National Water Resources Management Agency
29 King Harman Road, Freetown

DELINEATION, MAPPING, AND ASSESSMENT OF THE UPPER MIDDLE SEWA RIVER BASIN

PHASE 1

5 September 2023

Executive Summary

Water catchment sources in Sierra Leone are diminishing rapidly due to increased agricultural and mining activities, as well as growing household demands. These catchments play a vital role in water resource management, serving as points where surface water converges. Modern technologies like remote sensing and Geographic Information Systems (GIS) allow for advanced analysis of flow patterns and automated delineation of watersheds and stream networks. Precisely delineating river basin and catchment boundaries is essential for integrated water resources management (IWRM) within a watershed.

This project by the NWRMA aims to map and delineate critical catchment areas within the Sewa River Basin, considering land use, human activities, resource pressures, and water quality concerns. Simultaneously, this initiative seeks to provide fundamental baseline data that can be integrated into the creation of a nationwide water resources geodatabase platform. This platform, while aiding policy development, will also strengthen emergency preparedness and enable vulnerability assessments within the field of water resources management.

The project utilized remote sensing, GIS, and Microsoft Excel for data analysis. Various tools, including GIS and Excel, were employed to analyze and visualize the data gathered from mapping exercises. To map the upper middle section of the Sewa River Basin, GPS coordinates, drone surveys, and smart forms were employed to capture location data and high-resolution aerial views as part of the survey.

The key discoveries from the mapping survey reveal that farming is the predominant human activity in communities along the upper middle basin of the Sewa River. The primary sources of water in these settlements are dug wells and streams. Moreover, data on sanitation practices reveal a significant portion of communities engage in open defecation and backyard waste disposal.

The key findings lead to several key recommendations. These include the need for ongoing monitoring of the Sewa River Basin to observe changes in land use, water sources, and sanitation practices. To address issues like open defecation and improper waste disposal, targeted education and awareness campaigns are suggested. Furthermore, improving infrastructure through the construction of more latrines is advised to reduce open defecation and prevent pollution of the river basin. Lastly, promoting sustainable farming practices in the upper middle Sewa River Basin is recommended to minimize water pollution in the region.

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1 Introduction

1.1 Project Background

Water catchment sources in Sierra Leone are diminishing at an accelerated pace in our daily lives primarily due to the escalation of agricultural and mining activities, as well as the increasing demands of households. A water catchment, which serves as the fundamental component of water resource management, is delineated based on the topographical features of the region, functioning as the point where surface water converges into a common outlet. The advent of remote sensing and Geographic Information System (GIS) technology has ushered in innovative approaches to water resource management. Utilizing digital elevation models (DEMs), these technologies enable the analysis of flow direction and the establishment of flow networks, giving rise to numerous automated techniques for delineating watersheds and identifying stream networks.

In order to successfully execute integrated water resources management (IWRM) within a watershed, precise delineation of the river basin and catchment boundaries is a crucial prerequisite for any program related to catchment management. This initiative aims to chart the catchment areas, considering their specific land use and land cover characteristics, ongoing human activities, factors exerting pressure on water resources, and water quality concerns. These insights will be instrumental in identifying catchments facing critical threats. In light of these considerations, the NWRMA is embarking on this project dedicated to mapping and delineating critical catchment areas within the Sewa River Basin.

1.2 Project Objectives

The overall objectives of the project are:

- To identify and map human activities as well as water quality issues and pollution sources in each sub-catchment.
- To develop a recent land use/land cover map of the Sewa River basin
- To identify sub-catchments in the Sewa River Basin that are in critical danger.
- To develop a strategic action plan (SAP) resulting from the findings of the mapping and focus group discussion on each sub-catchment.

1.3 Project Justification

Sierra Leone's water resources have historically played a pivotal role in the nation's economy, serving various development sectors. Nevertheless, the rapid expansion of diverse developmental sectors such as mining, hydropower, agribusinesses, industries, and human activities like deforestation and urban sprawl have posed significant threats to the country's water resources, impacting both water quality and quantity. Amidst the challenges posed by climate change and the vulnerability of the environment, particularly in areas affected by mining and agriculture, the Sewa River basin confronts formidable obstacles in maintaining water quality and preventing catchment degradation attributed to anthropogenic activities.

Currently, there is a scarcity of up-to-date information regarding land use and land cover trends, as well as a lack of robust spatial analysis tools capable of providing insights for informed decision-making regarding the safeguarding and restoration of water catchment areas. This deficiency has hindered the advancement and optimal utilization of water resources, impeding the progress of water-related economic development. Furthermore, it has limited the availability of validated models for predicting the dynamics of river basins, which are essential for making sound and comprehensive decisions in this field.

Therefore, it is imperative to establish a robust monitoring system to comprehensively track and map ongoing human activities, particularly artisanal mining. Additionally, there is a pressing need to create an updated land use/land cover map and conduct a thorough analysis of the pressure and threats faced by these areas, facilitating the identification of critical catchments at risk. This project aims to deliver essential baseline data that can be incorporated into the development of a national water resources geodatabase platform. This platform will not only support policy formulation but also enhance emergency preparedness and enable vulnerability assessments in the realm of water resources management.

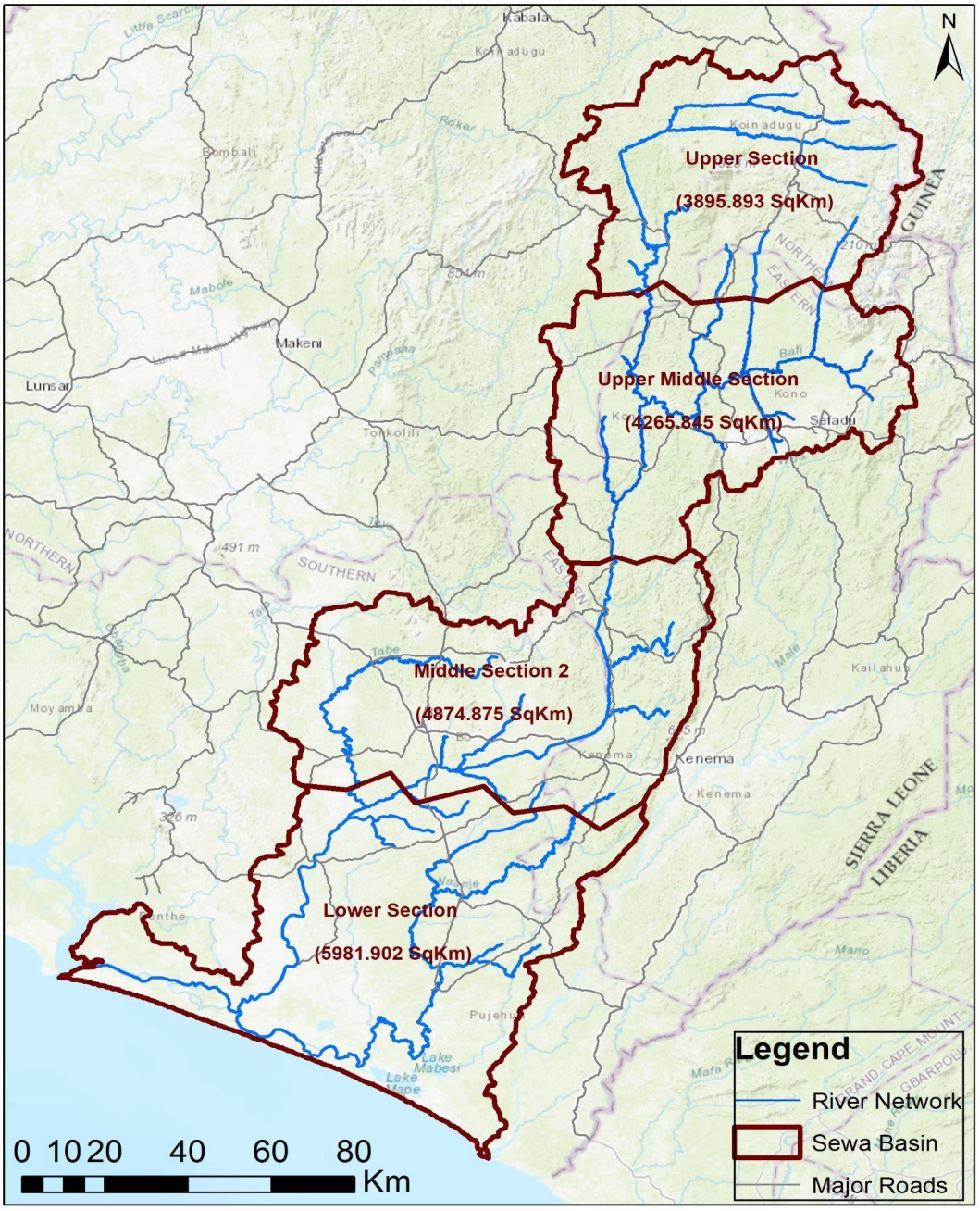

Figure 1: Map of entire Sewa River Basin

2 Procedures and Scope

2.1 Methodology

Field data collection on the mapping and identification of human-induced pressures on the Sewa River Basin is informed by a similar project implemented by the Agency in 2021 in the Western Area and Rokel River basin and similar procedures and activities will be replicated in order not to 'reinvent the wheel'. GPS coordinate points as well as drone surveys were used in addition to smart forms to store the location and high-resolution aerial view within the scope of the project.

Due to limited funds available, the Agency did not employ the services of a consultant but instead utilized its own human resource experts (GIS, water resources management and assessment) for the data collection and analysis of the data as well as the production of a report.

The Sewa River Basin was divided into four sections, the Upper, Middle 1, Middle 2 and Lower sections.

This report focuses on the first phase of the project which entailed mapping of the upper section of the Sewa River basin.

2.1.1 Preliminary Activities

The following activities were undertaken during the inception stage.

- Desk study to understand the spatial extent and socio-economic activities undertaken within the basin.
- Selection of the required questions based on the assessment and mapping objectives to be used in the smart forms.
- Development of smart forms using Survey 123 software containing required parameters (questions) to be administered during the assessment and mapping process.
- Development of assessment and mapping zones and the Avenza App that can be used to ease navigation to settlements located in each zone during the exercise.
- Refresher training at the NWRMA office for technical staff on the use of a drone and data collection using smart forms for the assessment and mapping process. The data collectors made use of their own smartphones for data collection.Refresher training workshop for technical staff on the use of smart forms and

- drone for the mapping process

Technical staff from the Hydrological Services department was given a day's refresher training on the use of Survey 123 for data collection as well as the use of an Unmanned Aerial Vehicle (drone) to capture aerial images of human activities within the catchment during the mapping process.

2.1.2 Field Data Collection

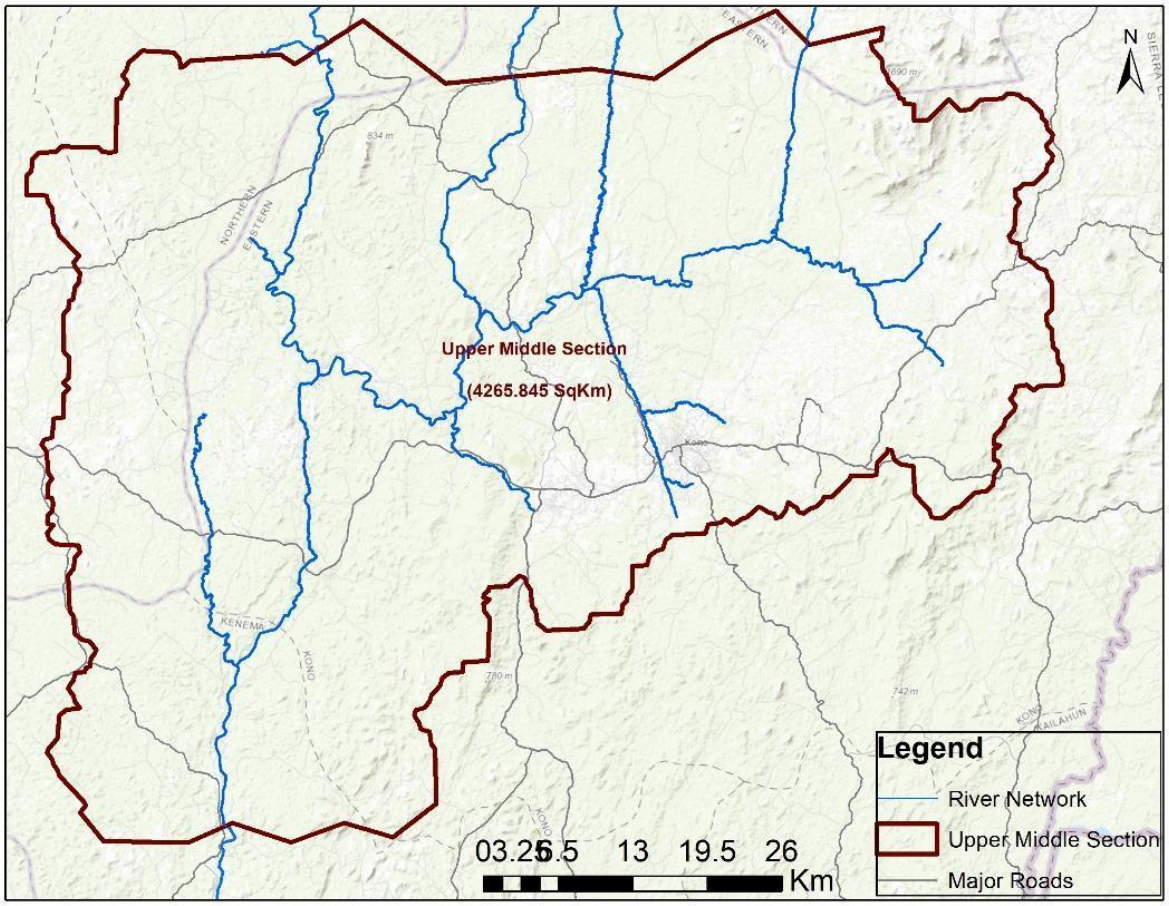

Figure 2: Map of Upper-Middle section of the Sewa River Basin

Phase one of this project included field data collection and assessment in the upper Sewa Basin (Figure 2.0). A total of five (5) technical staff and a driver visited the Sewa River basin and the data collection exercise lasted for twelve (12) days.

The vehicle took the data collectors to a central station which was determined by the team on site. Each staff was then provided with a motorbike for movement to data collection points located in remote or hard-to-reach areas.

For ease of navigation to various settlements within the mapping zones, each data collector utilized the Avenza app installed during the training for accuracy.

A set of handheld GPS, smart forms and field assistants were used in the land-use mapping process. Moreover, drone surveys and modelling were also used to obtain real-time and high-resolution satellite imagery in the study area.

Technical field staff were deployed in the field where they identified the various land uses, water sources and sanitation practices. They also collected both spatial and attribute information on each of these parameters. The spatial data was collected using the handheld GPS devices whilst the attribute information was collected using Survey 123.

At the end of the data collection exercise, all the saved geodatabase files from Survey 123 platform were downloaded and analysed using remote sensing, GIS applications and Microsoft Excel.

3 Data Analysis and Reporting

After the data collection exercise, the data was downloaded, processed, and analysed using different analysis and visualization tools (GIS, Excel). A draft report, along with all maps produced will be submitted after two weeks followed by a final report after necessary comments and editing of the draft.

4 Results

Phase one delineation, mapping, and assessment of Sewa River Basin was carried out at the upper section of the basin starting at Yormandu, in Sandor Chiefdom, Kono District. The upper section of the Sewa River Basin is covered by four districts: Kono, Tonkolili, and Kenema. About 80% of data points were collected in Kono. Seven (7) chiefdoms were visited and as shown below, Sandor chiefdom has the highest numbers of data points recorded while Kunike Sanda has the least.

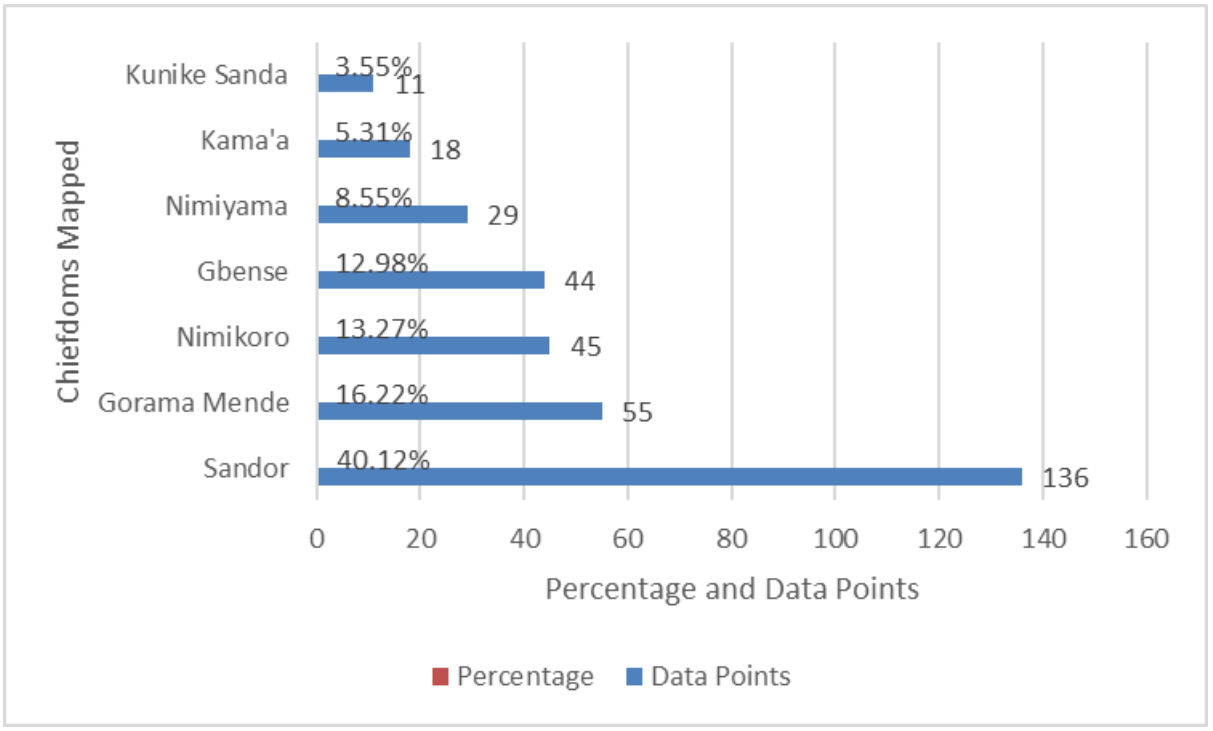

Figure 3: Data points collected by chiefdoms mapped

In addition, 99 towns/villages were mapped along the river basin of Sewa and 25.88% of these settlements have a population of 1000 or more while 37.35% have a population between 500 – 1000 people. Figure 3 reports fully the population profile of the communities mapped in phase one of the delineation, mapping, and assessment of Taia River Basin.

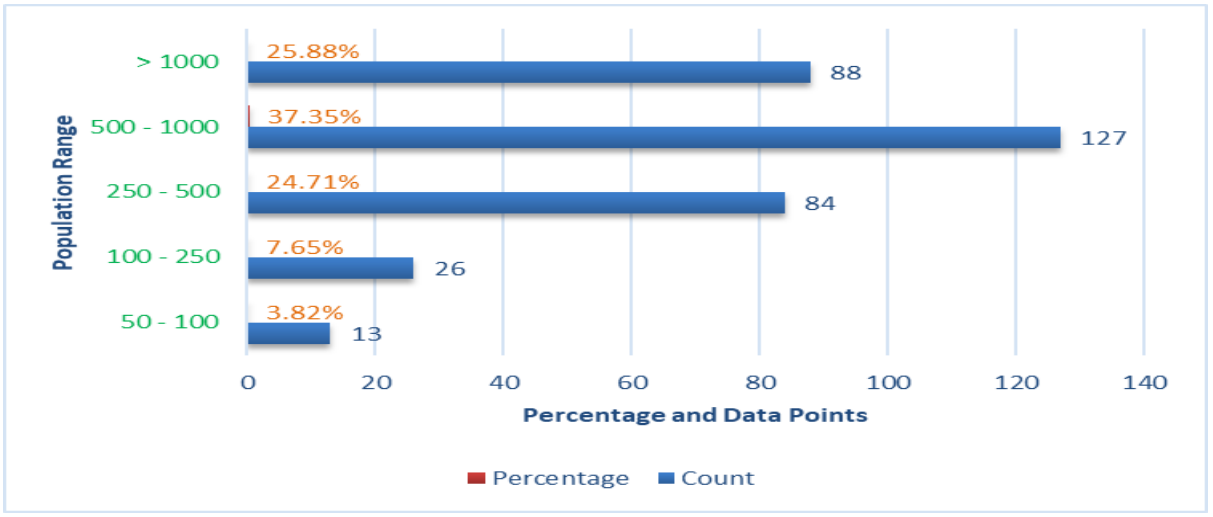

Figure 4: Population profile of settlements along upstream of the Sewa River basin

4.1 Primary water sources of communities upstream of the Sewa River Basin

The most common primary sources of water for communities visited in the upper part of the Sewa Basin are dug wells and streams which account for 52.48% and 22.78% respectively. Most of the communities lack access to protected and improved water sources for drinking and domestic uses and for many of the primary sources mapped, the availability of water is mainly seasonal. Also, communities with dug wells and streams as primary sources have swamps, ponds, and springs as alternative sources. These alternative sources are located some distance from the settlements and are also not protected.

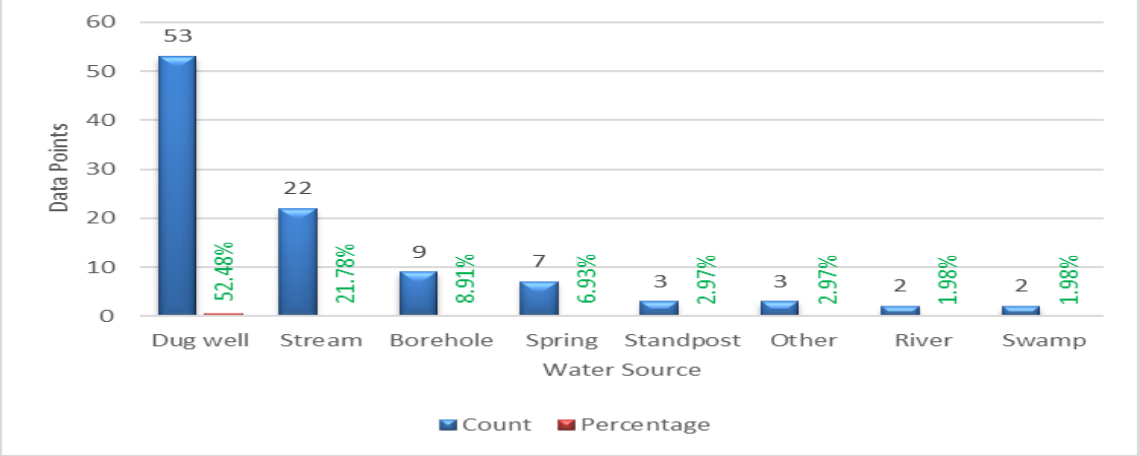

Figure 5: Primary water sources of communities upstream Sewa River basin

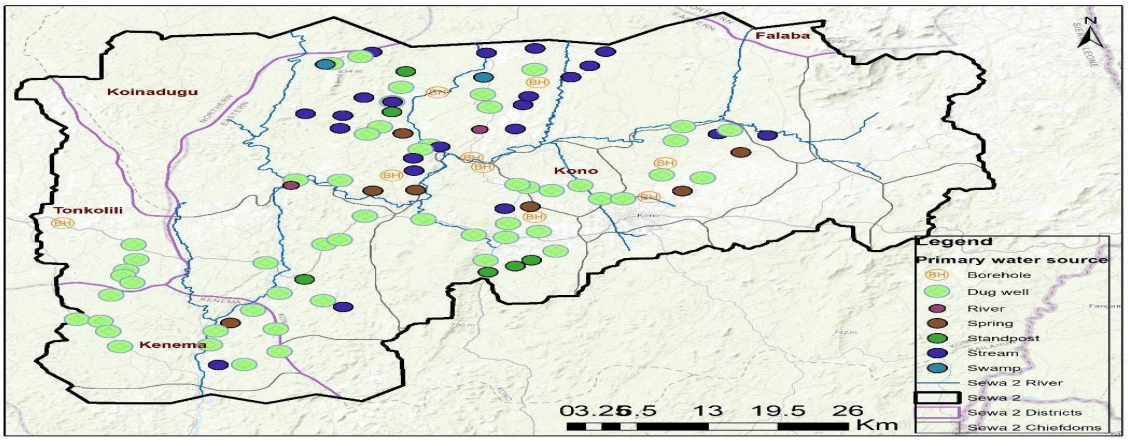

Figure 5: Map of middle-upstream Sewa River basin showing primary water sources surveyed.

4.2 Human activities of communities upstream of the Sewa River Basin

Data was collected on human activities which serves as the major sources of livelihood for all communities. Analysis of the data collected from the first phase shows that farming is the most predominant livelihood activity across the basin accounting for 71.85%. Subsistence farming activities are the most prevalent in the upper part of the Sewa River Basin. During the survey exercise, it was observed that most of the farms were found close to water sources but depended mainly on rain as a means of irrigation, but the farmers use little or no herbicides/insecticides that might pollute the water sources. However, pollution from farming activities within the upper part of the basin can mostly be seen during the rainy season when erosion from debris caught in vegetation or harvested crops are transported to nearby streams/rivers.

Small-scale mining and timber logging were also other main sources of livelihood accounting for 13.33% and 12.59% respectively.

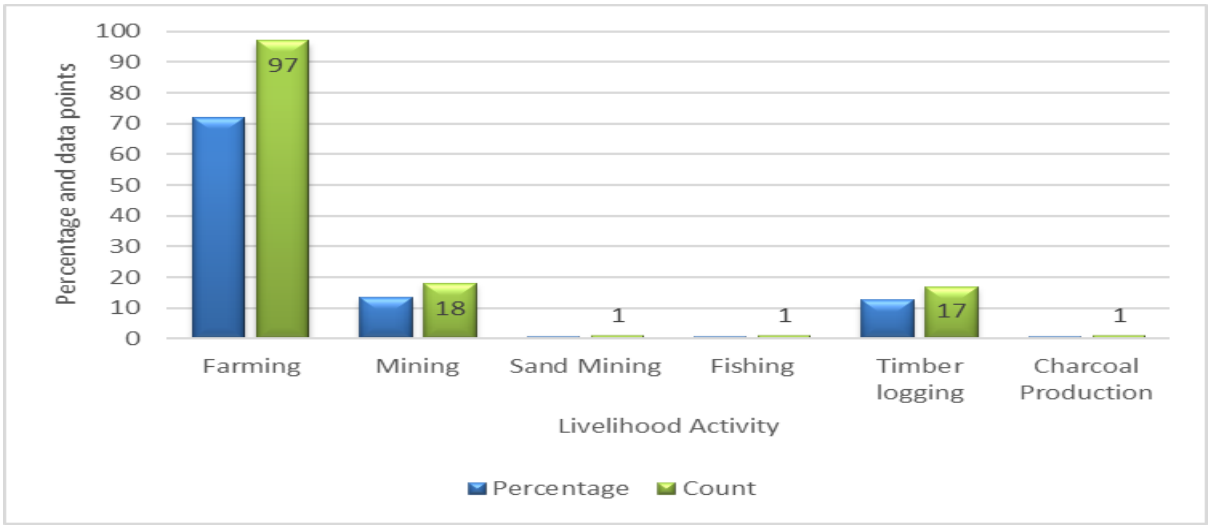

Figure 6: Human activities mapped upstream of the Sewa River basin.

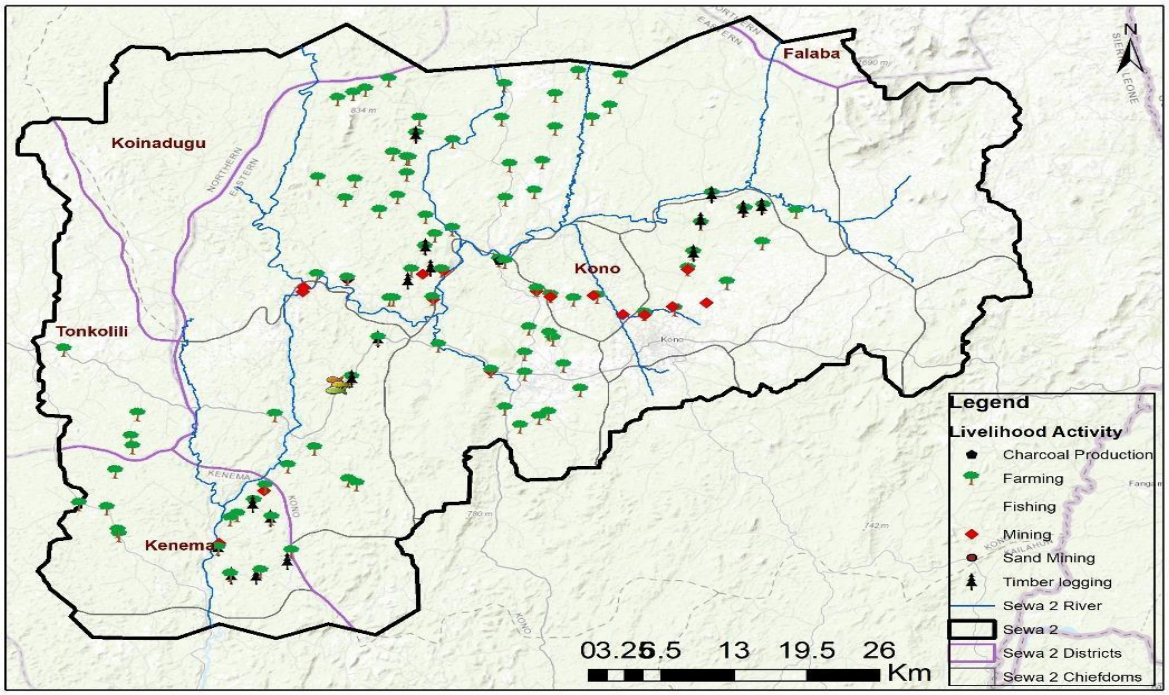

Figure 7: Map of upper-middle section of Sewa River Basin show human activities surveyed.

4.3 Sanitation profile of villages/towns middle-upstream the Sewa River basin

Sanitation is one the major categories considered for the mapping of the Sewa River basin. Sanitation practices by community people along the river basins influence the quality and quantity of River. Two sanitary factors were considered in the mapping process, which are Open defecation (ODF) and Waste Disposal Practices.

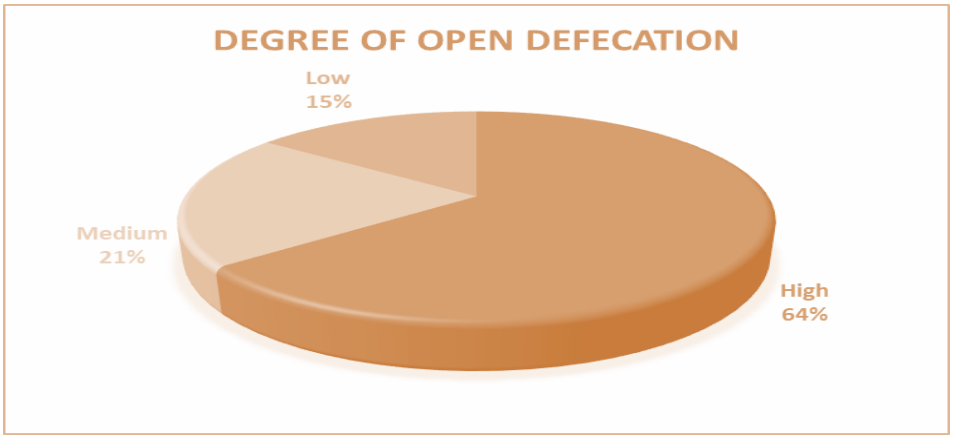

Figure 8: Degree of open defecation of communities surveyed.

From the information gathered, open defecation is the most common practice for most settlements in the upper part of the Sewa Basin. The data also revealed that most of the communities visited lacked access to improved sanitation facilities as a result the practice of high open defecation might also impact the quality of nearby water sources.

In the management of solid waste, almost all the settlements in the upper section of the Sewa River Basin do not have a community dustbin for the deposition of solid wastes and most have their wastes thrown at the backyard and with only 0.59% that have their domestic waste disposal along riverbanks.

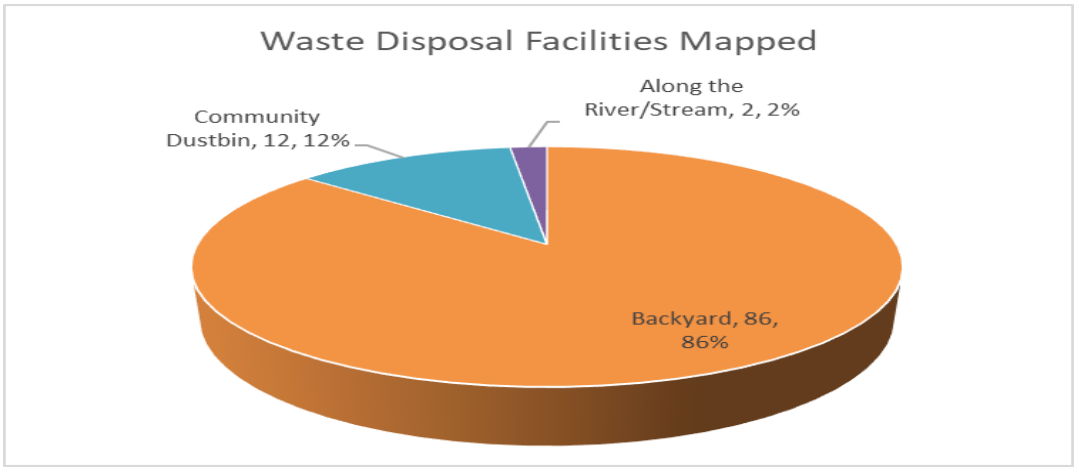

Figure 8: Waste disposal types surveyed in communities along the upper-middle of the Sewa basin.

5 Conclusion and Recommendations

The first phase of the delineation, mapping and assessment of the Sewa River Basin in the month of August 2023. A technical team from the Agency mapped and collected survey data from 99 towns/villages located in three districts including Kono, Kenema, Tonkolili. The data collection covers Human Activities, Water Sources, and Sanitation Practices.

The mapping survey of the upper section of the Sewa River Basin has provided valuable insights into the current state of the catchment area, including land use, human activities, water sources, and sanitation practices. The data collected and analyzed during this phase of the project has shed light on key aspects of the basin's condition and its vulnerability to various pressures.

Key findings include the prevalence of farming as the primary human activity in the upstream communities, the widespread use of dug wells and streams as primary water sources, and sanitation practices, with a significant proportion of communities practicing open defecation and backyard waste disposal.

Additionally, the mapping exercise has revealed variations in population density among chiefdoms, with Sandor Chiefdom having the highest number of data points recorded. These findings provide a baseline understanding of the socio-economic and environmental dynamics within the upper Sewa River Basin.

This exercise has laid a solid foundation for informed decision-making and proactive measures to address water resource challenges in the region. By implementing the above recommendations and continuing to gather data, Sierra Leone can work towards the sustainable management and preservation of its vital water catchment areas.

Recommendations:

1. Implement regular monitoring of the Sewa River Basin to track changes in land use, water sources, and sanitation practices.
2. Conduct targeted education and awareness campaigns to address open defecation and improper waste disposal practices.
3. Improve infrastructure by building more latrines to reduce open defecation and pollution of the river basin.
4. Promote sustainable farming practices to minimize water pollution in the upper Sewa River Basin.

5. Engage with local communities to raise awareness about the importance of catchment preservation and involve them in decision-making.
6. Integrate collected data into Sierra Leone's national water resources geodatabase platform for better policy formulation and emergency preparedness.
7. Expand mapping efforts to cover the entire Sewa River Basin, including Middle and Lower sections, for a holistic understanding of the region's water resource challenges.