Water Risk Filter

Country Overview - Liberia

Water Indicators

Indicator	Value	Description	Source
Overall Basin Risk (score)	2.37	Overall Basin Risk (score)	
Overall Basin Risk (rank)	154	Overall Basin Risk (rank)	
Physical risk (score)	1.84	Physical risk (score)	
Physical risk (rank)	174	Physical risk (rank)	
Regulatory risk (score)	3.88	Regulatory risk (score)	
Regulatory risk (rank)	10	Regulatory risk (rank)	
Reputation risk (score)	2.46	Reputation risk (score)	
Reputation risk (rank)	127	Reputation risk (rank)	
1. Quantity - Scarcity (score)	1.61	1. Quantity - Scarcity (score)	
1. Quantity - Scarcity (rank)	154	1. Quantity - Scarcity (rank)	
2. Quantity - Flooding (score)	2.56	2. Quantity - Flooding (score)	
2. Quantity - Flooding (rank)	137	2. Quantity - Flooding (rank)	
3. Quality (score)	1.34	3. Quality (score)	
3. Quality (rank)	174	3. Quality (rank)	
4. Ecosystem Service Status (score)	2.23	4. Ecosystem Service Status (score)	
4. Ecosystem Service Status (rank)	108	4. Ecosystem Service Status (rank)	
5. Enabling Environment (Policy & Laws) (score)	4.10	5. Enabling Environment (Policy & Laws) (score)	
5. Enabling Environment (Policy & Laws) (rank)	10	5. Enabling Environment (Policy & Laws) (rank)	
6. Institutions and Governance (score)	3.50	6. Institutions and Governance (score)	
6. Institutions and Governance (rank)	63	6. Institutions and Governance (rank)	
7. Management Instruments (score)	3.75	7. Management Instruments (score)	
7. Management Instruments (rank)	15	7. Management Instruments (rank)	
8 - Infrastructure & Finance (score)	4.45	8 - Infrastructure & Finance (score)	
8 - Infrastructure & Finance (rank)	29	8 - Infrastructure & Finance (rank)	
9. Cultural Diversity (score)	2.00	9. Cultural importance (score)	
9. Cultural Diversity (rank)	117	9. Cultural importance (rank)	
10. Biodiversity Importance (score)	4.40	10. Biodiversity importance (score)	

Water Risk Filter

Country Overview - Liberia

Indicator	Value	Description	Source
10. Biodiversity Importance (rank)	34	10. Biodiversity importance (rank)	
11. Media Scrutiny (score)	2.10	11. Media Scrutiny (score)	
11. Media Scrutiny (rank)	173	11. Media Scrutiny (rank)	
12. Conflict (score)	2.51	12. Conflict (score)	
12. Conflict (rank)	95	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)	160	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)	182	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)	1.00	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.

Indicator	Value	Description	Source
1.2 - Baseline Water Stress (rank)	180	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)	2.66	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)	91	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)	1.65	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)	123	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.

Indicator	Value	Description	Source
1.5 - Drought Frequency Probability (score)	1.74	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)	163	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)	133	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)	2.49	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)	140	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.

Indicator	Value	Description	Source
2.2 - Projected Change in Flood Occurrence (by ~2050) (score)	3.94	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)	6	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)	1.34	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.

Indicator	Value	Description	Source
3.1 - Surface Water Contamination Index (rank)	174	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)	1.35	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)	165	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)	4.71	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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Country Overview - Liberia

Indicator	Value	Description	Source
4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (rank)	4	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)	2.15	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)	110	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)	92	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)	5.00	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.

Indicator	Value	Description	Source
5.2 - Freshwater Law Status (SDG 6.5.1) (rank)	3	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)	3.00	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)	109	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)	86	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.

Indicator	Value	Description	Source
6.2 - Freedom in the World Index (rank)	128	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)	4.00	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)	37	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)	18	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.

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)	122	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)	3.31	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)	97	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)	40	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.

Indicator	Value	Description	Source
8.2 - Access to Sanitation (rank)	45	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)	4.00	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)	53	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)	2.00	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)	117	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)	3.80	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.

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Indicator	Value	Description	Source
10.1 - Freshwater Endemism (rank)	98	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)	5.00	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)	14	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)	3.00	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)	159	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)	1.00	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)	180	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)

Country Overview - Liberia

Indicator	Value	Description	Source
12.1 - Conflict News Events (RepRisk) (score)	4.00	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)	50	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)	1.01	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)	194	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 (#)	4613823	Population, total	The World Bank 2018, Data , hompage accessed 20/04/2018
GDP (current US$)	2101000000	GDP (current US$)	The World Bank 2018, Data , hompage accessed 20/04/2018
EPI 2018 score (0-100)	41.62	Environmental Performance Index	
WGI -Voice and Accountability (0-100)	25.71	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

Indicator	Value	Description	Source
WGI -Political stability no violence (0-100)	43.35	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)	8.17	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)	15.87	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)	17.79	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)	26.44	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 - Liberia

Indicator	Value	Description	Source
WRI BWS all industries (0-5)	0.27	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)	150	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)	145	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)	145	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)	144	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 - Liberia

Indicator	Value	Description	Source
Baseline Water Stress (BWS) - 2030 BAU (increasing rank describes lower risk)	147	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)	147	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)	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) - 2040 BAU (increasing rank describes lower risk)	151	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)	151	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)	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.

Water Risk Filter

Country Overview - Liberia

Indicator	Value	Description	Source
Total water footprint of national consumption (m3/a/cap)	1234.56	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 (%)	12.30	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)	0.10	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)	2.10	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)	200.00	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)	32.00	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)	200.00	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 - Liberia

Indicator	Value	Description	Source
Total renewable water resources (10^9 m3/year)	232.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Dependency ratio (%)	13.79	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)	51521.00	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]	3.50	WorldHappinessReport.org	World Happiness Report, homepage accessed 20/04/2018

Country Aspects

1. PHYSICAL ASPECTS

1.1. WATER RESOURCES

1.1.1. WATER RESOURCES

Liberia can be divided into two kinds of river systems:
-the major basins, which drain 97 per cent of the territory in a general northeast-southwest direction. Of these, the six major rivers, (Mano, Lofa, Saint Paul, Saint John, Cestos, and Cavalla) originating in Sierra Leone, Guinea or in Côte d'Ivoire together drain 65.5 per cent of the country; and
-the short coastal watercourses, which drain about 3 per cent of the country [WAEA, 2008].
Internal renewable surface water resources are estimated to be 200km3/year and internal groundwater is estimated to be 60km3/year; all of the latter is believed to be drained by watercourses [WAEA, 2008]. Thus, the total internally produced renewable water resources are 200km3/year, while an additional 32km3/year comes from Guinea and Côte d'Ivoire, bringing the total renewable water resources to 232km3/year. [WAEA, 2008]. Liberia is one of the African countries with the highest amount of renewable water resources per inhabitant; more than 71,000m3/year.
There are several important rivers in Liberia. The longest is the Cavalla River shared between Liberia and Cote D'Ivoire while the Mano River is shared between Liberia and Sierra Leone. St. Paul River is the second longest river feeding Mt. Coffee hydro-electric plant and providing the bulk of the raw water for Monrovia [MLME, 2007].
There are only two major lakes in Liberia: Lake Shepherd in Maryland County; and Lake Piso in Grand Cape Mount County, with Piso being larger of the two. Both of them are situated along the Atlantic Ocean, with Lake Piso characterized by a vast expanse of wetlands and lowland forest vegetation [MLME, 2007].
Generally, groundwater is available and can be exploited in most parts of the country in amounts needed for rural water supply, which relies on dug wells and to some extent on drilled boreholes. Data from the rural water supply programme indicate that the depth to the water table in shallow wells can be less than one metre. Drilled boreholes can be as deep as 100 metres. Reliable data on boreholes and yields are, however, scarce [MLME, 2007].

1.1.2. WATER USE

Total water withdrawal in the year 2000 was estimated at 106.8 million m3. The main water user was agriculture with 60 million m3/year (57 per cent), followed by municipalities with 30.4 million m3/year (28 per cent) and industry with 16.4 million m3/year (15 per cent).

Liberia has a total land area of approximately 98,000km², of which 46,000 km² is arable land (46 per cent). Of the arable land, 40,000km² is upland while the remaining 6,000km² is swampland, with irrigation potential. Prior to the war, about 6,340km² (13.8 per cent of total arable land) was cultivated, mainly under rice and cassava. At present, it is estimated that annual cultivation is less than 5 per cent of the arable land. Most of the swamp areas on which subsistence farmers cultivate rice comprise narrow inland valleys and widely scattered small swamps which are cleared using hand labour, and which make extensive of water control structures. Under traditional farming practices, yields of rice, is about 1ton/ha. However, under improved water management practices, rice yield is in the range of 3-4 tons/ha [WAEA, 2008].
According to the assessment on agriculture conducted in 2007, irrigation infrastructure is virtually non-existent, despite the presence of abundant water resources in the country. Areas with good water control and having the possibility of two crops per year are limited. Conventional upland irrigation is not considered an issue in Liberia because of water surplus in all the agro-ecological zones in the country and the large area of swampland available for development. Shallow-well irrigation farming and peri-urban irrigation also take place on a limited scale in Liberia. These activities are probably taken for granted and therefore do not receive any recognition in the plans for achieving food security [WAEA, 2008].
Three hydropower stations were functioning in the 1970s and 80s, but two of these have been destroyed. The smallest, a 4MW plant located in Harbel, Margibi County, is reportedly still working. Liberia generated 182MW of electricity through a combination of hydropower and oil-fired generation before the war. The biggest loss was the Mount Coffee hydropower plant which generated 35 per cent of the electricity for the country. Before the crisis, hydropower provided about 70 per cent of electricity in Liberia, but now, as a result of the crisis, the bulk of the present energy consumption, is derived from firewood and charcoal. About 97 per cent of Liberian households are without state generated electricity [WAEA, 2008].
Liberia is endowed with abundant water resources, but they are poorly utilized. It is estimated that there is an annual rainfall of about 5,000mm; hence food production during the rainy season is plentiful. However, this is not the case during the dry season when the water table goes down in most part of the country, with a notable loss of food and potential income by farmers. Fortunately, the country has many inland swamps that could be highly valuable for agriculture, particularly rice and vegetable production. However, the utilization of these lands has been minimal because of health hazards and cultural stigma. Adequate equipment, appropriate technology and sensitization to the productivity and usefulness of the swamps could help to integrate such lands into the agriculture and food production system of the country [NEPAD, 2005].
Inland swamps are generally under–utilized, but gained momentum during the 1990s with the advent of integrated agricultural development projects in Lofa, Bong and Nimba Counties. An appreciable impact was felt by the target population as a result of the introduction of lowland

development. Studies have shown that well–developed inland valley swamps, with sufficient water control systems, can become productive and sustainable farming undertakings. The use of appropriate equipment and sensitization of the people can significantly reduce the health hazards posed by swamps. Rice and vegetable production in the inland swamps is highly remunerative. Using inland swamps is also environmentally sound, as it can be cultivated on a continuous basis, hence reducing the need for the environmentally destructive practice of shifting cultivation [NEPAD, 2005].

1.2. WATER QUALITY, ECOSYSTEMS AND HUMAN HEALTH

The main environmental problems in Liberia are: tropical rain forest deforestation; soil erosion; loss of biodiversity; and pollution of coastal waters from oil residue and raw sewage. Water-borne diseases such as diarrhoea, dysentery, cholera and infectious hepatitis are common.

Data on water quality both from surface and groundwater are scarce. Domestic sewage, however, causes many problems as the only conventional sewerage system, - which was already poorly functioning before the civil crisis - is out of operation. Some sewage water is collected by vacuum trucks and disposed of into lagoons and other water bodies. In some areas there are indications that water quality is deteriorating due to mining, logging, farming and industrial activities [MLME, 2007].

Water and sanitation access data in Liberia is generally unreliable. However, it has been obvious that the water supply and sanitation (WSS) sector has seriously deteriorated after 14 years of civil war [USAID, 2006].

Destruction and population displacement (there are approximately 500,000 internally displaced people, about half living in camps and half in informal settlements) means that almost a complete rehabilitation of the WSS systems is required, including re-starting operation and maintenance (O&M) activities. With approximately 80 per cent of the population living in absolute poverty and 54 per cent in extreme poverty (living on less than US$1/per day), the WSS sector will be reliant on outside donor assistance for years to come. Cost recovery is a much lower priority than meeting essential needs. Rapid population growth in the capital, Monrovia, has severely stressed the only marginally functional urban WSS system. Rural areas remain relatively unpopulated and devoid of functional facilities while other urban areas have had their systems fall into complete disrepair. Looting, vandalism, lack of spare parts, and lack of technical knowledge perpetuate the difficulty in providing service. Management of water points remains a major challenge, even in those areas that are accessible. Communities are generally unwilling or unable to contribute funds for upkeep [USAID, 2006].

Rubber resources are a key source of wealth for Liberia, comprising one of the nation's top export commodities. The rubber concession of Firestone Nature Rubber Plantation (an American company), makes it the second-largest producer of rubber on the continent. Pollution from Firestone's plantation in Harbel, Lower Margibi County, 45 km from the capital Monrovia, however, has had a serious impact on the health and livelihoods of local residents. Operations have contaminated Ninpu creek, used by the Kpayah town community for fishing and drinking water. The local wetlands are an important resource for the area. Local residents have reported falling ill with diarrhoea after consuming the water [UNEP, 2010].

2. GOVERNANCE ASPECTS

2.1. WATER INSTITUTIONS

The National Water Resources and Sanitation Board was created in 1981 in order to coordinate the activities of the different institutions or corporations involved in the management of water resources. Before the conflict, the main institutions involved were:

-The Liberia Water and Sewer Corporation (LWSC), in charge of the water supply systems in the urban areas;

-The Ministry of Agriculture, in charge, inter alia, of irrigation;

-The Ministry of Health and Social Affairs, in charge of sewerage;

-The Liberia Electricity Corporation, in charge of hydro-electric energy production;

-The Ministry of Rural Development in charge of water supply in rural areas; and

-The Hydrology Service of the Ministry of Land, Mines and Energy.

Coordinating bodies

National Water Resources and Sanitation Board (NWRSB)

A National Water Resources Board was formed in 1980 in recognition of the need to adopt a coordinated approach to water development, especially in light of the International Drinking Water and Sanitation Decade (IDWSSD). The Ministry of Lands, Mines and Energy served as the chairman while the Liberian Hydrological Services served as the secretariat. The board worked on the coordination of all activities in water resources development, reviewing sectoral regulations and drafting water legislation and policy. The board has stopped operating, but is not formally dissolved. This board prepared Liberia's first water and sanitation action plan covering 12 years, from 1985 to 1997 [MLME, 2007].

National Public Health Committee

Established in 1986, the committee coordinated the water and sanitation affairs in the absence of the NWRSB. It was an ad-hoc committee constituted to spearhead the mitigation of serious rubbish problems in the City of Monrovia as the result of the inability of the NWRSB to function effectively [MLME, 2007].

WATSAN

The Water and Sanitation Coordinating Committee (WATSAN) was established in 1992 and tasked with coordination of the activities of the water sector institutions in the country. WATSAN produced working guidelines for the institutions, including the requirement to present an annual monitoring and evaluation report to the committee [MLME, 2007].

Ministry of Lands, Mines and Energy

The Ministry of Lands, Mines and Energy has the overall responsibility for water resources management and granting water permits, with the Liberian Hydrological Service Bureau of the ministry serving as the secretariat. The secretariat also serves as the focal point for hydrological data collection and storage. It provides technical support to other government agencies, and provides basic information on all aspects of water resources development, including water quality issues. Through the Liberian Hydrological Service the ministry had monitored over 40 hydrometric networks before the start of the civil crisis. The hydrometric networks monitored included rain gauges, staff gauges and discharge measuring units [MLME, 2007].

Ministry of Rural Development

The Ministry of Rural Development was charged with the responsibility for providing water supply and sanitation services to the rural population. This ministry provided boreholes, hand dug wells, and VIP Latrines thus serving numerous rural inhabitants. This ministry is now paused to be incorporated into the Ministry of Public Works [MLME, 2007].

Ministry of Health and Social Welfare

The Ministry of Health and Social Welfare is concerned primarily with health care delivery and is mandated in the water sector to make water quality assessments, in particular for domestic water supplies. The ministry sets standards of water quality and environmental health [MLME, 2007].

Ministry of Agriculture

The Ministry of Agriculture has been involved in the provision of safe and adequate water supply to their respective agricultural project localities [MLME, 2007].

Ministry of Transport

Ministry of Transport regulates the use of inland waterways [MLME, 2007].

The Liberia Water and Sewage Corporation

The Liberia Water and Sewage Corporation, was established in 1973 and mandated to provide safe drinking water for both the urban and rural population of Liberia. It operates on a commercial basis, although it provides basic water requirements to the urban poor at no cost [MLME, 2007].

Environmental Protection Agenc

The Environmental Protection Agency (EPA) has the mandate to promote environmental awareness and develop a national environmental policy for the country. The agency was established in 2003. EPA is responsible for coordinating, integrating and harmonizing the implementation of environmental policy and law under the guidance of the Environmental Council.

According to USAID (2006), in general, four government ministries oversee the WSS sector. WSS service is provided by one public corporation and a number of city corporations. The rules governing these bodies have not changed; however, the Water and Sanitation Coordination Committee and the inter-ministerial WatSan Committee are updating and developing standards, guidelines, policies, and laws for the WSS sector. Although good coordination of WSS sector objectives continues in the committees, a stronger secretariat is needed to effect the recommendations of both committees. In addition, greater transparency and accountability are needed so that political and financial interference does not constrain sector rebuilding.

Water resources management responsibilities are fragmented across several government agencies. The absence of a water policy, legal framework and a strong coordination mechanism has led to decreasing water quantity and quality even though Liberia potentially has substantial water resources. With the introduction of integrated water resources management (IWRM) in Liberia, a comprehensive framework of policy and environmental laws is now a key objective [MLME, 2007].

International commitmentsInternational commitments

The government is committed to working towards achieving the aims and objectives of the millennium development goals. Liberia's post-war Interim Poverty Reduction Strategy (iPRS) strongly supports 'providing water and sanitation'. The overall strategic objective 'is to increase safe drinking water and improve sanitation (healthy environment) for all in urban and rural areas' [iPRS, 2006 p.78]. Furthermore, the government has endorsed the general objectives of the IDWSSD since its inception in 1980 [MLME, 2007].The government is committed to working towards achieving the aims and objectives of the millennium development goals. Liberia's post-war Interim Poverty Reduction Strategy (iPRS) strongly supports 'providing water and sanitation'. The overall strategic objective 'is to increase safe drinking water and improve sanitation (healthy environment) for all in urban and rural areas' [iPRS, 2006 p.78]. Furthermore, the government has endorsed the general objectives of the IDWSSD since its inception in 1980 [MLME, 2007].

In addition, the declarations and guiding principles emanating from international forums on water resources management, which culminated in the UN Conference on Environment and Development (UNCED) in Rio de Janeiro in June 1992, have been endorsed by the government, especially Agenda 21 chapter 18 on freshwater resources.In addition, the declarations and guiding principles emanating from international forums on water resources management, which culminated in the UN Conference on Environment and Development (UNCED) in Rio de Janeiro in June 1992, have been endorsed by the government, especially Agenda 21 chapter 18 on freshwater resources.

The integrated water resources management policy promotes a new integrated approach to manage the water resources in ways that are sustainable and most beneficial to the people [MLME, 2007].The integrated water resources management policy promotes a new integrated approach to manage the water resources in ways that are sustainable and most beneficial to the people [MLME, 2007].

This new approach is based on the continued recognition of the social value of water, while at the same time giving due attention to its economic value. Thus, allocation in water resources development will aim to achieve the maximum net benefit to Liberia [MLME, 2007].This new approach is based on the continued recognition of the social value of water, while at the same time giving due attention to its economic value. Thus, allocation in water resources development will aim to achieve the maximum net benefit to Liberia [MLME, 2007].

Although the state is the ultimate custodian of the water resources, the aim of the policy is to achieve a public sense of ownership, thus mobilizing the people's resources to assist in the management, protection and conservation of this natural resource. The policy is designed to be a broad-based charter, which must be recognized by all concerned sector institutions, and be taken into account by all projects and programmes, both public and private [MLME, 2007].Although the state is the ultimate custodian of the water resources, the aim of the policy is to achieve a public sense of ownership, thus mobilizing the people's resources to assist in the management, protection and conservation of this natural resource. The policy is designed to be a broad-based charter, which must be recognized by all concerned sector institutions, and be taken into account by all projects and programmes, both public and private [MLME, 2007].

The policy covers two broad areas [MLME, 2007]:The policy covers two broad areas [MLME, 2007]:

•Water resources management: the management framework including policy objectives, principles and strategies for the monitoring, assessment, allocation and protection of the resources. The Ministry of Lands, Mines and Energy is to have overall responsibility for water resources management, regulation and coordination activities.•Water resources management: the management framework including policy objectives, principles and strategies for the monitoring, assessment, allocation and protection of the resources. The Ministry of Lands, Mines and Energy is to have overall responsibility for water resources management, regulation and coordination activities.

•Water resources use: policy objectives, principles and strategies for the development and use of water for people (domestic water supply), for food security (agriculture), for industry, for the maintenance of productive ecosystems and for other uses such as hydropower and, recreation, as well as non-revenue water (fire hydrants and trucks).•Water resources use: policy objectives, principles and strategies for the development and use of water for people (domestic water supply), for food security (agriculture), for industry, for the maintenance of productive ecosystems and for other uses such as hydropower and, recreation, as well as non-revenue water (fire hydrants and trucks).

Liberia has adopted the guiding principles for water resources management that emanated from the IDWSD Dublin-Rio de Janeiro (UNCED) process and Agenda 21's Chapter 18 on freshwater resources [MLME, 2007].Liberia has adopted the guiding principles for water resources management that emanated from the IDWSD Dublin-Rio de Janeiro (UNCED) process and Agenda 21's Chapter 18 on freshwater resources [MLME, 2007].

These guiding principles recognize [MLME, 2007]:These guiding principles recognize [MLME, 2007]:

•freshwater as a finite and vulnerable resource, essential to sustain life, development and the environment;•freshwater as a finite and vulnerable resource, essential to sustain life, development and the environment;

•management of water resources should take place at the lowest appropriate levels;•management of water resources should take place at the lowest appropriate levels;

•the role of government as an enabler in a participatory, demand-driven approach to development;•the role of government as an enabler in a participatory, demand-driven approach to development;

•water as a social and economic good, requiring integration of water and land use management;•water as a social and economic good, requiring integration of water and land use management;

•the essential role of women in the provision, management and safeguarding of water; and•the essential role of women in the provision, management and safeguarding of water; and

•the important role of the private sector in water management.•the important role of the private sector in water management.

Presently, there is no concrete comprehensive legal framework governing water resources in Liberia. Neither has there been an effective national integrated water resources management policy guiding the development, use, protection and conservation of water resources. Liberia's first water pollution control laws were contained in the Public Health Law 1956 which was revised in 1975 to become Title 33, the Act Establishing the New Public Health Law of Liberia. The key objective of Chapter 24 of the Act was to protect the water resources of Liberia [MLME, 2007].Presently, there is no concrete comprehensive legal framework governing water resources in Liberia. Neither has there been an effective national integrated water resources management policy guiding the development, use, protection and conservation of water resources. Liberia's first water pollution control laws were contained in the Public Health Law 1956 which was revised in 1975 to become Title 33, the Act Establishing the New Public Health Law of Liberia. The key objective of Chapter 24 of the Act was to protect the water resources of Liberia [MLME, 2007].

The Environment Protection and Management Law of the Republic of Liberia was approved in November 2002 with the key objective of ensuring the sound management of environmental and natural resources [MLME, 2007].The Environment Protection and Management Law of the Republic of Liberia was approved in November 2002 with the key objective of ensuring the sound management of environmental and natural resources [MLME, 2007].

<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

Liberia, located in West Africa, it borders Sierra Leone to the northwest, Guinea to the north, Cote d'Ivoire to the northeast and east, and the Atlantic Ocean to the south and southwest.

Liberia shares rivers with all its neighbouring countries:

-the Mano and Mugowi Rivers with Sierra Leone;

-the Makone, Lofa, Via, Nianda and Mani Rivers with Guinea; and

-the Cavalla River with Côte d'Ivoire, which forms a large part of the border between the two countries.

Liberia belongs to the Mano river basin organization known as the Mano River Union (MRU), comprising Sierra Leone, Liberia, and Guinea. The Mano River Union Agreement was signed by representatives of the three countries in 1973. The Union's secretariat has established a fruitful collaboration with development partners [MLME, 2007].

4. SOURCES

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