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a case study of the Songwe River Basin

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DOI
10.1016/B978-0-323-91223-5.00003-4

Publication date
2022

Document Version
Final published version

Published in
Water - Energy - Food Nexus Narratives and Resource Securities

Citation (APA)
Masia, S., Sušnik, J., Jewitt, G., Kiala, Z., & Mabhaudhi, T. (2022). Transboundary WEF nexus analysis: a case study of the Songwe River Basin. In *Water - Energy - Food Nexus Narratives and Resource Securities: A Global South Perspective* (pp. 91-109). Elsevier. https://doi.org/10.1016/B978-0-323-91223-5.00003-4

CHAPTER 6

Transboundary WEF nexus analysis: a case study of the Songwe River Basin

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1. Introduction

One of the main challenges of the 21st century is to cope with the rising pressures on resource demand due to the world's rapid population growth and socioeconomic development. By 2050, global water and energy demand are expected to increase by 55% and 80%, respectively (OECD, 2012), while to meet food demand, agricultural production needs to increase by almost 50% more than in 2012 (FAO, 2017). These trends threaten water, energy, and food (WEF) security putting at risk their access and availability. Over the past decade, the call to move from a "silo-thinking approach" to an "integrated approach" to understand and analyze these sectors and better address resource management and decision-making has been growing worldwide. The WEF nexus is recognized as an effective approach to highlight interlinkages, enhance synergies, and minimize trade-offs among the components in a system. The WEF nexus approach is emerging as an important pillar of the global 2030 Agenda for Sustainable Development in that progress toward the majority of the Sustainable Development Goals (SDGs) is closely related to the water, energy, and food sustainable management (FAO, 2018). Recently, in view of the need to accelerate progress toward meeting the SDGs, the number of stakeholders such as nongovernmental organizations, governmental ministries, private and public sectors, and academic institutions expressing their support for a WEF nexus approach is increasing.

Water, energy, and food are at the core of developing countries' development goals and strategies, and interest in the WEF nexus approach is rapidly

Water - Energy - Food Nexus Narratives and Resource Securities. https://doi.org/10.1016/B978-0-323-91223-5.00003-4

growing (SADC, 2016; GWP-SA, 2019). For example, the Southern African Development Community (SADC) has adopted the WEF nexus approach as a framework to achieve national goals aligned with the National Development Plan and the SDGs. In SADC, this approach has evolved as a focus for integrated resources development and is strongly aligned with activities under SADC Regional Strategic Action Plan (RSAP IV) for Water Resources Management and the SADC Industrialization Strategy and Roadmap. The SADC regions largely rely on goods derived from natural resources, which are essential for eradicating poverty. In these countries, food security often depends on ecosystem goods and services; thus the integrated management of these resources is at the basis of sustainable development (SADC and GWP, 2019). However, a lack of empirical evidence and a need for appropriate methods, and qualitative and quantitative WEF nexus assessment tools have been highlighted.

This chapter presents an overview of a WEF nexus analysis approach to support sustainable socioeconomic development in the Songwe River Basin (SRB) located on the border of two SADC countries, i.e., Malawi and Tanzania and a detailed description of the first component of this approach. This research is currently ongoing within the WEF Nexus Toolkit (WEF-Tools) project (https://wef-tools.un-ihe.org, 2020–23). The work aims at assessing the SRB Development Programme's (SRBDP's) expected outcomes by applying an approach that follows from conceptual mapping of the SRB nexus system to the development of quantitative tools such as system dynamics models (SDMs), and identification of indicators for the assessment of different scenarios and management strategies, which can contribute to information for decision-makers to assess feasible development pathways.

The expected outcomes of the SRBDP assessment will be a structured knowledge base, simulation tool, dashboard, and a composite nexus index codeveloped, tested, validated, and refined through interactive collaboration with stakeholders and local experts. Ultimately, this toolkit is intended to support the development of short-, medium-, and long-term strategies for sustainable integrated resource management and policy development in this and similar basin development initiatives. Outcomes will provide a means for government ministries, NGOs, and development agencies to assess progress toward relevant SDGs, particularly SDGs 2, 6, and 7.

2. Case study description

The SRB is located in southwest Tanzania and northern Malawi. The Songwe River creates an international border between the two countries and is 200 km in length (Fig. 6.1). The basin area is 4243 km^2, and the population is over 341,000 of which about 52,000 are reported to suffer from flooding and land losses. The basin is composed of six districts: Ileje, Mbozi, Mbeya,

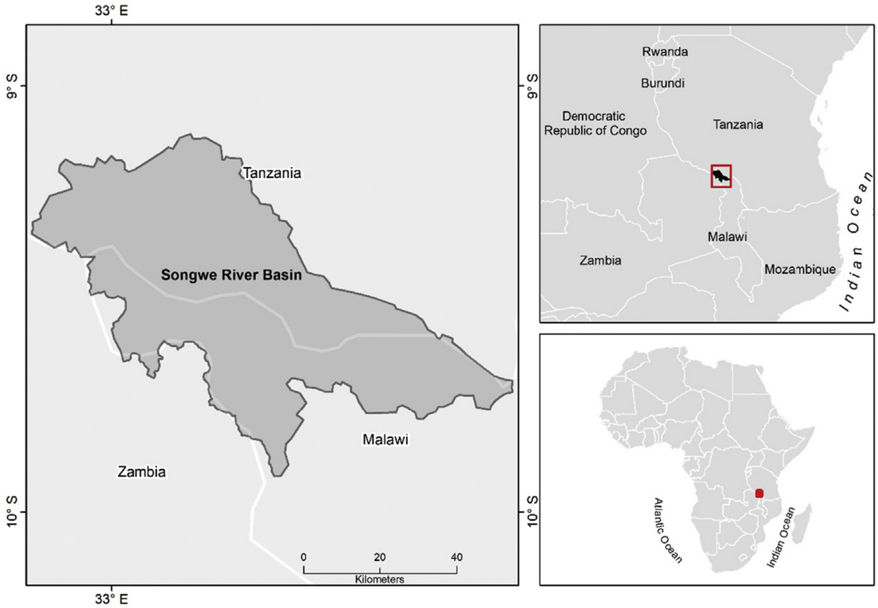

FIGURE 6.1
Location of the Songwe River Basin.

and Kyela (Tanzania side) and Karonga and Chitipa (on the Malawi side) (Munthali et al., 2011; SRBDP, 2018). The SRB is characterized by fertile alluvial soil and abundant water resources on which people rely for their living. Rural people represent about 80% of the total basin's population. Average annual income is about 386 USD per capita. In the basin, about 50% and 75% of the people lack access to safe water supply and electricity, respectively. Both Malawi and Tanzania are currently experiencing electricity shortages. The increasing population growth is having a negative impact on the environment and resource availability (CRIDF). Reducing poverty, improving human health and livelihoods, ensuring water, food, and energy security, mitigating floods, and enhancing sustainable river basin management are the main challenges that the two countries are currently facing in the SRB.

2.1 The Songwe River Basin Development Programme

The governments of Malawi and Tanzania have decided to collaborate to develop the SRBDP, which includes 26 multisectoral projects (CRIDF). Socioeconomic development, poverty, electricity, and clean water access, and riverbank instability are among the main challenges that the SRBDP aims to address in the near future (SIWI, 2019). The core of the Programme is the construction of a multipurpose reservoir located in the Lower Songwe. The reservoir will have a capacity of 330 Mm^3 and a hydropower plant capacity of

180.2 MW and is planned to be managed as a public–private partnership that can feed the Southern Africa Power Plant (CRIDF, SRBDP, 2018). The Programme includes the development of two irrigation schemes with a total area of 6200 ha made up of cover 3050 ha in the Lower Songwe River Malawi (LSRM) and 3150 ha in the Lower Songwe River Tanzania (LSRT) to which the reservoir will supply water (SRBDP, 2018). The irrigated land will be beneficial to over 5500 farming families. Two urban water supply projects will serve a total of 450,000 people. Livelihoods will be enhanced by increasing access to water and irrigated land, but also to electricity thanks to the planned Rural Electrification Project, which will benefit around 120,000 people in 22,200 households and fisheries. Additional Tourism Development Projects are planned to boost socioeconomic development in the basin (SIWI, 2019; CRIDF).

Some of the SRBDP outcomes are as follows:

- "**Increased hydropower production** to facilitate the development of small and medium industries (SMI) and improve energy source in the basin, and electricity grids in Malawi and Tanzania (increased electricity access for 60% of the SRB population)
- **Increased food production** through irrigated agriculture (a benefit for 5500 farm families)
- **Increased access to water supply and sanitation** in the basin (more than 260,000 people by 2025)
- **Water conservation/storage** to improve water access during droughts
- **Socioeconomic improvement** of the SRB inhabitants (up to 5244 full-time jobs per year in agriculture. 5560 and 3000 people per year for the infrastructure construction and operation and maintenance for 50 years for agriculture and HHP, respectively)
- **Mitigation of floods** (more than 52,000 people will be relieved)
- **Small-scale fisheries activities** to enhance protein intake and provide an alternative source of income to the inhabitants
- **Sustainable management of the SRB**
- **Improved management information system** through water resources monitoring, development, and management
- **Improved cooperation in transboundary WRM** through a formal framework
- **Enhanced cooperation between Malawi and Tanzania**"

(SRBDP, 2018; SIWI, 2019).

The application of the aforementioned WEF nexus analysis approach will help to address the main expected outcomes identified in the SRBDP both qualitatively and quantitatively.

2.2 WEF nexus analysis approach for the Songwe River Basin

The approach proposed to assess the outcomes of SRBDP consists of four main steps:

(1) Case study nexus system conceptualization
(2) Data mapping and collection
(3) System dynamics modeling
(4) Composite nexus index development

The *first step* aims at developing a conceptual nexus map where the main nexus issues, sectors, subsectors, and interlinkages between WEF components are highlighted. The conceptual model represents a qualitative assessment of the case study. It usually starts relatively simply, gradually building up in complexity according to the information that can be collected and the needs of stakeholders. The conceptual model represents WEF interactions at a high level and should be developed and validated by stakeholders and local experts (see details about the conceptual framework in Chapter 6, Susnik et al., 2018; Vamvakeridou-Lyroudia et al., 2019). The *second step* is focused on data identification and collection. Data can be collected in different units and formats from various sources (Eddy covariance stations, Earth observations, thematic models, statistics, etc.). They can be at different temporal and spatial scales. The collected data need to be used in a quantitative model (see details about data and scale in Chapters 3, 4, and 5). These data are then used in the *third step*, which is to develop the quantitative model as an SDM (Ford, 2010). SDM is a widely known modeling approach used to understand and quantify complex systems. The SDM can be developed with local experts to ensure that it is as representative of the case study as possible. Once the SDM structure is ready and the model runs, obtained results should be discussed with local experts and stakeholders for maximum impact (see details about the SDM in Chapter 5, Sušnik et al., 2020). Once results are validated, they can be used in step 4 to develop a composite nexus index, which, again, should be discussed and validated by local experts and stakeholders (see details about the composite indicators in Chapter 6; https://wefnexusindex.org).

The approach described in this chapter considers the role of local experts and stakeholders as crucial for the achievement of the final result. Indeed, stakeholders and local experts are essential to guide and validate the work developed in each step of the approach. The approach applied to analyze the WEF nexus system in the SRB is intended to directly address the expected outcomes identified in the SRBDP. The final results in steps 3 and 4 depend on data availability. A similar approach to that described here was adopted in the SIM4NEXUS project (https://www.sim4nexus.eu/) where it has been applied successfully from regional to global scale in 12 case studies (https://www.sim4nexus.eu/, Susnik et al., 2018).

In this chapter, we focus on step 1, i.e., case study nexus system conceptualization.

2.3 Conceptualizing the WEF nexus in the Songwe River Basin

The qualitative assessment of the SRB was undertaken by developing conceptual maps, which consist of two main parts: a "high level conceptual model" where only the main sectors and the major links among them are highlighted, and an "extended conceptual model," which describes in detail each nexus sector and the main links among its subsectors and all the other sectors of the system.

The analysis of the SRB has been carried at basin scale. The geographical boundary of the basin itself has been set as the boundary for the WEF nexus system assessment (Fig. 6.1).

2.3.1 High-level conceptual model

In-depth desktop analysis of the SRB was carried out and used as a base to build the high-level nexus system conceptual model. The analysis identified six main nexus components/sectors and how they interact with each other. The six sectors, i.e., water, land, food, energy, climate, socioeconomic system, human health, ecosystem health, and the main interlinkages between them are illustrated in the high-level conceptual model (Fig. 6.2). The human and ecosystem health sectors are part of the socioeconomic and land sectors, respectively, but given their crucial relevance in this case study, they have been explicitly incorporated in the map (dotted box in Fig. 6.2). The qualitative map highlights the strong link between the socioeconomic system and the land sector. Indeed, it is evident in the basin that there is considerable land use change, in particular from wetlands to cropland to accommodate growing food demand. An unavoidable consequence of increasing agricultural production is water pollution due to the use of fertilizers and pesticides needed to enhance food production and prevent crop diseases. This issue is projected to worsen due to projected increasing food demand.

One of the main challenges of the SRBDP is to increase clean water access and supply. In this regard, a new reservoir is planned, which will increase water storage, access, and supply, in particular during droughts. The reservoir is intended to supply water to irrigate fields and allow for diversification of crop types and increased yields. The construction of a reservoir will be essential for flood control, potentially helping to protect more than 52,000 people who live in the

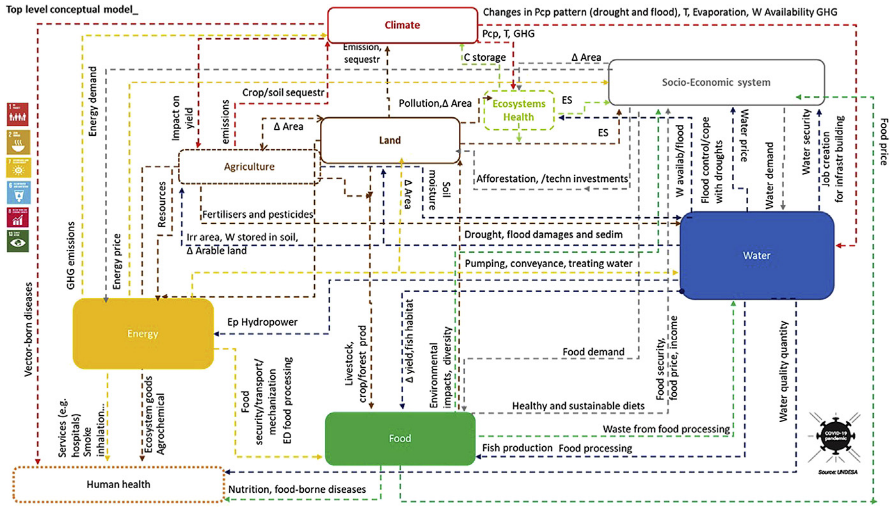

FIGURE 6.2
High-level nexus conceptual model for the Songwe River Basin. The main tentative SDGs are shown (left). *SDG*, Sustainable Development Goal.

flood plain and that currently suffer from flooding and land loss. In addition, the reservoir will increase energy production and, with the improvements in water and food availability and access, is intended to improve livelihoods, boost the economy, reduce poverty, and improve the quality of life and human health. The reservoir is therefore expected to have significant impact on the socioeconomic system in terms of job employment in the different sectors and income generation. The main SDGs that are addressed in the SRB qualitative analysis are 1, 2, 6, 7, 8, and 13.

2.3.2 Extended conceptual model

Following the development of a high-level conceptual model, a more detailed analysis of each of the components in the high-level conceptualization was undertaken.

2.3.2.1 Water

In the water sector, three main subsectors, i.e., water availability, water use, and water quality, have been identified in the SRB. The links between them and the other nexus sectors are shown in Fig. 6.3. In the basin, not everyone has access to clean water, and ways of enhancing supply are being sought. In the water availability subsector, access to basic water requirements as well as agricultural supply is limited. As a consequence, basic WHO health, e.g., prevention measures recommended during the COVID-19 pandemic may not be met. Blue and green water have been explicitly represented to emphasize the importance

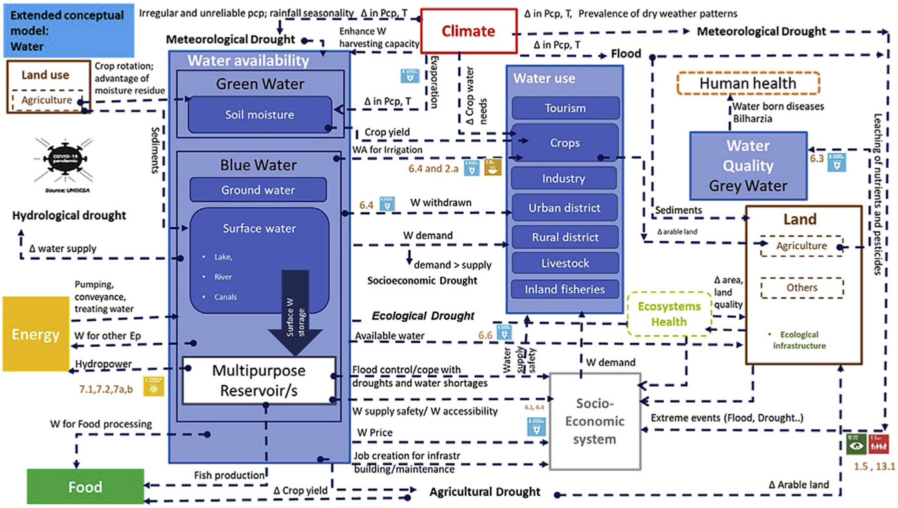

FIGURE 6.3

Extended conceptual model for the water sector in the Songwe River Basin. The main tentative SDGs and SDG targets (in orange) are shown. *SDG*, Sustainable Development Goal.

of assessing soil moisture in the agricultural production. Groundwater and surface water are represented in blue water (Fig. 6.3), highlighting the potential role of reservoir construction for increasing surface water storage and water availability. The natural variability of rainfall and its likely changes in the future result in imbalances between water supply and demand and have a knock-on effect on the other sectors, in particular on the land sector on which the food production depends. Indeed, the SRB currently relies mostly on rain-fed agriculture. Therefore, prolonged drought conditions lead to increase pressure on food security. These and the impacts of climate change on the SRB are intended to be mitigated through the implementation of multisectoral solutions (SRBP, 2019). The potential impact of meteorological, hydrological, agricultural, ecological, and socioeconomic drought is shown in Fig. 6.3. The qualitative analysis of the SRB system confirmed potential positive impact of the reservoir on water, energy, and food availability and access, irrigated land, food diversification, job creation, income generation, and ecosystem health (Fig. 6.3). The downside of the increasing land use and crop yield, as expected from the SRBDP, for growing food (cropland and wetlands in particular), is a likely negative impact on water quality (gray water, Fig. 6.3) due to the amount of nutrient and pesticides loads in the river. The role of small-scale fisheries in wetlands has been highlighted in the basin. Increasing these activities is one of the main Programme outcomes. Indeed, wetlands contribute to food security, income, and job creation in rural communities that live in these areas.

The research included the identification of relevant SDGs and the related targets that may be possible to address and compute in a future analysis of the basin (Fig. 6.3). From the number of SDGs, objectives, and indicators tentatively identified in the water sector is already possible to understand the important role of the nexus assessment in contributing to achieving the SDGs in the SRB. The main SDGs identified in the water sector are 1, 2, 6, 7, and 13. The tentative SDG targets are shown in Fig. 6.3 (in orange) (https://sdgs.un.org/goals).

2.3.2.2 Land and food

The land and the food sector are closely linked. The food sector is one of the most influential due to the high demand for water and energy. Food production influences all nexus sectors in the SRB, but in particular the land sector where both irrigated and rain-fed crops are cultivated. Most crops are currently cultivated in rain-fed, and the main crop is rice. Due to the increasing demand for rice, farmers have started to cultivate in wetlands (Kalisa et al., 2013). The cultivation of these lands is not controlled, and it is rapidly increasing due to the high pressure from food demand/crop production. These changes are having a considerable impact on socio-economic activities and the livelihood of local people (Gwambene, 2017). Income is generated from the expansion of agricultural land (for rice production in particular). However, the rapid land use change is undermining other sources of livelihood and is having a significant impact on biodiversity (Fig. 6.4) (Kalisa et al., 2013). For example, to increase rice production, permanent wet areas have been converted to arable land to ensure this cultivation. This turns out to be one of the main causes of the loss of four different fish species and the reduction in macrophytes (Kalisa et al., 2013).

Hunting, which is a means to ensure food security in the basin, is also greatly affected. The increasing population is having a considerable impact on the use of wetland resources and on the sustainability of the wetland ecosystem. In part of the study area, it has been reported that, due to resource overexploitation, natural vegetation was removed and permanent wet areas have disappeared. In the lower plain of the basin, it is noticed that over 95% of the land has been converted to cultivated area (Kalisa et al., 2013) to meet the increasing food demand. The intensive agriculture on available cropland is leading to soil fertility decline that, together with the highly variable climate and associated water supply, and an increasing need for arable land, is one of the main reasons for farmers' migration to wetlands. Indeed, people who are living in the wetlands have different sources of livelihoods including fishing, crop production and livestock keeping, and handcraft production (Kalisa et al., 2013). Wetlands are a source of income in particular for fisheries (Fig. 6.4). They contribute to improving the socioeconomic development in the basin by

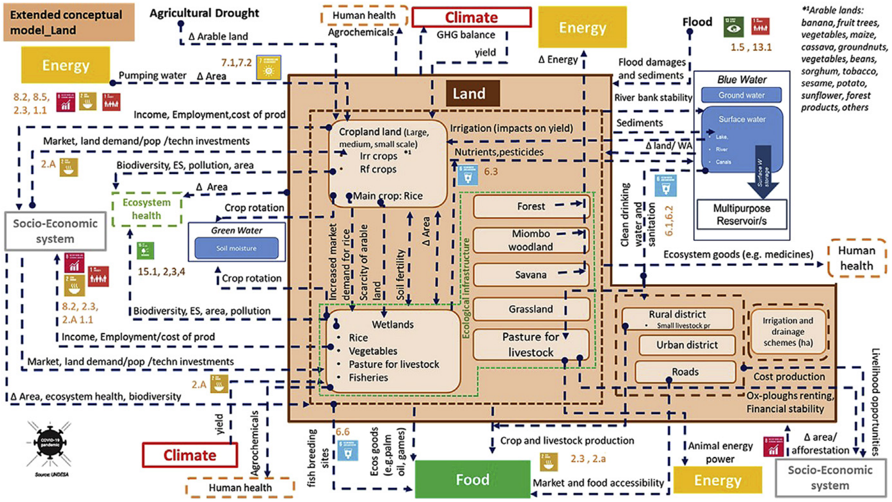

FIGURE 6.4

Extended conceptual model for the land sector in the Songwe River Basin. The main tentative SDGs and SDG targets (in orange) are shown. *SDG*, Sustainable Development Goal.

generating income and employment, thus enhancing the quality of life of the inhabitants of these areas. The future impact of climate change on crop yield is expected to exacerbate existing climate variability and threaten food security given the significant rain-fed production in the basin (Gwambene, 2017). From this perspective, the construction of the multipurpose reservoir, a key component of the SRBDP, is expected to significantly reduce this risk.

Relevant issues directly linked to food security are related to energy and water access and availability, and to ecosystem health, which are strongly linked to the sustained provision of ecosystem goods and services in the basin. The two irrigation schemes included in the SRBDP are expected to increase food production, as well as allow food diversification, resulting in a positive impact on human health and socioeconomic activities. However, it is important to consider that the increase of agricultural products may lead to the use of more chemicals (Gwambene, 2017) that can adversely influence human and ecosystem health (Fig. 6.4). The sustainable management of the SRB has been emphasized by the Programme and needs to be guaranteed. Flooding is the main cause of damages to the population living in the plain and to fertile land (Munthali et al., 2011). For that reason, flood mitigation is an important goal of the Programme. In this regard, the construction of the dam may be relevant to reduce the flood risk in the study area. In addition, this analysis highlighted the population whose access to food is threatened by a lack of services, such access to markets (Gwambene, 2017). The SRBDP also includes the improvement of roads, which could enhance food accessibility and production (Fig. 6.4).

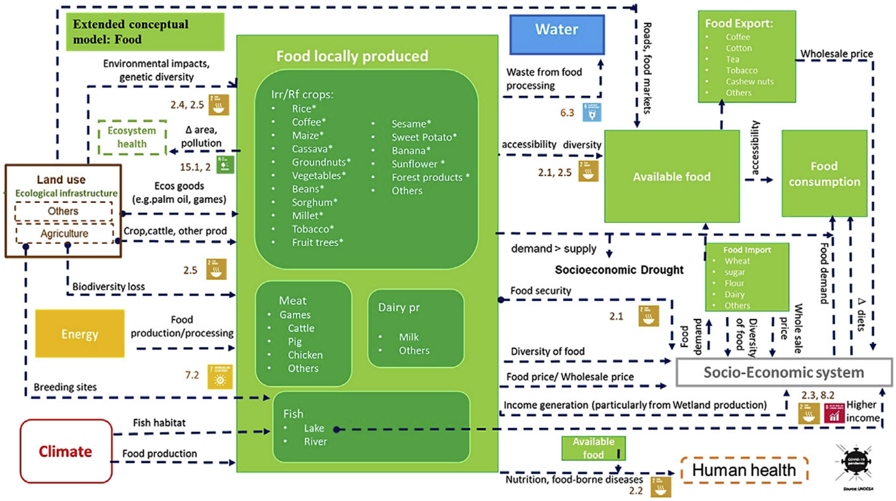

FIGURE 6.5
Extended conceptual model for the food sector in the Songwe River Basin. The main tentative SDGs and SDG targets (in orange) are shown. *SDG*, Sustainable Development Goal.

Fig. 6.5 shows the food balance in terms of food locally produced, imported, exported, and consumed food. The importance of increasing and ensuring food availability, accessibility, diversity, and price is considered. The increasing demand for food driven by the increasing population growth in the basin is having a considerable impact on the food balance. To meet the increasing local demand, more intensive crop production is needed. The rapid land use change in the basin is undermining biodiversity and threatening ecosystem health (Figs. 6.4 and 6.5). The local food production and food export are sources of income for the people who live in the basin (PO-RALG, 2019). The diversification of food produced and available/accessible for consumption is crucial for coping with nutrition issues and food-borne diseases (Fig. 6.5). Due to COVID-19, the already relevant difficulties related to food security are expected to potentially increase due to a disruption of food production and distribution (Figs. 6.4 and 6.5). The main tentative SDGs identified in the land sector are 1, 2, 6, 7, 8, 13, and 15 (https://sdgs.un.org/goals).

2.3.2.3 Energy

The analysis of the energy sector in the SRB highlighted the importance of available energy resources, available secondary energy, and energy use (NBS, 2016). Both available energy resources and available secondary energy have been divided into renewable and nonrenewable, and the use of both is also indicated. This is crucial to ensure sustainable development in the case study. This issue is also included in the SRBDP where the construction of dams is directly linked to hydropower production, and thus to the possibility of increasing availability, access, and use of renewable energy. Energy is crucial in food production and processing. The use of fossil fuels has an impact on climate in terms of greenhouse gas emissions (Fig. 6.6). The available energy is mainly used in rural and urban districts, mining, and the agricultural sector, but not everybody has electricity access. The imported and exported available energy resources, as well as the cost of energy from various sources, which has an impact on the socioeconomic system, have been also accounted for. The availability of energy is expected to contribute to increasing human empowerment and services (like hospitals and so on) with an impact on socioeconomic development and human health. The need to build infrastructure to provide and increase access to affordable, reliable, and sustainable energy is indicated in the analysis. The link between firewood and land is relevant in this case study because, despite firewood being a source of income, its collection is also a main cause of deforestation. Health problems are caused by kerosene, coal, and oil smoke inhalation, and this is an important aspect in terms of impact on human health.

The impact of mining on water quality is addressed in terms of water pollution. Personnel and facilities shortages due to COVID-19 can lead to disrupted access to electricity, further weakening health system response and capacity (Fig. 6.6). The people that most suffer from energy access are located in rural districts; thus the rural electrification project included in the SRBDP will be beneficial to improve the socioeconomic system in these areas. SDGs 2, 6, and 7 have been shown in Fig. 6.6 (https://sdgs.un.org/goals).

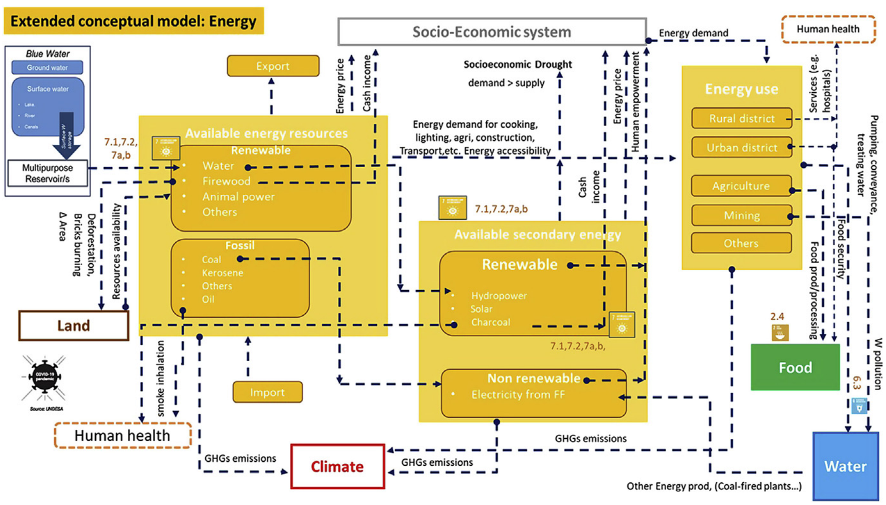

FIGURE 6.6

Extended conceptual model for the energy sector in the Songwe River Basin. The main tentative SDGs and SDG targets (in orange) are shown. *SDGs*, Sustainable Development Goals.

2.3.2.4 Climate

Climate variables such as precipitation, wind, and temperature were assessed to identify the impact of increasing greenhouse gas emissions, particularly in the land and energy sectors (Fig. 6.7). Climate change is expected to amplify the natural variability of the climate and further compromise the availability and timing of water in the basin, and thus the available water for domestic use, crop productions, and hydropower production. Changes in the frequency and intensity of extreme events are expected with a significant impact on the socioeconomic system (Gwambene, 2017). The role of the reservoir in reducing the risk of flooding may be crucial to mitigate damage to people, villages, and food production. Investments in increasing water storage are key to ensuring water, food, and energy security in the basin. The conservation and restoration of ecological infrastructure is crucial for coping with current climate variability as well as climate change. SDGs 1 and 13 have been tentatively indicated as the main goals that can be addressed through the nexus analysis of the SRB (https://sdgs.un.org/goals).

2.3.2.5 Socioeconomic system

The main sectors that characterize the socioeconomic system of the study area include agriculture, fisheries, and tourism. Increasing population growth and the changes in food demand and diet are having an impact on the food sector and therefore in the land sector (Fig. 6.8). Investments in technologies can

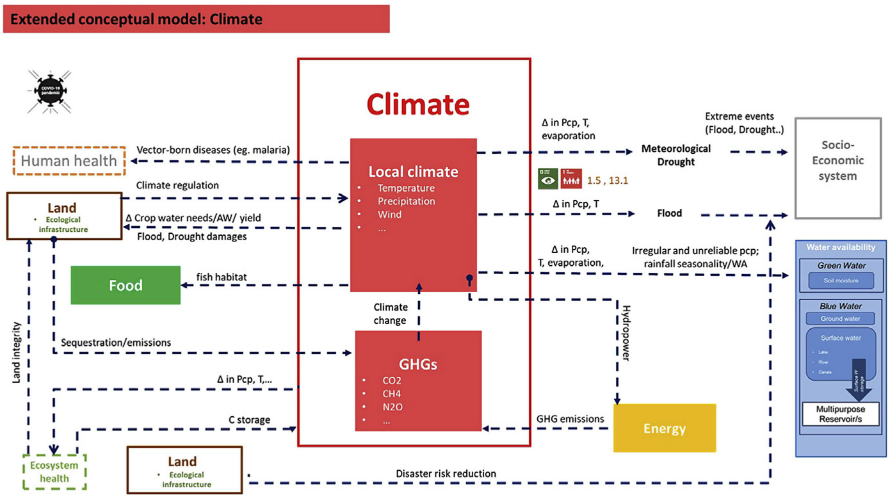

FIGURE 6.7

Extended conceptual model for the climate sector in the Songwe River Basin. The main tentative SDGs and SDG targets (in orange) are shown. *SDGs*, Sustainable Development Goals.

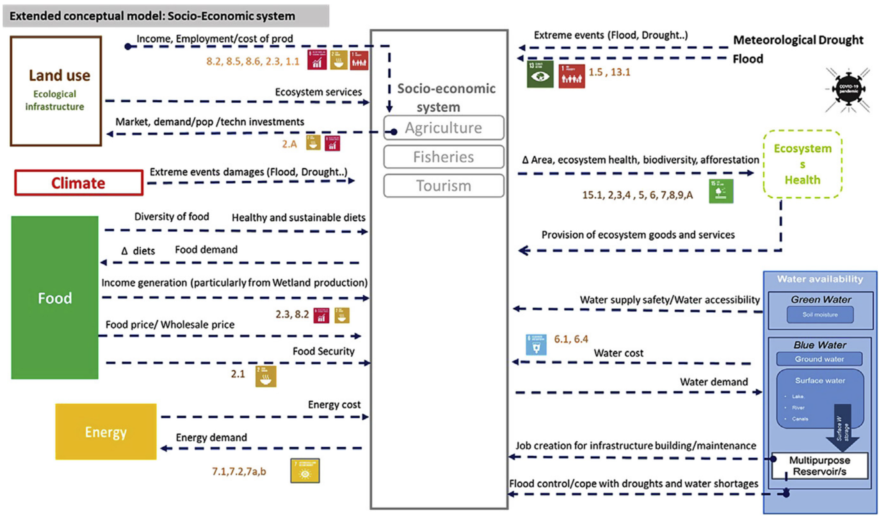

FIGURE 6.8

Extended conceptual model for the socioeconomic sector in the Songwe River Basin. The main tentative SDGs and SDG targets (in orange) are shown. *SDG*, Sustainable Development Goal.

help to ensure water, food, and energy security. Technology is also expected to increase sustainable resource management in the basin (e.g., monitoring systems). Higher income is expected from increasing food production, in particular from the increasing productions in wetlands, with a beneficial effect on the socioeconomic system, but a detrimental impact on ecosystem. Changes in food, water, and energy prices due to changes in production and consumption are also expected. Increasing water, energy, and food demand is expected to have a negative impact on ecosystem health, which in turn is fundamental to provide goods and services. Extreme events are expected to change in intensity and frequency and to impact the socioeconomic system causing damages to built-up areas and cultivated land. The SRBDP aims at reducing the impact of drought and floods in the basin. The links between these sectors and all the others identified in the basin are particularly evident from the number of SDGs shown in Fig. 6.8. The tentative SDGs indicated are 1, 8, 13, and15 (https://sdgs.un.org/goals).

2.3.2.6 Ecosystem and human health

The ecosystem health (Fig. 6.9) in the SRB is threatened in particular by water availability and land use changes. Degradation of the landscape and climate change are threatening ecosystem health, and concerns of an ecological drought, which would impact negatively on the socioeconomic system, have been raised. Increasing agricultural activities have an impact in terms of pollution, loss of biodiversity, provision of ecosystem goods and services, land

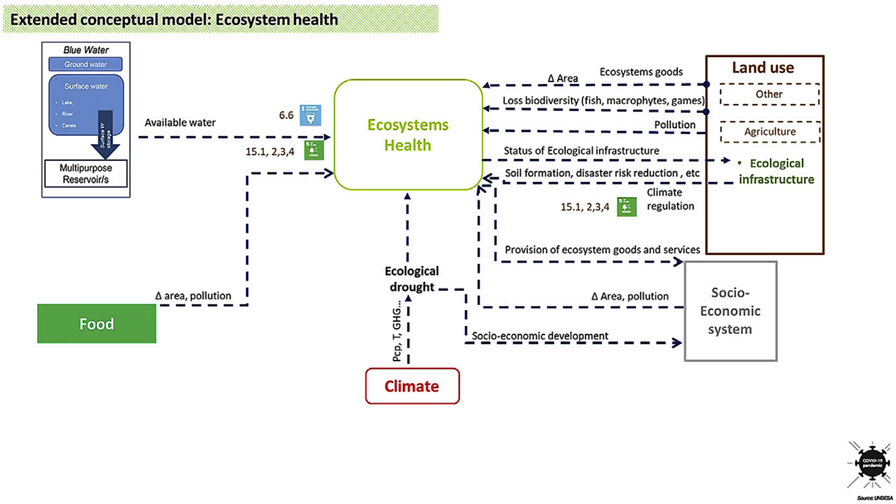

FIGURE 6.9
Extended conceptual model for the ecosystem sector in the Songwe River Basin. The main tentative SDGs and SDG targets (in orange) are shown. *SDG*, Sustainable Development Goal.

degradation, and soil fertility (Gwambene, 2017). The status of ecological infrastructure is crucial to ensure ecosystem health, so actions to preserve it are fundamental.

Human health is threatened by activities in all nexus sectors (Fig. 6.10). Actions to improve availability and accessibility to water, food, and energy are crucial to

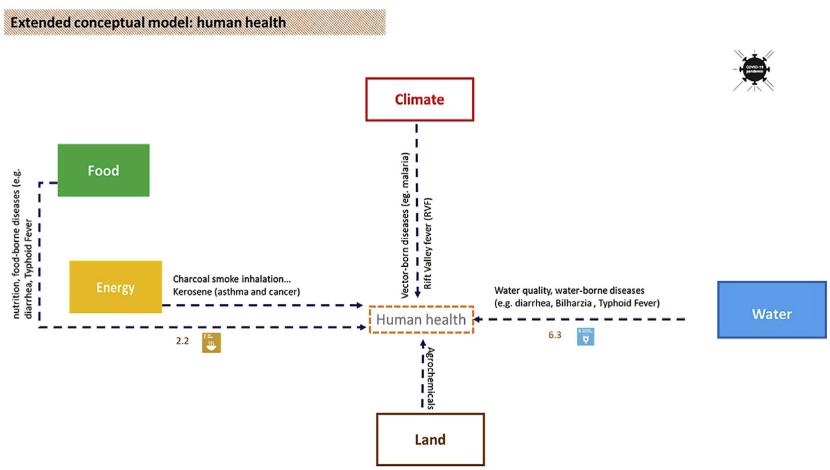

FIGURE 6.10
Extended conceptual model for the human health sector in the Songwe River Basin. The main tentative SDGs and SDG targets (in orange) are shown. *SDG*, Sustainable Development Goal.

ensure WEF security, as well as maintain human health. Improving the sustainable resources use in the nexus sectors will contribute to reduce the risk of diseases. Technology and knowledge have a key role in this sector.

The ecosystem and human health system have been analyzed separately because their importance in the basin is crucial. The SDGs, the objectives, and the indicators shown in Fig. 6.9 are already identified in the land sector (Fig. 6.4), while SDGs 2 and 6 come into focus in the human health system (Fig. 6.10) (https://sdgs.un.org/goals).

3. Conclusions

The approach outlined in this chapter aims at supporting sustainable socioeconomic development. The analysis carried out focuses on the assessment of the WEF nexus in the SRB located on the border between Malawi and Tanzania. Reducing poverty, improving human health and livelihoods, ensuring water, food, and energy security, mitigating natural climate variability and associated floods and droughts, and enhancing sustainable river basin management are the main challenges recognized by the SRBDP jointly developed by the governments of both countries. The construction of a multipurpose reservoir is a key objective of the SRBDP. The reservoir will supply water for 180 MW hydropower plant, 3000 ha of irrigation schemes in each country, and control floods in the lower part of the basin. The assessment of SRBDP's expected outcomes will be carried out by applying an approach that starts from conceptual mapping of the SRB nexus system to the development of quantitative tools such as SDMs, and identification of suitable indicators for the assessment of different scenarios and management strategies, subsequently providing decision-makers with feasible development pathways. This research is currently ongoing within the WEF Nexus Toolkit (WEF-Tools) project (https://wef-tools.un-ihe.org, 2020–23).

In this chapter, the qualitative nexus analysis of the SRB is applied to illustrate the main sectors and subsectors involved in the SRBDP and to identify the main interlinkages between them. The analysis showed how a potential decision made in a sector may have an influence on multiple sectors. The qualitative assessment can help to understand where there can be synergies and tradeoffs, and thus to work on strategies that enhance the former and reduce/avoid the latter. The cooperation between Malawi and Tanzania is critical to successfully achieve the outcomes of the Programme expected in the basin by the two countries and to guarantee the sustainable development of the case study. In this regard, the first attempt to identify the potential SDGs, objectives, and indicators that may be addressed in the basin through the nexus analysis has been made (Figs. 6.2–6.10). This highlighted the importance of the application of the holistic approach on the SRBDP to enhance and boost the achievement of SDGs in the basin. The next step, i.e., a quantitative analysis depends on the data that are possible to collect. The application of the WEF nexus approach for analysis of the SRB will provide structured knowledge base, tools, dashboard, and a composite nexus index. The approach considers the role of local experts and stakeholders as essential for the achievement of the final results of each step which are codeveloped, tested, validated, and refined with interactive collaboration. The SRB assessment is intended to support decision-making and, therefore, the development of short-, medium-, and long-term strategies for sustainable integrated resource management in the basin itself and in others with similar characteristics. The outcomes will provide a means to assess progress toward relevant SDGs, in particular SDGs 2, 6, and 7.

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