Water Risk Filter

## Country Overview - Haiti

# Water Indicators

| Indicator | Value | Description | Source |
|---|---|---|---|
| Overall Basin Risk (score) | 3.09 | Overall Basin Risk (score) | |
| Overall Basin Risk (rank) | 24 | Overall Basin Risk (rank) | |
| Physical risk (score) | 3.10 | Physical risk (score) | |
| Physical risk (rank) | 41 | Physical risk (rank) | |
| Regulatory risk (score) | 3.68 | Regulatory risk (score) | |
| Regulatory risk (rank) | 19 | Regulatory risk (rank) | |
| Reputation risk (score) | 2.48 | Reputation risk (score) | |
| Reputation risk (rank) | 118 | Reputation risk (rank) | |
| 1. Quantity - Scarcity (score) | 2.45 | 1. Quantity - Scarcity (score) | |
| 1. Quantity - Scarcity (rank) | 69 | 1. Quantity - Scarcity (rank) | |
| 2. Quantity - Flooding (score) | 4.79 | 2. Quantity - Flooding (score) | |
| 2. Quantity - Flooding (rank) | 9 | 2. Quantity - Flooding (rank) | |
| 3. Quality (score) | 3.03 | 3. Quality (score) | |
| 3. Quality (rank) | 91 | 3. Quality (rank) | |
| 4. Ecosystem Service Status (score) | 3.04 | 4. Ecosystem Service Status (score) | |
| 4. Ecosystem Service Status (rank) | 51 | 4. Ecosystem Service Status (rank) | |
| 5. Enabling Environment (Policy & Laws) (score) | 3.35 | 5. Enabling Environment (Policy & Laws) (score) | |
| 5. Enabling Environment (Policy & Laws) (rank) | 39 | 5. Enabling Environment (Policy & Laws) (rank) | |
| 6. Institutions and Governance (score) | 3.50 | 6. Institutions and Governance (score) | |
| 6. Institutions and Governance (rank) | 50 | 6. Institutions and Governance (rank) | |
| 7. Management Instruments (score) | 3.85 | 7. Management Instruments (score) | |
| 7. Management Instruments (rank) | 13 | 7. Management Instruments (rank) | |
| 8 - Infrastructure & Finance (score) | 4.45 | 8 - Infrastructure & Finance (score) | |
| 8 - Infrastructure & Finance (rank) | 21 | 8 - Infrastructure & Finance (rank) | |
| 9. Cultural Diversity (score) | 3.00 | 9. Cultural importance (score) | |
| 9. Cultural Diversity (rank) | 35 | 9. Cultural importance (rank) | |
| 10. Biodiversity Importance (score) | 3.50 | 10. Biodiversity importance (score) | |

Water Risk Filter

## Country Overview - Haiti

| Indicator | Value | Description | Source |
|---|---|---|---|
| 10. Biodiversity Importance (rank) | 84 | 10. Biodiversity importance (rank) | |
| 11. Media Scrutiny (score) | 2.55 | 11. Media Scrutiny (score) | |
| 11. Media Scrutiny (rank) | 95 | 11. Media Scrutiny (rank) | |
| 12. Conflict (score) | 1.74 | 12. Conflict (score) | |
| 12. Conflict (rank) | 171 | 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) | 123 | 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) | 3.00 | 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) | 35 | 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) | 1.98 | 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) | 92 | 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) | 3.25 | 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) | 64 | 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) | 3.00 | 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) | 11 | 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) | 2.00 | 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) | 131 | 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) | 75 | 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) | 4.94 | 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) | 9 | 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) | 2.00 | 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). 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) | 123 | 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) | 3.03 | 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).<br><br>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) | 91 | 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).<br><br>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) | 2.96 | 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) | 76 | 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) | 3.42 | 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.<br>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. |

| Indicator | Value | Description | Source |
|---|---|---|---|
| 4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (rank) | 33 | 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.<br>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) | 2.28 | 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) | 103 | 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) | 4.00 | 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) | 11 | 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) | 3.00 | 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.<br><br>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) | 52 | 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.<br><br>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.<br><br>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) | 57 | 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.<br><br>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) | 29 | 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) | 3.00 | 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) | 63 | 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) | 54 | 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.<br><br>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) | 8 | 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.<br><br>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) | 39 | 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) | 4.02 | 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) | 36 | 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) | 22 | 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) | 13 | 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) | 16 | 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) | 3.00 | 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.<br>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) | 35 | 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.<br>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) | 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. 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. |

## Country Overview - Haiti

| Indicator | Value | Description | Source |
|---|---|---|---|
| 10.1 - Freshwater Endemism (rank) | 1 | 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) | 2.00 | 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) | 154 | 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) | 72 | 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) | 86 | 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 - Haiti

| Indicator | Value | Description | Source |
|---|---|---|---|
| 12.1 - Conflict News Events (RepRisk) (score) | 1.00 | 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) | 157 | 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) | 2.47 | 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) | 80 | 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 (#) | 10847334 | Population, total | The World Bank 2018, Data , hompage accessed 20/04/2018 |
| GDP (current US$) | 8022638722 | GDP (current US$) | The World Bank 2018, Data , hompage accessed 20/04/2018 |
| EPI 2018 score (0-100) | 33.74 | Environmental Performance Index | |
| WGI -Voice and Accountability (0-100) | 22.38 | 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) | 26.60 | 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) | 0.96 | 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) | 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 - Rule of Law (0-100) | 16.35 | 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 - Control of Corruption (0-100) | 7.21 | 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 |
|---|---|---|---|
| WRI BWS all industries (0-5) | 2.38 | 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) | 79 | 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) | 61 | 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) | 57 | 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) | 61 | 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. |

## Country Overview - Haiti

| Indicator | Value | Description | Source |
|---|---|---|---|
| Baseline Water Stress (BWS) - 2030 BAU (increasing rank describes lower risk) | 57 | 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) | 55 | 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) | 56 | 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) | 50 | 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) | 53 | 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) | 48 | 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. |

## Country Overview - Haiti

| Indicator | Value | Description | Source |
|---|---|---|---|
| Total water footprint of national consumption (m3/a/cap) | 1029.81 | 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 (%) | 21.03 | 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) | 97.00 | 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) | 97.00 | 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 (%) | 71.50 | 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) | 8.71 | World Development Indicators | The World Bank 2018, Data , hompage accessed 20/04/2018 |
| Total internal renewable water resources (IRWR) (10^9 m3/year) | 13.01 | 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) | 1.02 | 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) | 13.01 | Aquastat - Water Ressources | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13 |

# Country Overview - Haiti

| Indicator | Value | Description | Source |
|---|---|---|---|
| Total renewable water resources (10^9 m3/year) | 14.03 | Aquastat - Water Ressources | FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13 |
| Dependency ratio (%) | 7.24 | 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) | 1310.00 | 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] | 3.58 | WorldHappinessReport.org | World Happiness Report, homepage accessed 20/04/2018 |

# Country Aspects

## 1. PHYSICAL ASPECTS

## 1.1. WATER RESOURCES

### 1.1.1. WATER RESOURCES

A detailed survey carried out by the UN Technical Cooperation for Development Department in 1991 assessed the water resources of Haiti. In that study, the country was divided into six major basins.

Haiti has 12.11km3 of internal renewable water resources plus 0.9km3 of external renewable water resources that come from the Artibonite River from the Dominican Republic. Currently, only about 7.5 per cent of the renewable water resources are utilized, of which 7.1 per cent is for irrigation. The rivers' water flow is characterized by wide seasonal fluctuation, partly because of rainfall irregularity, but also because of erosion and catchment area deforestation.

In 1991, the total installed hydroelectric capacity was 70MW. The production from hydroplants was 280GWh/year, and hydropower amounts for 50 per cent of total electricity production.

According to the Ministère de L'Environnement (ME) [2006], the water resources of the country are quite important but are poorly distributed as five rivers account for almost 60 per cent of the country's resources [MDE, 1999a]. Rainfall has a negative impact on these water resources, due to soil erosion.

After rains, the rivers fill up quickly with water of a low quality - carrying soil and sediments. Water from unprotected sources is contaminated not only by soil erosion but also from contact with runoff, and becomes unusable in a potable water supply system. Drinking water is thus becoming scarce and the availability of this basic service is reducing.

Although Haiti has the highest available average water figure in the world (approximately 24,400m³ per person), water access in the country is not only the lowest among its Latin American and Caribbean (LAC) neighbours but is the lowest in the Western Hemisphere [World Bank, 2007]. Data concerning the exact circumstances of Haiti's water and sanitation differ according to the source but all of them produce similar distressing results [McLeod, 2009].

With an average annual rainfall of 1,400mm, Haiti should have an adequate supply of water to meet its demands [USACE, 1999]. However, with no public system for sewage, few poorly managed wastewater treatment facilities and a scarcity of essential hydrologic data, it is evident why Haiti is incapable of providing water that is both clean and constant to its people [McLeod, 2009].

The long term average available freshwater resources of Haiti are 14,000 million m³ (14km³) per year as of 2005 [United Nations Statistics Division] but according to the CIA World Fact book, only 0.99km³ is withdrawn per year which means that only approximately seven per cent of available water is used. Of this 7 per cent withdrawn, only 5 per cent is used for domestic purposes; 1 per cent for industrial uses; and the remaining 94 per cent is used for irrigation [McLeod, 2009].

Furthermore, water in Haiti is usually either contaminated or saline. Surface water and groundwater from shallow aquifers are polluted with human excreta and agricultural waste. 60 per cent of Haitians consume water without attempting to treat it while 30 per cent add bleach or chlorine, and 2 per cent attempt to boil the water which facilitates the prevalence of waterborne illnesses and high mortality rates [McLeod, 2009].

As islanders flee rural areas in hope of a better life, rapid urbanization continues to negatively affect the water supply in Haiti - particularly in the capital of PortauPrince - as result of high population density creating an additional strain on water demands [USACE, 1999].

Haiti's natural climate is subject to an uneven distribution of rainfall due the orientation of a mountain ridge, which is the natural divisor of Hispaniola. The mountains cut off the trade winds, which produce rainfall [CIA]. The report, updated in 1999, also lists the existence of 30 hydrographic basins and zones which drain from the mountains to the coastal waters [McLeod, 2009].

There are more than 100 streams from the Haitian mountains flowing into the Golfe de la Gonâve, the Atlantic Ocean, and the Caribbean Sea but none toward the Dominican Republic. While streamflow within the highlands is rapid, the streams of the lowlands are quite slow. The average annual precipitation in lowland areas is usually less than 1,200mm ( 42 inches) and can be as little as 550mm (22 inches) [McLeod, 2009].

Often described as a semiarid country [CIA], Haiti is subject to high rates of evaporation, preventing many streams from ever reaching the sea, and often undergoes periodic droughts. The Plaine du Gonaïves and the eastern part of the Plaine du CuldeSac are the driest areas in the country [USACE, 1999]. The Plaine du Gonaïves averages 550mm (22 inches) of precipitation annually, and the eastern part of the Plaine du CuldeSac averages 850mm (33 inches) [McLeod, 2009].

With an unfortunate location in the middle of a hurricane belt, Haiti is often subject to hurricanes and severe storms during the hurricane season from June to October [CIA]. Hurricanes and storms further complicate Haiti's water supply because of subsequent intense flooding. While flooding can occur at any time during the year, flash flooding, (which is rapid flooding of lowlying areas, washes, rivers and streams caused by heavy rain associated with thunderstorms, hurricanes, or tropical storms, occurs only during the wet season of April to November [USACE, 1999].

Lack of vegetation on surrounding hillsides and an absence of sufficient storm water drainage systems produces serious flooding, which has detrimental effects as most major Haitian cities are coastal [USACE, 1999]. Flood water, usually rainwater mixed with biological waste and trash, often invades cramped homes of poor construction and causes property damage, increases Haitians' susceptibility to waterborne diseases, and destroys livestock as well as human lives [McLeod, 2009].

In November 1994, the tropical storm Gordon killed 800 Haitians; September 1998 brought Hurricane George that left 18,000 people homeless; and the aftermath of Hurricane Jeanne in 2004 was 3,000 deaths and houses floating down the streets [USACE, 1999]. According to USAID, just a few days after Jeanne, “open sewage, stagnant water and the decaying bodies of animals and flood victims had seriously contaminated local water supplies, causing a public health crisis.” [McLeod, 2009]

## 1.1.2. WATER USE

Industrial/commercial use

Annually, the food-processing industry (i.e. juice, carbonated drinks, beer) in the Plaine du Cul-de-Sac uses more than 4 million m³ of water. Groundwater, obtained from about 800 wells, is the primary source of this water. Information on other industrial uses and needs is unavailable [USACE, 1999].

Agricultural useAgricultural use

Surface water flows directly into a great number of irrigation systems. The most important agricultural areas in the country are the irrigated plains that include the Plaine du Nord, the Fort-Liberté area, the Plaine du Cul-de-Sac, the Plaine des Cayes , and the lower Rivière de l’Artibonite and Rivière de l’Estère valleys. The quantity of surface water available for irrigation is decreasing due to deforestation. Although agriculture accounts for 66 per cent of employment in Haiti, it generates only 35 per cent of the GDP. This is partly because of the uneven distribution of rainfall, which forces farmers to rely on irrigation to meet their needs. About 80 per cent of the total quantity of water utilized in the country is for irrigation. In 1996 an estimated 1,170 million m³ was used for irrigation. A 1996 report listed the total number of irrigation projects at 128, serving a total area of about 700km². However, because of system malfunctions and losses, only about 420km² are irrigated on a regular basis. The largest irrigation projects, which irrigate 250km², are along the Rivière de l’Artibonite [USACE, 1999].Surface water flows directly into a great number of irrigation systems. The most important agricultural areas in the country are the irrigated plains that include the Plaine du Nord, the Fort-Liberté area, the Plaine du Cul-de-Sac, the Plaine des Cayes , and the lower Rivière de l’Artibonite and Rivière de l’Estère valleys. The quantity of surface water available for irrigation is decreasing due to deforestation. Although agriculture accounts for 66 per cent of employment in Haiti, it generates only 35 per cent of the GDP. This is partly because of the uneven distribution of rainfall, which forces farmers to rely on irrigation to meet their needs. About 80 per cent of the total quantity of water utilized in the country is for irrigation. In 1996 an estimated 1,170 million m³ was used for irrigation. A 1996 report listed the total number of irrigation projects at 128, serving a total area of about 700km². However, because of system malfunctions and losses, only about 420km² are irrigated on a regular basis. The largest irrigation projects, which irrigate 250km², are along the Rivière de l’Artibonite [USACE, 1999].

The Ministry of Agriculture, Natural Resources and Rural Development (MARNDR) does not maintain current records on the amount of land irrigated or the amount of water used for irrigation purposes. Consequently, actual numbers on the amount of land irrigated are difficult to verify [USACE, 1999].The Ministry of Agriculture, Natural Resources and Rural Development (MARNDR) does not maintain current records on the amount of land irrigated or the amount of water used for irrigation purposes. Consequently, actual numbers on the amount of land irrigated are difficult to verify [USACE, 1999].

HydropowerHydropower

Electricité d’Haiti (ED'H) is responsible for the electrical energy system. Electrical power is concentrated in Port-au-Prince and limited to a rotating-sector service during dry periods. System losses - attributed to theft - create additional stress on the system. Haiti has seven hydropower projects, of which the Peligre project, with an installed capacity of more than 47MW, is by far the largest. The most serious problem facing the Peligre project is deforestation which causes erosion leading to sedimentation filling the reservoir [USACE, 1999].Electricité d’Haiti (ED'H) is responsible for the electrical energy system. Electrical power is concentrated in Port-au-Prince and limited to a rotating-sector service during dry periods. System losses - attributed to theft - create additional stress on the system. Haiti has seven hydropower projects, of which the Peligre project, with an installed capacity of more than 47MW, is by far the largest. The most serious problem facing the Peligre project is deforestation which causes erosion leading to sedimentation filling the reservoir [USACE, 1999].

Waterway TransportationWaterway Transportation

Commercial navigation along the rivers is almost non-existent. The Rivière de l’Artibonite, navigable only by small shallow draft vessels, is occasionally used by small boats that serve local transportation and commerce [USACE, 1999].Commercial navigation along the rivers is almost non-existent. The Rivière de l’Artibonite, navigable only by small shallow draft vessels, is occasionally used by small boats that serve local transportation and commerce [USACE, 1999].

Water accessWater access

Before the earthquake of January 2010, 58 per cent of the population lacked access to clean water [UNDP, 2010].Before the earthquake of January 2010, 58 per cent of the population lacked access to clean water [UNDP, 2010].

According to USACE [1999], much of the surface water is contaminated or saline; however, it is used for domestic purposes by much of the population with little or no treatment. The government and NGOs are trying to supply potable water to the population from water wells. About 40 per cent of the population obtains water from supply systems or wells constructed by the government and NGOs.According to USACE [1999], much of the surface water is contaminated or saline; however, it is used for domestic purposes by much of the population with little or no treatment. The government and NGOs are trying to supply potable water to the population from water wells. About 40 per cent of the population obtains water from supply systems or wells constructed by the government and NGOs.

The 1996 estimated percentages of populations with access to either a water supply system or a well are as follows: 35 per cent of Port-au-Prince, including the surrounding areas of Pétionville, Carrefour, and Delmas; 43 per cent of the secondary villages (with populations over 5,000); and 39 per cent of the rural villages (with populations less than 5,000) [USACE, 1999].The 1996 estimated percentages of populations with access to either a water supply system or a well are as follows: 35 per cent of Port-au-Prince, including the surrounding areas of Pétionville, Carrefour, and Delmas; 43 per cent of the secondary villages (with populations over 5,000); and 39 per cent of the rural villages (with populations less than 5,000) [USACE, 1999].

The sources of water for Port-au-Prince are facing several major problems that are decreasing the quality and quantity of water available. One problem is contamination. All the springs are reported to be contaminated by biological contamination from human and solid wastes. A couple of the springs are too polluted to be used. Human sewage, agricultural runoff, and industrial waste are also threatening the wells. A second major problem is decreasing yields from the springs [USACE, 1999].The sources of water for Port-au-Prince are facing several major problems that are decreasing the quality and quantity of water available. One problem is contamination. All the springs are reported to be contaminated by biological contamination from human and solid wastes. A couple of the springs are too polluted to be used. Human sewage, agricultural runoff, and industrial waste are also threatening the wells. A second major problem is decreasing yields from the springs [USACE, 1999].

Deforestation, urbanization, and drought are greatly diminishing the amount of water infiltrating into the ground to recharge the aquifers, resulting in a decreasing flow from the springs. For many of the inhabitants, especially the poor, the only source of water is surface water from Rivière Grise, Rivière Blanche, smaller streams, irrigation ditches, and the city's storm water drains. The surface water near the city is severely polluted by human sewage, solid wastes, and industrial chemical contamination [USACE, 1999].Deforestation, urbanization, and drought are greatly diminishing the amount of water infiltrating into the ground to recharge the aquifers, resulting in a decreasing flow from the springs. For many of the inhabitants, especially the poor, the only source of water is surface water from Rivière Grise, Rivière Blanche, smaller streams, irrigation ditches, and the city's storm water drains. The surface water near the city is severely polluted by human sewage, solid wastes, and industrial chemical contamination [USACE, 1999].

The Service National d'Eau Potable (or National Drinking Water Service (SNEP)) manages many water supply systems that serve the smaller secondary cities. Of 28 SNEP-managed systems, five are pumped, three are a combination of gravity-fed and pumped systems, and the remaining 20 are gravity-fed systems. If all residential connections and public fountains are considered, 260,000 people are served by SNEP. UNICEF, the World Bank, IDP, the German Foundation for Technical Assistance, and the U.S. Agency for International Development (USAID) have provided assistance in the development of water supply projects to SNEP. Other agencies and organizations also provide water supply services to this sector. In 1995 about 43 per cent of the population of secondary villages had access to water systems [USACE, 1999].The Service National d'Eau Potable (or National Drinking Water Service (SNEP)) manages many water supply systems that serve the smaller secondary cities. Of 28 SNEP-managed systems, five are pumped, three are a combination of gravity-fed and pumped systems, and the remaining 20 are gravity-fed systems. If all residential connections and public fountains are considered, 260,000 people are served by SNEP. UNICEF, the World Bank, IDP, the German Foundation for Technical Assistance, and the U.S. Agency for International Development (USAID) have provided assistance in the development of water supply projects to SNEP. Other agencies and organizations also provide water supply services to this sector. In 1995 about 43 per cent of the population of secondary villages had access to water systems [USACE, 1999].

Structural issues, such as the lack of water and sanitation systems and the insufficient presence of health facilities throughout the country, have become dramatically evident through the ongoing cholera epidemic. The World Health Organisation (WHO) and the Pan-American Health Organisation (PAHO) estimate that a recent cholera outbreak could affect up to 400,000 people. The UN and partners issued an inter-sector cholera response strategy to support the government's efforts, aiming to reduce mortality and morbidity by advancing preventative and medical treatment interventions over the next 14 months [UNDP, 2010].Structural issues, such as the lack of water and sanitation systems and the insufficient presence of health facilities throughout the country, have become dramatically evident through the ongoing cholera epidemic. The World Health Organisation (WHO) and the Pan-American Health Organisation (PAHO) estimate that a recent cholera outbreak could affect up to 400,000 people. The UN and partners issued an inter-sector cholera response strategy to support the government's efforts, aiming to reduce mortality and morbidity by advancing preventative and medical treatment interventions over the next 14 months [UNDP, 2010].

Ongoing efforts are complicated by the lack of awareness and understanding of Haitians of this disease which is new to Haiti; by the absence of immunity; and by various long-term structural factors, including: chronic poverty, destroyed or non-functioning infrastructure, and large-scale lack of access to clean water, sanitation, health care and other basic services, as well as inadequate shelter [UNDP, 2010].Ongoing efforts are complicated by the lack of awareness and understanding of Haitians of this disease which is new to Haiti; by the absence of immunity; and by various long-term structural factors, including: chronic poverty, destroyed or non-functioning infrastructure, and large-scale lack of access to clean water, sanitation, health care and other basic services, as well as inadequate shelter [UNDP, 2010].

Sanitation continuously emerges as a dire problem in Haiti. It is the only country in which access to improved sanitation has significantly decreased over the past decade as indicated by the sanitation report by the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) entitled 'Progress in Drinkingwater and Sanitation: special focus on sanitation (2008)', which details how different developing countries cope with heavily polluted water. The country's existing water regulatory agencies do not account for sanitation, resulting in the absence of any sewage systems as well as isolated and inadequate wastewater systems, no control of hospital waste and, according to PAHO, bad excreta disposal practices, which are polluting almost all 18 water sources supplying PortauPrince [McLeod, 2009].Sanitation continuously emerges as a dire problem in Haiti. It is the only country in which access to improved sanitation has significantly decreased over the past decade as indicated by the sanitation report by the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) entitled 'Progress in Drinkingwater and Sanitation: special focus on sanitation (2008)', which details how different developing countries cope with heavily polluted water. The country's existing water regulatory agencies do not account for sanitation, resulting in the absence of any sewage systems as well as isolated and inadequate wastewater systems, no control of hospital waste and, according to PAHO, bad excreta disposal practices, which are polluting almost all 18 water sources supplying PortauPrince [McLeod, 2009].

UNICEF states that only 19 per cent of Haitians have access to improved sanitation services while the LAC average stands at 79 per cent. UNICEF has also identified that 29 per cent of the urban population and 19 per cent of the rural population has access to improved sanitation sources. Given that 70 per cent of Haiti's approximate nine million citizens [CIA] live in rural areas of the island, this statistic indicates that the majority of these islanders are extremely deprived of basic services [McLeod, 2009].UNICEF states that only 19 per cent of Haitians have access to improved sanitation services while the LAC average stands at 79 per cent. UNICEF has also identified that 29 per cent of the urban population and 19 per cent of the rural population has access to improved sanitation sources. Given that 70 per cent of Haiti's approximate nine million citizens [CIA] live in rural areas of the island, this statistic indicates that the majority of these islanders are extremely deprived of basic services [McLeod, 2009].

The probability of waterborne diseases is very high, making Haiti a breeding ground for bacterial and protozoal diarrhoea, hepatitis A and E, and typhoid fever, dengue fever, leptospirosis, malaria, chronic diarrhoea, and intestinal infections which are caused by water contaminated by rubbish and faecal matter [USACE, 1999]. Haiti's water is so polluted that after Hurricane Jeanne in 2004, many fell ill from "intestinal, topical or pulmonary maladies linked directly to the standing, contaminated water they had been trekking through, bathing in and, in too many cases, consuming." [McLeod, 2009]The probability of waterborne diseases is very high, making Haiti a breeding ground for bacterial and protozoal diarrhoea, hepatitis A and E, and typhoid fever, dengue fever, leptospirosis, malaria, chronic diarrhoea, and intestinal infections which are caused by water contaminated by rubbish and faecal matter [USACE, 1999]. Haiti's water is so polluted that after Hurricane Jeanne in 2004, many fell ill from "intestinal, topical or pulmonary maladies linked directly to the standing, contaminated water they had been trekking through, bathing in and, in too many cases, consuming." [McLeod, 2009]

USACE [1999] also indicates that hypertension is also a side effect of consuming the polluted waters of Haiti. In arid areas of Haiti, such as the northwest, "brackish water" is consumed and the report reveals that "as many as three quarters of the population suffer from intestinal parasites and hypertension (high blood pressure) caused by excessive salt consumption."USACE [1999] also indicates that hypertension is also a side effect of consuming the polluted waters of Haiti. In arid areas of Haiti, such as the northwest, "brackish water" is consumed and the report reveals that "as many as three quarters of the population suffer from intestinal parasites and hypertension (high blood pressure) caused by excessive salt consumption."

<h3>1.2.WATER QUALITY, ECOSYSTEMS AND HUMAN HEALTH1.2.WATER QUALITY, ECOSYSTEMS AND HUMAN HEALTH

# 2. GOVERNANCE ASPECTS

## 2.1.WATER INSTITUTIONS

The main institutions involved in water resources management are:

-The Ministère des Travaux Publics, des Transports et des Communications (or Ministry of Public Works, Transport and Communications (MTPTC)) is responsible for the overall management of the drinking water supply and sanitation sector. Under this Ministry, the Autonomous Metropolitan Drinking Water Company is responsible for services in Port-au-Prince, and SNEP for services in the remainder of the country. The Ministry of Health finances and constructs drinking water supply and sanitation facilities in small rural communities. Once completed, these systems are turned over to SNEP for operation and maintenance.

-The Ministry of Agriculture, Natural Resources and Rural Development (MARNDR) is responsible for the promotion of agriculture, the conservation and utilization of natural resources, and rural development. This includes irrigation and drainage. Regional development organizations report to this Ministry. The Directorate of Natural Resources (DRN) operates and maintains all public irrigation systems through the Irrigation and Rural Engineering Service. Most irrigation systems are under the administrative control of the Ministry. However, because of the Ministry's financial constraints, rehabilitation and maintenance operations are taking place under the auspices of other autonomous agencies operating directly with donor support, such as the Organization for the Development of the Artibonite Valley and the Organization for the Development of the Gonaives Plain. The Water Resources Service of DRN is primarily concerned with data collection and the Watershed Management Service is responsible for watershed management, including the surveying and inventory of soil conservation programmes and providing assistance to peasants in implementing conservation work at the farm level.

-Electricité d'Haiti (EdH), an autonomous Government company, is the sole body responsible for electric power generation, transmission and retail distribution in the country. The Minister of Public Works, Transport and Communications acts as the chairperson of EdH's board of directors and sets policy directives; the board approves major investment plans, loans and policies, as well as electricity tariffs.

-The Ministry of Agriculture, Natural Resources and Rural Development has prime responsibility for protecting natural resources, but conservation policy rests with the Institute for the Safeguard of the National Patrimony, under the Ministry of Education.

The flaws in the Haitian legal system are pervasive, penetrating its water regulation with tenuous policies. The InterAmerican Development Bank has declared that Haiti's water system ranks the lowest of the LAC region with its poor service standards and extremely limited coverage. The labour force is also drawn from a small and uneducated pool, limiting efficient operation of the water system [McLeod, 2009].

Furthermore, overall management is deficient as the current governing water laws are ambiguous and theoretically, water issues are controlled by boards consisting of representatives from several

Haitian ministries. The dispersion of water responsibilities has only led to chaos because there has been no clear leadership within Haiti's water regulatory system. Therefore, the core problem is that there is no water ministry [Guy/PBS, 2004].

Despite the general disorganization of Haiti's water system, there are two central water agencies that serve Haiti: the Centrale Autonome Metropolitaine d'Eau Potable (CAMEP) and the Service National d'Eau Potable (SNEP), which both fall within the boundaries of the MTPTC. A third agency, the Poste Communautaire d'Hygiene et d'Eau Potable (POCHEP), a subset of the Ministry of Public Health (MSPP), provides support to SNEP [McLeod, 2009].

All three of these agencies suffer from limited resources in many areas, such as: a lack of funding resulting in insignificant salaries and low retention rates; the poor infrastructure constructed since the 1970s , which results in fragmented services; and substandard operational and management standards which encourage theft of pipelines and vandalism [McLeod, 2009].

Charged with the responsibility for water provision in the PortauPrince and surrounding metropolitan areas, CAMEP was founded in 1964 under the authoritarian regime of Francois Duvalier [USACE, 1999]. While CAMEP provides the most consistent water service, it is still extremely intermittent as a result of power outages, despite the existence of secondary generators [USACE, 1999]. It also only services between 20 and 30 per cent of its designated regions [Guy/PBS, 2004]. CAMEP is also the only water agency with a watertesting laboratory and regularly injects chlorine into its wells, but the water of PortauPrince remains contaminated with human waste, especially with the rapid urbanization from rural communities [McLeod, 2009].

## 2.2. WATER MANAGEMENT

The tariffs and metering of Haiti's water system is a reflection of its incoherent governing structure. Most of CAMEP's and SNEP's consumers are not metered but rather pay tariffs of flat rates which vary, with no defined rules, by region. CAMEP's tariffs are much higher than those of SNEP's, around $7 USD rather than SNEP's $1 USD. The consumers that are usually metered fall under the management of CAMEP, targeting the citizens in the PortauPrince metropolitan areas, ranging from those living in disorganized settlements to its wealthier constituents. Many of the particularly affluent residents of Haiti or international businesses, such as hotels, do not source their water from the Haitian network but rather rely on tanker trucks [McLeod, 2009].

There are many challenges in financing Haiti's water system. Poor law enforcement encourages the proliferation of illegal water connections, and with the abundance of unregistered Comités d'Eau, payment for water services is a task that is often circumvented. Overall, this leads to a water system operating on a deficit because the funds that are received are insufficient for proper maintenance [McLeod, 2009].

While more recent data is not available, in 1998 only three of the 35 gauging stations and 25 per cent of the hydro-meterological gauges were operative when assessed by the United States Army Corps of Engineers Mobile District and Topographic Engineering Center. This is a vivid reflection of the many technical deficiencies in the Haitian water system. Without crucial data from these gauging stations, detailed assessments and subsequent commensurate recommendations are difficult to obtain [McLeod, 1999].

In addition to lack of data, the water supply often malfunctions as a result of the ageing infrastructure, theft or vandalism, electricity supply outages at pumps and wells and higher than usual contaminations. Theft actually accounts for 60 per cent of losses in the distribution system as people usually opt to break the gravityfed pipelines rather than use the often unsanitary public fountains [McLeod, 1999].

Haitians in rural districts encounter the most water adversities as they often do not have access to power supplies. As the depths in mountainous areas make hand pumps impractical, this makes it almost impossible to access water as most pumps are operated via electricity [McLeod, 1999].

According to the IDB's project proposal for their "Rural Water and Sanitation Program," which is currently being implemented in Haiti, water in Haiti is mostly obtained through: (i) protected and unprotected springs and rivers (50.5 per cent); (ii) public fountains (22.8 per cent); (iii) wells (11.2 per cent); (iv) purchase of water buckets (5.3 per cent); and (v) rainwater (3.1 per cent). The project document also emphasizes that most rural communities depend on unsafe water - for example water runoff and irrigation water - for consumption. These water sources are usually polluted, often with human excreta, but often the options for these Haitians are either polluted water or nothing [McLeod, 1999].

The WHO considers water from unprotected wells and springs, water from vendors, bottled water and water supplied by trucks as unimproved sources of water. Within that definition, 51 per cent of Haitians in rural areas and 70 per cent within the urban communities have access to improved sources of drinking water, resulting in the alarming statistic that improved drinking water is only accessible to 58 per cent of Haitians, far below the LAC average of 80 per cent [McLeod, 1999].

According to USACE [1999], most of the available water data is for the periods 1922 to 1940, the 1960s, and the late 1980s. The collected data was mainly for the development of specific water projects and programmes.

The Service National de Ressources en Eau (SNRE) is the agency responsible for the collection of water data. However, budget problems in the past years have caused the deterioration of the data-gathering network. In 1994 a survey by SNRE and the Association Haitienne pour la Maîtrise de l'Eau en Milieu Rural (ASSODLO) determined that of the 183 hydro-meteorological gauges located, only 25 per cent were functional. Based on interviews with SNRE officials in April 1998, only three of their 35 stream gauging stations were functioning. One of the biggest problems of the actual network is its altimetric distribution. About 63 per cent of the network is located between zero and 200 metres altitude. This is largely due to the difficulties of accessing the mountainous areas. Deforestation is becoming critical in many of the mountainous areas of the northwest, making the need for accurate climatological information even more important. A great need exists to re-establish the national network of river and rain gauges. The technical information obtained from such a network is critical for effective water resources management [USACE, 1999].

Haiti's broken water system

The politics of Haiti's governmental debt burden is only one facet of Haiti's broken water system. The Haitians themselves, whose daily lives are shaped by the consequences of this failed system, represent another critical facet. Only 55.2 per cent of Haiti’s people have access to an improved water source, and close to 70 per cent have no direct access to potable water. It is likely that these figures overstate Haitians’ access to improved water sources: public systems are rarely available year round; and in rural areas, water is often difficult to access during the dry season. Lack of access is aggravated by lack of sanitation: only 27 per cent of the country benefits from basic sewerage, and 70 per cent of households have either rudimentary toilets (34.9 per cent) or none at all (34.7 per cent). Faecal contamination of water is a leading cause of disease. As one study noted recently, Haiti is “moving in [the] wrong direction” with respect to potable water; the percentage of the population without access to safe drinking water actually increased by 7 per cent between 1990 and 2005 [Kalra et al, 2008].

Haiti’s national water systemHaiti’s national water system

As outlined above, SNEP, currently supervised by MTPTC, officially manages Haiti’s water system outside Port-au-Prince. SNEP’s 2006 national water strategy for rural areas was developed with World Bank financing. The World Bank has found that, although “there are competent and motivated managers and staff in the public Haitian water system,” financial means and political support are often lacking, severely limiting the capacity of these agencies to fulfil even their basic functions. Further, Haiti currently has no agency to direct efforts to improve sanitation. As the Haitian NGO, FOKAL (Fondation Connaissance et Liberté / Fondasyon Konesans Ak Libète), summarizes the situation, “Organizations and institutions develop in the absence of clear direction, approaches, and different techniques and technologies — sometimes antagonistic — which result in a great diversity of situations on the ground.” Only between 2 per cent and 8 per cent of Haitian homes have household water connections. In addition, there are virtually no sewage or wastewater treatment facilities in Haiti. All water is consequently vulnerable to contamination, and it must be treated at the point of use in the household before consumption. Nearly 70 per cent of households are unable to provide treatment, however. Boiling water, the most common treatment method, is difficult due to fuel costs. As one government water expert told our investigative team, “it’s necessary to place ‘potable’ and ‘pure’ in quotation marks. One must speak of access to water, but not of potable water. The sources are not protected; there is no practice of [water] treatment; the infrastructure is weak; and there is also a persistent problem of pollution.” [Kalra et al, 2008].As outlined above, SNEP, currently supervised by MTPTC, officially manages Haiti’s water system outside Port-au-Prince. SNEP’s 2006 national water strategy for rural areas was developed with World Bank financing. The World Bank has found that, although “there are competent and motivated managers and staff in the public Haitian water system,” financial means and political support are often lacking, severely limiting the capacity of these agencies to fulfil even their basic functions. Further, Haiti currently has no agency to direct efforts to improve sanitation. As the Haitian NGO, FOKAL (Fondation Connaissance et Liberté / Fondasyon Konesans Ak Libète), summarizes the situation, “Organizations and institutions develop in the absence of clear direction, approaches, and different techniques and technologies — sometimes antagonistic — which result in a great diversity of situations on the ground.” Only between 2 per cent and 8 per cent of Haitian homes have household water connections. In addition, there are virtually no sewage or wastewater treatment facilities in Haiti. All water is consequently vulnerable to contamination, and it must be treated at the point of use in the household before consumption. Nearly 70 per cent of households are unable to provide treatment, however. Boiling water, the most common treatment method, is difficult due to fuel costs. As one government water expert told our investigative team, “it’s necessary to place ‘potable’ and ‘pure’ in quotation marks. One must speak of access to water, but not of potable water. The sources are not protected; there is no practice of [water] treatment; the infrastructure is weak; and there is also a persistent problem of pollution.” [Kalra et al, 2008].

Many households must obtain their water from private water vendors, surface water, and wells. The private water sector developed in the 1970s. In many cities, tanker trucks are among the most important distributors of water. Tankers fill from wells or other public sources, paying fees only to the owners of the pumping equipment, and then deliver water to owners of cisterns. Institutions and affluent private homes with cisterns purchase water by the truckload; poor households depend on local cistern owners who sell it from their cisterns by the bucket or bottle. Some cistern owners treat the water, or claim to. Others sell water as it is delivered. According to FOKAL, “the poorest populations pay the most for water, because of the diversity of tariff systems and the [variable] availability of water.” Without funding for government oversight, there is no system to regulate private water sellers. This means that there are no checks on the private sector use of public water sources, no regulations ensuring the water quality, and there is nothing to ensure fair prices. Reports indicate that tanker companies make significant profits in this unregulated atmosphere [Kalra et al, 2008].Many households must obtain their water from private water vendors, surface water, and wells. The private water sector developed in the 1970s. In many cities, tanker trucks are among the most important distributors of water. Tankers fill from wells or other public sources, paying fees only to the owners of the pumping equipment, and then deliver water to owners of cisterns. Institutions and affluent private homes with cisterns purchase water by the truckload; poor households depend on local cistern owners who sell it from their cisterns by the bucket or bottle. Some cistern owners treat the water, or claim to. Others sell water as it is delivered. According to FOKAL, “the poorest populations pay the most for water, because of the diversity of tariff systems and the [variable] availability of water.” Without funding for government oversight, there is no system to regulate private water sellers. This means that there are no checks on the private sector use of public water sources, no regulations ensuring the water quality, and there is nothing to ensure fair prices. Reports indicate that tanker companies make significant profits in this unregulated atmosphere [Kalra et al, 2008].

Other NGOs are also active in the water sector. NGOs tend to focus their activities on providing water services. A few have teamed up with pharmaceutical companies and engineers to provide effective and simple point-of-use chemical treatment systems. These efforts have been modest at best: in rural areas, more Haitians use lime juice than chemical packets to disinfect their water. Few NGOs in Haiti conduct sanitation or hygiene programs. On the national level, some are entirely autonomous, and others work directly with SNEP. SNEP’s 2006 Strategic Plan stressed the need for NGOs to partner with the government, yet SNEP’s inability to compel coordination in practice is striking. FOKAL has emphasized the problem of ownership over water projects set up by NGOs: when NGO-installed systems break down, they often remain unusable indefinitely, with water pipes “desperately empty” while the community searches for the system’s “owner” to fix the problem. Thus, sustainability and maintenance pose enormous problems for NGO-based projects in Haiti [Kalra et al, 2008].Other NGOs are also active in the water sector. NGOs tend to focus their activities on providing water services. A few have teamed up with pharmaceutical companies and engineers to provide effective and simple point-of-use chemical treatment systems. These efforts have been modest at best: in rural areas, more Haitians use lime juice than chemical packets to disinfect their water. Few NGOs in Haiti conduct sanitation or hygiene programs. On the national level, some are entirely autonomous, and others work directly with SNEP. SNEP’s 2006 Strategic Plan stressed the need for NGOs to partner with the government, yet SNEP’s inability to compel coordination in practice is striking. FOKAL has emphasized the problem of ownership over water projects set up by NGOs: when NGO-installed systems break down, they often remain unusable indefinitely, with water pipes “desperately empty” while the community searches for the system’s “owner” to fix the problem. Thus, sustainability and maintenance pose enormous problems for NGO-based projects in Haiti [Kalra et al, 2008].

Donor states provide another source of water and sanitation projects in Haiti. Some donations have been designated to support SNEP, usually through loans from the World Bank or the IDB. Donor states have also channeled aid through NGOs active in the water sector. Several individuals told our investigators that international donors often fund NGOs or UN agencies that may act in the water sector without coordinating activities with SNEP. This has reportedly led to some projects being implemented without consideration for which areas have the most pressing need (Kalra et al, 2008).Donor states provide another source of water and sanitation projects in Haiti. Some donations have been designated to support SNEP, usually through loans from the World Bank or the IDB. Donor states have also channeled aid through NGOs active in the water sector. Several individuals told our investigators that international donors often fund NGOs or UN agencies that may act in the water sector without coordinating activities with SNEP. This has reportedly led to some projects being implemented without consideration for which areas have the most pressing need (Kalra et al, 2008).

Water sector reformWater sector reform

Water and sanitation sector reform has been discussed among the government of Haiti, donor states, and international financial institutions for over a decade, with a draft water and sanitation sector law discussed since 1996. Some funds from the IDB’s Potable Water and Sanitation Sector Reform and Investment Program Loans were earmarked for this reform. The draft framework law (loi cadre) would, inter alia: decentralize the water and sanitation system by creating regional water and sanitation companies; introduce public-private partnerships; create a Water and Sanitation Directorate within the MTPTC; give the public sector legal responsibility for sanitation; and allow for the transfer of authority for water and sanitation to the municipal level once relevant agencies demonstrate their capacity to govern effectively [Kalra et al, 2008].Water and sanitation sector reform has been discussed among the government of Haiti, donor states, and international financial institutions for over a decade, with a draft water and sanitation sector law discussed since 1996. Some funds from the IDB’s Potable Water and Sanitation Sector Reform and Investment Program Loans were earmarked for this reform. The draft framework law (loi cadre) would, inter alia: decentralize the water and sanitation system by creating regional water and sanitation companies; introduce public-private partnerships; create a Water and Sanitation Directorate within the MTPTC; give the public sector legal responsibility for sanitation; and allow for the transfer of authority for water and sanitation to the municipal level once relevant agencies demonstrate their capacity to govern effectively [Kalra et al, 2008].

In July 1996, the Unité de Réforme du Secteur de l’Eau Potable (URSEP) was created by the MTPTC to oversee the water sector reform using the anticipated IDB loans. Under the loi cadre, the national water authorities were to be dissolved and new agencies created: the Office National de l’Eau Potable et de l’Assainissement (ONEPA) and the Conseil de Régulation de l’Eau Potable et de l’Assainissement (CREPA). In the interim, URSEP is charged with finalizing the regulatory framework and promulgating policies for tariffs, rules concerning levels of service, arrangements for decentralization, and rules for private sector participation. FOKAL analyzed the loi cadre and concluded that, while it is impossible to determine whether the new structure would be more effective than the existing one, the reformed sector promises greater participation by the local community. Among the most striking elements of the loi cadre is a provision that, according to the World Bank, would allow municipalities to “delegate service provision to the private sector, municipal water companies, or water committees.” Without more information on the regulatory aspects of the loi cadre, it is difficult to assess how this kind of privatization would function. Reported plans include installing water meters aimed at “making users responsible and avoiding waste.” [Kalra et al, 2008].In July 1996, the Unité de Réforme du Secteur de l’Eau Potable (URSEP) was created by the MTPTC to oversee the water sector reform using the anticipated IDB loans. Under the loi cadre, the national water authorities were to be dissolved and new agencies created: the Office National de l’Eau Potable et de l’Assainissement (ONEPA) and the Conseil de Régulation de l’Eau Potable et de l’Assainissement (CREPA). In the interim, URSEP is charged with finalizing the regulatory framework and promulgating policies for tariffs, rules concerning levels of service, arrangements for decentralization, and rules for private sector participation. FOKAL analyzed the loi cadre and concluded that, while it is impossible to determine whether the new structure would be more effective than the existing one, the reformed sector promises greater participation by the local community. Among the most striking elements of the loi cadre is a provision that, according to the World Bank, would allow municipalities to “delegate service provision to the private sector, municipal water companies, or water committees.” Without more information on the regulatory aspects of the loi cadre, it is difficult to assess how this kind of privatization would function. Reported plans include installing water meters aimed at “making users responsible and avoiding waste.” [Kalra et al, 2008].

According to USAID [1999], Haiti does not have a comprehensive water policy. Current laws that address water issues are fragmented, with authorities spread among various agencies. However, in recent years, the MTPTC recognized the need for comprehensive national water management with the creation of URSEP, outlined above. URSEP is currently working with the IDB to establish a new drinking water policy. Upon completion of this effort, plans call for the development of a national sanitation policy to include new laws and the creation of a regulatory agency.According to USAID [1999], Haiti does not have a comprehensive water policy. Current laws that address water issues are fragmented, with authorities spread among various agencies. However, in recent years, the MTPTC recognized the need for comprehensive national water management with the creation of URSEP, outlined above. URSEP is currently working with the IDB to establish a new drinking water policy. Upon completion of this effort, plans call for the development of a national sanitation policy to include new laws and the creation of a regulatory agency.

According to the Political Risk Yearbook [2008], “Haitian law is deficient in the following areas: operation of the judicial system; organization and operation of the executive branch; publication of laws, regulations and official notices; establishment of companies; land tenure and real property law and procedures; bank and credit operations; insurance and pension regulation; accounting standards; civil status documentation; customs law and administration; international trade and investment promotion; foreign investment regime; and regulation of market concentration and competition.”According to the Political Risk Yearbook [2008], “Haitian law is deficient in the following areas: operation of the judicial system; organization and operation of the executive branch; publication of laws, regulations and official notices; establishment of companies; land tenure and real property law and procedures; bank and credit operations; insurance and pension regulation; accounting standards; civil status documentation; customs law and administration; international trade and investment promotion; foreign investment regime; and regulation of market concentration and competition.”

Haiti has only recently emerged from decades of rampant political instability, leaving the country’s legal system enervated. In general, its laws and regulation are slow, inefficient and antiquated, with most laws unchanged since 1944 [USACE, 1999]. The legal system is also infused with corruption and excessive bureaucracy. Haiti maintains a heavy dependence on foreign intervention as there are many weaknesses within its legal system. Many public officials use their position for personal gain and so, actual enforcement of law is usually absent. The situation is so precarious that current President Rene Preval has disbanded the Haitian army since 2004 in favour of using United Nations peacekeepers – the United Nations Stabilization Mission [McLeod, 2009].Haiti has only recently emerged from decades of rampant political instability, leaving the country’s legal system enervated. In general, its laws and regulation are slow, inefficient and antiquated, with most laws unchanged since 1944 [USACE, 1999]. The legal system is also infused with corruption and excessive bureaucracy. Haiti maintains a heavy dependence on foreign intervention as there are many weaknesses within its legal system. Many public officials use their position for personal gain and so, actual enforcement of law is usually absent. The situation is so precarious that current President Rene Preval has disbanded the Haitian army since 2004 in favour of using United Nations peacekeepers – the United Nations Stabilization Mission [McLeod, 2009].

As the situation in Haiti makes clear, legal rights provide no real protection for individuals without corresponding responsibilities, and the responsibility for fulfilling fundamental human rights is an integral part of all legal rights. Generally, the government of each state bears the primary responsibility for ensuring the protection and achievement of human rights for those on its territory or otherwise under its jurisdiction. A state’s human rights obligations also apply when it acts as part of a multilateral or international organization, such as the UN or the World Bank. Thus, members of the international community bear a measure of legal responsibility [Kalra et al, 2008].As the situation in Haiti makes clear, legal rights provide no real protection for individuals without corresponding responsibilities, and the responsibility for fulfilling fundamental human rights is an integral part of all legal rights. Generally, the government of each state bears the primary responsibility for ensuring the protection and achievement of human rights for those on its territory or otherwise under its jurisdiction. A state’s human rights obligations also apply when it acts as part of a multilateral or international organization, such as the UN or the World Bank. Thus, members of the international community bear a measure of legal responsibility [Kalra et al, 2008].

The case of water in Haiti is directly relevant to the issue of international human rights law as codified in treaties and under customary international law. When a state signs a treaty, the state is required to refrain from any action that would contradict the object and purpose of the treaty, and when a state ratifies a treaty, the state thereby accepts the duties contained within the treaty and is required to immediately take positive steps to realize the rights contained in the treaty. Even if a state has neither signed nor ratified a human rights treaty, it has certain obligations under customary international law, which protects fundamental human rights and in general applies to all states [Kalra et al, 2008].The case of water in Haiti is directly relevant to the issue of international human rights law as codified in treaties and under customary international law. When a state signs a treaty, the state is required to refrain from any action that would contradict the object and purpose of the treaty, and when a state ratifies a treaty, the state thereby accepts the duties contained within the treaty and is required to immediately take positive steps to realize the rights contained in the treaty. Even if a state has neither signed nor ratified a human rights treaty, it has certain obligations under customary international law, which protects fundamental human rights and in general applies to all states [Kalra et al, 2008].

In accordance with these treaty-based obligations and customary international law, the Haitian government is responsible for guaranteeing and fulfilling the human rights of everyone in Haiti. Haiti is a party to the ICCPR, the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), the Convention on the Rights of the Child, the Organization of American States (OAS) Charter, and the American Convention on Human Rights; it is thus responsible for all the obligations found within each of these treaties. The Haitian government has signed, but not yet ratified the Protocol of San Salvador; thus, these treaties do not strictly bind the government of Haiti. However, as a signatory, Haiti has an obligation to refrain from actions that will frustrate the object and purpose of these treaties. Furthermore, given that the Haitian constitution protects the rights to health and food, the Haitian government has an obligation to ensure the satisfaction of - at the very least - minimum essential levels of each of these rights, of which access to water is an integral component. All Haitians, as rights-holders, have a particular set of entitlements, and the

Haitian state, as the primary duty-bearer, has a particular set of obligations. Haitians who cannot access even the most basic forms of these entitlements are being deprived of their constitutional economic and social rights and their rights under treaties guaranteeing basic civil and political rights, such as the rights to life, personal liberty, and security.In accordance with these treaty-based obligations and customary international law, the Haitian government is responsible for guaranteeing and fulfilling the human rights of everyone in Haiti. Haiti is a party to the ICCPR, the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), the Convention on the Rights of the Child, the Organization of American States (OAS) Charter, and the American Convention on Human Rights; it is thus responsible for all the obligations found within each of these treaties. The Haitian government has signed, but not yet ratified the Protocol of San Salvador; thus, these treaties do not strictly bind the government of Haiti. However, as a signatory, Haiti has an obligation to refrain from actions that will frustrate the object and purpose of these treaties. Furthermore, given that the Haitian constitution protects the rights to health and food, the Haitian government has an obligation to ensure the satisfaction of - at the very least - minimum essential levels of each of these rights, of which access to water is an integral component. All Haitians, as rights-holders, have a particular set of entitlements, and the Haitian state, as the primary duty-bearer, has a particular set of obligations. Haitians who cannot access even the most basic forms of these entitlements are being deprived of their constitutional economic and social rights and their rights under treaties guaranteeing basic civil and political rights, such as the rights to life, personal liberty, and security.

The Haitian constitution requires the Haitian government to recognize and protect Haitians' rights to health, decent housing, education, and food. Because the right to water is an important component of these rights, the Haitian government has a responsibility to ensure the full realization of the right to water through national legislation and policies. A national water strategy should elaborate how the right to water is to be realized and should include concrete goals, policies, and a time frame for implementation [Kalra et al, 2008].The Haitian constitution requires the Haitian government to recognize and protect Haitians' rights to health, decent housing, education, and food. Because the right to water is an important component of these rights, the Haitian government has a responsibility to ensure the full realization of the right to water through national legislation and policies. A national water strategy should elaborate how the right to water is to be realized and should include concrete goals, policies, and a time frame for implementation [Kalra et al, 2008].

<h2>2.3.WATER POLICY AND LEGAL FRAMEWORK2.3.WATER POLICY AND LEGAL FRAMEWORK

## 3. GEOPOLITICAL ASPECTS

The Dominican Republic and Haiti share a single island, called Hispaniola, in the Caribbean Sea. Hispaniola is the second largest island in the West Indies, located between Cuba and Puerto Rico. The Dominican Republic occupies two thirds of the island and Haiti the remaining third. Three mountain chains run across the island from east to west, characterized by many, relatively fertile, intermountain valleys. Rich forests were originally present on mountains and hills but are disappearing rapidly, mainly in Haiti. Soil exhaustion has entailed, especially in Haiti, a reduction of agricultural productivity, forcing people to migrate [UNESCO, 2005].

Water availability on the island, historically relatively modest, has decreased dramatically. Although the Dominican Republic almost doubles Haiti in annual per capita water availability, both countries have mediocre figures that fall below the mean recommendations of the United Nations Development Programme (UNDP). The values reported in 2000 indicate a situation of real water stress. Whereas the Dominican Republic has gradually felt water stress since the late 1980s, Haiti has been confronted with a shortage of water since the late 1970s. As for the Pedernalis basin, the availability of water in the Dominican part of the basin is 70 per cent lower than the national average, while conditions prevailing in the Haitian part are above national averages [UNESCO, 2005].

The Pedernalis basin occupies a relatively modest surface of 302$km^2$, in contrast to its huge conflict potential. About two thirds of the basin is located in Haiti and about 103$km^2$ in the Dominican Republic. The main drain length is 48km and average rainfall per year is 996mm, or 296.81 million $m^3$. The runoff is an estimated 50.84 million $m^3$, with an equivalent average instant runoff of 1.61 $m^3$ /s [UNESCO, 2005].

In the central parts of the basin, rainfall amounts to 900-1100mm with a high standard deviation, which is related to unstable hydro-meteorological phenomena. In contrast, in the southern portions of the basin, average rainfall, characteristically convective and very erratic, can be close to 750mm or less. Karstic formations are partly responsible for water losses that occur in the basin final behaviour. Most water percolated into karstic formations is finally discharged into the ocean via underground phenomena that, in turn, trigger a rich flora and fauna close to the seashore (related both to freshwater supply that lowers salinity in certain areas, as well as the presence of nutrients , mostly of a mineral nature). Flora and fauna on the coastline are typical of semi-arid areas, however, such fragile ecosystems are endangered by human pressure on land use, as well as by lack of regulations and control [UNESCO, 2005].

Groundwater discharge is estimated to represent 30 per cent of the surface runoff although some specialists argue that the volume of groundwater is exceeding the surface runoff. In any case, insufficient measuring stations or observatories near the final discharge are severely limiting data availability on water losses, on volumes regained downstream by the main drain, or on possible direct discharge phenomena [UNESCO, 2005].

Extreme hydro-meteorological events, mainly tropical storms and hurricanes might occur during the rainy season. Large areas in the Caribbean, especially in Haiti, were struck on at least two occasions during 2004. Flash floods of sequential nature provoked, e.g. in the western portion of the Pedernalis River, substantial damage. The water of the Pedernalis River is not entirely allocated, principally as a result of modest human-induced water regulation via reservoirs or other hydrological infrastructure. Hence, total water use amounts to 69 per cent, which is relatively high. Low water efficiencies in primitive water diversions common to certain basin portions blur the importance of water uses and their productivity [UNESCO, 2005].

The basin is managed by the 'Service des Ressources en Eau' (SNRE) in Haiti and by the 'Instituto Nacional de Recursos Hídricos' (INDRHI) in the Dominican Republic. Both entities are endowed with capable human resources although financial means are scarce, especially in Haiti. Basin disputes have mostly taken root because of complex economic, social and political reasons, rather than because of a lack of support or coordination by both technical areas. In conclusion, the key facts to bear in mind are that [UNESCO, 2005]:

•water is scarce;
•pollution exists with no monitoring in place;
•a considerable volume of all water available in the basin is already allocated (formally or informally);
•soil has been depleted;
•border disputes exist;
•a fragile economic basis (mainly in the Haitian part of the basin) is triggering migration and social unrest; and
•institutions in both countries are unable to address all such management shortages.

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