Food and Agriculture Organization
of the United Nations

GEMI – Integrated Monitoring Initiative for SDG 6
Step-by-step monitoring methodology for SDG Indicator 6.4.1

Version: 30 July 2019

STEP-BY-STEP MONITORING METHODOLOGY FOR INDICATOR 6.4.1

CHANGE IN WATER-USE EFFICIENCY OVER TIME[1]

1. MONITORING CONTEXT

1.1 INTRODUCTION OF THE INDICATOR

Target 6.4 **By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity**

Indicator 6.4.1 Change in water-use efficiency over time

Indicator 6.4.1 on water-use efficiency (WUE) has been designed to address the economic component of Target 6.4. This indicator was newly introduced by the SDG process and had never been monitored at a global level within the context of the MDGs. Thus, an entirely new methodology needed to be developed to monitor the indicator. This also meant that no previous data existed for the indicator, resulting in new data computations and related interpretation of the results.

The monitoring concept of this indicator can be resumed as follows:

- The indicator should assess the impact of economic growth on the utilization of water resources
- Only runoff water and groundwater (so-called blue water) have to be considered in computing the indicator. This is particularly important when computing the indicator for the agricultural sector. For this reason, a specific parameter (C_r) has been introduced in the formula to estimate the amount of agricultural production done under rainfed conditions. For the same reason, the value added of sub-sectoral productions making mainly use of non-abstracted water should be subtracted from the overall sectoral value added.
- The indicator differs from the concept of water productivity as it does not consider the productivity of the water used in a given activity as an input to production. Moreover, water productivity is calculated as the ratio of economic output to the amount of water consumed, not water used. In fact, this indicator provides an estimation of the reliance of economic growth on the exploitation of water resources, it shows the level of decoupling of economic growth from water use. In other terms, how much water use increases if the value added (VA) produced by the economy increases by 10%.

[1] For any request of information, please contact riccardo.biancalani@fao.org

These points have led to the following definition of the water-use efficiency for this indicator: the value added per water used[2], expressed in USD/m^3 of a given section, division or group of divisions of the economy (showing over time the trend in water-use efficiency).

The indicator is in fact defined as the change in water-use efficiency over time (CWUE). That is the change in the ratio of the value added to the volume of water-used, over time.

The data on freshwater abstraction are also used for the calculation of indicator 6.4.2 on water stress.

1.2 Target levels for the indicator

As this is a new indicator, with no pre-existing experience or data, it is not possible to define a specific target for its value. While water-use efficiency has a measurable and comparable value at every measurement instance, the indicator's meaning becomes visible when its values are compared over time.

The main interpretation rationale should be the comparison with the economic growth of the country: the indicator should, as a minimum, follow the same trend than the economic growth in order to be acceptable.

If WUE grows more than the economy VA, we can say that the indicator is on the right path, while attention should be given to a situation where the opposite occurs.

2. Monitoring methodology

2.1 Monitoring concept and definitions

Concept: this indicator provides an estimation of the reliance of economic growth of a country on the exploitation of its water resources. An indicator growing less than the economy indicates a potential problem on the medium or long term sustainability of the economic growth itself.

As this is an indicator focusing on economy, it is calculated by computing individual indicators for each of the main economic sectors, and then aggregating them into a single figure.

This indicator is defined as the value added per water used, expressed in USD/m^3 over time of a given major sector (showing the trend in water-use efficiency). Following International Standard Industrial Classification of All Economic Activities (ISIC), rev. 4 coding, sectors are defined as:

1. agriculture; forestry; fishing (ISIC A), hereinafter "agriculture";
2. mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; constructions (ISIC B, C, D and F), hereinafter "MIMEC"[3];
3. all the service sectors (ISIC E and ISIC G-T), hereinafter "services"

[2] In order to maintain consistency with the terminology used in SEEA-Water, the terms "water use" and "water abstraction" are utilized in this text. In particular, "water abstraction" has to be considered synonym of "water withdrawal", as expressed in both AQUASTAT and the statement of the SDG target 6.4.
[3] The acronym MIMEC takes the name from mining, industry, manufacturing, electricity and constructions. In AQUASTAT, as well as in the World Bank databank and in other national and international datasets, the MIMEC sector is referred to as "Industry". Also SEEA-W uses the term "industrial use" of water.

For the purpose of this note, the following terminology is used:

- Water use: water that is received by an industry or households from another industry or is directly abstracted.
- Water abstraction: water removed from the environment by the economy

Computation

The indicator is computed as the sum of the three sectors listed above, weighted according to the proportion of water used by each sector over the total water-use. In formula:

$$WUE = A_{we} \times P_A + M_{we} \times P_M + S_{we} \times P_S$$

Where:

WUE	=	*Water-use efficiency [USD/m³]*
A_{we}	=	*Irrigated agriculture water-use efficiency [USD/m³]*
M_{we}	=	*MIMEC water-use efficiency [USD/m³]*
S_{we}	=	*Services water-use efficiency [USD/m³]*
P_A	=	*Proportion of water used by the agricultural sector over the total use*
P_M	=	*Proportion of water used by the MIMEC sector over the total use*
P_S	=	*Proportion of water used by the service sector over the total use*

Units of volume:
1 km^3 = 1 billion m^3 = 1000 million m^3 = 10^9 m^3

The computing of each sector is described below.

Water-use efficiency in irrigated agriculture is calculated as the agriculture value added per agricultural water use, expressed in USD/m^3. In formula:

$$A_{we} = \frac{GVA_a \times (1 - C_r)}{V_a}$$

Where:

A_{we}	=	*Irrigated agriculture water-use efficiency [USD/m³]*
GVA_a	=	*Gross value added by agriculture (excluding river and marine fisheries and forestry) [USD]*
C_r	=	*Proportion of agricultural GVA produced by rainfed agriculture [%]*
V_a	=	*Volume of water used by the agricultural sector (including irrigation, livestock and aquaculture) [m³]*

The data on the volume of water used by the agricultural sectors (V_a) are collected at country level through national records and reported in questionnaires, in units of km^3/year (as for example in

AQUASTAT). Agricultural value added in national currency is obtained from national statistics, converted to USD and deflated to the baseline year.

C_r can be calculated from the proportion of irrigated land on the total crop land[4], as follows:

$$C_r = \frac{1}{1 + \frac{A_i}{(1 - A_i) * 0.563}}$$

Where:

A_i = *proportion of irrigated land[5] on the total cropland, in decimals*

0.563 = *generic default ratio between rainfed and irrigated yields*

More detailed estimations are available for some countries (see Annex 1). Countries are encouraged to use national level figures, where available.

In order to cover adequately also water-use for livestock and aquaculture the indicator for the agricultural sector can be disaggregated as follows:

$$A_{we} = \frac{GVA_{al} + GVA_{aa} + [GVA_{ai} \times (1 - C_r)]}{V_a}$$

Where:

GVA_{al} = *Gross value added of the livestock sub-sector [USD]*

GVA_{aa} = *Gross value added of the aquaculture sub-sector [USD]*

GVA_{ai} = *Gross value added of the irrigated cultivations sub-sector [USD]*

Water-use efficiency of the MIMEC sector (including power production): MIMEC value added per unit of water used by the MIMEC sector, expressed in USD/m^3.

In formula:

$$M_{we} = \frac{GVA_m}{V_m}$$

Where:

M_{we} = *MIMEC sector water-use efficiency [USD/m^3]*

GVA_m = *Gross value added by MIMEC (including energy) [USD]*

V_m = *Volume of water used by MIMEC (including energy) [m^3]*

[4] This category is a sum of areas under “Arable land” and “Permanent crops” of FAOSTAT.

[5] Total harvested irrigated crop area. Area under double irrigated cropping (same area cultivated and irrigated twice a year) is counted twice. (AQUASTAT glossary)

The data for the MIMEC water-use (V_m) are collected at country level through national records and reported in questionnaires, in units of km^3/year (as for example in AQUASTAT). MIMEC value added is obtained from national statistics, deflated to the baseline year.

Water-use efficiency of the services sectors is calculated as the service sector value added divided by water used for distribution by the water collection, treatment and supply industry (ISIC E 36), expressed in USD/m^3.

In formula:

$$S_{we} = \frac{GVA_s}{V_s}$$

Where:

- S_{we} = *Services water-use efficiency [USD/ m^3]*
- GVA_s = *Gross value added by services [USD]*
- V_s = *Volume of water used by the service sector [m^3]*

Data on volumes of water used for services sector are collected at country level from the water supply utilities records and reported in questionnaires, in units of km^3/year (as for example in AQUASTAT). Services value added is obtained from national statistics, deflated to the baseline year.

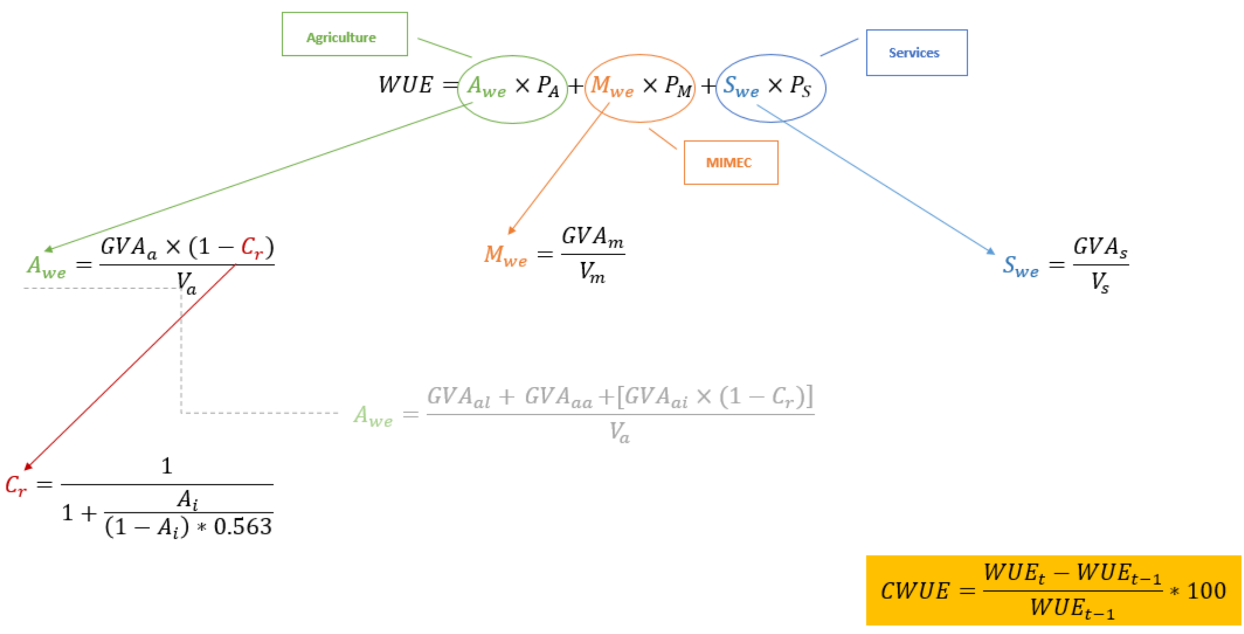


Figure 1: Overview of the indicator's formula and its components

2.2 Recommendations on country process for monitoring

As data from different sectors and sources are needed for the computation of this indicator, it is necessary that a national coordination is in place in order to assure the timely and consistent collection of the data.

2.3 Recommendations on spatial and temporal coverage

The data for this indicator should be collected annually. As this indicator is connected to economic growth, collecting annual data would be advisable, even in the case where no substantial changes in water-use is foreseen on yearly basis.

In any case, particularly in countries with a water stress issue as assessed through Indicator 6.4.2, and strong economic and demographic growth, a reporting period of no more than two years should be considered, in order to be able to build an early trend capable to detect possible problems.

2.4 Monitoring ladder

The methodology for Indicator 6.4.1 – recognizing that countries have different levels of capacity when it comes to monitoring of water–use efficiency – allows countries to start their monitoring efforts according to the level of their national capacity and available resources, and from there advance progressively.

1. As a first step, the indicator can be populated with estimations based on national information. If needed, data can be retrieved from internationally accessible databases for both, water-use and economic data in different sectors. The agricultural rainfed production factor C_r can be calculated following the default coefficient provided in these guidelines.
2. Moving on to the next step, the indicator can be populated with nationally produced data. The agricultural rainfed production factor C_r can be calculated following the default coefficient provided in these guidelines.
3. For more advanced steps, the nationally produced data have high accuracy (e.g. geo-referenced and based on metered volumes). The agricultural rainfed production factor C_r is calculated according to national studies.

3. Data sources and collection

3.1 Data requirements to compute the indicator

The indicator has two main components: hydrologic and economic. Thus, two set of data are needed to compute this indicator. Water-use data will be utilized to calculate the denominators of the three sectoral sub-indicators illustrated above. Country economic statistics will be needed to compile the numerator of each sectoral sub-indicator. Here the two sets will be analyzed separately.

3.1.1 Water-Use Data

In order to be able to disaggregate the indicator, it would be advisable that the components described above are in turn computed by aggregating the variables per sub-sector, as follows:

3.1.1.1 Agriculture water-use (km^3/year)

Annual quantity of self-supplied water used for irrigation, livestock and aquaculture purposes. It includes water from renewable freshwater resources, as well as water from over-abstraction (i.e. abstraction beyond replenishment rates) of renewable groundwater or abstraction of fossil groundwater, direct use of agricultural drainage water and (treated) wastewater, and desalinated water. This definition refers to self-supplied agricultural establishments not connected to the public water supply networks. If connected to such networks, water used for agriculture may be included in the services water-use, unless disaggregated data are available.

Water-use for irrigation (km^3/year)

Annual quantity of water used for irrigation purposes. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or abstraction of fossil groundwater, direct use of agricultural drainage water, (treated) wastewater, and desalinated water.

Water-use for livestock (watering and cleaning) (km^3/year)

Annual quantity of water used for livestock purposes. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or abstraction of fossil groundwater, direct use of agricultural drainage water, (treated) wastewater, and desalinated water. It includes livestock watering, sanitation, cleaning of stables, etc.

Water-use for aquaculture (km^3/year)

Annual quantity of water used for aquaculture. It includes water from renewable freshwater resources, as well as water from over-abstraction of renewable groundwater or abstraction of fossil groundwater, direct use of agricultural drainage water, (treated) wastewater, and desalinated water. Aquaculture is the farming of aquatic organisms in inland and coastal areas, involving intervention in the rearing process to enhance production and the individual or corporate ownership of the stock being cultivated.

This sector corresponds to the ISIC section A:

01 – Crop animal production, hunting and related service activities

0210 – Silviculture and other forestry activities

0322 – Freshwater aquaculture

3.1.1.2 MIMEC water-use (incl. for cooling of thermoelectric plants) (km^3/year)

Annual quantity of water used for the MIMEC sector. It includes water from renewable freshwater resources, as well as over-abstraction of renewable groundwater or abstraction of fossil groundwater and use of desalinated water or direct use of (treated) wastewater. This definition refers to self-supplied industries not connected to the public water supply networks. If connected to such networks, water used for MIMEC sector may be included in the services water-use, unless disaggregated data are available.

Water-use for this sector should include the losses for evaporation from artificial lakes used for hydropower production. More information can be found at http://www.fao.org/3/a-bc814e.pdf and http://www.fao.org/nr/water/aquastat/dams/index.stm. On the contrary, this sector does not include water used for powering the hydroelectric turbines, as such water is immediately returned to the river bed.
This sector corresponds to the ISIC sections B, C, D and F.

3.1.1.3 Services related water use (km^3/year)

Annual quantity of water used primarily for the direct use by the population. It includes water from renewable freshwater resources, as well as over-abstraction of renewable groundwater or abstraction of fossil groundwater and the use of desalinated water or direct use of treated wastewater. It is usually computed as the total water used by the public distribution network. It can include that part of the agriculture and MIMEC sectors, which are connected to the public water supply network.[6]

This corresponds to the water used (or directly abstracted) for distribution by the ISIC division E-36.[7]

An overview of water-use in the three sectors described above is provided in Annex 2.

3.1.2 Economic Data

3.1.2.1 Economic data for computing 'Water-use efficiency in the Agriculture sector' [A_{we}]

The WUE in agriculture (A_{we}) is defined as **'gross value added in agriculture** (GVA_a)' per '**agricultural water use (V_a)**' (in USD/m^3). According to the ISIC rev. 4, 'Agriculture' corresponds to divisions 01-03 (i.e., crops and animal production, forestry, and fishing). For the purpose of WUE in agriculture; fresh water fishing, marine fishing, and forestry should be excluded.

The Gross value added by agriculture (GVA_a) is calculated by adding up all agricultural outputs and subtracting intermediate inputs; but without making deductions for depreciation of fixed assets or depletion and degradation of natural resources. It should be noted that in calculating water-use efficiency in agriculture, the GVA_a figure needs to exclude value added from forestry and fishing. If GVA_a is reported as a single aggregate value (including forestry and fishing) in a national accounts

[6] To be noted that in AQUASTAT, the "services" sector is referred to as "municipal".
[7] See SEEA-W, table III.1-A.

system; forestry and fishing values need to be deducted, with the exception of forest tree nurseries and freshwater aquaculture.

Also for the purpose of the economic component of the indicator, the agriculture sector comprises the following divisions of the ISIC section A:

01 - Crop and animal production, hunting and related service activities

0210 - Silviculture and other forestry activities

0322 - Freshwater aquaculture

3.1.2.2 Economic data for computing 'Water-use efficiency in the MIMEC sector [M_{we}]

For the purpose of the SDG 6.4.1 indicator, water-use efficiency in MIMEC (M_{we}) is defined as the gross MIMEC value added (GVA_m) per unit of water used by MIMEC sector (V_m), (expressed in USD/m^3). In this definition, the subscript m represents the aggregated MIMEC sections including mining and quarrying, manufacturing, electricity/energy, and construction (ISIC: B, C, D, F based on ISIC rev. 4).

The 'value added' data can be computed by summing the value added of each of the four MIMEC sections as defined in the ISIC coding. However, it is important to note that different agencies (governmental or international) may pursue slightly different approaches in compiling the national accounts. For example, in some cases the ISIC rev. 3 coding is still in use. When extracting GVA_m from different databases (national or international), attention need to be paid in order to avoid double counting or underestimation.

Furthermore, we need to notice that in most cases, the value added of water distribution (E 36) is included in the aggregated MIMEC value added. In that case, for a correct calculation of the indicator, that value added should be subtracted from MIMEC and counted under the service sector.

3.1.2.3 Economic data for computing 'Water-use efficiency in Services sector' [S_{we}]

Water-use efficiency in services is defined as the service sector value added (ISIC E; G-T) [GVA_s] divided by the volume of water used [V_s] for distribution by the water collection, treatment and supply industry (ISIC E 36), expressed in USD/m^3.

According to the ISIC rev. 4, 'Services' sector comprises 52 divisions. The sector includes a wide range and diverse categories of economic activities. According to the methodology adopted by IAEG-SDG for this indicator, the ISIC coding E ('Water Supply') is included in service sector and hence the value added from this coding should be included into 'service sector value added'. However, in national accounts main aggregates database (e.g., World Bank; UNSD; and OECD), the value added of the ISIC coding E is counted under the 'industrial value added' aggregate rather than the 'service sector value added'. In those cases and for the purpose of Indicator 6.4.1 compilation, the value added of ISIC E section needs to be subtracted from the 'industrial value added', summed to the 'service sector value added'.

Example of the economic data and their usage can be found in Annex 3.

3.2 Sources of data

3.2.1 Globally available data

3.2.1.1 Water-use data

The water-use data needed for the compilation of the indicator can be found in the AQUASTAT database of FAO. Using AQUASTAT data would be probably the simplest way to compile the indicator in the short term. However, it must be considered that AQUASTAT is a repository of data, and as such it does not produce new data. Without a specific effort by the countries, no update, and consequently no monitoring, could be done. Hence, in order to monitor the indicator over the years, a national data collection process needs to be established or reinforced in each country.

3.2.1.2 Economic data

Most countries compile their national accounts using the internationally agreed standard set of recommendations provided in the Systems of National Accounting (SNA); mainly using either the SNA-1993 (http://unstats.un.org/unsd/nationalaccount/docs/1993sna.pdf) or the SNA-2008 (http://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf) recommendations. The set of concepts, definitions, classifications and accounting rules recommended in the SNA allow international comparison of data and economic performance among countries. Essentially, three approaches (output approach, expenditure approach, and income approach) are used to compile economic data in national accounts. The 'output approach' provides sectoral 'value added' data following the ISIC coding. Thus, the 'value added' for computing the SDG 6.4.1 indicator for the three major economic sectors (agriculture, MIMEC, and services) can be obtained from national statistical departments or other relevant national government agencies and international sources such as the World Bank, UNSD, and OECD databases some of which are listed in Table 1.

Economic data types (three major sectors)	• Gross value added by agriculture sector • Gross value added by the MIMEC sector • Gross value added by services sector
Key international data sources	• World Bank Databank (World Economic Indicators): http://databank.worldbank.org/data/home.aspx • UNSD: https://unstats.un.org/unsd/snaama/downloads • OECD (national accounts data files): http://www.oecd-ilibrary.org/economics/data/oecd-national-accounts-statistics_na-data-en

Table 1. Key international sources of sectoral gross value added data

Full guidelines for the preparation of the economic data are given in Annex 3.

3.2.2 National data

As described above, a national data collection and coordination mechanism should be put in place to ensure a regular update of the datasets needed to compile the indicators. It is worth noting that the indicators can be useful to support and inform the decision making process only if they are updated, and if the basic data used for their compilation are as up-to-date and accurate as possible. Building institutional capacity and coordination may be needed to carry on the data collection and processing tasks.

A calculation sheet for the preparation of the indicators of Target 6.4 is available here: https://tinyurl.com/SDG-6-4-documents. As this calculation sheet is quite related with the general AQUASTAT questionnaire, the AQUASTAT guidelines are a useful reference: http://www.fao.org/nr/water/aquastat/sets/aq-5yr-guide_eng.pdf.

No specific field survey is expected to be undertaken to collect the data. A complete field survey would involve too much time and would be too costly. Information is to be collected through an in-depth scanning of all existing datasets, reports and maps dealing with water resources and water-use at country level, and from the country's economic statistics.

3.2.3 AQUASTAT

FAO has been developing guidelines and training materials to assist countries in incorporating the SDG indicators in their national statistical programmes and monitoring mechanisms. As the custodian agency for SDG 6.4.1 and 6.4.2 indicators, FAO is also responsible for compiling regional and global aggregates and international data. This is done through AQUASTAT, its global water information system that is active since 1994.

AQUASTAT data are obtained through detailed questionnaires filled in by national experts who collect information from the different institutions and ministries having water-related issues in their mandate. The standard AQUASTAT questionnaire to be filled annually includes 35 variables, mostly SDG related. A longer questionnaire containing additional variables on dams, irrigated crop calendar and institutions is to be filled in every 3 to 5 years to complete the water overview.

FAO has invited countries to nominate an AQUASTAT national correspondent (and alternates) in order to coordinate and to improve the process of data collection and transmission. National correspondents are responsible for collecting the data within the country - by contacting all the various agencies involved in water and irrigation as needed - performing a first check of the collected data and providing the corresponding data sources and metadata.

At country level data can be retrieved from national policies and strategies; water resources and irrigation master plans; national reports, yearbooks and statistics; reports from projects; international surveys; results and publications from national and international research centers.

AQUASTAT data accuracy and reliability is ensured through manual checking and crosschecking processes - between variables, time series and neighbouring countries - as well as automatized controls once the data is uploaded into the database. Data obtained from national sources are systematically reviewed to ensure consistency in definitions and consistency in data from countries located in the same river basin. In addition, the very strength of the AQUASTAT database is that every data-point is backed by a source, collected through the metadata in the questionnaire, allowing to track back all characteristics of the data. As regards transboundary basins, the comparison of information between countries enables the verification and completion of data concerning the flows of transboundary rivers and it ensures data coherence at the river basin level.

In spite of these precautions, the accuracy, reliability and frequency with which information is collected may vary considerably by region, country and category of information. Information can be completed using models when necessary. Modelled data are used with caution. Data on water resources can be modelled by using GIS-based hydrological models. Data on water use are estimated by sector based on standard unit values of water use. If data are modelled, it has to be always explicitly indicated, as is done in the AQUASTAT database, to avoid that modelers use modelled data for their models.

AQUASTAT data on water resources and use are published when new information becomes available on the FAO-AQUASTAT website at http://www.fao.org/nr/aquastat.

3.3 Recommendations on data management

3.3.1 Institutional setup

As data from different sectors and sources are required to compute the indicator, having a national, cross-sectoral coordination in place will assure the timely and consistent collection of the data on regular basis. Partner institutions in the data collection process at country level are usually the line ministry for water resources and the national statistical office. Data for the indicator’s components are usually collected by national ministries and institutions that have water related thematic areas in their mandate, such as the ministries of water resources, agriculture, industry, economy or environment.

3.3.2 Metadata

Metadata are essential for the proper understanding, usage and archiving of data. Each data series should be briefly described. Complete information on the main institutions dealing with data collection should be provided, including the year of reference and any limitation of the data presented. For each institution, the organization type and the fields of activity should be indicated too.

3.3.3 Data quality

As a general rule, the most recent available data should be provided and always with its reference source. Some data may become outdated faster than other and judgement has to be made on a case by case basis with regards to the reliability of a source. If the latest available data are known to be outdated, this fact should be mentioned in a “comments” section of the metadata.

If different sources give significantly different figures (especially for the same year), a critical analysis is necessary in order to choose the figure that is most likely to represent reality. The other figures together with the sources can be referred to in the comments.

Moreover, a fully-fledged Quality Control/Quality Assurance (QC/QA) mechanism should be put in place, in order to ensure the quality of the data collection process and its outcome. A final verification of the data with those from independent sources, if available, would be also advisable.

4. Step-by-step data collection and computation of indicator

4.1.1 Step 1

A national institution will be identified/appointed with the task to compile the indicator. That institution will carry out a review of all the national and sub-national sources of relevant data, such as maps, reports, yearbooks and articles. The collection will focus on the most recent data, but without excluding any potential sources of information. Also partial data, with respect to time or area, will be collected, such as data produced by local projects. Older data shall also be collected for reference. The data collected will be compared with those available on the AQUASTAT, World Bank and other datasets.

4.1.2 Step 2

A participatory analysis of the outcome of step 1 will be done through a technical meeting of all the involved institutions. The final dataset to be used for the baseline will be selected. Possible older datasets will also be indicated if available, to be used to produce a preliminary backward timeline.

4.1.3 Step 3

The indicator will be computed following the indications of the metadata and these guidelines, using the dataset(s) identified in step 2.

The indicator is calculated with the following formula, as described in chapter 2 above:

$$WUE = A_{we} \times P_A + M_{we} \times P_M + S_{we} \times P_S$$

4.1.4 Step 4

The outcome of step 3 will be discussed and commented in a national workshop among national and possible international actors. Needs and constrains for the implementation of a constant monitoring of the indicator will be identified, and the steps to be undertaken to overcome them will be indicated.

4.1.5 Step 5

Change in water-use efficiency (CWUE) is computed as the ratio of water-use efficiency (WUE) in time t minus water-use efficiency in time t-1, divided by water-use efficiency in time t-1 and multiplied by 100:

$$CWUE = \frac{WUE_t - WUE_{t-1}}{WUE_{t-1}} * 100$$

On the other side, in order to calculate the trend over a longer time period the following formula can be used:

$$TWUE = \frac{WUE_t - WUE_{t_0}}{WUE_{t_0}} * 100$$

Where t_0 is the value of WUE at time zero (the base year).

EXAMPLE

Example of calculation of the indicator under the proof-of-concept phase of Integrated monitoring initiative (GEMI).

Country: the Netherlands[8]

Component	Reference year 2012	Values
Gross value added by sector (M Euro)	GVA	
GVA by agriculture, excl. fish & forestry (ISIC 01)	GVAa	10,210
GVA by agriculture, fish & forestry (ISIC 02-03)	GVAa	336
GVA by industry, incl. energy (ISIC 06-35)	GVAi	91,393
GVA by services (ISIC 41-43)	GVAs	28,323
GVA by services (ISIC 36-39 and ISIC 45-99)	GVAs	448,792
GVA total Netherlands	GVA	579,054
Volume water withdrawn by sector (Mm3)	Vx	
Withdrawal by the agricultural sector (ISIC 01-03)	Va (freshwater TWW)	60.7
Withdrawal by the industries (ISIC 06-35)	Vi (freshwater TWW)	8,924.70
Withdrawn by the service sector (ISIC 36)	Vs (freshwater TWW)	1,217.30
Withdrawn by service sector (ISIC 37-97)	(freshwater TWW)	580.7
Withdrawal total Netherlands		10,783.40
Area land (ha)		
Total agricultural land used	Area	1,841,698.50
Total arable land used	Area 'arable'	520,802.90
Total land for horticulture in the open	Area	86,421.00
Total land for forage plants	Area	237,989.30
Irrigated agricultural land	Area	53,865.00
Irrigated arable land	Area 'arable'	15,027.50
Irrigated horticulture land	Area	10,105.60
Underlying indices needed for the calculation		
Ai prop. irrigated land on total arable land (ratio)	15,027.5 / 520,802.9 =	0.0289
Cr Agricultural GVA by rain fed agriculture (ratio) (1)	1/(1+(0.0289/((1-0.0289)*0.375)))	0.9265
Sectoral water use Efficiency calculation: Awe; Iwe; Swe;		
Ai prop. irrigated land on total arable land (ratio)	= 15,027.5 / 520,802.9 =	0.0289
Cr Agricultural GVA by rain fed agriculture (ratio) 2)	1/(1+(0.0289/((1-0.0289)*0.375)))	0.9265
Awe Irrigated agricultural WUE (€/m3)	=(GVAa * (1 - Cr)) / Va = 10,210 * (1-0.9265) / 60.7 =	12.4
Iwe Industrial WUE (€/m3)	= GVAi / Vi = 91,393 / 8,924.7 =	10.2
Swe Services WUE (€/m3)	= GVAs / Vs = 448,792 / 1,217.3 =	368.7
PX Proportion of water withdrawn by the sector X, over the total withdrawals		
Pa Proportion of water withdrawn by the agricultural sector		0.0059
Pi Proportion of water withdrawn by the industry sector		0.8747
Ps Proportion of water withdrawn by the service sector		0.1193
Computation of 6.4.1: WUE		
WUE = Awe x Pa + Iwe x Pi + Swe x Ps =	= 12.4 * 0.0059 + 10.2 * 0.8747 + 368.7 * 0.1193 =	52.981 (53.0 €/m3)
(1) Ai and Cr are based upon irrigated 'arable land'. Once land used for horticulture and land for forage plants are included this figure on Agricultural GVA by rain fed agriculture versus by irrigated agriculture will change.		

[8] In this example, MIMEC sector is referred to as Industry.

5. Rationale and interpretation

The rationale behind this indicator consists in providing information on the efficiency of the economic and social usage of water resources, i.e. value added generated by the use of water in the different main sectors of the economy, including distribution network losses. The efficiency of the water distribution systems is implicit within the calculations and could be made explicit if needed and where data are available.

Water-use efficiency is strongly influenced by a country's economic structure, the proportion of water intensive sectors and any "real" improvements or deteriorations. Hence, the indicator can help formulate water policy by focusing attention on sectors or regions with low water-use efficiency. This will guide countries in their efforts to improve water-use efficiency and help them to apply successful actions from sectors or regions with higher water-use efficiency levels to those with lower efficiency levels.

However, it should be noted that in most cases, it would be futile to try to devise policies that aim to move water from one economic sector to another to increase the value of water-use efficiency. If a country's general development becomes unbalanced due to its use of water resources, other indicators will signal problems and the need for changes.

This indicator addresses specifically the target component "substantially increase water-use efficiency across all sectors", comparing the value added produced by the economy with the volumes of water used by the same economy, including losses in the distribution networks. Increasing water-use efficiency over time means decoupling economic growth from water use across the main water-using sectors, which are agriculture, industry, energy and services. This is strongly interlinked with sustainable food production (SDG 2), gender equality and natural resources (SDG 5), economic growth (SDG 8), infrastructure and industrialization (SDG 9), cities and human settlements (SDG 11) and consumption and production (SDG 12).

This indicator does not aim at giving an exhaustive picture of the water utilization in a country. In particular, the indicator needs to be combined with the water stress indicator 6.4.2 to provide adequate follow-up of Target 6.4 formulation. Furthermore, the use of supplementary indicators at

Key messages

1. The rationale behind this indicator consists in providing information on the efficiency of the economic and social usage of water resources
2. The interpretation of the indicator would be enhanced by the utilization of supplementary indicators to be used at country level, including irrigation efficiency and distribution network efficiency.
3. Water-use efficiency is strongly influenced by the economic structure and the proportion of water intensive sectors
4. The change in water-use efficiency is influenced by both 'real' improvements and deteriorations, as well as by changes in economic and social structure.
5. Increasing values in time series indicate decoupling of the economic growth from water use. It does not necessarily indicate decline in total water use or a reduction of the impact of water use (see Indicator 6.4.2 - Level of water stress).

the country level, including the monitoring of irrigation, water distribution networks, and industrial and energy cooling efficiencies would enhance the interpretation of this indicator.

6. REFERENCES

Food and Agricultural Organization of the United Nations. AQUASTAT - FAO's Global Water Information System. Rome. Website http://www.fao.org/nr/aquastat.

The following resources of specific interest to this indicator are available:

- AQUASTAT main page: http://www.fao.org/nr/water/aquastat/main/index.stm
- AQUASTAT glossary: http://www.fao.org/nr/water/aquastat/data/glossary/search.html?lang=en
- AQUASTAT Main country database: http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en
- AQUASTAT Water use: http://www.fao.org/nr/water/aquastat/water_use/index.stm
- AQUASTAT Water resources: http://www.fao.org/nr/water/aquastat/water_res/index.stm
- AQUASTAT publications dealing with concepts, methodologies, definitions, terminologies, metadata, etc.: http://www.fao.org/nr/water/aquastat/catalogues/index.stm
- AQUASTAT Quality Control: http://www.fao.org/nr/water/aquastat/sets/index.stm#main
- AQUASTAT Guidelines: http://www.fao.org/nr/water/aquastat/sets/aq-5yr-guide_eng.pdf
- FAOSTAT production database : http://faostat3.fao.org/download/Q/*/E
- UNSD/UNEP Questionnaire on Environment Statistics – Water Section:
  http://unstats.un.org/unsd/environment/questionnaire.htm
  http://unstats.un.org/unsd/environment/qindicators.htm
- Framework for the Development of Environment Statistics (FDES 2013) (Chapter 3): http://unstats.un.org/unsd/environment/FDES/FDES-2015-supporting-tools/FDES.pdf
- International Recommendations for Water Statistics (IRWS) (2012): http://unstats.un.org/unsd/envaccounting/irws/
- OECD/Eurostat Questionnaire on Environment Statistics – Water Section: http://ec.europa.eu/eurostat/web/environment/water
- OECD National Accounts data files: http://www.oecd-ilibrary.org/economics/data/oecd-national-accounts-statistics_na-data-en
- System of Environmental-Economic Accounting - SEEA-Water: https://seea.un.org/sites/seea.un.org/files/seeawaterwebversion_final_en.pdf
- System of Environmental-Economic Accounting - SEEA Central Framework: https://seea.un.org/sites/seea.un.org/files/seea_cf_final_en.pdf
- UNSD National Accounts – Analysis of Main Aggregates: https://unstats.un.org/unsd/snaama/downloads
- World Bank Databank (World Economic Indicators): http://databank.worldbank.org/data/home.aspx
- International Standard Industrial Classification of All Economic Activities - ISIC rev. 4: https://unstats.un.org/unsd/publication/SeriesM/seriesm_4rev4e.pdf

ANNEX 1: RATIO BETWEEN RAINFED AND IRRIGATED YIELDS – NATIONAL LEVEL ESTIMATES[9]

Country	Ratio between Rainfed and Irrigated yields
Afghanistan	0.472
Algeria	0.471
Angola	0.687
Argentina	0.592
Australia	0.461
Bangladesh	0.633
Benin	0.718
Bolivia (Plurinational State of)	0.499
Botswana	0.748
Brazil	0.543
Burkina Faso	0.733
Burundi	0.429
Cambodia	0.619
Cameroon	0.658
Canada	0.484
Chad	0.724
Chile	0.569
China	0.650
Colombia	0.624
Congo	0.693
Costa Rica	0.742
Côte d'Ivoire	0.378
Cuba	0.448
Democratic People's Republic of Korea	0.566
Democratic Republic of the Congo	0.327
Dominican Republic	0.621
Ecuador	0.565
El Salvador	0.706
Eritrea	0.413
Ethiopia	0.728
Gabon	0.731
Gambia	0.589
Ghana	0.643
Guatemala	0.495
Guinea	0.520
Haiti	0.472
Honduras	0.596
India	0.460
Indonesia	0.620
Iran (Islamic Republic of)	0.398
Iraq	0.454

[9] For the countries not included in the table, the generic default ratio (0.563) can be used.

Country	**Ratio between Rainfed and Irrigated yields**
Israel	0.522
Jamaica	0.658
Japan	0.647
Jordan	0.563
Kenya	0.737
Lao People's Democratic Republic	0.723
Lebanon	0.538
Lesotho	0.347
Liberia	0.580
Libya	0.374
Madagascar	0.500
Malawi	0.736
Malaysia	0.639
Mali	0.824
Mauritania	0.280
Mauritius	0.594
Mexico	0.526
Morocco	0.557
Mozambique	0.706
Myanmar	0.652
Nepal	0.392
New Zealand	0.776
Nicaragua	0.636
Niger	0.453
Nigeria	0.469
Pakistan	0.418
Panama	0.604
Paraguay	0.377
Peru	0.502
Philippines	0.777
Republic of Korea	0.668
Russian Federation	0.508
Rwanda	0.715
Senegal	0.558
Sierra Leone	0.301
Somalia	0.312
South Africa	0.471
Sri Lanka	0.606
Sudan	0.285
Swaziland	0.710
Syrian Arab Republic	0.482
Thailand	0.471
Togo	0.639
Tunisia	0.466

Country	Ratio between Rainfed and Irrigated yields
Turkey	0.622
Uganda	0.890
United Republic of Tanzania	0.383
United States of America	0.633
Uruguay	0.615
Venezuela (Bolivarian Republic of)	0.649
Viet Nam	0.492
Yemen	0.427
Zambia	0.347
Zimbabwe	0.604

Annex 2: Overview of sectoral water-use

☑ surface freshwater ☑ renewable groundwater ☑ fossil groundwater ☑ direct use of non-conventional water (direct use of treated wastewater, direct use of agricultural drainage water, desalinated water)

AGRICULTURAL WATER-USE

ISIC sector A

Freshwater-use for **irrigation**	irrigation purposes	✓	**agricultural** water-use
	irrigated fodder	✓	**agricultural** water-use
	irrigated meadows and pastures	✓	**agricultural** water-use
Freshwater-use for **livestock**	livestock watering	✓	**agricultural** water-use
	sanitation	✓	**agricultural** water-use
	cleaning of stables etc.	✓	**agricultural** water-use
	irrigated fodder	✗	**agricultural** water-use
	Irrigated meadows and pastures	✗	**agricultural** water-use
Freshwater-use for **aquaculture**	aquaculture purposes	✓	**agricultural** water-use
	transformation of agricultural products	✗	**MIMEC** water-use
Non-conventional water-use	agricultural purposes	✓	**agricultural** water-use
	However, if the water is provided by/connected to the public water supply network, it should be included under the category of services water-use, regardless of its use.	✗	**services** water-use (**agricultural** water-use if data available)

MIMEC WATER-USE ISIC sectors B, C, D and F			
Freshwater and non-conventional water-use	self-supplied industries not connected to the public distribution network	✓	**MIMEC** water-use
	cooling of thermos-electric, hydroelectric and nuclear power plants	✓	**MIMEC** water-use
	hydropower	✗	Not included
	losses for evaporation from artificial lakes used for hydropower production	✓	**MIMEC** water-use
Non-conventional water-use	MIMEC sector purposes	✓	**MIMEC** water-use
	However, if the water is provided by/connected to the public water supply network, it should be included under the category of services water-use, regardless of its use.	✗	**services** water-use (**MIMEC** water-use if data available)
SERVICES[10] WATER-USE ISIC sectors E, G-T			
Freshwater-use	total water-use by the **public distribution network**	✓	**services** water-use
	agriculture and industries **connected to** the municipal distribution network	✓	**services** water-use
Non-conventional water-use	services purposes	✓	**services** water-use

[10] In AQUASTAT, Services water withdrawal is reported as Municipal water withdrawal.

ANNEX 3: GUIDELINES FOR IDENTIFICATION AND PROCESSING OF ECONOMIC DATA

1. INTRODUCTION

SDG 6 – **Ensure availability and sustainable management of water and sanitation for all** – is one of the 17 Sustainable Development Goals (SDGs) adopted in 2015. The SDG 6 contains eight targets (six on outcomes in regards to water and sanitation and two on the means of implementing) and ten core suggested indicators for monitoring global progress. The indicators under target 6.4 comprise SDG 6.4.1 "change in water-use efficiency over time" and SDG 6.4.2 "Level of water stress". Five Proof of Concept (POC) countries (Jordan, Netherlands, Peru, Senegal and Uganda) were selected to test the methodologies developed by UN organizations on the indicators linked to SDGs 6.3 to 6.6.

This report focuses on the types, sources, and utilization of economic data required for computing the SDG 6.4.1 indicator – 'change in water-use efficiency over time'. This indicator is supposed to provide information on the efficiency of the economic usage of water resources by the three aggregated sectors (agriculture, MIMEC, and services; following the ISIC rev. 4 coding). The water-use efficiency for a given major economic sector is broadly defined as gross value added of the sector divided by the volume of water use by the sector. Besides the water use data; the effective construction and usage of this indicator as a monitoring tool for SDG 6.4.1, depends on the accurate definition of the types of economic data, identification of data sources, and proper utilization of the data over time.

The report is structured as follows. Section 2 documents the types of economic data and the national and international data sources for computing the SDG 6.4.1 indicator. Section 3 provides guidelines on how to identify relevant economic data from national accounts system (national and international). A step-by-step guideline of adjusting economic data for price changes over time, esp. use of deflator in standardizing time series economic aggregates, is provided in section 4. The last section provides concise concluding statements and key points for consideration while compiling economic data. At the end of the report, tables with relevant economic data for the five POC countries are included as annexes.

2. TYPES OF ECONOMIC DATA AND NATIONAL/INTERNATIONAL SOURCES

This section provides the types and sources of economic data needed for computing the SDG 6.4.1 indicator. An economic sector's *water-use efficiency (WUE)*, as a sectoral indicator to the SDG 6.4.1, is defined as the '**value added'** of a given major economic sector divided by the '**volume of water used'** by the sector. The change in this indicator over time shows the trend in water-use efficiency across the major economic sectors and the economy at large over time. Based on the ISIC-4 coding system, the three major economic sectors are:

- *Agriculture*: (agriculture, forestry, and fishing) (ISIC. A). For the purpose of water-use efficiency computation in agriculture, this sector includes all the economic classes as defined in ISIC 4 except fresh water fishing, marine fishing and forestry.
- *MIMEC*: This includes mining and quarrying, manufacturing, electricity/gas/steam/air-condition supply, and construction (ISIC. B, C, D, F).
- *Services:* all the service sectors (ISIC 36-39) and (ISIC 45-98). 'Services' sector includes a wide range and diverse categories of economic activities. Based on the ISIC 4 classification, 16 industrial *sections* (i.e., ISIC. G -U plus ISIC- E) out of the 21 industrial *sections* and 52 out of the 89 industrial *divisions* are included in 'services' category.

The WUE at the overall economy level is the sum of the efficiencies in the three sectors weighted according to the proportion of water used by each sector over the total use. Data on water use by economic sectors are available in FAO-AQUASTAT. To compute the WUE indicator, the 'value added' data of the major sectors need to be defined and the sources of these data need to be identified.

2.1 Economic data for computing 'Water-use efficiency in agriculture' $[A_{we}]$

The WUE in irrigated agriculture (A_{we}) is used as a proxy indicator for the WUE in agriculture sector. This has been defined as **'gross value added in agriculture** (GVA_a)' per '**agricultural water use (V_a)'** (in USD/m^3). According to the ISIC Rev. 4, 'Agriculture' corresponds to divisions 01-03 (i.e., crops and animal production, forestry, and fishing). For the purpose of WUE in agriculture, fresh water fishing, marine fishing, and forestry are excluded. The type of economic data needed for computing WUE in agriculture sector are:

i) Gross value added by agriculture (GVA_a): it is calculated by adding up all agricultural outputs and subtracting intermediate inputs; but without making deductions for depreciation of fixed assets or depletion and degradation of natural resources. It should be noted that in calculating water-use efficiency in agriculture, the GVA_a figure needs to exclude value added from forestry and fishing. If 'gross value added by agriculture' is reported as a single aggregate value (including forestry and fishing) in a national accounts system, forestry and fishing values need to be deducted. For example, according to the Ugandan Bureau of Statistics, in the 2015 'GDP by economic activity', the national accounts of Uganda which was based on the ISIC rev. 4 coding, agriculture, forestry and fishing (ISIC: A) has a sectoral gross value added of 12,229 billion Ugandan Shillings (at 2009/10 constant price). This includes the value of forestry and fishing amounting to 2836 billion Ugandan Shillings. Thus, the GVA_a for computing the SDG 6.4.1 indicator should be 9393 billion Ugandan Shillings (i.e., 12,229 –2836 = 9393).

ii) Proportion of agricultural value added by rainfed agriculture (C_r): In countries where rainfed agriculture dominates the agricultural sector, a large proportion of agricultural GVA in national accounts comes from values produced by rainfed agriculture. As the rainfed system does not entail direct water abstraction, the value added from this system needs to be deducted from the total agricultural GVA in order to obtain a realistic figure of WUE in agriculture. However, disaggregated value added data in rainfed and irrigated agriculture are not commonly reported in national accounts. Using the methodology provided in the metadata for SDG 6.4.1 indicator, the C_r can be calculated from the total cropland area of a country and the default yield ratio between rainfed and irrigated agriculture (i.e., 0.563). Data on the area of cropland is readily available from individual country's land use data or FAOSTAT or from other organizations, e.g., the World Bank.

2.2 Economic data for computing 'Water-use efficiency in the MIMEC sector $[M_{we}]$

For the purpose of SDG 6.4.1 indicator, water-use efficiency in MIMEC (M_{we}) is defined as the gross MIMEC value added (GVA_m) per unit of MIMEC water use (V_m), i.e., $M_{we} = GVA_m / V_m$ (expressed in USD/m^3). In this definition, the subscript m represents aggregated MIMEC divisions including mining and quarrying, manufacturing, electricity/energy, and construction (ISIC B, C, D, F; based on ISIC rev. 4).

The 'value added' data can be computed by adding the value added of each of the four MIMEC divisions as defined in ISIC coding. However, it is important to note that different agencies (government or international) may pursue slightly different approaches in compiling the national accounts. For instance, the UNSD 'National Accounts Main Aggregates Database' compiles the 'valued by economic activity' following ISIC rev. 3. Accordingly, the gross value added data can be obtained from ISIC (rev. 3): C, D. E, and F., but the data is presented in three different columns: aggregated data of Mining (C), Manufacturing (D) and Utilities (E); Manufacturing (D) in a separate column; and construction (F) in a different column. So, when one extracts GVA_m from different databases (national or international), one has to be careful in order to avoid double counting or underestimation.

2.3 Economic data for computing 'Water-use efficiency in Services' $[S_{we}]$

Water-use efficiency in services is defined as the service sector value added (ISIC 36-39) and (ISIC 45-98) $[GVA_s]$ divided by the volume of water used $[V_s]$ for distribution by the water collection, treatment and supply industry (ISIC 36), expressed in USD/m³. According to the ISIC rev. 4, 'Services' sector comprises of 52 industrial divisions within (ISIC 36-39) and (ISIC 45-98). This sector includes a wide range and diverse categories of economic activities. According to the methodology proposed by the UN-Water for SDG 6.4.1 indicator (Proof-of-Concept), the industrial coding-E or ISIC36-39 (i.e., 'Water Supply' sector based on ISIC rev. 4) is included in service sector and hence the value added from this coding should be included into 'service sector value added'. However, in national accounts main aggregates database (e.g., World Bank; UNSD; and OECD), the value added of coding ISIC36-39 is added into the 'industrial value added' aggregate rather than the 'service sector value added'. Furthermore, the industrial origin of value added may vary between ISIC rev. 3 and ISIC rev. 4. For instance, while 'Water Supply' is merged with 'Electricity' according to the ISIC rev. 3 coding; in ISIC rev. 4 the 'electricity' and 'water supply' have a distinctive coding. To illustrate, let's examine the 2015 Ugandan national accounts. In this data set, the aggregate services sector valued added (at constant local currency unit, 2010=100) is 27,451 billion Ugandan shillings. But this does not included the 'value added' of the 'Water Supply' sector (i.e. ISIC coding-E) which amounts to 3504 billion Ugandan Shillings. Thus, the correct service sector value added $[S_{we}]$ to be used in service sector water-use efficiency computation should be 30, 955 billion Ugandan Shillings (i.e., the sum of 27,451 and 3504).

2.4 Sources of 'value added' data for the major sectors

Most countries compile their national accounts using the internationally agreed standard set of recommendations provided in the Systems of National Accounting (SNA); mainly using either the SNA-1993 (http://unstats.un.org/unsd/nationalaccount/docs/1993sna.pdf) or the SNA-2008 (http://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf) recommendations. The set of concepts, definitions, classifications and accounting rules recommended in the SNA allow international comparison of data and economic performance among countries. Essentially, three approaches (output approach, expenditure approach, and income approach) are used to compile economic data in national accounts. The 'output approach' provides sectoral 'value added' data following the ISIC 3 or 4 coding. Thus, the 'value added' for computing SDG 6.4.1 indicator for the major economic sectors (agriculture, MIMEC, and services) can be obtained from national statistical departments or other relevant national government agencies and international sources such as the World Bank, UNSD, and OECD databases some of which are listed in Table 2.

Table 2. Key sources of sectoral gross value-added data

Economic data types (three major sectors)	• *Gross value added by agriculture* • *Gross value added by the MIMEC sectors* • *Gross value added by services*

Key data sources: International	• World Bank Databank (World Economic Indicators): http://databank.worldbank.org/data/home.aspx • UNSD: https://unstats.un.org/unsd/snaama/downloads • FAOSTAT: http://www.fao.org/faostat/en/ • OECD – national accounts data files: http://www.oecd-ilibrary.org/economics/data/oecd-national-accounts-statistics_na-data-en
Key data Sources: National (examples from the POC countries	• ***Jordan***: Department of statistics (DoS) – national accounts. The DoS website contains national accounts data from 1976-2009 based on ISIC Rev. 3. From 2014 onwards, quarterly national accounts data is available in this website. http://web.dos.gov.jo/sectors/national-account/ • ***Netherlands****:* Centraal Bureau voor der Statistiek (CBS) – Statistics Netherlands http://statline.cbs.nl/Statweb/dome/?TH=5490&LA=en • ***Peru****:* El Instituto Nacional de Estadísticas e Informática– INEI (Spanish). The National Institute of Statistics and Informatics (English). INEI, through its national accounts department, compiles data on gross aggregate value added of all economic activities. http://www.inei.gob.pe/estadisticas/indice-tematico/economia/ • ***Senegal****:* l'Agence Nationale de la Statistique et de la Démographie –ANSD (French). National Agency for Statistics and Demography (English). http://www.ansd.sn/# • ***Uganda****:* Uganda Bureau of Statistics (UBOS) http://www.ubos.org/statistics/macro-economic/national-accounts/

3. Guidelines: How to identify data within the national accounts – (including some examples)

The economic data (i.e., value added by economic sectors) for computing the SDG 6.4.1 indicator are derived by aggregating data from several economic activities. These data can be organized and aggregated in different ways in national accounts system, for example, by expenditure categories (e.g., consumption, investment, government, and import/export) or by economic activity (e.g., following the International standard industrial classification of all economic activities (ISIC) coding system). The ISIC itself has undergone different revisions. For instance, ISIC rev. 3/3.1 and ISIC rev. 4 show differences as far as the industrial classification of economic activities is concerned. Though the ISIC rev. 4 coding system was suggested for computing SDG 6.4.1 indicator, we may not find economic data organized following ISIC rev. 4 classification system for all countries and/or all economic sectors. On the other hand, various international agencies (e.g., World Bank, UNSD, OECD, and FAOSTAT) have their own way of organizing and aggregating macro-economic data in their respective databases. The following paragraph provides guidelines on how to identify relevant economic data from standard national accounts system for computing the SDG 6.4.1 indicator.

Step-by-step guide to identify relevant economic data for computing SDG 6.4.1:

A. *Understand/identify the approaches to data compilation in national accounts:* As highlighted in section 2 above, the major sources of sectoral value-added data is national accounts of individual countries though relevant data could also be available at custody of various relevant ministries or other national authorities. Different agencies or organizations could be involved in collecting, processing/summarizing and compiling sectoral economic data and these data could be kept electronically and/or in print at various locations or web sites. National accounts data can be compiled and presented using the output approach, expenditure approach, or income approach. The 'output approach' of national accounts provides 'value added' data by major economic sectors which could provide relevant value added data for computing SDG 6.4.1 indicator. Thus, one has to focus on the *National Accounts Main Aggregates* produced using the 'output approach' which is commonly used by most countries. But if a country does not pursue 'output approach' and 'value added by economic activity' data cannot be obtained directly, one has to be very cautious in extracting and aggregating data from relevant sources.

B. *Understand/identify the classification of economic activities (i.e., which ISIC coding adopted?)*: The actual magnitude of sectoral gross value added depends on how all economic activities are classified. Some countries compile national accounts data using the ISIC rev. 3 and others adopt the ISIC rev. 4.

Example: Two of the POC countries, the Netherlands and Uganda have adopted ISIC rev. 4 coding system for compiling their national accounts by economic activities. According to the methodologies proposed by UN agencies for the SDG 6.4.1 indicator, for example, 'MIMEC' includes mining and quarrying, manufacturing, electricity/gas, and construction (ISIC. B, C, D, F) respectively. But, the OECD database for the Netherlands shows the aggregation of ISIC: B, C, D, and E as a '*gross value added by industry*' sector. This is not consistent with the definition of the 'gross value added by MIMEC' proposed by UN agencies for the SDG 6.4.1 indicator; because it excludes 'Construction' sector (ISIC. F), but includes 'Water Supply' sector (ISIC. E). Thus one has to adjust this inconsistency before computing the water-use efficiency in the MIMEC sectors. On the other hand, Statistics Netherlands (StatLine) provides separate value added figures for ISIC: B, C, D, E, and F (see the table below). Thus, for instance, the industrial gross value added for 2015 can be computed by adding the relevant economic activities (B, C, D and F), which is equal to 118, 121 (million Euro).

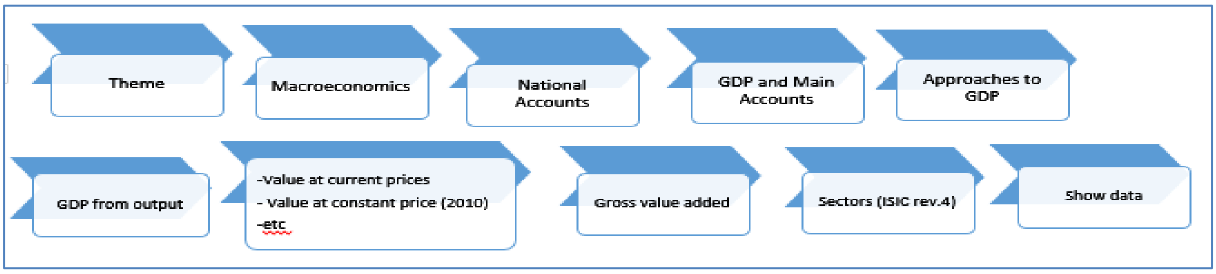
			Periods	2007	2008	2009	2010	2011	2012	2013	2014	2015*
Gross value added basic prices	B-E Industry (no construction), energy	Total	mln euro	100 563	104 723	92 601	95 149	99 481	101 456	99 658	95 277	93 694
		B Mining and quarrying		16 071	21 507	16 239	17 283	18 559	21 327	22 161	17 072	12 573
		C Manufacturing		74 866	73 899	65 005	67 024	69 979	69 074	66 676	68 004	71 120
		D Electricity and gas supply		6 202	5 633	7 829	7 301	7 277	7 458	7 206	6 479	6 380
		E Water supply and waste management		3 424	3 684	3 528	3 541	3 666	3 597	3 615	3 722	3 621
	F Construction			31 033	33 369	33 636	30 531	30 295	27 826	26 456	27 223	28 048

Source: Statistics Netherlands (accessed 30 Dec 2016).
http://statline.cbs.nl/Statweb/publication/?DM=SLEN&PA=82262ENG&D1=4-9&D2=12-20&LA=EN&VW=T

C. *Understand/identify the metadata*: a good understanding of the definitions, concepts, assumptions, statistical methodology, and aggregation methods employed is important for effective use of the economic data in national accounts. For example, major international organizations such as the World Bank Data, FAO, UNSD, and OECD have included metadata for their databases that users can refer to in order to understand the definitions, aggregations methods, etc. of the different variables/factors included in the database.

D. *Understand/identify how the data was structured or organized*: national accounts data can be presented in series of tables using simple spreadsheet format (e.g., Uganda Bureau of Statistics- http://www.ubos.org/statistics/macro-economic/national-accounts/) or structured in a database (e.g., the national accounts data by Statistics Netherlands- http://statline.cbs.nl/Statweb/dome/?LA=en; the World Bank Databank; and the UNSD National Accounts Main Aggregates Database) or in printed reports. Particularly, if data is organized in a structured database, it is important to understand how to navigate or query the database to identify the relevant economic data.

Example: Statistics Netherlands (CBS) website (www.cbs.nl) publishes the Netherlands national accounts figures in the electronic databank which can be found under the 'Theme' Macroeconomics. To access the sectoral value added data from the CBS database, one has to know how to navigate the data base as shown below.



E. *Understand data access condition (open access vs. restrictions)*: Though most data sources of national accounts is open access, there may be some restriction to specific data types. So, it is important to understand data access conditions.

4. Guidelines: How to utilize data (with particular focus on deflators to standardize data over time)

4.1 Effect of price changes

SDG runs for a period of 15 years (2015-2030). Values of sectoral aggregates in national accounts over time need to be adjusted in order to correct for price changes. These values generated over time need to be adjusted to compare and monitor the trends on real changes in water-use efficiency of the economic sectors. This necessitates conversion of the values over time into a base year (i.e., 2015) using a conversion factor. This section provides guidelines on how to standardize economic data over time measured in 'current prices' into a 'constant' base year (2015) data using GDP deflators and/or other sectoral deflators, e.g., value added deflator in agriculture.

GDP and other main aggregates in national accounts can be expressed in terms of either current or constant prices. Current price figures measure value of transactions in the prices relating to the period being measured. On the other hand, constant price data for each year are in the value of the currency at a particular base year. For example, a GDP data reported in constant 2015 prices show data for 1995, 2005, and all other years in 2015 prices. Current series are influenced by the effect of price changes; so in order to compare and monitor the real changes over time, it is important to adjust for the effects of price changes. Suppose that an agricultural value added rises from 100 million to 110 million in year 2011, and inflation of agricultural goods is about 6%. If 2010 is used as the base year, the 2011 agricultural value added in the base year prices, would be approximately 104 million, reflecting its true growth is only about 4%.

4.2 How to remove the effect of price changes over time?

The effects of price changes over time on a time series data can be eliminated by using price indices. The GDP deflator (also known as implicit price deflator) is an important and a much broader price index compared to other price indexes such as the consumer prices index (CPI) and the retail prices index (RPI) that are used to measure consumer inflation. The GDP deflator is a price index measuring the average prices of all goods and services included in the economy. The GDP deflator can be viewed as a measure of general inflation in the domestic economy. It is a tool used to measure the level of price changes over time so that current prices can be accurately compared to a base year prices. In other words, it eliminates the effects of price changes over time i.e., it converts nominal values to real values. The nominal value of any economic statistic is measured in terms of actual prices that exist at the time and the real value refers to the same economic statistic after it has been adjusted for price changes. The GDP deflators user guide (UK) (see the web link below) could be a useful further reading. (https://www.gov.uk/government/publications/gross-domestic-product-gdp-deflators-user-guide)

The GDP deflator or other sectoral price deflator (e.g., value added deflator in agriculture) can be calculated by dividing the current nominal value (say nominal GDP) by the real value (say real GDP) of a selected base year. The base year is the year whose prices are used to compute the real value. To illustrate this, let's use the data in Table 2 from the U.S. Bureau of Economic Analysis (BEA). When we calculate real GDP, we take the quantities of goods and services produced in each year and multiply them by their prices in the base year, in this case, 2005.

Table 2. Nominal GDP and GDP deflator (USA: 2005=100)*

Year	Nominal GDP (billions USD)	GDP deflator
1960	543.3	19.0
1965	743.7	20.3
1970	1,075.9	24.8
1975	1,688.9	34.1
1980	2,862.5	48.3
1985	4,346.7	62.3
1990	5,979.	72.7
1995	7,664.0	81.7
2000	10,289.7	89.0
2005	13,095.4	100.0
2010	14,958.3	110.0

Source: www.bea.gov (U.S. Bureau of Economic Analysis). *"2005=100" means 2005 is the *base year*.

Given the GDP deflator series, however, we can easily convert nominal GDP to real GDP using the formula: $Real\ GDP = \frac{Nominal\ \ GDP}{GDP\ \ deflator} \times 100$. Thus, the real GDP, for example, of 2010 can be computed as: $\frac{\$14{,}958.3\, billion}{110} \times 100 = \$13{,}598.5\, billion$.

In general, as long as inflation is positive, i.e., prices increase on average from year to year, real GDP is lower than nominal GDP in any year after the base year. Similarly, real GDP is greater than nominal GDP in any year before the base year in situations where prices increase over time.

Note: To convert nominal economic data from several different years into a real value, i.e., inflation-adjusted data, first choose the base year and then use a price index (GDP deflator in the case of GDP data series) to convert the measurements so that they are measured in the prices prevailing in the base year. For the aggregate sectoral value added figures to be used in computing the SD G6.4.1 indicator, the suggested base is year 2015, unless differently defined at country level. Thus, all future flows of sectoral value added data can be converted to the base year by using either the GDP deflator series over the period or their respective sectoral deflator series (if sectoral deflators are available).

4.2.1 Changing the base year (i.e rebase)

As indicated above the actual value of annual deflator values depend on the base year. In some instances, it may be necessary to change the base year. The simplest way to change the base year is to divide all the deflators by the value of the deflator in the new base year and then multiply by 100. For example, to rebase the deflator series in Table 2 so that the year 1990 is the base year (i.e. 1990=100), we recalculate the deflators as shown in Table 3.

Table 3. Changing the base year

Year	Nominal GDP (billions USD)	GDP deflator (2005=100)	GDP deflator (1990=100)
1960.0	543.3	19.0	26.1
1965.0	743.7	20.3	27.9
1970.0	1075.9	24.8	34.1
1975.0	1688.9	34.1	46.9
1980.0	2862.5	48.3	66.4
1985.0	4346.7	62.3	85.7
1990.0	5979.0	72.7	100.0
1995.0	7664.0	81.7	112.4
2000.0	10289.7	89.0	122.4
2005.0	13095.4	100.0	137.6
2010.0	14958.3	110.0	151.3

4.3 STEPS TO STANDARDIZE AGGREGATE SECTORAL VALUE ADDED DATA TO A BASELINE YEAR: USER GUIDE

The GDP and other main aggregates data in national accounts such as the value added of the major economic sectors are normally reported in current prices (nominal value). To be able to compare and monitor the changes in water-use efficiency over time (SDG 6.4.1), these nominal data need to be standardized into a common base year. The following step-by-step approach can be used to guide standardization of the data:

I. ***Identify or select a base year***: The base year is the year whose prices are used to convert nominal values into real value to enable comparison of data over time. In national accounts database, the base year vary from country to country. For example, two of the POC SDG6 countries (Netherlands and Uganda) adopted 2010 as their base year for adjusting price changes in the national accounts data. Since the base year for SDG 6.4.1 is 2015, the future value-added data for the economic sectors need to be adjusted to the 2015 base year.

II. ***Identify the relevant price index series (i.e., the deflators)***: Nowadays, the data sources of national accounts (both national and international sources) also include GDP implicit deflators. National accounts data sources for some countries also provide sectoral deflators such as price deflators for agriculture and industry sectors. Use of sectoral deflators is recommended if such data is available. Table 4 shows the GDP deflator and price deflator for major economic sectors for the Ugandan economy (2009/10=100). This series can be used to adjust nominal figures (value added) to price changes in the three respective major sectors.

Table 4. GDP and sectoral deflators (Uganda, local currency unit (LCU))

	ISIC Rev.4	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
GDP deflator	Economy	105.6	100.0	106.3	129.2	133.8	139.7	147.9	157.7
Agriculture deflator	A	87.9	100.0	107.0	140.6	143.6	149.4	155.0	160.7
Industry deflator	B-F	190.5	100.0	113.1	145.0	146.2	146.0	147.2	156.3
Services deflator	G-T	86.5	100.0	103.9	121.6	126.9	135.4	146.6	158.9

Source: Ugandan Bureau of Statistics

III. ***Identify the relevant economic nominal data series***: After selection of the base year and identification of relevant deflator series, the next step is to identify the relevant gross value added (nominal) data. Data types and sources were already discussed in sections 2 and 3. Table 5 shows the nominal value added data (in local currency) for the three major sectors of Ugandan economy.

Table 5. GDP and sectoral Gross Value Added (GVA), Uganda (in Billions of Ugandan Shillings, current prices)

	ISIC Rev.4	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
GDP (current prices)	Economy	40,922	40,942	47,649	60,134	64,465	70,882	78,770	87,891
Agriculture (GVA)	A	9,166	10,731	11,860	15,691	16,338	17,507	18,587	19,880
Industry (GVA)	B-F	13,110	7,424	9,349	12,345	12,714	13,507	14,679	16,051
Services (GVA)	G-T	16,039	19,857	23,055	28,065	30,843	34,752	39,323	45,426

Source: Ugandan Bureau of Statistics

IV. ***Apply the formula***: Divide the nominal (current) gross valued added by the relevant price index (or deflator). For example, adjusting the nominal GVA (service sector) in Table 5 using the services deflator in Table 4 gives us the following real GVA for the services sector.

	ISIC Rev.4	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Services (real GVA)	G-T	**18,548**	**19,857**	**22,184**	**23,078**	**24,312**	**25,662**	**26,816**	**28,589**

V. ***Convert the real GVA in LCU into USD equivalent using the appropriate exchange rate and utilize the standardized data (real values in USD) for computing the SDG 6.4.1 indicator:*** In order to enable meaningful aggregations and comparisons over time, GVA figures expressed in LCU - at constant prices - shall be converted to a common currency, i.e. the US dollar, using an appropriate exchange rate for the base year. The so-called 'market exchange rate' (MER), which is the rate prevailing in the foreign exchange market, is generally used for this conversion. When MERs are not available, United Nations operational rates of exchange represent a valid alternative. National Accounts data expressed in US dollars may be distorted by fluctuations in exchange rates and domestic inflation movements. In these cases, price-adjusted rates of exchange (PARE) can be used. Each relevant exchange rate among those described above (i.e. MERs, UN operational rates and PAREs) is available for every country in the National Accounts – Analysis of Main Aggregates (AMA) database maintained by the United Nations Statistics Division[11] (UNSD). The methodologies used to determine these rates and identify the most appropriate one given a country's situation, are described in Annex 4. An overview of an alternative exchange rate based on the purchasing power parity (PPP) approach and of the related advantages and disadvantages, is provided as well in the same Annex.

CONCLUSIONS/RECOMMENDATIONS

This report has explored the types of economic data for computing SDG 6.4.1, the national and international sources of these data, and the guidelines on how to identify the data from national account systems and how to standardize/utilize value-added time series data using conversion factors (deflators). The study consulted diverse national data sources (mainly Statistical Departments of the five POC countries) and international sources such as the World Bank, UNSD, FAO-STAT, AQUASTAT, UNSD, UN-Water, and OECD. Overall, the relevant economic data for computing SDG 6.4.1 are available and can be pooled from various sources. However, the following key challenges were recognized during the course of this study:

- *Compilation of data in national accounts system*: though all countries are encouraged to adopt the SNA-2008 recommendations in compiling their national accounts; some countries such as Jordan still use the SNA-1993. This may lead to inter-country comparison difficult.
- *Classification of economic activities adopted in national accounts system*: With regard to the classification of economic activities; some countries compile their national accounts using the ISIC rev. 3 and others adopt the ISIC rev. 4. This could lead to inconsistency in aggregating the major economic sectors. Thus one has to understand the different industrial classification system and adjust possible aggregation inconsistencies before using the 'sectoral gross value-added' for computing the water-use efficiency for the sector.

[11] https://unstats.un.org/unsd/snaama/downloads

- *Lags in data availability*: For some countries it is difficult to find recent 'value-added by economic activity' data in public domain.
- *Base year (GDP deflators)*: different countries and other national accounts data compiling organization use different base years for converting 'current or nominal' data to 'real or constant' data. Future computations of SDG 6.4.1 indicator need to be based on a base year of 2015.

5. References

- AQUASTAT database: http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en
- FAOSTAT: http://www.fao.org/faostat/en/
- GEMI POC Countries Reports (Jordan, Netherlands, Peru, Senegal, Uganda)
- ISIC rev 3. and ISIC rev 4:
  - https://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=17
  - http://unstats.un.org/unsd/cr/registry/isic-4.asp
- OECD: national accounts data files: http://www.oecd-ilibrary.org/economics/data/oecd-national-accounts-statistics_na-data-en
- POC Countries Statistical Web sites (Refer Table 1)
- UNSD: National Accounts – Analysis of Main Aggregates: https://unstats.un.org/unsd/snaama/downloads
- UN-Water/GEMI: http://www.unwater.org/gemi/en/
- World Bank: World Bank Databank (World Economic Indicators): http://databank.worldbank.org/data/home.aspx

ANNEX 4: CONVERSION OF GVA FIGURES FROM LCU TO USD

Two different types of exchange rates may be used to convert GVA figures expressed in LCU to a common currency, i.e. the US dollar: the so-called 'market exchange rate', which is the rate prevailing in the foreign exchange market; and the purchasing power parity (PPP) exchange rate, which is the rate at which the currency of one country would have to be converted into that of another country (e.g. the US dollar) to buy the same amount of goods and services in each country (Callen, 2007).

International organizations use both of these approaches. In order to estimate real GDP growth, for instance, the World Bank uses market-based rates to determine the weights in its regional and global aggregations of real GDP, while the IMF and the OECD use weights based on PPP rates (although the IMF also publishes, in its World Economic Outlook, a global growth aggregate based on market rates) (Callen, 2007). Within the SDGs, PPP is being used in the context of selected indicators under the following goals: 1 ('End poverty in all its forms everywhere); 3 ('Ensure healthy lives and promote well-being for all at all ages'); 7 ('Ensure access to affordable, reliable, sustainable and modern energy for all') and 9 ('Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation').

PPP exchange rates present some advantages over MERs, as they tend to be less volatile than the latter. While MERs are relevant only for internationally traded goods, PPP rates account as well for differences in the prices of nontraded goods across countries, resulting in more accurate estimates of the output of economies and the welfare of their inhabitants, controlling for price level differences across countries (Callen, 2007).

However, the PPP approach presents some disadvantages as well, which limit its applicability. Overall, PPP is harder to measure than market-based rates. Even though the World Bank, under the auspices of the UNSC, leads a worldwide statistical initiative – i.e. the International Comparison Programme[12] (ICP) – collecting and comparing price data and GDP expenditures to estimate purchasing power parities of the world's economies, new price comparisons are available only at infrequent intervals. In between survey dates, PPP rates have to be estimated, which can introduce inaccuracies into the measurement (Callen, 2007). In light of this and considering that the latest ICP figures date back to 2011, the PPP approach may not be optimal for indicator 6.4.1, which foresees 2015 as base year and for which an annual data collection process and a reporting period of not more than two years are recommended.

Market exchange rates can be obtained from one of IMF's principal statistical datasets, i.e. International Financial Statistics[13] (IFS). These MERs are averages of the market rates communicated to the IMF by the Monetary Authority of each member country or end-of-month quotations in the market of the country. MERs are generally comprised of three types of rates: a) market rates, determined mainly by market forces; b) official rates, set by government authorities; and c) principal rates, for countries maintaining multiple exchange rates arrangements (UNSD, no date).

When MERs from the IMF are not available, United Nations operational rates of exchange are used. These rates, which were established for accounting purposes and are used in official transactions of the UN, are based on official, commercial and/or tourist rates of exchange (UNSD, no date). In its National Accounts – Analysis of Main Aggregates (AMA) database[14], UNSD provides information on the MER, or alternatively the UN operational rate, for every country.

[12] http://www.worldbank.org/en/programs/icp
[13] http://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B
[14] https://unstats.un.org/unsd/snaama/downloads

National Accounts data expressed in US dollars may be distorted by fluctuations in exchange rates and domestic inflation movements. In order to detect and minimize such distortions, the data are examined by UNSD to identify countries for which changes in the per capita GDP converted in US dollars are not consistent with the economic developments in the country as reflected by the relative movements of domestic and international inflation. To this goal, a MER valuation index (MVI) is calculated for each country, using the following formula (UNSD, no date):

Assume,

R = growth rate of per capita GDP between period 1 and 2

P_{US} *= price changes in the US*

$E(Y_2)$ *= expected per capita GDP (in USD) in period 2*

Y_1 *= per capita GDP in period 1*

Then,

$E(Y_2) = r \times P_{US} \times Y_1$

and

$MVI = Y_2 / E(Y_2)$

The MER of countries experiencing considerable distortion in the conversion rates (i.e. with an MVI above 1.2 or below 0.8) is considered for adjustment by UNSD.

Example: Country A had a GDP per capita of 5,500 USD in 2015. Between 2015 and 2018, this figure grew by 10 percent, while prices in the US experienced an average increase of 7 percent.

Therefore:

E(2019) = 1.1 x 1.07 x 5,500 USD = 6,473.5 USD

and

MVI = 5,900 USD / 6,473.5 USD = 0.9

As the MVI is neither above 1.2 nor below 0.8, the MER of country A is not considered for adjustment.

Country B had a GDP per capita of 6,800 USD in 2015. During the 2015-2018 period, the GDP per capita increased by 15 percent, while prices in the US experienced an average increase of 7 percent.

Therefore:

E(2019) = 1.15 x 1.07 x 6,800 USD = 8,367.4 USD

and

MVI = 10,300 / 8,367.4 = 1.23

In this case, the MER valuation index above 1.2 suggests the existence of a distortion in the exchange rate and the need for an adjustment of the latter.

In case significant distortions are detected based on the MVI, UNSD uses price-adjusted rates of exchange (PAREs) as an alternative to the exchange rates reported by the IMF or UN operational rates of exchange. These rates are reported in the 'AMA exchange rate' row of the UNSD's National Accounts – Analysis of Main Aggregates database. During the 2010-2017 period, UNSD had to use the PARE only for one country, i.e. Venezuela.

The PARE is calculated using the following formula (UNSD, no date):

Assume,

x_t = *exchange rate for year t*

c_t = *current price GDP for year t*

k_t = *constant price GDP for year t*

d_t = *deflator for year t*

Then,

$d_t = c_t / k_t$

and

$PARE_t = x_{t+n} \text{ x } (d^{us}_{t+n} / d^{us}_t) \text{ x } (d_t / d_{t+n})$

The conversion based on PARE corrects the distorting effects of uneven price changes that are not well reflected in the other conversion rates.

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- Callen, T. 2007. "PPP Versus the Market: Which Weight Matters?" Finance and Development, March 2007, Volume 44, Number 1. https://www.imf.org/external/pubs/ft/fandd/2007/03/basics.htm
- IMF: International Financial Statistics: http://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B
- UNSD: National Accounts – Analysis of Main Aggregates: https://unstats.un.org/unsd/snaama/downloads
- UNSD. No date. Methodology for the National Accounts – Main Aggregates Database. https://unstats.un.org/unsd/snaama/assets/pdf/methodology.pdf
- World Bank: International Comparison Programme: http://www.worldbank.org/en/programs/icp

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