June 2014

2030 Water Resources Group

TANZANIA:

PRIORITIZING WATER BASINS FOR INTERVENTION

Disclaimer

Rights and permissions

About 2030 Water Resources Group

The 2030 Water Resources Group is a unique public-private civil society partnership that helps governments accelerate reforms that will ensure sustainable water resource management for the long-term development and economic growth of their country. It does so by helping to change the “political economy” for water reform in the country by convening a wide range of actors and providing water-resource analyses in ways that are digestible for politicians and business leaders.

Acknowledgments

The 2030 Water Resources Group wishes to thank all of the companies, organizations, institutions, and individuals that have shared their knowledge on water resources in Tanzania to produce this report. This report has been prepared by AMEC Environment & Infrastructure UK Limited with particular note to the contribution of Dr Chris Fawcett, Colin Carter, and Onesmo Sigala. The report takes into account the particular instructions and requirements of clients. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Executive Summary

This report presents recommendations to prioritize Tanzanian river basins for further hydro-economic analysis.

The work is part of a program undertaken by the 2030 Water Resources Group (2030 WRG), which formed a partnership with the Tanzanian government in October 2013 to inform and accelerate sustainable transformation in the water sector to support economic growth. The Minister of Water is the partnership's patron and the Permanent Secretary of the Prime Minister's Office is the chairperson.

This study follows on from the partnership's first assignment, which included a national overview of the magnitude and urgency of the country's water challenges, and a review of two river basins: the Wami Ruvu, which includes Dar es Salaam, the largest urban center in Tanzania, and the Rufiji river basin, the focus area of the government's Southern Agricultural Growth Corridor of Tanzania (SAGCOT) investment program. This report is available at www.203wrg.org.

Objectives

The analysis of Tanzania's river basins used the following high-level criteria:

- **Economic potential**, with a focus on new economic growth, better use of water, and illustrating and resolving issues in water-stressed regions.
- **Readiness and capacity of the basin water boards** to play an active role in future discussions and work on various programs as a result of the 2030 WRG's work.

These criteria were used to assess the contribution that basins make to the national economy and the risks to growth due to water stress. Basin water boards with sufficient capacity are more likely to implement water resource management interventions that effectively respond to challenges.

The initial outputs of the assessment were presented to various stakeholders at the 2030 WRG Tanzania Partnership's second workshop on February 19, 2014, in Dar es Salaam.

Results

The overall rankings and scores for each river basin's economic potential and its water board's readiness and capacity are shown in Table A.

The economic potential scores and rankings used indicators based on:

- A comprehensive list of areas and activities that could affect economic potential, including government policies, water resources, infrastructure, and economic sectors.

- Drivers of economic potential categorized as “human activities”, “private sector”, or “the environment”.

The results were assessed according to numerical scores and ranking, and in terms of sensitivity to the inclusion of indicators from different sectors (on a decling scale, with 1 representing the highest score).

The economic potential criterion has a conservative Business as Usual scenario, which is based on observed performance and gives equal weight to each indicator, and a Targeted Investment scenario, which includes future investment plans for key sectors, although these may not be achieved in practice.

In the Business as Usual scenario, the Wami Ruvu and Pangani basins score the highest, while the Lake Nyasa and Lake Rukwa basins are ranked first and second in the Targeted Investment scenario. Rufiji consistently remains in third place in both scenarios.

The scores for readiness and capacity were similar, and the highest-scoring three basins (Pangani, Lake Rukwa, and Lake Nyasa) also ranked in the top five basins with economic potential.

Table A: Overall rankings

Ranking			
	Economic potential		**Readiness and capacity (basin water boards)**
Scenario	***Business as Usual***	***Targeted Investment***	
Wami Ruvu	**1**	4	8
Pangani	**2**	5	1
Rufiji	**3**	3	7
Lake Rukwa	**4**	2	2
Lake Nyasa	**5**	1	3
Internal Drainage	**6**	7	5
Lake Victoria	**7**	8	6
Ruvuma	**8**	6	9
Lake Tanganyika	**9**	9	4

The analysis aims to guide the prioritization of basins for further hydro-economic analysis rather than, for example, selecting areas for private investment or institutional capacity building. It draws on current statistical information and forecasts reported in detailed studies. As such, it presents existing data, not an analysis that provides new evidence.

In using these results, it is important to note that:

- Indicators do not take the actual number of people affected into account because scores are on a per head or per area basis.
- Indicators show the relative ranking of basins and do not capture a national picture.
- Indicators that have data for all basins are preferred, which leads to under-representation of unique aspects for which no comparative statistics exist.

- The level of aggregation may obscure important details such as local environmental problems.

Recommendations

Based on the quantitative rankings and each river basin's strategic context, the report recommends the following five geographic areas for further hydro-economic analysis:

The Wami Ruvu basin, which is first in terms of Business as Usual economic potential, is located in the country's main industrial and commercial hub. The basin water board's lack of readiness and capacity is a concern given the area's population, economic activity, and strategic importance to the country.

The Pangani basin ranks second for economic potential in the Business as Usual scenario and first for its water board's readiness and capacity. The Pangani basin is important due to its significant irrigation and hydropower. It also has relatively good data and information on the hydrological situation. Strategically, it provides a small-scale glimpse of the potential issues that other parts of Tanzania may face (in terms of competition for water for different economic activities).

The Rufiji basin is third in terms of economic potential in both the Business as Usual and Targeted Investment scenarios. It has good sources of available water, but is also at risk of severe environmental problems in some catchments. The basin is likely to be substantially affected by the country's large-scale SAGCOT investment program. The Rufiji basin is important for developing and managing economic and environmental resources in Tanzania.

***Selected catchments draining into the western lakes (Lake Rukwa and Lake Nyasa)*.** Both basins are highly ranked for future investment, which is due in part to the local development of coal and thermal power generation in Mbeya. These developments are important to the country, and further hydro-economic analysis is needed.

Contents

Tables

1. Introduction

1.1 Overview

The 2030 WRG is a public-private civil society partnership that supports governments seeking to enhance sustainable water-resources management for long-term economic growth. The group aims to provide compelling water-resources analysis for politicians and business leaders, and support the establishment of multi-stakeholder partnerships to enhance collaboration across sectors and stakeholder groups. The objective is for this analysis and convening to provide the basis for the development of transformative interventions that benefit water resources, people, and the economy.

In October 2013, the Tanzanian government established the 2030 WRG Tanzania Partnership. The partnership supports, complements, and strengthens the government's existing efforts to:

- Provide a complete picture of water resources and economic information to help the government make and align policy decisions.
- Increase awareness, support, and momentum of water-resources management among political and business leaders and the water industry in Tanzania.
- Facilitate access to best practice, knowledge, experts, and technology from the 2030 WRG global network.
- Develop and prioritize new projects, programs and initiatives to strengthen the development and management of water resources in Tanzania.

The first 2030 WRG Tanzania Partnership meeting in December 2013 highlighted the need for water efficiency, water security and water-source protection, and cross-sectoral collaboration in Tanzania. These three themes form the basis for working groups established under the partnership. To guide initial partnership activities, it was further agreed to conduct a rapid assessment of the nine Tanzanian water basins and prioritize them for further in-depth hydro-economic analysis. This report is the result of the review.

1.2 Assignment criteria

The country's river basins were assessed using two criteria:

- **Economic potential**, with a focus on new economic growth, better use of water, and illustrating and resolving issues in water-stressed regions.
- **Readiness and capacity of the basin water boards** to play an active role in future discussions and work on various programs as a result of the 2030 WRG's work.

These criteria reflect the contribution that basins with higher economic potential make to the national economy, as well as the risks to growth caused by water stress. Basin water boards with sufficient capacity will be able to effectively respond to these risks and more effectively implement water-resource management interventions.

The outputs of this review and analysis were presented to a multi-stakeholder group at the 2030 WRG Tanzania Partnership's second workshop on February 19, 2014, in Dar es Salaam.

1.3 Approach

This report is based on an analysis of the characteristics of water basins and their water boards. The assessment of the first criterion (economic potential) used and built on the partnership's literature base and stakeholder inputs, supplemented by input from experts.

The assessment of the second criterion – the analysis of the basin water boards' readiness and capacity – used input from the boards themselves.

The assessments of the criteria are based on analysis of different factors and were independently conducted. Each is discussed separately, followed by a combined assessment to inform the report's recommendations.

1.4 Report structure

The following section (Section 2) looks at the river basins in terms of economic potential, focusing on how indicators were selected and how they were applied in the assessment. Section 3 explores the readiness and capacity of the basin water boards. Section 4 presents the report's conclusions and recommendations.

2. Economic Potential

2.1 Characterizing economic potential

Economic potential can be divided into three coexisting, non-mutually exclusive categories:

- *General economic potential*, as assessed in terms of health improvements in the population and higher labor productivity due to access to more good-quality water.
- *Sectoral potential*, as assessed in terms of the provision of water to individual sectors of the economy, particularly those for which water is an important and sometimes irreplaceable input (such as agriculture, mining, or food processing), through development and better use of water resources.
- *Potential for growth in the water-supply industry*, as assessed by, for example, the number of borehole drillers in the region. Such growth often accompanies public or private expenditure.

Sectoral potential and water-supply industry growth potential are almost always reflected in a region's general economic potential. This study focuses on sectoral potential because:

- Investment programs are often undertaken on a sectoral basis.
- Skills and markets are often specific to sectors.
- A sectoral approach is taken in the development and implementation of a Tanzanian national strategy.
- Current industrial thinking for Africa is focused on sectors (illustrated in the 2011 United Nations Industrial Development Organization report,[1] "Fostering Industrial Development in Africa in the New Global Environment").

The selected indicators should provide the best guidance for the future. Two sets of indicators are used to assess economic potential: the first set captures a scenario based on past performance (Business as Usual scenario), while the second set includes planned and expected investment (Targeted Investment scenario).

2.2 General considerations when selecting economic potential indicators

All ranking assessments require a breakdown of the high-level criteria so that they can be represented by specific indicators. It is also important that there is sufficient data for each indicator.

Choices are required between qualitative and quantitative indicators and the level of detail. For example, an indicator of “manufacturing performance” might be captured using measures of annual growth, volume of sales (quantitative measures), or a survey of business leaders (a qualitative measure).

Overall, the assessment should achieve the best balance between indicator selection, data availability, and the study’s high-level criteria.

Indicators should be sufficient to distinguish basins according to the overarching criteria. Because this is a geographical prioritization, the characteristics of the river-basin regions are important, including the current levels of economic activity, existing institutions, infrastructure, and natural endowments.

In summary, the set of indicators should:

- Match the high-level criteria
- Be limited to the minimum number needed to capture all relevant characteristics
- Distinguish between basins
- Be constructed using unambiguous underlying measures
- Be consistently derived for all basins
- Represent more than one characteristic when they have a similar structure across basins.

2.3 Identifying possible indicators

The list of possible indicators was developed according to water availability and use, as well as more general considerations of economic and environmental context. The list comprehensively covers the main factors that may influence economic potential (see Appendix A).

Of the indicators for **national and regional economy**, the most important is gross domestic product (GDP) – a measure of expenditure on goods and services.[1] It is used as an indicator because economic potential may be high where GDP is high. Observed GDP “proves” that public and private sector activity is possible, and can be used to compare the relative level of activity between two locations. Like other indicators of activity, it does not show whether current levels are close to thresholds that could constrain future growth. Detailed GDP statistics for the different business sectors are available nationally, but only partially at regional level, which limits their use for comparing river basins. Where available, statistics on the numbers of companies and the volumes of trade and investment can provide alternative indicators of current economic activity.

[1] GDP is the sum of value added by all domestic producers in the economy. It represents the monetary value of all goods and services produced within a country by economic activity during a specified period, usually a year, before providing for the consumption of fixed capital.

Plans specified in **government policies and initiatives** provide a forward-looking perspective of the types and locations of future benefits for society and the areas where current disadvantages might be corrected. Quantitative information in these plans and initiatives, such as expected levels of investment, can be used as indicators.

Infrastructure is critical for realizing economic potential. Major investment programs in Tanzania are focusing on roads and energy. Increased levels of infrastructure may lead to increased demand for water associated with higher standards of living and relocating populations.

Available and accessible **water resources** are important for realizing economic potential. An improved water supply for drinking and sanitation has significant benefits for society,[2] and water-resource availability and accessibility is important for economic activity in the agricultural, industrial, and commercial sectors. Economic potential may also be related to the level of particular water-resource assets, such as seasonal storage.

Energy availability is directly linked to economic potential, particularly for the manufacturing industry, the fastest-growing sector in Tanzania's economy. Hydropower is a dominant source of electricity generation in Tanzania and new thermal (gas-fired) plant require appreciable volumes of cooling water. Economic potential also lies in the development of small-scale hydropower.

In the **agriculture sector**, irrigation increases agricultural productivity, leading to higher economic returns for commercial farmers and smallholders. Economic potential in the sector is closely linked to agricultural development programs, which are a major driver of future growth in Tanzania. Agriculture plays a large role in the national economy and provides food security. The economic potential in the **food-processing sector** is affected by the availability and quality of agricultural inputs, which themselves depend on water availability, as well as the substantial water needed for processing activities such as washing.

New developments in the **construction sector** inevitably lead to greater long-term water demand, often in areas with existing constraints such as urban centers. In the short term, water shortages may affect the manufacture and supply of building materials such as concrete, which in turn affects property developers and their investment plans. Constrained construction development is also likely to have knock-on effects in other sectors. Similarly, expanding the **manufacturing and mining sectors** leads to increased water demand, both for production and due to increases in the number of people working at the site.

The **tourism sector**, which is closely linked to the natural environment, is a major contributor to the country's foreign-exchange earnings. The country's economic potential depends on preventing damage to natural sites and on maintaining an international reputation that continues to attract tourists.

Various **social factors** also affect economic potential, such as population density in the region and the workforce's level of skills and education.

2.4 Selecting indicators

The indicators were selected from the list above, taking into account the need for:

- Representation of economic potential at regional/basin level
- Specific drivers related to water resources and their use
- Data availability.

Two sets of indicators were developed, the first representing the Business as Usual scenario, based on current and historical statistics, and the second the Targeted Investment scenario, which includes new plans and expectations.

The indicators are grouped into the following categories: **human activity** (irrigation and roads), **economic sectors**, and **environment** (water availability is used as an indicator of the overall pressure on the environment due to water-related issues). A minimum number of indicators is used, recognizing that each indicator should capture a different aspect of the situation. For example, the difference between the demand for water and its availability (the water gap) represents a level of constraint that is important to both tourism and food processing.

2.4.1 Business as Usual scenario

The indicators selected for this scenario are as follows:

- **Current water use in agriculture** – Agriculture is the largest sector of the economy and enables activities in other sectors, such as food processing. The indicator selected is ***irrigation water volume per square kilometer in 2012***, which measures the intensity of agricultural practices (taken from a previous 2030 WRG Tanzania Partnership assignment).[3] River basins with a higher value for this indicator use more irrigation water and may be assumed to have higher productivity, indicating greater potential.

- **Current access to markets** – Roads provide a general measure of the level of infrastructure that is likely to correlate with time to market (affecting wastage rates). It also provides a measure of other transport infrastructure (road density is likely to be higher near airports and ports). The indicator selected is ***kilometers of road per square kilometer of land***, a measure of the relative density of the road network.[4]

- **Commercial agriculture** – The level of activity in the commercial farming sector indicates geographic areas and development, which fits into the strategy of “doing more of what you already do well”. Extending areas near current operations (a cluster approach) is already understood as a viable development method. The indicator (***number of commercial farms and agribusiness per square kilometer***) reflects the relative density of current commercial farming.[4]

- **Manufacturing and mining** – Manufacturing has achieved high, sustained growth over the past 10 years, with mining making up the greatest volume of exports by value. The current level of economic activity is shown by the volume of sales, and the indicator is ***gross industry output per person***.[5] Alternative value-added measures, such as gross value added, capture the difference between input costs and output sales. These measures might in theory provide a better representation of the net benefit within a region. However, such measures are more subject to interpretation in their construction and data for them is less widely available.

- **Pressure on water resources** – Pressure on water resources constrains economic potential. Basins with the greatest water availability are likely to have the greatest potential for growth. The indicator (***water gap 2012 million cubic meters per square kilometer***) was derived for each basin in the previous 2030 WRG Tanzania assignment,[3] and is based on the estimate of annual, reliable, and accessible renewable water resources after considering current demand.

2.4.2 Targeted investment scenario

This forward-looking scenario includes indicators with forecast values taken from the Tanzanian government's integrated water resource management development plans[6] and other sources. Differences between forecasts were taken to indicate a range of views. The forecasts were prepared before the Tanzania Partnership decided to undertake a prioritization exercise, so there was no risk of bias.

The indicators selected for this scenario are as follows:

- **Future water use in agriculture** – Agriculture is expected to remain a key sector based on current forecasts, which assume both increased irrigation and efficiency improvements. The net effects are represented in the integrated water resource management development plan forecasts, which use methods chosen by the respective consultants working on each river basin. The approaches taken in each plan are broadly similar, although some provide a greater level of resolution in terms of estimates of future crops and water efficiencies achieved. The projected increase in areas of irrigated agriculture due to key agricultural sector investments (including SAGCOT) were added to the plans' forecasts where not already included.[3,7] The indicator used is ***irrigation water volume per square kilometer in 2035***.

- **Future access to markets** – Information on future investments for road construction and improvement was obtained from Tanzania's Five Year Development Plan.[8] The total length of new road was added to that in the Business as Usual scenario for each basin to give an indicator of ***future kilometers of road per square kilometer of land***, which is a structural indicator of economic potential.

- **Commercial activity in agriculture** – The same indicator used in the Business as Usual scenario[4] provides a structural indicator of economic potential in agriculture (***number of commercial farms and agribusiness per square kilometer***). This indicator reflects, for example, the potential for agro-processing in addition to current farming.

- **Targeted investment in manufacturing** – The regional investment plan for manufacturing from the Five Year Development Plan[8] was applied to river basins using area mapping. The indicator is ***monetary value of investment in manufacturing per person.***

- **Targeted investment in mining** – This indicator (***monetary value of investment in mining per person***) uses the mining forecasts from the Five Year Development Plan relevant to the river basins.

- **Targeted investment in hydropower** – Based on information in the integrated water resource management plans, the latest Power System Master Plan[9] forecasts that an additional 21 megawatts (MW) of hydropower could potentially be added to the Pangani basin, and another 292MW of hydropower to the Ruvuma basin. The indicator is ***energy production per person***.

- **Targeted investment in agriculture** – This reflects the expected impact of investment under the SAGCOT program.[7] Other programs (including Feed the Future[10] and the Tanzania Bread Basket Transformation Project) are sufficiently minor in comparison that their inclusion would not affect the rankings. The indicator is ***monetary value of investment in agriculture, agro-processing, and supporting infrastructure per person***.

- **Pressure on water resources** – The same indicator for the Business as Usual scenario is used here, but for the year 2035 instead of 2012 (***water gap 2035 MCM per square kilometer***). This takes into account changes to total renewable water resources and demand. In particular, it includes additional water use for irrigation as a result of planned investment in the agricultural sector.[3,7]

2.4.3 Calculating total scores

Each indicator needs a numerical representation. Because each indicator has its own unit (for example, the roads indicator is measured in kilometers), it needs to be converted to a standardized representation, with the highest value indicating the greatest potential. The highest value for each type of indicator is set at 100 – this is known as the ***equal maximum method***.

As a refinement, indicators may be weighted. Indicators are intended to represent different, but equally important, aspects. For example, roads providing market access should be as important as new irrigation for crops. However, where indicators do not depend on each other (such as different types of business), those that are more important can be scaled up to contribute more “weight” to the total score.

A justification is required for a system of weighting related to the relative benefit from two activities, such as mining and agriculture. Here, alternative weightings are analyzed using test weights of zero, in effect excluding an indicator, to understand the robustness of the results.

The ***equal points method*** is an alternative to the equal maximum method. Under this method, the total points for each indicator are the same when summed across the basins. For example, three river basins might score 100, 99, and 0 for one indicator, and 100, 1, and 0 for a second indicator, giving total points of 199 for the first and 101 for the second. This means that the first indicator contributes more to the

overall score. The equal points method applies an adjustment so that each indicator has the same total points, which are then allocated between the basins. In the example, the three adjusted scores for the first indicator would be 0.502 (100/199), 0.497 (99/199), and 0, all scored out of 1. For the second, the adjusted scores would be 0.99 (100/101), 0.01 (1/101), and 0, also scored equally out of 1.

Although the equal points and equal maximum methods cannot be combined, a choice only needs to be made between them when they result in different rankings. They often agree closely in practice.

The equal points method is used to calculate the total scores for the final ranking because it is considered fairer due to its equal emphasis on each indicator. The equal maximum method is also referred to because it is easier for understanding the structure of individual indicators. This method gives each indicator the same highest value.

2.5 Economic potential results

The main results for the Business as Usual and Targeted Investment scenarios are shown in Tables 2.1 and 2.2 respectively.

Using the equal points method, Wami Ruvu, Pangani, Rufiji, Lake Nyasa, and Lake Rukwa are the highest-scoring basins in both scenarios. These top five basins are also ranked highest when the equal maximum method is used in the Targeted Investment scenario. However, when the equal maximum method us used in the Business as Usual scenario, Lake Nyasa drops off the list of top five basins and is replaced by the Internal Drainage basin. The rankings for each scenario are discussed in more detail in Sections 2.5.1 and 2.5.2.

When interpreting the results, it is important to note that:

- ***High scores are better than low scores*.** All measures are relative, with a high score indicating "better than other basins" rather than "good".
- ***All indicators are on a per person or per area basis*.** A basic measure (such as manufacturing output in Wami Ruvu) is divided by the population in the basin's area to create the indicator, because there is likely to be greater economic potential where a particular asset or resource occurs more abundantly per head or per hectare. A high score for an indicator in the Business as Usual scenario shows potential to improve on existing activities, while a high score in the Targeted Investment scenario indicates that more investment per person is expected to lead to greater potential.
- ***Equivalence in use of per person or per area figures*.** Although population density varies across Tanzania, the variation is small compared to the variation in the indicators. This means that there is no significant difference in expressing indicators in terms of "per person" or "per hectare".
- ***Indicators are selected independently for the two scenarios*** and have differences in definitions and data sources (for example, current manufacturing output in the Business as Usual

scenario uses a different data source compared to future manufacturing investment in the Targeted Investment scenario).

2.5.1 Business as Usual scenario results

Using the equal points method, the three highest-scoring basins are Wami Ruvu, Pangani, and Rufiji, followed by Lake Rukwa and Lake Nyasa in fourth and fifth place, respectively. The top four basins maintain their positions in the equal maximum method.

Table 2.1 Economic potential – Business as Usual scenario

	Human activity		Private sector		Environment	Total	Rank
Indicators	**Irrigation**	**Roads**	**Manufacturing and mining**	**Commercial farms**	**Water gap**		
Equal points method							
Wami Ruvu	2	9	8	2	3	**24**	***1***
Pangani	8	2	2	4	1	**17**	***2***
Rufiji	4	1	2	3	3	**13**	***3***
Lake Rukwa	4	1	1	1	2	**9**	***4***
Lake Nyasa	1	2	2	3	0	**8**	***5***
Internal Drainage	0	1	2	3	3	**9**	***6***
Lake Victoria	0	2	1	2	3	**8**	***7***
Ruvuma	1	1	1	2	2	**7**	***8***
Lake Tanganyika	0	1	1	0	3	**5**	***9***
Total	*20*	*20*	*20*	*20*	*20*	**100**	
Equal maximum method							
Wami Ruvu	1	6	6	2	5	**20**	***1***
Pangani	6	1	1	6	2	**15**	***2***
Rufiji	2	1	1	4	6	**14**	***3***
Internal Drainage	0	1	1	3	4	**10**	***4***
Lake Rukwa	3	1	1	1	4	**9**	***5***
Ruvuma	0	1	1	3	4	**9**	***6***
Lake Victoria	0	1	2	1	5	**9**	***7***
Lake Nyasa	1	1	2	4	0	**8**	***8***
Lake Tanganyika	0	1	0	0	5	**7**	***9***
Total	*13*	*14*	*15*	*24*	*35*	**100**	

An assessment of the results for this scenario reveals that:

- Wami Ruvu is highly ranked overall because it scored highest for the roads and manufacturing and mining indicators, with 9 and 8 points respectively using the equal points method. The basin also scored maximum points for the roads and manufacturing and mining indicators using the equal maximum method.

- Pangani is ranked second-highest overall due to high equal points scores for the irrigation and commercial farms indicators (8 and 4 points respectively). The importance of these indicators is evident when looking at the basin's equal maximum scores. The Pangani basin received maximum points (6/6) for both the irrigation and commercial farms indicators. It received a low score for the water gap indicator, indicating greater pressure on water resources compared to other basins.

- Rufiji has good equal points scores for the irrigation, commercial farms and water gap indicators. Using the equal maximum method, Rufiji has the least water pressure per person, although this aggregate measure does not account for issues in individual catchments, such as those arising in the Great Ruaha sub-basin.[2]

- While very close, the equal points method total scores for Lake Nyasa (9) and Lake Rukwa (8) reflect structural differences that are more evident in the equal maximum scores. Lake Rukwa has relatively high equal maximum scores (3/6 for irrigation and 4/6 for the water gap), compared to scores of 1/6 and 0/6 for Lake Nyasa. However, Lake Rukwa has relatively low scores (1/6 for both commercial farms and manufacturing and mining), whereas Lake Nyasa has higher scores of 2/6 (commercial farms) and 4/6 (manufacturing and mining).

- Basins with high total scores using the equal points method also score highly for individual indicators using the equal maximum method. The three highest scoring basins (Wami Ruvu, Pangani and Rufiji) have the highest individual equal maximum indicator scores.

- The scores are more evenly distributed for the water gap indicator, which means it makes less of a contribution to the difference in the river basins' total scores.

Sensitivities

The sensitivity of results is assessed by considering the level of changes in indicator scores that would result in a change in rankings. These changes best reflect sensitivities to uncertainty in the underlying data. The method of assessing sensitivity using an alternative set of indicators has not been used, largely because there is limited evidence of the drivers of economic potential, and a lack of available data for certain indicators.

The high total score for Wami Ruvu compared to the other basins makes its position relatively robust to changes in the underlying indicators. Only major changes in the roads and manufacturing indicators

[2] The Greater Ruaha is a sub-catchment of the Rujifi where the level of pressure on water resources is very high due to significant water intensive economic activity.

would result in a change in Wami Ruvu's ranking. Similarly, the scores for Pangani and Rufiji are sufficiently above those of the next group of basins that their positions are also strong.

Conversely, the total scores for the remaining five basins, except Lake Tanganyika, are similar. Small differences in scoring would change their ranking under the Business as Usual scenario. The order of these basins depends on uncertainty in datasets. Supplementary analysis (such as that provided in the following Targeted Investment scenario) should be used to confirm any prioritization of these basins.

2.5.2 Targeted investment scenario results

This scenario takes account of future investment in particular river basins. The analysis is based on the same indicators as the Business as Usual scenario in the human activity and environment categories, but uses their expected values for 2035. Additional indicators are used in the private sector category to reflect possible outcomes of known plans for specific sectors. The underlying assumption is that the existence of plans indicates economic potential, with the stated level of ambition indicating the quantitative impact in each basin. While trade-offs between sectors are likely in practice (for example, between hydropower and irrigation), the intention of this prioritization is to identify economic potential rather than predict how it will occur.

The Business as Usual and Targeted Investment scenarios have the same highest-ranking five river basins (using the equal points method). However, introducing the Targeted Investment scenario's new indicators shifted Lake Nyasa and Lake Rukwa to first and second place respectively, followed by Rufiji (which is third in both scenarios). Wami Ruvu and Pangani (formerly first and second) are ranked fourth and fifth respectively. The main reason for the change in ranking is the effect of the new investment programs on mining (particularly in Mchuchuma), hydropower, and agriculture on Lake Nyasa and Lake Rukwa. Wami Ruvu and Pangani remain in the top five due to their inherent advantages (roads and irrigation), rather than as a result of new investment programs.

The manufacturing and mining indicators are constructed differently in the two scenarios. In the Business as Usual scenario, they reflect current levels of output, while the Targeted Investment scenario reflects future investment identified in the Five Year Development Plan.[8] The plan does not include substantial investment programs for Wami Ruvu, despite it being an important area for manufacturing. Investment in Wami Ruvu is still expected, but it is not reported in the plan because it is likely to result from incremental investment by individual companies. This indicates how the two scenarios provide complementary perspectives on economic potential because they incorporate different current and future information.

Table 2.2 Economic potential – Targeted Investment scenario

	Human activity		Private sector					Environment	Total	Rank
	Irrigation	Roads	Commercial farms	Manufacturing investment	Mining investment	Hydropower investment	Agriculture investment	Water gap		
Equal points method										
Lake Nyasa	3	1	2	8	0	7	7	0	**28**	***1***
Lake Rukwa	3	1	1	0	10	0	2	1	**17**	***2***
Rufiji	2	1	2	0	0	4	3	1	**14**	***3***
Wami Ruvu	1	5	1	2	0	0	0	2	**11**	***4***
Pangani	2	1	3	0	0	0	0	1	**7**	***5***
Ruvuma	0	1	1	1	0	1	0	2	**7**	***6***
Internal Drainage	0	1	2	1	0	0	0	2	**6**	***7***
Lake Victoria	0	1	1	0	2	0	0	2	**5**	***8***
Lake Tanganyika	0	1	0	0	0	0	1	2	**4**	***9***
Total	*13*	*13*	*13*	*13*	*13*	*13*	*13*	*13*	**100**	
Equal maximum method										
Lake Nyasa	4	1	3	4	0	4	4	0	**21**	***1***
Rufiji	3	1	3	0	0	2	2	3	**14**	***2***
Lake Rukwa	4	1	1	0	4	0	1	3	**13**	***3***
Wami Ruvu	2	4	2	1	0	0	0	3	**12**	***4***
Pangani	3	1	4	0	0	0	0	2	**11**	***5***
Ruvuma	0	1	2	1	0	1	0	4	**9**	***6***
Internal Drainage	1	1	2	0	0	0	0	4	**8**	***7***
Lake Victoria	0	1	1	0	1	0	0	4	**7**	***8***
Lake Tanganyika	1	1	0	0	0	0	0	4	**6**	***9***
Total	*17*	*10*	*19*	*7*	*5*	*7*	*7*	*27*	***100***	

Totals may not always add due to rounding.

An assessment of the results for this scenario reveals that:

- Lake Nyasa scores highly for agriculture, hydropower, and manufacturing investments. Rufiji has the second-highest equal points score for agriculture investment, while five other basins scored zero in this category because they are outside the area of expected investment. The scores for hydropower investment, which is affected by the suitability of each basin's topology, are similar, with Lake Nyasa and Rufiji ranked the highest.

- Lake Rukwa has the greatest potential for mining investment (10), while the other basins do not receive any points in this category, except the Lake Victoria basin, with a low score of 2 points.

- Lake Nyasa and Lake Rukwa have higher scores for irrigation in comparison to the Business as Usual case. The Rufiji basin has an equal points score of 2, which, given that it is the largest basin, highlights the large scale of the agricultural investment program planned, because this indicator is based on irrigation volume per square kilometer.

- The Rufiji basin scores highly for hydropower and agriculture investments.

- Five of the nine basins have the same equal maximum score for the water gap indicator, which is expressed per area of catchment and implies (in simple terms) that they are equally pressured. As in the Business as Usual scenario, Lake Nyasa and Lake Rukwa have low scores for this indicator.

Sensitivities

The sectoral indicators can be refined within this model without changing their overall structure. In the Targeted Investment scenario, the national plans for sectors refined the sectoral descriptions using planning data not applicable in the Business as Usual scenario. The sensitivity analysis here focuses on assessing the impact of the relative contributions of these sectoral indicators, while keeping other structural elements, such as the water gap and roads, the same. The sensitivities are shown in Table 2.3.

Table 2.3 Sensitivities in the Targeted Investment scenario

Sensitivity	**Base**		**Targeted Investment 1**		**Targeted Investment 2**		**Targeted Investment 3**		**Targeted Investment 4**	
Equal points method	**Total**	**Rank**	**Total**	**Rank**	**Total**	**Rank**	**Total**	**Rank**	**Total**	**Rank**
Lake Nyasa	28	**1**	32	**1**	22	**1**	30	**1**	28	**1**
Lake Rukwa	17	**2**	8	**5**	8	**7**	19	**2**	17	**2**
Rufiji	14	**3**	16	**2**	11	**4**	14	**3**	14	**3**
Wami Ruvu	12	**4**	13	**3**	18	**2**	12	**4**	11	**4**
Pangani	7	**5**	8	**4**	12	**3**	5	**6**	7	**5**
Ruvuma	7	**6**	8	**6**	9	**5**	6	**5**	7	**6**
Internal Drainage	5	**7**	6	**7**	9	**6**	4	**8**	6	**7**
Lake Victoria	5	**8**	4	**9**	6	**8**	5	**7**	5	**8**
Lake Tanganyika	4	**9**	*5*	**8**	*5*	**9**	*4*	**9**	*4*	**9**
	100		*100*		*100*		*100*		*100*	

Sensitivity	Base		Targeted Investment 1		Targeted Investment 2		Targeted Investment 3		Targeted Investment 4	
Equal maximum method	**Total**	**Rank**	**Total**	**Rank**	**Total**	**Rank**	**Total**	**Rank**	**Total**	**Rank**
Lake Nyasa	20	**1**	21	**1**	15	**1**	21	**1**	21	**1**
Lake Rukwa	13	**3**	9	**5**	10	**5**	15	**2**	13	**3**
Rufiji	15	**2**	15	**2**	13	**4**	14	**3**	14	**2**
Wami Ruvu	12	**4**	13	**3**	15	**2**	13	**4**	12	**4**
Pangani	11	**5**	11	**4**	13	**3**	8	**5**	11	**5**
Ruvuma	8	**6**	9	**6**	10	**7**	8	**6**	9	**6**
Internal Drainage	8	**7**	8	**7**	10	**6**	7	**9**	8	**7**
Lake Victoria	7	**8**	6	**9**	7	**8**	7	**8**	7	**8**
Lake Tanganyika	6	**9**	*6*	**8**	*7*	**9**	*7*	**7**	*6*	**9**
	100		100		100		100		100	

The first Targeted Investment sensitivity shows the effect of removing the mining sector indicator (in other words, setting the weight for mining to zero). Lake Rukwa falls from second to fifth place and Lake Victoria moves one rank lower, with all other basins remaining in their existing order.

The second sensitivity shows the effect of removing hydropower and agriculture investment, in addition to mining. This does not change things significantly – only Lake Rukwa falls slightly down the rankings (from fifth to seventh using the equal points method). The highest-scoring four basins remain the same as in the first sensitivity, although Rufiji falls from second to fourth place due to the loss of agriculture investment. Lake Nyasa remains in first place due to the high level of manufacturing investment and the expected increase in irrigation (both measured per person).

The third sensitivity shows the effect of removing the commercial farms indicator. While planned levels of mining, hydropower, and agriculture investment indicate the possible effects of future sectoral investment programs, the number of commercial farms indicates the overall suitability of the basin for private agriculture. Its removal has a minimal impact on the rankings. The highest scoring four basins remain the same as in the Targeted Investment base, with Rufiji and Lake Rukwa exchanging second and third place under the equal maximum method.

The fourth sensitivity addresses uncertainty in the water gap forecasts. It uses an alternative and higher estimate of environmental flows. Although the gap is 21 percent greater in total, it has little effect on the basins' rankings.

3. Readiness and Capacity of the Basin Water Boards

3.1 Context

The study's second objective is to assess whether basin water boards have the readiness and capacity to support their basin's economic potential by developing and implementing programs, including those of the 2030 WRG.

The National Water Sector Development Strategy (2006)[11] and the Water Resources Management Act (2009) established a new institutional framework for water resources, based on autonomous basin-level organizations. The Ministry of Water has the overarching role of coordination, policy and guideline formulation, and regulation. The ministry delegates responsibilities to the National Water Board, the basin water boards, catchment water committees, sub-catchment water committees, and water-user associations.

Along with the Ministry of Water, the basin water boards and water offices are key actors in the 2030 WRG's programs. The readiness and capacity of the boards has been assessed using qualitative and quantitative indicators that reflect their main functions and responsibilities. The basin water boards' responsibilities, as defined in the National Water Sector Development Strategy, are summarized in Table 3.1.

Table 3.1 Functions and responsibilities of basin water boards

Function	Responsibility
Monitoring	Collect, process, and analyze data for water resource monitoring and assessment
Planning	Coordinate and approve basin water resource management planning/budgets Cooperate between sectors at the local level Coordinate stakeholders Integrate district plans into water resource management plans Coordinate technical aspects of trans-boundary issues in the basin
Licensing and enforcement	Approve and revoke water-use and discharge permits Enforce water-use permits and pollution control measures Resolve conflicts between water users

Source: National Water Sector Development Strategy (2006)11

3.2 Assessment

3.2.1 Scoping potential measures

An initial set of measures was developed to indicate the readiness and capacity of basin water boards. These measures covered past and current performance, and were informed by considerations of consistency in scoring between boards.

3.2.2 Refining measures and developing questionnaires

Following the scoping phase, the list of measures was used to develop a template of key information required from each basin water board. Because the boards' water offices generally had the relevant information, the 2030 WRG assignment team developed a questionnaire for staff at the basin water offices. Face-to-face meetings with each board were preferred, but were not practical given the timescale of the assignment, resources, and location of each office. The Ministry of Water therefore sent the questionnaires by email to each board. A copy of the questionnaire is provided in Appendix B.

3.2.3 Reviewing questionnaire responses and selecting final indicators

Overall, the basin water boards responded well to the questionnaires and the assignment team's follow-up phone calls. A compilation of the completed questionnaires is provided in Appendix C. The data from the questionnaires was used to derive indicators, which are presented in Table 3.2.

Table 3.2 Final indicators for basin water board readiness and capacity

Function	Indicator	Description
Institutional capacity	1. Experience	The length of time since the board's establishment.
	2. Staffing levels	Staffing level (filled and vacant posts).
	3. Equipment status	The board's equipment.
	4. Institutional connectivity	Whether the number of institutional structures reporting to the board meets the target. For example, are there sufficient sub-catchment committees and water-user associations in existence?
Monitoring	5. Monitoring stations	The number of active monitoring stations for flow, water quality, and weather variables, and whether the monitoring data is being analyzed.
	6. Frequency of monitoring	The frequency of monitoring data collected at operational stations for flow, water quality, and weather variables.
	7. Accessibility	The presence of airport, railway, and road infrastructure, with a score of 1 assigned to each.
Planning	8. Monitoring and evaluation plan	The existence of a monitoring and evaluation plan.
	9. Business plan and implementation	The existence of a business plan, its key targets, and the extent to which it is being implemented.
	10. Integrated water resource management development plan	Whether an integrated water resource management development plan is being developed.
Licensing and enforcement	11. Efficiency in resource mobilization	The degree to which revenue from water-use fees meets targets.
	12. Conflict resolution	The number of water-use conflicts resolved against those reported in each basin.
	13. Permits issued	The number of water-use and discharge permits that have been issued per person since the Water Sector Development Program was implemented.

Data missing from the questionnaire was taken from the 2013 Water Sector Status Report.[12]

3.2.4 Indicator scoring, normalizing, and weighting

The method used to derive indicators from the questionnaire responses and follow-up questions is set out in Appendix D. Each indicator was normalized by expressing it as a proportion of the basin water board with the maximum score. It was then weighted and summed to produce a total score.

Four sets of indicator weightings were used. The first assumed an equal weight for all indicators and the next three reflected the professional judgment of the assignment team and two additional Tanzanian water-resource professionals. The different weightings' effect on the total score for each basin water board was explored through sensitivity analysis, which showed that while the total scores for each board changed based on the different weighting set used, the change in ranking between basin water boards was minimal. As a result, an equal weighting for the 13 indicators is used to present the boards' scores. The total score for each basin water board was calculated by summing the 13 normalized and equal weighted indicator scores.

3.3 Readiness and capacity results

The final results for each basin water board are shown in Table 3.3, followed by a review based on each indicator and each board.

Table 3.3 Readiness and capacity of basin water boards

Criteria	Indicator	Pangani	Wami Ruvu	Rufiji	Ruvuma	Lake Nyasa	Lake Rukwa	Lake Tanganyika	Lake Victoria	Internal drainage
Institutional capacity	Experience (years in operation)	7.7	4.0	7.0	3.3	4.0	3.3	3.0	4.7	3.3
	Staffing levels	6.0	7.7	4.0	5.9	4.0	3.8	3.6	5.6	4.5
	Equipment status	5.1	5.1	5.1	5.1	5.1	7.7	5.1	5.1	5.1
	Institutional connectivity	5.2	4.9	7.7	4.4	4.4	4.8	7.3	4.1	7.5
Monitoring	Monitoring stations	6.8	6.0	6.0	5.4	7.7	7.0	7.7	7.4	5.5
	Frequency of monitoring	7.7	4.5	6.7	2.9	7.7	7.7	5.8	6.3	7.7
	Accessibility	5.1	7.7	6.4	5.1	2.6	7.7	6.4	7.7	2.6
Planning	Monitoring and evaluation plan	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Business plan and implementation	7.4	4.4	5.2	7.4	6.7	7.7	7.4	3.7	7.4
	Integrated water resource management development plan	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
Licensing and enforcement	Efficiency in resource mobilization	7.1	3.5	0.0	2.3	4.9	2.6	7.7	5.9	7.5
	Conflict resolution	3.6	7.7	7.7	5.8	7.7	7.7	7.7	7.7	7.7
	Permits issued	1.1	2.0	2.4	4.4	7.7	3.2	0.4	1.3	1.4
Total		78.3	65.2	65.9	59.9	70.1	70.9	69.7	67.1	68.0
Rank		1	8	7	9	3	2	4	6	5

3.3.1 Review by indicator

Institutional capacity

- **Experience.** The Pangani and Rufiji boards are the oldest, at 23 and 21 years respectively, and were established prior to the new institutional framework.[11] The remaining boards have been in existence for between nine and 14 years.

- **Staffing levels.** The Wami Ruvu board has exceeded its staff complement target, while the Pangani, Ruvuma, and Lake Victoria boards are all slightly under-resourced, with an average of between 77 percent and 83 percent of posts filled. The remaining basins are all under-resourced, with fewer than 63 percent of posts filled. More than half of Lake Tanganyika's board posts are vacant.

- **Equipment status.** The boards reported little difference between their equipment. The Lake Rukwa board has all its required equipment, while the other boards reported that they needed some additional equipment.

- **Institutional connectivity.** Rufiji and Lake Victoria were the only basin water boards with sub-catchment committees, although the number of committees was below target. Lake Tanganyika exceeded its targeted number of water-user associations for 2014, while the Pangani, Rufiji, and Wami Ruvu basin water boards had 80 percent or more of their targeted number of associations. The other basins had between 50 percent and 75 percent of their targeted number.

Monitoring

- **Monitoring stations.** Lake Tanganyika and Lake Nyasa are the only boards with the targeted number of sites for monitoring flow, water quality, and weather variables in operation. On average, 94 percent of the monitoring stations in the Lake Victoria and Ruvuma basins are operational. The boards in the Lake Rukwa, Pangani, Rufiji, and Internal Drainage basins were monitoring at an average of 88 percent, 84 percent, 71 percent, and 63 percent of the targeted stations respectively. All boards were analyzing the monitoring data with the exception of Wami Ruvu and Ruvuma.

- **Frequency of monitoring.** Internal Drainage, Pangani, Lake Rukwa, and Lake Nyasa all achieved their monitoring frequency targets, while Wami Ruvu and Ruvuma only met 50 percent of their frequency targets.

- **Accessibility.** This indicator provides a measure of the ease of basin water board communication, both internally and externally, using transport infrastructure. Wami Ruvu, Lake Rukwa, Lake Tanganyika, and Lake Victoria boards all achieved high scores due to the presence of airport, railway, and road networks. Lake Nyasa and the Internal Drainage basins have the lowest scores because there is no airport or railway infrastructure nearby.

Planning

- **Monitoring and evaluation plan.** Pangani is the only basin water board with a monitoring and evaluation plan in place.

- **Business plan and implementation.** All the boards have business plans, although none have been fully implemented due to lack of finances and resource constraints. Lake Rukwa's board reports the greatest progress in implementation, while the Pangani, Ruvuma, Lake Tanganyika, and Internal Drainage boards have achieved about 50 percent implementation. The Lake Victoria board has not started to implement its business plan.

- **Integrated water resource management development plan.** All basins are actively involved in developing their integrated water resource management development plans and, although some were at a more advanced stage than others, all basins achieved the same score.

Licensing and enforcement

- **Efficiency in resource mobilization.** The Pangani, Lake Tanganyika, and Internal Drainage boards have exceeded their revenue-collection targets for water-use related fees. Lake Rukwa and Ruvuma scored the lowest, at 50 percent below target. The Rufiji board did not report actual revenue fees, so it failed to score.

- **Conflict resolution.** All the basin water boards achieved the maximum score for water-use conflict resolution with the exception of Ruvuma and Pangani.

- **Permits issued.** Relative to their population sizes, Lake Nyasa, Ruvuma, and Lake Rukwa issued the greatest number of permits for water use and effluent discharge, while Lake Tanganyika and Pangani issued the least.

3.3.2 Review per basin water board

The boards can be broadly classified into five groups based on the total scores shown in Table 3.3. The Pangani board has the highest score (group 1), followed by Lake Rukwa, Lake Nyasa, and Lake Tanganyika (group 2), which have similar scores that are on average 10 percent lower than Pangani's score. The Internal Drainage and Lake Victoria boards are in group 3, followed by Rufiji and Wami Ruvu in group 4. The Ruvuma board (group 5) has a score 24 percent lower than Pangani.

An assessment of the basin water boards' results, in order of overall ranking, reveals that:

- The Pangani board has the highest scores for its experience, and its monitoring and evaluation plan. It also has joint highest score for its frequency of monitoring data, the second-highest score for staffing levels, and joint second-highest for its equipment and business plan implementation. Pangani's lowest scores are for conflict resolution and permits issued.

- The Lake Rukwa board has the highest score for business-plan implementation and is joint highest for equipment, frequency of monitoring, accessibility, and conflict resolution. Its lowest score is for staffing levels, where it ranked eighth out of the nine boards.

- The Lake Nyasa board, which has an overall score only 1 percent lower than Lake Rukwa, has the highest score for permits issued and the joint highest scores for monitoring stations, frequency of monitoring, and conflict resolution. Its two lowest scores are for institutional connectivity and accessibility.

- The Lake Tanganyika board has the highest score for efficiency in resource mobilization and joint highest scores for monitoring stations and conflict resolution.

- The Internal Drainage board has joint highest scores for frequency in monitoring and conflict resolution. It has joint second-highest scores for equipment, institutional connectivity, and business-plan implementation. Its lowest score is for accessibility.

- The Lake Victoria board has joint highest scores for accessibility and conflict resolution. Of all the basin water boards, it has the lowest scores for institutional connectivity and business-plan implementation.

- The Rufiji board has the highest score for institutional connectivity, but it has the lowest score for efficiency in resource mobilization because no data was available for this indicator.

- The Wami Ruvu board has a score 17 percent lower than that of Pangani. It has the highest score for staffing levels and the joint highest scores for accessibility and efficiency in resource mobilization.

- The Ruvuma board has joint second-highest score for permits issued and business-plan implementation. It has the lowest scores for monitoring frequency and monitoring stations.

4. Conclusions and Recommendations

The overall rankings and scores for each river basin's economic potential and its basin water board's readiness and capacity are shown in Table 4.1.

Table 4.1 Overall rankings and scores

Rankings					
	Economic potential				**Readiness and capacity (basin water boards)**
Scenario	***Business as Usual (equal points)***	***Business as Usual (equal maximum)***	***Targeted Investment (equal points)***	***Targeted Investment (equal maximum)***	
Wami Ruvu	1	1	4	4	8
Pangani	2	2	5	5	1
Rufiji	3	3	3	2	7
Lake Rukwa	4	5	2	3	2
Lake Nyasa	5	8	1	1	3
Internal Drainage	6	4	7	7	5
Lake Victoria	7	7	8	8	6
Ruvuma	8	6	6	6	9
Lake Tanganyika	9	9	9	9	4
Scores					
	Economic potential				**Readiness and capacity (basin water boards)**
Scenario	***Business as Usual (equal points)***	***Business as Usual (equal maximum)***	***Targeted Investment (equal points)***	***Targeted Investment (equal maximum)***	
Wami Ruvu	24	20	11	12	11
Pangani	17	15	7	11	13
Rufiji	13	14	14	14	11
Lake Rukwa	9	9	17	13	12
Lake Nyasa	8	8	28	21	11
Internal Drainage	8	10	6	8	11
Lake Victoria	8	9	5	7	11
Ruvuma	8	9	7	9	10
Lake Tanganyika	5	7	4	6	11
	100	*100*	*100*	*100*	*100*

The scores and rankings for economic potential are shown in Table 4.1 based on two scenarios (Business as Usual and Targeted Investment) and using two methods of ranking (equal points and equal maximum). The two methods are independent and cannot be meaningfully aggregated.

If a single result is required, the Business as Usual scenario using the equal points method is recommended because it is based on observed performance and gives equal weight to each indicator. The Targeted Investment scenario using the equal points method is a good alternative because it includes future investment plans for key sectors, although these may not be achieved in practice.

Across the four scenarios and methods, there are five basins consistently showing good economic potential. Of these, the Rufiji basin is the most consistently placed, ranking third or second.

The Wami Ruvu and Pangani basins are highest scoring in the Business as Usual scenario, which is based on current economic activities, while Lake Nyasa and Lake Rukwa are highest scoring in the Targeted Investment scenario, which includes future investment plans.

The readiness and capacity scores are close for all basins, but the highest-scoring three basins (Pangani, Lake Rukwa, and Lake Nyasa) are also among the top five basins with the greatest economic potential. The Internal Drainage and Lake Tanganyika basins are ranked fourth and fifth, and the Rufiji, Wami Ruvu, and Ruvuma basins are in the lowest three positions.

The analysis aims to guide the prioritization of basins for further hydro-economic analysis rather than, for example, selecting areas for private investment or institutional capacity building. It draws on current statistical information and forecasts reported in detailed studies. As such, it presents existing data, not an analysis that provides new evidence.

In using these results, it is also important to note that:

- Indicators do not take account of the actual number of people affected because scores are on a per head or per area basis.
- Indicators show the relative ranking of basins and do not capture a national picture.
- Indicators that have data for all basins are preferred, which leads to under-representation of aspects for which no comparative statistics exist, such as those unique to a single basin.
- The level of aggregation required may obscure important details such as local environmental problems.

Recommendations

Based on the quantitative ranking and each river basin's strategic context, the report recommends the following five geographic areas for further hydro-economic analysis:

The Wami Ruvu basin, which is first in terms of Business as Usual economic potential, is located in the country's main industrial and commercial hub. The basin water board's lack of readiness and capacity is

a concern given the area's concentration of population and economic activity, and its strategic importance to the country.

The Pangani basin ranks second for economic potential in the Business as Usual scenario and first for its water board's readiness and capacity. The Pangani basin is important due to its significant irrigation and hydropower. It also has relatively good records of the water regime. Strategically, it provides a small-scale glimpse of the potential issues that other parts of Tanzania may face.

The Rufiji basin is third in terms of economic potential in both the Business as Usual and Targeted Investment scenarios. It has good sources of available water, but it is also at risk of severe environmental problems in some catchments. The basin is likely to be substantially affected by the country's large-scale SAGCOT investment program. The Rufiji basin is of major importance to the management and development of economic and environmental resources in Tanzania.

Selected catchments draining into the western lakes (Lake Rukwa and Lake Nyasa). Both basins are ranked highly for future investment, which is due in part to the local development of coal and thermal power generation in Mbeya. These developments are important to the country, and further hydro-economic analysis is needed on these catchments according to the estimated scale of impact.

Appendix A: Categorization of Indicators of Economic Potential

POSSIBLE INDICATORS		
Type	**Indicator**	**Variants**
National and regional economy		
	GDP	GDP GDP (growth) GDP (projected) GDP (projected growth) Sectoral GDP Sectoral GDP (growth) Sectoral GDP (projected) Sectoral GDP (projected growth)
	Number of private companies	Turnover Number Rate of net company formation
	International trade	Value/volume per year
	Foreign direct investment	Regional grants per year
Policies/government initiatives		
	National/regional programs	Number applicable to the region Net GDP increase delivered by plan Expected value Number of people affected by plans
Infrastructure		
	Roads	All/trunk/regional road density/area All/trunk/regional road density/capita Time between ports/markets
	Airports	Number of airports Volume – number of passengers Volume – tonnes
	Rail	Length of rail
	Ports	Volume – number of passengers Volume – tonnes
	Markets	Number of markets Traded volumes/value
Water resources		
	Availability of water	Gap between demand and supply Indicators of water shortages in the basin Water conflicts
	Basin research	Number of studies/expenditure
	Water storage facilities	Number/size of seasonal storage facilities Number of mini dams (locally built by people) Number of mini dams (commercial) Number of water tanks sold
Domestic water supply and water supply networks		

	Urban/rural coverage	% coverage % of days water available Pipeline length replaced
Energy		
	Production of electric power	Existence of power generation plant Energy generated Hydro-electric power/energy
	Use of electric power	Consumption of electricity from grid Consumption of electricity from private generators Access to electricity transmission network density
Agriculture sector		
		Area of arable land farmed Area of horticultural crops Areas of cash crops Area of large scale commercial farming Area of smallholder farming Area of irrigated land Area of irrigated land (large-scale commercial farming) Area of irrigated land (smallholder farming) Livestock numbers Area of high potential irrigation land Area of medium potential irrigation land Area of low potential irrigation land Area of arable land unfarmed (need to ensure that accessibility is factored in)
Food-processing sector		
		Sectoral GDP/gross value added/number companies
Construction sector		
		Sectoral GDP/ gross value added /number companies New water needs from developments
Manufacturing sector		
	Size/presence of industry	Sectoral GDP/ gross value added /number companies
Mining sector		
		Sectoral GDP/ gross value added /number companies Water demand by type of mine/deposit
Tourism sector		
		Sectoral GDP Number of beach resorts/hotels Area of national parks in the basin
Social factors		
	Population Social deprivation and health Human and skills development	Number/workforce Health statistics Social indicators

Appendix B: Questionnaire for Basin Water Boards

Date of interview: ……. Name of interviewee: ……..…….

Title of interviewee: …….. Name of institution: ……...

Name of interviewer: ……

Focus area: Basin institutional capacity

1. When is the official date/year of establishment? .....
2. What is your institutional structure?
   a. Within the office ……..

      ……
   b. Hierarchically (beyond the office) ...…….....

      ……..……..
   c. How many Catchment Water Committees and water-user associations are there in your basin?

      .....
   d. What is your target ……..…and target horizon……

Focus area: Total resource and skills (staff and equipment)

1. What are the staff capacity needs for your office/institution?
   a. Existing number of professional staff …….. Needs …….
   b. Existing number of technicians ……..... Needs …….
   c. Existing number of support staff …….. Needs ……
   d. What are the training needs ……..……
   e. What is the staff turnover (in average of the past 3–5 years) ...……..
   f. What key trainings have you received so far (as an office)…….
   g. How does the office support these trainings (full or partial payments or granting

      official leave without deductions)? ……

……

h. The level of water management expertise within the basin that could be harnessed (even if not in the water board, for example, from the private sector or NGOs) ……

……

2. What are the equipment needs?
   a. On a scale of (i) – (iv), what would you consider your equipment status to be?

      (i) No equipment (ii) Some equipment (iii) Enough equipment (iv) All equipment
   b. Which area has the greatest gap in equipment needs ……....

      And how does it affect your work (give example) ……..
3. Is a capacity needs assessment carried out? (Y/N) …….
   a. How is it implemented ……..……
   b. Can you share any documentation on this? ……

Focus area: Implementation of ongoing activities

1. Do you have a business plan in place? (Y/N) ……. (Can the document be shared?)
2. What are the main targets in the business plan? ……..
3. What is the actual implementation vs the plan? ……

   ……
4. What has been funding planned vs fund received? ……

   ……

Focus area: Enforcement of own mandates

Permit system

1. Number of water permits issued since establishment of the office
   a. Water-use permits ……...
   b. Effluent discharge permits …….

c. Drilling permits …….

2. Number issued in the past 2–3 years

   a. Water-use permits ……...

   b. Effluent discharge permits …….

   c. Drilling permits …….

3. What is your “best guess” in terms of actual requests, granting, and illegal uses (indicative percentage) ……. (If there is any assessment, please share documents)

4. List any factor contributing to number 3 above …….

   ……...…….

Conflict resolution

1. Number of cases (conflicts, illegal use, etc.) pursued ……..

2. Number of successfully prosecuted ……

3. Do the incidences decrease or increase? ……..

4. What contributes to the existence of such cases? ……..

   ……...……

Focus area: Monitoring and evaluation

1. Do you have a monitoring and evaluation plan/strategy? (Y/N) …. (Can it be shared?)

2. How many monitoring stations do you have? ……

   a. Flow …….. What is the requirement/your target ……

   b. Weather ……. What is the requirement/your target ……..

   c. Water quality ……..What is the requirement/your target ……..

   d. Any analysis carried out? ……..

3. How often do you collect this data? …….

   a. Flow …….. What is the requirement/your target ……

   b. Weather ……. What is the requirement/your target ……..

c. Water quality ……..What is the requirement/your target ……..

d. Any analysis carried out? ……..

4. What is the impact of establishments of Water Resource Management institutions (especially at grass-root level)

   a. On water flows or water sources rejuvenation (give examples) ……

      ……..…….

   b. On water-use fee collection (give examples) …….

5. Targeted revenue collection ……vs actual collection ……..

   a. What are the sources of funds? ……..….

   b. How old or when were these sources of funds established? ……..

Interviewee consent

Name: ……. Title: ……

Signature: ……..……. Date: ……

Appendix C: Compilation of Questionnaire Responses

Criteria	Category	Pangani	Wami Ruvu	Rufiji	Ruvuma	Lake Nyasa	Lake Rukwa	Lake Tanganyika	Lake Victoria	Internal Drainage
Experience of the basin water board (age)		1.000	0.522	0.913	0.435	0.522	0.435	0.391	0.609	0.435
Ratio of existing staff	Professional	0.686	0.607	0.550	0.655	0.800	0.587	0.480	1.000	0.471
	Technicians	0.503	1.000	0.313	0.760	0.123	0.484	0.253	0.426	0.412
	Support	1.000	0.909	0.547	0.429	0.597	0.022	0.563	0.414	0.742
	Average	0.783	1.000	0.518	0.773	0.526	0.499	0.462	0.725	0.587
Equipment status		0.667	0.667	0.667	0.667	0.667	1.000	0.667	0.667	0.667
Institutional connectivity		0.679	0.638	1.000	0.576	0.567	0.620	0.944	0.531	0.974
Efficiency in resource mobilization		0.922	0.453	0.000	0.300	0.633	0.338	1.000	0.767	0.976
Accessibility	Road	1.000	1.000	1.000	1.000	1.000	1.000	0.500	1.000	1.000
	Rail	0.000	1.000	1.000	0.000	0.000	1.000	1.000	1.000	0.000
	Air	1.000	1.000	0.500	1.000	0.000	1.000	1.000	1.000	0.000
	Average	0.667	1.000	0.833	0.667	0.333	1.000	0.833	1.000	0.333
Business plan and implementation	Presence	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Efficiency in implementation	0.926	0.171	0.370	0.926	0.741	1.000	0.926	0.000	0.926
	Average	0.962	0.569	0.673	0.962	0.865	1.000	0.962	0.481	0.962
Existence of monitoring and evaluation plan		1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ratio of existing monitoring stations										
Flow		0.864	0.586	0.820	1.000	0.864	0.830	0.864	0.762	0.568
Weather		0.765	0.455	0.600	0.667	1.000	0.667	1.000	0.947	0.727
Water quality		0.750	1.000	0.585	1.000	1.000	1.000	1.000	1.000	0.500
Any analysis carried out on the data acquired		1.000	0.000	1.000	0.000	1.000	1.000	1.000	1.000	1.000
Average		0.879	0.783	0.784	0.706	1.000	0.907	1.000	0.957	0.721
Efficiency in monitoring data collection										
Flow		1.000	1.000	0.167	0.500	1.000	1.000	0.500	1.000	1.000
Weather		1.000	0.500	0.333	0.500	1.000	1.000	1.000	1.000	1.000
Water quality		1.000	0.000	0.500	0.500	1.000	1.000	0.500	0.250	1.000
Any analysis		1.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000
Average		1.000	0.375	0.250	0.375	1.000	1.000	0.750	0.813	1.000
Integrated water resource management development plan in preparation		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Conflict resolution		0.474	1.000	1.000	0.750	1.000	1.000	1.000	1.000	1.000
Permits/population		0.145	0.255	0.309	0.574	1.000	0.419	0.048	0.174	0.187

Appendix D: Specification of Indicators for Basin Water Board Assessment

Institutional capacity	1. Experience of the Basin Water Board	The length of time since establishment of the Basin Water Board (years)
	2. Staffing levels	Staffing level distinguishing filled and vacant posts. The average of the ratio of posts with staff in post to target number of positions for three grades of staff: professional, technicans and support.
	3. Equipment status	The equipment needs of the Basin Water Board. No requirements =3, some requirements = 2, significant requirements = 1.
	4. Institutional connectivity	Whether the institutional structures below the Basin Water Boards are in operation e.g. were sub catchment committees and water user associations in existence against the targets set. Maximum score is 3. Water usr association in existence = 1. Ratio of number of water user associations in formation to target number of water user associations by 2014 in Water Sector Status Report. Sub catchment committee in formation = 1.
Monitoring	5. Monitoring stations	Average score from: the number of monitoring stations in operation against target for flow, water quality and weather variables and whether the monitoring data was being analysed.
	6. Frequency of monitoring	The average score: the ratio of the frequency of monitoring data being collected at operational stations against target for flow, water quality and weather variables.
	7. Accessibility	Based on the average of the following three variables. The presence of an airport, railway line and road network was assessed in the basin and a score of 1 assigned to each variable where this was the case.
Planning	8. Monitoring and evaluation plan	The existence of a monitoring and evaluation plan. In place score = 1, not in place = 0.
	9. Business plan and implementation	An average calculated from the following two variables. If a business plan in existence = 1, no plan =0. The extent to which the plan is being implemented max score = 2.
	10. Integrated Water Resource Development Master Plan in development	Whether Integrated Water Resource Management Development Plan is being developed. Being developed = 1, no plan in development = 0.
Licensing and Enforcement	11. Efficiency in resource mobilisation	The degree to which revenue from water use fees meets target. Revenue collected ($) divided by revenue target ($).
	12. Conflict resolution	The number of water use conflicts resolved against those reported in each basin. If no conflicts raised score = 1, otherwise conflicts resolved divided by total conflicts.
	13. Permits issued	The number of water use and discharge permits that have been issued since the Water Sector Development Program. Total permits issued since Water Sector Status Report divided by population in the basin.

References

[1] United Nations Industrial Development Organization. 2011. Fostering Industrial Development in Africa in the New Global Environment.

[2] United Nations Development Programme. 2006. Human Development Report 2006: Beyond Scarcity: Power, Poverty and the Global Water Crisis.

[3] AMEC. 2014. Tanzania: Targeted Analysis on Water Resources Management Issues. Final report for 2030 Water Resources Group.

[4] Ministry of Finance. 2013. Statistical Abstract Report 2012. National Bureau of Statistics.

[5] United Republic of Tanzania. 2012. Annual Survey of Industrial Production 2009. Statistical Report. Ministry of Industry and Trade.

[6] Ministry of Water. Integrated water resource management development plans for each of the nine basins *(still in preparation stage.*

[7] SAGCOT. 2011. Southern Agricultural Growth Corridor of Tanzania Investment Blueprint.

[8] United Republic of Tanzania. 2011. The Tanzania Five Year Development Plan 2011/12–2015/16. President's Office.

[9] Ministry of Energy and Minerals. 2013. Power System Master Plan 2012 Update.

[10] US Government. 2011. Tanzania FY 2011–2015 Multi Year Strategy.

[11] United Republic of Tanzania. 2006. National Water Sector Development Strategy. Ministry of Water and Irrigation.

[12] Ministry of Water. 2013. Water Sector Development Program Water Sector Status Report.