Water Risk Filter

Country Overview - Iraq

Water Indicators

Indicator	Value	Description	Source
Overall Basin Risk (score)	3.08	Overall Basin Risk (score)	
Overall Basin Risk (rank)	25	Overall Basin Risk (rank)	
Physical risk (score)	3.29	Physical risk (score)	
Physical risk (rank)	19	Physical risk (rank)	
Regulatory risk (score)	3.12	Regulatory risk (score)	
Regulatory risk (rank)	52	Regulatory risk (rank)	
Reputation risk (score)	2.41	Reputation risk (score)	
Reputation risk (rank)	141	Reputation risk (rank)	
1. Quantity - Scarcity (score)	3.57	1. Quantity - Scarcity (score)	
1. Quantity - Scarcity (rank)	29	1. Quantity - Scarcity (rank)	
2. Quantity - Flooding (score)	2.37	2. Quantity - Flooding (score)	
2. Quantity - Flooding (rank)	144	2. Quantity - Flooding (rank)	
3. Quality (score)	4.18	3. Quality (score)	
3. Quality (rank)	10	3. Quality (rank)	
4. Ecosystem Service Status (score)	2.56	4. Ecosystem Service Status (score)	
4. Ecosystem Service Status (rank)	85	4. Ecosystem Service Status (rank)	
5. Enabling Environment (Policy & Laws) (score)	3.10	5. Enabling Environment (Policy & Laws) (score)	
5. Enabling Environment (Policy & Laws) (rank)	46	5. Enabling Environment (Policy & Laws) (rank)	
6. Institutions and Governance (score)	4.50	6. Institutions and Governance (score)	
6. Institutions and Governance (rank)	8	6. Institutions and Governance (rank)	
7. Management Instruments (score)	2.30	7. Management Instruments (score)	
7. Management Instruments (rank)	132	7. Management Instruments (rank)	
8 - Infrastructure & Finance (score)	1.75	8 - Infrastructure & Finance (score)	
8 - Infrastructure & Finance (rank)	108	8 - Infrastructure & Finance (rank)	
9. Cultural Diversity (score)	1.00	9. Cultural importance (score)	
9. Cultural Diversity (rank)	127	9. Cultural importance (rank)	
10. Biodiversity Importance (score)	3.07	10. Biodiversity importance (score)	

Indicator	Value	Description	Source
10. Biodiversity Importance (rank)	117	10. Biodiversity importance (rank)	
11. Media Scrutiny (score)	2.55	11. Media Scrutiny (score)	
11. Media Scrutiny (rank)	96	11. Media Scrutiny (rank)	
12. Conflict (score)	2.73	12. Conflict (score)	
12. Conflict (rank)	71	12. Conflict (rank)	
1.0 - Aridity (score)	3.75	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)	22	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)	3.20	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)	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.
1.2 - Baseline Water Stress (score)	3.44	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)	41	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)	4.32	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)	30	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)	2.77	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)	32	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)	3.49	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)	46	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)	3.25	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)	38	This risk indicator is based on multi-model simulation that applies both global climate and drought models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) . A drought threshold for pre-industrial conditions was calculated based on time-series averages. Results are expressed in terms of relative change (%) in probability between pre-industrial and 2°C scenarios.	Frieler, K., Lange, S., Piontek, F., Reyer, C. P., Schewe, J., Warszawski, L., ... & Geiger, T. (2017). Assessing the impacts of 1.5 C global warming–simulation protocol of the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP2b). Geoscientific Model Development.
2.1 - Estimated Flood Occurrence (score)	2.41	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)	143	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)	1.67	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)	161	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)	4.18	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)	10	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)	2.94	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)	78	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)	1.00	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)	158	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)	4.99	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)	5	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)	2.00	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)	112	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Policy" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
5.2 - Freshwater Law Status (SDG 6.5.1) (score)	4.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation "National Water Resources Law(s)" indicator, which corresponds to one of the three national level indicators under the Enabling Environment category. For SDG 6.5.1, enabling environment depicts the conditions that help to support the implementation of IWRM, which includes legal and strategic planning tools for IWRM.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.

Indicator	Value	Description	Source
5.2 - Freshwater Law Status (SDG 6.5.1) (rank)	8	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)	2.00	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)	128	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)	5.00	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)	8	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)	4.00	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)	45	This risk indicator is based on Freedom House (2019), an annual global report on political rights and civil liberties, composed of numerical ratings and descriptive texts for each country and a select group of territories. The 2019 edition involved more than 100 analysts and more than 30 advisers with global, regional, and issue-based expertise to covers developments in 195 countries and 14 territories from January 1, 2018, through December 31, 2018.	Freedom House (2019). Freedom in the world 2019. Washington, DC: Freedom House.
6.3 - Business Participation in Water Management (SDG 6.5.1) (score)	4.00	This risk indicator is based on SDG 6.5.1. Degree of IWRM Implementation “Business Participation in Water Resources Development, Management and Use” indicator, which corresponds to one of the six national level indicators under the Institutions and Participation category.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
6.3 - Business Participation in Water Management (SDG 6.5.1) (rank)	10	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)	2.00	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)	118	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)	40	This risk indicator is based on the data set by UN IGRAC (2019) to determine the level of availability of groundwater monitoring data at country level as groundwater management decisions rely strongly on data availability. The level of groundwater monitoring data availability for groundwater management is determined according to a combination of three criteria developed by WWF and IGRAC: 1) Status of country groundwater monitoring programme, 2) groundwater data availability for NGOs and 3) Public access to processed groundwater monitoring data.	UN IGRAC (2019). Global Groundwater Monitoring Network GGMN Portal. UN International Groundwater Resources Assessment Centre (IGRAC).
7.3 - Density of Runoff Monitoring Stations (score)	3.02	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)	117	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)	1.00	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)	99	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)	2.00	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)	102	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)	17	This risk indicator is based on the average 'Financing' score of UN SDG 6.5.1. Degree of IWRM Implementation database. UN SDG 6.5.1 database contains a category on financing which assesses different aspects related to budgeting and financing made available and used for water resources development and management from various sources.	UN Environment (2018). Progress on integrated water resources management. Global baseline for SDG 6 Indicator 6.5.1: degree of IWRM implementation.
9.1 - Cultural Diversity (score)	1.00	Water is a social and cultural good. The cultural diversity risk indicator was included in order to acknowledge that businesses face reputational risk due to the importance of freshwater for indigenous and traditional people in their daily life, religion and culture. This risk indicator is based on Oviedo and Larsen (2000) data set, which mapped the world's ethnolinguistic groups onto the WWF map of the world's ecoregions. This cross-mapping showed for the very first time the significant overlap that exists between the global geographic distribution of biodiversity and that of linguistic diversity.	Oviedo, G., Maffi, L., & Larsen, P. B. (2000). Indigenous and traditional peoples of the world and ecoregion conservation: An integrated approach to conserving the world's biological and cultural diversity. Gland: WWF (World Wide Fund for Nature) International.
9.1 - Cultural Diversity (rank)	127	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)	4.06	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.

Indicator	Value	Description	Source
10.1 - Freshwater Endemism (rank)	71	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)	2.07	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)	144	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)	73	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)	87	This risk indicator is based on joint qualitative research by WWF and Tecnoma (Typsa Group). It indicates how aware people are of water-related issues due to global media coverage. Familiarity to and media coverage of the region and regional water-related disasters are taken into account.	WWF & Tecnoma (TYPSA Group)

Water Risk Filter

Country Overview - Iraq

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)	117	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)	3.46	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)	16	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 (#)	37202572	Population, total	The World Bank 2018, Data , hompage accessed 20/04/2018
GDP (current US$)	171489001692	GDP (current US$)	The World Bank 2018, Data , hompage accessed 20/04/2018
EPI 2018 score (0-100)	43.20	Environmental Performance Index	
WGI -Voice and Accountability (0-100)	3.33	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)	22.17	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 - Government Effectiveness (0-100)	9.13	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 - Regulatory Quality (0-100)	11.06	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)	2.40	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)	6.25	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)	3.48	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)	46	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)	19	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)	20	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)	19	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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Country Overview - Iraq

Indicator	Value	Description	Source
Baseline Water Stress (BWS) - 2030 BAU (increasing rank describes lower risk)	19	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)	20	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)	19	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)	21	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)	21	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)	19	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 - Iraq

Indicator	Value	Description	Source
Total water footprint of national consumption (m3/a/cap)	0.00	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 (%)	0.00	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)	3525.00	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)	3525.00	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 (%)	54.90	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)	4.33	World Development Indicators	The World Bank 2018, Data , hompage accessed 20/04/2018
Total internal renewable water resources (IRWR) (10^9 m3/year)	35.20	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)	54.66	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)	35.20	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13

Country Overview - Iraq

Indicator	Value	Description	Source
Total renewable water resources (10^9 m3/year)	89.86	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
Dependency ratio (%)	60.83	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)	2467.00	Aquastat - Water Ressources	FAO. 2016. AQUASTAT website. Food and Agriculture Organization of the United Nations (FAO). Website accessed on 2018/04/13
World happiness [0-8]	4.46	WorldHappinessReport.org	World Happiness Report, homepage accessed 20/04/2018

Country Aspects

1. PHYSICAL ASPECTS

1.1. WATER RESOURCES

1.1.1. WATER RESOURCES

Both the Tigris and the Euphrates are transboundary rivers, originating in Turkey. Before their confluence, the Euphrates flows for about 1,000km and the Tigris for about 1,300km within the territory of Iraq.

The area of the Tigris River Basin in Iraq is 253,000km2, which is 54 per cent of the total river basin area. The average annual runoff is estimated at 21.33km3 as it enters Iraq. All the Tigris tributaries are on the left bank. From upstream to downstream:

-The Greater Zab, which originates in Turkey. It generates 13.18km3 at its confluence with the Tigris; 62 per cent of the total area of this river basin of 25,810km2 is in Iraq;

-The Lesser Zab, which originates in the Islamic Republic of Iran and which is equipped with the Dokan Dam (6.8km3). The river basin of 21,475km2 (of which 74 per cent is in Iraqi territory) generates about 7.17km3, of which 5.07km3 is of annual safe yield after construction of the Dokan Dam;

-The Al-Adhaim (or Nahr Al Uzaym), which drains about 13,000km2 entirely in Iraq. It generates about 0.79km3 at its confluence with the Tigris. It is an intermittent stream subject to flash floods;

-The Diyala, which originates in the Islamic Republic of Iran and drains about 31,896km2, 75 per cent of which in Iraqi territory. It is equipped with the Derbendi Khan Dam and generates about 5.74km3 at its confluence with the Tigris;

-The Nahr at Tib, Dewarege (Doveyrich) and Shehabi rivers, draining together more than 8,000km2. They originate in Iranian territory and bring together about 1km3 of highly saline waters in the Tigris;

-The Karkheh, the main course of which is in the Islamic Republic of Iran and which, from a drainage area of 46,000km2, brings around 6.3km3 yearly into Iraq, namely into the Hawr Al Hawiza during the flood season and into the Tigris River during the dry season.

The average annual flow of the Euphrates as it enters Iraq is estimated at 30km3, with a fluctuating annual value of between 10 and 40km3. Unlike the Tigris, the Euphrates receives no tributaries during its passage in Iraq. About 10km3 per year are drained into the Hawr al Harnmar (a marsh in the south of the country). The Shatt Al-Arab is the river formed by the confluence downstream of the Euphrates and the Tigris; it flows into the Gulf after a course of only 190km. The Karun River, originating in Iranian territory, has a mean annual flow of 24.7km3 and flows into the Shatt Al-Arab, to which it brings a large amount of fresh water just before reaching the sea.

It is difficult to determine the average annual discharge of the Euphrates and Tigris rivers together due to the large yearly fluctuation. According to the records for 1938–1980, there have been years in the mid-1960s when 68km3 were recorded in the two rivers and years in the mid-1970s when the amount reached over 84km3. On the other hand, there was the critical drought year with less than 30km3 at the beginning of the 1960s. Such variations in annual discharge make it difficult to develop an adequate water allocation plan for competing water demand from each sector as well as to ensure fair sharing of water among neighbouring countries (UNDG, 2005).

This yearly fluctuation in the annual discharge has also caused large and possibly disastrous floods as well as periodic severe droughts. The level of water in the Tigris can rise at a rate of over 30cm/hour. In the southern part of the country, immense areas are regularly inundated, levees often collapse, and villages and roads must be built on high embankments. The Tharthar Reservoir was planned in the 1950s, partly to protect Baghdad from the ravages of the periodic flooding of the Tigris by storing extra water upstream of the Samarra Barrage.

The major part of the river flow occurs during the spring flood period, which is from February through June on the Tigris River and from March through July on the Euphrates River. On the Tigris the natural flow during this period makes up 60–80 per cent of the total annual flow and on the Euphrates 45–80 per cent. During the low water period (July through September) the natural flow does not exceed 10 per cent of the annual amount under normal conditions.

In order to increase water transport efficiency, minimize losses and waterlogging, and improve water quality, a number of new watercourses were constructed, especially in the southern part of the country. The Third River (also called Saddam River), which was completed in 1992, functions as a main outfall drain collecting drainage waters from more than 15,000km2 of agricultural land from the north of Baghdad to the Gulf between the Euphrates and the Tigris. The length of the watercourse, completed in December 1992, is 565km, with a total discharge of 210m3/s. In 1995 an estimated 17 million tons of salt was said to have been transported to the Gulf through the Third River. Other watercourses were also constructed to reclaim new lands or to reduce waterlogging.

Groundwater aquifers in Iraq consist of extensive alluvial deposits of the Tigris and Euphrates rivers, and are composed of Mesopotamian-clastic and carbonate formations. The alluvial aquifers have limited potential because of poor water quality. The Mesopotamian-clastic aquifers in the northwestern foothills consist of Fars, Bakhtiari and alluvial sediments. The Fars formation is made up of anhydrite and gypsum inter-bedded with limestone and covers a large area of Iraq. The Bakhtiari and alluvial formations consist of a variety of material, including silt, sand, gravel, conglomerate and boulders, with a thickness of up to 6,000m. Water quality ranges from 300 to 1,000ppm. Another major aquifer system is contained in the carbonate layers of the Zagros Mountains. Two main aquifers are found in the limestone and dolomite layers, as well as in the Quaternary alluvium deposits. The limestone aquifer contributes large volumes of water through a number of springs. The alluvial aquifers contain large volume reservoirs and annual recharge is estimated at 620 million m3 from direct infiltration of rainfall and surface water runoff. Water quality is good, ranging from 150 to 1,400ppm (ESCWA, 2001).

Good quality subterranean water has been found in the foothills of the mountains in the northeast of the country and in the area on the right bank of the Euphrates. The aquifer in the northeast of Iraq has an estimated safe yield of between 10 to 40m3/sec at depths of 5–50m. Its salinity increases towards the southeast of the area until it reaches between 0.5 and 1mg/l. The aquifers on the right bank of the Euphrates River, trapped between gypsum and dolomite at depths increasing towards the west where water is found at 300m (at Abu-Aljeer), have an estimated safe yield of 13m3/sec. In the western part of that area the salinity of the water is only 0.3mg/l compared with 0.5–1mg/l in the eastern section. In other areas of the country good quality water is fairly limited because of high levels of salinity (Ministry of Irrigation, 1986). An estimated 0.08km3/year of water from the Umm er Radhuma aquifer enters Iraq from Saudi Arabia. Internal renewable water resources are estimated at 35.2km3/year.

Total gross dam capacity of the major dams in the Tigris Basin is estimated at 102.2km3, of which on-river dam capacity is 29.4km3 (seven dams). The off-river storage Samarra-Tharthar Dam, constructed in 1954, has a capacity of 72.8km3. It is filled with Wadi Tharthar waters and, since 1985, also with Euphrates water.

Total gross capacity of the major dams in the Euphrates Basin is estimated at 37.5km3, of which on-river dam capacity is 34.2km3. The off-river Ramadi-Habbaniya Dam, constructed in 1951, has a capacity of 3.3km3; it can be filled with upstream Euphrates waters and drains into the Euphrates downstream (UNEP, 2001a).

There are 11 major wastewater treatment plants in Iraq, 3 of which are in Baghdad. All the treatment plants are located near rivers (three near the Euphrates, two near the Tigris, two near the Diala, and one each near the Kahla, the Aw Diwaniyah, the Husseinya and the Shatt Basrah). The total treatment capacity of these plants is 650,000 m3/day. The technologies used are primary sedimentation, aeration and secondary sedimentation (chlorination) at five plants; primary sedimentation, trickling filtering and chlorination at three plants; primary sedimentation, extended aeration and chlorination at two plants; aeration lagoons and secondary sedimentation at one plant (UNEP, 2001b). Until now, the majority of wastewater after treatment has been discharged into rivers and drainage canals by gravity and there is no definite canal network for wastewater collection.

The two largest wastewater treatment plants were built in Baghdad County (Salih, 2001). The first, Al-Rustumia, was designed to handle an average flow of 204 million m3/year and the second, Al-Karkh, handles an average flow of 150 million m3/year. Baghdad city is generally supplied by less saline drinking water (0.8–1.2 dS/m) and this salinity increases 2–3 times in the wastewater. It can therefore be used without creating any salinity and alkalinity problems except for very sensitive crops. The sodium concentration is rather low, resulting in a sodium adsorption ratio (SAR) ranging between 2.68 and 3.12 for the Al-Rustumia station and between 4.38 and 5.24 for the Al-Karkh station. The chloride content of wastewater of the Al-Karkh station is fairly high for surface irrigation and not recommended for sprinkler irrigation, while the chloride content of the Al-Rustomia station is appropriate for surface irrigation but generally inadequate for sprinkler irrigation. The bicarbonate content of wastewater from both stations is adequate for surface irrigation but inappropriate for sprinkler irrigation. The phosphorus and potassium contents of wastewater from both stations are fairly low. Contents of iron, magnesium, chromium, zinc, cobalt and boron in wastewater of both stations are generally within acceptable limits.

In 2002, the total installed desalination capacity was 384,513 m3/day. This refers to the installed gross capacity (design capacity) (Wangnick Consulting, 2002).

According to the European Union (2011), Iraq depends mainly on surface water from three renewable sources: the Euphrates, Tigris and Karun rivers. The Euphrates and the Tigris originate from Turkey and are shared with the two neighbouring countries Turkey and Syria. The Karun originates from Iran. The average annual water flow of the three rivers varies between 45 and 75 billion m3. There are no international agreements to share the water between these three countries. This makes Iraq's water resources fluctuate from one year to another. Groundwater aquifers in Iraq consist of extensive alluvial deposits of the Tigris and Euphrates rivers. The alluvial aquifers contain large volume reservoirs and the annual recharge is estimated at 620 million m3 from direct infiltration of rainfall and surface water runoff. Groundwater withdrawals are small compared to surface water. Further exploitation of groundwater has a large potential but little data and analysis are available.

1.1.2. WATER USE

In 2000, total water withdrawal was estimated at 66km3, of which 79 per cent was for agricultural purposes, 6.5 per cent for domestic supplies and 14.5 per cent for industrial use (ESCWA, 2005).

Hydroelectric power generation is about 17 per cent of current electrical energy production in Iraq. Existing power plants have been neglected for over a decade and a number of new projects were suspended in the aftermath of the Gulf War. The volume and timing of water entering Iraq from neighbouring countries is a significant factor in hydropower production (UNDG, 2005).

Most of the Euphrates and Tigris rivers' source is from rain and snowmelt from the mountains in the north of Iraq and the south of Turkey. The water drainage characteristics of these two rivers are changeable according to the seasons of the year. Consequently, percentages of water consumption by the different activities in Iraq are as follows (Behnam, 2005):

•Home consumption: 5 per cent

•Industrial consumption: 8 per cent

•Agricultural consumption: 87 per cent

The country has passed through dry seasons in the last years. In addition, large dams have been constructed on the heads of the two rivers in Turkey, so the rivers' average drainage is continuously decreasing. Accordingly, it was necessary to concentrate on increasing rationalization of water. We have had more than ten years of scientific and economic embargos on the country. Meanwhile, the industrial, agricultural and environmental sectors were working together to achieve the goal of conserving water sources, and preventing their contamination. Moreover, the Iraqi legislature has issued deterrent laws, with respect to the administrative establishments that

are wasting water or contaminating water with industrial wastes (Behnam, 2005).
According to the European Union (2011) the available surface and groundwater amounts in Iraq were previously sufficient to meet water needs for agriculture, domestic and industrial uses. Today however the total annual water withdrawal is estimated at around 45 billion m3, out of which 90 per cent is used for agriculture, 6.5 per cent for domestic supplies and 3.5 per cent for industry. This is significantly less than in the past. The increased demand of the upstream riparian states and climate variables has led to a decrease of available water by 10 billion m3 per year and a drop in water quality (increased salinity).
Agricultural applications
Agricultural consumption of water is estimated at 78 per cent of the overall consumption in Iraq. The authorities have therefore adopted measures to control irrigation in order to preserve water. Conservation and demand rationalization must be accomplished through controlling rivers' drainages. Some of the activities in these areas are as follows (Behnam, 2005):
•Dam construction on the Euphrates and Tigris rivers and on the Tigris river branches, in order to conserve water and control drainage. This can be accomplished by specifying the maximum utility of water in all seasons of the year.
•Reduction of the riverbed surface area by decreasing the river width and lining its sides with stones. This was initiated two years ago, in Baghdad.
•Construction of concrete channels for irrigation. The width does not exceed 60cm, having a 'V' shape for water transfer from major channels through the use of pumps. These channels are branched out to the agricultural regions.
•Utilization of industrial sprinklers to control water quantities for irrigation.
•Application of modern technology to improve irrigation.
•Expansion in construction of greenhouses for agriculture.
•Selection of crop type in accordance with regional rainfall.
•Construction of specialized centres for agricultural research, to develop seed production with a high economic yield, and the ability to germinate under difficult circumstances. These centres also cultivate new breeds of crops that depend on smaller quantities of water.
•Construction of training centres for the farmers, to teach them modern methods in agriculture and demand rationalization of water.
According to the European Union (2011), in the agricultural sector, around 50 per cent of the total arable and dry land could be irrigated. However, only around half of this surface is currently irrigated, which consumes an average amount of 40 billion m3 per year. The drop in water availability has put pressure on the agricultural sector to improve methods of managing the shrinking water resources and to raise awareness of water related issues.
Industrial applicationsIndustrial applications
Industrial consumption of water is estimated at 8 per cent of the overall consumption in Iraq. The following measures are being taken within the industrial sector, in demand rationalization of water:Industrial consumption of water is estimated at 8 per cent of the overall consumption in Iraq. The following measures are being taken within the industrial sector, in demand rationalization of water:
•Specifying the water share for each industrial establishment. Any increase in water consumption will occasion a commensurate increase in price.•Specifying the water share for each industrial establishment. Any increase in water consumption will occasion a commensurate increase in price.
•During construction of the factories, potable water is distributed in standard plastic refills, with a capacity of one litre, in order to curb consumption.•During construction of the factories, potable water is distributed in standard plastic refills, with a capacity of one litre, in order to curb consumption.
•Expansion in the industrial sprinklers, polyethylene and plastic water pipe industry. These pipes can be used for transferring water instead of using channels. This reduces water waste, and modernizes water piping systems.•Expansion in the industrial sprinklers, polyethylene and plastic water pipe industry. These pipes can be used for transferring water instead of using channels. This reduces water waste, and modernizes water piping systems.
According to the European Union (2011), the estimated amount of water for the industrial sector is around 1.5 billion m3/year. The water for heavy industry is supplied from rivers while light industries use water from the municipal network. The problems in the industrial sector are similar to those in the domestic sector (see below).According to the European Union (2011), the estimated amount of water for the industrial sector is around 1.5 billion m3/year. The water for heavy industry is supplied from rivers while light industries use water from the municipal network. The problems in the industrial sector are similar to those in the domestic sector (see below).
Domestic applicationsDomestic applications
The percentage of potable water for domestic consumption is estimated at 5 per cent of the overall consumption in Iraq. Particular attention has been given to this sector of water consumption because it is connected to the health of the citizen. Therefore, and in spite of the embargo and the different sectors affected by it, the State has given special importance to this by enforcing the necessary requirements for preservation of potable water quantity and quality. The following are some of the activities for achieving the sought-after target in increased demand rationalization of potable water.The percentage of potable water for domestic consumption is estimated at 5 per cent of the overall consumption in Iraq. Particular attention has been given to this sector of water consumption because it is connected to the health of the citizen. Therefore, and in spite of the embargo and the different sectors affected by it, the State has given special importance to this by enforcing the necessary requirements for preservation of potable water quantity and quality. The following are some of the activities for achieving the sought-after target in increased demand rationalization of potable water.
Modernization of potable water piping systemsModernization of potable water piping systems
Due to the embargo on the country and because potable water pipes are derived from imported materials and paid for with hard currency, all water piping systems in the country are considered to be old. The lifetime of these piping systems is estimated as more than 25 years and the pipes are in great need of modernization, in order to reduce the waste that is occurring in transferring water. Waste percentage as a consequence of leakage in the Baghdad piping system is estimated

at 50 per cent of the overall production.Due to the embargo on the country and because potable water pipes are derived from imported materials and paid for with hard currency, all water piping systems in the country are considered to be old. The lifetime of these piping systems is estimated as more than 25 years and the pipes are in great need of modernization, in order to reduce the waste that is occurring in transferring water. Waste percentage as a consequence of leakage in the Baghdad piping system is estimated at 50 per cent of the overall production.

Consequently, the authorities have imported large quantities of pipes, in order to modernize some of the piping systems. In addition, they have expanded the use of polyethylene pipes in house connections to replace the old iron pipes.Consequently, the authorities have imported large quantities of pipes, in order to modernize some of the piping systems. In addition, they have expanded the use of polyethylene pipes in house connections to replace the old iron pipes.

Modernization and installation of calculation gaugesModernization and installation of calculation gauges

During the 10 years of the embargo, 20 per cent of the consumers calculated their consumption by applying gauges. The rest of the consumers estimated their consumed quantities, and the percentage of wasted water was high as a consequence of unpaid consumption. The departments concerned have therefore imported and installed new water gauges in order to promote consumption rationalization, with corresponding price scales.During the 10 years of the embargo, 20 per cent of the consumers calculated their consumption by applying gauges. The rest of the consumers estimated their consumed quantities, and the percentage of wasted water was high as a consequence of unpaid consumption. The departments concerned have therefore imported and installed new water gauges in order to promote consumption rationalization, with corresponding price scales.

Control system for spillsControl system for spills

In order to control spills which happen as a result of old networks and mistakes in consumers' estimation of consumption, the authorities have created a complete control system for spills, through the use of modern, scientific equipment. In addition, pressure is controlled in the networks and new equipment designs minimize spills of potable water.In order to control spills which happen as a result of old networks and mistakes in consumers' estimation of consumption, the authorities have created a complete control system for spills, through the use of modern, scientific equipment. In addition, pressure is controlled in the networks and new equipment designs minimize spills of potable water.

Exploitation of unprocessed waterExploitation of unprocessed water

In order to preserve the environment inside towns and surrounding districts, citizens have planted in vacant areas. Potable water was used for the plants, because transfer networks of unprocessed water did not exist. The authorities have started to develop new networks for unprocessed water, in order to maintain the environment and increase planted areas and trees inside towns' limits.In order to preserve the environment inside towns and surrounding districts, citizens have planted in vacant areas. Potable water was used for the plants, because transfer networks of unprocessed water did not exist. The authorities have started to develop new networks for unprocessed water, in order to maintain the environment and increase planted areas and trees inside towns' limits.

Citizen awarenessCitizen awareness

The government authorities are instructing consumers in water consumption in agriculture and industry. They are also developing specific programmes that teach people about water consumption through information campaigns, and they are providing courses for farmers and industries. The aim is to teach about new scientific ways that are available to utilize water most efficiently.The government authorities are instructing consumers in water consumption in agriculture and industry. They are also developing specific programmes that teach people about water consumption through information campaigns, and they are providing courses for farmers and industries. The aim is to teach about new scientific ways that are available to utilize water most efficiently.

According to the European Union, in the domestic sector, the total amount supplied for domestic uses is around 2.9 billion m3 per year with a daily consumption of 7.2 million m3. Around 74 per cent of urban areas and only 48 per cent of rural areas are covered. Many populated areas rely on water tanks. The estimated average amount of water per capita in Iraq is around 327 litres/person/day. This is considered very high compared to the average figure for aggregate per capita consumption in the EU of about 150 litres/person/day. Around 50 per cent of the water produced is lost in the networks as there is no adequate monitoring system in place. The continuity of water supply is reported to be at about 77 per cent overall, with around 90 per cent in urban areas and 64 per cent in rural areas. Moreover, in most areas, water consumption is not metered. 90 per cent of installed household meters in Baghdad are not functional. The domestic water in Iraq is heavily subsidized, with a tariff of 0.0034 USD/m3. The estimated revenues cover only 2-5 per cent of the operation and maintenance cost. People continue to consume high amounts of water as there is a lack of awareness of the importance of efficient use of water resources.According to the European Union, in the domestic sector, the total amount supplied for domestic uses is around 2.9 billion m3 per year with a daily consumption of 7.2 million m3. Around 74 per cent of urban areas and only 48 per cent of rural areas are covered. Many populated areas rely on water tanks. The estimated average amount of water per capita in Iraq is around 327 litres/person/day. This is considered very high compared to the average figure for aggregate per capita consumption in the EU of about 150 litres/person/day. Around 50 per cent of the water produced is lost in the networks as there is no adequate monitoring system in place. The continuity of water supply is reported to be at about 77 per cent overall, with around 90 per cent in urban areas and 64 per cent in rural areas. Moreover, in most areas, water consumption is not metered. 90 per cent of installed household meters in Baghdad are not functional. The domestic water in Iraq is heavily subsidized, with a tariff of 0.0034 USD/m3. The estimated revenues cover only 2-5 per cent of the operation and maintenance cost. People continue to consume high amounts of water as there is a lack of awareness of the importance of efficient use of water resources.

The present quality of water in the Tigris near the Syrian border is presumed good, including water originating in both Turkey and Iraq. Water quality degrades downstream, with major pollution inflows from urban areas such as Baghdad due to poor infrastructure for wastewater treatment. The water quality of the Euphrates entering Iraq is less than that of the Tigris, as it is currently affected by the return flow from irrigation projects in Turkey and the Syrian Arab Republic and is expected to get worse as more lands come under irrigation. The quality is further degraded as flood flows are diverted into off-stream storage in Tharthar and later returned to the river system. Salts in Tharthar are absorbed by the water stored there. The quality of water in both the Euphrates and Tigris is further degraded by return flows from land irrigated in Iraq as well as urban pollution. The amount and quality of water entering southern Iraq from Iranian territory is largely unknown, although it is clear that flows are impacted by irrigation return flow originating in the Islamic Republic of Iran (UNDG, 2005).The present quality of water in the Tigris near the Syrian border is presumed good, including water originating in both Turkey and Iraq. Water quality degrades downstream, with major pollution inflows from urban areas such as Baghdad due to poor infrastructure for wastewater treatment. The water quality of the Euphrates entering Iraq is less than that of the Tigris, as it is currently affected by the return flow from irrigation projects in Turkey and the Syrian Arab Republic and is expected to get worse as more lands come under irrigation. The quality is further degraded as flood flows are diverted into off-stream storage in Tharthar and later returned to the river system. Salts in Tharthar are absorbed by the water stored there. The quality of water in both the Euphrates and Tigris is further degraded by return flows from land irrigated in Iraq as well as urban pollution. The amount and quality of water entering southern Iraq from Iranian territory is largely unknown, although it is clear that flows are impacted by irrigation return flow originating in the Islamic Republic of Iran (UNDG, 2005).

The deterioration of water quality and the heavy pollution from many sources are becoming serious threats to Iraq. One problem is the lack of any effective water monitoring network so that it is difficult to take measures to address water quality and pollution as it is impossible to identify the causes. Hence, the rehabilitation and reconstruction of the water monitoring network are becoming urgent to ensure water security.The deterioration of water quality and the heavy pollution from many sources are becoming serious threats to Iraq. One problem is the lack of any effective water monitoring network so that it is difficult to take measures to address water quality and pollution as it is impossible to identify the causes. Hence, the rehabilitation and reconstruction of the water monitoring network are becoming urgent to ensure water security.

The Mesopotamian marshlands in the furthest downstream part of the Tigris and Euphrates Basin have been seriously damaged during the last two decades. Dewatering the marshland areas to foster agricultural production as well as to divert waters away from the marshes for political reasons has caused an adverse impact on the ecosystem and the indigenous populations. The historical marsh area of 17,000km2 has now shrunk to about 3,000km2 after construction of a number of dams upstream. The potential success of recent restoration efforts depends primarily on the availability of sufficient quantities of satisfactory quality water to the marshland areas.The Mesopotamian marshlands in the furthest downstream part of the Tigris and Euphrates Basin have been seriously damaged during the last two decades. Dewatering the marshland areas to foster agricultural production as well as to divert waters away from the marshes for political reasons has caused an adverse impact on the ecosystem and the indigenous populations. The historical marsh area of 17,000km2 has now shrunk to about 3,000km2 after construction of a number of dams upstream. The potential success of recent restoration efforts depends primarily on the availability of sufficient quantities of satisfactory quality water to the marshland areas.

The quantity and quality of water entering the Gulf is also an issue to be addressed since fisheries are an important food source for the region. Other environmental issues to be taken into account are the impact of water management and changed flow regimes on migrating fish and terrestrial species and on the viability of riverine and floodplain ecosystems throughout the Tigris and Euphrates basins.The quantity and quality of water entering the Gulf is also an issue to be addressed since fisheries are an important food source for the region. Other environmental issues to be taken into account are the impact of water management and changed flow regimes on migrating fish and terrestrial species and on the viability of riverine and floodplain ecosystems throughout the Tigris and Euphrates basins.

Quality of water used for drinking and agriculture is poor, violating Iraq National Standards and WHO guidelines. Much of the groundwater along the developed central plain is unusable due to high salinity and pollution. Moreover, 8 per cent of the rural population use saline shallow village wells as a main drinking source (IAU, 2010).Quality of water used for drinking and agriculture is poor, violating Iraq National Standards and WHO guidelines. Much of the groundwater along the developed central plain is unusable due to high salinity and pollution. Moreover, 8 per cent of the rural population use saline shallow village wells as a main drinking source (IAU, 2010).

In the first six months of 2010, there were over 360,000 diarrhoea cases, a result of polluted drinking water and poor hygiene practices (IAU, 2010).In the first six months of 2010, there were over 360,000 diarrhoea cases, a result of polluted drinking water and poor hygiene practices (IAU, 2010).

According to the European Union (2011), water quality is good, with measurements of pollution factors ranging from 150 to 1,400ppm. However, due to drought and deterioration of rivers the quality of water is significantly affected especially in the central and southern parts of Iraq.According to the European Union (2011), water quality is good, with measurements of pollution factors ranging from 150 to 1,400ppm. However, due to drought and deterioration of rivers the quality of water is significantly affected especially in the central and southern parts of Iraq.

The sanitation services in Iraq are below the required level. Only 25.7 per cent of the population are connected to sewage network services while 51.2 per cent are connected to septic tanks. Most of the sewage infrastructure is in bad shape and would require massive capital investment. Moreover, potable water is often contaminated due to a lack of monitoring of perforated water pipes. The population is also not aware of potential environmental and health risks. This situation has created an environment where serious diseases such as cholera and hepatitis may flourish as a result (European Union, 2011).The sanitation services in Iraq are below the required level. Only 25.7 per cent of the population are connected to sewage network services while 51.2 per cent are connected to septic tanks. Most of the sewage infrastructure is in bad shape and would require massive capital investment. Moreover, potable water is often contaminated due to a lack of monitoring of perforated water pipes. The population is also not aware of potential environmental and health risks. This situation has created an environment where serious diseases such as cholera and hepatitis may flourish as a result (European Union, 2011).

DroughtDrought

While in 2009 more rain was received than in 2008, the situation is still critical with rainfall 50 per cent below average. Between 2007 and 2009, almost 40 per cent of cropland throughout Iraq, but particularly in the north, experienced reduced crop coverage and livestock was decimated (IAU, 2010).While in 2009 more rain was received than in 2008, the situation is still critical with rainfall 50 per cent below average. Between 2007 and 2009, almost 40 per cent of cropland throughout Iraq, but particularly in the north, experienced reduced crop coverage and livestock was decimated (IAU, 2010).

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

2. GOVERNANCE ASPECTS

2.1. WATER INSTITUTIONS

Governance in Iraq is in a state of flux at present. The Ministry of Water Resources (MWR) is the bulk water supplier for the country and responsible for national water planning, operating 25 major dams, hydropower stations and barrages and 275 irrigation pumping stations serving almost the entire irrigated area. The MWR comprises five commissions and 11 companies, employing 12,000 staff. Making the MWR functional again in the aftermath of the wars and collapse of the previous regime is a top priority and measures to achieve this are under way. Other key institutions related to water in Iraq include the Ministry of Agriculture, the Ministry of Energy, the Ministry of Municipalities and Public Works, the Ministry of Environment and other ministries and local governorates concerned with economic and human resources. Higher educational institutions could provide scientific support on water issues and potential human resources for the government. A few NGOs are springing up, such as the Iraq Foundation, which is dedicated to restoring the Mesopotamian marshlands (UNDG, 2005).

2.2. WATER MANAGEMENT

One of the principal challenges in water management is the coordination of diverging ministerial and regional interests within Iraq. Awareness of the degradation of Iraq's natural resources and ecosystems is high among Iraqi decision-makers, but concrete actions at local and national levels remain uncoordinated and limited. The UN is supporting the government of Iraq and other partners in implementing 121 water projects (IAU, 2010).

FAO is supporting the Ministry of Water Resources and the Governorate of Erbil in the rehabilitation infrastructure to enhance water supply and drainage across eight governorates, to improve food security and rural livelihoods (IAU, 2010).

UNESCO launched a scientific survey of Iraq's groundwater to improve government capacity to address water scarcity. The project will provide data on groundwater to address shortages in the worst affected areas, improve planning of agriculture projects and enable sustainable management of Iraq's underground aquifers (IAU, 2010).

WHO and UNICEF work with the Kurdistan Regional Government in Sulaymaniyah to enhance the quantity and quality of water delivered to underserved residential areas, particularly in the city of Sulaymaniyah and Sarchinar district (IAU, 2010).

Through the Public Sector Modernization Programme UN HABITAT and UNICEF will support the government of Iraq's efforts at modernizing and reforming its public sector by focusing on water and sanitation. Support to be provided will include a functional review of the sector, new modern service delivery models and a road map for the modernization of the sector (IAU, 2010).

2.3. WATER POLICY AND LEGAL FRAMEWORK

Water resources development and management plans were drawn up in the 1960s and 1980s. These studies included a comprehensive and detailed analysis of needs, opportunities and plans for the development and management of Iraq's water resources. Investments in water resources development over the years have generally followed the plans outlined in these documents. They have not been updated or revisited since their publication, but the population has grown substantially, much project development has taken place, multiple wars have been conducted, institutions and regimes have changed, and regional and world markets for products have become greatly altered (FAO, 2004).

A Law on Irrigation (No. 12 of 1995) and another on Environment (No. 3 of 1997) have been enacted (ESCWA, 2004).

3. GEOPOLITICAL ASPECTS

The water resources of Iraq depend largely on the surface water of the Tigris and Euphrates rivers and most of the natural renewable water resources of Iraq come from outside the country.

The protocol concerning the regulation of water use of the Euphrates and Tigris rivers dates back to 1946 when Turkey and Iraq agreed that the rivers' control and management depended to a large extent on the regulation of flow in Turkish source areas. At that time, Turkey agreed to begin monitoring the two rivers and to share related data with Iraq. In 1980 Turkey and Iraq further specified the nature of the earlier protocol by establishing a Joint Technical Committee on Regional Waters. After a bilateral agreement in 1982, the Syrian Arab Republic joined the committee. Turkey has unilaterally guaranteed to allow 15.75km3/year (500 m3/s) of water of the Euphrates across the border to the Syrian Arab Republic, but no formal agreement has been reached so far on the sharing of the Euphrates water. According to an agreement between the Syrian Arab Republic and Iraq (1990), Syria agrees to share the Euphrates water with Iraq on a 58 per cent (Iraq) and 42 per cent (Syria) basis, which corresponds to a flow of 9km3/year at the border with Iraq when using the figure of 15.75km3/year from Turkey. Up to now, there has been no global agreement between the three countries concerning the Euphrates waters (FAO, 2004).

The construction of the Ataturk Dam, one of the projects of GAP completed in 1992, has been widely portrayed in the Arab media as a belligerent act, since Turkey began the process of filling the Ataturk Dam by shutting off the river flow for a month (Akanda et al, 2007). Both the Syrian Arab Republic and Iraq accused Turkey of not informing them about the cut-off, thereby causing considerable harm. Iraq even threatened to bomb the Euphrates dams. Turkey countered that its co-riparians "had been informed in time that river flow would be interrupted for a period of one month, due to technical necessity" (Kaya, 1998). Turkey returned to previous flow-sharing agreements after the dam became operational, but the conflicts were never fully resolved as downstream demands had increased in the meantime (Akanda et al, 2007).

Turkey contributes about 90 per cent of the total annual flow of the Euphrates, while the remaining part originates in the Syrian Arab Republic and very little is added in Iraq. Turkey also contributes 38 per cent directly to the main Tigris River and another 11 per cent to its tributaries, which join the main stream of the Tigris further downstream in Iraq. Most of the remainder comes from three tributaries originating in the Islamic Republic of Iran (FAO, 2004).

As shown, a number of crises have occurred in the Euphrates-Tigris Basin, partly due to lack of communication, conflicting approaches, unilateral development, and inefficient water management practices. The Arab countries have long accused Turkey of violating international water laws with regard to the Euphrates and the Tigris rivers. Iraq and the Syrian Arab Republic consider these rivers to be international and thus claim a share of their waters. Turkey, in contrast, refuses to concede the international character of the two rivers and only speaks of the rational utilization of transboundary waters. According to Turkey, the Euphrates becomes an international river only after it joins the Tigris in lower Iraq to form the Shatt al-Arab, which then serves as the border between Iraq and the Islamic Republic of Iran until it reaches the Gulf only 193km further downstream. Furthermore, Turkey is the only country in the Euphrates Basin to have voted against the United Nations Convention on the Law of Non-navigational Uses of International Watercourses. According to Turkey, if signed, the law would give the lower riparians "a veto right" over Turkey's development plans. Consequently, Turkey maintains that the Convention does not apply to it and is therefore not legally binding (Akanda et al, 2007). Problems regarding sharing water might arise between Turkey, the Syrian Arab Republic and Iraq, since according to different scenarios full irrigation development by the countries in the Euphrates-Tigris river basins would lead to water shortages and solutions will have to be found at basin level through regional cooperation.

In 2002, a bilateral agreement between the Syrian Arab Republic and Iraq was signed concerning the installation of a Syrian pump station on the Tigris River for irrigation purposes. The quantity of water drawn annually from the Tigris River, when the flow of water is within the average, will be 1.25km3 with a drainage capacity proportional to the projected surface of 1,500 km2 (FAO, 2002).

In April 2008, Turkey, the Syrian Arab Republic and Iraq decided to cooperate on water issues by establishing a water institute consisting of 18 water experts from each country to work towards the solution of water-related problems among the three countries. The institute will conduct its studies at the facilities of the Atatürk Dam, the biggest dam in Turkey, and plans to develop projects for the fair and effective use of transboundary water resources (Yavuz, 2008).

On July 9 2001 Iraq accepted the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (UNTC).

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