2018 Water Abstraction Survey Report

Current Water Use in the Lower Mara River Basin, Tanzania

Lake Victoria Basin Water Board under the Ministry of Water of the United Republic of Tanzania

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Executive Summary

The Sustainable Water Partnership aims to support the improvement of water resources management in the Mara River Basin. Among the tasks of the partnership is to develop a Water Allocation Plan for the entire river basin. The Water Allocation Plan will define the amount of water provided to different water users in the basin, as well as the priority of categories of water user, to ensure the equitable sharing of freshwater resources and to support the proper management of these resources during times of scarce water availability. As part of the Water Allocation Planning process, information on the current water use is important. This report describes the information gathered during field work in the Mara River Basin in Tanzania (TzMRB) to estimate current use, including locations, source types, approximate amounts abstracted, and purposes for the water abstractions. Information reported here will be combined with data presented separately on water resource availability, future demand projections, and the reserve to calculate the water balance to be included in the Mara-wide Water Allocation Plan.

Current water use has been quantified based on information gathered in the field during the abstraction survey. In total, 499 abstraction points were recorded, out of which only 344 were functional. Serengeti District has the largest number of abstractions at 196, followed by Tarime District with 183, Butiama District with 144, and Rorya District with 6 abstraction points. Considering hydrological boundaries, 3 hydrological units make up the TzMRB: Serengeti, Somoche and Mara. A total of 13,577 m^3 of water is abstracted daily with 1,874 m^3/day being abstracted from the Serengeti HU, 11,178 m^3/day in the Mara HU, and 525 m^3/day in the Somoche HU. Groundwater use is quite common in the basin, with over 400 abstractors relying on either deep boreholes, springs, or shallow wells equipped with hand pumps. Only 39 abstractors were found which draw water directly from the river, while 46 take water from water pans/dams. The most common use of water abstracted (49 percent) is for domestic purposes (including public supply). Livestock use amounted to 25 percent, 18 percent for mining, 4 percent for irrigation, and 1 percent for hotels and tourism.

The information from the abstraction survey was presented to stakeholders during a stakeholder engagement workshop on November 5th & 6th, 2018 in Tarime, Tanzania. A technical review meeting was also conducted by the Ministry of Water and other partners in July 2019. Feedback from these meetings was collected and incorporated into the findings presented in this report.

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Acronyms

HU	hydrological unit
IHE Delft	IHE Delft Institute for Water Education
km2	square kilometres
LVBWB	Lake Victoria Basin Water Board
m3/d	cubic metres per day
MoW	United Republic of Tanzania Ministry of Water
TzMRB	Mara River Basin in Tanzania
SENAPA	Serengeti National Park
SWP	Sustainable Water Partnership
WAP	Water Allocation Plan
WUA	Water Users Association

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1. INTRODUCTION

The Sustainable Water Partnership (SWP) is a programme that aims to support the improvement of water resources management in the Mara River Basin. One of their tasks is to develop a Mara-wide Water Allocation Plan (WAP) for the entire river basin. The WAP will define the amount of water provided to different water users in the basin, as well as the priority of categories of water user, to ensure the equitable sharing of freshwater resources and to support the proper management of these resources during times of scarce water supply.

As part of the WAP process in the Mara River Basin in Tanzania (TzMRB), information on current water use is required. A water abstraction survey was carried out by the Lake Victoria Basin Water Board (LVBWB) under the United Republic of Tanzania Ministry of Water (MoW) and in partnership with IHE Delft Institute for Water Education (IHE Delft) and the SWP. During this survey, field teams used a customized cell phone application from mWater to gather data on the water abstractions from rivers, groundwater, dams & water pan, and springs across the TzMRB. Information included the location of the abstraction, an estimate on the amount of water abstracted, and the purpose of the abstraction, among other information. This information will be used to provide estimates on water use across various sectors within the TzMRB. It also served as an important awareness campaign for the LVBWB to connect with the water users and discuss the need and importance of proper permitting and management of freshwater resources.

1.1. LAKE VICTORIA BASIN WATER BOARD

The LVBWB was established in the year 2000 in accordance with Water Utilization and Allocation Act of 1974, which was repealed by Water Resources Management Act, 2009. Under the Act of 2009, the water resources within Tanzania were divided into nine river basins, each to be run by a basin water board. Each board has the mandate of managing water resources within their basin, as guided by the language in the Act. The basins include Pangani, Wami/Ruvu, Rufiji, Ruvuma and South Coastal, Lake Nyasa, Internal Drainage Basin, Lake Rukwa, Lake Tanganyika and Lake Victoria Basin. The TzMRB lies within the Lake Victoria Basin and is managed by the LVBWB. The LVBWB has their main office in Mwanza, with sub-offices in Musoma and Bukoba.

1.2. MARA RIVER

The Mara River is an international river shared between two East African countries: Kenya and Tanzania. The size of the basin is about 13,750 km_2, of which about 65 percent is located in Kenya and 35 percent in Tanzania. It is roughly located between longitudes 33°47'E and 35°47'E and latitudes 0°38'S and 1°52'S. The Mara River drains its water into Lake Victoria and the basin covers Butiama, Rorya, Tarime and Serengeti districts in Tanzania.

The entire Mara River Basin has eight major tributaries: the Amala, Nyangores, Talek, and Sand streams in Kenya, and the Borogonja, Somoche, Tobora, and Tigithe Streams in Tanzania.

The Borogonja Stream originates from Borogonja Spring in Serengeti National Park (SENAPA) and drains into Mara River within the SENAPA. The Tobora Stream originates from Serengeti District (close to the town of Mugumu) and drains into Mara River at the village of Nyansurura. The Tigithe Stream originates from Nyamwaga Hills and flows into Mara River downstream of North Mara Gold Mine. Figure 1 shows the map of the Mara River Basin.

The Mara River is very important in supporting community livelihoods, particularly through agricultural production. Natural resources (including water, soils, forest, wildlife, macrophytes and others) in most river basins including the Mara River have been managed in an unsustainable manner, leading to their depletion and degradation with negative impacts to community livelihoods (Majule, 2010).

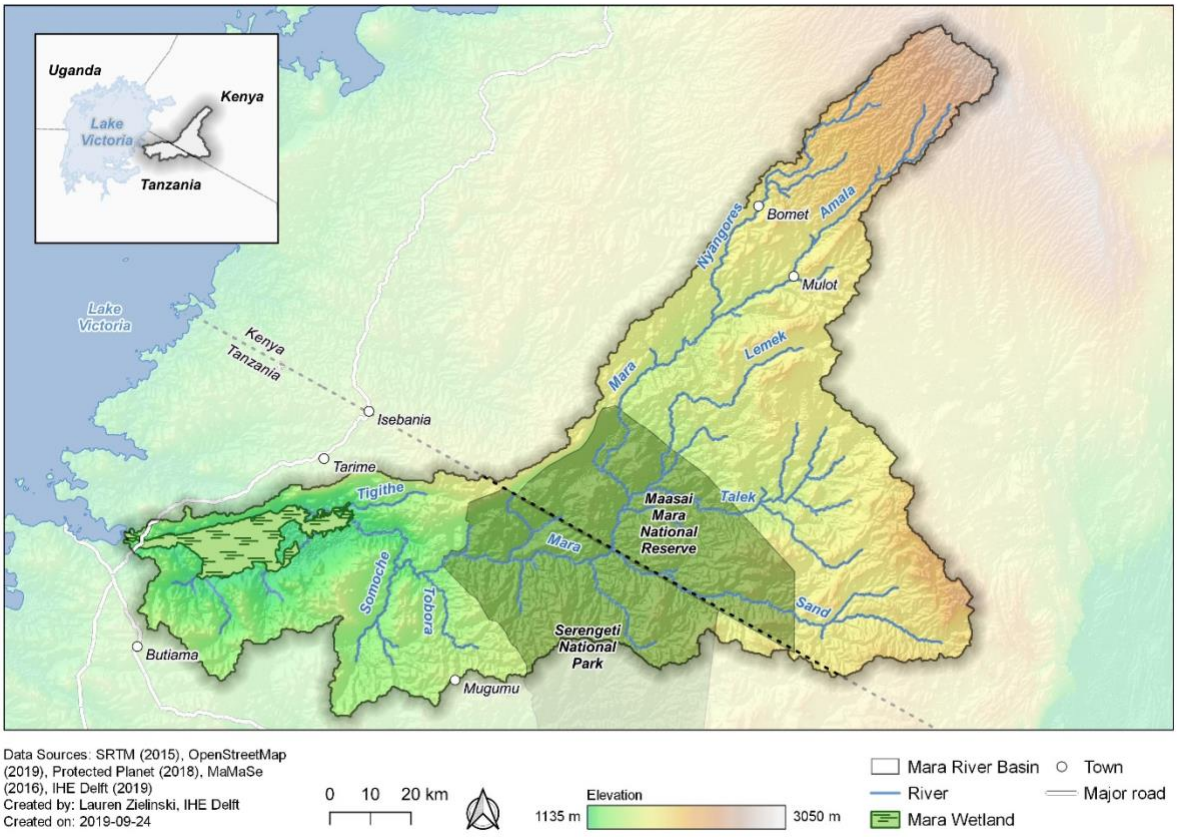


Figure 1: Map of Mara River Basin

The survival of the entire Mara ecosystem depends on the Mara River and the Mara Wetland, located at the outlet to Lake Victoria. The ecosystem has a rich biodiversity of plants and animals which are of local, national and global importance. However, the biodiversity of the river basin is increasingly being threatened because of over-exploitation of its natural resources for socio-economic benefits. The loss of vegetation cover, together with overgrazing, over-abstraction of water sources, poor farming methods, and haphazard disposal of solid and liquid wastes have resulted in increased soil erosion and sedimentation, poor water quality, declining water flows and subsequent water scarcity (especially during the dry season). Previous studies have shown that low water flows and subsequent water shortages may significantly affect biodiversity in the Mara River Basin (Gereta *et al.*, 2002). Due to environmental degradation there is severe deterioration of the services provided by freshwater resources, including aquatic habitat, fish production, and water supply for households and agriculture.

1.3. OBJECTIVES OF THE ABSTRACTION SURVEY

The main objective of the abstraction survey was to collect water use information that will be used for the preparation of the WAP in the TzMRB.
Specific objectives of the survey were:

- To identify the water abstractors within the basin and record their locations
- To identify the different water sources and their status
- To quantify the amount of water abstracted from these different sources
- To identify the different categories of water uses within the basin

1.4. SCOPE OF SURVEY

The water abstraction survey covered the entire TzMRB. This included the districts of Serengeti, Tarime, Rorya, and Butiama (Bunda District was not officially included in the analysis due to the small area located inside the study area), 27 complete wards and 27 partial wards, the northeastern section of SENAPA, and the major four sub-catchments (Borogonja, Somoche, Tobora, and Tigithe Streams) (Figure 2, Table 1). The goal was to obtain information on all abstractions of freshwater from different sources, including directly from the river, groundwater wells, springs, rainwater harvesting, and small dams & water pans.

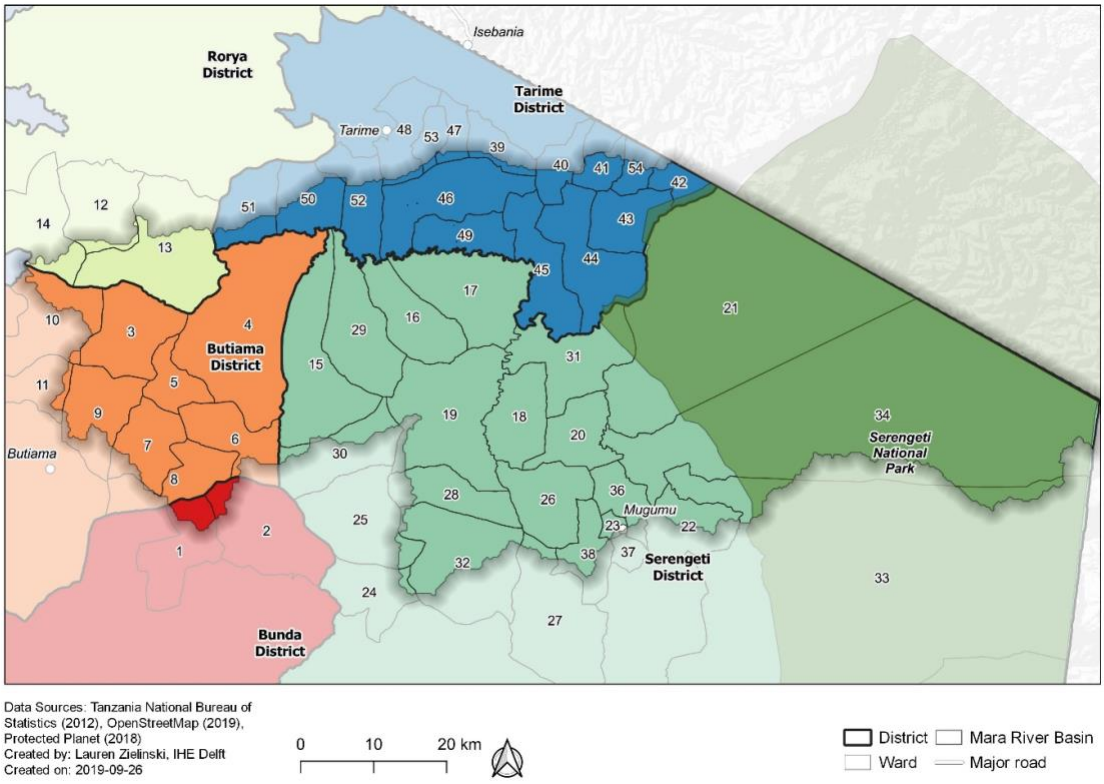


Figure 2: Abstraction survey coverage by district and ward

Table 1: Wards covered in the abstraction survey

Number	District Name	Ward Name	Number	District Name	Ward Name
1	Bunda	Salama	28	Serengeti	Nyamatare
2	Bunda	Mihingo	29	Serengeti	Majimoto
3	Butiama	Bwiregi	30	Serengeti	Magange
4	Butiama	Buswahili	31	Serengeti	Nyansurura
5	Butiama	Nyamimange	32	Serengeti	Mosongo
6	Butiama	Sirorisimba	33	Serengeti	Sedeco
7	Butiama	Buhemba	34	Serengeti	Mbalibali
8	Butiama	Mirwa	35	Serengeti	Stendi Kuu
9	Butiama	Muriaza	36	Serengeti	Geitasamo
10	Butiama	Bukabwa	37	Serengeti	Morotonga
11	Butiama	Butuguri	38	Serengeti	Uwanja wa Ndege

Table 1: Wards covered in the abstraction survey

Number	District Name	Ward Name	Number	District Name	Ward Name
12	Rorya	Rabour	39	Tarime	Nyarero
13	Rorya	Kisumwa	40	Tarime	Nyamwaga
14	Rorya	Komuge	41	Tarime	Muriba
15	Serengeti	Kenyamonta	42	Tarime	Nyanungu
16	Serengeti	Busawe	43	Tarime	Gorong'a
17	Serengeti	Kisaka	44	Tarime	Nyarokoba
18	Serengeti	Kebanchabancha	45	Tarime	Kemambo
19	Serengeti	Ring'wani	46	Tarime	Kibasuka
20	Serengeti	Rung'abure	47	Tarime	Binagi
21	Serengeti	Machochwe	48	Tarime	Turwa
22	Serengeti	Kisangura	49	Tarime	Matongo
23	Serengeti	Mugumu	50	Tarime	Manga
24	Serengeti	Rigicha	51	Tarime	Komaswa
25	Serengeti	Nyambureti	52	Tarime	Kiore
26	Serengeti	Nyamoko	53	Tarime	Kentare
27	Serengeti	Kyambahi	54	Tarime	Itiryo

2. INCEPTION PHASE

2.1. RECONNAISSANCE VISITS

The objective of reconnaissance visits are to familiarize the team with the area prior to the actual day of data collection. Since the basin lies within the LVBWB mandated operational areas and LVBWB staff often conduct field work across the TzMRB, previous visits during monitoring activities served the purpose, hence no separate visit was necessary. Due to the high level of familiarity of the LVBWB staff, it became possible to:

- Know which relevant authorities to contact for permission to carry out the exercise
- Identify key people to contact during field work and who would also be involved in the exercise.
- Identify routes to use to access different locations

2.2. DESKTOP REVIEW

Relevant documents containing information about the basin and the general water rules and regulations in Tanzania were obtained. The emphasis on desk review was to:

- Identify some of the existing abstractors in the basin from the Tanzanian permit database
- Familiarize the team with the mWater app and how it would be used in collecting information
- Understand some of the lessons learned from similar exercises done in other areas in order to be well prepared for the survey
- To understand the features/coverage of the basin
- To produce area maps that guided the team in the field

3. PREPARATION PHASE

3.1. DATA CAPTURE FORMS AND DATABASE

The agreed tool that was used for data collection is called mWater Surveyor. mWater is a partner organization within the SWP and they specialize in collecting field data related to water and sanitation. mWater Surveyor is an open source mobile application that has been designed to map sites like water sources and sanitation facilities. The application works on both Android and Apple operating systems for smart phones and tablets, as well as computers through a browser link. The advantages of using the mWater Surveyor app are:

1. It gives the flexibility of working offline, hence it is very convenient to use in areas with poor internet or mobile data connection.
2. Once data have been collected in the field and submitted, it becomes visible in an online portal and data verification can be done immediately by assigned managers before the enumerator leaves the site.
3. It enables one to develop reports, graphs and an interactive dashboard that can be shared to others who do not have administrative access to the portal.
4. The app has the option of being displayed in other languages (although this has to be prepared beforehand).
5. It is possible to build and connect several questionnaires on one abstraction point, hence offers the possibility of monitoring change over time.

Because of these capabilities, it was decided by the LVBWB, the MoW, and the SWP to use mWater Surveyor for this effort.

For the abstraction survey in the TzMRB, a custom survey was developed for mapping abstraction points and collecting responses to questions connected to these points. The LVBWB was responsible for deciding what set of questions would be included in the survey. This was completed in a collaborative and iterative process between the LVBWB, the MoW, IHE Delft, and mWater. Once the final survey questions were approved, they were uploaded in the mWater portal and deployed so that each enumerator was able to access the questionnaire via their phones and multiple teams could collect data simultaneously. An example screenshot from the mWater Surveyor app can be found in Figure 3, while an example screenshot from the web browser can be found in Figure 4.

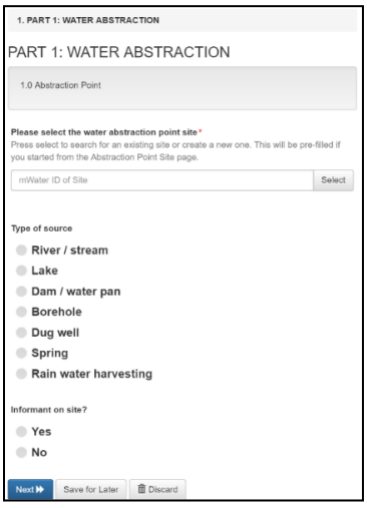


Figure 3: Overview of the survey questionnaire in the mWater app

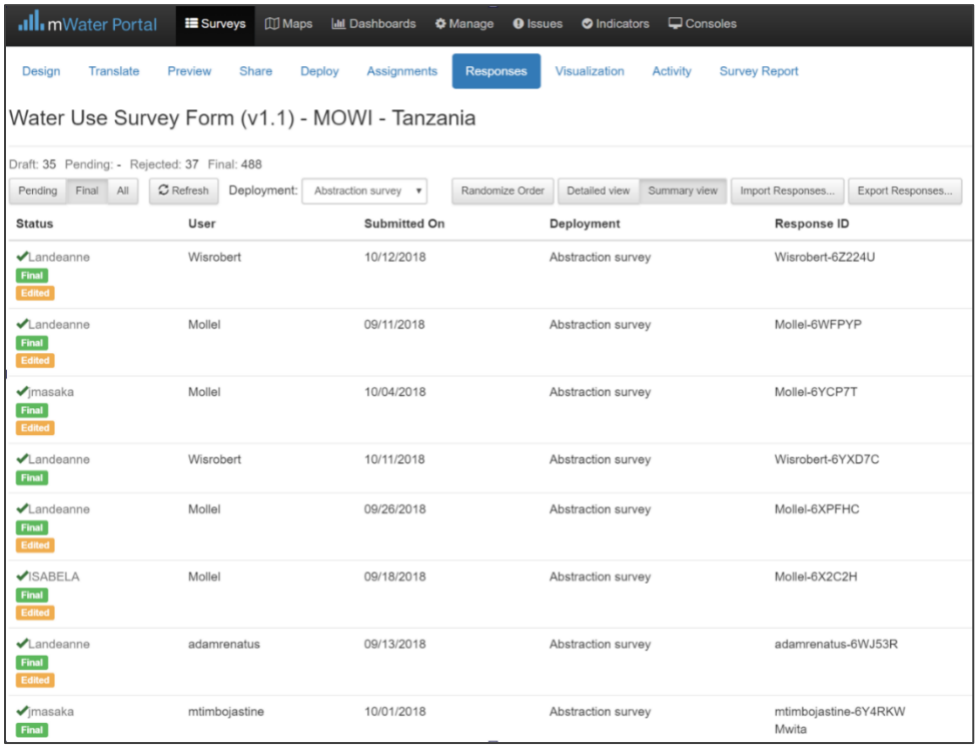


Figure 4: Overview of survey responses in the mWater portal

3.2. TRAINING OF FIELD TEAMS

A training on how to use the mWater Surveyor app and web portal was held on the 13th - 17th of August 2018 at Kifa Best Point Hotel in Tarime town, Mara Region, Tanzania. The training was conducted by experts from mWater who used power point presentations, dialogues, and practical field visits, as well as sessions of questions and answers. The training was attended by the LVBWB, IHE Delft, and mWater.

The training was conducted in preparation for the abstraction survey to enable LVBWB staff to use the mWater Surveyor app in the field. It involved the functioning of the mWater app, adding and editing responses in the app, and submitting the collected information. The team was also trained on simple troubleshooting options when the app stops working in the field. They were also shown how to make simple reports and graphs from data collected and how to share this with other people. The managers were trained on how to check data that has been collected in the field and to approve or reject. As part of the training, the teams visited a nearby water supply company and carried out a mock survey.

3.3. STAKEHOLDER CONSULTATIONS

Several stakeholders were involved throughout the water abstraction survey, ranging from local government offices to local businesses to groups to national agencies. Each stakeholder played a different role in ensuring the success of the whole exercise. Table 2 below describes the key stakeholders who were involved in the work.

Table 2: List of stakeholders and their roles in the TzMRB

Stakeholder	Role
District Executive Director	Permission for conducting abstraction survey in the area
District Commissioner	Granted permission for free access to the park
Serengeti National Park (SENAPA)	Permission to access the park and provision of security guard and staff during the exercise
District Water Engineers' Office	Helped in water points identification and provision of staff members to accompany the team in the field
Ward and Village Executive Office	Availed their staff members to assist the team in moving around the villages and identification of abstraction points.
Water Users Association (WUA)	Assisted in data collection in the field
North Mara Gold Mine	Access to their mining areas
Lake Victoria Basin Water Board (LVBWB)	Availed both staff and vehicles for the exercise. Leading in the development of the abstraction report.

3.4. PUBLIC NOTIFICATION

After the training, notification letters were written to the different local government officials within the TzMRB and mailed on the 28th and 29th of August 2018. The notification letters were sent to the District Executive Directors and District Commissioners of the four District Councils. Other letters were sent to the Regional Administrative Secretary of Mara Region, North Mara Gold Mine, SENAPA, as well as Tanzania National Parks. Other key stakeholders who were important to the survey were also notified. In addition to the letters, the survey teams presented themselves to the ward and village leaders before they began collecting data in that area to explain the objectives of their planned activities.

3.5. EQUIPMENT PREPARATION

For the abstraction survey, each team needed a way to gather and upload data while in the field. Equipment provided to the teams included:

- 4 Infinix mobile phones (1 phone per team for enumerators)
- 1 Samsung tablet (for the pair of team leaders)
- 4 power banks (1 per team of enumerators)
- 5 Sim cards (for the 4 mobile phones and 1 tablet)

At the end of the abstraction survey, this equipment became the property of the LVBWB.

4. FIELD WORK

4.1. COMPOSITION OF FIELD TEAMS

The abstraction survey team consisted of 14 LVBWB staff members from Musoma and Mwanza offices: eight enumerators who collected field data, four drivers, and two data managers who reviewed and approved the data submitted by the enumerators in the mWater portal. There was also two representative from IHE Delft who joined the field teams for the survey. Table 3 below includes the names of the LVBWB and IHE Delft staff who participated in the abstraction survey.

Table 3: Field team members

No.	Name	Organization	Title/Position
1	Joseph Masaka	Musoma, LVBWB	Water Engineer
2	Isabella Tenganiza	Mwanza, LVBWB	Hydrologist
3	Wiston Robert	Musoma, LVBWB	Water Engineer
4	Shoma Stephano	Mwanza, LVBWB	Civil Technician
5	Justine Mtimbo	Musoma, LVBWB	Hydrogeology Technician
6	Innocent Kandimba	Musoma, LVBWB	Hydrology Technician
7	John Ngawambala	Musoma, LVBWB	Community Development Officer
8	Adam Renatus	Musoma, LVBWB	Hydrogeology Technician
9	Mollel Meigaru	Mwanza, LVBWB	Hydrologist
10	Batuli Seif	Mwanza, LVBWB	Community Development Officer
11	Amos Kishebuka	Mwanza, LVBWB	Driver
12	Friday Wilson	Musoma, LVBWB	Driver
13	Ramadhan Hassan	Mwanza, LVBWB	Driver
14	Elisha Robert	Mwanza, LVBWB	Driver
15	Anne Siema	IHE Delft	Project Coordinator
16	Lauren Zielinski	IHE Delft	Project Coordinator

Each field team consisted of, at minimum, two enumerators and one driver using a LVBWB vehicle. Often, other stakeholders, such as a local government official, a member of the local WUA, or a village leader, would accompany each team as they moved through an area. In addition, representatives from project partners, like the MoW, IHE Delft, or the SWP, would also frequently join the field teams. In this way, the knowledge of local stakeholders was used to interview as many abstractors as possible, and stakeholders from all levels were included in the data collection process.

4.2. PERIOD OF FIELD WORK

The field work exercise was conducted from 4th September to 16th October 2018. The field team stayed the first few weeks in Mugumu town, which had easier access to SENAPA, Serengeti District, and parts of Butiama District. The remaining weeks were spent in Tarime town, which had easier access to Rorya District, Tarime District, and other parts of Butiama District. After the field work was completed on October 16th, the LVBWB team members wrote their findings and are the primary authors of this report.

4.3. CHALLENGES ENCOUNTERED

The abstraction survey provided snapshot of the “on the ground” conditions of water abstraction in the TzMRB, and provided the LVBWB with an up-to-date abstraction database. It also provided valuable interaction between the LVBWB and water users in the basin. However, data collection activities in the field often present many challenges that may impact the completeness or accuracy of the data collected. Below are a list of challenges encountered by the field team during this abstraction survey:

Accessibility to water sources: Some abstraction points were located in areas that could not be accessed by the LVBWB vehicles. When this occurred, the field team(s) were required to walk up to a few kilometers to reach the location. This slowed the pace of the overall survey and may have prevented collecting data on extremely remote abstractions there were unknown to local officials.

Vehicle maintenance: Due to rough road conditions, the vehicles required frequent maintenance. When repairs or maintenance needed to occur, this also slowed the pace of the survey.

Difficulty obtaining the actual abstraction amounts: Almost all abstraction rates were estimated in the field since most abstractors did not have water meters or measuring devices installed. This was completed by measuring the pumping rate to fill a bucket (for functional hand pumps), by estimating the size of agricultural plot and the crop type (for irrigated areas), estimating the number of livestock drinking from the abstraction point (for livestock watering areas), or by asking local villagers or WUA representatives to estimate about how many people use that source and how much they collect per day. Due to these types of estimation, the values for the abstraction rates provided should not be considered absolute but an approximation.

Theft or vandalism: In some areas, water pumps have been vandalized and many of the shallow wells are in need of repair. Hence it became quite hard to estimate the amount of water that is abstracted from such sources.

Lack of awareness about water use permit: Most of the respondents were not aware of the permit conditions, such as the need to obtain a water permit, pay for the water used, or even the need to install a water meter to monitor their abstractions. Conversations between the LVBWB and the local water users were critical for raising awareness for this topic.

5. ANALYSIS OF ABSTRACTIONS

5.1. OVERVIEW

The abstraction survey involved field visits to all towns within the TzMRB, focusing on abstraction points known to local officials and investigating areas close to surface water for new abstraction points. The survey collected data on:

- existing water abstractors and their locations
- estimates on the amount being abstracted
- the water source from which water is being abstracted
- the water use for which water is being abstracted
- the functionality of the infrastructure around the abstraction point
- compliance with legal requirements of water abstraction and use

A total of 499 abstraction points (functional and non-functional) were collected in the TzMRB (Figure 5). Out of the 499 abstraction points, 196 (39 percent) are located within Serengeti District, 183 (37 percent) within Tarime District, 114 (23 percent) within Butiama District, and 6 (1 percent) in Rorya District (Figure 6).

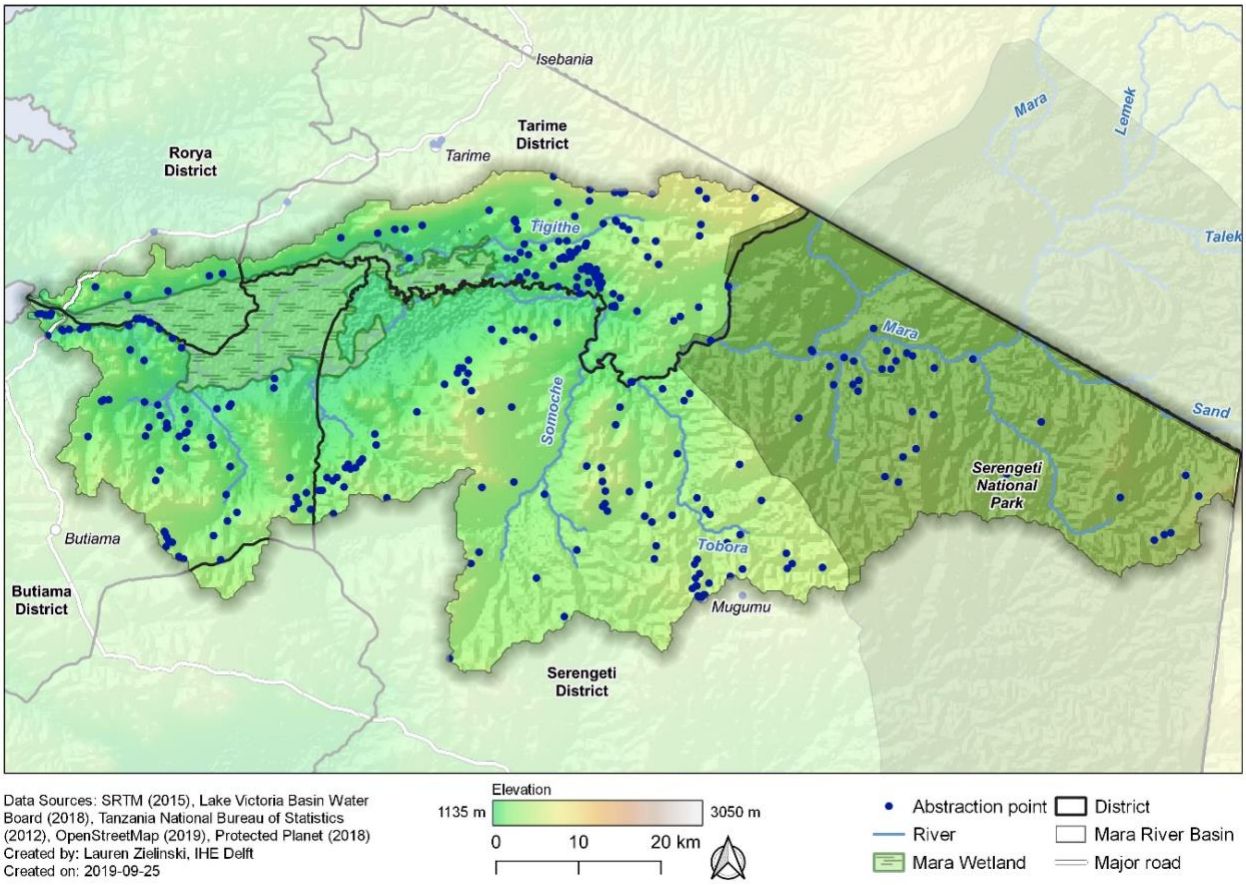


Figure 5: Map of abstractions in the TzMRB by district

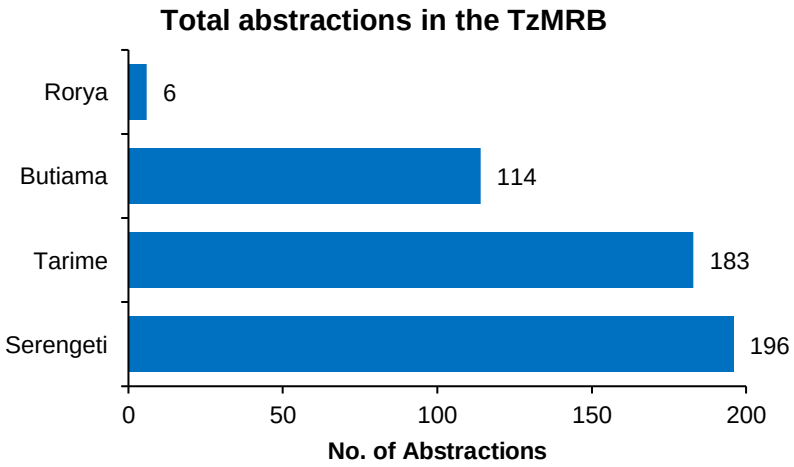


Figure 6: Number of abstractions in the TzMRB by district

Aside from the administrative boundaries, the TzMRB has been sub-divided into 3 hydrological units (HU) namely Serengeti, Somoche and Mara. A very small portion of the Sand HU is located on the Tanzanian side, although the majority of the Sand HU is located within Kenya. As such, it has been analysed as part of the Kenyan demand analysis and not in this document (Figure 7).

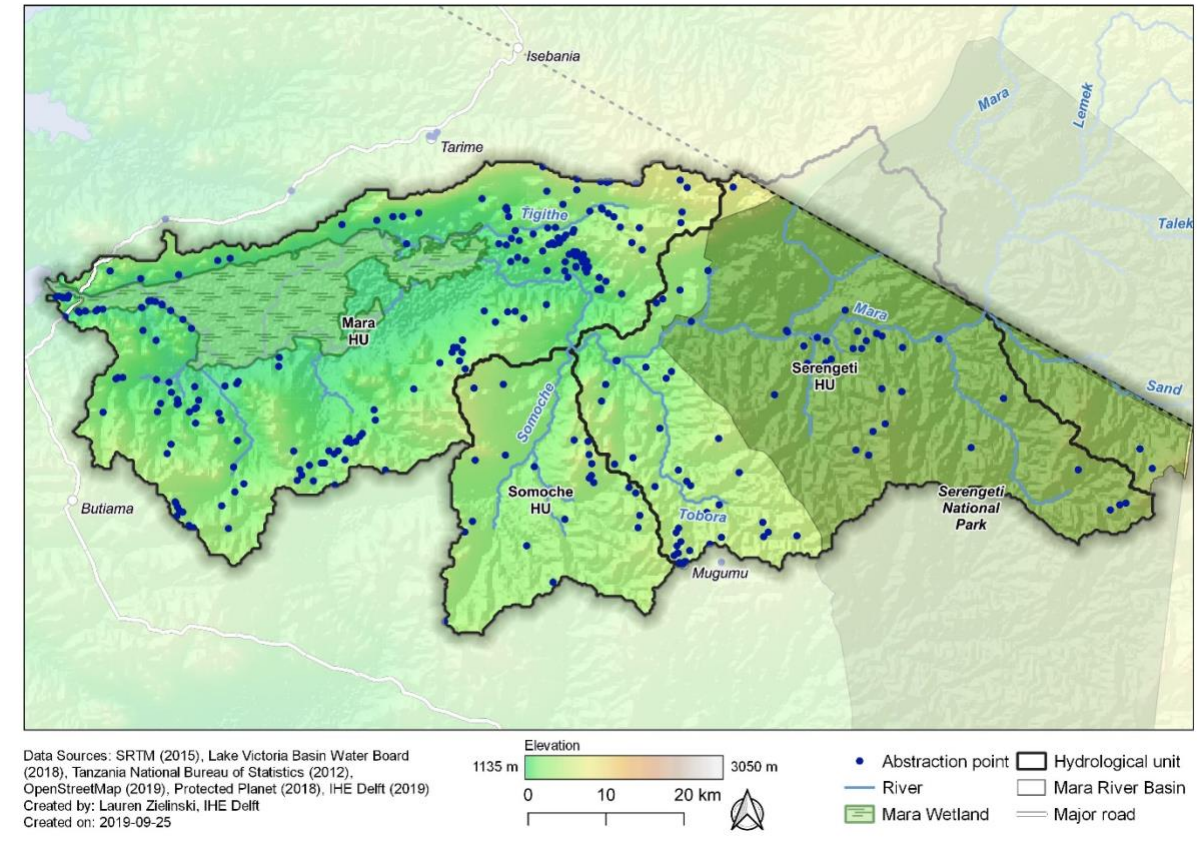


Figure 7: Map of abstractions in the TzMRB by hydrological units

5.2. FUNCTIONALITY

In general, out of the total abstraction points collected, 65 percent (322) are functional, 4 percent (22) partially working and in need of some repairs, and 30 percent (149) are nonfunctioning due to various reasons such as missing pumps, broken down systems, missing spares etc. Only 1 percent (6) is abandoned and not in use anymore (Figure 8). ***N/B:*** *The non-functioning and abandoned water abstraction points have been excluded from the analysis. The results included in this report are from the functioning and partially functioning abstraction points.*

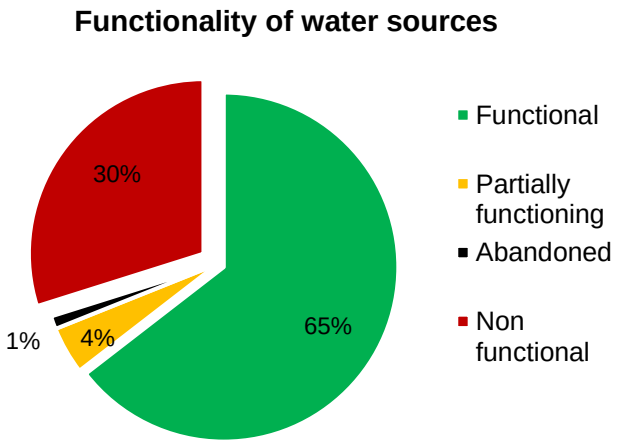


Figure 8: Functional status of the water sources

With regards to functional abstraction points in the HUs, 23 abstractions are located in Somoche, 229 in Mara and 92 in Serengeti (Figure 9). In terms of abstraction volumes, 13,577 m3/day is abstracted in the HUs. Mara HU abstracts the most water at 11,178 m3/day (82 percent of total abstractions). Serengeti follows with a total of 1,874 m3/day (14 percent), and finally Somoche at 525 m3/day (4 percent) (Figure 10).

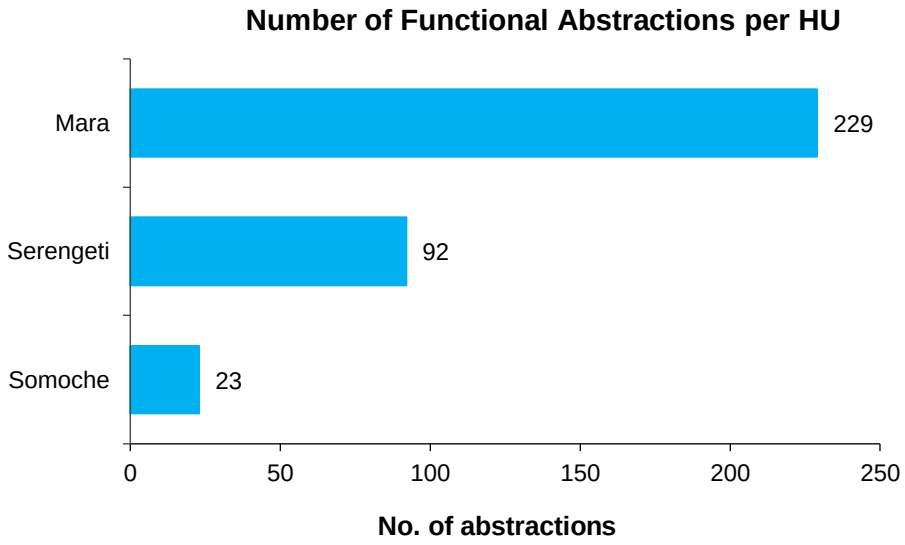


Figure 9: Functional abstractions per hydrological units

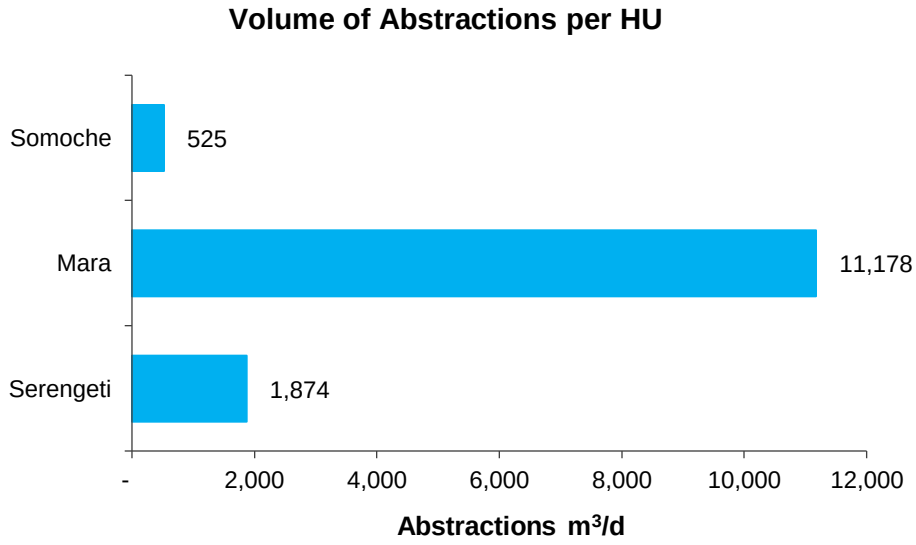


Figure 10: Total volume of abstractions (m3/day) in the HUs

Each abstractor uses different amounts of water for their need and they have been categorized according to the amount of water they abstract. 409 users abstract a total volume of water between 0 – 20 m3/day, 35 users from 20 – 40 m3/day, 21 users from 40 – 60 m3/day, 11 users from 60 – 80 m3/day, 11 users from 80 – 100 m3/day and 17 users abstracting water more than 100 m3/day (Figure 11).

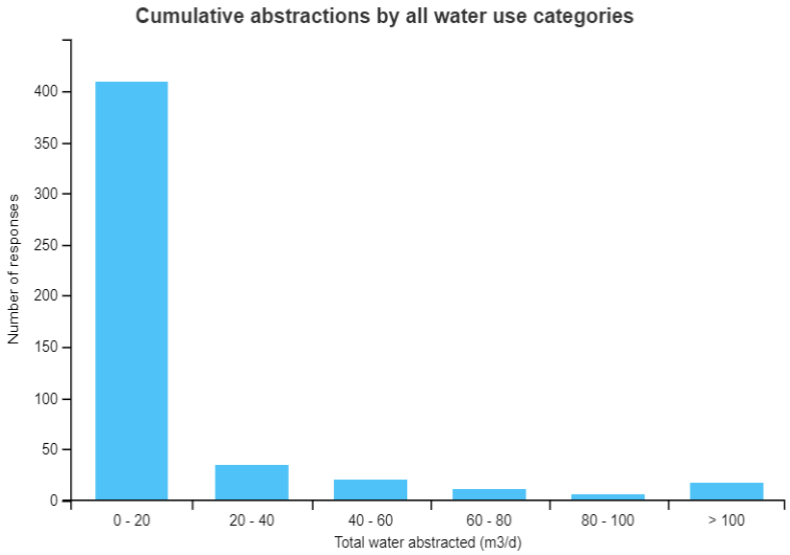


Figure 11: Cumulative abstractions for all water use categories

5.3. ABSTRACTIONS BY WATER SOURCE

Figure 12 below shows a map of abstraction points from different sources in the whole TzMRB. A total volume of 13,577 m3/d is abstracted from different sources (Table 4, Figure 13 and Figure 14). Water from dams/water pans contributes 63 percent of the total abstractions followed by boreholes at 15 percent and dug wells at 11 percent. Very few abstractors (7 percent) are getting water directly from the river while spring and rainwater harvesting is not very common.

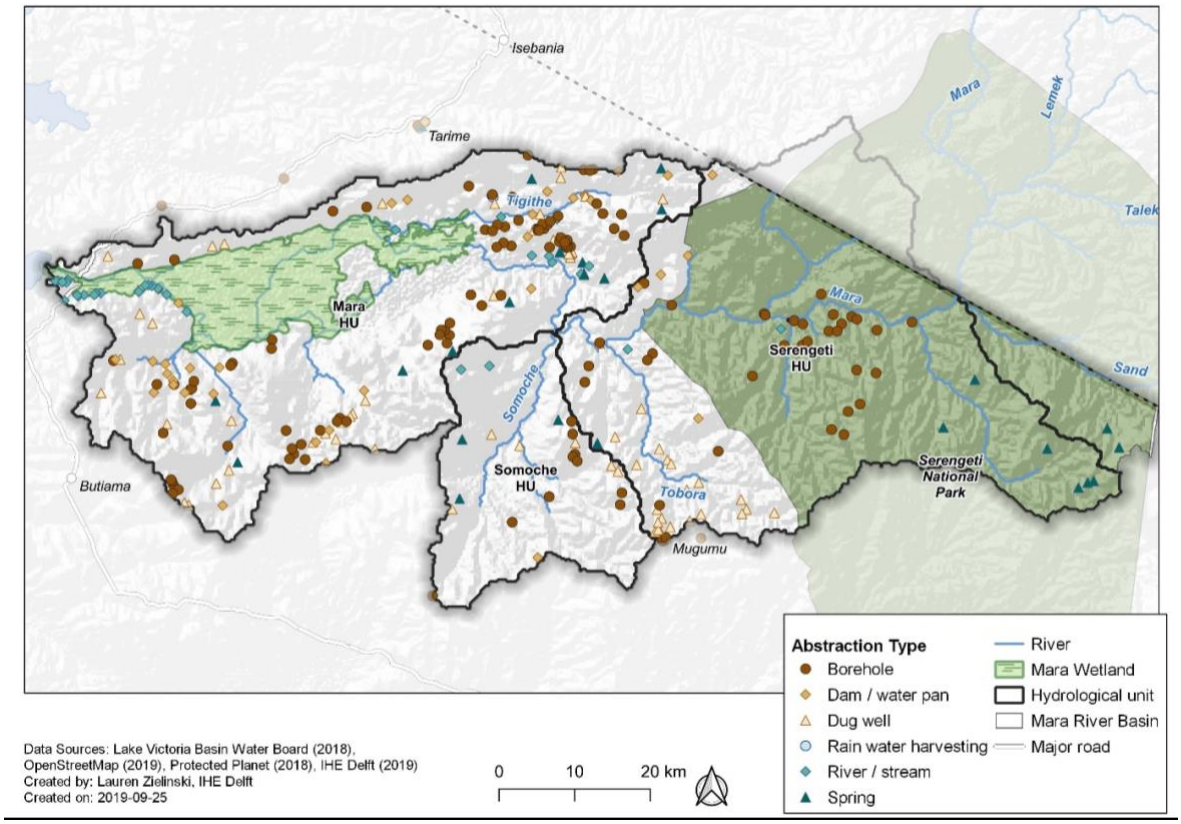
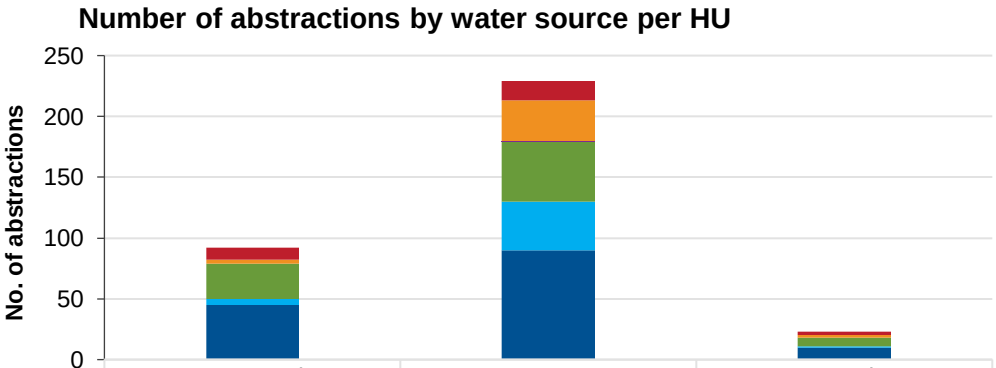


Figure 12: Abstraction sources in the TzMRB by hydrological units

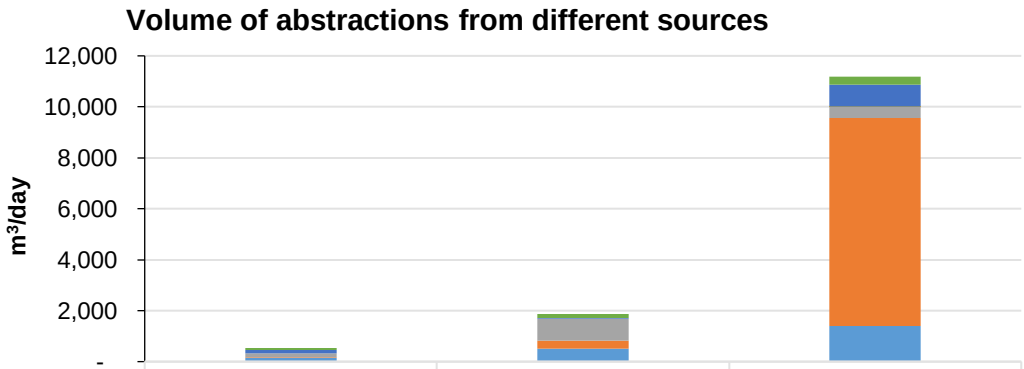
Table 4: Total number and volume of abstractions in the TzMRB by water source

Water Source	Number	Percent	Amount (m3/d)	Percent
Borehole	201	40%	2,039	15%
Dam/water pan	46	9%	8,539	63%
Dug well	181	36%	1,438	11%
River/stream	39	8%	993	7%
Spring	31	6%	566	4%
Rainwater	1	>1%	2	>1%
Total	**499**	**100%**	**13,577**	**100%**



	Serengeti	Mara	Somoche
Spring	10	16	3
River / stream	3	33	2
Rain water harvesting		1	
Dug well	29	49	7
Dam / water pan	5	40	1
Borehole	45	90	10

Figure 13: Number of abstraction points by water source per HU

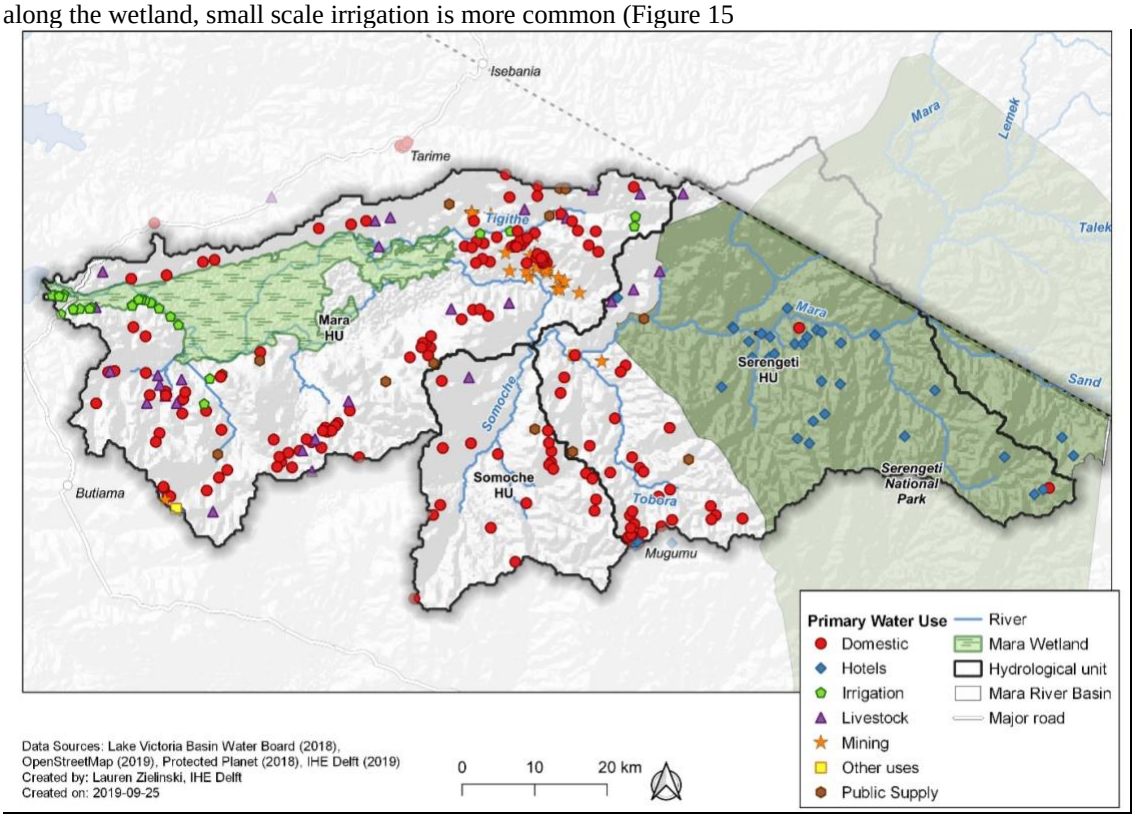


	Somoche	Serengeti	Mara
Spring	78	171	318
River / stream	134	12	846
Rain water harvesting			2
Dug well	136	861	441
Dam / water pan	34	323	8,182
Borehole	144	507	1,389

Figure 14: Total volume of abstractions by source

5.4. ABSTRACTIONS BY WATER USE

For the TzMRB, different water sources were identified where the abstractors get their water from, including rivers, streams, boreholes, springs, water pans/dams, and shallow dug wells. The water use categories vary depending on the location. Within SENAPA, water abstracted is mostly for use in the lodges and camps. In the Somoche and Tigithe catchments, water is abstracted mostly for domestic, livestock and mining activities while further down along the wetland, small scale irrigation is more common (Figure 15



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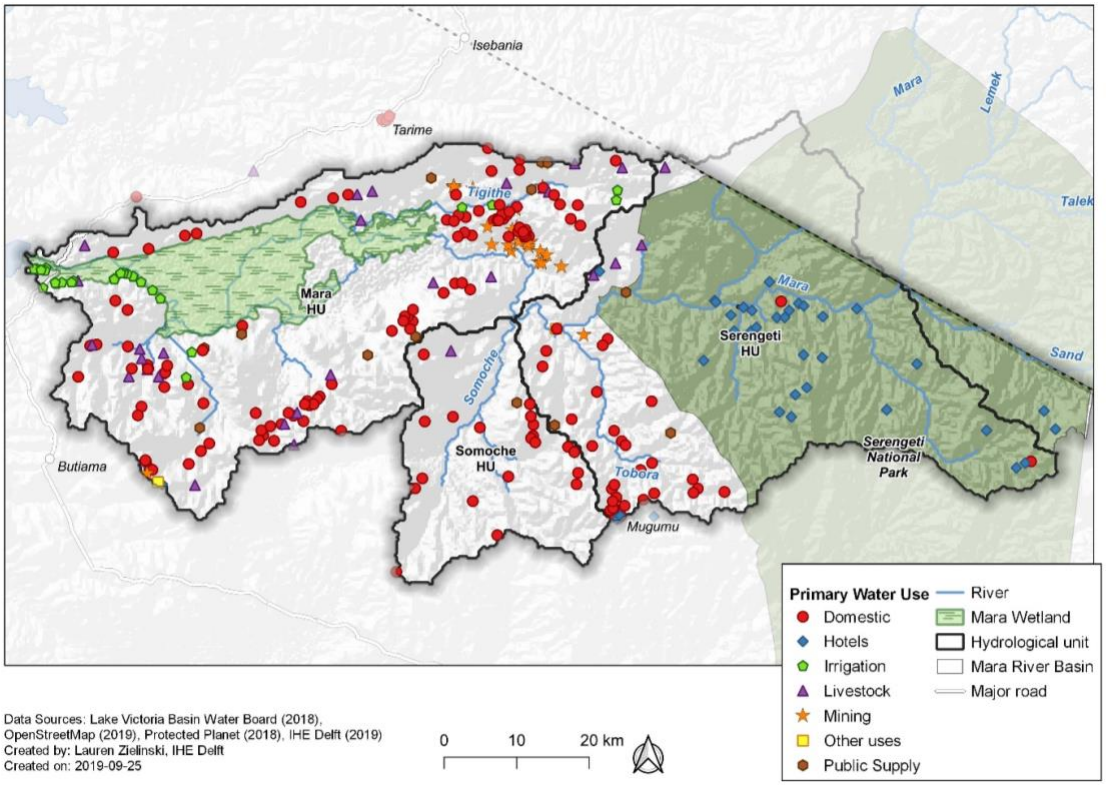

Figure 15: Categories of water uses in the TzMRB by hydrological unit

From the analysis, 4,696 m3/day representing 35 percent of the total water abstraction volumes is used for domestic purposes. Water abstractions for livestock use is second with 3,419 m3/day (25 percent) then mining third with 2,501 m3/day which represents 18 percent of the total abstractions (Table 5 and Figure 16).

Table 5: Total number and volume of abstractions in the TzMRB by water use

Water Use	Number	Percent	Amount (m3/d)	Percent
Domestic	183	53%	4,696	35%
Livestock	34	10%	3,419	25%
Mining	35	10%	2,501	18%
Public Supply	14	4%	1,843	14%
Hotel	46	13%	201	1%
Irrigation	30	9%	599	4%
Other	2	1%	317	2%
Total	**344**	**100%**	**13,577**	**100%**

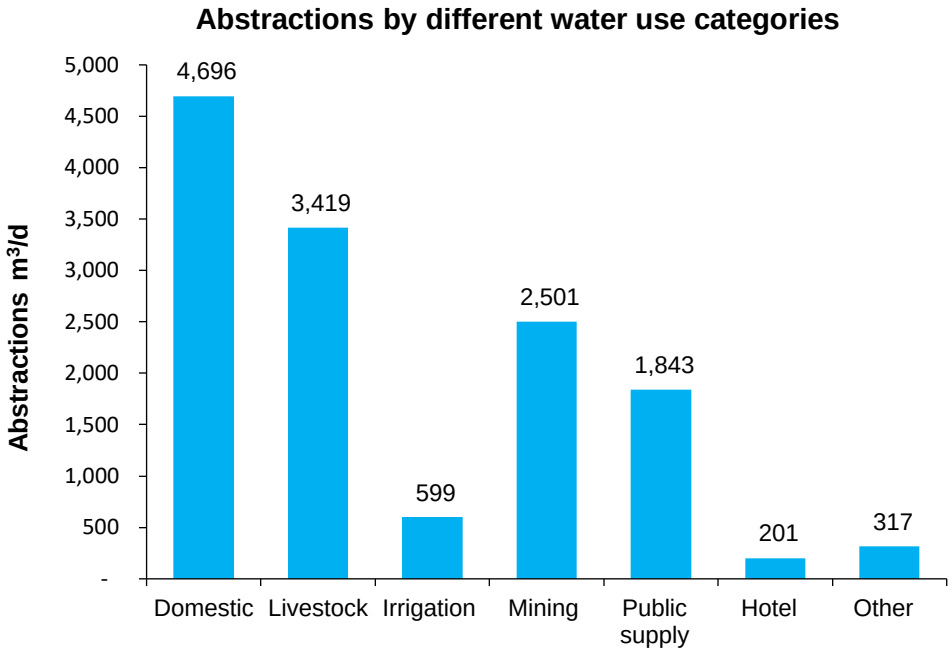

Figure 16: Volume of abstractions by different water use categories

5.5. LEGAL COMPLIANCE

This deals with what the law stipulates when dealing with water abstractions, payment of water use and the purpose of abstracting.
There are permit requirements in Tanzania for surface water and ground water:

- The Law stipulates that any person may construct a groundwater well and abstract water for domestic purposes without a permit provided that the shallow hand dug well does not exceed a depth of 15m.
- For surface water, any person may abstract and use water for domestic purposes without a water use permit provided that no construction of any works will be undertaken. (cap. 20 (1) of Water Resources Management Regulation).

Permit thresholds can be seen also on quantity of water and category of use. Payment of application fee for the person who abstracts water for domestic is quite different to the one who abstracts water for large scale irrigation. Likewise, different water use fee apply on the quantity of water abstracted for different categories of use (Tariffs advertised in Government gazette No. 9 of 28th February 2014).

5.5.1. PERMIT STATUS

Out of the 344 functional abstraction points recorded, only 1 percent of the abstractors have a water use permit while 3 percent are in the process of applying for a water use permit. The total amount of water abstracted by abstractors with either a permit or in the process of applying for one is 2,736 m3/day making up 20 percent of the total abstractions. The rest of the abstractors (329) do not have a permit. This group abstracts 10,841 m3/day making up 80 percent of total water abstracted (Figure 17).

Of the 329 unpermitted abstractors, it is unknown how many require a permit (and would be considered illegal abstractors) and how many do not require a permit (and would be considered legal abstractors). During the abstraction survey, the depth of groundwater wells could not be determined so it is unknown how many are less than 15 meters. In addition, many of the surface water uses for domestic and livestock do not have infrastructure associated with them, in which case they would not require a permit.

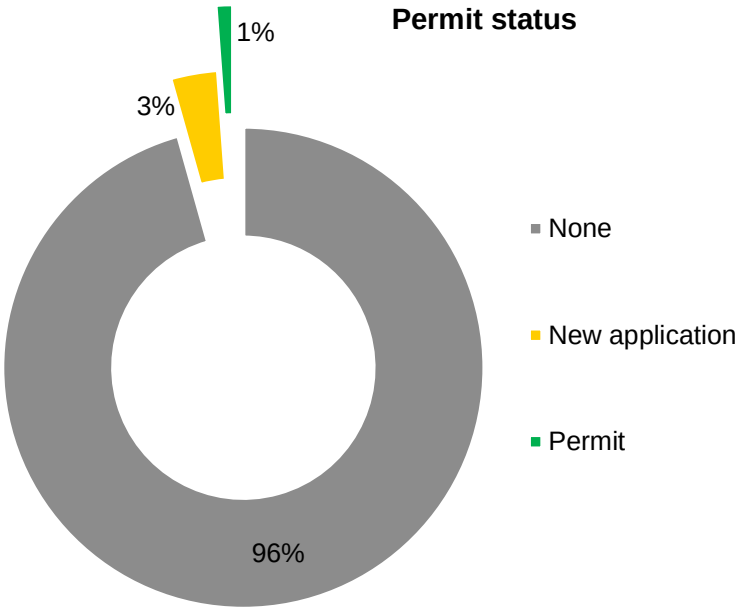

Figure 17: Permit status

5.5.2. NUMBER OF METERS

97.2 percent of abstractors visited had no measuring devices installed to measure the amount of water abstracted and only 2.8 percent had meters installed (Figure 18).

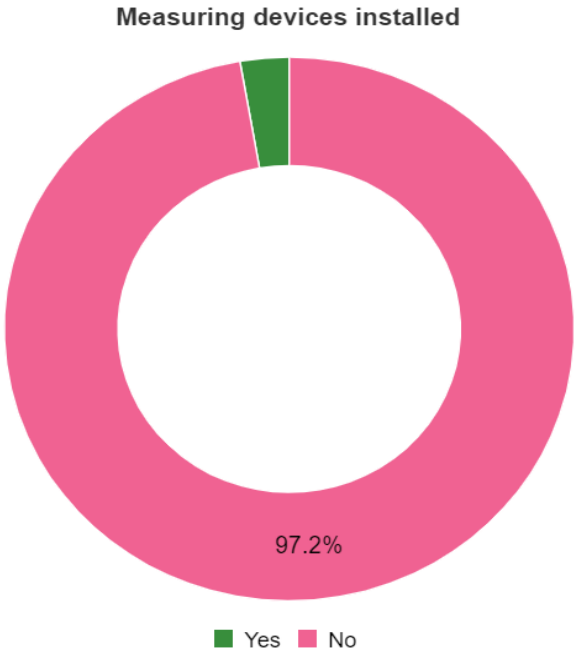

Figure 18: Percentage of metered vs unmetered abstractions

5.5.3. COMPLIANCE TO CONDITIONS OF MONITORING AND STORAGE

A holder of a water use permit shall comply with the conditions of monitoring according to the Water Resources Monitoring Act No. 11 of 2009 Sec. 48 (a – h) and other conditions which may be attached to the permit.

A person who stores water is subjected to the water use permit according to sec. 43(1) of WRMA No. 11 of 2009 except for the one who harvests rain water for domestic purposes shall be entitled to the grant of water use permit if no works for purpose of rainwater harvesting shall exceed 20,000 litres capacity of water. (Water Resources Management (Water Abstraction, Use and Discharge) Regulation, 2010 Sec. 20(3))

5.5.4. PAYMENT OF WATER USE CHARGES

Based on the survey done 98.8 percent abstractors do not pay water use fees while 1.2 percent abstractors pay water use fees for the water that they abstract (Figure 19).

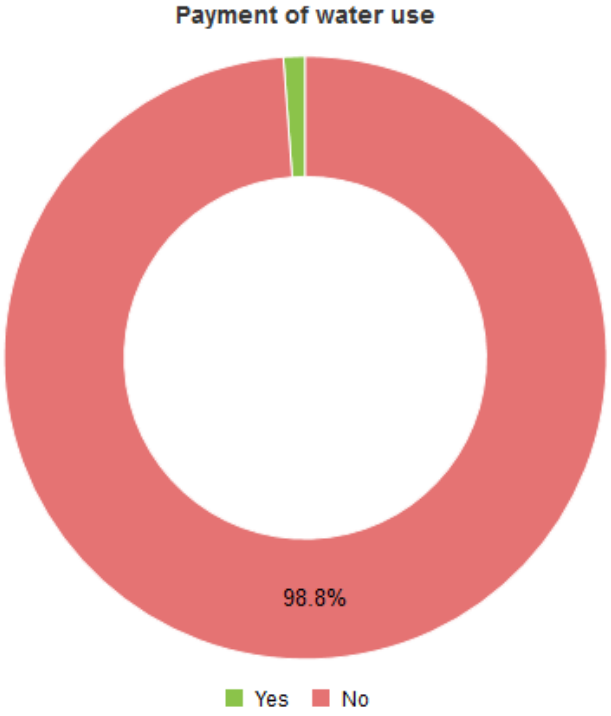

Figure 19: Status of water use payment

5.5.5. AWARENESS AND PERCEPTION OF ABSTRACTORS

Observations from the survey indicates that there is little awareness concerning the details of water resources management in the TzMRB, although abstractors have good perceptions on water resources management overall.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. PATTERNS OF ABSTRACTION

The distribution of types of abstraction in the Mara River is quite different across the basin. This is due to level of services and type of economic activities in a particular area (e.g., mining, livestock grazing, agriculture, etc.). Different management priorities should be defined for different areas to properly address sector-specific issues and sustainably manage water resources across the basin

6.2. PAYMENT OF WATER USE CHARGES

Some of the water abstractors have already been permitted by the LVBWB yet do not pay for water use. The LVBWB should put much effort to identify and make sure that all water users who abstract water from either surface or groundwater sources pay the water use fee.

6.3. AWARENESS AND PERCEPTION OF WATER USERS

There was low levels of awareness regarding water resources management, including the requirement of water permits and prohibiting activities within the sixty (60) meter buffer zone. The LVBWB should act in joint collaboration with other authorities and stakeholders to reach out to water users and make sure that they have a common understanding on issues related to water resources management and protection, including collection of water permit fees.

6.4. CAPACITY DEVELOPMENT FOR WATER USER ASSOCIATIONS (WUAS)

Whenever possible, leaders from the local WUAs were involved with the data collection activities. Being able to move throughout their sub basin and speaking with the different users does not occur often due to resource limitations. It is thus important for LVBWB to work closely with the WUAs to increase their capacity to help identify and resolve water-related issues at the local level.

References

Gereta, E. *et al.* (2002) 'Use of an ecohydrology model to predict the impact on the Serengeti ecosystem of deforestation, irrigation and the proposed Amala Weir Water Diversion Project in Kenya', *Ecohydrology & Hydrobiology*, 2(1–4), pp. 135–142.

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