Water Risk Filter

Country Overview - Burkina Faso

Water Indicators

Indicator	Value	Description	Source
Overall Basin Risk (score)	2.96	Overall Basin Risk (score)	
Overall Basin Risk (rank)	36	Overall Basin Risk (rank)	
Physical risk (score)	3.32	Physical risk (score)	
Physical risk (rank)	15	Physical risk (rank)	
Regulatory risk (score)	2.41	Regulatory risk (score)	
Regulatory risk (rank)	133	Regulatory risk (rank)	
Reputation risk (score)	2.44	Reputation risk (score)	
Reputation risk (rank)	135	Reputation risk (rank)	
1. Quantity - Scarcity (score)	3.33	1. Quantity - Scarcity (score)	
1. Quantity - Scarcity (rank)	32	1. Quantity - Scarcity (rank)	
2. Quantity - Flooding (score)	3.48	2. Quantity - Flooding (score)	
2. Quantity - Flooding (rank)	79	2. Quantity - Flooding (rank)	
3. Quality (score)	3.60	3. Quality (score)	
3. Quality (rank)	50	3. Quality (rank)	
4. Ecosystem Service Status (score)	2.73	4. Ecosystem Service Status (score)	
4. Ecosystem Service Status (rank)	70	4. Ecosystem Service Status (rank)	
5. Enabling Environment (Policy & Laws) (score)	1.00	5. Enabling Environment (Policy & Laws) (score)	
5. Enabling Environment (Policy & Laws) (rank)	174	5. Enabling Environment (Policy & Laws) (rank)	
6. Institutions and Governance (score)	2.25	6. Institutions and Governance (score)	
6. Institutions and Governance (rank)	143	6. Institutions and Governance (rank)	
7. Management Instruments (score)	2.85	7. Management Instruments (score)	
7. Management Instruments (rank)	96	7. Management Instruments (rank)	
8 - Infrastructure & Finance (score)	4.80	8 - Infrastructure & Finance (score)	
8 - Infrastructure & Finance (rank)	10	8 - Infrastructure & Finance (rank)	
9. Cultural Diversity (score)	3.00	9. Cultural importance (score)	
9. Cultural Diversity (rank)	38	9. Cultural importance (rank)	
10. Biodiversity Importance (score)	3.64	10. Biodiversity importance (score)	

Country Overview - Burkina Faso

Indicator	Value	Description	Source
10. Biodiversity Importance (rank)	75	10. Biodiversity importance (rank)	
11. Media Scrutiny (score)	2.10	11. Media Scrutiny (score)	
11. Media Scrutiny (rank)	154	11. Media Scrutiny (rank)	
12. Conflict (score)	2.20	12. Conflict (score)	
12. Conflict (rank)	128	12. Conflict (rank)	
1.0 - Aridity (score)	2.95	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)	43	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)	2.24	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)	74	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)	3.45	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)	40	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)	4.07	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)	36	The blue water scarcity risk indicator is based on Mekonnen and Hoekstra (2016) global assessment of blue water scarcity on a monthly basis and at high spatial resolution (grid cells of 30 × 30 arc min resolution). Blue water scarcity is calculated as the ratio of the blue water footprint in a grid cell to the total blue water availability in the cell. The time period analyzed in this study ranges from 1996 to 2005.	Mekonnen, M. M., & Hoekstra, A. Y. (2016). Four billion people facing severe water scarcity. Science advances, 2(2), e1500323.
1.4 - Projected Change in Water Discharge (by ~2050) (score)	1.67	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)	120	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)	4.20	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)	28	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)	3.27	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)	36	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)	3.57	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)	78	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)	1.78	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)	156	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)	3.60	The underlying data for this risk indicator is based on a broad suite of pollutants with well-documented direct or indirect negative effects on water security for both humans and freshwater biodiversity, compiled by Vörösmarty et al. (2010). The negative effects are specific to individual pollutants, ranging from impacts mediated by eutrophication such as algal blooms and oxygen depletion (e.g., caused by phosphorus and organic loading) to direct toxic effects (e.g., caused by pesticides, mercury). The overall Surface Water Contamination Index is calculated based on a range of key pollutants with different weightings according to the level of their negative effects on water security for both humans and freshwater biodiversity: soil salinization (8%), nitrogen (12%) and phosphorus (P, 13%) loading, mercury deposition (5%), pesticide loading (10%), sediment loading (17%), organic loading (as Biological Oxygen Demand, BOD; 15%), potential acidification (9%), and thermal alteration (11%).	Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., ... & Davies, P. M. (2010). Global threats to human water security and river biodiversity. Nature, 467(7315), 555.

Indicator	Value	Description	Source
3.1 - Surface Water Contamination Index (rank)	50	The underlying data for this risk indicator is based on a broad suite of pollutants with well-documented direct or indirect negative effects on water security for both humans and freshwater biodiversity, compiled by Vörösmarty et al. (2010). The negative effects are specific to individual pollutants, ranging from impacts mediated by eutrophication such as algal blooms and oxygen depletion (e.g., caused by phosphorus and organic loading) to direct toxic effects (e.g., caused by pesticides, mercury). The overall Surface Water Contamination Index is calculated based on a range of key pollutants with different weightings according to the level of their negative effects on water security for both humans and freshwater biodiversity: soil salinization (8%), nitrogen (12%) and phosphorus (P, 13%) loading, mercury deposition (5%), pesticide loading (10%), sediment loading (17%), organic loading (as Biological Oxygen Demand, BOD; 15%), potential acidification (9%), and thermal alteration (11%).	Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., ... & Davies, P. M. (2010). Global threats to human water security and river biodiversity. Nature, 467(7315), 555.
4.1 - Fragmentation Status of Rivers (score)	3.17	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)	46	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)	1.30	For this risk indicator, tree cover loss was applied as a proxy to represent catchment ecosystem services degradation since forests play an important role in terms of water regulation, supply and pollution control. The forest cover data is based on Hansen et al.'s global Landsat data at a 30-meter spatial resolution to characterize forest cover and change. The authors defined trees as vegetation taller than 5 meters in height, and forest cover loss as a stand-replacement disturbance, or a change from a forest to non-forest state, during the period 2000 – 2018.	Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A. A., Tyukavina, A., ... & Kommareddy, A. (2013). High-resolution global maps of 21st-century forest cover change. science, 342(6160), 850-853.

Indicator	Value	Description	Source
4.2 - Catchment Ecosystem Services Degradation Level (tree cover loss) (rank)	127	For this risk indicator, tree cover loss was applied as a proxy to represent catchment ecosystem services degradation since forests play an important role in terms of water regulation, supply and pollution control. The forest cover data is based on Hansen et al.'s global Landsat data at a 30-meter spatial resolution to characterize forest cover and change. The authors defined trees as vegetation taller than 5 meters in height, and forest cover loss as a stand-replacement disturbance, or a change from a forest to non-forest state, during the period 2000 – 2018.	Hansen, M. C., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S. A. A., Tyukavina, A., ... & Kommareddy, A. (2013). High-resolution global maps of 21st-century forest cover change. science, 342(6160), 850-853.
4.3 - Projected Impacts on Freshwater Biodiversity (score)	3.81	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)	39	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)	1.00	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)	160	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)	1.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Law(s)" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.

Indicator	Value	Description	Source
5.2 - Freshwater Law Status (SDG 6.5.1) (rank)	145	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Law(s)" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.3 - Implementation Status of Water Management Plans (SDG 6.5.1) (score)	1.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National IWRM plans" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.3 - Implementation Status of Water Management Plans (SDG 6.5.1) (rank)	169	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National IWRM plans" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
6.1 - Corruption Perceptions Index (score)	3.00	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)	99	This risk Indicator is based on the latest Transparency International's data: the Corruption Perceptions Index 2018. This index aggregates data from a number of different sources that provide perceptions of business people and country experts on the level of corruption in the public sector.	Transparency International (2019). Corruption Perceptions Index 2018. Berlin: Transparency International.
6.2 - Freedom in the World Index (score)	2.00	This risk indicator is based on Freedom House (2019), an annual global report on political rights and civil liberties, composed of numerical ratings and descriptive texts for each country and a select group of territories. The 2019 edition involved more than 100 analysts and more than 30 advisers with global, regional, and issue-based expertise to covers developments in 195 countries and 14 territories from January 1, 2018, through December 31, 2018.	Freedom House (2019). Freedom in the world 2019. Washington, DC: Freedom House.

Indicator	Value	Description	Source
6.2 - Freedom in the World Index (rank)	95	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)	1.00	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)	144	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)	3.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Sustainable and efficient water use management" indicator, which corresponds to one of the five national level indicators under the Management Instruments category. For SDG 6.5.1, management instruments refer to the tools and activities that enable decision-makers and users to make rational and informed choices between alternative actions.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
7.1 - Management Instruments for Water Management (SDG 6.5.1) (rank)	41	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "Sustainable and efficient water use management" indicator, which corresponds to one of the five national level indicators under the Management Instruments category. For SDG 6.5.1, management instruments refer to the tools and activities that enable decision-makers and users to make rational and informed choices between alternative actions.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.

Indicator	Value	Description	Source
7.2 - Groundwater Monitoring Data Availability and Management (score)	3.00	This risk indicator is based on the data set by UN IGRAC (2019) to determine the level of availability of groundwater monitoring data at country level as groundwater management decisions rely strongly on data availability. The level of groundwater monitoring data availability for groundwater management is determined according to a combination of three criteria developed by WWF and IGRAC: 1) Status of country groundwater monitoring programme, 2) groundwater data availability for NGOs and 3) Public access to processed groundwater monitoring data.	UN IGRAC (2019). Global Groundwater Monitoring Network GGMN Portal. UN International Groundwater Resources Assessment Centre (IGRAC).
7.2 - Groundwater Monitoring Data Availability and Management (rank)	48	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)	2.02	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)	171	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)	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.
8.1 - Access to Safe Drinking Water (rank)	6	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)	14	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)	3.00	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)	78	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. 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)	38	Water is a social and cultural good. The cultural diversity risk indicator was included in order to acknowledge that businesses face reputational risk due to the importance of freshwater for indigenous and traditional people in their daily life, religion and culture. This risk indicator is based on Oviedo and Larsen (2000) data set, which mapped the world's ethnolinguistic groups onto the WWF map of the world's ecoregions. This cross-mapping showed for the very first time the significant overlap that exists between the global geographic distribution of biodiversity and that of linguistic diversity.	Oviedo, G., Maffi, L., & Larsen, P. B. (2000). Indigenous and traditional peoples of the world and ecoregion conservation: An integrated approach to conserving the world's biological and cultural diversity. Gland: WWF (World Wide Fund for Nature) International.
10.1 - Freshwater Endemism (score)	2.78	The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Companies operating in basins with higher number of endemic fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.

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Indicator	Value	Description	Source
10.1 - Freshwater Endemism (rank)	148	The underlying data set for this risk indicator comes from the Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Companies operating in basins with higher number of endemic fish species are exposed to higher reputational risks.	WWF & TNC (2015). Freshwater Ecoregions of the World.
10.2 - Freshwater Biodiversity Richness (score)	4.51	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)	41	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)	79	This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group). It indicates how aware local residents typically are of water-related issues due to national media coverage. The status of the river basin (e.g., scarcity and pollution) is taken into account, as well as the importance of water for livelihoods (e.g., food and shelter).	WWF & Tecnoma (TYPSA Group)
11.2 - Global Media Coverage (score)	1.00	This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group). It indicates how aware people are of water-related issues due to global media coverage. Familiarity to and media coverage of the region and regional water-related disasters are taken into account.	WWF & Tecnoma (TYPSA Group)
11.2 - Global Media Coverage (rank)	156	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)

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Indicator	Value	Description	Source
12.1 - Conflict News Events (RepRisk) (score)	2.00	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)	120	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)	2.40	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)	89	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 (#)	18646433	Population, total	The World Bank 2018, Data , hompage accessed 20/04/2018
GDP (current US$)	11693235542	GDP (current US$)	The World Bank 2018, Data , hompage accessed 20/04/2018
EPI 2018 score (0-100)	42.83	Environmental Performance Index	
WGI -Voice and Accountability (0-100)	15.24	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

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Indicator	Value	Description	Source
WGI -Political stability no violence (0-100)	48.77	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)	34.62	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)	37.98	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)	34.13	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)	53.37	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

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Country Overview - Burkina Faso

Indicator	Value	Description	Source
WRI BWS all industries (0-5)	0.00	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)	175	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)	154	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2020 Optimistic (increasing rank describes lower risk)	154	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2020 Pessimistic (increasing rank describes lower risk)	154	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.

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Indicator	Value	Description	Source
Baseline Water Stress (BWS) - 2030 BAU (increasing rank describes lower risk)	145	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2030 Optimistic (increasing rank describes lower risk)	144	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.
Baseline Water Stress (BWS) - 2030 Pessimistic (increasing rank describes lower risk)	146	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)	134	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)	131	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)	140	WRI country ranking	Luo, T., R. Young, and P. Reig. 2015. "Aqueduct projected water stress rankings." Technical note. Washington, DC: World Resources Institute, August 215. Available online at http://www.wri.org/publication/aqueduct-projected-water-stress-country-rankings.

Water Risk Filter

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Indicator	Value	Description	Source
Total water footprint of national consumption (m3/a/cap)	1702.92	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 (%)	3.39	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)	29.73	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)	54.27	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 (%)	85.00	Aquastat - Irrigation	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Electricity production from hydroelectric sources (% of total)	0.00	World Development Indicators	The World Bank 2018, Data , hompage accessed 20/04/2018
Total internal renewable water resources (IRWR) (10^9 m3/year)	12.50	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)	1.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Water resources: total external renewable (10^9 m3/year)	12.50	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13

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Indicator	Value	Description	Source
Total renewable water resources (10^9 m3/year)	13.50	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Dependency ratio (%)	7.41	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)	745.60	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
World happiness [0-8]	4.42	WorldHappinessReport.org	World Happiness Report, homepage accessed 20/04/2018

Country Aspects

1. PHYSICAL ASPECTS

1.1. WATER RESOURCES

1.1.1. WATER RESOURCES

The hydrographic network is made up of many rivers and ponds in the southern part of the country. It is divided into three main basins:
•the Volta basin, which covers 63 per cent of the land in the centre and west and consists of the Mouhoun, Nakambé and Nazinon Pendjari rivers, which join in Ghana;
•the Niger basin, which occupies 30 per cent of the country and drains the east and north before emptying into the Niger river;
•the Comoé basin, which covers 7 per cent of the country and traverses the Ivory Coast before emptying into the Gulf of Guinea.
The country has many wetlands, which occupy about 1,800km2.
The average rainfall is 748mm for the whole country. Considering the common surface water and groundwater resources, the total internal renewable water resources are estimated to be 17.5km3/year. The renewable surface water resources are estimated to be 8km3/year. With the exception of those in the southwest, all the rivers of Burkina Faso are temporary. In dry years, this potential falls to 4.3km3/year. The total volume of renewable groundwater resources is around 9.5km3/year. However, according to the inventory of water resources prepared by the Ministry of Environment and Water in 2001, the fluctuations observed in the aquifer for 20 years indicate that there are no renewable groundwater resources in Burkina Faso.

1.1.2. WATER USE

Total water withdrawals in 2000 amounted to 690 million m3 for irrigation and livestock (86 per cent of the total), 104 million m3 for domestic use (13 per cent) and 6 million m3 for industry (1 per cent).

1.2. WATER QUALITY, ECOSYSTEMS AND HUMAN HEALTH

Surface water in Burkina Faso usually contains little dissolved solids. The bacteriological contamination of water is linked in particular to farming and the presence of houses near water points.
Surface water seems generally to be of fairly good quality. High concentrations of nitrates (more than 100mg/l) and chlorides are present in Mouhoun and Sourou regions. In some areas of the southeast, the salinity level is high but acceptable according to WHO standards.
Dams and irrigation schemes, like natural aquatic environments, are magnets for people; this promotes the development of pathogens whose reproductive cycle depends on the proximity of human sources of water.
A major problem for water-environment relations is the lack of an effective water policy to enforce the provisions of the Water Act No. 002-2001/AN.
According to NERC (2002), as with many arid African countries, groundwater quality has been an issue of lower priority than groundwater availability and has hence received relatively little attention. Hence, few data exist on which to base an adequate assessment of the quality of the nation's groundwater. From the data available, the groundwater from the basement rocks is typically fresh, with Ca-Mg-HCO3-dominant water types. Investigations suggest that pollution from contaminants such as nitrate is a common problem, especially in shallow groundwater sources. Arsenic has also been identified as a problem in some areas. The extent of the occurrence of high-arsenic water is not known; recognized problems appear to be localized to one or two villages. Few other water-quality problems have been singled out as major issues
Shallow groundwater has significant potential for being contaminated by pollutants from domestic (latrines, drains, waste tips) as well as agricultural and industrial sources. Groen et al. (1988) noted the presence of nitrates at concentrations above the WHO guideline value in several groundwater samples from tubewells and open dug wells in northwestern Burkina Faso. In a study of 168 tubewell samples, 15 per cent were found to have NO3-N concentrations greater than 10mg/l. In addition, of 123 samples of well water investigated, 36 per cent had concentrations above this value. The maximum observed concentration was 90mg/l (as N). Nitrate concentrations were highest in areas with increased housing density and were also elevated in groundwater downgradient of the housing areas (NERC, 2002).
Increased nitrate was found to be accompanied by increased electrical conductivity, which suggests that the concentrations of many other major ions (notably chloride, sulphate, sodium, potassium) were likewise increased as a result of the pollutant inputs. High nitrate concentrations are likely to be a feature of shallow groundwaters in many areas of the country. The concentrations of ammonium and nitrite are less clear. Some exceedances above WHO guideline values are expected, though these are likely to be less common than exceedances of nitrate (NERC, 2002)
Groundwater abstracted from the basement aquifers and overlying weathered horizons is for the most part likely to be fresh, based on data available from Birimian aquifers elsewhere (Smedley et al., 1995). However, Groen et al. (1988) found variable salinity in groundwater samples from their study of northwestern Burkina Faso. Electrical conductivity values were in the range 50-2700µS/cm. The highest values observed are relatively saline and unsuitable for drinking. However, median values determined (270µS/cm and 370µS/cm respectively for dug wells and tubewells) indicate the presence of predominantly fresh groundwater. The salinity variations in groundwater from the sedimentary formations along the northwest and northern border areas of

Burkina Faso are not known (NERC, 2002).

2. GOVERNANCE ASPECTS

2.1. WATER INSTITUTIONS

The water sector has been under the Ministry of Agriculture, Water and Fisheries Resources since July 2002. Before that date, it was under the Ministry of Environment and Water. Water withdrawn for purposes other than agriculture is managed through the National Water Council. But the Ministry of Agriculture remains the guarantor of the integrated management of water resources throughout the country.

Three departments are in charge of the water management:

-the Ministry of Agriculture, Water and Fisheries Resources, and six services attached to it:

i.the branch agricultural water (DGHA);

ii.the authority for the development of Sourou (AMVS);

iii.the Bagré project (MOB);

iv.the fund for water and rural infrastructure (FEER);

v.national dams and irrigation schemes (ONBAH);

vi.the Programme of Integrated Resource Management (IWRM), funded by Denmark through its cooperation agency DANIDA;

-the Ministry of Animal Resources;

-the Ministry of Environment.

The General Directorate of Agricultural Water is responsible for developing and monitoring the implementation of the legislation regarding agricultural water. A sub-directorate for the promotion of small village irrigation installs treadle pumps at low cost in the slums. The MOB and the AMVS perform land management, and manage infrastructure and royalties in their respective areas of intervention. The FEER manages external funds for small facilities. Finally, the IWRM oversees the establishment of the new framework for water resources management.

These institutions are supported by:

•the National Council for Environment and Sustainable Development (CONEDD), responsible for issues related to the environment;

•the Association of Irrigation Professionals (APIPAC);

•the National Committee on Irrigation and Drainage (CNID), comprising managers of irrigation;

•the National Institute of Environmental and Agricultural Research (INERA), in charge of agricultural research;

•the Inter-State Committee to Fight against Drought in the Sahel (CILSS).

2.2. WATER MANAGEMENT

Most schemes have been designed following the model of the peasantry, with tower-irrigation water. The DGHA tries to promote the organization of surface water users' associations and participatory irrigation management through decentralized local organizations. The IWRM deals with water management through water agencies that will be installed in the four national watersheds. Management of water resources has major shortcomings, including:

•the absence of concerted management of water resources in river basins and aquifer units, resulting in uncoordinated interventions in the sector and the risk of saturation works in certain watersheds;

•the absence of documents recognized by all stakeholders to guide decisions on water management at the level of major rivers and major river basins and sub-basins.

The adoption and promulgation of the law nb 002-2001/AN of 8 February, 2001 related to the orientation law on water management makes Integrated Water Resources Management (IWRM) the foundation of the global strategy concerning public action reform with regard to water (MAFHR, 2003).

IWRM involves management directed by consensus and the participatory management of water resources by several intervening parties, each having different interests and positions and operating at different levels. It involves particularly the state, local communities, and users. The orientation law related to water management addresses the reconstruction of the water sector through its provisions related to water administration, to water and public services systems and to water sector funding (MAFHR, 2003).

The overall objective of the Action Plan for Integrated Water Resources Integrated Management (PAGIRE) in Burkina Faso is to contribute to the implementation of integrated water resources management in the country, adapted to the national context in conformity with the orientations defined by the government and respecting the principles acknowledged on an international level in relation to a sustainable and ecologically rational management of water resources (MAFHR, 2003).

Its specific objectives are the following (MAFHR, 2003):

•to define and plan the implementation of the future framework for water resources integrated management;

•to identify specific actions and propose the necessary means for their implementation.

The PAGIRE seeks to define operational strategies, specific actions and a working plan which will permit a deep reform of the institutional, legal, technical and financial framework of the water resources management in the country (MAFHR, 2003).

2.3. WATER POLICY AND LEGAL FRAMEWORK

The final report of the National Seminar on Water Policy of 1976 presented for the first time a policy of irrigation development. The objectives that it assigned to agricultural water are still valid today: to contribute to food security, improve income and living conditions of rural populations, to improve the trade balance, to protect and restore the environment and to limit migration to coastal areas and the rural exodus. In May 1992, the Policy Letter for Agricultural Development (LPDA) fundamentally changed the strategic directions of agriculture and agricultural water (considered a supporting sub-sector of agricultural production). Among its objectives were the withdrawal of the state, increased production, and improved natural resource management. In

August 1993, a note on agricultural water policy that included a general diagnosis of the current situation was published, with development actions and new directions imposed by the cotemporary situation. Finally, the National Water Policy adopted by the Government of Burkina Faso in July 1998 aimed to contribute to sustainable development by providing appropriate solutions to problems related to water, so that such problems do not become a limiting factor for socio-economic development.

The following laws also relate to water resources management:

•Law No. 23-94 of May 19, 1994 of the Code of Public Health (Article 12) discusses the regulatory drinking water standards and health regulations to which all water must be submitted;

•Law No. 014/96/ADP of 23 May 1996 on agrarian and land reform (RAF) and its implementing Decree No. 97-054/PRES/PM/MEF of 6 February, 1997 set out the powers of the State and legislation for the management of water resources;

•Sections 48 and 50 of Law No. 005/97/ADP of January 30, 1997 (the Environmental Code) regulate activities that may degrade the quality of surface water or groundwater and soil;

•Law No. 006/97/ADP of January 31, 1997 (Forestry Code (Title 4)) defines water protection measures;

•Decree No. 97-598/PRES/PM/MEE/AGRI covers the adoption of specifications for the management of irrigation schemes;

•Article 70 of Law No. 023/97/II/AN of 22 October, 1997 (the Mining Code) requires an environmental impact statement accompanied by a programme of conservation and environmental management before any work is undertaken;

•Law No. 040/98/AN of August 3, 1998 on decentralization and Laws No. 041 and No. 042/98/AN of 6 August, 1998 on the organization of the territory of Burkina Faso address the role of local authorities in managing water infrastructure;

•Joint Order No. 98-032/MEE/MA/MEF/MATS 98-033/MEE/MA/MEF/MATS cover the Sourou Valley, the upper valley of the Black Volta and the hydro-agricultural region Bagré;

•Law No. 002-2001/AN of February 8, 2001 gives new directions for national policy regarding water resources management;

•Decree No. 2002-317/PRES/PM/MAHRH of 17 July, 2002 organizes Ministry of Agriculture, Water and Fisheries resources.

Since the beginning of the 1990s, Burkina has implemented important reforms in order to create an institutional, economic and political environment that is favourable to the resumption of sustainable growth in a context of economic liberalization (MAFHR, 2003).

The document entitled 'Policy and Strategy Related to Water', adopted by the government of Burkina Faso, has been approved by the decree NB 98-365/PRES/PM/MEE of 10 September, 1998. The national water policy which is defined therein opens prospects for sustainable institutional development through such measures as (MAFHR, 2003):

•the institutional and financial mobilization of the state, local communities and users;

•sector integration within the overall framework of the political, social and economic development objectives of the country (decentralization, gender equality, private sector development, creation of jobs and incomes).

The following points should also be emphasized in relation to national water policy (MAFHR, 2003):

•Law no. 14/96/ADP of 26 May, 1996, related to land reform;

•Law no. 006/97/ADP of 31 January,1997, related to the Forest Code;

•Law no. 023/97/II/AN of 22 October, 1997, related to the Mining Code;

•Law no. 023/94/ADP of 19 May, 1994, related to the Code of Public Health.

In addition, with regard to the application of the national policy, the following can be noted (MAFHR, 2003):

•the existence of the national strategy for the sanitation sub-sector;

•Decree no. 2005-514/PRES/PM/MEE of 3 November, related to a framework document concerning reform of the AEP infrastructures management system in rural and semi-urban areas;

•Decree no. 97-598/PRES/PM/AGRI/MEE/MRA/MEF of 3 March, 2000, related to the adoption of overall specifications for the management of small hydroagricultural developments;

•the implementation of structural interventions such as the IWRM programme, the UREO programme, reform of the AEP infrastructures management system, the Development of Private Irrigation and Connected Activities (DIPAC) and the small irrigation promotion project.

3. GEOPOLITICAL ASPECTS

As part of the watershed management of the Niger and Volta, Burkina Faso has established agreements with other countries sharing these basins. The main rivers (the Nakambé, Mouhoun, Comoé and tributaries of the Niger) also irrigate the neighbouring countries. Burkina Faso is a member of the Niger Basin Association (NBA) to promote cooperation between member countries in all areas where water is present, and a participant in integrated management of the Volta basin.

According to Andersen et al (2005), several tributaries of the Niger river originate in Burkina Faso. About 25 per cent (58,50km2) of the country's total territory is within the Niger river basin, comprising about 3.9 per cent of the basin's area. A quarter of Burkina Faso's population, 2.12 million, lives in the basin, which is the driest region of the country. It is also the poorest economic area, with pastoral livelihoods that are seminomadic in the north and sedentary in the south.

The Niger river basin is a unique and complex river system with an extensive network of tributaries. Because of climatic variations, the annual river flood does not occur at the same time in different parts of the basin. There are usually high flows from the headwaters in Guinea, a decrease in flow caused by evaporation and expansion in the floodplain of the Inland Delta, followed by an increase in flow from tributary input through the Middle and Lower reaches as the river enters the Niger Delta. In the Upper Niger, the high-water discharges generally occur in September, and the low-water season is generally April–May. The Inland Delta has an estimated storage capacity of 70km3 but has a high rate of loss caused by evaporation over the thousands of square kilometers of its floodplain. This loss is estimated at about 44 per cent of the inflow. The peak flow period that arrives in September is delayed as it spreads out, exiting the Inland Delta three months later. A phase of receding water extends into February. In the Middle Niger, at Niamey, the maximum flows are usually twofold: a first wet seasonal peak flow and the upstream peak flow that arrives during the dry season. The first high-water discharge, known as the white flood (because of the light sediment content of the water), occurs soon after the rainy season in September. A second rise, known as the black flood, begins in December with the arrival of inflow from upstream. May and June are the low-water months in the Middle Niger.

On the Benue, there is only one high-water season, because of the Benue's more southerly climatic location; this normally occurs from May to October, which is earlier than on the Middle Niger. The Lower Niger below its confluence with the Benue consequently has a high-water period that begins in May or June and a low-water period that is at least a month shorter than on the Middle Niger because the rains in the south start earlier. In terms of water quality, an increase in siltation is linked to erosion, deforestation, and soil depletion (Andersen et al, 2005).

The Niger Basin Summit of Heads of State has embarked on a Shared Vision process. This is a bold commitment, moving from a past of unilateral actions on the river toward enhanced coordination, collaboration and joint action. The process is an expression of the political commitment of the heads of state to a cooperative agenda. The Shared Vision will guide the formulation of the SDAP, which will identify and define the development opportunities in which the basin countries can jointly participate. The Shared Vision and the SDAP will form a platform for mobilizing resources from the NBA countries and from the donor communities for investments to implement the SDAP (Andersen et al, 2005)

According to Madiodio (2005), the Volta river system is increasingly targeted both in Ghana and in Burkina Faso to address national development needs. The Akosombo Dam, completed in 1965, created the largest man-made lake in the world with an area of 8,500km2 and a volume of 148km3 at full reservoir capacity. In 1982, the Kpong dam was built downstream of Akosombo. Together these two dams have an installed capacity of 1,060MW (or 95 per cent of Ghana's total electricity supply). In an average year, 56 per cent of the waters flowing to the Akosombo Reservoir come from the White and Black Volta (against 44 per cent from the OtiPendjari river). In 1998, the water in the Akosombo Reservoir fell below its operating level, resulting in severe power shortages. This gave rise to various speculations about the causes of the low level of water inflows to the Akosombo Reservoir (also known as the Volta Lake).

One view was that Burkina Faso had unduly increased water withdrawals in the upper basin through dam building and irrigation development. Indeed, a few years earlier, Burkina Faso had announced plans to build three large dams on tributaries of the Volta within its territory for water supply to Ouagadougou, the capital city (Ziga Dam), and for power production. At that time, Burkina Faso had already built two large dams and an estimated 1,500 small dams in the upper basin of the Volta river. In addition, the irrigated area in Burkina Faso increased from 20km2 in 1966 to 250km2 in the late 1990s, whereas in Ghana the area irrigated increased from 10km2 to 70km2 during the same period (Madiodio, 2005).

While these trends seem to support the feeling that Burkina Faso's investments in water infrastructures were the main causes of water deficits in the lower Volta, there is an alternative view that the total storage capacity of Burkina Faso's planned and existing large and small reservoirs represents only 1.49km3, or less than 5 per cent of the storage capacity of the Akosombo Reservoir. It is therefore more plausible to link Ghana's 1998 energy crisis to reduced discharge of the Volta as a result of climate change and variability rather than to increased water withdrawals in Burkina Faso (Madiodio, 2005).

In addition to water withdrawals, there are two other potential sources of misconception and tensions – both to some extent related to changing climate conditions in the basin. The first issue relates to alleged water releases from dams in Burkina Faso (particularly the Bagre Dam) resulting in floods in northern Ghana, as occurred in 1999. The second issue relates to the proliferation and migration of aquatic weeds along the Volta river system as well as perceived signs of increased water pollution. Today it is estimated that 30 per cent of the lower Volta is covered by water weeds (mainly Pistia stratiotes, Azolla, and Salvinia) while water hyacinth, which has already invaded the Black and White Volta in Burkina Faso, represents an even greater threat to the lower reaches of the river basin (Madiodio, 2005).

According to Gao and Margolies (2009), as the basin population may increase by as much as 80 per cent over the next 25 years, water resources are going to become even scarcer (Andah and Gichuki, 2005). Water scarcity arises as a result of diminishing precipitation, reduction in river flows, falling water tables, an increase in the amount of evapotranspiration (due to the construction of thousands of large and small reservoirs in the basin) and inefficient use of water resources. Over the past 20 years, the basin has seen a reduction in the amount of precipitation and river flows (Gyau-Boakye and Tumbulto, 2000). Furthermore, groundwater in the basin is overexploited through excessive pumping without due regard to the recharge characteristics of aquifers. Lowering of the water tables has also been observed in large parts of the basin, and can lead to saltwater intrusion in the southern parts of the basin near the Gulf of Guinea coast (Andah and Gichuki, 2005).

Since the six countries of the basin are very poor, they lack the financial resources to build water infrastructure. As a result, sanitation, water supply facilities and water and wastewater treatment are inadequate. At the same time, as water is an important development resource, the six countries are trying to exploit the basin's water resources as much as possible to develop their economies. There are competing uses of water resources both among different sectors within each country and between the upstream and downstream countries (Gao et al, 2009). Within each country, water has diverse uses: irrigation, fishery, domestic water supply and livestock watering. Internationally, conflict exists between Burkina Faso, which wants to expand its irrigation by extracting more water from the river, and Ghana, which wants to generate more hydropower to fuel its economic development (Andah and Gichuki, 2005). The need to develop the region economically to improve the livelihoods of its people conflicts with the need to preserve and protect the ecosystem for future generations. These issues are essential to address in any plan of water management for the basin (Gao et al, 2009).

The riparian countries have very limited capacity to deal with environmental issues such as loss of biodiversity, reduction of fisheries resources, groundwater resources depletion, flooding and river pollution (Gao et al, 2009). These problems are water-related and transboundary in nature. In the six basin countries, many institutions are charged with responsibilities for managing water, food, and soil resources. This results in overlapping of responsibilities and difficulties in coordination. Coordination of activities among institutions is weak, and in some cases exists only on an ad hoc basis for crisis situations. For the management of water and soil resources to be effective, it should be integrated at the local and national level, with emphasis on inter-sectoral coordination (Andah and Gichuki, 2005).

Furthermore, there has been little coordinated transboundary effort in the basin until recently, with the establishment of the Volta Basin Authority in 2006. Previously, each country acted independently in harnessing the river. Many of the causes and effects of the water issues are transboundary in nature. If no cooperation is achieved, potential for conflicts among riparian countries might increase with rising water withdrawals. Conflict prevention and resolution can be found in some countries in Africa at the local and national level, but nearly no functional provisions exist at the international level (Gao et al, 2009).

The history of transboundary actions in the basin can be dated back to the pre-colonial period when France and Great Britain signed two territory agreements in 1906. The first one was called 'Exchange of Notes between France and Great Britain relative to the Boundary between the Gold Coast and French Soudan', and the second 'Agreement between France and Great Britain relative to the frontier between French and British possessions from the Gulf of Guinea to the Niger (Southern Nigeria and Dahomey)'. These two agreements both involved the Volta river basin. In many cases, the establishment of colonial boundaries separated people from the water resources they had traditionally used (Gao et al, 2009).

Burkina Faso accepted on 22 March, 2011 the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (UNTC).

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