MEWINA

مشروع التقييم والمتابعة لقطاع المياه بدول شمال أفريقيا

Monitoring and Evaluation for Water In North Africa

CEDARE

African Water Facility
Facilité africaine de l'eau

Mobilising Resources for Water in Africa

Libya 2012 State of the Water Report

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List of Acronyms And Abbreviations

AEMMmRP	Authority for the Execution and Management of the Man-made River Project
AWC	Arab Water Council
CD	Census Department
CEDARE	Center for Environment and Development in the Arab Region and Europe
EGA	Environmental General Authority
FAO	UN Food and Agriculture Organization
GCWW	General Company for Water and Wastewater
GDCOL	General Desalination Company of Libya
GECOL	General Electricity Company of Libya
GWA	General Water Authority
MAAMW	Ministry of Agriculture, Animal and Marine Wealth
MEWINA	Monitoring and Evaluation of Water in North Africa
LNCM	Libyan National Center for Meteorology
MoH	Ministry of Health
MoP	Ministry of Planning
UNDP	UN Development Programme
WHO	UN World Health Organization

1. Introduction

Libya is a water short country centrally located among North Africa's five states. Having no perennial water resources, Libya relies almost completely on non-renewable groundwater resources. Water resources management is assigned to the General Water Authority (GWA), a subdivision within the Ministry of Water Resources (MoWR). The GWA undertakes monitoring and evaluation (M & E) operations and preparation of state of the water (SOW) reports.

Libya has engaged in extensive ground and surface water projects for decades with the ultimate objective of satisfying the increasing demands for water and for better levels of water services. Studies, national plans and programs as well as large scale water infrastructures projects have been executed covering most of the country. The role of water institutions has been vital in conducting, supervising, and utilizing these works.

1.1. SOW Reporting in Libya

Considering the increasing water scarcity Libya has been facing due to growing water demands and resource limitations, development of structured, regular SOW monitoring, evaluation, and assessment and reporting mechanisms becomes of special importance. Data and indicators obtained upon assessment of the results of such operations are an invaluable tool for performance assessment, gap analysis and planning. To this end, the GWA has prepared several SOW reports within the last four decades. These semi-regular reports contained data, indicators, conclusions and recommendations on local, basin, and national levels. National level reports addressed the following indicators:

- Available water quantities (million cubic meters per year).
- Amount of water utilized (million cubic meters per year).
- Water budget (million cubic meters per year).

The 2006 SOW report addressed the state of water on regional and sub-regional basis. The report provided data on water sources, major uses, impact of uses on water resources, new agricultural projects. Each region was addressed separately in a dedicated chapter which ended with recommendation for addressing water situation challenges. The impacts of water use were reported in the form of piezometric level (pressure) and quality (Electric conductivity) changes over time.

The coverage extended for intervals starting from the 1970's to 2005, but was not consistent among regions and sub-regions and throughout the reporting period. It was not strictly a SOW report, but a technical report intended in line with official planning and follow-up institutional reports. Several gaps existed both in the quantitative and qualitative indicators geographically and temporally. Water uses were classified into domestic, industrial, and agricultural and reported accordingly only in a few sub-regions. In most cases, these uses were reported collectively. The methods of calculation of volumetric indicators were not reported in the report.

The SOW reports were made irregularly with a noticeable difference in report structures, scarcity of data and indicators which were not standardized. Distribution of these reports was also limited to the GWA and a few other directly involved institutions making minimum impacts on national planning and

policy. Evidently, there is an urgent need for a structured, comprehensive SOW report especially in light of Libya's persisting water scarcity and the water management challenges it has been facing for several decades.

1.2. Report Objectives and Scope

This report is the third and final version of the 2012 Baseline SOW in Libya Report. It is the final update of version 1 and 2 reports prepared in September and December, 2014, consecutively. The main objective of this report is to describe the SOW in Libya and, based on the findings, draw conclusions regarding this state and actions needed to enhance it. These diagnostic findings and conclusions can be utilized as a basis for preparation and upgrading of policy recommendations and action plans with local and national impacts, the second objective of the report.

To realize the report objectives, national, continental, and global targets are presented followed by national SOW indicators and institutions in charge. Validated MEWINA-indicators (176 indicators) covering 15 different categories (fields of application).are discussed next with the detailed indicator values, sources, dates, and further clarifications presented in a special table. Further indicator values analysis and trends are summarized in a special section of the report. Finally, policy recommendations are presented.

1.3. Report Preparation and Importance

This Baseline SOW in Libya report is the result of efforts made by the Libya – MEWINA National Task Force consisting of representatives of the different water sector institutions of Libya under the guidance of the GWA and the direct supervision of a CEDARE team and Misr Consult. Additional "Libya-specific indicators" are also presented in this report. These indicators should be monitored and reported regularly along with regional indicators for their significance in the overall state of the water diagnosis in Libya. A detailed listing and discussion of the indicators is presented separately in special report.

This report is the first comprehensive SOW in Libya report. Prepared within a standard format, the report compiles indicators validated on the level of the North Africa region. It has been prepared as part of the Monitoring and Evaluation in North Africa (MEWINA) Project sponsored by the African Ministers for Water of the African Union (AMCOW) and financed by the African Water Utility.

It is, therefore, a valuable reference as well as a base for further work and enhancement. It should be approved by the concerned Libya authorities and adopted by the Libyan government bodies as a national document (report) to be referenced officially. Moreover, it should be subjected to further scrutiny to improve the accuracy of the data presented and fill the data gaps within the report. Although it is a reliable and comprehensive document, there remains large room for improvement and updating.

2. National, Continental, and Global Targets

This section presents water related targets set nationally at level of Libya, at the level of the African continent, and internationally (UNDP MDGs and Sustainable Development Goals). Target indicators on all of these levels are listed along with methodology of calculation / measurement of each indicator.

2.1. National Water-Related Target Indicators and Monitoring Methodology

The National Strategy for Integrated Water Resources Management (NSIWRM) adapted by Libya for the period 2000 - 2025 has two major goals, namely, reversing the on-going: 1) deficits due to excessive water withdrawals and 2) water quality deteriorations. It proposed a general action plan which did not specify target indicators.

An extensive review of national water strategies, SOW reports, water monitoring and evaluation reports and other water related reports revealed that there are no officially declared national water-related target indicators in the forms adapted by regional, continental, or international organizations. However, such target indicators can be deduced from the different monitoring and SOW reports published by the institution charged with water resources management nationally, the GWA.

The national indicators are simply those indicators monitored presently by the different water related institutions. They are listed in Appendix I along with the units of measurement and the monitoring / reporting institutions. The total number of these indicators is 50. They cover 8 categories as shown in the appendix. They are monitored by 9 institutions. Values of national indicators are reported in sections 3 and 4 of this report along with remarks regarding the source of information and estimates (MEWINA-validated indicators of the SOW in Libya).

The methodologies used to monitor / calculate these indicators have been outlined in the report on National State of the Water Monitoring and Evaluation Operational Framework and Guidelines (1).

2.2. AMCOW/AUC Targets Indicators

The African Water Vision 2025 contained a comprehensive Framework for Action in which a road map towards achieving the vision was defined. This framework consisted of actions required under four broad categories. Milestones and targets were set for each action for the years 2005, 2015, and 2025. The African Vision Framework for Action was adapted by the African Union states and made official through the Sharm El-Sheikh Declaration and Commitments. Subsequently, it was translated into Guidelines leading to a minimum set of indicators and submitted to the African Union Commission (AUC).

The AMCOW / AUC target indicators applicable to Libya and the country's performance levels have been updated to the year 2012; they are summarized in Appendix II along with explanatory remarks. Consequently, it is believed that further discussion of these target indicators is not warranted.

2.3 Global Targets

Global targets include both the millennium development goals (MDGs) and the Post-2015 Sustainable Development Goals. The latter are under development and will not be considered in this report. .

2.3.1. MDGs

These goals require that states halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation. Although Libya has adopted the MDGs, they have not been incorporated explicitly into the goals or indicators of the different water sector institutions. As access to coverages was not reported in the pre-2006 census or by the GCWW, it is not possible to measure the improvements made in these indicators. However, Libya has exceeded the targets set by these goals as is described below.

It is to be noted that water supply in Libya is mainly through public networks (to cities and towns) and private tube wells (in rural and remote areas). In rare cases, and mainly during summer months, water is transported to a small fraction of the population by tankers through public or private transporters. Coverage by public taps, dug wells, standpipes, protected springs and rainwater are practically non-existent.

The percentage of urban and rural populations supplied with piped water directly into their premises is presented in this report. Bottled water is used almost exclusively by most households for drinking purposes.

Similarly, sanitation services are provided through public sewerage networks or septic tanks. The coverage percentages are presented in this report. Use of pit latrines, pit latrines with slab, or covered ventilated improved pits is non-existent.

2.3.2. Levels of Achievement of MDGs

The level of WSS services in Libya is among Africa's and the Arab states' highest thanks to the country's commitment to continuous upgrading of the WSS sector. According to the Arab Water Council/ CEDARE report on Water Supply and Sanitation Coverage in the Arab States (2), the fraction of Libya's population having access to improved water rose from 45 % in 1990 to 84 % in 2005. The WHO/ UNICEF Joint Program for WSS (3), reported fractions of 54.2, 54.9, and 54.4 % urban, rural, of the total population connected to public networks with those supplied from private wells accounting for 35.8, 26.9, and 33.5 %, respectively. Assuming that well water is protected and, hence, safe to drink, the total coverage for urban, rural and total population is 90, 81.8, and 87.9 %, respectively.

According to the National 2006-census data (4), Ministry of Health data (5), and to data provided to MEWNA – Libya Project in 2013 by the GCWW (6), about 65 % of the potable water is supplied by public networks, 17 % by private wells, 16 % by harvested rainwater, and 2 % by water transported by vehicles. Rainwater harvesting is practiced mostly in the Western Mountain region of Libya with a population fraction of about 5 % of Libya's total population. It is most likely that the harvested rainwater

fraction also includes private wells and transported water as this fraction far exceeds that for rainwater alone. Assuming that 85 % of "harvested" rainwater is actually private wells and transported water and that all sources other than rainwater are safe, then access to safe potable water in Libya may be estimated at 98 %.

National 2006-census data (4) and Ministry of Health data (5) indicate that 89 % of Libya's population is urban. Consequently, based on coverage rates reported by these sources, urban and rural population access to potable water is 98 and 96 %, respectively.

Access to sanitation is estimated by the same sources cited above at 99 % with 45 % served by centralized public networks and 54 % served by on-site sanitation systems. Based on coverage rates reported by these sources, urban and rural population access to safe sanitation is 99 and 99 %, respectively.

According to the UNDP Arab Human Development Report published in 2013 (7), access to safe sanitation rose from 97 % in 1990 to 98 % in 2004. The AWC/CEDARE report published in 2009 gave fractions of 85 % and 97 % in 1990 and 2005, respectively (2).

Based on the national and international data reported above, it can be concluded that Libya has exceeded the MDGs. It should also be stressed here that the present fraction of population with access to safe water supply and sanitation will increase as Libya completes implementation of its ongoing comprehensive National Program for Water Supply and Sanitation extending coverage to newly urbanized "smaller" communities and settlements. It is expected that the levels of services will increase in response to user raised expectations and demands.

3. MEWINA Validated Indicators of the SOW in Libya

A "reference" list of the MEWINA SOW indicators was agreed to during the Regional Validation Workshop held in Cairo in Oct. 2013. A total of 112 indicators placed under 15 categories were validated. This "reference" list was expanded as a result of feedback from participating states to a total of 173 indicators. A total of 145 of the indicators are primary indicators including 51 country-specific indicators (proposed by one or more of the MEWINA states and 31 are secondary (derived) indicators. Three more "Libya specific" indicators were added to this list making the final total for Libya 176 indicators.

3.1. Institutions and State of the SOW Indicators Monitored

MEWINA-validated indicators monitored by Libyan water institutions are outlined in Appendix III along with monitoring institutions. Nine major institutions monitor / report SOW indicators, namely, the GWA, EGA, GCWW, GDCOL, AEMMmRP, MOH, MOP, CB, and, LNCM. The largest number of indicators is monitored by the GWA. Reporting of monitored indicators is limited to the institutions themselves with little exchange of data or coordination and with no standardization.

The state of monitoring of the MEWINA-validated indicators is summarized in Table 1. The main findings are as follows:

1. The total number of indicators whose values were reported is 140 indicators (including 31 secondary indicators) comprising 80 % of all indicators. Thus number of primary indicators reported is 109 indicators. This represents 75.

Table 1. State of Monitoring of MEWINA-validated SOW Indicators in Libya

Category	Indicator			Reported by				Number of indicators and percentage					
	Primary	Secondary	Total	Water institutions	Water institutions / MEWINA	MEWINA	International organizations	Total reported	Unreported	Inapplicable	Total Unreported	% Reported	% Unreported
1. Water & Availability	17	11	28	11	0	1	5	28	0	0	0	100	0
2. Water & Uses	20	4	24	3	0	11	3	21	1	2	3	88	13
3. Water & Land Use Changes	9	0	9	4	0	5	0	9	0	0	0	100	0
4. Water Coverage & Accessibility	17	0	17	10	2	4	0	16	1	0	1	94	6
5. Water & Energy	4	0	4	0	0	1	0	1	0	3	3	25	75
6. Water & Population	1	12	13	1	0	0	0	13	0	0	0	100	0
7. Water & Health	6	1	7	3	0	1	1	6	1	0	1	86	14
8. Water & Quality	11	0	11	8	0	0	0	8	3	0	3	73	27
9. Water & Eco Systems	7	0	7	2	0	0	0	2	5	0	5	29	71
10. Water & Climate	12	0	12	0	0	7	0	7	5	0	5	58	42
11. Water & Socio-Economics	6	0	6	1	0	2	3	6	0	0	0	100	0
12. Water & Finance	8	0	8	1	0	0	1	2	6	0	6	25	75
13. Water & Trade	2	0	2	0	0	0	2	2	0	0	0	100	0

Category	Indicator			Reported by				Number of indicators and percentage					
	Primary	Secondary	Total	Water institutions	Water institutions / MEWINA	MEWINA	International organizations	Total reported	Unreported	Inapplicable	Total Unreported	% Reported	% Unreported
14. Water & Governance	21	3	24	1	1	9	1	15	9	0	9	63	38
15. Water & Water & International Relations	4	0	4	3	1	0	0	4	0	0	0	100	0
Subtotal	145	31	176	48	4	41	16	140	31	5	36	80	20

% of all primary indicators to be monitored. This is a high percentage considering the large number of indicators. It forms a sound for assessing the overall state of the water in Libya.

2. The number of primary indicators reported by water institutions is 48, however. This number constitutes only 34 % of all primary indicators; this low fraction should not be surprising, however, as the water institutions have not adopted the MEWINA indicators yet and had different indicators of the SOW in Libya. Practically, this fraction implies a high need for enforcing of the capabilities of the water institutions in Libya to be able to M & E the MEWINA indicators once adopted.
3. If the number of indicators reported by water institutions through data contributed MEWINA-Libya unit is added to the number reported by institutions only, the total number will increase to 52 indicators forming 37 % of all primary indicators. This is about one third of the primary indicators confirming the need for concrete enhancements in M and E capacities.
4. MEWINA-Libya unit reported 41 indicators or about 28 % of all primary indicators. The units contribution increases to 45 indicators (32 % of all primary indicators) when indicators reported through representatives of the water institutions are included.
5. The reported fractions of indicators per category vary from 100 % to 25 %. All indicators of six categories were reported, namely, categories 1, 3, 6, 11, 13, and 15. The lowest fractions are for water and ecosystems and water and finance. The actual value for water and energy is 100 % considering that three of the indicators listed don't apply to Libya.
6. The high indicator reporting values do not reflect fully the actual state of monitoring of the water sector. This is mainly because most of the reported values were calculated based on estimated values that are extracted from reports and not from regular monitoring data. A case in point is the water and governance indicator whose value is 63 % but whose indicators data is mostly estimates that need to be validated / verified.

3.2. Values of MEWINA-validated SOW in Libya Indicators

Values of the "final" 176 MEWINA-validated 2102 SOW in Libya indicators for each of the 15 categories are provided in Appendixes III along with reporting institutions, notes and remarks. The appendix contains also unreported indicators and indicators that don't apply to Libya.

The appendix is color coded for ease of reading and differentiation of indicators. Primary indicators

reported by water institutions and/or MEWINA-Libya unit are not colored. Those reported by international organizations are light green. Secondary indicators are light grey. Finally, unreported and inapplicable indicators are yellow and red, respectively.

Reported indicators values were obtained or computed / estimated based on information / data from different sources. They have been determined by the MEWINA-Libya team with access to data from their different institutions while many of the data have been extracted from monitoring, calculations, reports by national, regional, or international organizations. The following remarks may be made regarding these values:

- Most of the reported values are for the year 2012. If the 2012 values are not available, they have been estimated based on values available for other (before or after) years employing sound and reasonable extrapolation methods. In such cases, an explanation of the peculiar circumstances leading to the un-availability of the 2012 data / value is provided in the remarks column of the appendix.
- For most indicators, the number of measurements made over a long period of time is very small.
- Methodologies and frequencies of measuring, testing, and calculation of indicators are not specified by the monitoring institutions or in the references used for preparing Appendix III leaving room for speculation and error.
- There is a strong reliance on technical studies and literature available from national, regional and international institutions for estimation of indicator values with little verification of these values or of the models or methods employed for estimation. Some of the studies are a few decades old!
- Special efforts were made to compute as many indicators as possible to ensure completeness of the report although at the expense of reliability of some data at times. Special care has also been taken to ensure the reliability and accuracy of the values reported to the best level possible. It is hoped that specialists reading this report will verify, validate and correct the reported values.

Explanations of the state of each indicator and possible reasons for deterioration or improvements it underwent are also presented below. These explanations are complimentary to the notes and remarks presented in Appendix III.

3.2.1. Water & Availability

This category consists of 28 indicators including 18 primary indicators and 10 secondary indicators. They are monitored mainly by the GWA and NCM.

Table 2. Values of MEWINA-validated indicators: 1. Water & Availability

No.	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	1	**Water & Availability**				
1	1.1	Annual Spatially Averaged Precipitation Depth	mm/Yr	46.00	LNCM	Good agreement between NCM and FAO values
2	1.2	Annual Precipitation Volume	BCM/Yr	75.10	LNCM	LNCM long term values of depth and volume are 53.5 mm and 87.23 BCM, respectively. The difference between values from the two sources is very large. The NCR value clearly has a big effect on all related indicators.

No.	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	*	**Blue Water**				
3	1.3	Internal Renewable Surface Water (IRSW)	BCM/Yr	0.39	GWA	SOW Report 2005.
4	1.4	Internal Renewable Groundwater (IRG)	BCM/Yr	0.60	GWA	GWA data was adopted as it is the only data available. Methodology of estimation was not specified. Indicator value needs verification. Accordingly, accuracy is not high. FAO AQUASTAT value is 0.9 BCM/yr.
5	1.5	Total Internal Renewable Blue Water Resources (TIRBWR)=(IRSW+IRG)	BCM/Yr	0.99	Secondary	FAO AQUASTAT value is 1.29. The difference is due to the high surface runoff fraction estimated by the NCM
6	1.6	External Surface Water Inflow (ESWI)	BCM/Yr	0.00	GWA	FAO AQUASTAT value is 0
7	1.7	External Surface Water Outflow (ESWO)	BCM/Yr	0.00	GWA	FAO AQUASTAT value is 0
8	1.8	External Groundwater Inflow (EGI)	BCM/Yr	0.00	GWA	FAO AQUASTAT value is 0
9	1.9	External Groundwater outflow (EGO)	BCM/Yr	0.00	GWA	FAO AQUASTAT value is 0.7
10	1.1	Total External Renewable Blue Water Resources Inflow (TERBWR) = (ESWI + EGI)	BCM/Yr	0.00	Secondary	FAO AQUASTAT value is 0
11	1.11	Total Renewable Blue Surface Water (TRBSW) = (IRSW) + (ESWI) - (ESWO)	BCM/Yr	0.39	Secondary	FAO AQUASTAT value is 0.39
12	1.12	Total Renewable Blue Groundwater (TRBG) = (IRG) + (EGI) - (EGO)	BCM/Yr	0.60	Secondary	Further investigation is needed
13	1.13	Overlap between Surface Water and Groundwater (OSWG)	BCM/Yr	0.10	CEDARE/ AWC	CEDARE/AWC value adopted as it is the only data available. FAO AQUASTAT value is 0.1
14	1.14	Total Renewable Blue Water Resources (TRBWR) = (TRBSW) + (TRBG) - (OSW)	BCM/Yr	0.89	Secondary	
15	1.15	Total Exploitable Non-Renewable Groundwater (TNRG)	BCM/Yr	1.79	GWA	Adopt GWA value; methodology is not specified. FAO AQUASTAT value is 0.34.
16	1.16	Total Blue Water Resources (TBWR) = (TRBW) + (TNRG)	BCM/Yr	2.68	Secondary	= TRBWR + TNRG - OSWG. Large discrepency between national and FAO values
*	*	**Green Water**				
17	1.17	Water for Rain-fed Agricultural Consumption	BCM/Yr	2.35	CEDARE/ AWC	There are no national values. Values reported by CEDARE/AWC have been adopted. They are 2.35, 20.12, and 0.26, respectively.
18	1.18	Water for Rain-fed Pasture Consumption	BCM/Yr	20.12	CEDARE/ AWC	
19	1.19	Water for Rain-fed Forest Consumption	BCM/Yr	0.26	CEDARE/ AWC	
20	1.2	Total Renewable Green Water Resources (TRGWR)	BCM/Yr	22.73	Secondary	
21	1.21	Total Renewable Water Resources (TRWR)=(TRBWR+TRGWR)	BCM/Yr	23.62	Secondary	

No.	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
22	1.22	Total Conventional Water Resources (TCWR)= TNRG + TRWR = TBWR+TRGWR	BCM/Yr	25.41	Secondary	
*	*	**Non-Conventional Water**				
23	1.23	Produced Municipal Wastewater (PMW)	BCM/Yr	0.50	GCWW	2014 value adopted for year 2012 as little change has occurred since 2012. Industrial production component is not available. CEDARE/AWC Value is 0.55 (very close)
24	1.24	Produced Industrial Wastewater (PIW)	BCM/Yr	0.04	MEWINA-LIBYA	Calculated as Produced municipal and industrial wastewaters - Produced municipal wastewater. PMI was reported by CEDARE / AWC while PM was reported by GCWW. Indicator value is approximate at best.
25	1.25	Produced Agricultural Drainage (PAD)	BCM/Yr	0.90	CEDARE/ AWC	There are no national values. CEDARE/AWC value of 0.9 was adopted.
26	1.26	Produced Desalinated Water (PDW)	BCM/Yr	0.01	GDCOL	Does not include desalinated water produced by industry and oil sector
27	1.27	Total Non-Conventional Water Resources (TNCWR)= (PMW)+(PIW)+(PAD)+(PDW)	BCM/Yr	1.46	Secondary	
28	1.28	Total Available Water Resources (TAWR) = TCWR+TNCWR	BCM/Yr	26.86	Secondary	

Precipitation values are available for a long period of time and cover many areas in Libya. The values reported indicate severely arid climatic conditions. Their reliability and accuracy are generally high. They compare well with international (FAO) reported values (8).

Precipitation volume reported is also for a long period of time. The GWA estimate is 0.257-0.385 BCM/yr. NCM long term values of depth and volume are 53.5 mm and 87.23 BCM, respectively. The difference between values from the two sources is very large. The NCR value clearly has a big effect on all related indicators. However, the computation method utilizing GIS technology and advanced modeling is applied for the first time in this exercise. The value has not been verified and further validation of the models is needed. These values are much larger than those reported by other (national and international) institutions. This value is the cause of the notable differences with reported national and international values.

Water resources indicators – reported in several of the GWAs reports – are several years old. Moreover, the methods of monitoring, calculation, and/or estimation are not stated. Due to this and the nature of the indicators which encompasses spatial and temporal changes over large areas and volumes, it is very difficult to assess the completeness and accuracy of the values reported. Notable differences exist between data according to reports and with other institutions. The same remarks apply to the nine secondary indicators of this category. There is a clear need to monitor these resources more regularly and rigorously.

Internal Renewable Surface Water (IRSW). The fraction of precipitation turned into runoff was estimated to be 10 % of total precipitation. The GWA value is from SOW Report 2005 (9). The NCR

value was adopted in favor of GWA as it is based on actual data and updated models. Hence it is more accurate. Again the differences between values reported from two sources are very large.

Internal Renewable Groundwater (IRG). GWA data was adopted as it is the only data available. Methodology of measurement / estimation was not specified. Indicator value needs verification. Accordingly, accuracy is not high. FAO AQUASTAT value is 0.9 BCM/yr (8).

External water inflows and outflows. These flows are zero as Libya does not share surface water courses and no surface runoff flow into or out of the country.

Overlap between Surface Water and Groundwater (OSWG). There are no national values for this indicator. Reference had to be made to values reported by CEDARE/AWC and FAO data (8).

Total Exploitable Non-Renewable Groundwater (TNRG). The value reported by the GWA has been adopted. A large difference exists between GWA and FAO values of 0.34 BCM/yr. In both cases, the time range and methodologies are not specified.

Green water resources indicators values were not available from national institutions. Reference had to be made to corresponding values reported by CEDARE/AWC. As green water presents a major fraction of water supply sources, the data gap must be addressed properly.

Water for Rain-fed Agricultural Consumption, Water for Rain-fed Pasture Consumption, Water for Rain-fed Forest Consumption. Values for these indicators have not been reported by national institutions. Therefore, reference had to be made to CEDARE/AWC and FAO values which were identical.

Produced Municipal Wastewater (PMW), Produced Industrial Wastewater (PIW), Produced Desalinated Water (PDW). Values for these indicators have been determined by the MEWINA-Libya unit based on the recent data supplied by the team members of the institutions concerned, reported data and professional experience. The accuracy of these values is high.

Produced Agricultural Drainage (PAD). Values for this indicators have not been reported by national institutions. Therefore, reference had to be made to CEDARE/AWC value the time range and methodologies of which have not been specified.

Other "secondary" Indicators. Values of secondary indicators are subject to the same remarks specified above regarding the primary indicators from which they have been derived. Subsequently, some are recent and accurate while others are either not dated or old and less accurate.

The lack of reliable data on Water & Availability / Use based on regular monitoring and evaluation is evident. As this category is the base for water budget calculations and assessment of the SOW in Libya, prompt action is needed to introduce and operationalize effective M & E mechanisms nationally at the level of all institutions. Such actions require provision of sustainable financial resources and highly skilled human resources. Training on a national level is therefore a priority to ensure that indicators are monitored as soon as possible.

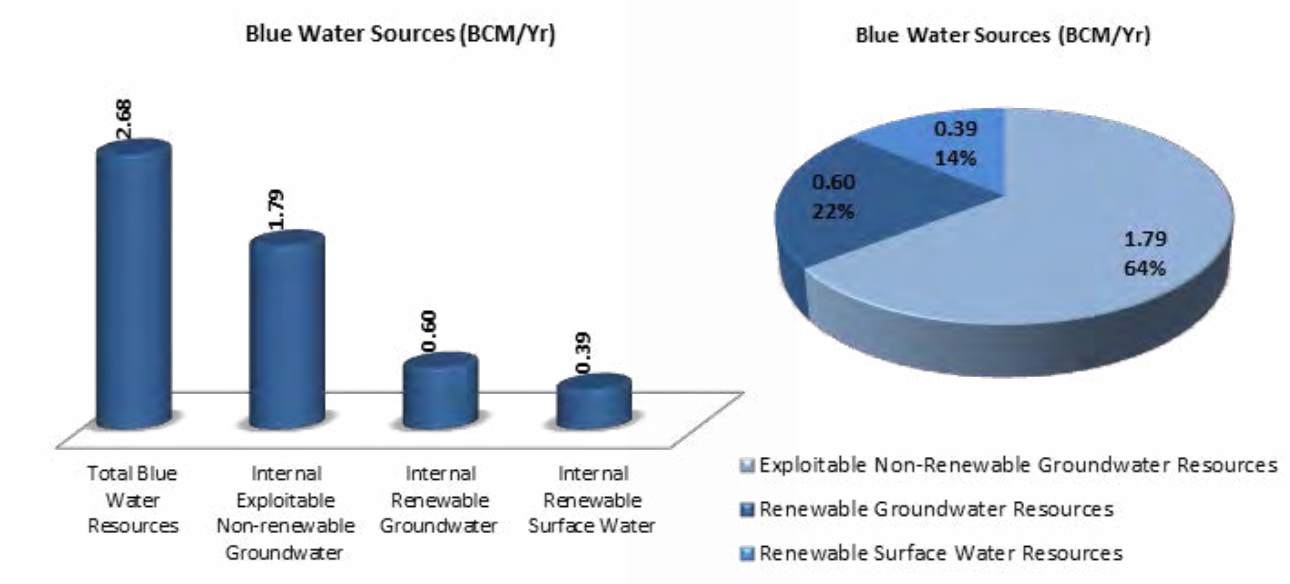

Figure 1. Water and Availability: Blue Water Sources

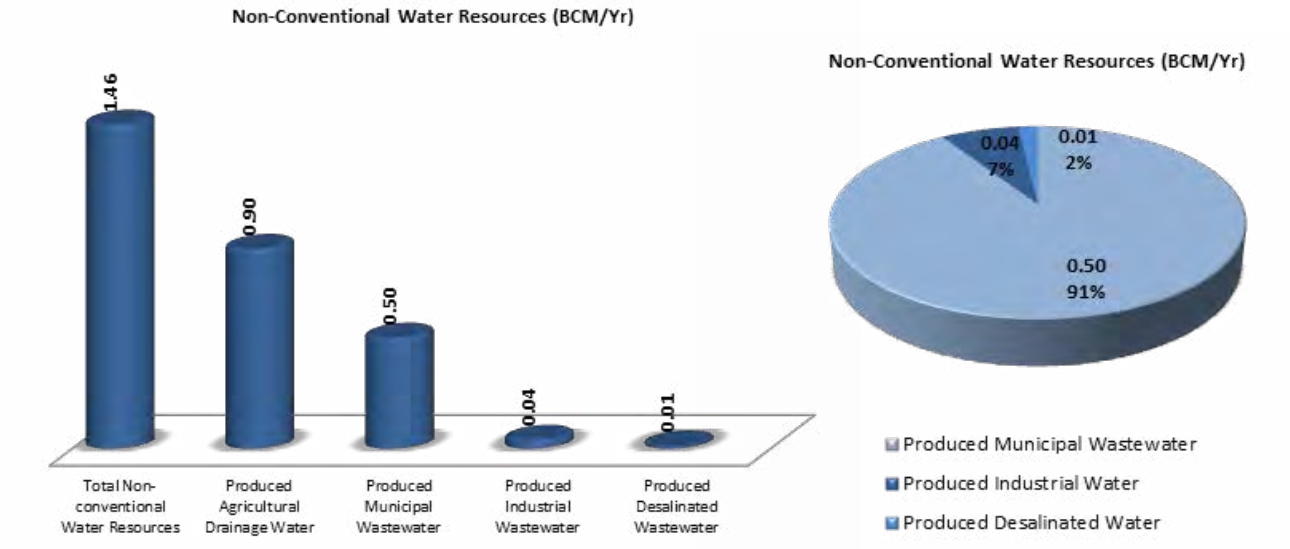

Figure 2. Water and Availability: Non-Conventional Water Resources

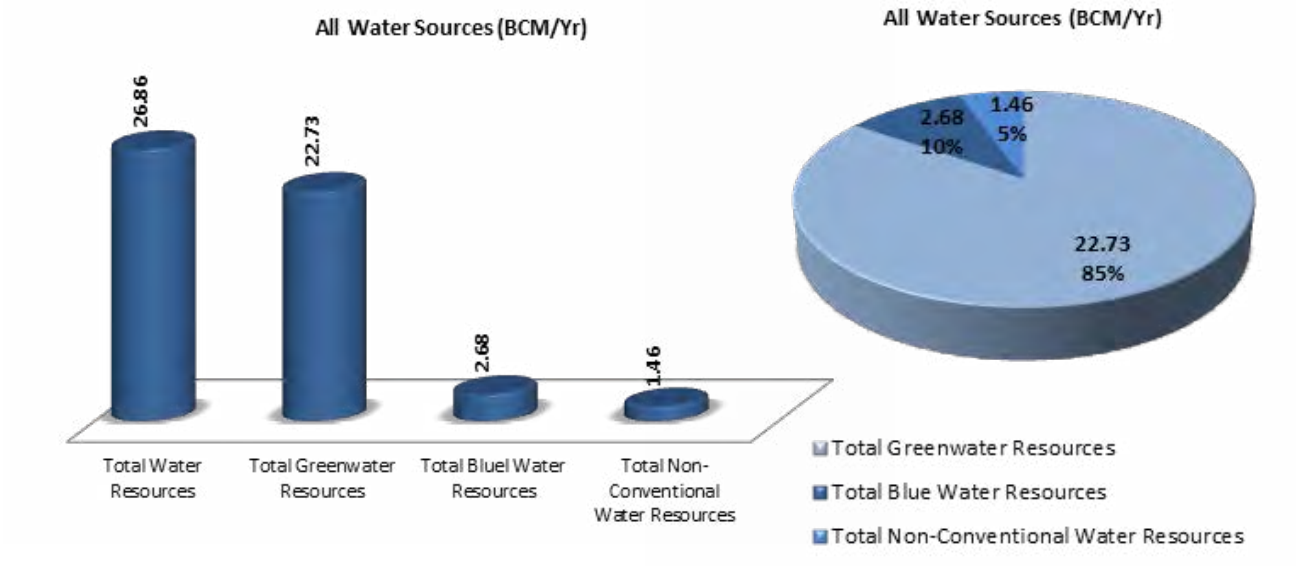

Figure 3. Water and Availability: All Water Sources

3.2.2. Water & Uses

This category consists of 21 indicators including 3 secondary indicators and 9 country-specific indicators. Two of the country specific indicators are inapplicable to Libya. MEWINA-RAR reported indicators have been obtained directly from institutions in charge based on recent data or extrapolated from reports that may not be recent. The values reported are, therefore, updated and reasonably-reliable.

Withdrawals for Domestic Water Use. The value for this indicator has been prepared by MEWINA-Libya based on actual data provided by the MmRP, a major water supplier and the GCWW, the domestic water supply service provider. It is also compared with previous estimates of the GWA SOW report (9), the NSIWRM (10) and estimates based on per capita consumptions in 2012. The metered indicator values are reliable; however, for the small fraction of the population which relies on private water supplies, reliability is reduced.

Withdrawals for Industrial Water Use. Data on this indicator are scarce. Those of the NSIWRM represent the only thoroughly researched values. Those values have been adopted with the assumption that industrial activities have remained constant at the year 2000 levels. This assumption is acceptable in light of the fact that large industries consuming the largest water fraction have not expanded in the last 15 years. **Considering that the sector has seen privatization of public sector industries and a parallel growth in private section industrial activities, the survey conducted within the NSIWRM.**

Withdrawals for Agricultural Water Use. Water withdrawals for agriculture are approximate at best as accurate values for irrigated land and quantities of irrigated water are not available. Both the farmed areas and number of wells supplying irrigated water have increased markedly in the last five decades. Changes in land use patterns and expansion in large scale private farms contribute to the complexity of the problem. Water use inefficiencies are very high. Data are very scarce whether from official institutions or academic institutions.

Sectoral and national water withdrawals (uses) are shown in figure 4. It can be seen from this figure that agricultural withdrawals account for 88 % of the total water withdrawals. Consequently, water resources management plans MUST focus on agricultural water withdrawals as a national priority and prerequisite to overcoming the water scarcity problems Libya has been facing for several decades.

Table 3. Values of MEWINA-validated indicators: 2. Water & Uses

No.	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	2	Water & Uses				
29	2.1	Withdrawals for Domestic Water Use	BCM/Yr	0.575	MEWINA-LIBYA	Close to value reported by AEMmRP (0.628). Also close to value reported by MEWINA-LIBYA, but both are higher than value reported by GWA based on SOW 2005 (0.392).
30	2.2	Withdrawals for Industrial Water Use	BCM/Yr	0.1725	MEWINA-LIBYA	Three values reported by GWA (0.018, 0.125 & 0.073) are lower than value reported by MEWINA-LIBYA
31	2.3	Withdrawals for Agricultural Water Use	BCM/Yr	5.31	MEWINA-LIBYA	FAO AQUASTAT Value is 3.58. National & FAO values are close
32	2.4	Annual Total Water Withdrawals	BCM/Yr	6.0575	Secondary	FAO AQUASTAT Value is 4.65. National & FAO values are close
33	2.5	Green Water Consumption for Agriculture Water Use	BCM/Yr	2.35	CEDARE / AWC	CEDARE/AWC value is 2.35. Large discrepancy between national and FAO values
34	2.6	Total Agricultural Water Uses	BCM/Yr	7.66	Secondary	
35	2.7	Withdrawals from Blue Surface Water	BCM/Yr	0	FAO	
36	2.8	Withdrawals from Blue Renewable Groundwater	BCM/Yr	0.6	GWA	FAO AQUASTAT Value is 4.61. Much larger than GWA (assume renewable GW = 0.6). GWA value is adopted.
37	2.9	Withdrawals from Blue Non-Renewable Groundwater	BCM/Yr	4.35	MEWINA-LIBYA	National, CEDARE/AWC& FAO values are close (4.35 vs 4, 4.61).
38	2.1	Total Withdrawals from Blue Water	BCM/Yr	4.95	Secondary	
39	2.11	Agricultural Drainage Water Reuse	BCM/Yr	0	CEDARE / AWC	There are no national values. CEDARE/ AWC values were adopted
40	2.12	Withdrawals from Desalinated Water	BCM/Yr	0.007	GDCOL	Does not include desalinated water produced by industry and oil sector
41	****	Withdrawals from treated domestic wastewater	BCM/Yr	0.00548	GCWW	2014 value adopted for year 2012 as little change has occurred since 2012.
43	2.13	Total Withdrawals from Non-Conventional Water Resources	BCM/Yr	0.01248	Secondary	

No.	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
44	2.14	Annual Volume of Total Actual Evapotranspiration	BCM/Yr	22.73	MEWINA-LIBYA	Calculated based on the total evapotranspiration rates of irrigated, rain-fed, pastoral, and forest areas.
45	2.15	Greenwater Consumption for Livestock Fodder Water Use	BCM/Yr	0.06	MEWINA-LIBYA	Based on numbers of livestock reported by the Arab Organization for Agricultural Development in 2012.
46	2.16	Inland Fisheries & Aquaculture Demands	BCM/Yr			
47	2.17	Navigation Demands	BCM/Yr			
48	2.18	Evaporation Losses	BCM/Yr	0.029	MEWINA-LIBYA	Sum of evaporation losses from average dam storage and MMR reservoirs. Evaporation losses are assumed to be about 25 % of total storage (Refs).
49	2.19	Bottled Water Production	BCM/Yr	0.00303	MEWINA-LIBYA	Estimated based on a percapita consumption of 1 lit/day, a fraction drinking bottled water of 0.67 of population and an equivalent volume used by institutions (hospitals, hotels, restaurants, cafes, etc.).
50	2.20	Water Demand for Environmental Uses	BCM/Yr	23.556	MEWINA-LIBYA	Estimation of environmetal / ecological water demand is a very tedious and difficult task as it requires detailed data on land uses, densities, spatial and temporal changes as well as a set national policy balancing uses with social, economic and environmental sustainability conditions / goals. Sophistical models utilizing advanced GIS technologies and validation requiring long term monitoring are a prerequisite for environmental water demand estimation. As such requirements can not be met presently and no data exist on EWD, a very rough estimate is presented here. It assumes that EWD = green water withdrawals + 10 % if irrigated water used (for ecological needs in farmed areas) + wild life water demand (assumed to equal animal water demand).
51	2.21	Withdrawals for Oil & Gas Water Use	BCM/Yr	0.13	MEWINA-LIBYA	Based on an estimated oil production of 1.483 million barrrels/day in 2012 and a water withdrawal of 2 m3 per m^3 of oil produced (1 barrel = 119.24 liters)
52	added	Produced water "associated with oil production"	BCM/Yr	0.13	MEWINA-LIBYA	Based on a reported productivity of 1.83 mb/d of oil and 2 barrels water/barrel of oil prodcued

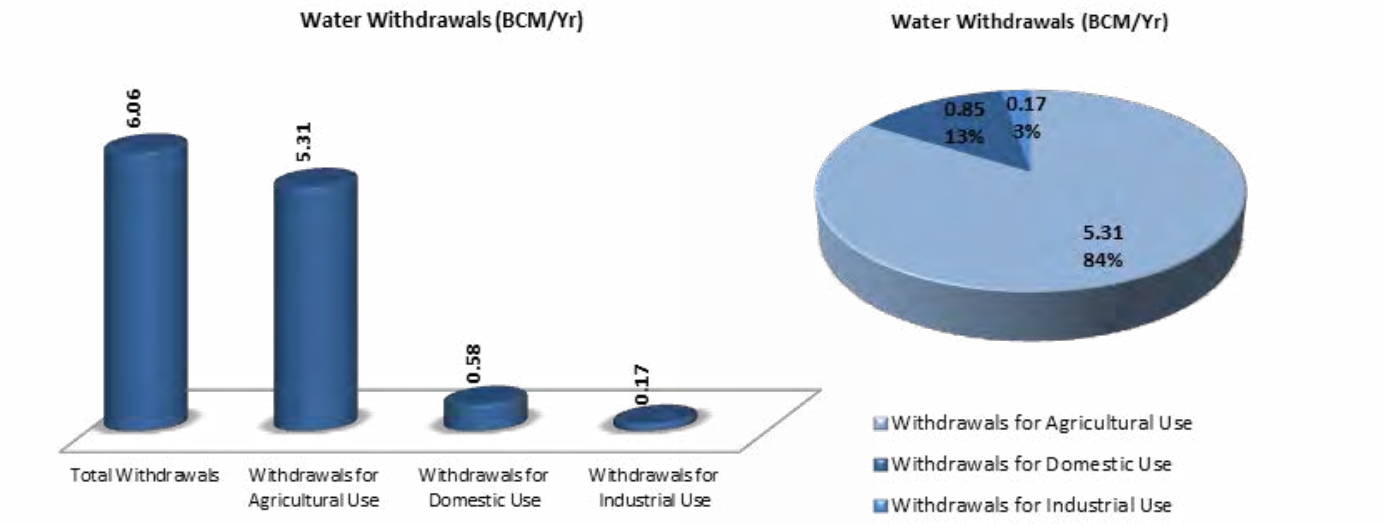

Figure 4. Water and Use: Water Withdrawals

Green Water Consumption for Agriculture Water Use. The national value reported by the GWA for this indicator (0.696 BCM/yr) is markedly smaller that those reported by CEDARE/AWC and FAO. The definition, assumptions and basis for calculation have not been stated clearly in these sources which may be one reason for the large discrepancy. Assuming a rain-fed area of 1489000 ha at an average rainfall intensity of 0.25 m/yr, the green water consumption is 3.7 BCM/yr. This value gives more credibility to the CEDARE/AWC/FAO value which has been adopted.

Withdrawals from Blue Surface Water. There are no national values for this indicator; the FAO value is zero. However, water from dams is used directly and indirectly; quantities used have not been reported. A case in point is bottling of a fraction of Wadi Ghan dam water for domestic uses. **This indicator has to be monitored as a regular indicator of dam water indicators.**

Withdrawals from Blue Renewable Groundwater. The value adopted is that reported by the GWA which is an estimate of the fraction of precipitation seeping through soils to become groundwater. Validation of this "historic non-updated" estimate is in order.

Withdrawals from Blue Non-Renewable Groundwater. The value reported is the sum of major water withdrawals as stated in many national references. The accuracy and reliability of this indicator are simply those of the primary indicators on which it has been based.

Agricultural Drainage Water Reuse. There are no data on this indicator although drainage water is collected on a very small level in clayey soils. However, it is safe to ignore the amounts reused as both the actual drainage quantities are small and the practice of drainage water reuse is not common among Libyan farmers. This practice is encouraged by the small irrigation water tariffs "prices".

Withdrawals from Desalinated Water. Values for this "country specific" indicator are both accurate and updated as the NCDW monitors regularly the amounts of desalinated water production and uses.

Withdrawals from treated domestic wastewater. Values for this indicator are both accurate and

updated as they have been provided by the GCWW which monitors regularly this indicator.

Annual Volume of Total Actual Evapotranspiration. There are no national data on this "country specific" indicator. It has been calculated as the sum of actual transpiration volumes of irrigation and rain-fed agriculture, pasture, and forests. Evapotranspiration loss indicator values are inherently approximate as uncertainties associated with the factors determining these indicators are high. Moreover, there are no reference data for these indicators making it necessary to resort to national and international literature for estimation.

Greenwater Consumption for Livestock Fodder Water Use. There are no national data on this "country specific" indicator. It has been calculated as the sum of demands of sheep/goats, cattle, chicken, horses/donkeys, and chicken based on estimated numbers of livestock (11). The demands are merely the numbers multiplied by the average daily water demand per animal. The indicator value is a reasonable estimate as actual data are not available and the numbers of livestock are subject to reasonable seasonal changes.

Inland Fisheries & Aquaculture Demands, Navigation Demands. These two indicators are not applicable to Libya.

Evaporation Losses. Evaporation losses included both dams and large Man-made River project reservoirs. Evaporation losses are assumed to be about 25 % of total storage (12). Evaporation loss indicators values are inherently approximate as uncertainties associated with the factors determining these indicators are high. Moreover, there are no reference data for these indicators making it necessary to resort to national and international literature for estimation.

Bottled Water Production. There are no national data on this "country specific" indicator. It has been calculated based on a per capita consumption of 1 lit/day, a fraction drinking bottled water of 0.67 of population and an equivalent volume used by institutions (hospitals, hotels, restaurants, cafes, etc.). Both the consumption rate and the number of consumers are reasonable estimates supported by the large number of bottling firms and the widespread use of bottled water in Libya. The affordable prices of bottled water and users' strong preference to domestic water supply based on taste and "conceived" quality factors are also drivers of water bottling markets.

Water Demand for Environmental Uses. Estimation of environmental / ecological water demand (EWD) is a very tedious and difficult task as it requires detailed data on land uses, densities, spatial and temporal changes as well as a set national policy balancing uses with social, economic and environmental sustainability conditions / goals. Sophistical models utilizing advanced GIS technologies and validation requiring long term monitoring are a prerequisite for environmental water demand estimation. As such requirements cannot be met presently and no data exist on EWD, a very rough estimate is presented here. It assumes that EWD = green water withdrawals + 10 % if irrigated water used (for ecological needs in farmed areas) + wild life water demand (assumed to equal animal water demand).

Clearly, the value reported herein is very approximate; it is meant to: 1) alert institutions, planners, decision makers, environmentalists, and public at large to the need to preserve, protect, and conserve the environment, and, 2) to start the practice of estimating AND allocating water for the environment. As such, both awareness campaigns and estimation methods for EWD should be initiated promptly.

Withdrawals for Oil & Gas Water Use. Data on this "country specific" indicator are scarce. The value of this indicator has been provided by the Oil sector member of the MEWINA-Libya unit. It is a reasonable estimate as it is not based on a comprehensive survey of all oil & gas production withdrawals. **The urgent need for such surveys is clear.**

Values of some of the indicators are very close to those reported by other national / international institutions. However, there appears to be some differences between values of some of the indicators reported by MEWINA-LIBYA and other national / international institutions. These differences may be attributed to the uncertainties associated with and inaccuracies in measurements of the factors determining these indicators.

Values of other country-specific indicators are estimated based on available data. They are considered to be reasonably accurate although data were available for a short period.

Produce Water. Large quantities of water are produced in association with oil production. A new "country-specific" indicator "Produced Water: has been added to the Water & Use category, to describe these quantities and their potential impacts. The actual Produce Water quantities vary considerably but are estimated as 2 barrels per barrel of oil produced. For an oil production of 1.83 million barrels/day in 2012 (13), the estimated Produce Water volume is 147 BCM/yr. Because these amounts are very large and distributed geographically with the oil fields, they constitute a large source of pollution, and, at the same time, a valuable water resource if properly treated / managed.

3.2.3. Water & Land Use Changes

Reported values of indicators of this category are listed in table 4. They include Total Irrigated Agricultural Land, Total Rain-fed Agricultural Land, Total Pasture Land, and Total Forests Land. Data on these indicators have been provided by national

Table 4. Values of MEWINA-validated indicators: 3. Water & Land Use Changes

No.	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	3	Water & Land Use Changes				
53	3.1	Total Irrigated Agricultural Land	ha	590000	MAAMW	Large difference between national & FAO / GWA value of 470000 ha. Slightly reduced FAO land use study value is probably more accurate as it is based on recent study employing modern technologies.
54	3.2	Total Rain-fed Agricultural Land	ha	1489000	MAAMW	National, CEDARE/AWC & FAO values are close.
55	3.3	Total Pasture Land	ha	14833000	MAAMW	National, CEDARE/AWC (13,500,000 ha.) & FAO values are close.
56	3.4	Total Forests Land	ha	170000	MAAMW	National value from study referred to is 338000. This value was adjusted in light of the urban encroachment over the last four decades. A value of 50 % of the above value was adopted as it may be more reliable.

No.	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
57	3.5	Urban Encroachment on Green Cover	ha lost/ Yr	3600	MEWINA - LIBYA	According to agricultural survey study conducted by FAO for Ministry of Agriculture, urban area of Tripoli doubled in the last 25 years from 11.587 ha of 1976 to 22.534 ha in 2001. Based on these figures, the encroachment rate is 440 ha/yr. Applying this rate to the urban areas of the agricultural coastal corridor, the estimated rate for the country for last 50 years is about 3600 ha/yr.
*	*	**Impact of Urban Encroachment on water Resources**				
58	3.6	Decrease in Groundwater Recharge	BCM/Yr	0.0009	MEWINA-LIBYA	Decrease is calculated as urban area*rainfall*recharge rate of 10 % of rainfall.
59	3.7	Decrease in Water Consumptions of Green Cover	BCM/Yr	0.00559	MEWINA - Libya	Decrease is equal to total water withdrawals from blue water (irrigation) and greenwater (rainfed, etc) times the ratio of urban area/total greenwater withdrawal area. Linearity is assumed for fractions and withdrawals. The total area is 17,108,000 ha and the total withdrawals are 26.56 BCM/yr from indicators above.
60	3.8	Increase in Surface Runoff	BCM/Yr	0.00585	MEWINA - Libya	Increase = urban area*rainfall intensity*runoff coefficient. Rainfall intensity = 0.25 m/yr, runoff coef. = 0.65.
61	3.9	Increase in Domestic Water Withdrawals	BCM/Yr	0.00986	MEWINA - Libya	Assuming urban area population density of 30 person/ha and a per capita water consumption of 0.25 m3/person.d

and international sources. The most recent, comprehensive and most technically sound are those determined by the Land Use Survey / Classification Study implemented by FAO for the MAAMW in 2004 (14). A large difference exists between the national and the FAO / GWA value of irrigated area (610000 vs 470000 ha). Indicator values reported in this study have been adopted. Forest land area was estimated to be about 50 % of values reported in the Land Use Study literature (14) as deforestation activities spiraled following the downfall of the past regime in 2011.

Urban Encroachment on Green Cover.

This subcategory contains several indicators. Data on indicators of urban encroachment impacts on Green Cover & Water resources are not available nationally or internationally. They have been determined based on limited data available from the Land Use Survey / Classification Study (14) on urban encroachment on green cover for the region of Tripoli, Libya during the period 1976-2001.

According to this study, the urban area of Tripoli doubled in the last 25 years from 11.587 ha of 1976 to 22.534 ha in 2001. Based on these figures, the encroachment rate is 440 ha/yr. Applying this rate to the urban areas of the agricultural coastal corridor, the estimated rate for the country for last 50 years is about 3600 ha/yr.

Impact of Urban Encroachment on Water Resources.

Decrease in Groundwater Recharge. The decrease was calculated as: urban area (3600 ha)*rainfall (250 mm/yr)*recharge rate of 10 % of rainfall. This indicator's value is approximate and needs to be validated / verified.

Decrease in Water Consumptions of Green Cover. The decrease is equal to the total water withdrawals from blue water (irrigation) and green water (rain-fed, etc) times the ratio of urban area/total green water withdrawal area. Linearity is assumed for fractions and withdrawals. The total area is 17,108,000 ha and the total withdrawals are 26.56 BCM/yr from indicators above. This indicator's value is approximate and needs to be validated / verified.

Increase in Surface Runoff. The increase = urban area*rainfall intensity*runoff coefficient. Rainfall intensity = 0.25 m/yr, runoff coefficient = 0.65. This indicator's value is approximate and needs to be validated / verified.

Increase in Domestic Water Withdrawals. The value of this indicator has been estimated assuming urban area population density of 30 person/ha and a per capita water consumption of 0.25 m3/person.d. This indicator's value is approximate and needs to be validated / verified.

3.2.4. Water & Services

***Water & Services**

This subcategory comprises several indicators. These indicators and their determination methods are outlined below.

Water Coverage and Accessibility, Improved Urban Water Supply Coverage, Improved Rural Water Supply Coverage, Improved Urban Sanitation Coverage, Improved Rural Sanitation Coverage, Improved Water Supply Coverage, Improved Sanitation Coverage. The reported indicator values are based on GCWW and CB data. These values have been adopted in favor of JMP because they are based on actual nationally sourced data while source of JMP data has not been specified. The 2012 values are assumed to be identical.

***Water Infrastructure**

This subcategory comprises several indicators. These indicators and their determination methods are outlined below.

Length of Water Supply Networks and Length of Sewage Networks. Value of these two indicators were based on GCWW data for 2014. Values for 2012-2014 are assumed to be identical.

A significant indicator that should be added to the infrastructures indicators is the stormwater network length. Otherwise, this indicator should be included with the sewage network length under the title "Length of Sewage and Stormwater Networks"

This indicator also neglects the length of water transport lines which form a very component of the national water works. The different nature of water supply, sewerage, and stormwater works makes it necessary to divide this indicator into two indicators water transport and supply networks and wastewater and stormwater networks.

Table 5. Values of MEWINA-validated indicators: 4. Water & Services

No.	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	4	**Water & Services**				
*	*	**Water Coverage and Accessibility**				
62	4.1	Improved Urban Water Supply Coverage	%	86.9	GCWW / CB	GCWW + CB values are adopted in favor of JMP because they are based on census data while source of JMP data has not been specified. The 2012 values are assumed to be identical.
63	4.2	Improved Rural Water Supply Coverage	%	10.7	GCWW / CB	GCWW + CB values are adopted in favor of JMP because they are based on census data while source of JMP data has not been specified. The 2012 values are assumed to be identical.
64	4.3	Improved Urban Sanitation Coverage	%	88.1	GCWW / CB	GCWW + CB values are adopted in favor of JMP because they are based on census data while source of JMP data has not been specified. The 2012 values are assumed to be identical.
65	4.4	Improved Rural Sanitation Coverage	%	10.1	GCWW / CB	GCWW + CB values are adopted in favor of JMP because they are based on census data while source of JMP data has not been specified. The 2012 values are assumed to be identical.
66	4.5	Improved Water Supply Coverage	%	70	MEWINA-LIBYA	GCWW + CB values are adopted in favor of JMP because they are based on census data while source of JMP data has not been specified. The 2012 values are assumed to be identical.
67	4.6	Improved Sanitation Coverage	%	70	GCWW / CB	GCWW + CB values are adopted in favor of JMP because they are based on census data while source of JMP data has not been specified. The 2012 values are assumed to be identical.
*	*	**Water Infrastructure**				
68	4.7	Length of Water Supply Networks	km	20000	GCWW / CB	Inclcudes only water distribution systems in cities and towns. Does not include large water transport lines of the MmRP
69	4.8	Length of Sewage Networks	km	8000	GCWW / CB	Includes wastewater and stormwater netowrks. Values for 2012-2014 are very close
70	4.9	Length of Irrigation Networks	km	4000	AEMMmRP / MEWINA-Libya	This length represents the MMR pipelines forming the major skeleton of the water transport system. To this should be added irrigation networks of public projects and private farms for which no published data exist.
72	4.11	Dam Storage Capacity	BCM	0.06	GWA	Avg storage = 0.038 bcm/yr is a better indicator than design storage capacity
73	4.12	Water Supply Capacity	BCM/Yr	2.879266	GCWW	Total water treatment plant capacity (domestic only)
74	4.13	Desalination Capacity	BCM/Yr	2.68275	GDCOL	Based on data supplied by the GDCOL

No.	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
75	4.14	Municipal Wastewater Treatment Capacity	BCM/Yr	0.148555	GCWW	Based on data supplied by the GCWW
76	4.15	Industrial Wastewater Treatment Capacity	BCM/Yr	0.024	MEWINA-LIBYA	Calculated based on an industrial water demand of about 120 mm3/yr and a wastewater generation of about 20 % of industrial water demand due to slowdown of industrial activities in the years 2012-2014 (Ref). Demand data are extrapolations from NWS (1999).
77	4.16	Wastewater Collection Capacity	BCM/Yr	0.438	GCWW / MEWINA-LIBYA	Based on data supplied by the GCWW
78	4.17	Maximum Annual Dam Storage Reached	BCM	0.0909	MEWINA-LIBYA	Estimated based on available data for some dams showing a ratio of maximum to average stored water of 1.5.

Length of Irrigation Networks. The indicator value reported represents the MmRP pipelines forming the major skeleton of the water transport system. To this value should be added irrigation networks installed in public projects and private farms for which no published data exist.

Length of Drainage Networks. No data are available for this indicator.

Water Supply Capacity. The reported indicator value was based on GCWW supplied data for 2014. The 2012 and 2014 values are assumed to be identical.

Desalination Capacity. The reported indicator value was based on GCDW supplied data for 2014. The 2012 and 2014 values are assumed to be identical.

Municipal Wastewater Treatment Capacity. The reported indicator value was based on GCWW supplied data for 2014. The 2012 and 2014 values are assumed to be identical.

Industrial Wastewater Treatment Capacity. This indicator's value was calculated based on an industrial water demand extrapolations from NSIWRM (10) of about 120 mm3/yr and a wastewater generation of about 20 % of industrial water demand due to slowdown of industrial activities in the years 2012-2014.

Wastewater Collection Capacity. The reported indicator value was based on GCWW supplied data for 2014. The 2012 and 2014 values are assumed to be identical.

Dam Storage Capacity. This "country specific" indicator value was reported for dam design capacities which were theoretical with little practical implications. It was proposed to introduce a new more practical "country specific" indicator, the maximum stored volume. The reported value for this indicator was calculated based on a maximum to average ratio of 1.5 and total average storage of 0.038 BCM/yr.

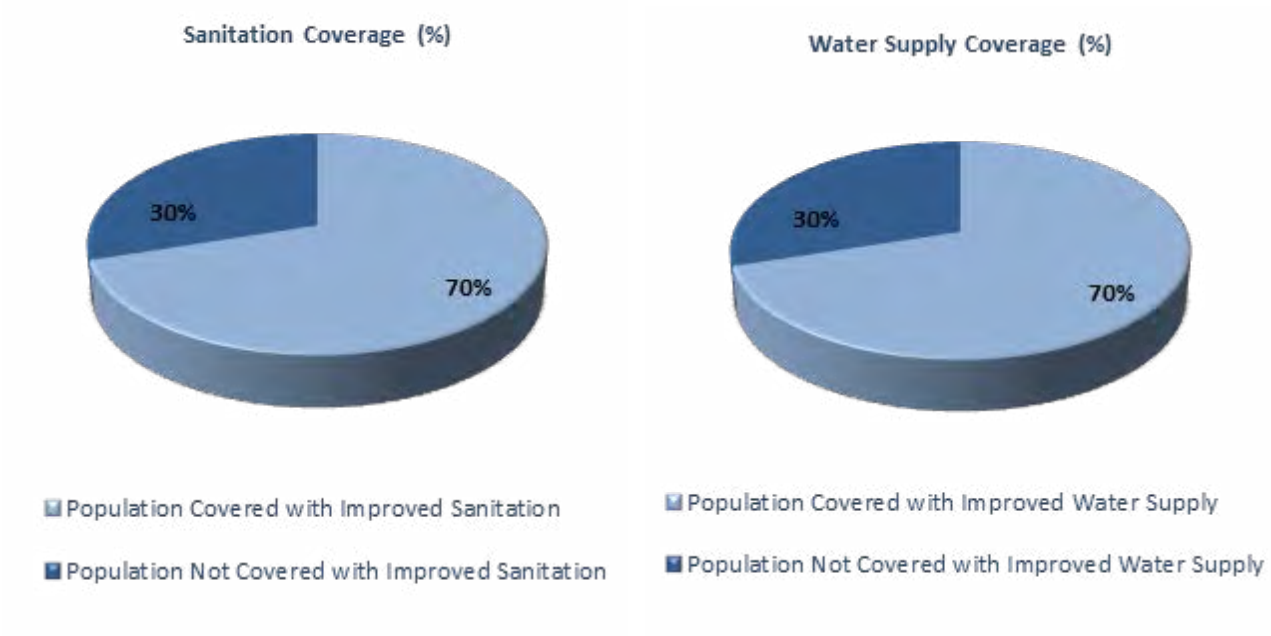

Figure 5. Water and Services: Water Supply & Sanitation Coverage

3.2.5. Water & Energy

Electricity Generated Using Hydropower, Hydropower as % of Total Generated Electricity, Installed Hydropower Capacity. These indicators do not apply to Libya

Water Used to Generate Electricity. The value of this "country specific" indicator was calculated based on international institutions estimates that 3.9 % of total installed desalination capacity which totaled 0.05 million cubic meters per year in 2005 is utilized to generate electricity (15).

Table 6. Values of MEWINA-validated indicators: 5. Water & Energy

No	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	5	Water & Energy				
79	5.1	Electricity Generated Using Hydropower	GWh/Yr			
80	5.2	Hydropower as % of Total Generated Electricity	%			
81	5.3	Installed Hydropower Capacity	MW			
82	5.4	Water Used to Generate Electricity	BCM/Yr	0.003559	MEWINA-Libya	Assumed as 3.9 % of total installed desal capacity which totaled 0.05 mm3/yr in 2005

3.2.6. Water & Population

Indicators for this category are summarized in table 7. Practically all of these indicators are secondary indicators based on population and previously reported indicators.

Table 7. Values of MEWINA-validated indicators: 6. Water & Population

No	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	6	Water & Population				
83	6.1	Total Population	1000 persons	6300	CB	based on 2006 census
84	6.2	Internal Renewable Water Resources Per Capita	CM/capita/Yr	157	Secondary	
85	6.3	Total Renewable Blue Water Resources Per Capita	CM/capita/Yr	157	Secondary	
86	6.4	Total Renewable Water Resources Per Capita	CM/capita/Yr	3749	Secondary	
87	6.5	Total Available Water Resources Per Capita	CM/capita/Yr	4264	Secondary	
88	6.6	Blue Water Withdrawal Per Capita	CM/capita/Yr	786	Secondary	
89	6.7	Green Water Use Per Capita	CM/capita/Yr	3608	Secondary	
90	6.8	Total Water Consumption Per Capita	CM/capita/Yr	91	Secondary	
91	6.9	Agricultural Water Withdrawal Per Capita	CM/capita/Yr	843	Secondary	
92	6.1	Industrial Water Withdrawal Per Capita	CM/capita/Yr	27	Secondary	
93	6.11	Domestic Water Withdrawal Per Capita	CM/capita/Yr	91	Secondary	
94	6.12	Population Without Improved Water Supply	1000 persons	151	Secondary	
95	6.13	Population Without Improved Sanitation	1000 persons	113	Secondary	

Total Population. The 2012 population of Libya was estimated based on national population census data of 2006 and a growth rate of 1.8 % recommended by the CB.

Other "secondary" indicators. All other indicators in this category are secondary indicators. They were determined simply by dividing the primary indicator of interest by the estimated population in 2012.

Access to safe drinking water and sanitation are among the highest in Africa (figure 5). As stated in 2.3.2, about 65 % of the potable water is supplied by public networks. Public taps and standpipes are not used in Libya. Dug wells have practically disappeared as water tables have declined with the increasing use of pumps giving way to tubewells, the major source of water for 17 % of the Libyan population. Use of springs as a permanent source of domestic water is rare; they are used mainly for small scale irrigation.

About 45 % of the population is served by centralized public networks and 54 % served are by on-site sanitation systems; therefore the overall coverage is almost 99 %. Use of pit latrines, pit latrines with slabs, and ventilated improved pits is non-existant in Libya.

Two other indicators merit special attention, specifically total annual consumption of 962 m3 per capita and total available renewable water resources of 157 m3 per capita per year. These levels are below the water poverty level of 1000 m3/capita/day and water scarcity level of 500 m3/capita/day (figure 6).

3.2.7. Water & Health

Indicators for this category are summarized in table 8. Practically all of these indicators are supplied by the MOH and made available in its annual report.

Diarrhea Prevalence in Children Under 5 Years. No data are available on this indicator. So, it was not reported. However, reported data by the WHO state that 3 % of children under five years in Libya die of diarrhea (16).

Dracunculiasis Reported Cases. The value of this indicator is zero based on WHO published statistics which classified Libya as non Dracunculiasis state (17).

Open Defecation Practice and Percentage of Open Defecation. The practice of open defecation is non-existent in Libya because all citizens enjoy access to proper sanitation facilities; this can be seen from sanitation indicators reported in the preceding relevant sections. So, the value is zero although official values are not reported.

Table 8. Values of MEWINA-validated indicators: 7. Water & Health

No	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	7	Water & Health				
97	7.2	Dracunculiasis Reported Cases	%	0	WHO	Libya is reported as non Dracunculiasis state by WHO
98	7.3	Open Defecation Practice	Number	0	MEWINA-LIBYA	Assumed base on existing practices and observations.
99	7.4	Percentage of Open Defecation	%	0	Secondary	
100	7.5	Cholera Reported Cases	Number/ Year	0	MOH	Based on Ministry of Health Statistics
101	7.6	Typhoid Reported Cases	Number/ Year	314	MOH	Based on Ministry of Health Statistics
102	7.7	Hepatitis A Reported Cases	Number/ Year	176	MOH	Based on Ministry of Health Statistics

Cholera Reported Cases, Typhoid Reported Cases, and Hepatitis A Reported Cases. Values for these "country specific" are drawn directly from the Ministry of Health Statistics which are both regular and reliable.

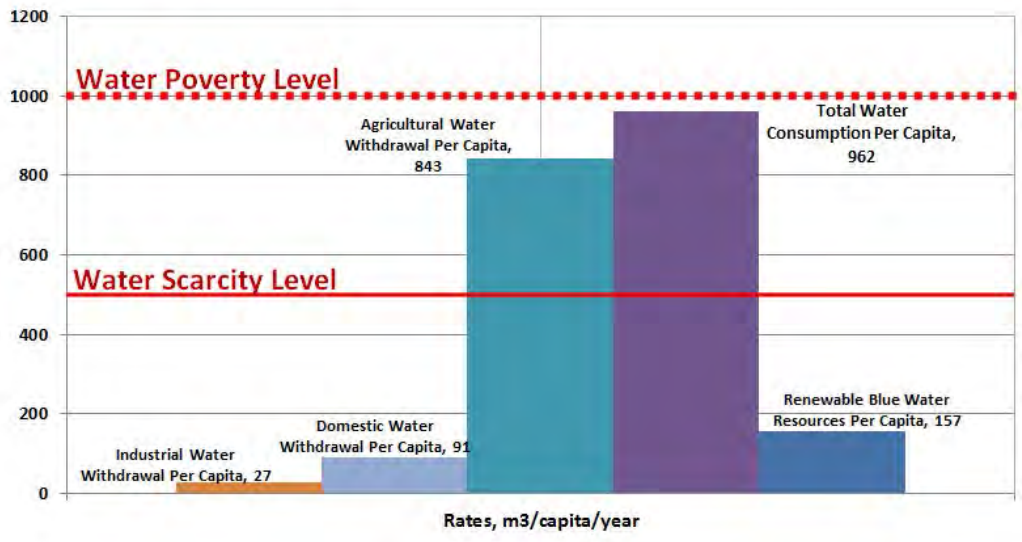

Figure 6. Water and Population: Annual Per Capita Availability & Withdrawal Rates

3.2.8. Water & Quality

Water quality indicators have been reported by many institutions semi-regularly at times. Expectedly, the values differ with source and time; so it is not possible to specify a representative value for all indicators from all sources. Because the MmRA is by far the most regular in water quality analysis and the amounts of water supplied by this institution, and more specifically the AlHasawana Water System, values reported by the MmRA AlHasawna System have been adopted.

Table 9. Values of MEWINA-validated indicators: 8. Water & Quality

No	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	8	Water & Quality				
103	8.1	Dissolved Oxygen (DO)	mg/l	7.3	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
104	8.2	pH	no	7.3-7.65	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
105	8.3	Electric Conductivity (EC)	1/OHM (S/M)	1630	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
106	8.4	Nitrogen Concentration	mg/l	50	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
108	8.6	Total Dissolved Solids	mg/l	1060	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
109	8.7	Fecal Choliform	Colonies/100ML	0	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
112	8.10	Chloride Concentration	mg/l	243	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
113	8.11	Total Hardness ($CaCo_3$)	mg/l	379	AEMMmRP	Reported by the AEMMmRP for Phase II well fields

It is to be noted that some of the "country specific" indicators are geared towards surface water quality assessment (DO, P, BOD, COD) while others are geared towards groundwater quality assessment (EC, TDS, Cl-, Hardness). This explains the fact that Libyan water institutions focus mainly on water quality indicators.

Dissolved Oxygen (DO) and Phosphorous Concentrations. No data are available for these indicators.

pH, Electric Conductivity (EC), and Nitrogen Concentration. Values of these indicators reported by the MmRA were adopted. Nitrogen concentration in the form of nitrates only has been reported probably because of its potential public health impacts. although concentrations of other nitrogen forms are likely to be zero, it is essential this assumption should be demonstrated through repeated analytical tests.

Total Dissolved Solids, Fecal Choliform, Chloride Concentration, and Total Hardness (as $CaCO_3$). Values of these "country specific" indicators reported by the MmRA were adopted.

Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). No data are available for these "country specific" indicators.

A national water quality indicator can be determined by compositing individual water sources and quantities produced by each source. As water quality indicators are site specific, the use of a national water quality indicator is of limited use.

3.2.9. Water & EcoSystems

Water and Ecosystems are limited to wetlands (table 10). They have been reported solely by the EGA. Two indicators have been added to this category, namely, inland lakes and areas of inland lakes.

Table 10. Values of MEWINA-validated indicators: 9. Water & EcoSystems

No.	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	9	Water & EcoSystems				
114	9.1	Number of Wetlands Sites Acknowledged by RAMSAR	Number	2	EGA	
115	9.2	Total Wetlands Areas	ha	8300	EGA	

Number of Wetlands Sites Acknowledged by RAMSAR and Total Wetlands Areas. Values of these indicators have been adopted from EGA reported values. They are both recent and accurate.

Total Freshwater Species Count. No data are available for this indicator simply because of the absence of freshwater bodies. So, this indicator is practically inapplicable to Libya.

Number of Endangered Species, Number of Invasive Species. No data are available for this "country specific" indicator.

Inland Lakes, areas of inland lakes. Several lakes exist in the Libyan Sahara. They represent unique ecologic systems which are subject to deterioration and disappearance. Consequently, they deserve special attention and care. For this reason, two additional "country specific" indicators are proposed relating to inland lakes in Libya.

3.2.10. Water & Climate

Reported values of Water and Climate indicators are listed in table 11. Most of them have been calculated by national climate experts within the MEWINA-Libya team.

Extreme Weather Events

Number of Class 1 flood events, Number of Class 1.5 flood events, Number of class 2 flood events, Drought events. Values for these indicators were calculated employing generated data and formulas.

Table 11. Values of MEWINA-validated indicators: 10. Water & Climate

No	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	10	Water & Climate				
*	*	Extreme Weather Events				
121	10.1	Number of Class 1 Flood Events	Number	7	MEWINA-LIBYA	Estimated based on LNCM data
122	10.2	Number of Class 1.5 Flood Events	Number	6	MEWINA-LIBYA	Estimated based on LNCM data
123	10.3	Number of Class 2 Flood Events	Number	0	MEWINA-LIBYA	Estimated based on LNCM data
124	10.4	Average Temperature	°C	21.1	MEWINA-LIBYA	Estimated based on LNCM data
130	10.10	Unusual Weather Events (Snow, Hail,……)	Number / Type	7	MEWINA-LIBYA	Estimated based on LNCM data

No	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
131	10.11	Existence of Early Warning Disaster prevention System and Year of establishment	Yes/No	NO	MEWINA-LIBYA	Estimated based on LNCM data
132	10.12	National Climate Change Adaptation Plan	Yes/No	NO	MEWINA-LIBYA	Estimated based on LNCM data

Cost of Annual damage induced by floods, Cost of Annual damage induced by droughts, Annual human losses related to Floods, Annual human losses related to Droughts. No data were available on these indicators.

Average Temperature, Unusual Weather Events (Snow, Hail,). Values were reported for these indicators based on existing weather data.

Existence of Early Warning Disaster prevention System and Year of establishment, Existence of National Climate Change Adaptation Plan. Both indicators were not considered to date.

3.2.11. Water & Socio-economics

Reported values of Water and Socioeconomics indicators are listed in table 12. Half of these indicators were reported by AWC / CEDARE, two by MEWINA-Libya.

Table 12. Values of MEWINA-validated indicators: 11. Water & Socio-economics

No	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	11	**Water & Socio-economics**				
*	*	**Water Productivity**				
133	11.1	Industrial Water Productivity	$/CM	369.48	CEDARE / AWC	Value reported by CEDARE/AWC adopted
134	11.2	Agricultural Water Productivity "Crop Per Drop"	$/CM	0.32	CEDARE / AWC	Value reported by CEDARE/AWC adopted
135	11.3	Employment in Agriculture "Job Per Drop"	Jobs/ MCM	53	CEDARE / AWC	Value reported by CEDARE/AWC adopted
136	11.4	Employment in Industry "Job Per Drop"	Jobs/ MCM	3	MEWINA-LIBYA	Based on a total industrial work force of 0.38 million persons. Water withdrawals include oil sector.
137	11.5	GDP	Billion $	73.8	MOP	Ministry of Planning Data
*	*	**Tariffs and Affordability**				
138	11.6	Water and Sanitation Charges as % of Average Household Income	%	1.5	MEWINA-LIBYA	Method of calculation is provided in AMCOW indicators report (annex of the report)

***Water Productivity**

This subcategory comprises several indicators. These indicators and their determination methods are outlined below.

Industrial Water Productivity, Agricultural Water Productivity "Crop Per Drop", Employment

in Agriculture "Job Per Drop". No national data are available for these indicators. Indicator value reported by AWC/ CEDARE (2) was adopted.

Employment in Industry "Job Per Drop". No national data are available for this indicator. It was estimated based on literature data reporting a total industrial work force of 0.38 million persons (18). Water withdrawals include oil sector.

GDP. The value of this "country specific" indicator was based on data reported by the Ministry of Planning. Such values are prepared annually. They are updated and accurate.

***Tariffs and Affordability**

Water and Sanitation Charges as % of Average Household Income. The value for this indicator was calculated as part of the AMCOW-Libya Report based on national consumption averages and existing water supply and sanitation tariffs. Therefore, it is approximate and subject to change in response to raises in household incomes.

3.2.12. Water & Finance

Values of only two Water and Finance indicators were reported (table 13).

Percentage of National Budget Directed to Water & Sanitation Sector, Operation & Maintenance Cost Recovery for Water Supply and Sanitation, Percent of GDP Directed to Sanitation & Hygiene, Foreign Aid for Water & Sanitation, and Operation& Maintenance Cost Recovery for Irrigation. No national data are available for these indicators. Considering their importance for sector performance evaluation, planning, and management, the fact that they are not monitored is indicative of the wide gap that exists in water sector financing, a major factor in national planning and resource allocation. The need for monitoring these indicators is very serious. It is worth noting that the monitoring process factors are many, interdependent, and multi-sectoral. Special efforts are needed to put in place the proper mechanism for such a process.

Table 13. Values of MEWINA-validated indicators: 12. Water & Finance

No.	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	12	Water & Finance				
139	12.1	Percentage of National Budget Directed to Water & Sanitation Sector	%	0.74	MOP	Ministry of Planning Data
142	12.4	Foreign Aid for Water & Sanitation	Million US$	0.02	CEDARE / AWC	

Operation & Maintenance Cost Recovery for Industry and Total Investment. No national data are available for these "country specific" indicators.

Aid to Water & Sanitation in Foreign Countries. No national data are available for this "country specific" indicator. It is difficult to assess it as aid to foreign countries is usually lumped into one category with little classification based on field of assistance.

It is clear, base on the above remarks, that national institutions practices pay less attention to operation and maintenance, cost recovery, finance and investment. Such practices reflect a non-cost oriented

planning and management which is a serious obstacle to any institutions accountability, performance and efficiency assessment, and improvement. **Special awareness raising efforts and comprehensive organizational changes are warranted to ensure the sectors financial / economic sustainability.**

3.2.13. Water & Trade

This category consists of only two indicators. Values for both indicators were not available nationally; therefore, reference was made to values estimated by AWC / CEDARE (table 14). It is clear that agricultural virtual water imports are several times agricultural virtual water exports (8.1 vs. 0.04 BCM/yr). This practice is natural as Libya is water short and Libya agricultural products are less competitive with water abundant countries with cheap labor and more fertile soils.

Agricultural Virtual Water Export and Agricultural Virtual Water Import. No national data are available for these "country specific" indicators. Indicator values reported by CEDARE / AWC were adopted (table 14). Agricultural virtual water exports consisted of potatoes, pulses, vegetables, fruits, and fats and oils; the latter being the major export commodity. Agricultural virtual water exports consisted of all food categories but were dominated by wheat and flour, oils and fats (table 15).

Table 14. Values of MEWINA-validated indicators: 13. Water & Trade

No	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	13	Water & Trade				
147	13-1	Agricultural Virtual Water Export	BCM/Yr	0.04	CEDARE / AWC	Value reported by CEDARE / AWC adopted
148	13-2	Agricultural Virtual Water Import	BCM/Yr	8.1	CEDARE / AWC	Value reported by CEDARE / AWC adopted

Table 15. Libya's Agricultural Virtual Water Exports and Imports

Commodity	Virtual water, BCM/yr	
	Export	Import
Wheat and Flour	0	1.934
Maize	0	0.482
Rice	0	0.238
Barley	0	0.338
Potatoes	0.01	0.003
Pulses (Total)	0.11	0.011
Vegetables (Total)	0.18	0.006
Fruits (Total)	0.05	0.026
Sugar(Refined)	0	0.369
Fats & Oils(Total)	2.02	2.571
Red Meat	0	0.317
Poultry Meat	0	0.00005
Eggs	0	0.032
Milk & Dairy Prod.	0	1.774
Total, BCM/Year	2.37	8.102

The net virtual water export far exceeded the net virtual water imports implying Libya's total dependence

on food imports. Such finding is expected, but the fact remains that **virtual water exports should be minimized if not stopped completely in light of the serious water shortages faced by the country. In the meantime, food produce locally should be optimized based on water availability and costs.**

3.2.14. Water & Governance

This category is a major one consisting of 24 indicators; two were secondary indicators, nine indicators were not reported, eight were reported by the GWA / MEWINA-Libya unit. Values of the reported indicators are listed in table 16.

IWRM Plan. A national IWRM plan for a specified time period does not exist presently. However, an annual plan is prepared by the GWA for planning, budgeting, and execution monitoring purposes. A national WRM strategy has been in place since 2000 with a general IWRM plan. This strategy is being updated by the Ministry of Water Resources presently.

National Water and Sanitation M&E & R System. National institutions implement semi-official, semi-structured M & E & R systems. Perhaps the most relevant systems are those of the GCWW. However, these systems are far from uniform, standardized, and coordinated. Moreover, reporting is very limited both in scope and in distribution. Therefore, the sum of outputs from these institutions does not rise to the national level.

Table 16. Values of MEWINA-validated indicators: 14. Water & Governance

No	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	14	Water & Governance				
149	14-1	IWRM Plan	Yes/No	No	GWA	
150	14-2	National Water and Sanitation M&E & R System	Yes/No	No	MEWINA-LIBYA	
151	14-3	Surface Water Permits Issued to Date	Number	0	GWA / MEWINA-LIBYA	
152	14-4	Total Volumetric Rights Associated with surface Water Permits	BCM/Yr	9.2	MEWINA-LIBYA	
153	14-5	Volume associated with surface Water permits as a Percent of Annual Blue Surface Water Withdrawals	%	0	MEWINA-LIBYA	
154	14-6	Groundwater Well Permits Issued to Date	Number	35340	MEWINA-LIBYA	Estimated based on data available for NW Libya regions and applied as percentage to all regions of Libya
160	14-12	Number of Water Supply Meters Installed as a Percent of Total Number of Covered Households	%	25-30	MEWINA-LIBYA	Estimated based on typical values for similar regions
163	14-15	Physical Domestic Water Losses	BCM/Yr	0.2013	MEWINA-LIBYA	Estimated assuming a leakage loss percentage
164	14-16	Overall Water Use Efficiency	%	99.94	Secondary	Calculated assuming an irrigation efficiency of 65 %

No	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
165	14-17	Water Sustainability/ Depletion Index	%	18.41	Secondary	
166	14-18	Wastewater and Drainage Outflows	BCM/Yr	1.4	CEDARE /AWC	
167	14-19	Transboundary Wastewater and Drainage Outflows	BCM/Yr	0	MEWINA-LIBYA	
169	14-21	Physical Irrigation Water Losses	BCM/Yr	1.33	MEWINA-LIBYA	calculated assuming an irrigation efficiency of 65 %
171	14-23	Number of Water Users Associations	Number	0	MEWINA-LIBYA	
172	14-24	Water Users Associations Agricultural Land Coverage	% of Ag. Land	0	Secondary	

Surface Water Permits Issued to Date, Total Volumetric Rights Associated with surface Water Permits, Volume associated with surface Water permits as a Percent of Annual Blue Surface Water Withdrawals. Values for these indicators were reported based on surface water data available at the GWA.

Groundwater Well Permits Issued to Date. Values for this indicator was estimated from existing data for 3 of the 5 water regions of Libya. The total was calculated by assuming that the regions for which no data exist represent 25 % of the total.

Total Volumetric Water Rights Associated with Well Permits, Total Volume associated with well permits as a percent of Annual Blue Groundwater Abstractions, Number of unlicensed wells, Irrigation & Drainage Related Complaints as a percentage of Irrigation Water Users, Water supply and Sanitation Related Complaints as a percentage of Serviced Households. No national data are available for these indicators so no values were reported.

Number of Water Supply Meters Installed as a Percent of Total Number of Covered Households. The value for this indicator was based on referenced data.

Number of Groundwater Meters Installed as a percent of Serviced Households, Number of Surface Irrigation Meters Installed as a % of Surface Irrigation Water Permits No national data are available for these indicators so no values were reported.

Physical Domestic Water Losses. The value reported was an estimate from a reference.

Overall Water Use Efficiency, Water Sustainability/ Depletion Index. Values for these two "secondary indicators" were calculated based on values of the corresponding "primary indicators". It is to be noted that the Overall Water Use Efficiency indicator value is very high while that of the Water Sustainability/ Depletion Index is very low. Both values should be accepted cautiously; the high efficiency indicator value is simply an indication that all water available is used. Similarly, the low water sustainability index is indicative that Libya is less reliant on transboundary water resources which is reflective of the fact that Libya's water resources are mainly groundwater.

Wastewater and Drainage Outflows and Transboundary Wastewater and Drainage Outflows. Values for these two indicators are zero as such flows don't exist.

Commercial Water Losses. No national data are available for these "country specific" indicators.

Physical Irrigation Water Losses. No national data are available for these "country specific" indicators. However, an estimate was made of its value based on literature reported losses averaging one third of water withdrawals.

Number of Water related citations (Water Laws Enforcement). No national data are available for these "country specific" indicators.

Number of Water Users Associations. Presently, there are no water use associations in Libya. This practice is perhaps due to the fact that most Libyan farmers rely on private water supply sources with no official efforts to coordinate their work and experiences. This practice is enforced by farmers' unawareness of the potential benefits of Water Use Associations.

Water Users Associations Agricultural Land Coverage. With no WUAs, the value of this indicator is expectedly zero.

It can be seen from table 16 that values for major "primary" Water Governance Indicators were not reported. **As state above, this finding indicates a weakness in water governance in Libya that should be addressed urgently.**

3.2.15. Water & International Relations

This category consists of only four primary indicators. Values for all of these indicators were reported (table 17). It is clear that agricultural virtual water imports are several times agricultural virtual water exports (8.1 vs. 0.04 BCM/yr). This practice is natural as Libya is water short and Libya agricultural products are less competitive with water abundant countries with cheap labor and more fertile soils.

Transboundary Water Dependency Ratio, Shared Waters related Bilateral/ Multilateral Agreements and/or Memorandums of Understanding and Cooperation Mechanisms, Number of Riparian's Sharing All Shared Water Bodies, Number of Shared Water Resources. Values of all indicators of this category were readily reported based on basic "physical" and "political" data available from national sources. **It is clear, based on these values that Libya does not depend on other states in terms of transboundary waters that it has established the mechanisms needed for sharing and managing transboundary water resources which account for a large portion of its water resources.**

Table 17. Values of MEWINA-validated indicators: 15. Water & International Relations

No	Code	Water Related Indicators	Units	Value in 2012	Source	Notes / Remarks
*	15	Water & International Relations				
173	15-1	Transboundary Water Dependency Ratio	%	0	GWA / MEWINA-LIBYA	
174	15-2	Shared Waters related Bilateral/ Multilateral Agreements and/or Memorandums of Understanding and Cooperation Mechanisms	Number	2	GWA	
175	15-3	Number of Riparians sharing all shared water bodies	Number	5	GWA	
176	15-4	Number of Shared Water Resources	Number	2	GWA	

4. Analysis and Trends

This section provides an overall analysis of the national SOW based on the values of indicators presented in Appendix III, an inventory of the available historical data for indicators (as applicable), observed trends compared with the 2012 values, and an explanation of the state of the indicators (whenever possible or applicable) and possible reasons for deterioration or improvement.

4.1. Analysis of Values of MEWINA-validated Indicators

Reviewing the contents of Appendix IV, the following general remarks are made:

- Values of monitored indicators reported are probably the most accurate of all reported indicators. It should be noted, however, that the monitoring process is irregular, not uniform, and not unified among institutions. In several cases, the data are very few and very old. Therefore, the values reported should be utilized with some caution.
- Values for most of the reported indicators have been based on data submitted by the concerned institutions.
- Values of 10 indicators were adopted from reports prepared by international organizations (2, 8). These values have not been elaborated and may be outdated or based on assumptions that have to be verified.
- Several of the indicators don't apply to Libya. They have been included in the report only for the purpose of following the standard regional format.

4.2. Available Historical Data for Selected Indicators and Observed Trends

Of the major indicators reported officially and included in the additional MEWINA list, only piezometric water level changes and basic water quality variations have been monitored over a relatively long period of time. Available historic data for these indicators and the observed trends are discussed briefly below.

a) **Piezometric water level changes.** The water level and pressure declines in aquifers have been measured regularly in selected monitoring wells in the five designated water regions of Libya. An example of the water level declines is shown in Figure 7. It can be seen from this figure that aquifers are pumped excessively with serious adverse impacts on sustainability of the aquifers and the communities utilizing waters from these aquifers.

b) **Basic water quality variations.** General water quality changes are monitored using the non-specific TDS test. An example of the water quality deteriorations taking place in the north western aquifers is shown in Figure 8. The impacts of seawater intrusion due to excessive mining of coastal groundwater aquifers are very serious as the water quality is unsuitable for domestic, industrial and agricultural uses.

c) **Changes in water supply, withdrawals, and deficits.** Although no actual "field monitored" data exist on water withdrawals for domestic, industrial, and agricultural uses, estimates have been reported for these demands in several references (2, 8, 9, 10). Estimated changes in water demand for the period 2000-2015 are shown in Figure 3. It can be seen from this figure that: **1) the available water supplies are finite, 2) water withdrawals have been increasing rapidly, 3) water withdrawals exceed water supplies with a deficit increasing sharply with time, 4) agricultural withdrawals constitute about 88 % of total water withdrawals accounting for most of the increase in water withdrawals and for the increasing water deficit. The water deficits are responsible for freshwater depletions and seawater intrusions with detrimental impacts. Clearly, any remedial measures foreseen must be directed towards cubing the agricultural water withdrawals.**

4.3. Hot Spots Associated With Selected Indicators

Values of many indicators are at, below or above critical levels. When these indicators are of physical / geographical significance, the locations where they are may be considered hot spots. The indicators and hot spot areas are listed in table 18.

Table 18. Indicators and corresponding hot spots locations

Indicator	Hot spot location
Evaporation Losses	Dams and open MmRP reservoirs. Total number is 20
Produced water "associated with oil production"	Oil fields. Spread throughout oil fields Total number is Unknown presently
Urban Encroachment on Green Cover	Urban areas and oasis
Total Forests Land	Coastal areas and mountainous areas. Total number is Unknown presently.
Chloride	Coastal areas. Indicators of seawater intrusion
TDS	Coastal and inland well fields. Seawater intrusion or poor quality waters
Other water quality	Nitrates are present in numerous wells in Hasawna well fields
Total Inland Lakes and areas	Six lakes located in southern Libya desert.
Number of unlicensed wells	A very large number of wells located all over Libya.
Physical Domestic Water Losses	Cities and towns with water distribution networks.
Commercial Water Losses	Cities and towns with water distribution networks.
Physical Irrigation Water Losses	Private and public irrigated farms located throughout Libya

It can be seen from table 6 that hot spots exist for many indicators. These numerous hot spots extend over large areas and cover many locations implying large and probably high impacts. Further investigations are warranted to identify more precisely the numbers of these hot spots and their boundaries in order to assess the values of the indicators and the state of these hot spots. Consequently, remedial actions can be specified to address any adverse impacts.

4.4. Gaps and Errors in Indicator Values

As indicated in the previous sections, many of the SOW indicators are not monitored and reported. This is especially the case for water consumed in irrigation which is the major fraction of water consumed in Libya. Coverage of water supply and sanitation services has not been studied and the demands reported are based on census data and limited studies. Industrial water demands are estimated as a percentage of

the total water demand with no justification for such estimates. Finally, the sustainable yields of water resources are estimated with no explicit elaboration of the assumption upon which such estimates are made.

As most of the indicator values reported is collected from different sources including international organizations, these data must be compared closely and verified against each other. The GWA should review these data and finalize the values to minimize confusion and unify and formalize these values; in other words, update the report and disseminate to all parties concerned.

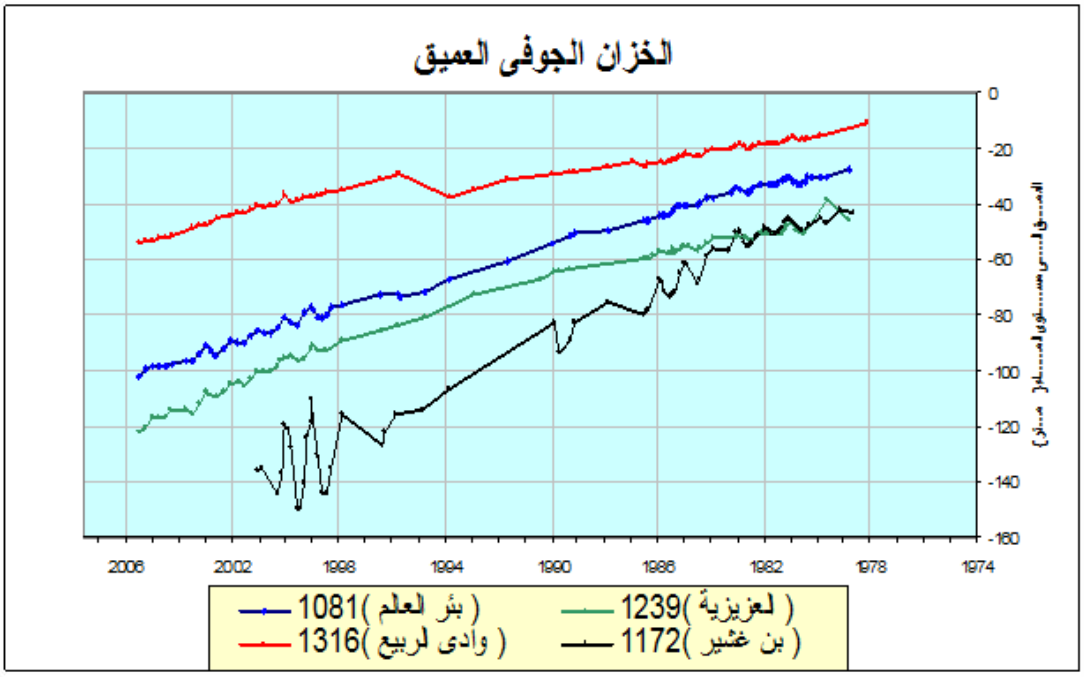

Figure 7. Progressive Water Level Declines in Aquifers in NW Libya (19)

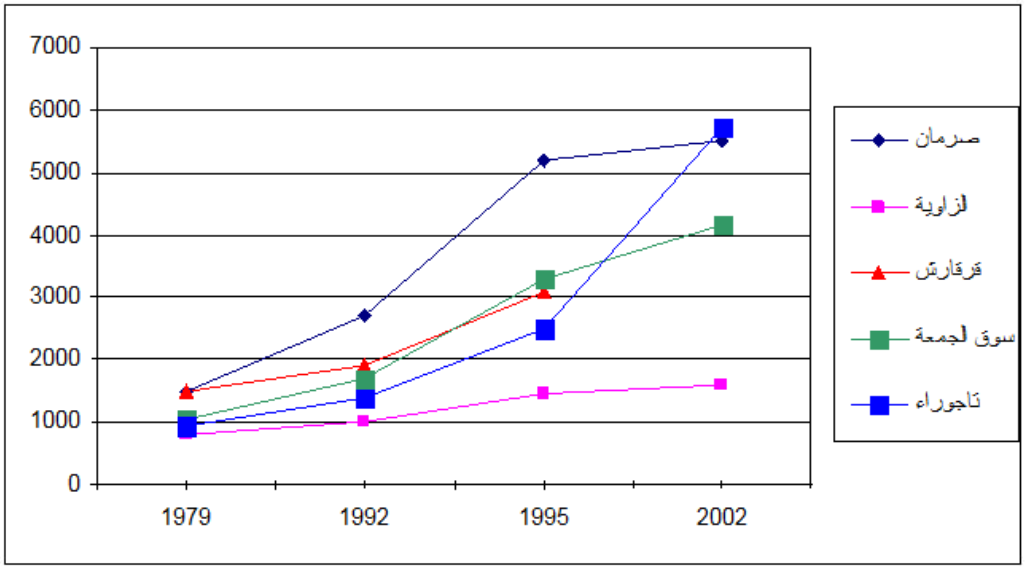

Figure 8. Progressive Water Quality Deterioration in Aquifers NW of Libya (19)

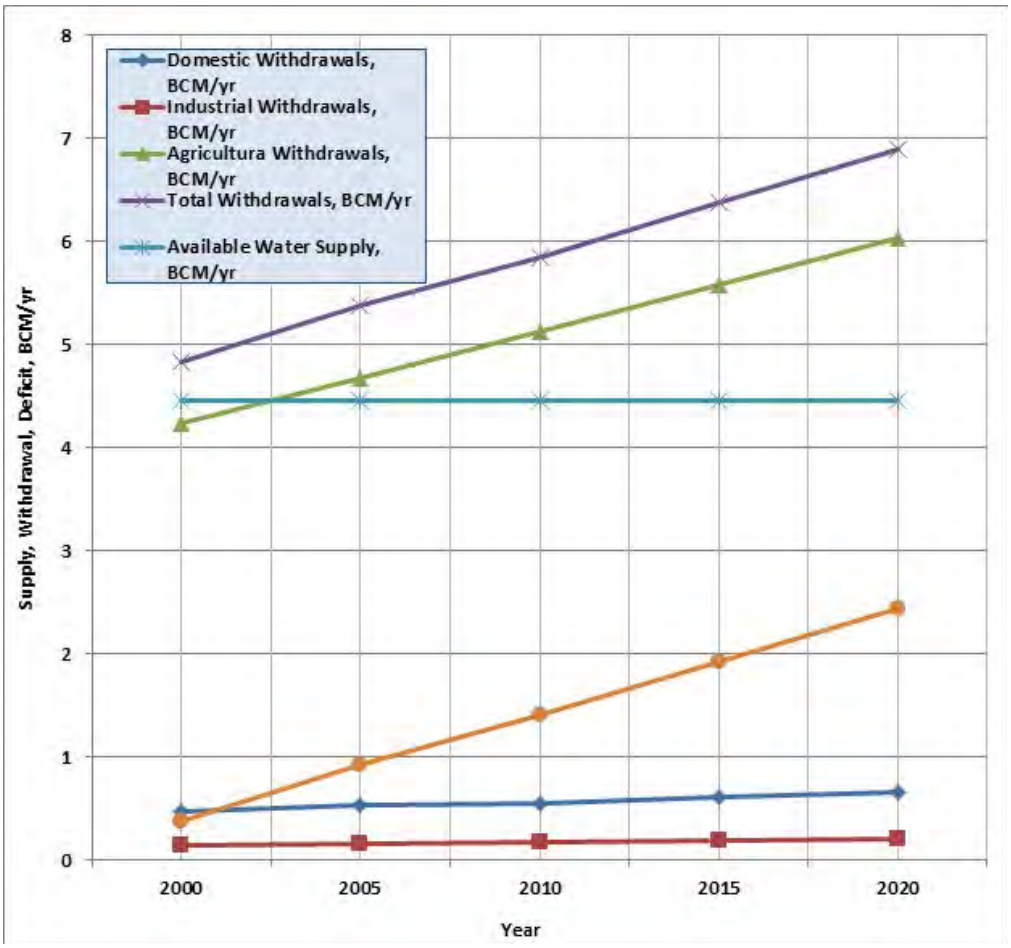

Figure 9. State of Supply, Withdrawals, and Deficits for the Period 2000-2020

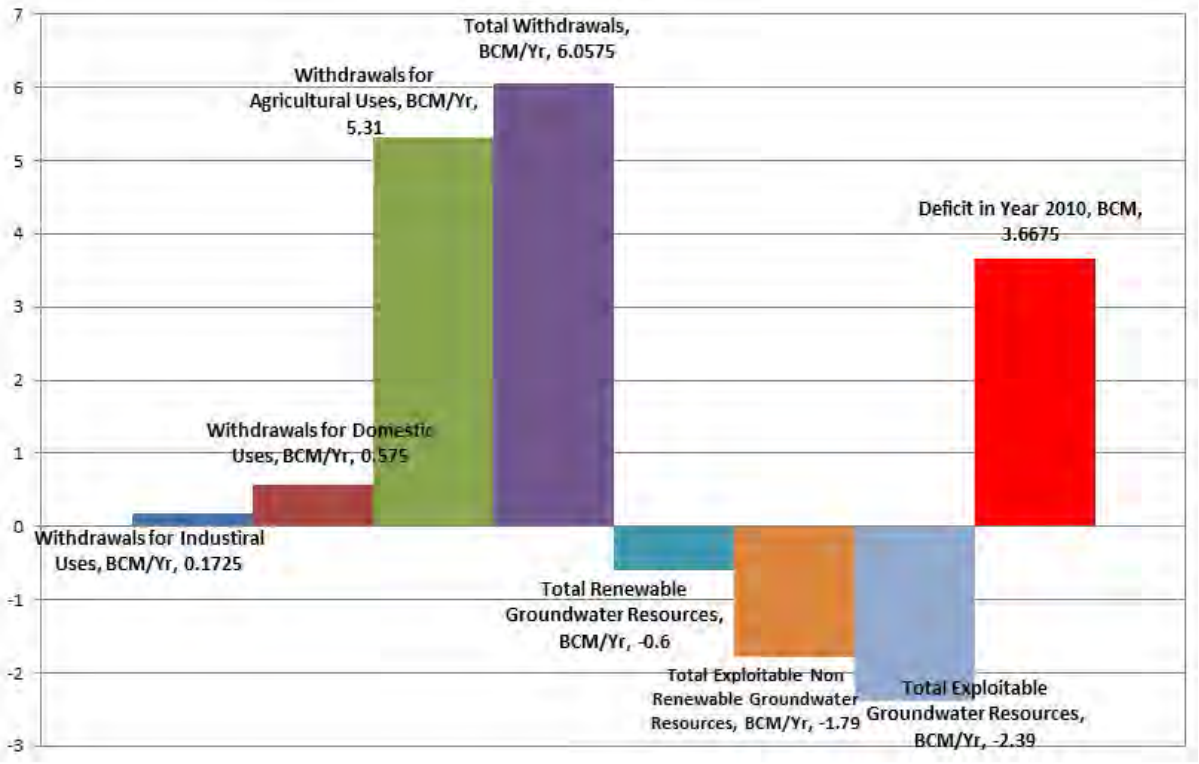

Figure 10. Water Sources & Withdrawals (Budget): Year 2012

percentage of the total water demand with no justification for such estimates. Finally, the sustainable yields of water resources are estimated with no explicit elaboration of the assumption upon which such estimates are made.

As most of the indicator values reported is collected from different sources including international

4.5. An Overview of the SOW Monitoring, Evaluation and Reporting in Libya

A good base exists for monitoring and evaluation of SOW indicators exemplified by the different institutions engaged in monitoring and the capacities available to them. The GWA is the institution officially in charge of water monitoring and evaluation. It has been conducting this task for over four decades. Its deliverables included several SOW reports; the latest was issued on 2006.

The SOW reporting process has evolved gradually with SOW reports prepared and disseminated on semi-regular basis by a single institution, namely, the GWA. Presently, there is no national water M/E/R system. The water institutions concerned with water are isolated; coordination between them is lacking, and their communication with institutions outside the water sector is also limited.

Hence, there is a need for building the capacity to reform the monitoring and evaluation processes in order to produce more comprehensive, updated, and easily accessible SOW reports that should form the basis for continuously diagnosing and upgrading the water sector performance.

This SOW report contains values for 141 indicators, i.e., 80 % of the total MEWINA-validated indicators thus providing for the first time a comprehensive and structured assessment of the SOW in Libya. Despite the limitations in continuity, accuracy, and coverage of the data used, this report can be used as a general guide for setting water monitoring and management policies.

Moreover, it will form a basis for further assessment of both the report contents and their quality and the future sector challenges inviting inputs from water experts in technical as well as non-technical fields. The feedback generated upon utilization of the report will be used to improve the contents of newer editions systematically. Another expected outcome of this report is that it will raise the reader's (including decision makers) awareness of monitoring and evaluation and will serve as the roadmap to a practical, science based monitoring and evaluation plan.

The absence of workplans in many fields including early warning system for extreme weather events, national plan for climate change adaptation, water and sanitation plan, monitoring plan, and IWRM plan warrants special attention and urgent action.

Due to severe data and geographic limitations, many of the indicators reported are based on estimates rather than measurements; hence, applications related to these indicators should consider these limitations. Meanwhile, updating and corrections of these indicators based on more accurate and/or recent data will be invaluable and highly valued.

In spite of the limitations in data and shortcomings associated with SOW monitoring in Libya, the seriousness of the water scarcity problem is unquestionable with detrimental and irreversible socio-economic and environmental impacts. The SOW in Libya is, therefore, critical demanding prompt actions at the highest level directed towards a complete reform of the whole water sector.

5. Policy Recommendations

The baseline SOW in Libya has been described in terms of a total of 176 indicators validated by the MEWINA-project teams. Despite the serious data limitations, values of 141 (80 % of the) indicators have been reported. Only about one third of the primary indicators are monitored / reported by government institutions presently, however, implying an urgent need for enhancing the M & E process in order to provide efficient and reliable monitoring, evaluation, and reporting. The following policy reforms are recommended to realize this objective:

1. An updated water sector reform strategy and work plan should be prepared immediately to put an end to the accelerating damages resulting from this deteriorating SOW leading to new practices based on sound monitoring involving all concerned parties and covering all socio-economic and environmental aspects and concerns.

2. The establishment of a unified national water M & E & R program and a workplan to be implemented by all concerned institutions / stakeholders with one national institution in charge of the overall preparation and implementation operations, but with corresponding units in the different water sector institutions. This central institution in charge of overseeing monitoring operations should implement a national M&E national plan and its responsibilities should include the preparation of the SOW report. It should ensure harmonization, coordination and information exchange effectively.

3. The GWA is well structured to be this central institution / hub for all nationwide M&E activities. It is one of the oldest institutions around. It hosts the HydroManager and GIS lab. It currently stores all information related to the MmRP, some information from the GCDW, as well as information from the transboundary aquifers.

4. AMCOW-MEWINA-validated indicators should be adopted immediately as a base for M/E/R operations and the implementation of the SOW reporting process in Libya. Adoption of MEWINA and African indicators will facilitate communication and coordination regionally and benefit from technical capacities as well as to follow upon requirements / obligations on the regional, continental, and international levels.

5. A national M&E Guideline should be developed for harmonized assessing, measuring, calculating, documenting, monitoring, evaluation, and reporting the of all Indicators and preparing of the SOW report.

6. Sector performance indicators need to be developed and incorporated into the SOW report to assess each sub-sector's performance and the overall water sector performance.

7. Because the agricultural sector is the largest water consumer and the least monitored one, agricultural water withdrawals and economics should be the monitored and evaluated continuously and immediately.

8. Water governance, socio-economic and financing indicators deserve special attention and special efforts should be made to enable enforcement of their monitoring.

9. A national M / E / R capacity building strategy / program / plan should be prepared and implemented urgently engaging all stakeholders to enable the water related institutions to monitor the state of the water effectively and efficiently.

10. The existing legislation regarding the monitoring and evaluation and reporting responsibilities, coordination, and exchange is weak although generally, the GWA is the national entity in charge of managing the water sector.

11. This SOW in Libya report should be made available to all water concerned institutions, organizations, societies, and experts in order to obtain feedback on its contents, their completeness, and accuracy. This feedback should be utilized to produce a upgraded official version of the SOW report.

6. References

1. Abufayed, A A, National State of the Water Monitoring and Evaluation Operational Framework and Guidelines, a report prepared as part of the MEWINA-project, Libya, CEDARE/Misr Consult, March, 2014.
2. Arab Water Council / CEDARE, Status of Water MDGs achievements in the Arab World.
3. WHO and UNICEF, Joint Monitoring Program for Water Supply and Sanitation, 2012.
4. State of Libya, National Authority for Information, Census Bureau, 2006-Census Report.
5. State of Libya, Ministry of Health, Health Information Center, Annual Report 2010.
6. MEWNA – Libya Project, GCWW Report, 2013.
7. UNDP, Arab Human Development Report, 2009.
8. FAO AQUASTAT Water and Agriculture Data Portal: ww.fao.org/nr/water/aquastat/main/index.stm
9. State of Libya, General Water Authority, State of the Water Report – 2005.
10. State of Libya, The Study of the State of Water and the National Strategy for Integrated Water Resources Management for the Period 2000-2025, Dec. 1999.
11. Arab Organization for Agricultural Development, Agricultural Statistical Book, vol. 13, 2013.
12. Ikweiri, F. S., Gabril, H., Jahawi, M., and Almatrdi, M, "Evaluating The Evaporation Water Loss From The Omar Muktar Open Water Reservoir", 12th International Water Technology Conference, Alexandria, Egypt, 2008.
13. US Energy Information Administration, Independent Statistics and Analysis, Libya, http://www.eia.gov/countries/cab.cfm?fips=LY.
14. State of Libya, FAO and the United Nations Development Programme (UNDP), Mapping of Natural Resources for Agriculture Use and Planning in Libya Report, 2004.
15. MENA Regional Water Outlook, 2011, www.medrc.org.
16. World Health Organization (WHO), World Health Statistics, 2011.
17. World Health Organization (WHO), "Eradication of Dracunculiasis in the Libyan Arab Jamahyria", Report of the International Certification Team, March, 1999.
18. www.indexmundi.com
19. General Water Authority, "State of the Water Report in Libya 2006", 2006.

7. Appendixes

Appendix 1: National Target Indicators and Monitoring / Reporting Institutions

No.	Water Related Indicators	Units	Source of Data
*	Water & Availability		
1	Annual Spatially Averaged Precipitation Depth	mm/ Yr	LNCM
2	Annual Precipitation Volume	BCM/Yr	LNCM
3	Piezometric water level changes	m/yr	GWA, MMRA, GCWW
4	Water Budget	mm^3/yr	GWA
*	Blue Water		
5	Internal Renewable Surface Water (IRSW)	BCM/Yr	GWA
6	Internal Renewable Groundwater (IRG)	BCM/Yr	GWA
7	External Surface Water Inflow (ESWI)	BCM/Yr	GWA
8	External Surface Water Outflow (ESWO)	BCM/Yr	GWA
9	External Groundwater Inflow (EGI)	BCM/Yr	GWA
10	External Groundwater outflow (EGO)	BCM/Yr	GWA
11	Total Exploitable Non-Renewable Groundwater (TNRG)	BCM/Yr	GWA
*	Non-Conventional Water		
12	Produced Municipal Wastewater (PMW)	BCM/Yr	GCWW
13	Produced Desalinated Water (PDW)	BCM/Yr	GDCOL
*	Water & Uses		
14	Withdrawals from Blue Renewable Groundwater	BCM/Yr	GWA
15	Withdrawals from Desalinated Water	BCM/Yr	GDCOL
16	Withdrawals from treated domestic wastewater	BCM/Yr	GCWW
*	Water & Land Use		
17	Total Irrigated Agricultural Land	ha	MAAMW
18	Total Rain-fed Agricultural Land	ha	MAAMW
19	Total Pasture Land	ha	MAAMW
20	Total Forests Land	ha	MAAMW
*	Water & Services		
*	Water Coverage and Accessibility		
21	Improved Urban Water Supply Coverage	%	GCWW / CB
22	Improved Rural Water Supply Coverage	%	GCWW / CB
23	Improved Urban Sanitation Coverage	%	GCWW / CB
24	Improved Rural Sanitation Coverage	%	GCWW / CB
*	Water Infrastructure		
25	Length of Water Supply Networks	km	GCWW / CB
26	Length of Sewage Networks	km	GCWW / CB
27	Dam Storage Capacity	BCM	GWA
28	Water Supply Capacity	BCM/Yr	GCWW
29	Desalination Capacity	BCM/Yr	GDCOL

No.	Water Related Indicators	Units	Source of Data
30	Municipal Wastewater Treatment Capacity	BCM/Yr	GCWW
*	Water & Population		
31	Total Population	1000 inhabitants	CB
*	Water & Health		
32	Cholera Reported Cases	Number/Year	MOH
33	Typhoid Reported Cases	Number/Year	MOH
34	Hepatitis A Reported Cases	Number/Year	MOH
*	Water & Quality		
35	Dissolved Oxygen (DO)	mg/l	AEMMmRP
36	pH	Dimensionless	AEMMmRP
37	Electric Conductivity (EC)	1/OHM (S/M)	AEMMmRP
38	Nitrogen Concentration	mg/l	AEMMmRP
39	Total Dissolved Solids	mg/l	AEMMmRP
40	Fecal Choliform	Colonies/100ML	AEMMmRP
41	Chloride Concentration	mg/l	AEMMmRP
42	Total Hardness ($CaCO_3$)	mg/l	AEMMmRP
*	Water & EcoSystems		
43	Number of Wetlands Sites Acknowledged by RAMSAR	Number	EGA
44	Total Wetlands Areas	ha	EGA
*	Water & Socio-economics		
*	Water Productivity		
45	GDP	Billion LYD	MOP
*	Water & Finance		
46	Percentage of National Budget Directed to Water & Sanitation Sector	%	MOP
*	Water & Governance		
47	IWRM Plan	Yes/No	GWA
*	Water & International Relations		
48	Shared Waters related Bilateral/ Multilateral Agreements and/or Memorandums of Understanding and Cooperation Mechanisms	Number	GWA
49	Number of Riparians sharing all shared water bodies	Number	GWA
50	Number of Shared Water Resources	Number	GWA

Appendix 2: AMCOW pan African Water and Sanitation Monitoring, Evaluation and Reporting Format

Country Background Information Sheet

Country Name: **Libya**

<table>
<tr><th>Items</th><th>Information</th></tr>
<tr><td>1. Population trends for the last 4 years, and GDP.</td><td>
<table>
<tr><td>Years</td><td>2000</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td><td>2013</td></tr>
<tr><td>Urban pop.</td><td>4399287</td><td>5258044</td><td>5374446</td><td>5490302</td><td>5611689</td><td>5735675</td><td>5859104</td></tr>
<tr><td>Rural pop.</td><td>716163</td><td>607036</td><td>597161</td><td>589767</td><td>578812</td><td>567265</td><td>558315</td></tr>
<tr><td>*Total pop.</td><td>5115450</td><td>5865079</td><td>5971607</td><td>6080069</td><td>6190501</td><td>6302939</td><td>6417419</td></tr>
<tr><td>GDP (Billion USD)</td><td>34.3</td><td>39.71</td><td>63.1</td><td>74.8</td><td>34.7</td><td>73.8</td><td>73.6</td></tr>
</table>
*Last census was conducted in 2006. Values are estimates. Values are for Libyans only. Non-Libyans accounts for about 6.5% of the population (2007 Statistics year book)
</td></tr>
<tr><td>2. Basis of the existing water sector Policy/Reform and potential policy targets.</td><td>Important issues addressed in the existing Water Sector Reform?
-Bridging water demand / supply deficit.
- Excessive groundwater mining.
- Seawater intrusion and water quality deterioration.
-Improving domestic water supply and sanitation access.
-Review and redirection of irrigated agricultural policies.
- Institutional capacity building.
- Integrated water resources management.
- Uncontrolled groundwater mining
- Low Water Tariffs and Poor Recovery Rates</td></tr>
<tr><td>3. Knowledge of international and African Milestones on Water and Sanitation.</td><td>Which are the ones well known and used in the county? Specify how it is used.
- Agenda 21-Rio principles: as a general guide for sustainable use of water for development.
- The Dublin principles: as a general guide for sustainable use of water for development.
- UN Millennium Development Goals (MDGs): as a measure of progress towards achieving MDGs.
- African Water Vision 2025: as a base for updating plans and as a measure of progress.
-Sharm-el-Sheikh Declaration: as a base for updating plans to accelerate meeting water supply and sanitation goals.</td></tr>
<tr><td>4. Trend of the 3 latest reviews in national water Policy and Reforms.</td><td>
<table>
<tr><th>Years</th><th>2008</th><th>2009</th><th>2010</th></tr>
<tr><td>Drivers of the Reviews</td><td>Reducing increasing water deficits
Decreasing water quality decline
Improving service levels</td><td>Reducing increasing water deficits
Decreasing water quality decline
Improving service levels</td><td>Reducing increasing water deficits
Decreasing water quality decline
Improving service levels</td></tr>
<tr><td>Targeted Impacts and effectiveness</td><td>Decreasing deficits
Improving quality
Improving services</td><td>Decreasing deficits
Improving quality
Improving services</td><td>Decreasing deficits
Improving quality
Improving services</td></tr>
</table>
</td></tr>
</table>

Items	Information
5. Comments on the national water sector regarding the strengths, weaknesses, opportunities, threats and outstanding problems.	- Strengths: a) a national water strategy exists, b) a ministry for water resources has been established, c) strong official commitment to the water sector, d) specialized institutions for water supply and distribution exist, e) skilled workforce exists, f) financing is available with many major projects under execution, g) rising water awareness, h) favorable political climate. -Weaknesses: a) weak governance and institutional capacities, b) lack of data and information, c) weak monitoring, evaluation, and enforcement, d) socio-cultural factors, e) geographic and demographic factors (large area and low population density), f) poor inter sectoral coordination. - Opportunities: a) easy access to international experience and technological advancements, b) more stakeholder participation and private sector involvement, c) favorable oil prices, d) favorable climate for international investments, e) availability of water technologies. - Threats: a) water scarcity and quality degradation, b) multiplicity of transboundary basins, c) climate change and desertification, d)political instability, e)food sufficiency syndrome. - Outstanding problems: a) continuing deficit, b) low standard of service, c) inefficiency of utilization, d) water pricing and financing, e) lack of data and information, f) lack of a national framework for water planning, M&E.

Country Water and Sanitation Performances Evaluation Sheet

Country Name: **Libya**

<table>
<tr><th>Performance Category</th><th>Country Information</th></tr>
<tr><td>PC. 1.1. Water & Energy</td><td>This category does not apply to Libya</td></tr>
<tr><td>PC. 1.2. Water and Agriculture

Targets:

-Increase water productivity Rain fed agriculture & Irrigation by 30% from 2000 to 2015.

and

-Increase the size of irrigated areas by 50% from 2000 to 2015</td><td>

Specific actions taken so far for the milestone:

The initiation of a water harvesting programme.
Construction of new dams and maintenance of one “damaged” old dam.
Local manufacturing of drip irrigation systems and their adaptation by farmers.
Mapping and soil classification studies with special reference to rainfed agriculture areas.
Construction of rain water collection reservoirs and water retaining structures on Wadis by government and private sector.

Achievement on water productivity:

<table>
<tr><td>Years (i)</td><td>2000</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td><td>2013</td></tr>
<tr><td>Agricultural GDP (Billion USD) (A)</td><td>0.74</td><td>0.98</td><td>1.56</td><td>1.09</td><td>0.69</td><td>1.48</td><td>1.47</td></tr>
<tr><td>Total Agri. Water withdrawal (Billion m3)(B)</td><td>4.23</td><td>4.95</td><td>5.04</td><td>5.13</td><td>5.22</td><td>5.31</td><td>6.06</td></tr>
<tr><td>-Water Return to Environment (C)</td><td>0.2**</td><td>0.2</td><td>0.2</td><td>0.2</td><td>0.2</td><td>0.2</td><td>0.2</td></tr>
<tr><td>Water productivity (USD/m3) Wp=A/(B-C)</td><td>0.18</td><td>0.21</td><td>0.32</td><td>0.22</td><td>0.14</td><td>0.29</td><td>0.25</td></tr>
<tr><td>Rate of increase RiWp(%) = (Wpi-Wp2000)/Wp2000</td><td>12.26</td><td>75.06</td><td>19.94</td><td>-25.15</td><td>56.39</td><td>36.06</td><td>xxxx</td></tr>
</table>
*NA = not available

**Estimated

Achievement on irrigated areas:

<table>
<tr><td>Years (i)</td><td>2000</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td><td>2013</td></tr>
<tr><td>-Irrigated areas(IA)</td><td>470000</td><td>550000</td><td>560000</td><td>570000</td><td>580000</td><td>590000</td><td>600000</td></tr>
<tr><td>Rate of increase RiIA(%) = (IAi-IA2000) /IA2000</td><td>17.02</td><td>19.15</td><td>21.28</td><td>23.40</td><td>25.53</td><td>27.66</td><td>xxxxx</td></tr>
</table>

Sources of verification:

Ministry of Planning and Ministry of Agriculture reports.
National Strategy for Integrated Water Resources Management (2000 – 2025).
FAO country profile and reports on Libya.

</td></tr>
</table>

Performance Category	Country Information
	▪ Specific comments: o Increase in water productivity from rain-fed agriculture is very difficult to estimate or verify as: 1) no data are collected on rain-fed agricultural production, 2) solely rain-fed agriculture is limited geographically and plays a minor role in agricultural production, and, 4) rain-fed agriculture is almost always complimented with irrigation in major agriculture areas. An increase is very likely, however, due to actions taken officially and privately to harvest rain water as described in milestones listed above. The increase, although real, is difficult to quantify, however. o Water productivity of irrigated agriculture has probably increased due to the rapid increase in drip irrigation systems recently coupled with improvements in traditional irrigation practices. This increase may have also been forced by the water scarcity problem which is spreading rapidly in the Gefara plane, the bread basket of Libya. The increase is difficult to quantify, however, with no data collected especially from the private sector which is the major agricultural producer. o Increase of irrigated land by private sector especially on large scales (pivot irrigation) in southwestern Libya. However, in other areas of Libya, the increase in irrigated land areas is very small for several reasons; firstly, water has become limiting in many areas of "traditionally irrigated" areas. Secondly, many of the large scale government administered "public projects" have suffered neglect and deterioration (of wells, equipment, etc.) resulting in a decrease in irrigated areas. Finally, encroachment of urbanization has been at the expense of irrigated areas. o On the other hand, new "virgin" lands are being turned into farms by private farmers despite the severe lack of arable land and scarce water resources, a trend that is likely to continue as water and power costs are still very low encouraging large scale farming especially in the south west region of Libya. o On the whole, it is safe to assume that there is an increase in irrigated areas and an improvement in irrigation efficiency, but they are below the set target. o In the case of Libya, expansion of irrigated areas is not possible and should not be planned due to severe limitations on arable land and, more importantly, on water and to the adverse social, economic and environmental impacts of continuing these practices. Improvement in irrigated water efficiency and other aspects of agricultural production management should be among the Libya's water policy reform priorities. This target is not realistic for Libya and will not be achieved.
PC. 1.3. Water for multiple Uses *Target:* Increase the Water Demand Satisfaction Index (WDSI) by 10% from 2000 to 2015.	▪ Specific actions taken so far for the milestone: o Increase water supply sources through completion of the Manmade River Project. o Increase water supply through desalination but quantities were very limited as plant construction takes time. Desalination capacities should increase notably in near future. o Increase quantities of treated effluents through execution and rehabilitation of many wastewater treatment facilities which should go into operation in the near future. o Increase harvested rainfall through construction and rehabilitation of many dams. ▪ Achievement:

Years (i)	2000	2008	2009	2010	2011	2012	2013
- Total all sectors Water Demand (A)	4829	5646	5748	5851	5954	6058	4450
Total all sectors Water supply (B)	4450	4450	4450	4450	4450	4450	4451
- WDSI =B/A	0.922	0.788	0.774	0.761	0.747	0.735	1.000
Rate of increase RiWDSI(%) = (WDSIi -WDSI2000)/ WDSI2000)	**-14.5**	**-16.0**	**-17.5**	**-18.9**	**-20.3**	**8.5**	**xxxx**

▪ Sources of verification

Ministry of water resources, Public Company for Desalination, and Ministry of Agriculture and Animal Wealth reports.

Performance Category	Country Information
	▪ Specific comments: o Contributions of desalination and effluent reuse were ignored in calculations above as they were insignificant in the specified period (2000-2011). o RiWDSI is decreasing with time signaling a serious deficit that must be addressed urgently. The trend should be reversed if sustainable development is to be realized. o The major user of water is agriculture which consumes about 85 % of the total water supplied. Any remedies (efforts to reverse the situation) must start with and focus on agriculture and food production policies. Another measure will be to address inefficiencies in irrigation practices and introduce improvements through improving efficiency and not expanding horizontally by increasing areas cultivated. o Uncontrolled groundwater mining that is not monitored is expected to account for the imbalance between water supply and demand. o The 1000 m3/capita/yr that is used by the indicator might not be reasonable for Libya. o Lack of data is masking the agricultural malpractices along with the "food sufficiency syndrome" which dominates the agricultural strategies and plans of many developing countries including Libya. o The agricultural work force is mostly "non-Libyan" and lacks basic skills relying mostly on outdated practices. o Agricultural sector suffers many serious weaknesses and faces severe threats especially environmental ones including arid climate, climate change, desertification, and water scarcity. o The total sector water supply will increase with the increase in productivities of the Manmade River Project, desalination plants, treated effluent, and harvested rainwater. If projects are executed as planned, it will be very likely that the set target will be reached. o None-the-less, the deficiency should be taken seriously and used as a base for urgent water policy decisions and actions!
PC. 2.1. Basin and Transboundary water resources management *Target:* Develop a national Water Efficiency Plan by 2015.	ON THE NATIONAL LEVEL ▪ Specific actions taken so far for the milestone: o Establishment of the Ministry of Water Resources as an independent organ responsible for the management of water resources on a national level. o Preparation of the National Strategy for Water Resources Management (2000 – 2025) and endorsement of this strategy in 2006. o Division of Libya into Water Regions and management of each region semi-independently. o Establishment of dedicated ministries for the major water using sectors, namely, agriculture, industry, and housing and utilities. o Establishment of independent auditing bodies for technical, administrative, and financial performance of the ministries. o Establishment of a committee on the level of the National Congress in charge of follow up of infrastructures plans progress. o Establishment of the General Environment Authority to oversee the water resources management and monitor resource utilization and quality changes. ▪ Availability of Water Efficiency or IWRM Plan and Year of Adoption: There is a National Strategy for Integrated Water Resources Management and annual sector plans. This strategy, although officially adopted in 2006, has not been operationalized yet. However, it has been followed by the water sector organs as a generated basis / guide for action plans. Many of its recommendations have been implemented.

Performance Category	Country Information
	Elements of the policy and legal environment: o Water Law (2) / 1982 and Environment Protection and Enhancement Law (15)/ 2006 are in place along with several decrees. o The National Strategy for Integrated Water Resources Management (2000 – 2025). o Water pollution control and water quality standards are in place. o Existing policies and annual plans on level of ministries concerned with water supply and utilization. o Regional and international guidelines and targets are considered in policy formulation and execution. o All water concerned ministries are in the process of preparing sectoral strategies which must include action plans rather than annual plans. Elements of the institutional arrangements: o A special ministry for water resources (MoWRs) was established in Nov. 2012. o The General Water Authority, an organ affiliated with the MoWRs, has been in service for over two decades with capacities and experience in water resources management. o Several organs specialized in water supply, transportation, and distribution have been established. These organs are semi-autonomous with sufficient human and financial resources. Elements of the financial structure: o Budgets are allocated annually for water sector organizations. Expenditure auditing is practiced on all sectors including water.
	Management tools: o Sectoral plans are available for evaluation and follow-up. o Regional and international guidelines for M&E&R are available. o M&E systems are in place in the water sector organs although at different levels of advancement. However, a national M&E system is not in place yet. o M&E systems are in place in the Environment General Authority but capacities to apply them are limited. o Research centers, academic institutions, and private consulting offices and laboratories are available to assist in the E&M processes. o Civil society organizations (NGOs) are emerging with a powerful role in monitoring and overseeing environment and water issues. ▪ Sources of verification: o Ministry of Water Resources o General Water Authority o Manmade River Execution and Management Authority o Environment General Authority ▪ Specific comments: o M&E systems are not present in major water consuming sectors such as agriculture and industry. o Enforcement mechanisms are very weak. o Request of information and data is limited so M&E systems are driven mostly in response to specific organizations initiatives. o A national framework on M&E does not exist so the nature of data collected and levels of analysis and outputs are not comparable. Hence, data collected are of limited use. Please refer to section on Observations and Comments at the end of this report for more comments.

Performance Category	Country Information
	ON THE LEVEL OF TRANSBOUNDARY BASINS ▪ Specific actions taken so far for the milestone: 1. Establishment of the Joint Authority for the Study and Management of the Nubian Sandstone Aquifer System (JASMNSSAS) with headquarters in Tripoli, Libya. This JA has accomplished the following major tasks: o Building capacities for the management of the aquifer. o Generation of valuable data on the NSSA and modeling. o Establishment of a regional database and monitoring system. o Preparation of several technical reports. o Organization of a conference on shared aquifers. 2. Establishment of the Sahara and Sahel Observatory for the Northwestern Sahara Aquifer System (NWSAS). This organization has accomplished the following major tasks: o Conducting of the first phase of the NWSAS project (1999 – 2002): information system, modeling, and consultative mechanisms. o Preparation of several reports technical reports. ▪ Target Indicator: Availability of Water Efficiency or IWRM Plan and Year of Adoption There is no Water Efficiency or IWRM Plan presently on the level of the Transboundary water resources management. Elements of the policy and legal environment: o Memoranda of understanding have been signed between sharing partners. o International agreements / conventions have been consulted. o International help is available / has been offered. o An agreement exists regarding the NSSAS exploitation with quantity and quality monitoring and data collection and exchange.
	Element of the institutional arrangements: o Bodies for management of the basins have been formulated with clear mandates. o Capacities for execution of plans have been provided in the form of office buildings, manpower, equipment, etc. o Database management systems are in place (SAP and SADA) o CEDARE is the base for annual data collection and analysis. o For NWSAS, a technical level Administerial Mechanism was formulated in 2002 along with an Operation Structure (2008) and a Consulting Mechanism (2007). o Official bodies have been undertaking their responsibilities successfully. o Practical experience (technical, legal, financial, and administrative) has been gained. Element of the financial structure: o Financial structures with basic financing mechanisms have been put in place for several years. o Budgets have been approved and money forwarded by the member states for the NSSAS. o Financial assistance from member states, African, European and UN organizations has been available. Management tools: o Basic monitoring and reporting mechanisms agreed to and implemented. o Specialized bodies formed for the shared aquifers management. o Minutes of understanding between partners. o Joint committees with consultation mechanisms. o Engagement of technical consultative bodies (CEDARE). ▪ Sources of verification: o JQSMNSSAS, Tripoli, Libya o NWSAS, Tunis, Tunisia

<table>
<tr><th>Performance Category</th><th>Country Information</th></tr>
<tr><td></td><td>

Specific comments:

Shared aquifers management policies and plans are still in evolutionary stages.
A solid database is being built and data are utilized.
Models have been constructed and implemented.
Memoranda of Understanding have been signed.
Evaluation and monitoring are underway.
Mechanisms for consultation are underway.
Other aspects of management are being developed.
A comprehensive regional water resources management plan will only be possible once all aspects of basin development are completed.
In summary, a satisfactory level of progress has been made with practical results that are essential for sustainable utilization of shared basins.
Progress has been steady and is expected to reach targets easily.

</td></tr>
<tr><td>PC. 2.2.Transboundary</td><td>

Not applicable

</td></tr>
<tr><td>PC. 2.3. Groundwater</td><td>

Not applicable

</td></tr>
<tr><td>PC. 2.4. Rainwater

Target:

Increase the share of rainwater use in total municipal water consumption up to 10% by 2015.</td><td>

Specific actions taken so far for the milestone:

-A national programme on rainwater harvesting has been initiated. New dams are under construction along with reservoirs for collection of rainwater.

- The ministry of agriculture has financed private collection reservoirs.

- Rainwater has been traditionally harvested by a very small number of people for domestic purposes. The amount harvested is negligible, however.

Achievement:

<table>
<tr><td>Years (i)</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td><td>2013</td></tr>
<tr><td>-Total municipal water supply (A)</td><td>0.57</td><td>0.585</td><td>0.6</td><td>0.614</td><td>0.629</td><td>0.643</td></tr>
<tr><td>- Rainwater use (B)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>-Water use from other sources (C)</td><td>0.57</td><td>0.585</td><td>0.6</td><td>0.614</td><td>0.629</td><td>0.629</td></tr>
<tr><td>Total municipal water consumption Twc = (A+B+C)</td><td>1.14</td><td>1.17</td><td>1.2</td><td>1.228</td><td>1.258</td><td>1.27231</td></tr>
<tr><td>Percentage of rainwater use pRu(%)= B/Twc</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
*No data are available, but the amounts harvested are negligible relative to the total municipal demand.
</td></tr>
</table>

<table>
<tr><th>Performance Category</th><th>Country Information</th></tr>
<tr><td></td><td>
▪ Sources of verification:
o General Company for Water and Wastewater
o Ministry of Housing and Utilities reports
o Ministry of Agriculture

▪ Specific comments:
o Therefore, this target has not been achieved because rainfall is sporadic and collectable amounts are very low in most cases so people rely heavily on piped water or on transported water.
o The realization of this objective is possible, however, if special efforts are made to encourage people in water short regions to collect water. This should be a major component of the Ministry of Agriculture's "Water Harvesting Program" under way currently. A major obstacle will be that major water supply schemes are under construction and, when completed, practically all Libyans living in urban areas will have piped water.
</td></tr>
<tr><td>PC. 3.1. Urban Water Supply

PC. 3.2. Urban Sanitation

PC. 3.3. Rural Water Supply

PC. 3.3. Rural Sanitation and Hygiene</td><td>
▪ Specific actions taken so far for the milestone:

o Establishment of the National Programme for Water and Wastewater (NPWWw) intended to identify all urban communities, towns, and cities in need of WSS systems or whose existing systems need to be expanded or upgraded.

o As part of the NPWWw, WSS systems were designed for all "urban" communities, towns, and cities of Libya.

o Establishment of the Development Programme 2008 – 2012, a comprehensive national programme with a special focus on housing and infrastructures. The programme implementation costs were estimated at 100 billion Libyan dinars (US $ 80 billion); about 15 billion Libyan dinars are allocated to infrastructures. The programme projects are in line with the NPWWw.

o Establishment of public service companies, namely, the General Company for Water and Wastewater for operation and maintenance of WSS systems and the General Company for Desalination for supplying desalinated water.

o Establishment of the Manmade River Authority in charge of execution and management of the Manmade River Project. The project is nearing completion and will supply water for all purposes including domestic uses. The Project has been supplying Libya's major coastal cities with water for over 20 years. Over 50 % of domestic water supplies in 2012 were from the Manmade River Project.

o National drinking and effluent standards have been promulgated.

o Establishment of the Ministry of Water Supplies in Nov. 2012 with authority to oversee the water sector in Libya.

▪ Achievement in water supply:

<table>
<tr><th>Years (i)</th><th>1990</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th></tr>
<tr><td>-Urban access (%)</td><td>72</td><td>92</td><td>93</td><td>94</td><td>94</td><td>94</td><td>94</td></tr>
<tr><td>-Rural access (%)</td><td>68</td><td>80</td><td>82</td><td>84</td><td>84</td><td>84</td><td>84</td></tr>
<tr><td>-Total access (%) (W)</td><td>71</td><td>89</td><td>91</td><td>92</td><td>92</td><td>92</td><td>92</td></tr>
<tr><td>Rate of Inaccessibility reduction for water IRwat (%) = (Wi-W1990)/(100-W1990)</td><td>0</td><td>62</td><td>69</td><td>72</td><td>72</td><td>72</td><td>xxxx</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Performance Category</th><th>Country Information</th></tr>
<tr><td>Target:

Reduce by 50% from 1990 to 2015, the proportion of the population without improved drinking water source, and the proportion without improved sanitation facility (Urban/ Rural / Total).</td><td>
▪ Achievement in improved sanitation:
<table>
<tr><td>Years (i)</td><td>1990</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td><td>2013</td></tr>
<tr><td>-Urban access (%)</td><td>84</td><td>94</td><td>94</td><td>96</td><td>99</td><td>99</td><td>99</td></tr>
<tr><td>-Rural access (%)</td><td>85</td><td>95</td><td>96</td><td>96</td><td>97</td><td>97</td><td>97</td></tr>
<tr><td>-Total access (%) (S)</td><td>84</td><td>94</td><td>94</td><td>96</td><td>98.8</td><td>98.8</td><td>98.8</td></tr>
<tr><td>Rate of Inaccessibility reduction for sanitation IRsan (%) = (Si-S1990)/(100-S1990)</td><td>0</td><td>62.5</td><td>62.5</td><td>75</td><td>92.5</td><td>92.5</td><td>xxxx</td></tr>
</table>
▪ Sources of verification
o General Company for Water and Wastewater Reports.
o CEDARE, MDGs Achievement Status in the Arab Region.
o WHO / UNICEF Joint Monitoring Programme for Water Supply and Sanitation Report, 2008.

▪ Specific comments:
o Libya has exceeded the MDGs targets in reducing inaccessibility to safe water supply and sanitation and hygiene in urban areas.
o Libya has exceeded the MDGs targets in reducing inaccessibility to safe water supply and sanitation and hygiene in rural areas.
o Libya has exceeded the MDGs targets in reducing inaccessibility to safe water supply and sanitation and hygiene nationally, i.e., in urban and rural areas.
o Access and coverage rates higher than those presented above have been cited in some references mainly those of the UN organizations.
</td></tr>
<tr><td>PC. 4.1. Adaptation to Climate Change

Target:

Develop and implement, at least 1 Climate Change Adaptation Strategy by 2015.</td><td>
▪ Specific actions taken so far for the milestone (New initiatives to improve resilience):
o The National Committee for Climate Change (CC) has been formed; it is headed by the Environment General Authority with members from 14 concerned ministries and institutions. The Ministry of Water Resources is a member in this Committee.
o A National Project for Studies of Climate Change has been started by the National Authority for Scientific Research to study and research the phenomenon and its impacts on Libya.
o Libya has endorsed / ratified all CC conventions and participated in most Climate Change Panel Meetings.
o Several studies have been conducted on climate change and its impacts on parts of Libya.
o However, the overall institutional framework is still weak and little concrete results have been obtained.

▪ Existence of a National Climate Change Adaptation Strategy and Year of adoption:
o There is no National CC Adaptation Strategy despite recommendations to develop this strategy made by several concerned institutions.

▪ Existence of a Actions Plans on Water for Climate Change resilience:
o No.

▪ Existence of Programmes for implementing the Actions plans:
o No

▪ Sources of verification and Specific comments:
o National Authority for Scientific Research
o Environment General Authority.
o National Center for Meteorology.
</td></tr>
</table>

Performance Category	Country Information
PC. 4.2. Water-related Hazards *Target:* Establish at least 1 Early warning System for disaster prevention at national level by 2015.	▪ Specific actions taken so far for the milestone *(water disaster prevention initiatives)*: o Establishment of the National Safety Authority in 2008 which is affiliated directly with the Prime Ministers Council. Its mandate includes water disaster management. o Establishment of the Environmental Emergencies Administration in the General Environment Authority whose mandate include environmental monitoring and disaster mitigation. o Preparation of the National Plan for Natural Disaster Management. ▪ Existence of Early Warning Disaster prevention System and Year of establishment: o No. ▪ Sources of verification: o Environment General Authority. o National Safety Authority ▪ Specific comments: o This goal is likely to be realized as the National Plan for Disaster Management exists. Updating of this plan and establishment of an early warning system is part of this plan. o Bodies concerned with early warning are still in early stages of formation; there is little experience, lack of skilled personnel and equipment, and above all, lack of a national strategy. o Bodies concerned take part in regional and international events to benefit from accumulated experience and know-how. o There is a clear overlapping in mandates and a lack of coordination between concerned bodies.
PC. 5.1. Institutional arrangements PC. 5.2. Ethics, transparency, empowerment	▪ Specific actions taken so far for the milestone: o Establishment of the Ministry of Water Resources (MoWRs) which combined for the first time most of the organizations/institutions dealing with water. It controls planning and execution decisions on water centrally. o Existence of water law and environmental protection law. o Formation of several committees by the MoWRs to draft an action plan and craft policies for integrated water resources management. o Formation of a water research center within the MoWRs. ▪ Existence of Water sector policy that reflects good governance principles, and Year of latest update: o A policy on good governance does not exist. However, the National Strategy for Integrated Water Resources Management and the action plans of water concerned institutions included continuously upgrading of institutional capacities with strong stress on governance.

Performance Category	Country Information
PC. 5.3. Public and private roles PC. 5.4. Right to water PC. 5.5. Regulatory approaches	Elements on Partnership and commitment: o Policies of institutions don't address partnership explicitly while partners roles are not well defined and exclusive. Overlapping exists in roles. Coordination and cooperation are unstructured. o Commitment varies with institutions and their capacities. Lack of monitoring and accountability leave the door open for institutions to be completely committed or not committed at all. This phenomenon is enforced by weak legislation and overlapping mandates. Elements on Ethics - transparency, equity and fairness: o Establishment of the National Congress as a representative system whose members are accountable to their constituents. o Establishment of a transparency Committee within the Higher Judicial system of Libya. o Establishment of Infrastructures Committee and Legislation Committee's within Libya's National Congress. o Establishment of several water/environment non-government organizations. o Establishment of many mass media organizations (papers, radio and television stations)with a multi-faceted role of informing and uncovering of government actions. o Water from major sources (Manmade River) is allocated "equitably" between users with special attention to domestic users, water-short agricultural areas, and existing agricultural projects (settlements). o Water costs are subsidized in consideration of its significance to domestic and agricultural users. o Water use regulations are known to all users and applied fairly.
Target: Institute/ update, by 2015, water sector policy reforms that reflect good governance principles of: (i) Partnership commitment; (ii) ethics -transparency, equity and fairness; (iii) responsibility and accountability; (iv) inclusiveness, participation, predictability and responsiveness; and (v) coherence.	Elements on responsibility and accountability: o These elements are not always stated clearly in regulations; moreover, their applications are very limited. Elements on inclusiveness, participation, predictability and responsiveness: o These elements are not well defined. Role of stakeholders is evolving slowly and is "unseen" presently. Use of private water sources and independence of users from the government may be the cause of this poor participation. Predictability and responsiveness are neither well defined nor addressed in water policies. Elements on Coherence: o These elements are neither well defined nor well adhered to. ▪ Sources of verification: o National Strategy for Integrated Water Resources Management (2000-2025). o GWA reports. ▪ Specific comments: o Water sector policies have always been centrally planned and executed. Water legislation and management practices have focused on addressing the users' needs at practically no cost to the user. This practice did not encourage user participation or the development of good governance.

<table>
<tr><th>Performance Category</th><th>Country Information</th></tr>
<tr><td>PC. 6.1. Financing Local Authorities

Targets:

-Allocate immediately at least 0.5 % of GDP to sanitation &hygiene.

and

-Allocate immediately 5% of national budget for water & sanitation.</td><td>

Specific actions taken so far for the milestone:

Full commitment to financing all water supply and sanitation schemes as well as operation and maintenance of these schemes.

Achievement for GDP allocation:

<table>
<tr><td>Years (i)</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td><td>2013</td></tr>
<tr><td>- GDP (A_1)</td><td>39.71</td><td>63.1</td><td>74.8</td><td>34.7*</td><td>81.9</td><td>73.6</td></tr>
<tr><td>- Sanitation and Hygiene Budget (B_1)</td><td>1.91</td><td>1.91</td><td>1.91</td><td>1.91</td><td>1.91</td><td>1.91</td></tr>
<tr><td>Percentage of GDP to Sanitation and Hygiene gdpSH (%) = B_1/A_1</td><td>5</td><td>3</td><td>3</td><td>6</td><td>2</td><td>3</td></tr>
</table>
*Estimated

Achievement for national budget allocation:

<table>
<tr><td>Years (i)</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td><td>2013</td></tr>
<tr><td>- Total National Budget (A_2)</td><td>19.86</td><td>19.21</td><td>21.75</td><td>32*</td><td>48</td><td>53</td></tr>
<tr><td>- Water and Sanitation Budget (B_2)</td><td>2.86</td><td>2.86</td><td>2.86</td><td>2.86</td><td>2.86</td><td>2.86</td></tr>
<tr><td>Percentage of national Budget to Water and Sanitation

BdgWS (%) = B_2/A_2</td><td>14</td><td>15</td><td>13</td><td>9</td><td>6</td><td>5</td></tr>
</table>
*Estimated
</td></tr>
<tr><td></td><td>

Sources of verification

Ministry of Planning.
General Company for Water and Wastewater.
Manmade River Execution and Management Authority.
General Company for Water Desalination.

Specific comments:

Targets have been met.
Values for GDP and budget are in US dollars.
Investments in WSS have been very large.
Actual amounts spent may vary from allocated budgets reported above. However, a strong commitment can still be seen from the high percentages planned.
Improvements may be constrained by the ability of execution bodies (contractors, etc.) rather than by the availability of financing/funding.

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</table>

Performance Category	Country Information
PC. 6.2. Pricing Strategies PC. 6.3.Pro-poor financing Strategies *Target:* Set by 2015, water tariff system that addresses cross-subsidy and the need of poor.	▪ Specific actions taken so far for the milestone: o The water law states that water is a common property and that every citizen has the right to water for different uses. This principle is the base for all water strategies including pricing strategies. o A tariff for water according to user type is in place. o Water prices are higher than water tariffs. o The cost difference is subsidized by the state reflecting a pro-poor financing strategy. o The state finances all infrastructure projects (construction, operation and maintenance). This has been the implemented strategy since independence (1951). ▪ Describe the Water Tariff Structure: ✓ *Lifeline Water (l/ca/day):* *150-350* ✓ *Minimum salary of the population (Libyan dinar LYD):* *450* ✓ *Rate (USD / LYD):* *1 USD for 1.26 LYD* Tariff Structure:

(Consumption categories (m^3	(Rate (local currency
XX m^3 >	XXX llcc/ m^3
XX m^3 to XX m^3	XXX llcc/ m^3
XX m^3 to XX m^3	XXX llcc/ m^3
XX m^3 <	XXX llcc/ m^3
?Any other specific charge	LYD/ m^3 0.25

Adjustments for cross-subsidy:

Adjustments	Rate
Industrial	LYD/ m^3 0.796
Commercial	LYD/ m^3 0.25
Regional Adjustment	None
Other? Agricultural	LYD/ m^3 0.47
Companies and public sector	LYD/ m^3 1.30

Performance Category	Country Information
	Tariff for rural areas if any: o None ▪ Describe the sanitation services pricing if there is any: o Included with water supply tariffs. ▪ Sources of verification: o National Water Strategy. o General Water and Wastewater Company. o Manmade Execution and Management Authority. ▪ Specific comments: o Water tariffs vary with user type. o Water tariffs include both water supply and sanitation. o Tariffs don't cover of water production. Domestic and commercial uses are subsidized by the state. o Tariffs cover only about one third of the total cost; the remainder is subsidized by the state. o The state subsidizes heavily the water production organizations. o Tariffs recovery rate is low. o For a hypothetical 5 persons family: ✓ *water used = 175 l/c/d * 5 * 30 /1000= 26.3 m3* ✓ *cost at 0.25 LYD/m3 = 6.6 LYD* ✓ *% of minimum monthly income = 6.6/450 = 1.5 % < 3%*
PC. 7.1. Education and capacity development *Target:* To be identified.	▪ *Not to be reported.*

<table>
<tr><th>Performance Category</th><th>Country Information</th></tr>
<tr><td>PC. 7.2. Information

Target:

Enhance by 2016, the national water and sanitation Monitoring, Evaluation and Reporting (M&E, &R) Systems in a way to be in line with the pan African M&E.</td><td>
▪ Specific actions taken so far for the milestone:
o M&E systems have been incorporated into most organs involved with water supply although at subsectoral levels only.
o M&E systems have been incorporated into the transboundary basins agreements.
o M&E systems don't evolve from Africa-wide systems as such systems have only been in use recently. However, it is expected that the present M&E systems are in line with the African M&E systems.

▪ Existence of national Water & Sanitation M&E, & R System, and Year of Establishment.
o A national Water & Sanitation M&E, & R system does not exist. However, annual plans are made by the General Company for Water and Wastewater, a sub-organ of the Ministry of Housing and Utilities with basic M&E&R operations.

Recent updates in the M&E System:

<table>
<tr><th>Items</th><th>Year 1</th><th>Year 2</th><th>Year 3</th><th>2011</th></tr>
<tr><td>New Elements incorpo--rated</td><td>xxxx</td><td>xxxx</td><td>xxxx</td><td>xxxx</td></tr>
<tr><td>Drivers-</td><td>xxxx</td><td>xxxx</td><td>xxxx</td><td>xxxx</td></tr>
</table>
</td></tr>
<tr><td></td><td>
Elements of the pan African M&E incorporated:
o Institutional capacity building.
o Improving governance.
o Improving knowledge base.
o Improving financing.
o Meeting the MDGs in water supply and sanitation.
o Meeting Sharm-elSheikh and Africa Water Vision 2025.

▪ Sources of verification:
o General Water Authority.
o General Environment Authority.
o General Company for Water and Wastewater.
o Manmade River Execution and Management Authority.

▪ Specific comments:
o A unified national Water & Sanitation M&E&R system does not exist. However, institutional responsibilities/mandates do include M&E&R procedures.
o The M&E&R mechanisms and database are not coherent and the efforts are not well coordinated.
o Implementation of the M&E&R procedures by all institutions is weak.
o The water sector database is fragmented, not up-to-date, with little analysis and reporting on any level.
o Some organizations have good data, however, namely, the Manmade River Execution and Management Authority and, to some extent, the General Water Authority.
o All organization concerned are well aware of the need for M&E&R on a nationally coordinated level. Efforts are led by the Ministry of Water Resources to establish such networks.
o Implementation of MEWINA will certainly accelerate these efforts and set a unified standard for both Libyan and Pan African networks and reporting.
</td></tr>
</table>

Performance Category	Country Information
PC. 7.3. Water and Technologies *Target:* To be identified.	▪ *Not be reported.*
PC. 7.4. Professional Networks/ Associations *Target:* To be identified.	▪ *Not be reported.*

Appendix 3. Values of MEWINA-validated SOW in Libya Indicators

(Values, M & E Reporting Institutions and Remarks)

No.	Code	Water Related Indicators	Units	Value in 2012	Source of Data	Notes / Remarks
*	1	Water & Availability				
1	1.1	Annual Spatially Averaged Precipitation Depth	mm/ Yr	46.00	LNCM	Good agreement between NCM and FAO values
2	1.2	Annual Precipitation Volume	BCM/Yr	75.10	LNCM	LNCM long term values of depth and volume are 53.5 mm and 87.23 BCM, respectively. The difference between values from the two sources is very large. The NCR value clearly has a big effect on all related indicators.
*	*	Blue Water				
3	1.3	Internal Renewable Surface Water (IRSW)	BCM/Yr	0.39	GWA	The GWA value is from SOW Report 2005.
4	1.4	Internal Renewable Groundwater (IRG)	BCM/Yr	0.60	GWA	GWA data was adopted as it is the only data available. Methodology of measurement / estimation was not specified. Indicator value needs verification. Accordingly, accuracy is not high. FAO AQUASTAT value is 0.9 BCM/yr.
5	1.5	Total Internal Renewable Blue Water Resources (TIRBWR)=(IRSW+IRG)	BCM/Yr	0.99	Secondary	FAO AQUASTAT value is 1.29. The difference is due to the high surface runoff fraction estimated by the NCM
6	1.6	External Surface Water Inflow (ESWI)	BCM/Yr	0.00	GWA	FAO AQUASTAT value is 0
7	1.7	External Surface Water Outflow (ESWO)	BCM/Yr	0.00	GWA	FAO AQUASTAT value is 0
8	1.8	External Groundwater Inflow (EGI)	BCM/Yr	0.00	GWA	FAO AQUASTAT value is 0
9	1.9	External Groundwater outflow (EGO)	BCM/Yr	0.00	GWA	FAO AQUASTAT value is 0.7
10	1.1	Total External Renewable Blue Water Resources Inflow (TERBWR) = (ESWI + EGI)	BCM/Yr	0.00	Secondary	FAO AQUASTAT value is 0
11	1.11	Total Renewable Blue Surface Water (TRBSW) = (IRSW) + (ESWI) - (ESWO)	BCM/Yr	0.39	Secondary	FAO AQUASTAT value is 0.39
12	1.12	Total Renewable Blue Groundwater (TRBG) = (IRG) + (EGI) - (EGO)	BCM/Yr	0.60	Secondary	Further investigation is needed
13	1.13	Overlap between Surface Water and Groundwater (OSWG)	BCM/Yr	0.10	CEDARE/ AWC	CEDARE/AWC value adopted as it is the only data available. FAO AQUASTAT value is 0.1
14	1.14	Total Renewable Blue Water Resources (TRBWR) = (TRBSW) + (TRBG) - (OSW)	BCM/Yr	0.89	Secondary	
15	1.15	Total Exploitable Non-Renewable Groundwater (TNRG)	BCM/Yr	1.79	GWA	Adopt GWA value. Large difference between GWA and FAO values. Accuracy is unknown as methodology is not specified. FAO AQUASTAT value is 0.34

No.	Code	Water Related Indicators	Units	Value in 2012	Source of Data	Notes / Remarks
16	1.16	Total Blue Water Resources (TBWR) = (TRBW) + (TNRG)	BCM/Yr	2.68		= TRBWR + TNRG - OSWG. Large discrepency between national and FAO values
*	*	Green Water				
17	1.17	Water for Rain-fed Agricultural Consumption	BCM/Yr	2.35	CEDARE/ AWC	There are no national values. Values reported by CEDARE/AWC have been adopted. They are 2.35, 20.12, and 0.26, respectively.
18	1.18	Water for Rain-fed Pasture Consumption	BCM/Yr	20.12	CEDARE/ AWC	
19	1.19	Water for Rain-fed Forest Consumption	BCM/Yr	0.26	CEDARE/ AWC	
20	1.2	Total Renewable Green Water Resources (TRGWR)	BCM/Yr	22.73	Secondary	
21	1.21	Total Renewable Water Resources (TRWR)=(TRBWR+TRGWR)	BCM/Yr	23.62	Secondary	
22	1.22	Total Conventional Water Resources (TCWR)= TNRG + TRWR = TBWR+TRGWR	BCM/Yr	25.41	Secondary	
*	*	Non-Conventional Water				
23	1.23	Produced Municipal Wastewater (PMW)	BCM/Yr	0.50	GCWW	2014 value adopted for year 2012 as little change has occurred since 2012. Industrial production component is not available. CEDARE/AWC Value is 0.55 (very close)
24	1.24	Produced Industrial Wastewater (PIW)	BCM/Yr	0.04	MEWINA-LIBYA	Calculated as Produced municipal and industrial wastewaters - Produced municipal wastewater. PMI was reported by CEDARE / AWC while PM was reported by GCWW. Indicator value is approximate at best.
25	1.25	Produced Agricultural Drainage (PAD)	BCM/Yr	0.90	CEDARE/AWC	There are no national values. CEDARE/AWC value of 0.9 was adopted.
26	1.26	Produced Desalinated Water (PDW)	BCM/Yr	0.01	GDCOL	Does not include desalinated water produced by industry and oil sector
27	1.27	Total Non-Conventional Water Resources (TNCWR)= (PMW)+(PIW)+(PAD)+(PDW)	BCM/Yr	1.46	Secondary	
28	1.28	Total Available Water Resources (TAWR) = TCWR+TNCWR	BCM/Yr	26.86	Secondary	
*	2	Water & Uses				
29	2.1	Withdrawals for Domestic Water Use	BCM/Yr	0.575	MEWINA-LIBYA	Close to value reported by AEMmRP (0.628). Also close to value reported by MEWINA-LIBYA, but both are higher than value reported by GWA based on SOW 2005 (0.392).
30	2.2	Withdrawals for Industrial Water Use	BCM/Yr	0.1725	MEWINA-LIBYA	Three values reported by GWA (0.018, 0.125 & 0.073) are lower than value reported by MEWINA-LIBYA
31	2.3	Withdrawals for Agricultural Water Use	BCM/Yr	5.31	MEWINA-LIBYA	FAO AQUASTAT Value is 3.58. National & FAO values are close
32	2.4	Annual Total Water Withdrawals	BCM/Yr	6.0575	Secondary	FAO AQUASTAT Value is 4.65. National & FAO values are close

No.	Code	Water Related Indicators	Units	Value in 2012	Source of Data	Notes / Remarks
33	2.5	Green Water Consumption for Agriculture Water Use	BCM/Yr	2.35	CEDARE /AWC	CEDARE/AWC value is 2.35. Large discrepancy between national and FAO values
34	2.6	Total Agricultural Water Uses	BCM/Yr	7.66	Secondary	
35	2.7	Withdrawals from Blue Surface Water	BCM/Yr	0	FAO	
36	2.8	Withdrawals from Blue Renewable Groundwater	BCM/Yr	0.6	GWA	FAO AQUASTAT Value is 4.61. Much larger than GWA (assume renewable GW = 0.6). GWA value is adopted.
37	2.9	Withdrawals from Blue Non-Renewable Groundwater	BCM/Yr	4.35	MEWINA-LIBYA	National, CEDARE/AWC& FAO values are close (4.35 vs 4, 4.61).
38	2.1	Total Withdrawals from Blue Water	BCM/Yr	4.95	Secondary	
39	2.11	Agricultural Drainage Water Reuse	BCM/Yr	0	CEDARE /AWC	There are no national values. CEDARE/AWC values were adopted
40	2.12	Withdrawals from Desalinated Water	BCM/Yr	0.007	GDCOL	Does not include desalinated water produced by industry and oil sector
41	****	Withdrawals from treated domestic wastewater	BCM/Yr	0.00548	GCWW	2014 value adopted for year 2012 as little change has occurred since 2012.
42	*****	Withdrawals from treated industrial wastewater	BCM/Yr	NA	MOI	NOT MONITORED
43	2.13	Total Withdrawals from Non-Conventional Water Resources	BCM/Yr	0.01248	Secondary	
44	2.14	Annual Volume of Total Actual Evapotrans-piration	BCM/Yr	22.73	MEWINA-LIBYA	Calculated based on the total evapotranspiration rates of irrigated, rain-fed, pastoral, and forest areas.
45	2.15	Greenwater Consumption for Livestock Fodder Water Use	BCM/Yr	0.06	MEWINA-LIBYA	Based on numbers of livestock reported by the Arab Organization for Agricul-tural Development in 2012.
46	2.16	Inland Fisheries & Aquaculture Demands	BCM/Yr			
47	2.17	Navigation Demands	BCM/Yr			
48	2.18	Evaporation Losses	BCM/Yr	0.029	MEWINA-LIBYA	Sum of evaporation losses from average dam storage and MMR reservoirs. Evaporation losses are assumed to be about 25 % of total storage (Refs).
49	2.19	Bottled Water Production	BCM/Yr	0.00303	MEWINA-LIBYA	Estimated based on a percapita consumption of 1 lit/day, a fraction drinking bot-tled water of 0.67 of population and an equivalent volume used by institutions (hospitals, hotels, restaurants, cafes, etc.).

No.	Code	Water Related Indicators	Units	Value in 2012	Source of Data	Notes / Remarks
50	2.2	Water Demand for Environmental Uses	BCM/Yr	23.556	MEWINA-LIBYA	Estimation of environmetal / ecological water demand is a very tedious and difficult task as it requires detailed data on land uses, densities, spatial and temporal changes as well as a set national policy balancing uses with social, economic and environmental sustainability conditions / goals. Sophistical models utilizing advanced GIS technologies and validation requiring long term monitoring are a prerequisite for environmental water demand estimation. As such requirements can not be met presently and no data exist on EWD, a very rough estimate is presented here. It assumes that EWD = green water withdrawals + 10 % if irrigated water used (for ecological needs in farmed areas) + wild life water demand (assumed to equal animal water demand).
51	2.21	Withdrawals for Oil & Gas Water Use	BCM/Yr	0.13	MEWINA-LIBYA	Based on an estimated oil production of 1.483 million barrrels/day in 2012 and a water withdrawal of 2 m3 per m3 of oil produced (1 barrel = 119.24 liters)
52	added	Produced water "associated with oil production"	BCM/Yr	0.13	MEWINA-LIBYA	Based on a reported productivity of 1.83 mb/d of oil and 2 barrels water/barrel of oil prodcued
*	3	Water & Land Use Changes				
53	3.1	Total Irrigated Agricultural Land	ha	590000	MAAMW	Large difference between national & FAO / GWA value of 470000 ha. Slightly reduced FAO land use study value is probably more accurate as it is based on recent study employing modern technologies.
54	3.2	Total Rain-fed Agricultural Land	ha	1489000	MAAMW	National, CEDARE/AWC & FAO values are close.
55	3.3	Total Pasture Land	ha	14833000	MAAMW	National, CEDARE/AWC (13,500,000 ha.) & FAO values are close.
56	3.4	Total Forests Land	ha	170000	MAAMW	National value from study referred to is 338000. This value was adjusted in light of the urban encroachment over the last four decades. A value of 50 % of the above value was adopted as it may be more reliable.
57	3.5	Urban Encroachment on Green Cover	ha lost/Yr	3600	MEWINA-LIBYA	According to agricultural survey study conducted by FAO for Ministry of Agriculture, urban area of Tripoli doubled in the last 25 years from 11.587 ha of 1976 to 22.534 ha in 2001. Based on these figures, the encroachment rate is 440 ha/yr. Applying this rate to the urban areas of the agricultural coastal corridor, the estimated rate for the country for last 50 years is about 3600 ha/yr.
*	*	Impact of Urban Encroachment on water Resources				
58	3.6	Decrease in Groundwater Recharge	BCM/Yr	0.0009	MEWINA-LIBYA	Decrease is calculated as urban area*rainfall*recharge rate of 10 % of rainfall.
59	3.7	Decrease in Water Consumptions of Green Cover	BCM/Yr	0.00559	MEWINA-Libya	Decrease is equal to total water withdrawals from blue water (irrigation) and greenwater (rainfed, etc) times the ratio of urban area/total greenwater withdrawal area. Linearity is assumed for fractions and withdrawals. The total area is 17,108,000 ha and the total withdrawals are 26.56 BCM/yr from indicators above.
60	3.8	Increase in Surface Runoff	BCM/Yr	0.00585	MEWINA-Libya	Increase = urban area*rainfall intensity*runoff coefficient. Rainfall intensity = 0.25 m/yr, runoff coef. = 0.65.

No.	Code	Water Related Indicators	Units	Value in 2012	Source of Data	Notes / Remarks
61	3.9	Increase in Domestic Water Withdrawals	BCM/Yr	0.00986	MEWINA-Libya	Assuming urban area population density of 30 person/ha and a per capita water consumption of 0.25 m3/person.d
*	4	Water & Services				
*	*	Water Coverage and Accessibility				
62	4.1	Improved Urban Water Supply Coverage	%	86.9	GCWW / CB	GCWW + CB values are adopted in favor of JMP because they are based on census data while source of JMP data has not been specified. The 2012 values are assumed to be identical.
63	4.2	Improved Rural Water Supply Coverage	%	10.7	GCWW / CB	GCWW + CB values are adopted in favor of JMP because they are based on census data while source of JMP data has not been specified. The 2012 values are assumed to be identical.
64	4.3	Improved Urban Sanitation Coverage	%	88.1	GCWW / CB	GCWW + CB values are adopted in favor of JMP because they are based on census data while source of JMP data has not been specified. The 2012 values are assumed to be identical.
65	4.4	Improved Rural Sanitation Coverage	%	10.1	GCWW / CB	GCWW + CB values are adopted in favor of JMP because they are based on census data while source of JMP data has not been specified. The 2012 values are assumed to be identical.
66	4.5	Improved Water Supply Coverage	%	70	MEWINA-LIBYA	GCWW + CB values are adopted in favor of JMP because they are based on census data while source of JMP data has not been specified. The 2012 values are assumed to be identical.
67	4.6	Improved Sanitation Coverage	%	70	GCWW / CB	GCWW + CB values are adopted in favor of JMP because they are based on census data while source of JMP data has not been specified. The 2012 values are assumed to be identical.
*	*	Water Infrastructure				
68	4.7	Length of Water Supply Networks	km	20000	GCWW / CB	Inclcudes only water distribution systems in cities and towns. Does not include large water transport lines of the MmRP
69	4.8	Length of Sewage Networks	km	8000	GCWW / CB	Includes wastewater and stormwater netowrks. Values for 2012-2014 are very close
70	4.9	Length of Irrigation Networks	km	4000	AEMMmRP / MEWI-NA-Libya	This length represents the MMR pipelines forming the major skeleton of the water transport system. To this should be added irrigation networks of public projects and private farms for which no published data exist.
71	4.10	Length of Drainage Networks	km	NA	MAAMW	NOT MONITORED
72	4.11	Dam Storage Capacity	BCM	0.06	GWA	Avg storage = 0.038 bcm/yr is a better indicator than design storage capacity
73	4.12	Water Supply Capacity	BCM/Yr	2.879266	GCWW	Total water treatment plant capacity (domestic only)
74	4.13	Desalination Capacity	BCM/Yr	2.68275	GDCOL	Based on data supplied by the GDCOL
75	4.14	Municipal Wastewater Treatment Capacity	BCM/Yr	0.148555	GCWW	Based on data supplied by the GCWW

No.	Code	Water Related Indicators	Units	Value in 2012	Source of Data	Notes / Remarks
76	4.15	Industrial Wastewater Treatment Capacity	BCM/Yr	0.024	MEWINA-LIBYA	Calculated based on an industrial water demand of about 120 mm3/yr and a wastewater generation of about 20 % of industrial water demand due to slow-down of industrial activities in the years 2012-2014 (Ref). Demand data are extrapolations from NWS (1999).
77	4.16	Wastewater Collection Capacity	BCM/Yr	0.438	GCWW / MEWI-NA-LIBYA	Based on data supplied by the GCWW
78	4.17	Maximum Annual Dam Storage Reached	BCM	0.0909	MEWINA-LIBYA	Estimated based on available data for some dams showing a ratio of maximum to average stored water of 1.5.
*	5	Water & Energy				
79	5.1	Electricity Generated Using Hydropower	GWh/Yr			
80	5.2	Hydropower as % of Total Generated Electricity	%			
81	5.3	Installed Hydropower Capacity	MW			
82	5.4	Water Used to Generate Electricity	BCM/Yr	0.003559	MEWINA-Libya	Assumed as 3.9 % of total installed desal capacity which totaled 0.05 mm3/yr in 2005
*	6	Water & Population				
83	6.1	Total Population	1000 inhabi-tants	6300	CB	Population has been adjusted based on 2006 data.
84	6.2	Internal Renewable Water Resources Per Capita	CM/capita/Yr	157	Secondary	
85	6.3	Total Renewable Blue Water Resources Per Capita	CM/capita/Yr	157	Secondary	
86	6.4	Total Renewable Water Resources Per Capita	CM/capita/Yr	3749	Secondary	
87	6.5	Total Available Water Resources Per Capita	CM/capita/Yr	4264	Secondary	
88	6.6	Blue Water Withdrawal Per Capita	CM/capita/Yr	786	Secondary	
89	6.7	Green Water Use Per Capita	CM/capita/Yr	3608	Secondary	
90	6.8	Total Water Consumption Per Capita	CM/capita/Yr	91	Secondary	
91	6.9	Agricultural Water Withdrawal Per Capita	CM/capita/Yr	843	Secondary	
92	6.1	Industrial Water Withdrawal Per Capita	CM/capita/Yr	27	Secondary	
93	6.11	Domestic Water Withdrawal Per Capita	CM/capita/Yr	91	Secondary	
94	6.12	Population Without Improved Water Supply	1000 inhabi-tants	151	Secondary	

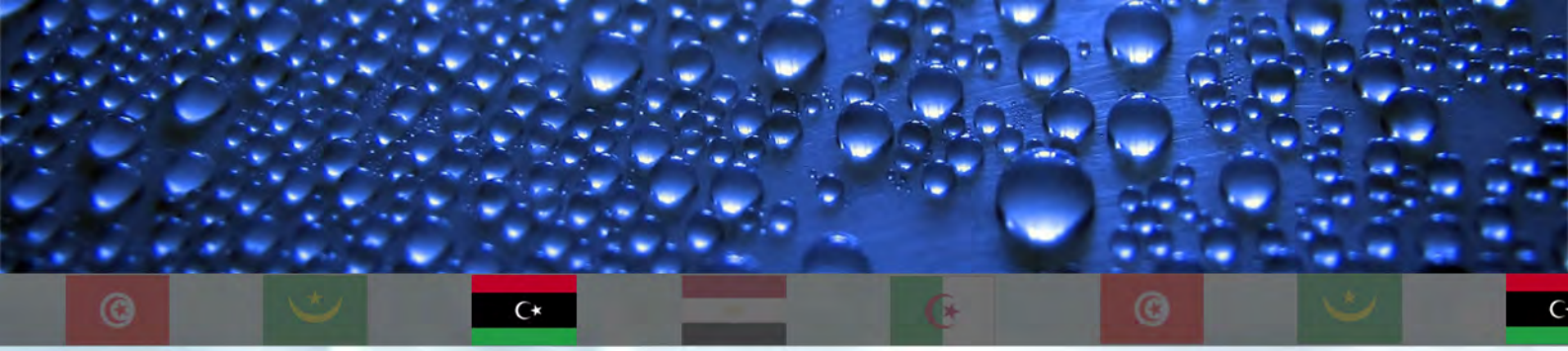
No.	Code	Water Related Indicators	Units	Value in 2012	Source of Data	Notes / Remarks
95	6.13	Population Without Improved Sanitation	1000 inhabi-tants	113	Secondary	
*	7	Water & Health				
96	7.1	Diarrhea Prevalence	%	NA	MOH	NOT MONITORED
97	7.2	Dracunculiasis Reported Cases	%	0	WHO	Libya is reported as non Dracunculiasis state by WHO
98	7.3	Open Defecation Practice	Number	0	MEWINA-LIBYA	Assumed base on existing practices and observations.
99	7.4	Percentage of Open Defecation	%	0	Secondary	
100	7.5	Cholera Reported Cases	Number/Year	0	MOH	Based on Ministry of Health Statistics
101	7.6	Typhoid Reported Cases	Number/Year	314	MOH	Based on Ministry of Health Statistics
102	7.7	Hepatitis A Reported Cases	Number/Year	176	MOH	Based on Ministry of Health Statistics
*	8	Water & Quality				
103	8.1	Dissolved Oxygen (DO)	mg/l	7.3	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
104	8.2	pH	Dimensionless	7.3-7.65	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
105	8.3	Electric Conductivity (EC)	1/OHM (S/M)	1630	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
106	8.4	Nitrogen Concentration	mg/l	50	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
107	8.5	Phosphorous Concentration	mg/l	NA	GWA, GCWW, AEM-MmRP, GDCOL	NOT MONITORED
108	8.6	Total Dissolved Solids	mg/l	1060	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
109	8.7	Fecal Choliform	Colo-nies/100ML	0	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
110	8.8	Biological Oxygen Demand (BOD)	mg/l	NA	GWA, GCWW, AEM-MmRP, GDCOL	NOT MONITORED
111	8.9	Chemical Oxygen Demand (COD)	mg/l	NA	GWA, GCWW, AEM-MmRP, GDCOL	NOT MONITORED
112	8.10	Chloride Concentration	mg/l	243	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
113	8.11	Total Hardness ($CaCo_3$)	mg/l	379	AEMMmRP	Reported by the AEMMmRP for Phase II well fields
*	9	Water & EcoSystems				
114	9.1	Number of Wetlands Sites Acknowledged by RAMSAR	Number	2	EGA	

No.	Code	Water Related Indicators	Units	Value in 2012	Source of Data	Notes / Remarks
115	9.2	Total Wetlands Areas	ha	8300	EGA	
116	9.3	Total Freshwater Species Count	Number	NA	EGA	NOT MONITORED
117	9.4	Number of Endangered Species	Number	NA	EGA	NOT MONITORED
118	9.5	Number of Invasive Species	Number	NA	EGA	NOT MONITORED
119	added	Total Inland Lakes	Number	NA	EGA	NOT MONITORED
120	added	Total Inland Lakes Areas	ha	NA	EGA	NOT MONITORED
*	10	Water & Climate				
*	*	Extreme Weather Events				
121	10.1	Number of Class 1 Flood Events	Number	7	MEWINA-LIBYA	Estimated based on LNCM data
122	10.2	Number of Class 1.5 Flood Events	Number	6	MEWINA-LIBYA	Estimated based on LNCM data
123	10.3	Number of Class 2 Flood Events	Number	0	MEWINA-LIBYA	Estimated based on LNCM data
124	10.4	Average Temperature	°C	21.1	MEWINA-LIBYA	Estimated based on LNCM data
125	10.5	Drought Events	Number	NA	LNCM	NOT MONITORED
126	10.6	Cost of Annual Damage Caused by Floods	$ - % of GDP	NA	NSA	NOT MONITORED
127	10.7	Cost of Annual Damage Caused by Droughts	$ - % of GDP	NA	NSA	NOT MONITORED
128	10.8	Annual Human Losses Related to Floods	Number	NA	NSA	NOT MONITORED
129	10.9	Annual Human Losses Related to Droughts	Number	NA	NSA	NOT MONITORED
130	10.10	Unusual Weather Events (Snow, Hail,.....)	Number /Type	7	MEWINA-LIBYA	Estimated based on LNCM data
131	10.11	Existence of Early Warning Disaster pre-vention System and Year of establishment	Yes/No	NO	MEWINA-LIBYA	Estimated based on LNCM data
132	10.12	National Climate Change Adaptation Plan	Yes/No	NO	MEWINA-LIBYA	Estimated based on LNCM data
*	11	Water & Socio-economics				
*	*	Water Productivity				
133	11.1	Industrial Water Productivity	$/CM	369.48	CEDARE / AWC	Value reported by CEDARE/AWC adopted
134	11.2	Agricultural Water Productivity “Crop Per Drop”	$/CM	0.32	CEDARE / AWC	Value reported by CEDARE/AWC adopted

No.	Code	Water Related Indicators	Units	Value in 2012	Source of Data	Notes / Remarks
135	11.3	Employment in Agriculture "Job Per Drop"	Jobs/MCM	53	CEDARE / AWC	Value reported by CEDARE/AWC adopted
136	11.4	Employment in Industry "Job Per Drop"	Jobs/MCM	3	MEWINA-LIBYA	Based on a total industrial work force of 0.38 million persons. Water withdrawals include oil sector.
137	11.5	GDP	Billion $	73.8	MOP	Ministry of Planning Data
*	*	Tariffs and Affordability				
138	11.6	Water and Sanitation Charges as % of Average Household Income	%	1.5	MEWINA-LIBYA	Method of calculation is provided in AMCOW indiicators report (annex of the report)
*	12	Water & Finance				
139	12.1	Percentage of National Budget Directed to Water & Sanitation Sector	%	0.74	MOP	Ministry of Planning Data
140	12.2	Operation & Maintenance Cost Recovery for Water Supply and Sanitation	%	NA	GCWW	NOT MONITORED
141	12.3	Percent of GDP Directed to Sanitation & Hygiene	%	NA	MOP	NOT MONITORED
142	12.4	Foreign Aid for Water & Sanitation	Million US$	0.02	CEDARE / AWC	
143	12.5	Operation& Maintenance Cost Recovery for Irrigation	%	NA	MAAMW	NOT MONITORED
144	12.6	Operation & Maintenance Cost Recovery for Industry	%	NA	MOI	NOT MONITORED
145	12.7	Aid to Water & Sanitation in Foreign Countries	Million US$	NA	MOP	NOT MONITORED
146	12.8	Total Investment	Million US$	NA	MOP	NOT MONITORED
*	13	Water & Trade				
147	13-1	Agricultural Virtual Water Export	BCM/Yr	0.04	CEDARE / AWC	Value reported by CEDARE / AWC adopted
148	13-2	Agricultural Virtual Water Import	BCM/Yr	8.1	CEDARE / AWC	Value reported by CEDARE / AWC adopted
*	14	Water & Governance				
149	14-1	IWRM Plan	Yes/No	No	GWA	
150	14-2	National Water and Sanitation M&E & R System	Yes/No	No	MEWINA-LIBYA	
151	14-3	Surface Water Permits Issued to Date	Number	0	GWA / MEWINA-LIBYA	

No.	Code	Water Related Indicators	Units	Value in 2012	Source of Data	Notes / Remarks
152	14-4	Total Volumetric Rights Associated with surface Water Permits	BCM/Yr	9.2	MEWINA-LIBYA	
153	14-5	Volume associated with surface Water permits as a Percent of Annual Blue Surface Water Withdrawals	%	0	MEWINA-LIBYA	
154	14-6	Groundwater Well Permits Issued to Date	Number	35340	MEWINA-LIBYA	Estimated based on data available for NW Libya regions and applied as percentage to all regions of Libya
155	14-7	Total Volumetric Water Rights Associated with Well Permits	BCM/Yr	NA	GWA	NOT MONITORED
156	14-8	Total Volume associated with well permits as a percent of Annual Blue Groundwater Abstractions	BCM/Yr	NA	GWA	NOT MONITORED
157	14-9	Number of unlicensed wells		NA	GWA	NOT MONITORED
158	14-10	Irrigation & Drainage Related Complaints as a percentage of Irrigation Water Users	Number/Yr	NA	GWA	NOT MONITORED
159	14-11	Water supply and Sanitation Related Complaints as a percentage of Serviced Households	Number/Yr	NA	GWA	NOT MONITORED
160	14-12	Number of Water Supply Meters Installed as a Percent of Total Number of Covered Households	%	25-30	MEWINA-LIBYA	Estimated based on typical values for similar regions
161	14-13	Number of Groundwater Meters Installed as a percent of Serviced Households	Number	NA	GWA	NOT MONITORED
162	14-14	Number of Surface Irrigation Meters Installed as a % of Surface Irrigation Water Permits	%	NA	GWA	NOT MONITORED
163	14-15	Physical Domestic Water Losses	BCM/Yr	0.20125	MEWINA-LIBYA	Estimated assuming a leakage loss percentage
164	14-16	Overall Water Use Efficiency	%	99.94	Secondary	Calculated assuming an irrigation efficiency of 65 %
165	14-17	Water Sustainability/ Depletion Index	%	18.41	Secondary	
166	14-18	Wastewater and Drainage Outflows	BCM/Yr	1.4	CEDARE /AWC	
167	14-19	Transboundary Wastewater and Drainage Outflows	BCM/Yr	0	MEWINA-LIBYA	
168	14-20	Commercial Water Losses	BCM/Yr	NA	GCWW, AEMMmRP	NOT MONITORED

No.	Code	Water Related Indicators	Units	Value in 2012	Source of Data	Notes / Remarks
169	14-21	Physical Irrigation Water Losses	BCM/Yr	1.33	MEWINA-LIBYA	calculated assuming an irrigation efficiency of 65 %
170	14-22	Number of Water related citations (Water Laws Enforcement)	Number	NA	GWA	NOT MONITORED
171	14-23	Number of Water Users Associations	Number	0	MEWINA-LIBYA	
172	14-24	Water Users Associations Agricultural Land Coverage	% of Ag. Land	0	Secondary	
*	15	Water & International Relations				
173	15-1	Transboundary Water Dependency Ratio	%	0	GWA / MEWI-NA-LIBYA	
174	15-2	Shared Waters related Bilateral/ Multilat-eral Agreements and/or Memorandums of Understanding and Cooperation Mecha-nisms	Number	2	GWA	
175	15-3	Number of Riparians sharing all shared water bodies	Number	5	GWA	
176	15-4	Number of Shared Water Resources	Number	2	GWA	



MEWINA

مشروع التقييم والمتابعة لقطاع المياه بدول شمال أفريقيا

Monitoring and Evaluation for Water In North Africa

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