosed in a shed and were manned by two recorders at fish scout grade. The fish scouts recorded loads of fish as they passed by. The fish loads were in form of neatly packed large baskets and cardboard boxes on bicycles, pick-up trucks or headloads. The recorders used a prescribed form to record the point of origin, destination, species composition, weight of the fish and mode of transport used. The species composition was determined through either inspecting the contents of the fish loads or through interviewing the fish traders. Since the time the WPS was introduced, the records have never been processed. As a result, the WPS died a natural death despite its comparative advantage over the conventional method.

A number of management and technical challenges related to conventional fish monitoring methods have been noted countrywide. Prominent among them include few GoM employed data recorders compared to the population of fishers for the lakes, enormously low funding allocations for data recording, some fish are landed while already processed (dried or smoked) and are therefore not recorded since CAS captures records on fresh basis, complexities related to fishing locality and most

fishers undertake their fishing operations for many months before landing at the designated sampling sites as required by the conventional system. A search for alternative fish monitoring methods is therefore looked into, using the fisheries of Lake Chilwa as a case study.

A logbook data collection system and Weighing Point System were chosen as pilot alternative systems for the Lake Chilwa. Through the fisher logbooks, fishers record their daily catch and effort records of the accomplished fishing trips. The system does not fully rely on the existence of conventional data recorders and could capture virtually all fishing activities taking place in a given fishery. It is cost-effective in that it demands less resources than the conventional methods do. In addition, the logbook system has the advantage of empowering the fishers to own the fisheries resources within the domain of participatory fisheries management (PFM). In the same vein, WPS also captures information which cannot be generated through the conventional means.

## **2.0 Objectives**

### *Main Objective*

- To pilot participatory fish monitoring systems for the fisheries of Lake Chilwa through fisher logbook and Weighing Point Systems and therefore ascertain the need to recommend them for further implementation.

### *Specific Objectives*

- To test the applicability of the fisher logbook and fish weighing point data collection systems;
- To compare the system with the conventional data collection systems taking place in the lake;
- To make recommendations for further improvement of the pilot data collection systems.

### 3.0 Materials & Methods

#### *Concept development*

Work on the fisher logbook data collection system for Lake Chilwa started with the development of a concept sometime in September 2010.

#### *Design of the data collection forms*

The format of the data forms used is presented in the Appendix A.

#### *Map of the area showing the Lake Chilwa*

Figure 1 shows the Map Lake Chilwa whose fisheries are conventionally monitored through annual census of fishing effort in combination with the monthly sample-based catch assessment surveys (CAS).

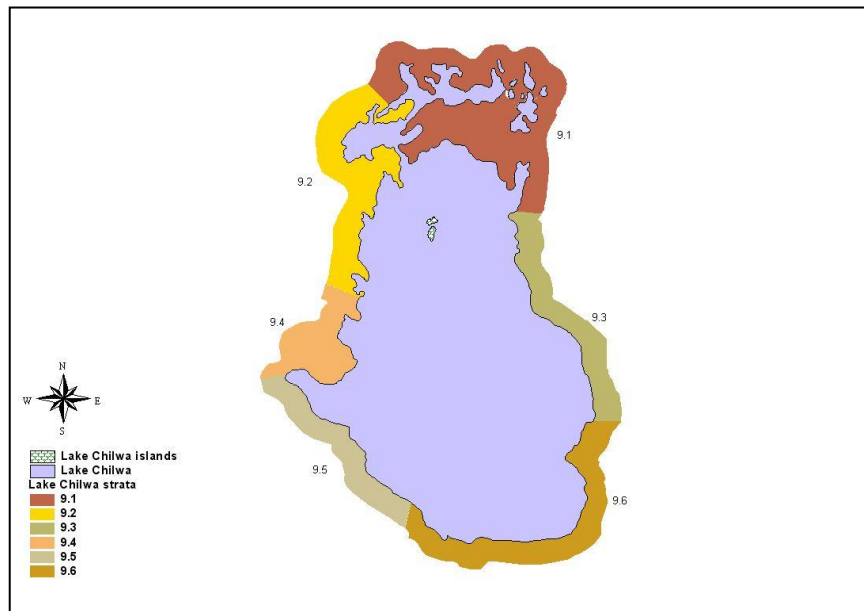


Figure 1: Map of Lake Chilwa showing sampling stratification for the conventional catch assessment surveys (CAS).

#### *Administration of the forms*

A study of the fisher logbooks is being undertaken by a number of stakeholders. Their roles and responsibilities were elaborated as detailed in Table 1.



Table 1: Roles and responsibilities of various stakeholders of the system

| Activity   | Responsible entity |
|--|--------------------|
| 1. Recording catch returns using the logbooks    | Fishersfolk        |
| 2. Retrieval and replenishment of data forms     | DFOs/BVCs          |
| 3. Supervision and monitoring                    | DFOs/BVCs          |
| 4. Technical backstopping of the data collection | Research team      |
| 5. Reporting (technical, progress reports, etc)  | BVCs/DFOs/Research |

#### *Data entry, collation and analysis*

Upon receipt of the data forms, the research team and DFOs checked the records prior to entry onto a computer. Where the records were not clear, efforts were made to have them clarified either by the DFOs or the concerned fishers. The collated data was then subjected to a pivot-table analysis, a built-in MS Excel analytical tool.

#### *Estimation of catch, effort and CPUE*

For all the participating fishers in the logbook system, the total monthly sample-based catch and effort in terms of total number of fishing trips per month were computed, resulting in monthly CPUE (catch per trip) for the entire sampling period. The actual catch estimate based on the logbook system was accomplished by raising the sample-based catch estimate from the participating fishers to the total number of fishers that are known to exist on the lake through annual frame surveys.

## **4.0 Results**

### *4.1 Landing Areas*

Based on the hotspots defined by the Lake Chilwa Basin Climate Change Adaptation Program (LCBCCAP), the landing sites that were earmarked for sampling included Mposa/Mapira and Namanja beaches in Machinga district, Kachulu and Chisi Island in Zomba district and Swang’oma in Phalombe district.

#### 4.2 Discard rate of the completed fisher log sheets

During the sampling period, a total of 4,250 datasheets on logbook system were disbursed to the fishing communities that are resident on the landing sites of Mposa/Mapira, Namanja, Chisi Island, Kachulu and Swang'oma, respectively (Table 2). Out of the disbursed log sheets, 2,526 were retrieved from the fishers thereby representing about 60 per-cent recovery rate. Out of the retrieved log sheets, 855 were discarded on account of illegibility thereby representing a discard rate of 34 per-cent.

Table 2: Rate of discard for the completed log sheets by the fishers during the sampling period: January 2011 to June 2012

| District       | Landing site | # Forms distributed | # Forms Retrieved | # Forms discarded | # Forms used | % discard |
|----------------|--------------|---------------------|-------------------|-------------------|--------------|-----------|
| Machinga       | Mposa        | 850                 | 625               | 134               | 491          | 21        |
|                | Namanja      | 850                 | 576               | 186               | 390          | 32        |
| Zomba          | Chisi Is.    | 850                 | 421               | 232               | 189          | 55        |
|                | Kachulu      | 850                 | 533               | 139               | 394          | 26        |
| Phalombe       | Swang'oma    | 850                 | 371               | 164               | 207          | 44        |
| <b>Overall</b> |              | <b>4,250</b>        | <b>2,526</b>      | <b>855</b>        | <b>1,671</b> | <b>34</b> |

#### 4.3 Fishing craft and gear utilization

Participating fishers in the logbook system from all the districts recorded five main fishing gears that included chomanga (CHO), fish traps (FT), gillnets (GN), longlines (LL) and matemba seines (MS). These gears were fished using either dugout canoes or planked boats mostly without outboard engines.

#### 4.4 Fishing grounds

Quite enormous number of fishing grounds have been identified on the Lake Chilwa where fishing activities occur in both open and marshy areas. In Zomba district, fish landed at Kachulu or Namakwaila or Namakwagela beaches on the Chisi Island

originated from many fishing grounds which included Thongwe and Chambalo, among others. In Phalombe district, fishing operations occurs around Chenjerani and Nansato islands, Malunguni and Njalo Islands after which the fish are landed mostly at Swang'oma. In Machinga, fishing activities occur in virtually all parts of the lake within the district and most of the fish are landed at Mposa (also known as Mapira beach) as well as Namanja landing site.

#### *4.5 Reported catch, effort and CPUE through the logbook system*

Through the logbooks, fishers reported a number of species which included Matemba, Chambo, Mlamba, Anjoli, Mphuta and Nkhalala, in that order (Table 3). A total of 7,775 fishing trips were accomplished by the fishers between January 2011 and June 2012 with an average CPUE of 258kg/trip.

The sample-based catch during the period between January 2011 and December 2011 yielded some 1,930 metric tons (Table 3). Based on this catch estimate, the raised total annual catch for the period in question is equivalent to 15,716 metric tons by simple proportion. That is, the estimated sampled based catch is as a result of 664 fishers who participated in the logbook system. From the latest official frame survey results, the lake is fished by some 5,408 fishers (2010 Annual Frame Survey).

Table 3: Sample based Catch, fishing effort and CPUE (in Kg, number of trips and Kg/trip, respectively) as reported by the fishers through logbook system from January 2011 to June 2012 (n = 2,138)

| Month        | Anjoli        | Chambo         | Matemba          | Mlamba         | Mphuta     | Nkhalala   | Other      | Total (Kg)       | # Trips      | Kg/trip    |
|--------------|---------------|----------------|------------------|----------------|------------|------------|------------|------------------|--------------|------------|
| Jan-11       | 3,337         | 64,595         | 108,010          | 28,326         | 99         | 29         | -          | 204,395          | 530          | 386        |
| Feb-11       | 2,706         | 52,370         | 87,568           | 22,965         | 80         | 23         | -          | 165,712          | 544          | 305        |
| Mar-11       | 1,395         | 70,409         | 46,134           | 111,659        | 142        | -          | -          | 229,740          | 480          | 479        |
| Apr-11       | 22,264        | 26,277         | 46,526           | 24,289         | -          | -          | -          | 119,356          | 520          | 230        |
| May-11       | -             | 52,829         | 175,099          | 962            | -          | -          | -          | 228,889          | 623          | 367        |
| Jun-11       | -             | 52,415         | 125,696          | -              | -          | -          | -          | 178,111          | 611          | 292        |
| July-11      | -             | -              | 176,439          | -              | -          | -          | -          | 176,439          | 451          | 391        |
| Aug-11       | -             | 70,966         | 157,792          | 1,889          | -          | -          | 207        | 230,853          | 398          | 580        |
| Sept-11      | -             | 180,898        | 57,993           | -              | -          | -          | -          | 238,891          | 288          | 829        |
| Oct-11       | 341           | 17,602         | 41,365           | 4,415          | 18         | 52         | -          | 63,793           | 780          | 82         |
| Nov-11       | -             | -              | 47,754           | -              | -          | -          | -          | 47,754           | 324          | 147        |
| Dec-11       | 244           | 12,598         | 29,605           | 3,160          | 13         | 37         | -          | 45,657           | 327          | 140        |
| Jan-12       | 128           | 6,617          | 15,549           | 1,660          | 7          | 19         | -          | 23,980           | 310          | 77         |
| Feb-12       | -             | 23,803         | 11,108           | 793            | -          | -          | -          | 35,704           | 361          | 99         |
| Mar-12       | -             | 6,484          | 6,672            | 14             | -          | -          | -          | 13,169           | 413          | 32         |
| Apr-12       | 136           | 16,340         | 11,123           | 3,768          | -          | -          | -          | 31,368           | 357          | 88         |
| May-12       | -             | 8,055          | 8,691            | 977            | -          | -          | -          | 17,723           | 242          | 73         |
| June-12      | -             | 8,872          | 356              | 100            | -          | -          | 3          | 9,330            | 216          | 43         |
| <b>Total</b> | <b>30,551</b> | <b>671,130</b> | <b>1,153,480</b> | <b>204,976</b> | <b>358</b> | <b>160</b> | <b>209</b> | <b>2,060,865</b> | <b>7,775</b> | <b>258</b> |

#### 4.6 Reported Income (MK) by the fishers through the Logbook system

A total of MK92.4 million was reported as gross income to the participating fishers through the logbook system (Table 5) during the sampling period. The Chambo and Matemba species fetched highest income levels of MK43.9 million and MK40.9 million, respectively, followed by Mlamba, Anjoli, Mphuta and Nkhalala, in that order.

Table 4: Sample based Income (MK) as reported by the fishers through logbook system from January 2011 to June 2012 (n = 2,138)

| Month              | Anjoli         | Chambo            | Matemba           | Mlamba           | Mphuta        | Nkhalala     | Other        | Grand Total       |
|--------------------|----------------|-------------------|-------------------|------------------|---------------|--------------|--------------|-------------------|
| Jan-11             | 21,434         | 1,030,876         | 1,047,332         | 556,839          | 2,694         | 1,442        | -            | 2,660,617         |
| Feb-11             | 17,378         | 835,772           | 849,114           | 451,452          | 2,184         | 1,169        | -            | 2,157,070         |
| Mar-11             | 8,960          | 1,123,663         | 447,350           | 2,195,028        | 3,883         | -            | -            | 3,778,884         |
| Apr-11             | 143,003        | 419,362           | 451,142           | 477,472          | -             | -            | -            | 1,490,979         |
| May-11             | -              | 843,090           | 1,697,870         | 18,911           | -             | -            | -            | 2,559,871         |
| Jun-11             | -              | 836,496           | 1,218,826         | -                | -             | -            | -            | 2,055,322         |
| Jul-11             | -              | -                 | 1,710,869         | -                | -             | -            | -            | 1,710,869         |
| Aug-11             | -              | 1,132,547         | 1,530,052         | 37,129           | -             | -            | 600          | 2,700,328         |
| Sep-11             | -              | 2,886,940         | 562,339           | -                | -             | -            | -            | 3,449,279         |
| Oct-11             | 38,570         | 1,855,030         | 1,884,643         | 1,002,015        | 4,848         | 2,595        | -            | 4,787,701         |
| Nov-11             | -              | -                 | 2,175,728         | -                | -             | -            | -            | 2,175,728         |
| Dec-11             | 27,605         | 1,327,658         | 1,348,853         | 717,150          | 3,469         | 1,857        | -            | 3,426,593         |
| Jan-12             | 14,499         | 697,319           | 708,450           | 376,665          | 1,822         | 976          | -            | 1,799,730         |
| Feb-12             | -              | 1,590,802         | 660,969           | 8,871            | -             | -            | -            | 2,260,642         |
| Mar-12             | -              | 6,597,611         | 7,236,264         | 23,656           | -             | -            | -            | 13,857,531        |
| Apr-12             | 37,150         | 9,814,880         | 6,119,670         | 636,554          | -             | -            | -            | 16,608,254        |
| May-12             | -              | 5,685,941         | 5,882,149         | 281,773          | -             | -            | -            | 11,849,863        |
| Jun-12             | -              | 7,242,687         | 5,388,642         | 394,937          | -             | -            | 4,800        | 13,031,066        |
| <b>Grand Total</b> | <b>308,600</b> | <b>43,920,672</b> | <b>40,920,264</b> | <b>7,178,451</b> | <b>18,900</b> | <b>8,040</b> | <b>5,400</b> | <b>92,360,327</b> |

#### 4.7 Beach price levels by district and species

There were some variations in the price levels of fish in the districts (Table 5). Fish from Zomba, on average, were most expensive (MK70 to 107/kg), followed by Machinga – Mposa area (MK80/kg). Chambo species (MK122/kg) were the most expensive species followed by Mlamba, Mphuta, Matemba and Anjoli, in that order.

Table 5: Species specific beach price levels (MK/kg) by district and landing site for the period between January 2011 and June 2012 in Lake Chilwa

| District       | Landing Site | Anjoli    | Chambo     | Matemba   | Mlamba    | Mphuta    | Average |
|----------------|--------------|-----------|------------|-----------|-----------|-----------|---------|
| Machinga       | Mposa        | 15        | 142        | 51        | 112       |           | 80      |
|                | Namanja      | 11        | 58         | 38        | 78        | 44        | 46      |
| Zomba          | Chisi Is.    |           | 124        | 37        | 50        |           | 70      |
|                | Kachulu      |           | 187        | 46        | 88        |           | 107     |
| Phalombe       | Swang'oma    |           | 98         | 53        | 38        | 57        | 62      |
| <b>Average</b> |              | <b>13</b> | <b>122</b> | <b>45</b> | <b>73</b> | <b>51</b> |         |

#### 4.7 Catch estimates based on CAS

The conventional catch assessment system (CAS) only describes fish species of the lake in four main species categories namely; Makumba (which is synonymous to Chambo), Matemba, Mlamba and unidentified species lumped as ‘other’ (Table 6). Between CAS January 2011 and December 2011, CAS method estimated a total catch of 7,346 metric tons for the entire Lake Chilwa. Out of this annual catch estimate, Chambo/Makumba, Matemba and Mlamba contributed 2,872 metric tons, 2,663 metric tons and 1,029 metric tons, respectively.

Table 6: Catch estimates for the fisheries of Lake Chilwa based on conventional catch assessment surveys (CAS) from January 2011 to December 2011

| <b>District/Species</b> | <b>Makumba</b> | <b>Matemba</b> | <b>Mlamba</b> | <b>Others</b> | <b>Total</b> |
|-------------------------|----------------|----------------|---------------|---------------|--------------|
| Machinga                | 1,144          | 759            | 356           | 380           | 2,640        |
| Zomba                   | 911            | 1,363          | 419           | 130           | 2,823        |
| Phalombe                | 816            | 542            | 254           | 272           | 1,884        |
| <b>Overall</b>          | <b>2,872</b>   | <b>2,663</b>   | <b>1,029</b>  | <b>782</b>    | <b>7,346</b> |

#### 4.8 Fish Weighing Point System

Mposa fish weighing point in Machinga district recorded a total of 380,453 kg of fish between August 2011 and June 2012 (Table 7). Chambo species dominated the quantities of fish recorded during the period, followed by Kasawala, Matemba and Mlamba, in that order. The fish production recorded at Mposa weighing point during the reference period was worth MK162 million (Table 8), with the highest contribution of MK79.6 million from Matemba species.

Table 7: Total Fish production (kg) recorded at Mposa fish weighing point from August 2011 to June 2012 (n = 318)

| <b>Month/Species</b> | <b>Chambo</b>  | <b>Kasawala</b> | <b>Matemba</b> | <b>Mlamba</b> | <b>Monthly Total</b> |
|----------------------|----------------|-----------------|----------------|---------------|----------------------|
| August, 2011         | 10,741         | 5,426           | 7,626          | 8,110         | <b>31,903</b>        |
| September, 2011      | 19,111         | 10,038          | 12,202         | 12,797        | <b>54,148</b>        |
| October, 2011        | 24,629         | 15,989          | 13,173         | 13,293        | <b>67,084</b>        |
| November, 2011       | 18,395         | 8,179           | 10,658         | 7,335         | <b>44,567</b>        |
| December, 2011       | 9,339          | 4,037           | 2,992          | 4,261         | <b>20,629</b>        |
| January, 2012        | 12,735         | 23,663          | 2,560          | 1,957         | <b>40,915</b>        |
| February, 2012       | 5,249          | 3,494           | 3,790          | 3,941         | <b>16,474</b>        |
| March, 2012          | 8,134          | 6,402           | 7,425          | 5,703         | <b>27,664</b>        |
| April, 2012          | 9,240          | 6,342           | 9,939          | 8,524         | <b>34,045</b>        |
| May, 2012            | 6,922          | 4,602           | 5,710          | 5,934         | <b>23,168</b>        |
| June, 2012           | 7,554          | 2,880           | 3,567          | 5,855         | <b>19,856</b>        |
| <b>Species Total</b> | <b>132,049</b> | <b>91,052</b>   | <b>79,642</b>  | <b>77,710</b> | <b>380,453</b>       |

Table 8: Total Fish Value (MK) recorded at Mposa fish weighing point from August 2011 to June 2012 (n = 318)

| <b>Month/Species</b> | <b>Chambo</b>     | <b>Kasawala</b>  | <b>Matemba</b>    | <b>Mlamba</b>     | <b>Monthly Total</b> |
|----------------------|-------------------|------------------|-------------------|-------------------|----------------------|
| August, 2011         | 3,540,850         | 793,450          | 7,637,500         | 5,528,940         | <b>17,500,740</b>    |
| September, 2011      | 4,555,811         | 996,342          | 11,226,850        | 8,707,385         | <b>25,486,388</b>    |
| October, 2011        | 5,272,933         | 2,826,103        | 13,850,770        | 9,177,541         | <b>31,127,347</b>    |
| November, 2011       | 3,389,180         | 823,670          | 7,363,388         | 4,909,790         | <b>16,486,028</b>    |
| December, 2011       | 1,864,885         | 547,712          | 3,292,750         | 3,354,250         | <b>9,059,597</b>     |
| January, 2012        | 765,310           | 225,600          | 2,559,820         | 1,336,300         | <b>4,887,030</b>     |
| February, 2012       | 1,387,600         | 302,980          | 4,445,260         | 2,782,500         | <b>8,918,340</b>     |
| March, 2012          | 1,400,720         | 461,789          | 1,762,040         | 2,295,650         | <b>5,920,199</b>     |
| April, 2012          | 2,471,535         | 651,390          | 9,356,610         | 4,733,980         | <b>17,213,515</b>    |
| June, 2012           | 2,509,018         | 393,380          | 6,209,880         | 4,147,470         | <b>13,259,748</b>    |
| May, 2012            | 1,737,391         | 494,940          | 6,037,250         | 3,903,480         | <b>12,173,061</b>    |
| <b>Species Total</b> | <b>28,895,233</b> | <b>8,517,356</b> | <b>73,742,118</b> | <b>50,877,286</b> | <b>162,031,993</b>   |

#### 4.9 Comparisons among the various Fish Monitoring Systems

The fisheries of Lake Chilwa have been subjected to a variety of monitoring methods as summarized in Table 9. Among these methods, the annual frame survey provides baseline information for the fishery and therefore cannot be substituted. The summary outlines some basic characteristics of each of the monitoring systems.

Table 9: A summary of the basic characteristics of the fish monitoring systems in relation to the fisheries of Lake Chilwa

| <b>Monitoring System</b> | <b>Basic Characteristics</b>   |
|--------------------------|--|
| 1. Frame Survey          | Annual complete census of fishing effort<br>Generates baseline information for subsequent sample-based surveys<br>No alternative but requires rational decision-making on budgets and logistics  |
| 2. CAS                   | Monthly and sample-based fish monitoring system<br>Relies on annual frame survey results<br>Based on pre-defined landing sites for sampling<br>Relies on permanent employees of the Government of Malawi<br>Inability to capture night fishing regimes<br>Groups species of Lake Chilwa into four species categories   |
| 3. Logbook               | A record of each fishing trip done by fishers themselves<br>Only relies on frame survey results when few fishers are involved<br>Ability to capture fishing activities regardless of time and place of landing<br>High possibility of under-reporting where fishers would want to draw sympathy<br>High possibility of not declaring illegal fishing operations<br>Records as many species as they are caught by the fishing gears |
| 4. Weighing Point        | Dependent on fish marketing portfolio of the landing sites<br>Tracks origin and destinations of the fish products<br>Records mostly already processed fish<br>Limited species level assessments  |

### 5.0 CAS vs Logbooks on catch estimation

The catch estimate for the Lake Chilwa fisheries between January 2011 and December 2011 using both CAS and the logbook method yielded completely different results (Table 10). The CAS method estimated a total annual catch of 7,346 metric tons whereas the logbook estimated some 15,716 metric tons. Through CAS method, the annual catch estimate for Chambo/Makumba species was higher than that of Matemba species and the opposite was true for the logbook method.



Table 10: Comparison between CAS and the Logbook system based on catch estimates (in metric tons) for the lake from January 2011 to December 2011

| <b>Species catch</b> | <b>CAS</b>   | <b>Log book</b> |
|----------------------|--------------|-----------------|
| Anjoli               | -            | 247             |
| Chambo/Makumba       | 2,872        | 4,895           |
| Matemba              | 2,663        | 8,959           |
| Mlamba               | 1,029        | 1,610           |
| Mphuta               | -            | 3               |
| Nkhalala             | -            | 1               |
| Other                | 782          | 2               |
| <b>Overall</b>       | <b>7,346</b> | <b>15,716</b>   |

### 5.1 CAS vs Logbooks on CPUE

The catch rates or CPUE estimates based on the CAS and logbook system showed considerable variations (Table 11). The estimates are, however, comparable although high variability with the logbook method implies compromise in the quality of data.

Table 11: Comparison of *cpue* profiles (kg/trip) between logbook system and the conventional CAS method for the period from January to September 2011 (n=170, all species)

| <b>District</b> | <b>Site</b>  | <b>Fishing gear</b> | <b>CAS</b>  |              | <b>Logbook</b> |              |
|-----------------|--------------|---------------------|-------------|--------------|----------------|--------------|
|                 |              |                     | <b>Mean</b> | <b>Stdev</b> | <b>Mean</b>    | <b>Stdev</b> |
| Machinga        | Mapila/Mposa | FT                  | 81.53       | 19.45        | 190.49         | 268.89       |
|                 |              | GN                  | 88.12       | 34.42        | 219.24         | 268.43       |
|                 |              | MS                  | 97.14       | 52.33        | 960.23         | 277.69       |
|                 | Namanja      | FT                  | 94.35       | 47.21        | 123.86         | 205.30       |
|                 |              | GN                  | 76.02       | 33.39        | 91.93          | 212.28       |
|                 |              | MS                  | 49.33       | 12.11        | 164.10         | 218.50       |
| Phalombe        | Swang'oma    | CHO                 | 77.32       | 34.54        | 713.07         | 228.37       |
|                 |              | FT                  | 67.74       | 41.87        | 569.00         | 170.52       |
|                 |              | GN                  | 58.16       | 19.84        | 272.56         | 107.34       |
|                 |              | LL                  | 66.01       | 21.36        | 276.18         | 100.64       |
| Zomba           | Kachulu      | GN                  | 84.51       | 37.17        | 147.96         | 83.90        |
|                 |              | MS                  | 67.28       | 14.88        | 15.22          | 88.31        |
|                 | Chisi        | CHO                 | 56.34       | 14.12        | 27.43          | 90.70        |
|                 |              | FT                  | 84.99       | 57.01        | 32.38          | 93.46        |
|                 |              | GN                  | 80.09       | 27.93        | 79.48          | 90.03        |
|                 |              | MS                  | 61.43       | 18.71        | 114.15         | 95.94        |

## **Discussion and Management Implications**

Basic fishery statistics such as catch, fishing effort and catch-per-unit-of-effort form the basis of fishery planning, resource management and other important uses a given fishery data can be put to. The routine data collection of such statistics involves enormously large sums of money on overheads as most of the capital as well as operational costs needed to sustain them are incurred on daily basis. As such, many fishery managers do not consider the routine data collection as a priority. This scenario therefore justifies the search for alternative data collection systems for monitoring the capture fisheries of Malawi in general and the fisheries of Lake Chilwa in particular. The use of fisher logbooks would therefore minimize sampling costs and administrative overheads which currently is the case with the conventional methods. It is a considered view that the fishers, through long experience in the fishing activity, possess some explicit ecological knowledge that can be vital for decision-making among the policy makers and the fisheries resource managers (Walters, 1995). This vast knowledge can only be harnessed if and only if the fishers are actively involved in the fishery resource monitoring framework.

The management of the fisheries of Lake Chilwa has evolved with time from a top-down approach based on technical restrictions and imposition of enforcement measures to a Participatory Fisheries Management (PFM) framework. The transition process which started sometime in 1996 was mainly financed through interventions from various donor funded projects such as the phased-out Lake Chilwa Wetland and Catchment Project which was jointly funded by the GoM and the Danish International Development Agency (DANIDA). The DANIDA project consolidated the community-based management as a strategy to facilitate the recovery of the collapsed fishery following the recession of the lake. It also supported the development of a management plan for the lake. The focus was on community participation as an option to gain legitimacy of any planned interventions earmarked for the Lake Chilwa

Basin. This therefore makes it easier for the fishing communities in the basin to adopt the use of fisher logbooks as an alternative fish monitoring system.

The piloting of the logbook system in the hotspots of the LCBCCAP met a number of challenges. Among them, the retrieval rate of the completed log sheets pegged at 60% and was very low. This was due to the migratory nature of the fishers as most of them took several months fishing consecutively without getting back to their port of landing. In addition, most of the fishers were not able to properly record their catch returns and this was evidenced by 34 per-cent of the retrieved log sheets discarded. This makes it important to treat the fisher reported information with some caution. In addition, this situation calls for refresher courses for the fishers coupled with continuous monitoring and supervision of the system.

Matemba seine, a small-meshed net, was the most frequently used fishing gear in the lake during the reference period. It is worth noting that the lake closes to fishing using small-meshed nets during the months of January and February. In contrast, the fishers mostly reported on the operation of matemba seine nets during this period of close season. Among the districts, the matemba seines were used more frequently at Namanja in Machinga district especially. It is interesting to note that this site is distantly located from the central administration of the district, implying that levels of interventions at Namanja through fisheries extension services are minimal and that the fishers operate illegal fishing uninterrupted. In addition to the use of small-meshed matemba seines, the fishers reported catch returns on Kasawala, juvenile Chambo species, through the logbooks. It can therefore be ascertained that a number of illegal, unregulated and unreported (IUU) fishing practices are still taking place in the lake.

The use of the logbooks unveiled excessive fishing effort in the exploitation of the fisheries resources of the Lake Chilwa as evidenced by more than 2 fishing trips per

fishing day. The fishers reported a total fishing effort of 7,775 fishing trips over a period of 18 months, implying a monthly average effort of 432 trips, a daily effort of 14 trips for the five main fishing gears of chomanga, fish traps, gillnets, longlines and matemba seines. The fishers reported the use of multiple shifts of the fishing crew for the same gear as a strategy for accomplishing a large number of trips in a fishing day. The conventional catch assessment method (CAS) cannot capture this fishing strategy. This is worsened by the fact that the Fisheries Conservation and Management Act of 1997 does not have provisions for this type of fishing strategy. From the fishers' perspective, this is one way of maximizing catches from a situation marked by persistent declining catches.

The merits and demerits of each of the fish monitoring systems used for the fisheries of Lake Chilwa can be depicted from the summary of basic characteristics in the results section. However, the catch rates from the use of the fisher logbook system showed larger fluctuations than those of CAS thereby implying a compromise in data quality. Although this is the case, the logbook system has still unveiled some important fishing practices among the fishing communities of the lake which have not been recognized through the conventional methods. Moreover, the annual catch estimate afforded by the system is more realistic compared to that of the conventional method. This therefore calls for further analysis of the use of fisher logbooks so that policy-makers can be convinced of its application, merits and the potential for sustainability in relation to the conventional method.

A total of MK92 million as gross income accruing from the fishing operations in the Lake Chilwa Basin as reported by the fishers is not a small feat. The income profiles of could be a basis to justify the need for provision of social services to the landing sites of the lake. These services may include banking, access to credit facilities, health centers, potable water supply, schools, and infrastructure development in form of better feeder roads, among others.

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## APPENDIX A

### Kalemba wa Nsomba mnyanja ya Chilwa

Dzina la msodzi

Dzina la BVC/Mudzi

Mwezi/Chaka

Mtundu wa Boti

Mtundu wa Chida

Malo ophera nsomba

Malo okochezera

| Tsiku |          | Mulingo wa nsomba (chigoba, chidebe, dazeni, chitini ndizina zotere) |        |        |         |        |              |            |        |      |          |            | Effort | Zoonjezera |
|-------|----------|--|--------|--------|---------|--------|--------------|------------|--------|------|----------|------------|--------|------------|
|       |          | Matemba  | Chambo | Miamba | Achonjo | Mphuta | Nichentcheta | Nkholokolo | Anjoli | Jeka | Nkhalala | Chilunguni |        |            |
| 1     | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 2     | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 3     | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 4     | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 5     | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 6     | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 7     | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 8     | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 9     | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 10    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 11    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 12    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 13    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 14    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 15    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 16    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 17    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 18    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 19    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 20    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 21    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 22    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 23    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 24    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 25    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 26    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 27    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |
| 28    | Quantity |  |        |        |         |        |              |            |        |      |          |            |        |            |
|       | Price    |  |        |        |         |        |              |            |        |      |          |            |        |            |