Water Risk Filter

Country Overview - Sierra Leone

Water Indicators

Indicator	Value	Description	Source
Overall Basin Risk (score)	2.48	Overall Basin Risk (score)	
Overall Basin Risk (rank)	130	Overall Basin Risk (rank)	
Physical risk (score)	2.03	Physical risk (score)	
Physical risk (rank)	164	Physical risk (rank)	
Regulatory risk (score)	3.71	Regulatory risk (score)	
Regulatory risk (rank)	18	Regulatory risk (rank)	
Reputation risk (score)	2.61	Reputation risk (score)	
Reputation risk (rank)	100	Reputation risk (rank)	
1. Quantity - Scarcity (score)	1.96	1. Quantity - Scarcity (score)	
1. Quantity - Scarcity (rank)	118	1. Quantity - Scarcity (rank)	
2. Quantity - Flooding (score)	2.44	2. Quantity - Flooding (score)	
2. Quantity - Flooding (rank)	142	2. Quantity - Flooding (rank)	
3. Quality (score)	1.55	3. Quality (score)	
3. Quality (rank)	168	3. Quality (rank)	
4. Ecosystem Service Status (score)	2.28	4. Ecosystem Service Status (score)	
4. Ecosystem Service Status (rank)	104	4. Ecosystem Service Status (rank)	
5. Enabling Environment (Policy & Laws) (score)	3.75	5. Enabling Environment (Policy & Laws) (score)	
5. Enabling Environment (Policy & Laws) (rank)	21	5. Enabling Environment (Policy & Laws) (rank)	
6. Institutions and Governance (score)	3.25	6. Institutions and Governance (score)	
6. Institutions and Governance (rank)	74	6. Institutions and Governance (rank)	
7. Management Instruments (score)	3.73	7. Management Instruments (score)	
7. Management Instruments (rank)	16	7. Management Instruments (rank)	
8 - Infrastructure & Finance (score)	4.55	8 - Infrastructure & Finance (score)	
8 - Infrastructure & Finance (rank)	18	8 - Infrastructure & Finance (rank)	
9. Cultural Diversity (score)	1.00	9. Cultural importance (score)	
9. Cultural Diversity (rank)	173	9. Cultural importance (rank)	
10. Biodiversity Importance (score)	4.32	10. Biodiversity importance (score)	

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Indicator	Value	Description	Source
10. Biodiversity Importance (rank)	38	10. Biodiversity importance (rank)	
11. Media Scrutiny (score)	3.10	11. Media Scrutiny (score)	
11. Media Scrutiny (rank)	61	11. Media Scrutiny (rank)	
12. Conflict (score)	2.13	12. Conflict (score)	
12. Conflict (rank)	136	12. Conflict (rank)	
1.0 - Aridity (score)	1.00	The aridity risk indicator is based on the Global Aridity Index (Global-Aridity) and Global Potential Evapo-Transpiration (Global-PET) Geospatial data sets by Trabucco and Zomer (2009). These data sets provide information about the potential availability of water in regions with low water demand, thus they are used in the Water Risk Filter 5.0 to better account for deserts and other arid areas in the risk assessment.	Trabucco, A., & Zomer, R. J. (2009). Global potential evapo-transpiration (Global-PET) and global aridity index (Global-Aridity) geo-database. CGIAR consortium for spatial information.
1.0 - Aridity (rank)	146	The aridity risk indicator is based on the Global Aridity Index (Global-Aridity) and Global Potential Evapo-Transpiration (Global-PET) Geospatial data sets by Trabucco and Zomer (2009). These data sets provide information about the potential availability of water in regions with low water demand, thus they are used in the Water Risk Filter 5.0 to better account for deserts and other arid areas in the risk assessment.	Trabucco, A., & Zomer, R. J. (2009). Global potential evapo-transpiration (Global-PET) and global aridity index (Global-Aridity) geo-database. CGIAR consortium for spatial information.
1.1 - Water Depletion (score)	1.00	The water depletion risk indicator is based on annual average monthly net water depletion from Brauman et al. (2016). Their analysis is based on model outputs from the newest version of the integrated water resources model WaterGAP3 which measures water depletion as the ratio of water consumption-to-availability.	Brauman, K. A., Richter, B. D., Postel, S., Malsy, M., & Flörke, M. (2016). Water depletion: An improved metric for incorporating seasonal and dry-year water scarcity into water risk assessments. Elem Sci Anth, 4.
1.1 - Water Depletion (rank)	176	The water depletion risk indicator is based on annual average monthly net water depletion from Brauman et al. (2016). Their analysis is based on model outputs from the newest version of the integrated water resources model WaterGAP3 which measures water depletion as the ratio of water consumption-to-availability.	Brauman, K. A., Richter, B. D., Postel, S., Malsy, M., & Flörke, M. (2016). Water depletion: An improved metric for incorporating seasonal and dry-year water scarcity into water risk assessments. Elem Sci Anth, 4.
1.2 - Baseline Water Stress (score)	1.04	World Resources Institute's Baseline Water Stress measures the ratio of total annual water withdrawals to total available annual renewable supply, accounting for upstream consumptive use. A higher percentage indicates more competition among users.	Hofste, R., Kuzma, S., Walker, S., ... & Sutanudjaja, E.H. (2019). Aqueduct 3.0: Updated decision relevant global water risk indicators. Technical note. Washington, DC: World Resources Institute.

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Indicator	Value	Description	Source
1.2 - Baseline Water Stress (rank)	152	World Resources Institute's Baseline Water Stress measures the ratio of total annual water withdrawals to total available annual renewable supply, accounting for upstream consumptive use. A higher percentage indicates more competition among users.	Hofste, R., Kuzma, S., Walker, S., ... & Sutanudjaja, E.H. (2019). Aqueduct 3.0: Updated decision relevant global water risk indicators. Technical note. Washington, DC: World Resources Institute.
1.3 - Blue Water Scarcity (score)	3.27	The blue water scarcity risk indicator is based on Mekonnen and Hoekstra (2016) global assessment of blue water scarcity on a monthly basis and at high spatial resolution (grid cells of 30 × 30 arc min resolution). Blue water scarcity is calculated as the ratio of the blue water footprint in a grid cell to the total blue water availability in the cell. The time period analyzed in this study ranges from 1996 to 2005.	Mekonnen, M. M., & Hoekstra, A. Y. (2016). Four billion people facing severe water scarcity. Science advances, 2(2), e1500323.
1.3 - Blue Water Scarcity (rank)	63	The blue water scarcity risk indicator is based on Mekonnen and Hoekstra (2016) global assessment of blue water scarcity on a monthly basis and at high spatial resolution (grid cells of 30 × 30 arc min resolution). Blue water scarcity is calculated as the ratio of the blue water footprint in a grid cell to the total blue water availability in the cell. The time period analyzed in this study ranges from 1996 to 2005.	Mekonnen, M. M., & Hoekstra, A. Y. (2016). Four billion people facing severe water scarcity. Science advances, 2(2), e1500323.
1.4 - Projected Change in Water Discharge (by ~2050) (score)	1.00	This risk indicator is based on multi-model simulation that applies both global climate and hydrological models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). To estimate the change at 2°C of global warming above 1980-2010 levels, simulated annual water discharge was averaged over a 31-year period with 2°C mean warming. Results are expressed in terms of relative change (%) in probability between present day (1980-2010) conditions and 2°C scenarios by 2050.	Schewe, J., Heinke, J., Gerten, D., Haddeland, I., Arnell, N. W., Clark, D. B., ... & Gosling, S. N. (2014). Multimodel assessment of water scarcity under climate change. Proceedings of the National Academy of Sciences, 111(9), 3245-3250.
1.4 - Projected Change in Water Discharge (by ~2050) (rank)	182	This risk indicator is based on multi-model simulation that applies both global climate and hydrological models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). To estimate the change at 2°C of global warming above 1980-2010 levels, simulated annual water discharge was averaged over a 31-year period with 2°C mean warming. Results are expressed in terms of relative change (%) in probability between present day (1980-2010) conditions and 2°C scenarios by 2050.	Schewe, J., Heinke, J., Gerten, D., Haddeland, I., Arnell, N. W., Clark, D. B., ... & Gosling, S. N. (2014). Multimodel assessment of water scarcity under climate change. Proceedings of the National Academy of Sciences, 111(9), 3245-3250.

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Indicator	Value	Description	Source
1.5 - Drought Frequency Probability (score)	3.00	This risk indicator is based on the Standardized Precipitation and Evaporation Index (SPEI). Vicente-Serrano et al. (2010) developed this multi-scalar drought index applying both precipitation and temperature data to detect, monitor and analyze different drought types and impacts in the context of global warming. The mathematical calculations used for SPEI are similar to the Standard Precipitation Index (SPI), but it has the advantage to include the role of evapotranspiration.	Vicente-Serrano, S. M., Beguería, S., & López-Moreno, J. I. (2010). A multiscalar drought index sensitive to global warming: the standardized precipitation evapotranspiration index. Journal of climate, 23(7), 1696-1718.
1.5 - Drought Frequency Probability (rank)	70	This risk indicator is based on the Standardized Precipitation and Evaporation Index (SPEI). Vicente-Serrano et al. (2010) developed this multi-scalar drought index applying both precipitation and temperature data to detect, monitor and analyze different drought types and impacts in the context of global warming. The mathematical calculations used for SPEI are similar to the Standard Precipitation Index (SPI), but it has the advantage to include the role of evapotranspiration.	Vicente-Serrano, S. M., Beguería, S., & López-Moreno, J. I. (2010). A multiscalar drought index sensitive to global warming: the standardized precipitation evapotranspiration index. Journal of climate, 23(7), 1696-1718.
1.6 - Projected Change in Drought Occurrence (by ~2050) (score)	3.00	This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) . A drought threshold for pre-industrial conditions was calculated based on time-series averages. Results are expressed in terms of relative change (%) in probability between pre-industrial and 2°C scenarios.	Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming–simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development.
1.6 - Projected Change in Drought Occurrence (by ~2050) (rank)	120	This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) . A drought threshold for pre-industrial conditions was calculated based on time-series averages. Results are expressed in terms of relative change (%) in probability between pre-industrial and 2°C scenarios.	Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming–simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development.
2.1 - Estimated Flood Occurrence (score)	2.34	This risk indicator is based on the recurrence of floods within the 34-year time frame period of 1985 to 2019. The occurrence of floods within a given location was estimated using data from Flood Observatory, University of Colorado. The Flood Observatory use data derived from a wide variety of news, governmental, instrumental, and remote sensing source.	Brakenridge, G. R. (2019). Global active archive of large flood events. Dartmouth Flood Observatory, University of Colorado.
2.1 - Estimated Flood Occurrence (rank)	146	This risk indicator is based on the recurrence of floods within the 34-year time frame period of 1985 to 2019. The occurrence of floods within a given location was estimated using data from Flood Observatory, University of Colorado. The Flood Observatory use data derived from a wide variety of news, governmental, instrumental, and remote sensing source.	Brakenridge, G. R. (2019). Global active archive of large flood events. Dartmouth Flood Observatory, University of Colorado.

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Indicator	Value	Description	Source
2.2 - Projected Change in Flood Occurrence (by ~2050) (score)	4.28	This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). The magnitude of the flood event was defined based on 100-year return period for pre-industrial conditions. Results are expressed in terms of change (%) in probability between pre-industrial and 2°C scenarios.	Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming–simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development.
2.2 - Projected Change in Flood Occurrence (by ~2050) (rank)	4	This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). The magnitude of the flood event was defined based on 100-year return period for pre-industrial conditions. Results are expressed in terms of change (%) in probability between pre-industrial and 2°C scenarios.	Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming–simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development.
3.1 - Surface Water Contamination Index (score)	1.55	The underlying data for this risk indicator is based on a broad suite of pollutants with well-documented direct or indirect negative effects on water security for both humans and freshwater biodiversity, compiled by Vörösmarty et al. (2010). The negative effects are specific to individual pollutants, ranging from impacts mediated by eutrophication such as algal blooms and oxygen depletion (e.g., caused by phosphorus and organic loading) to direct toxic effects (e.g., caused by pesticides, mercury). The overall Surface Water Contamination Index is calculated based on a range of key pollutants with different weightings according to the level of their negative effects on water security for both humans and freshwater biodiversity: soil salinization (8%), nitrogen (12%) and phosphorus (P, 13%) loading, mercury deposition (5%), pesticide loading (10%), sediment loading (17%), organic loading (as Biological Oxygen Demand, BOD; 15%), potential acidification (9%), and thermal alteration (11%).	Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., ... & Davies, P. M. (2010). Global threats to human water security and river biodiversity. Nature, 467(7315), 555.

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Indicator	Value	Description	Source
3.1 - Surface Water Contamination Index (rank)	168	The underlying data for this risk indicator is based on a broad suite of pollutants with well-documented direct or indirect negative effects on water security for both humans and freshwater biodiversity, compiled by Vörösmarty et al. (2010). The negative effects are specific to individual pollutants, ranging from impacts mediated by eutrophication such as algal blooms and oxygen depletion (e.g., caused by phosphorus and organic loading) to direct toxic effects (e.g., caused by pesticides, mercury). The overall Surface Water Contamination Index is calculated based on a range of key pollutants with different weightings according to the level of their negative effects on water security for both humans and freshwater biodiversity: soil salinization (8%), nitrogen (12%) and phosphorus (P, 13%) loading, mercury deposition (5%), pesticide loading (10%), sediment loading (17%), organic loading (as Biological Oxygen Demand, BOD; 15%), potential acidification (9%), and thermal alteration (11%).	Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., ... & Davies, P. M. (2010). Global threats to human water security and river biodiversity. Nature, 467(7315), 555.
4.1 - Fragmentation Status of Rivers (score)	1.37	This risk indicator is based on the data set by Grill et al. (2019) mapping the world's free-flowing rivers. Grill et al. (2019) compiled a geometric network of the global river system and associated attributes, such as hydro-geometric properties, as well as pressure indicators to calculate an integrated connectivity status index (CSI). While only rivers with high levels of connectivity in their entire length are classified as free-flowing, rivers of CSI < 95% are considered as fragmented at a certain degree.	Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., ... & Macedo, H. E. (2019). Mapping the world's free-flowing rivers. Nature, 569(7755), 215.
4.1 - Fragmentation Status of Rivers (rank)	164	This risk indicator is based on the data set by Grill et al. (2019) mapping the world's free-flowing rivers. Grill et al. (2019) compiled a geometric network of the global river system and associated attributes, such as hydro-geometric properties, as well as pressure indicators to calculate an integrated connectivity status index (CSI). While only rivers with high levels of connectivity in their entire length are classified as free-flowing, rivers of CSI < 95% are considered as fragmented at a certain degree.	Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., ... & Macedo, H. E. (2019). Mapping the world's free-flowing rivers. Nature, 569(7755), 215.
4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (score)	4.76	For this risk indicator, tree cover loss was applied as a proxy to represent catchment ecosystem services degradation since forests play an important role in terms of water regulation, supply and pollution control. The forest cover data is based on Hansen et al.'s global Landsat data at a 30-meter spatial resolution to characterize forest cover and change. The authors defined trees as vegetation taller than 5 meters in height, and forest cover loss as a stand-replacement disturbance, or a change from a forest to non-forest state, during the period 2000 – 2018.	Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A. A., Tyukavina, A., ... & Kommareddy, A. (2013). High-resolution global maps of 21st-century forest cover change. science, 342(6160), 850-853.

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Indicator	Value	Description	Source
4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (rank)	3	For this risk indicator, tree cover loss was applied as a proxy to represent catchment ecosystem services degradation since forests play an important role in terms of water regulation, supply and pollution control. The forest cover data is based on Hansen et al.'s global Landsat data at a 30-meter spatial resolution to characterize forest cover and change. The authors defined trees as vegetation taller than 5 meters in height, and forest cover loss as a stand-replacement disturbance, or a change from a forest to non-forest state, during the period 2000 – 2018.	Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A. A., Tyukavina, A., ... & Kommareddy, A. (2013). High-resolution global maps of 21st-century forest cover change. science, 342(6160), 850-853.
4.3 - Projected Impacts on Freshwater Biodiversity (score)	2.53	The study by Tedesco et al. (2013) to project changes [% increase or decrease] in extinction rate by ~2090 of freshwater fish due to water availability loss from climate change is used as a proxy to estimate the projected impacts on freshwater biodiversity.	Tedesco, P. A., Oberdorff, T., Cornu, J. F., Beauchard, O., Brosse, S., Dürr, H. H., ... & Hugueny, B. (2013). A scenario for impacts of water availability loss due to climate change on riverine fish extinction rates. Journal of Applied Ecology, 50(5), 1105-1115.
4.3 - Projected Impacts on Freshwater Biodiversity (rank)	90	The study by Tedesco et al. (2013) to project changes [% increase or decrease] in extinction rate by ~2090 of freshwater fish due to water availability loss from climate change is used as a proxy to estimate the projected impacts on freshwater biodiversity.	Tedesco, P. A., Oberdorff, T., Cornu, J. F., Beauchard, O., Brosse, S., Dürr, H. H., ... & Hugueny, B. (2013). A scenario for impacts of water availability loss due to climate change on riverine fish extinction rates. Journal of Applied Ecology, 50(5), 1105-1115.
5.1 - Freshwater Policy Status (SDG 6.5.1) (score)	3.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Policy" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.1 - Freshwater Policy Status (SDG 6.5.1) (rank)	79	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Policy" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.2 - Freshwater Law Status (SDG 6.5.1) (score)	4.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Law(s)" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.

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Indicator	Value	Description	Source
5.2 - Freshwater Law Status (SDG 6.5.1) (rank)	28	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Law(s)" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.3 - Implementation Status of Water Management Plans (SDG 6.5.1) (score)	5.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National IWRM plans" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.3 - Implementation Status of Water Management Plans (SDG 6.5.1) (rank)	11	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National IWRM plans" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
6.1 - Corruption Perceptions Index (score)	4.00	This risk Indicator is based on the latest Transparency International's data: the Corruption Perceptions Index 2018. This index aggregates data from a number of different sources that provide perceptions of business people and country experts on the level of corruption in the public sector.	Transparency International (2019). Corruption Perceptions Index 2018. Berlin: Transparency International.
6.1 - Corruption Perceptions Index (rank)	78	This risk Indicator is based on the latest Transparency International's data: the Corruption Perceptions Index 2018. This index aggregates data from a number of different sources that provide perceptions of business people and country experts on the level of corruption in the public sector.	Transparency International (2019). Corruption Perceptions Index 2018. Berlin: Transparency International.
6.2 - Freedom in the World Index (score)	2.00	This risk indicator is based on Freedom House (2019), an annual global report on political rights and civil liberties, composed of numerical ratings and descriptive texts for each country and a select group of territories. The 2019 edition involved more than 100 analysts and more than 30 advisers with global, regional, and issue-based expertise to covers developments in 195 countries and 14 territories from January 1, 2018, through December 31, 2018.	Freedom House (2019). Freedom in the world 2019. Washington, DC: Freedom House.

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Indicator	Value	Description	Source
6.2 - Freedom in the World Index (rank)	118	This risk indicator is based on Freedom House (2019), an annual global report on political rights and civil liberties, composed of numerical ratings and descriptive texts for each country and a select group of territories. The 2019 edition involved more than 100 analysts and more than 30 advisers with global, regional, and issue-based expertise to covers developments in 195 countries and 14 territories from January 1, 2018, through December 31, 2018.	Freedom House (2019). Freedom in the world 2019. Washington, DC: Freedom House.
6.3 - Business Participation in Water Management (SDG 6.5.1) (score)	3.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Business Participation in Water Resources Development, Management and Use" indicator, which corresponds to one of the six national level indicators under the Institutions and Participation category.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
6.3 - Business Participation in Water Management (SDG 6.5.1) (rank)	90	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Business Participation in Water Resources Development, Management and Use" indicator, which corresponds to one of the six national level indicators under the Institutions and Participation category.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
7.1 - Management Instruments for Water Management (SDG 6.5.1) (score)	4.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Sustainable and efficient water use management" indicator, which corresponds to one of the five national level indicators under the Management Instruments category. For SDG 6.5.1, management instruments refer to the tools and activities that enable decision-makers and users to make rational and informed choices between alternative actions.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
7.1 - Management Instruments for Water Management (SDG 6.5.1) (rank)	14	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Sustainable and efficient water use management" indicator, which corresponds to one of the five national level indicators under the Management Instruments category. For SDG 6.5.1, management instruments refer to the tools and activities that enable decision-makers and users to make rational and informed choices between alternative actions.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.

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Indicator	Value	Description	Source
7.2 - Groundwater Monitoring Data Availability and Management (score)	3.00	This risk indicator is based on the data set by UN IGRAC (2019) to determine the level of availability of groundwater monitoring data at country level as groundwater management decisions rely strongly on data availability. The level of groundwater monitoring data availability for groundwater management is determined according to a combination of three criteria developed by WWF and IGRAC: 1) Status of country groundwater monitoring programme, 2) groundwater data availability for NGOs and 3) Public access to processed groundwater monitoring data.	UN IGRAC (2019). Global Groundwater Monitoring Network GGMN Portal. UN International Groundwater Resources Assessment Centre (IGRAC).
7.2 - Groundwater Monitoring Data Availability and Management (rank)	107	This risk indicator is based on the data set by UN IGRAC (2019) to determine the level of availability of groundwater monitoring data at country level as groundwater management decisions rely strongly on data availability. The level of groundwater monitoring data availability for groundwater management is determined according to a combination of three criteria developed by WWF and IGRAC: 1) Status of country groundwater monitoring programme, 2) groundwater data availability for NGOs and 3) Public access to processed groundwater monitoring data.	UN IGRAC (2019). Global Groundwater Monitoring Network GGMN Portal. UN International Groundwater Resources Assessment Centre (IGRAC).
7.3 - Density of Runoff Monitoring Stations (score)	3.22	The density of monitoring stations for water quantity was applied as proxy to develop this risk indicator. The Global Runoff Data Base was used to estimate the number of monitoring stations per 1000km2 of the main river system (data base access date: May 2018).	BfG (2019). Global Runoff Data Base. German Federal Institute of Hydrology (BfG).
7.3 - Density of Runoff Monitoring Stations (rank)	100	The density of monitoring stations for water quantity was applied as proxy to develop this risk indicator. The Global Runoff Data Base was used to estimate the number of monitoring stations per 1000km2 of the main river system (data base access date: May 2018).	BfG (2019). Global Runoff Data Base. German Federal Institute of Hydrology (BfG).
8.1 - Access to Safe Drinking Water (score)	4.00	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017.	WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.
8.1 - Access to Safe Drinking Water (rank)	37	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017.	WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.
8.2 - Access to Sanitation (score)	5.00	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017.	WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.

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Indicator	Value	Description	Source
8.2 - Access to Sanitation (rank)	39	This risk indicator is based on the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (UNICEF/WHO) 2019 data. It provides estimates on the use of water, sanitation and hygiene by country for the period 2000-2017.	WHO & UNICEF (2019). Estimates on the use of water, sanitation and hygiene by country (2000-2017). Joint Monitoring Programme for Water Supply, Sanitation and Hygiene.
8.3 - Financing for Water Resource Development and Management (SDG 6.5.1) (score)	5.00	This risk indicator is based on the average 'Financing' score of UN SDG 6.5.1. Degree of IWRM Implementation database. UN SDG 6.5.1 database contains a category on financing which assesses different aspects related to budgeting and financing made available and used for water resources development and management from various sources.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
8.3 - Financing for Water Resource Development and Management (SDG 6.5.1) (rank)	4	This risk indicator is based on the average 'Financing' score of UN SDG 6.5.1. Degree of IWRM Implementation database. UN SDG 6.5.1 database contains a category on financing which assesses different aspects related to budgeting and financing made available and used for water resources development and management from various sources.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
9.1 - Cultural Diversity (score)	1.00	Water is a social and cultural good. The cultural diversity risk indicator was included in order to acknowledge that businesses face reputational risk due to the importance of freshwater for indigenous and traditional people in their daily life, religion and culture. This risk indicator is based on Oviedo and Larsen (2000) data set, which mapped the world's ethnolinguistic groups onto the WWF map of the world's ecoregions. This cross-mapping showed for the very first time the significant overlap that exists between the global geographic distribution of biodiversity and that of linguistic diversity.	Oviedo, G., Maffi, L., & Larsen, P. B. (2000). Indigenous and traditional peoples of the world and ecoregion conservation: An integrated approach to conserving the world's biological and cultural diversity. Gland: WWF (World Wide Fund for Nature) International.
9.1 - Cultural Diversity (rank)	173	Water is a social and cultural good. The cultural diversity risk indicator was included in order to acknowledge that businesses face reputational risk due to the importance of freshwater for indigenous and traditional people in their daily life, religion and culture. This risk indicator is based on Oviedo and Larsen (2000) data set, which mapped the world's ethnolinguistic groups onto the WWF map of the world's ecoregions. This cross-mapping showed for the very first time the significant overlap that exists between the global geographic distribution of biodiversity and that of linguistic diversity.	Oviedo, G., Maffi, L., & Larsen, P. B. (2000). Indigenous and traditional peoples of the world and ecoregion conservation: An integrated approach to conserving the world's biological and cultural diversity. Gland: WWF (World Wide Fund for Nature) International.
10.1 - Freshwater Endemism (score)	3.66	The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Companies operating in basins with higher number of endemic fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.

Water Risk Filter

Country Overview - Sierra Leone

Indicator	Value	Description	Source
10.1 - Freshwater Endemism (rank)	106	The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Companies operating in basins with higher number of endemic fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.
10.2 - Freshwater Biodiversity Richness (score)	4.97	The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Count of fish species is used as a representation of freshwater biodiversity richness. Companies operating in basins with higher number of fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.
10.2 - Freshwater Biodiversity Richness (rank)	24	The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Count of fish species is used as a representation of freshwater biodiversity richness. Companies operating in basins with higher number of fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.
11.1 - National Media Coverage (score)	4.00	This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group). It indicates how aware local residents typically are of water-related issues due to national media coverage. The status of the river basin (e.g., scarcity and pollution) is taken into account, as well as the importance of water for livelihoods (e.g., food and shelter).	WWF & Tecnoma (TYPSA Group)
11.1 - National Media Coverage (rank)	50	This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group). It indicates how aware local residents typically are of water-related issues due to national media coverage. The status of the river basin (e.g., scarcity and pollution) is taken into account, as well as the importance of water for livelihoods (e.g., food and shelter).	WWF & Tecnoma (TYPSA Group)
11.2 - Global Media Coverage (score)	2.00	This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group). It indicates how aware people are of water-related issues due to global media coverage. Familiarity to and media coverage of the region and regional water-related disasters are taken into account.	WWF & Tecnoma (TYPSA Group)
11.2 - Global Media Coverage (rank)	127	This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group). It indicates how aware people are of water-related issues due to global media coverage. Familiarity to and media coverage of the region and regional water-related disasters are taken into account.	WWF & Tecnoma (TYPSA Group)

Water Risk Filter

Country Overview - Sierra Leone

Indicator	Value	Description	Source
12.1 - Conflict News Events (RepRisk) (score)	3.00	This risk indicator is based on 2018 data collected by RepRisk on counts and registers of documented negative incidents, criticism and controversies that can affect a company's reputational risk. These negative news events are labelled per country and industry class.	RepRisk & WWF (2019). Due diligence database on ESG and business conduct risks. RepRisk.
12.1 - Conflict News Events (RepRisk) (rank)	94	This risk indicator is based on 2018 data collected by RepRisk on counts and registers of documented negative incidents, criticism and controversies that can affect a company's reputational risk. These negative news events are labelled per country and industry class.	RepRisk & WWF (2019). Due diligence database on ESG and business conduct risks. RepRisk.
12.2 - Hydro-political Risk (score)	1.27	This risk indicator is based on the assessment of hydro-political risk by Farinosi et al. (2018). More specifically, it is based on the results of spatial modelling by Farinosi et al. (2018) that determined the main parameters affecting water cross-border conflicts and calculated the likelihood of hydro-political issues.	Farinosi, F., Giupponi, C., Reynaud, A., Ceccherini, G., Carmona-Moreno, C., De Roo, A., ... & Bidoglio, G. (2018). An innovative approach to the assessment of hydro-political risk: A spatially explicit, data driven indicator of hydro-political issues. Global environmental change, 52, 286-313.
12.2 - Hydro-political Risk (rank)	179	This risk indicator is based on the assessment of hydro-political risk by Farinosi et al. (2018). More specifically, it is based on the results of spatial modelling by Farinosi et al. (2018) that determined the main parameters affecting water cross-border conflicts and calculated the likelihood of hydro-political issues.	Farinosi, F., Giupponi, C., Reynaud, A., Ceccherini, G., Carmona-Moreno, C., De Roo, A., ... & Bidoglio, G. (2018). An innovative approach to the assessment of hydro-political risk: A spatially explicit, data driven indicator of hydro-political issues. Global environmental change, 52, 286-313.
Population, total (#)	7396190	Population, total	The World Bank 2018, Data , hompage accessed 20/04/2018
GDP (current US$)	3736588554	GDP (current US$)	The World Bank 2018, Data , hompage accessed 20/04/2018
EPI 2018 score (0-100)	42.54	Environmental Performance Index	
WGI -Voice and Accountability (0-100)	40.48	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132

Water Risk Filter

Country Overview - Sierra Leone

Indicator	Value	Description	Source
WGI -Political stability no violence (0-100)	42.36	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132
WGI - Government Effectiveness (0-100)	10.10	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132
WGI - Regulatory Quality (0-100)	16.83	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132
WGI - Rule of Law (0-100)	21.63	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132
WGI - Control of Corruption (0-100)	20.19	Water Governance Indicator	Kaufmann, Daniel and Kraay, Aart and Mastruzzi, Massimo, The Worldwide Governance Indicators: Methodology and Analytical Issues (September 2010). World Bank Policy Research Working Paper No. 5430. Available at SSRN: https://ssrn.com/abstract=1682132

Water Risk Filter

Country Overview - Sierra Leone

Indicator	Value	Description	Source
WRI BWS all industries (0-5)	0.51	WRI Baseline Water Stress (BWS)	Gassert, F., P. Reig, T. Luo, and A. Maddocks. 2013. "Aqueduct country and river basin rankings: a weighted aggregation of spatially distinct hydrological indicators." Working paper. Washington, DC: World Resources Institute, December 2013. Available online at http://wri.org/publication/aqueduct-country-river-basin-rankings.
WRI BWS Ranking (1=very high)	134	WRI Baseline Water Stress (BWS)	Gassert, F., P. Reig, T. Luo, and A. Maddocks. 2013. "Aqueduct country and river basin rankings: a weighted aggregation of spatially distinct hydrological indicators." Working paper. Washington, DC: World Resources Institute, December 2013. Available online at http://wri.org/publication/aqueduct-country-river-basin-rankings.
Baseline Water Stress (BWS) - 2020 BAU (1=very high)	148	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2020 Optimistic (increasing rank describes lower risk)	148	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2020 Pessimistic (increasing rank describes lower risk)	148	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.

Water Risk Filter

Country Overview - Sierra Leone

Indicator	Value	Description	Source
Baseline Water Stress (BWS) - 2030 BAU (increasing rank describes lower risk)	149	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2030 Optimistic (increasing rank describes lower risk)	149	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2030 Pessimistic (increasing rank describes lower risk)	150	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2040 BAU (increasing rank describes lower risk)	153	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2040 Optimistic (increasing rank describes lower risk)	154	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2040 Pessimistic (increasing rank describes lower risk)	149	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.

Water Risk Filter

Country Overview - Sierra Leone

Indicator	Value	Description	Source
Total water footprint of national consumption (m3/a/cap)	1437.56	WFN Water Footprint Data	Mekonnen, M.M. and Hoekstra, A.Y. (2011) National water footprint accounts: The green, blue and grey water footprint of production and consumption, Value of Water Research Report Series No. 50, UNESCO-IHE, Delft, the Netherlands.http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf
Ratio external / total water footprint (%)	20.06	WFN Water Footprint Data	Mekonnen, M.M. and Hoekstra, A.Y. (2011) National water footprint accounts: The green, blue and grey water footprint of production and consumption, Value of Water Research Report Series No. 50, UNESCO-IHE, Delft, the Netherlands.http://www.waterfootprint.org/Reports/Report50-NationalWaterFootprints-Vol1.pdf
Area equipped for full control irrigation: total (1000 ha)	1.00	Aquastat - Irrigation	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Area equipped for irrigation: total (1000 ha)	29.36	Aquastat - Irrigation	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
% of the area equipped for irrigation actually irrigated (%)	0.00	Aquastat - Irrigation	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Electricity production from hydroelectric sources (% of total)	0.00	World Development Indicators	The World Bank 2018, Data , hompage accessed 20/04/2018
Total internal renewable water resources (IRWR) (10^9 m3/year)	160.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Total internal renewable water resources (IRWR) (10^9 m3/year)	0.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Water resources: total external renewable (10^9 m3/year)	160.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13

Water Risk Filter

Country Overview - Sierra Leone

Indicator	Value	Description	Source
Total renewable water resources (10^9 m3/year)	160.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Dependency ratio (%)	0.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Total renewable water resources per capita (m3/inhab/year)	24795.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
World happiness [0-8]	4.57	WorldHappinessReport.org	World Happiness Report, homepage accessed 20/04/2018

Country Aspects

1. PHYSICAL ASPECTS

1.1. WATER RESOURCES

1.1.1. WATER RESOURCES

Sierra Leone can be divided into 12 river basins, of which five are shared with Guinea and two with Liberia. The most important ones, from west to east, are: the Kolente (Great Scarcies), Kaba, Rokel, Pampana (Jong), Sewa, Moa, and Mano. The groundwater resources of the country have not been extensively studied. They correspond almost totally to the baseflow of the rivers, and the permeability of the substratum is high.

Internal renewable water resources are estimated at 160km3/year, with surface water accounting for 150km3/year. Seasonal variations are important: only 11-17 per cent of the annual discharge occurs between December and April, with minimum discharge in April. Internally produced groundwater is estimated to be 50km3/year. Of that, 40km3/year is considered to be overlap between surface water and groundwater.

Wetlands are important in rice and vegetable production. Sierra Leone signed the Ramsar Convention on Wetlands in 1999 and 66 Ramsar sites exist in the country.

Sierra Leone has only one major dam, the 68m-high Guma dam, built for hydroelectricity purposes, close to Freetown. However, there is considerable potential for the development of small-scale hydroelectric schemes that could also be designed to accommodate irrigated agriculture. An inventory identified 21 sites for hydropower development, with a hydroelectric potential which already exceeds by far the medium-term demand of the country (the total potential is believed to be much higher).

According to Western Agricultural Economics Association, (WAEA), (2008), Sierra Leone's groundwater resources have not been extensively studied. They correspond almost totally to the baseflow of the rivers, and the permeability of the substratum is high.

The hydropower potential of Sierra Leone is estimated at 1513MW, scattered in 27 sites across the country. At present, two sites have been developed. A 2.4MW plant is at Guma and a 4MW plant which supplies part of the electricity needs of Bo and Kemema. A plant is being built at Bumbuna, with an installed capacity of 47MW and a 203km-long transmission line intended for the Western Region (WAEA, 2008).

The development of additional hydropower sites is very important in Sierra Leone, as roughly 5 per cent of people have access to electricity. The energy situation is a serious impediment to Sierra Leone's economic growth, particularly in the industrial and service sectors. Furthermore, the country is also one of a small number in West Africa with some of the highest costs of electricity generation and delivery in the world (WAEA, 2008).

The country is drained by nine major rivers. These are the Rokel/Seli, Pampana/Jong, Sewa, Waanje and the coastal streams and creeks that originate from within the country. The rest are the Great and Little Scarcies and Moa Rivers that originate from the Fouta Jallon Plataeu in the Republic of Guinea, and the Mano River that originates from the Republic of Liberia. These rivers range in length from 160km for the Great Scarcies to 430km for the Sewa River, and in area from 2,530km2 for the coastal streams and creeks to 14,140km2 for the Sewa River. Out of the nine major river basins, four (Great Scarcies, Little Scarcies, Moa and the Mano) are shared with neighbouring countries (Economic Commission for Africa, (ECA), 2007).

The monthly runoff for the river basins follows the variability of the rainfall. The total mean annual runoff from the river basins is 160km3 (ECA, 2007).

Most of the country is underlain by Precambrian crystalline formations, which have no primary porosity. Groundwater accumulation therefore occurs in fractures, joints and fissures. The aquifers are therefore discontinuous (ECA, 2007).

Sierra Leone is endowed with vast surface and groundwater resources. These resources are unevenly distributed in space and time, however, and in the dry season in particular, they do not meet the country's needs. The resources are also threatened with rapid population growth, increased industrial activities, environmental degradation which causes soil erosion, drainage of wetlands and pollution of rivers. In addition, knowledge about these resources is inadequate (ECA, 2007).

1.1.2. WATER USE

Total water withdrawal in the year 2000 was estimated to be 379.9 million m3. Irrigation is the major water user, with a withdrawal of 353.6 million m3 in 2000, followed by the municipal sector with 19.6 million m3 and industry with 6.7 million m3. About 80 per cent of the rural population obtains its water from surface sources, including many streams and ponds. Groundwater is used for a limited number of rural wells and recent installations for large cities. A good number of provincial towns enjoy pipe-borne treated water.

Hydroelectric Power Potential

Sierra Leone's potential for hydroelectric generation is vast and underdeveloped. With its extensive river network, as well as the highest average rainfall on the continent – 2,526mm each year – Sierra Leone is rich in surface water resources. Sierra Leone also ranks sixth in Africa in terms of available renewable water resources per person, with an annual availability of 28,777m3 (United Nations Environment Programme (UNEP), 2010).

Although no official figures exist for Sierra Leone's electrification rate, a recent study, which uses remote sensing techniques, estimated a rate of 25 per cent. Most areas in the interior regions of Sierra Leone are either wholly or largely without access to electricity, and even for most electrified households access only lasts for up to a few hours a week (UNEP, 2010).

Despite the socioeconomic benefits, all too often hydropower development compromises the homes and livelihoods of riparian communities. Altered flows have many implications for native fish species that are either unable to pass through the dam or cannot adequately reproduce due to damaged spawning habitats (UNEP, 2010).
The recent commissioning of the 50MW Bumbuna hydroelectric plant is expected to increase the reliability and affordability of Sierra Leone's power supply. Reaching a balance between the electricity benefits of hydropower and the impacts on local communities and ecosystems is essential for the future of hydropower energy in Sierra Leone (UNEP, 2010).
Rural water and sanitation aspectsRural water and sanitation aspects
Since electricity throughout the country is often neither present nor stabilized, water pumps cannot command enough pressure to reach consumers living in high gradient or mountainous regions throughout the country. As a result, many people in remote communities are left to use untreated and unsanitary water (UNEP, 2010).Since electricity throughout the country is often neither present nor stabilized, water pumps cannot command enough pressure to reach consumers living in high gradient or mountainous regions throughout the country. As a result, many people in remote communities are left to use untreated and unsanitary water (UNEP, 2010).
Following independence in 1990, Sierra Leone made considerable progress in water supply and sanitation facilities. Despite this, in rural areas – which host 62 per cent of the population – 74 per cent of residents have no access to potable water and a further 94 per cent have no access to improved sanitation. The low levels of clean water, sanitation facilities and hygiene translate to fatalities and health problems (UNEP, 2010).Following independence in 1990, Sierra Leone made considerable progress in water supply and sanitation facilities. Despite this, in rural areas – which host 62 per cent of the population – 74 per cent of residents have no access to potable water and a further 94 per cent have no access to improved sanitation. The low levels of clean water, sanitation facilities and hygiene translate to fatalities and health problems (UNEP, 2010).
In the context of the World Wetlands Day Celebrations (2003) in Sierra Leone the following threats to wetlands in the country were identified:In the context of the World Wetlands Day Celebrations (2003) in Sierra Leone the following threats to wetlands in the country were identified:
-Developmental activities (construction, uncontrolled tourism);-Developmental activities (construction, uncontrolled tourism);
-Population, deforestation, mining, agriculture, peat harvesting;-Population, deforestation, mining, agriculture, peat harvesting;
-Creation of dams for hydroelectric power generation;-Creation of dams for hydroelectric power generation;
-Massive removal of mangroves.-Massive removal of mangroves.
The traditional slash-and-burn agriculture has resulted in deforestation and soil exhaustion.The traditional slash-and-burn agriculture has resulted in deforestation and soil exhaustion.
According to ECA (2007), drinking water quality standards will be established by the Sierra Leone Standards Bureau with the assistance of Guma Valley Water Company (GVWC), Sierra Leone Water Company (SALWACO), and the Ministry of Health and Sanitation. A mechanism for monitoring by the Ministry of Health and Sanitation will be established.According to ECA (2007), drinking water quality standards will be established by the Sierra Leone Standards Bureau with the assistance of Guma Valley Water Company (GVWC), Sierra Leone Water Company (SALWACO), and the Ministry of Health and Sanitation. A mechanism for monitoring by the Ministry of Health and Sanitation will be established.
Sierra Leone has the highest level of infant mortality in the world; 283 out of every 1,000 die before the age of five. Waterborne and water-related diseases – such as diarrhoea and malaria – and acute respiratory disease – are the most serious threats to public health in Sierra Leone (UNEP, 2010).Sierra Leone has the highest level of infant mortality in the world; 283 out of every 1,000 die before the age of five. Waterborne and water-related diseases – such as diarrhoea and malaria – and acute respiratory disease – are the most serious threats to public health in Sierra Leone (UNEP, 2010).

<h2>1.2.WATER QUALITY, ECOSYSTEMS AND HUMAN HEALTH1.2.WATER QUALITY, ECOSYSTEMS AND HUMAN HEALTH

2. GOVERNANCE ASPECTS

2.1.WATER INSTITUTIONS

Several agencies have been, to a limited extent, involved in the assessment of the potential water resources, such as the GVWC, Department of Energy and Power, Water Supply Division, Geological Survey, and Land and Water Development Division (LWDD) of the Department of Agriculture and Forestry.
The LWDD is responsible for appraisal of the land and the water resources of the country and to help develop sustainable agriculture. It has several technical sections: agronomy, remote sensing, soils, agroclimatology, analytical laboratory, water resources and cartography.
The Water Resources Section is in charge of investigating the water resources of the country with regard to their use for agricultural and rural development. This includes design preparation for swamp development. It liaises with the Water Supply Division of the Ministry of Energy and Power to investigate groundwater resources potential and for the siting and drilling of wells.
The GVWC is responsible for supplying water throughout Freetown and its environs; it supplies treated water from its main source at Guma Dam.
According to ECA (2007), there is no central body responsible for the management of the water resources towards meeting the needs of socio-economic development and those of the environment. The existing laws and regulations are scattered in different enactments.
The following institutions operate in the water sector in Sierra Leone (ECA, 2007):
Ministry of Energy and Power
The ministry is responsible for the water energy and power sectors. Together with the Ministry of Health and Sanitation, it is responsible for water supply and sanitation. It is therefore responsible for formulating policies and plans and their coordination, monitoring and evaluation to achieve

the government's development objectives in the water and sanitation sector (ECA, 2007).
Guma Valley Water Company Guma Valley Water Company
IThe GVWC is parastatal and was established in 1961 by an Act of Parliament. It is responsible for the water supply of the city of Freetown and its environs. It operates under the Ministry of Energy and Power. It has power to control water abstraction and pollution in the catchment upstream its water sources and is expected to be self-financing (ECA, 2007).IThe GVWC is parastatal and was established in 1961 by an Act of Parliament. It is responsible for the water supply of the city of Freetown and its environs. It operates under the Ministry of Energy and Power. It has power to control water abstraction and pollution in the catchment upstream its water sources and is expected to be self-financing (ECA, 2007).
Water Supply Division of MEPWater Supply Division of MEP
This division covers urban and rural areas outside the areas served by the GVWC. Its operations are guided by the Water Supply and Control Act of 1963 and has power to control water abstraction and pollution in the catchment behind its water supply sources (ECA, 2007).This division covers urban and rural areas outside the areas served by the GVWC. Its operations are guided by the Water Supply and Control Act of 1963 and has power to control water abstraction and pollution in the catchment behind its water supply sources (ECA, 2007).
Sierra Leone Water Company Sierra Leone Water Company
With the growth in urban and rural settlement and the transfer of the Water Supply Division from the Ministry of Works to the Ministry of Energy and Power, it became clear that a new organization was required to meet the needs of the growing population. As a result, SALWACO was established in 2001 to be responsible for urban water supplies in the whole of Sierra Leone, outside the jurisdiction of the GVWC. It is also under the Ministry of Energy and Power. Like the GVWC, it has power to control water abstraction and pollution in the catchments from which it takes water for its supply areas. The water supply systems under its control are expected to be self-financing (ECA, 2007).With the growth in urban and rural settlement and the transfer of the Water Supply Division from the Ministry of Works to the Ministry of Energy and Power, it became clear that a new organization was required to meet the needs of the growing population. As a result, SALWACO was established in 2001 to be responsible for urban water supplies in the whole of Sierra Leone, outside the jurisdiction of the GVWC. It is also under the Ministry of Energy and Power. Like the GVWC, it has power to control water abstraction and pollution in the catchments from which it takes water for its supply areas. The water supply systems under its control are expected to be self-financing (ECA, 2007).
Land and Water Development Division Land and Water Development Division
Falling under the Ministry of Agriculture, Forestry and Food Security, functions aim to improve the conservation and effective use of land and water resources and to provide agro-climatic data for sustained agricultural production. In addition, it works to carry out land evaluation for classification of inland valley swamps, and other ecologies, for suitability in irrigated rice production. This is to aid the development of a national irrigation and drainage programme to reduce the dependency on rain-fed agriculture, and to collect data on surface and groundwater resources (ECA, 2007).Falling under the Ministry of Agriculture, Forestry and Food Security, functions aim to improve the conservation and effective use of land and water resources and to provide agro-climatic data for sustained agricultural production. In addition, it works to carry out land evaluation for classification of inland valley swamps, and other ecologies, for suitability in irrigated rice production. This is to aid the development of a national irrigation and drainage programme to reduce the dependency on rain-fed agriculture, and to collect data on surface and groundwater resources (ECA, 2007).
The National Power Authority The National Power Authority
This is responsible for the planning, development, use and conservation of the power resources of the country including that of hydropower. It is under the Ministry of Energy and Power (ECA, 2007).This is responsible for the planning, development, use and conservation of the power resources of the country including that of hydropower. It is under the Ministry of Energy and Power (ECA, 2007).
Environmental Health and Sanitation DepartmentEnvironmental Health and Sanitation Department
This department is under the Ministry of Health and Sanitation, and is responsible for both urban and rural health and sanitation matters. Its activities cover water supply in rural and urban areas, sanitation and waste management in rural and urban areas, housing, vector control, food hygiene and safety and enforcement of environmental sanitation standards (ECA, 2007).This department is under the Ministry of Health and Sanitation, and is responsible for both urban and rural health and sanitation matters. Its activities cover water supply in rural and urban areas, sanitation and waste management in rural and urban areas, housing, vector control, food hygiene and safety and enforcement of environmental sanitation standards (ECA, 2007).
Department of EnvironmentDepartment of Environment
Controlled by the Ministry of Lands, Country Planning and the Environment. It is responsible for coordinating all the environmentally related activities of Government Ministries and local authorities and acts as the focal point of all national and international environmental matters relating to Sierra Leone (ECA, 2007).Controlled by the Ministry of Lands, Country Planning and the Environment. It is responsible for coordinating all the environmentally related activities of Government Ministries and local authorities and acts as the focal point of all national and international environmental matters relating to Sierra Leone (ECA, 2007).
The impact of the use of environmental resources (land, minerals, forests, wild life, etc.) and their mitigation on water resources is an important aspect of the department's functions (ECA, 2007).The impact of the use of environmental resources (land, minerals, forests, wild life, etc.) and their mitigation on water resources is an important aspect of the department's functions (ECA, 2007).
National Privatization CommissionNational Privatization Commission
This was established by an Act of Parliament and falls under the Ministry of Finance. It is required to manage parastatal organizations to such a stage that they become attractive for divestiture entirely to the private sector, or where the private sector can become a partner under various

arrangements with government, in order to take over public sector organizations in the production and service sectors of the economy. The commission must guide GVWC in its efforts to be self-financing with private sector involvement.This was established by an Act of Parliament and falls under the Ministry of Finance. It is required to manage parastatal organizations to such a stage that they become attractive for divestiture entirely to the private sector, or where the private sector can become a partner under various arrangements with government, in order to take over public sector organizations in the production and service sectors of the economy. The commission must guide GVWC in its efforts to be self-financing with private sector involvement.

Ministry of Local Government and Community DevelopmentMinistry of Local Government and Community Development

This Ministry has been given the role to champion the government policy of decentralization and devolution of power to the grassroots under the Local Government Act of 2004. It is expected to build the capacity of District Councils and Town Councils to assume their new responsibilities in providing government services including water supply and sanitation in the rural areas. Among the functions that have been devolved to the Local Councils is that of water supply and sanitation, presently assigned to SALWACO under the Ministry of Energy and Power. It will also coordinate the policies and programmes of the various ministries, departments and agencies as they relate to the water and sanitation sector (ECA, 2007).This Ministry has been given the role to champion the government policy of decentralization and devolution of power to the grassroots under the Local Government Act of 2004. It is expected to build the capacity of District Councils and Town Councils to assume their new responsibilities in providing government services including water supply and sanitation in the rural areas. Among the functions that have been devolved to the Local Councils is that of water supply and sanitation, presently assigned to SALWACO under the Ministry of Energy and Power. It will also coordinate the policies and programmes of the various ministries, departments and agencies as they relate to the water and sanitation sector (ECA, 2007).

Ministry of Planning and Economic DevelopmentMinistry of Planning and Economic Development

In view of the role of water in domestic, agricultural, industrial, commercial, energy use and the environment, economic planning and development must be integrated with water management. In the area of water resources development, it has responsibility for the formulation of national development objectives, strategies and implementation. It mobilizes both internal and external funds for projects including those of the water sector (ECA, 2007).In view of the role of water in domestic, agricultural, industrial, commercial, energy use and the environment, economic planning and development must be integrated with water management. In the area of water resources development, it has responsibility for the formulation of national development objectives, strategies and implementation. It mobilizes both internal and external funds for projects including those of the water sector (ECA, 2007).

Ministry of FinanceMinistry of Finance

The Ministry is responsible for mobilizing government revenue and marshalling other activities to finance government budgets including raising internal and external loans and their repayment (ECA, 2007).The Ministry is responsible for mobilizing government revenue and marshalling other activities to finance government budgets including raising internal and external loans and their repayment (ECA, 2007).

Development PartnersDevelopment Partners

These consist of governmental and non-governmental organizations. The non-governmental agencies work directly with communities to provide water supply and sanitation facilities. They include CARE, Action Aid, Water Aid, World Vision, Oxfam, Pan International, etc. The governmental ones include EU, UNICEF, GTZ, World Bank, Danida, and JICA (ECA, 2007).These consist of governmental and non-governmental organizations. The non-governmental agencies work directly with communities to provide water supply and sanitation facilities. They include CARE, Action Aid, Water Aid, World Vision, Oxfam, Pan International, etc. The governmental ones include EU, UNICEF, GTZ, World Bank, Danida, and JICA (ECA, 2007).

As water resources have never been a serious constraint to development in Sierra Leone, no base exists for their management (except for the water supply and sanitation sector).As water resources have never been a serious constraint to development in Sierra Leone, no base exists for their management (except for the water supply and sanitation sector).

According to ECA (2007), Sierra Leone is endowed with vast surface and groundwater resources. These resources are unevenly distributed in space and in time and in the dry season there appears to be an acute shortage of drinking water in urban and rural settlements. The demands on the resources are increasing and are also threatened by rapid population growth and shift, increased industrial activities, environmental degradation that causes soil erosion and pollution of wetlands.According to ECA (2007), Sierra Leone is endowed with vast surface and groundwater resources. These resources are unevenly distributed in space and in time and in the dry season there appears to be an acute shortage of drinking water in urban and rural settlements. The demands on the resources are increasing and are also threatened by rapid population growth and shift, increased industrial activities, environmental degradation that causes soil erosion and pollution of wetlands.

The laws for managing water are scattered and in different enactments. For example, the licensing of water abstraction is given to GVWCO, SALWACO and the Chief Engineer of the Public Works Department. The same applies to catchment management, which is also provided for in the Forestry Regulations and the Environmental Protection Act. There are no effective arrangements to implement the laws at the local level.The laws for managing water are scattered and in different enactments. For example, the licensing of water abstraction is given to GVWCO, SALWACO and the Chief Engineer of the Public Works Department. The same applies to catchment management, which is also provided for in the Forestry Regulations and the Environmental Protection Act. There are no effective arrangements to implement the laws at the local level.

ConstraintsConstraints

The problems of water resources management are due, among other things, to (ECA, 2007):The problems of water resources management are due, among other things, to (ECA, 2007):

•Lack of a central body that will ensure that resources are managed in an integrated manner, to meet the demand for socio-economic development and the demands of protecting the resources

and maintaining the productivity of the aquatic and terrestrial ecosystems – for present and future generations;•Lack of a central body that will ensure that resources are managed in an integrated manner, to meet the demand for socio-economic development and the demands of protecting the resources and maintaining the productivity of the aquatic and terrestrial ecosystems – for present and future generations;
•Lack of policies to respond to climate variability and change to ensure that there is a coping mechanism when water occurs in extremes (i.e. floods and droughts);•Lack of policies to respond to climate variability and change to ensure that there is a coping mechanism when water occurs in extremes (i.e. floods and droughts);
•Inadequate knowledge about both surface and groundwater resources.•Inadequate knowledge about both surface and groundwater resources.
•The laws and regulations for water resources management are scattered in different legislations leading to inertia;•The laws and regulations for water resources management are scattered in different legislations leading to inertia;
•Lack of public awareness on the need to manage water resources;•Lack of public awareness on the need to manage water resources;
•Lack of participation and capacity in the management of water resources at national, provincial, district and community levels.•Lack of participation and capacity in the management of water resources at national, provincial, district and community levels.
ChallengesChallenges
To overcome the above constraints the following challenges must be met (ECA, 2007):To overcome the above constraints the following challenges must be met (ECA, 2007):
•Developing comprehensive plans for the integrated management and efficient use of water resources;•Developing comprehensive plans for the integrated management and efficient use of water resources;
•Developing an institutional framework that addresses fundamental human needs, ecosystems, and conservation and promotes local participation in the management of the water resources;•Developing an institutional framework that addresses fundamental human needs, ecosystems, and conservation and promotes local participation in the management of the water resources;
•Encouraging capacity building efforts to make available the knowledge and the skills necessary to manage water resources at various levels;•Encouraging capacity building efforts to make available the knowledge and the skills necessary to manage water resources at various levels;
•Developing appropriate legal and regulatory frameworks;•Developing appropriate legal and regulatory frameworks;
•Strengthening basic and further professional training institutions in water management, or to create them, where necessary;•Strengthening basic and further professional training institutions in water management, or to create them, where necessary;
•Monitoring and carrying out an assessment of water resources availability (surface and groundwater) qualitatively and quantitatively.•Monitoring and carrying out an assessment of water resources availability (surface and groundwater) qualitatively and quantitatively.
Drinking water supplyDrinking water supply
Despite these vast resources, the country currently faces severe constraints in the availability of water for domestic and agricultural purposes. The national average water supply coverage is 22 per cent and ranged from 14 per cent for Kailahun to 46 per cent for the western area, while sanitation ranged from 6 per cent in Kailahun to 15 per cent in the western area. The present national coverage of 22 per cent for water supply compares unfavourably with 35 per cent achieved at the end of the International Drinking-Water Supply and Sanitation Decade (IDWSSD) in 1990.Despite these vast resources, the country currently faces severe constraints in the availability of water for domestic and agricultural purposes. The national average water supply coverage is 22 per cent and ranged from 14 per cent for Kailahun to 46 per cent for the western area, while sanitation ranged from 6 per cent in Kailahun to 15 per cent in the western area. The present national coverage of 22 per cent for water supply compares unfavourably with 35 per cent achieved at the end of the International Drinking-Water Supply and Sanitation Decade (IDWSSD) in 1990.
Constraints to drinking water supplyConstraints to drinking water supply
The low levels of coverage are due to the following institutional, water resource, infrastructure, financial, participation and capacity constraints. Among these are (ECA, 2007)The low levels of coverage are due to the following institutional, water resource, infrastructure, financial, participation and capacity constraints. Among these are (ECA, 2007)
- Dry season shortages due to:- Dry season shortages due to:
•Inadequate storage;•Inadequate storage;
•Depletion of water resources arising from deforestation; •Depletion of water resources arising from deforestation;
•Absence of drilling capacity to access the deeper aquifers; •Absence of drilling capacity to access the deeper aquifers;
•Lack of biophysical data and information (e.g. hydrometeorological) to assess the available surface and groundwater resources;•Lack of biophysical data and information (e.g. hydrometeorological) to assess the available surface and groundwater resources;
•Inability to use other water conservation techniques, such as rainfall harvesting;•Inability to use other water conservation techniques, such as rainfall harvesting;
•Loss of water in the water supply transmission and distribution systems;•Loss of water in the water supply transmission and distribution systems;
•Inability to plan to meet rising demand, partly due to demographic shift in such places as Freetown and the provincial capitals;•Inability to plan to meet rising demand, partly due to demographic shift in such places as Freetown and the provincial capitals;
•Inability to respond to climate variability and change. •Inability to respond to climate variability and change.
•Inability to control pollution of rivers.•Inability to control pollution of rivers.
-Many installed systems do not function due to lack of maintenance or vandalism;-Many installed

systems do not function due to lack of maintenance or vandalism;
-Inadequate maintenance due to lack of spare parts and insufficient commitment on the part of some WATSANS and caretakers to perform their jobs;-Inadequate maintenance due to lack of spare parts and insufficient commitment on the part of some WATSANS and caretakers to perform their jobs;
-Inability to raise capital to finance the rehabilitation and expansion of existing systems and construction of new ones;-Inability to raise capital to finance the rehabilitation and expansion of existing systems and construction of new ones;
-Lack of clear policy on capital cost, operations and maintenance and cost sharing;-Lack of clear policy on capital cost, operations and maintenance and cost sharing;
-Lack of mechanism for setting tariffs to ensure affordability and ability to pay;-Lack of mechanism for setting tariffs to ensure affordability and ability to pay;
-Inability to recover costs from beneficiaries and institutions of the Government of Sierra Leone (GOSL);-Inability to recover costs from beneficiaries and institutions of the Government of Sierra Leone (GOSL);
-Lack of participation by beneficiaries in setting tariffs;-Lack of participation by beneficiaries in setting tariffs;
-Lack of awareness of the need to make payment because water is perceived as a natural gift;-Lack of awareness of the need to make payment because water is perceived as a natural gift;
-Unwillingness to pay due to poor service;-Unwillingness to pay due to poor service;
-Capital and operations and maintenance cost-sharing arrangements not being fulfilled by GOSL;-Capital and operations and maintenance cost-sharing arrangements not being fulfilled by GOSL;
-Overburdening of government finances.-Overburdening of government finances.
-Inadequate participation of community leadership and members;-Inadequate participation of community leadership and members;
-Inability to recognize and cater for the special role of gender (particularly women and children);-Inability to recognize and cater for the special role of gender (particularly women and children);
-Lack of involvement of beneficiaries in the choice of infrastructural technologies;-Lack of involvement of beneficiaries in the choice of infrastructural technologies;
-Lack of management of the water resources-Lack of management of the water resources
-Over-concentration of organization at head office without sufficient representation at district level, where real development activities take place;-Over-concentration of organization at head office without sufficient representation at district level, where real development activities take place;
-Lack of coordination of the institutions in the water and sanitation sub-sector;-Lack of coordination of the institutions in the water and sanitation sub-sector;
-Inability to enforce regulations such as pollution control and quality standards;-Inability to enforce regulations such as pollution control and quality standards;
-Lack of clarity in ownership, management and over-concentration on the public sector institutions without involving the private sector;-Lack of clarity in ownership, management and over-concentration on the public sector institutions without involving the private sector;
-Inadequate data and information about water resources (surface and groundwater) for planning and operations and maintenance;-Inadequate data and information about water resources (surface and groundwater) for planning and operations and maintenance;
-Insufficient data on consumers for setting tariffs;-Insufficient data on consumers for setting tariffs;
-Insufficient data on coverage for planning;-Insufficient data on coverage for planning;
-Inadequate sanitation infrastructure to maximize the benefits from providing safe drinking water;-Inadequate sanitation infrastructure to maximize the benefits from providing safe drinking water;
-Inadequate capacity of the local councils in the urban centres to manage garbage and excreta in a safe manner;-Inadequate capacity of the local councils in the urban centres to manage garbage and excreta in a safe manner;
-Lack of organizational, manpower, financial and information capacity of the various institutions at central, provincial, district, chiefdom and town/village levels.-Lack of organizational, manpower, financial and information capacity of the various institutions at central, provincial, district, chiefdom and town/village levels.
ChallengesChallenges
To overcome the above constraints so that coverage can be increased to meet Vision 2025 targets, the following challenges must be addressed (ECA, 2007):To overcome the above constraints so that coverage can be increased to meet Vision 2025 targets, the following challenges must be addressed (ECA, 2007):
-Managing water resources and applying appropriate conservation technologies to meet demand in the dry seasons;-Managing water resources and applying appropriate conservation technologies to meet demand in the dry seasons;
-Increasing the participation of women in decision-making;-Increasing the participation of women in decision-making;
-Mainstreaming gender in hygiene promotion;-Mainstreaming gender in hygiene promotion;
-Using technologies that take account of capital, operation and maintenance costs;-Using technologies that take account of capital, operation and maintenance costs;
-Enforcing regulations and application of appropriate sanctions for violation of pollution laws;-Enforcing regulations and application of appropriate sanctions for violation of pollution laws;
-Involving communities in determining tariffs;-Involving communities in determining tariffs;
-Making tariff setting transparent;-Making tariff setting transparent;
-Improving knowledge about and management of water resources to meet the needs of other sectors and the environment;-Improving knowledge about and management of water resources to meet the needs of other sectors and the environment;
-Applying regulatory policies that allow private participation and eventually reduce dependence on donors;-Applying regulatory policies that allow private participation and eventually reduce dependence on donors;

-Promoting public and private partnership;-Promoting public and private partnership;
-Re-enforcing the policy of government payment for water consumed;-Re-enforcing the policy of government payment for water consumed;
-Charging fees for urban wastewater;-Charging fees for urban wastewater;
-Developing effective financial system;-Developing effective financial system;
-Decentralizing regulatory bodies;-Decentralizing regulatory bodies;
-Training professionals locally to be able to address national problems.-Training professionals locally to be able to address national problems.
Water for agriculture and food productionWater for agriculture and food production
In spite of its abundant water resources, the country is mainly a rain-fed agricultural country. Agriculture accounts for about 40 per cent of the gross domestic product (GDP). Available arable land is 53,000km2 , and almost 80 per cent of farmers cultivate less than 10 per cent of the land.In spite of its abundant water resources, the country is mainly a rain-fed agricultural country. Agriculture accounts for about 40 per cent of the gross domestic product (GDP). Available arable land is 53,000km2 , and almost 80 per cent of farmers cultivate less than 10 per cent of the land.
Constraints to water use in agriculture and food securityConstraints to water use in agriculture and food security
The following are among the constraints in managing water resources in the effort to achieve food security (ECA, 2007):The following are among the constraints in managing water resources in the effort to achieve food security (ECA, 2007):
-Erratic and high intensity rainfall that erodes vulnerable soils;-Erratic and high intensity rainfall that erodes vulnerable soils;
-Unevenly distributed and unpredictable rains that upset farming;-Unevenly distributed and unpredictable rains that upset farming;
-Poor water control in swamps and low-lying areas leading to salinity accumulation and iron toxicity;-Poor water control in swamps and low-lying areas leading to salinity accumulation and iron toxicity;
-Lack of adequate databases on water resources of Sierra Leone;-Lack of adequate databases on water resources of Sierra Leone;
-Inadequate training (formal or informal) in water resources management;-Inadequate training (formal or informal) in water resources management;
-Deforestation due to shifting cultivation, mining, urbanization, infrastructural development, logging for timber, fuelwood, etc.-Deforestation due to shifting cultivation, mining, urbanization, infrastructural development, logging for timber, fuelwood, etc.
-Inadequate coordinated support from other sectors for agriculture, inland fisheries and aquaculture;-Inadequate coordinated support from other sectors for agriculture, inland fisheries and aquaculture;
-Limited credit for financing irrigation and other capital-intensive investments involving water.-Limited credit for financing irrigation and other capital-intensive investments involving water.
ChallengesChallenges
The challenges facing use of water to increase food production to achieve food security include (ECA, 2007):The challenges facing use of water to increase food production to achieve food security include (ECA, 2007):
-Providing an enabling environment for equal opportunity to access, control and participate in water resources management;-Providing an enabling environment for equal opportunity to access, control and participate in water resources management;
-Formulating the rights of women in decision-making to access, control and participate in water issues for food production;-Formulating the rights of women in decision-making to access, control and participate in water issues for food production;
-Mainstream food security programmes in all ministries, especially:-Mainstream food security programmes in all ministries, especially:
•Ministry of Works•Ministry of Works
•Ministry of Trade and Industry •Ministry of Trade and Industry
•Ministry of Fisheries and Marine Resources•Ministry of Fisheries and Marine Resources
•Ministry of Local Government and Community Development, etc.•Ministry of Local Government and Community Development, etc.
-Developing inter-departmental cooperation between the Ministry of Agriculture, Forestry and Food Security and the Ministry of Trade and Industry for protection of local markets;-Developing inter-departmental cooperation between the Ministry of Agriculture, Forestry and Food Security and the Ministry of Trade and Industry for protection of local markets;
-Managing the river catchments to reduce deforestation and its impacts;-Managing the river catchments to reduce deforestation and its impacts;
-Building capacity to use water for irrigation of crops to increase food production;-Building capacity to use water for irrigation of crops to increase food production;
-Providing support for research in water resources management for food production;-Providing support for research in water resources management for food production;
-Supporting institutions that provide credit for irrigation schemes to increase food production.-Supporting institutions that provide credit for irrigation schemes to increase food production.
Water for EnergyWater for Energy
The hydropower potential of Sierra Leone is estimated at 1513MW, scattered in 27 sites across the country. There are considerable flow variations between wet and dry seasons at these sites. At present, two sites have been developed. These are a 2.4MW plant at Guma and a 4MW plant which supplies part of the electricity needs of Bo and Kenema. The third plant has been out of service since 1982, for lack of maintenance. A plant is being built at Bumbuna with an installed capacity of 47MW with a 203km-long transmission line intended for the western region. The construction has been set back because of destruction caused by a decade of war. In 1995, the national installed capacity for electricity generation was 42MW. Of this, 5 per cent was accounted for by hydropower generation (ECA, 2007).The hydropower potential of Sierra Leone is estimated at 1513MW, scattered in 27 sites across the country. There are considerable flow variations between wet and dry seasons at these sites. At present, two sites have been developed. These are a 2.4MW plant at

Guma and a 4MW plant which supplies part of the electricity needs of Bo and Kenema. The third plant has been out of service since 1982, for lack of maintenance. A plant is being built at Bumbuna with an installed capacity of 47MW with a 203km-long transmission line intended for the western region. The construction has been set back because of destruction caused by a decade of war. In 1995, the national installed capacity for electricity generation was 42MW. Of this, 5 per cent was accounted for by hydropower generation (ECA, 2007).

Water and EnvironmentWater and Environment

Rainfall shows variability in space and time. Apart from annual and seasonal variabilities, changes in climate caused by greenhouse gas emissions into the atmosphere could cause changes in the long-term average amounts of rainfall. In the 1970s and 1980s, there was a decrease in rainfall in West Africa, particularly in the Sahel region. Droughts seem to be more frequent. Climate variability and change affect the water available in the environment for domestic and industrial water supply, hydroelectric power generation, irrigation, etc. These are borne out by the difficulty of satisfying demand for domestic water from hand dug wells and boreholes, as well as from impounded reservoirs in the dry season (ECA, 2007).Rainfall shows variability in space and time. Apart from annual and seasonal variabilities, changes in climate caused by greenhouse gas emissions into the atmosphere could cause changes in the long-term average amounts of rainfall. In the 1970s and 1980s, there was a decrease in rainfall in West Africa, particularly in the Sahel region. Droughts seem to be more frequent. Climate variability and change affect the water available in the environment for domestic and industrial water supply, hydroelectric power generation, irrigation, etc. These are borne out by the difficulty of satisfying demand for domestic water from hand dug wells and boreholes, as well as from impounded reservoirs in the dry season (ECA, 2007).

Agriculture affects water in the environment as erosion from uplands cause sedimentation of reservoirs. It also causes pollution of surface waters from use of agrochemicals. This has a negative impact on human health and the flora and fauna in the aquatic ecosystem. Coastal and inland transportation may lead to pollution from propulsion engines. Mining and drilling operations contribute to these environmental problems in Sierra Leone. The increase in population, particularly in the urban centres of Freetown, Bo, Makena and Kenema during the war has increased wastes that find themselves directly and indirectly into water bodies. These cause degradation in the quality of freshwater that is used by humans and fauna and flora in the aquatic ecosystem. Deforestation can lead to depletion of the water resources, thereby putting the sustainability of projects in jeopardy. Construction of roads, bridges and jetties will increase siltation and pollute surface and groundwater resources (ECA, 2007).Agriculture affects water in the environment as erosion from uplands cause sedimentation of reservoirs. It also causes pollution of surface waters from use of agrochemicals. This has a negative impact on human health and the flora and fauna in the aquatic ecosystem. Coastal and inland transportation may lead to pollution from propulsion engines. Mining and drilling operations contribute to these environmental problems in Sierra Leone. The increase in population, particularly in the urban centres of Freetown, Bo, Makena and Kenema during the war has increased wastes that find themselves directly and indirectly into water bodies. These cause degradation in the quality of freshwater that is used by humans and fauna and flora in the aquatic ecosystem. Deforestation can lead to depletion of the water resources, thereby putting the sustainability of projects in jeopardy. Construction of roads, bridges and jetties will increase siltation and pollute surface and groundwater resources (ECA, 2007).

There is no comprehensive water resources development policy or strategy (except for the water supply and sanitation sector with the Sierra Leone Water Company Act of 1991) in Sierra Leone, for the same reason already mentioned above: water resources have never been a serious constraint to development in the country.There is no comprehensive water resources development policy or strategy (except for the water supply and sanitation sector with the Sierra Leone Water Company Act of 1991) in Sierra Leone, for the same reason already mentioned above: water resources have never been a serious constraint to development in the country.

According to WAEA (2008), with support from the United Nations Economic Commission of Africa, a water and sanitation policy for Sierra Leone has been developed. The policy seeks to mitigate the challenges that face the use of water to achieve food security. They include managing the river catchments to reduce deforestation and its impact, building capacity to use water for irrigation of crops to increase food production, and providing support for research in water resources management for food production. Supporting institutions that provide credit for irrigation schemes to increase food production was also highlighted.According to WAEA (2008), with support from the United Nations Economic Commission of Africa, a water and sanitation policy for Sierra Leone has been developed. The policy seeks to mitigate the challenges that face the use of water to achieve food security. They include managing the river catchments to reduce deforestation and its impact, building capacity to use water for irrigation of crops to increase food production, and providing support for research in water resources management for food production. Supporting institutions that provide credit for irrigation schemes to increase food production was also highlighted.

<h2>2.2.WATER MANAGEMENT2.2.WATER MANAGEMENT<h2>2.3.WATER POLICY AND LEGAL FRAMEWORK2.3.WATER POLICY AND LEGAL FRAMEWORK

3. GEOPOLITICAL ASPECTS

Sierra Leone is located in West Africa, is bordered by Guinea in the north and east, and by Liberia in the east and south.

Sierra Leone shares several river basins with neighbouring countries, such as the Kolente (Great Scarcies) and the Kaba with Guinea, the Mano with Liberia, and the Moa with Guinea and Liberia. The inflows into Sierra Leone from these transnational watercourses are considered negligible. Sierra Leone is a member of the Mano River Union, a regional body whose activities impact on agriculture and rural development.

According to ECA (2007), Sierra Leone shares four of its major rivers with neighbouring states, namely Guinea and Liberia. There are arrangements for cooperation in order to manage the

resources of the Mano River, and to meet the legitimate and equitable needs of the riparian countries. The arrangements are not being implemented for lack of political will and capacity. No arrangements have yet been put in place to manage the Great Scarcies, Little Scarcies and Moa river basins that Sierra Leone shares with the Republic of Guinea.

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