Food and Agriculture Organization of the United Nations

STEP-BY-STEP MONITORING METHODOLOGY FOR INDICATOR 6.4.1

CHANGE IN WATER USE EFFICIENCY OVER TIME

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

The indicator on water use efficiency (WUE) has been designed to address the economic component of the target 6.4. Such indicator did not exist in the previous MDG monitoring framework. The novelty of this indicator means that no data exist for it, so its computation and its interpretation must be faced anew.

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, or even better, the marginal productivity of the extra dose. Instead, this indicator shows the level of decoupling of economic growth from water use. In other terms, if the value added (VA) produced by the economy increases by 10%, how much will the water use increase?

These points have led to the following definition of the indicator: the value added per water used[1], 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 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

[1] 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.

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. In fact, while the indicator has a measurable and comparable value at every measurement instance, its meaning appears stronger 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. Proposed 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 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 ISIC 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. all the service sectors (ISIC E and ISIC G-T), hereinafter “services”

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 (V)

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 uses. In formula:

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

Where

- WUE = Water use efficiency
- A_{we} = Irrigated agriculture water use efficiency [USD/m^3]
- M_{we} = MIMEC water use efficiency [USD/m^3]
- S_{we} = Services water use efficiency [USD/m^3]
- 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

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/m^3]
- 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) [m^3]

The volume of water used by the agricultural sectors (V_a) is collected at country level through national records and reported in questionnaires, in units of m^3/year (see example in AQUASTAT http://www.fao.org/nr/water/aquastat/sets/aq-5yr-quest_eng.xls). 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 cultivated land[2], as follows:

$$C_r = \frac{1}{1 + \frac{A_i}{(1 - A_i) * 0.375}}$$

Where:

- A_i = proportion of irrigated land on the total cultivated land, in decimals

[2] This correspond to the category ´Arable land and Permanent crops´ of FAOSTAT.

- 0.375 = generic default ratio between rainfed and irrigated yields

More detailed estimations are however possible and encouraged at country level.

Water efficiency of the MIMEC sectors (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} = Industrial 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]

MIMEC water use (V_m) is collected at country level through national records and reported in questionnaires, in units of m^3/year (see example in AQUASTAT http://www.fao.org/nr/water/aquastat/sets/aq-5yr-quest_eng.xls)[3]. MIMEC value added is obtained from national statistics, deflated to the baseline year.

Water efficiency of the services sectors is calculated as the service sector value added (ISIC 36-39 and ISIC 45-98) divided by water used for distribution by the water collection, treatment and supply industry (ISIC 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 abstracted and distributed water are collected at country level from the municipal supply utilities records and reported in questionnaires, in units of km^3/year or million m^3/year (see

[3] 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.

example in AQUASTAT http://www.fao.org/nr/water/aquastat/sets/aq-5yr-quest_eng.xls). Services value added is obtained from national statistics, deflated to the baseline year.

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 directly related to/interlinked with 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 the 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 the indicator 6.4.1 – recognizing that countries have different starting points when it comes to water stress monitoring – allows countries to begin monitoring efforts at a level in line with 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 data. If needed, data can be retrieved from internationally accessible databases both for water use and for the economic data on water availability and uses by 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 steps, 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

Two set of data are needed to compute this indicator. Water use data will be utilized to calculate the denominators of the three indicator's components illustrated in the previous paragraph. Country economic statistics will be needed to compile the numerators of each component. 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 subsector, 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 of renewable groundwater or abstraction of fossil groundwater, direct use of agricultural drainage water and (treated) wastewater, and desalinated water.

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. If connected to the public water supply network, water used for livestock is included in the services water use.

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 sector A (1-3).

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 sector refers to self-supplied industries not connected to the public distribution network.

It is recommended to include in this sector the losses for evaporation from artificial lakes used for hydropower production. Data can be found at http://www.fao.org/3/a-bc814e.pdf and http://www.fao.org/nr/water/aquastat/dams/index.stm#evaporation. On the contrary, this sector does not include water abstracted for powering the hydroelectric turbines, as such water is immediately returned to the river bed.
This sector corresponds to the ISIC sectors B [5-9]; C [10-33], D [35] and F [41-43].

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 industries, which is connected to the municipal network.

This corresponds to the water abstracted for distribution by the ISIC sector E [36].[4]

3.1.2 Economic Data

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 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 fabricated 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 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 report 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 which amounts to 2,836 billion Ugandan Shillings. Thus, the GVA_a for computing the SDG 6.4.1 indicator should be 9,393 billion Ugandan Shillings (i.e., 12,229 –2,836 = 9,393).

3.1.2.1 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 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).

[4] See SEEA-W, table III.1

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.

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

3.1.2.2 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 E; G-T) $[GVA_s]$ divided by the volume of water use $[V_s]$ for distribution by the water collection, treatment and supply industry (ISIC 36), expressed in USD/m^3.

According to the ISIC rev. 4, 'Services' sector comprises of 52 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 UN-Water for the SDG 6.4.1 indicator (proof-of-concept), the ISIC coding 36-39 (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 the ISIC coding 36-39 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 3,504 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 3,504).

Units of volume:
1 km^3 = 1 billion m^3 = 1000 million m^3 = 10^9 m^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, but it does not produce new data. That means that without a specific effort by the countries, no update, and consequently no monitoring, could be done. This is due to the absence until now of a regular reporting system, which should indeed be put in place within the SDG process. Hence, in order to monitor the indicator over the years, a national data collection process needs to be established 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 3 or 4 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.

Table 1. 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: http://unstats.un.org/unsd/snaama/selbasicFast.asp • FAOSTAT: http://www.fao.org/faostat/en/#data/EL • OECD – national accounts data files: http://www.oecd-ilibrary.org/economics/data/oecd-national-accounts-statistics_na-data-en

Full guidelines for the preparation of the economic data are given in Annex 1.

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 updated and accurate as much as possible.
Building institutional capacity and coordination may be needed to carry on the data collection and processing tasks.

A specific questionnaire and a calculation sheet for the preparation of the indicators of the target 6.4 are available in Annex 2 of this document. As those questionnaires are 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 answer the questionnaire. 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 Institutions

In the institution table (sheet 4 of the questionnaire), provide complete information on the main institutions dealing with water resources for agriculture and rural development. For each institution, please indicate the organization type and the fields of activity. Further details can be given on activities such as research, development, planning, training, extension and education, monitoring and statistics.

3.3 Recommendations on data management

3.3.1 Data quality

As a general rule, the most recent available data must 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 data are known to be outdated, this fact should be mentioned in the "comments" column of the questionnaire. All relevant information must be provided in the "comments" column. In case the "comments" column does not offer enough space, a separate file (in Word or Excel) containing more explanations or clarifications needs to be created.

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, by 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:

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

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.

EXAMPLE

Example of calculation of the indicator under the proof-of-concept phase of GEMI

Country: the Netherlands

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.

5. (Background to the proposed indicator and methodology [0.5 page])

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, and distribution network losses.

The distribution efficiency of water systems is implicit within the calculations and could be made explicit if needed and where data are available.

This indicator addresses specifically the target component “substantially increase water-use efficiency across all sectors”, by measuring the output per unit of water from productive uses of water as well as losses in municipal water use. It does not aim at giving an exhaustive picture of the water utilization in a country. Other indicators, specifically those for Targets 1.1, 1.2, 2.1, 2.2, 5.4, 5.a, 6.1, 6.2, 6.3, 6.5 will complement the information provided by this indicator. In particular, the indicator needs to be combined with the water stress indicator 6.4.2 to provide adequate follow-up of the target formulation.

Together, the three sectoral efficiencies provide a measure of overall water efficiency in a country. The indicator provides incentives to improve water use efficiency through all sectors, highlighting those sectors where water use efficiency is lagging behind.

The interpretation of the indicator would be enhanced by the utilization of supplementary indicators to be used at country level. Particularly important in this sense would be the indicator on efficiency of water for energy and the indicator on the efficiency of the municipality distribution networks.

AQUASTAT data are obtained through detailed questionnaires filled in by national experts and consultants who collect information from the different institutions and ministries having water-related issues in their mandate. In order to complement the data collection and to inform the quality control and assessment process, literature and information at the country and sub-country level are reviewed including 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 centres; and the Internet.

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. A methodology has been developed by AQUASTAT and rules established to compute the different elements of national water balances. Guidance can be found at:

http://www.fao.org/nr/water/aquastat/sets/index.stm#main
http://www.fao.org/nr/water/aquastat/sets/aq-5yr-guide_eng.pdf

Estimates are based on country information, complemented, when necessary, with expert calculations based on unit water use figures by sector, and with available global datasets. In the case of conflicting sources of information, the difficulty lies in selecting the most reliable one. In some cases, water resources figures vary considerably from one source to another. There are various reasons for such differences, including differing computation methods, definitions or reference periods, double counting of surface water and groundwater or of transboundary river flows. Moreover, estimates of long-term average annual values can change due to the availability of better data from improvements in knowledge, methods or measurement networks.

Where several sources result in divergent or contradictory information, preference is given to information collected at the national or sub-national level rather than at regional or world levels. Moreover, except in the case of evident errors, official sources are privileged. As regards shared water resources, the comparison of information between countries makes it possible to verify and complete data concerning the flows of transboundary rivers and to ensure data coherence at the river basin level. In spite of these precautions, the accuracy, reliability and frequency with which information is collected vary considerably by region, country and category of information. Information is completed using models when necessary.

Regional and global level aggregations are obtained by applying the same procedure as for country level computation.

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.

Modelled data are used with caution to fill gaps while capacity is being developed. Data on water resources can be modelled by using GIS-based hydrological models. Data on water use are estimated by sector on the basis of standard unit values of water use. When data are modelled it always should be indicated, as is done in the AQUASTAT database, so as to avoid that modelers use modelled data for their models.

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 glossary: http://www.fao.org/nr/water/aquastat/data/glossary/search.html
- 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
- 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
- OECD/Eurostat Questionnaire on Environment Statistics – Water Section
- International Recommendations for Water Statistics (IRWS) (2012): http://unstats.un.org/unsd/envaccounting/irws/
- World Bank: World Bank Databank (World Economic Indicators): http://databank.worldbank.org/data/home.aspx

- Parasiewicz, P. 2007. The MesoHABSIM model revisited. River research and applications, 23/8/2007: http://onlinelibrary.wiley.com/doi/10.1002/rra.1045/abstract

ANNEX 1: 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 fabricated 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 rain-fed agriculture (C_r): In countries where rain-fed agriculture dominates the agricultural sector, a large proportion of agricultural GVA in national accounts comes from values produced by rain-fed agriculture. As the rain-fed system does not involve in direct water abstraction, the value added from the rain-fed system need to be deducted from the total agricultural GVA in order to arrive at a realistic WUE in agriculture. However, disaggregated value added data in rain-fed 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 cultivated land area of a country and the default yield ratio between rain-fed and irrigated agriculture (i.e., 0.375). Data on the area of cultivated land 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/m^3. 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 1.

Table 1. 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: http://unstats.un.org/unsd/snaama/selbasicFast.asp • FAOSTAT: http://www.fao.org/faostat/en/#data/EL • 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 involve 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).

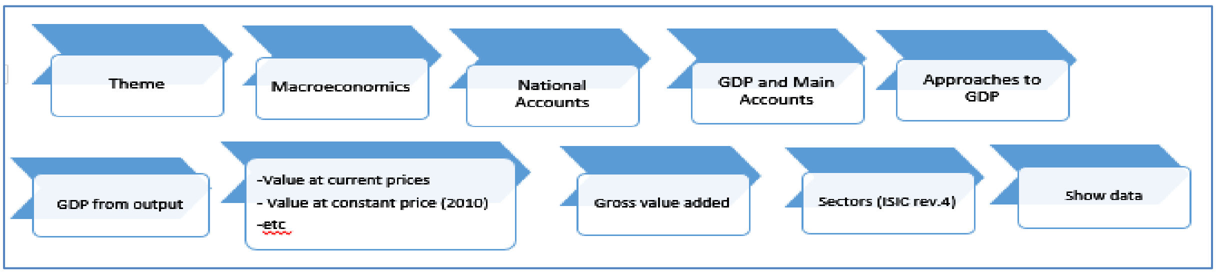
			Periods	2007	2008	2009	2010	2011	2012	2013	2014	2015*
Gross value added basic prices	B-E Industry (no construction), energy	Total	mln euro	100 563	104 723	92 601	95 149	99 481	101 456	99 658	95 277	93 694
		B Mining and quarrying		16 071	21 507	16 239	17 283	18 559	21 327	22 161	17 072	12 573
		C Manufacturing		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[5] and utilize the standardized data (real values in USD for computing the SDG 6.4.1 indicator***: The final step is utilize the valued added-adjusted for price changes for the SDG 6.4.1 calculation. This is important, because for example, the SDG 6.4.1 indicator calculation reported in the Ugandan POC report did not use adjusted sectoral GVA. They used GVA at current prices without adjustments to price changes. In their POC report the Netherlands calculated water use efficiency for a single year (2012).

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.
- *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]Ideally, the appropriate exchange rate should be the rate prevailing at the base year. Since all the nominal value-added at LCU are already adjusted to base year prices, use of exchange rates prevailing at the base year is justified for converting value-added data in LCU into USD. However, this presupposes the annual inflation rate in LCU and annual rate of change in exchange rate (USD) against the local currency do not vary significantly.

5. References

- AQUASTAT database: http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en
- FAOSTAT: http://www.fao.org/faostat/en/#data/EL
- GEMI POC Countries Reports (Jordan, Netherlands, Peru, Senegal, Uganda)
    - ISIC rev3. and ISIC rev4:
        - 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 Main Aggregates Database': http://unstats.un.org/unsd/snaama/selbasicFast.asp
- 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 1. Tables of relevant economic data for the 5 POC countries (including data sources)

In this annex we present selected economic data series relevant for computing SDG6.4.1 indicator for the five POC countries (Jordan, Netherlands, Peru, Senegal and Uganda). Data are obtained either from national sources or international sources or both.

Table A1. Gross value added by economic sectors for the 5 POC countries (agriculture, MIMEC, services sector) 2005-2015; see Table A2 for Metadata.

Value added by economic sector	Country Name	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Agriculture, value added (current LCU)	Jordan	246202500	275830600	307107400	376753400	459178200	560854900	598282700	604490400	713731400	845416200	979874900
Agriculture, value added (current LCU)	Netherlands	9766000000	10902000000	10760000000	10099000000	9192000000	10828000000	9697000000	10225000000	11198000000	10996000000	10965000000
Agriculture, value added (current LCU)	Peru	17187000000	19168000000	21438000000	25258000000	26946000000	28458000000	33587000000	34173000000	36246000000	38777000000	42528000000
Agriculture, value added (current LCU)	Senegal	6.71061E+11	6.33103E+11	6.4264E+11	8.38113E+11	9.19213E+11	9.78872E+11	8.6458E+11	9.94752E+11	1.00497E+12	1.01788E+12	1.22807E+12
Agriculture, value added (current LCU)	Uganda	4.02468E+12	4.37662E+12	4.71997E+12	5.23868E+12	9.1575E+12	1.0745E+13	1.18756E+13	1.56779E+13	1.62928E+13	1.74293E+13	1.85035E+13
Agriculture, value added (current US$)	Jordan	347253173.5	389041748.9	433155712.3	530862899.8	646729859.2	789936478.9	842651690.1	851394929.6	1005255493	1190727042	1380105493
Agriculture, value added (current US$)	Netherlands	12145255565	13677079413	14727621133	14792734730	12770213948	14341721854	13479288296	13137715615	14868038882	14588764216	12160363757
Agriculture, value added (current US$)	Peru	5213395213	5853539364	6851390221	8632557504	8945621141	10070776417	12192616256	12953149875	13410537221	13656758470	13347980289
Agriculture, value added (current US$)	Senegal	1272230544	1210777117	1340880627	1871600815	1946716925	1976412337	1832257963	1948480207	2034191965	2058746858	2076372797
Agriculture, value added (current US$)	Uganda	2260213212	2389696713	2738606989	3044958684	4744962851	5296022000	5111412189	6131016074	6287928954	6867262175	6543609313
Industry, value added (current LCU)	Jordan	2278530900	2713380900	3416257000	4728096600	4826325400	5044129600	5594287000	5801487900	6229874100	6663774500	6958366300
Industry, value added (current LCU)	Netherlands	1.16513E+11	1.24437E+11	1.31596E+11	1.38092E+11	1.26237E+11	1.2568E+11	1.29776E+11	1.29282E+11	1.26114E+11	1.225E+11	1.21742E+11
Industry, value added (current LCU)	Peru	86149000000	1.08729E+11	1.20521E+11	1.28132E+11	1.22109E+11	1.49092E+11	1.76145E+11	1.80557E+11	1.84046E+11	1.80677E+11	1.80014E+11
Industry, value added (current LCU)	Senegal	9.43374E+11	1.01144E+12	1.12516E+12	1.20108E+12	1.23615E+12	1.30379E+12	1.45091E+12	1.54116E+12	1.51285E+12	1.58949E+12	1.63972E+12
Industry, value added (current LCU)	Uganda	3.77352E+12	4.14558E+12	5.31302E+12	6.31253E+12	7.07966E+12	7.4241E+12	9.46151E+12	1.26209E+13	1.31708E+13	1.41719E+13	1.53224E+13
Industry, value added (current US$)	Jordan	3213724824	3827053456	4818416079	6662105960	6797641408	7104407887	7879277465	8171109718	8774470563	9385597887	9800515915
Industry, value added (current US$)	Netherlands	1.44899E+11	1.56112E+11	1.8012E+11	2.02273E+11	1.75378E+11	1.66464E+11	1.80395E+11	1.6611E+11	1.67447E+11	1.62525E+11	1.35014E+11
Industry, value added (current US$)	Peru	26131889465	33203750076	38517417705	43792337400	40538144877	52760988039	63943442117	68439466303	68094568596	63632105374	56499795989
Industry, value added (current US$)	Senegal	1788494824	1934325650	2347666741	2682140784	2617920669	2632439682	3074836446	3018759918	3062206902	3214900134	2772367349
Industry, value added (current US$)	Uganda	2119162060	2263547833	3082709609	3669128050	3668330341	3659209960	4072362337	4935528302	5083056440	5583815343	5418639891
Services, etc., value added (current US$)	Jordan	7671191537	8989522003	9988383216	12493096661	13745080000	15228458451	16612800704	18158001268	19771589155	20924965634	21883842254
Services, etc., value added (current US$)	Netherlands	4.4786E+11	4.7754E+11	5.54561E+11	6.19153E+11	5.81078E+11	5.71191E+11	6.11783E+11	5.70896E+11	5.99107E+11	6.15496E+11	5.26952E+11
Services, etc., value added (current US$)	Peru	37905784572	42032003909	48332054970	58302402680	61301374411	72188052941	82012560351	94625502236	1.01633E+11	1.0546E+11	1.02225E+11
Services, etc., value added (current US$)	Senegal	4507531701	4948403843	6046290383	7180833519	6668629325	6697039095	7588255374	7491193124	7896869361	8066973751	7020763198
Services, etc., value added (current US$)	Uganda	4084371237	4684931641	5768537767	6677517052	8396574795	9787311718	9830422815	10862442870	11857994635	13294005505	13381126978
Services, etc., value added (current LCU)	Jordan	5438874800	6373571100	7081763700	8866350700	9759006800	10812205500	11795088500	12892180900	14037828300	14856725600	15537528000
Services, etc., value added (current LCU)	Netherlands	3.60124E+11	3.80647E+11	4.05162E+11	4.22696E+11	4.1826E+11	4.31249E+11	4.40117E+11	4.44325E+11	4.51223E+11	4.63918E+11	4.75153E+11
Services, etc., value added (current LCU)	Peru	1.24964E+11	1.37638E+11	1.51231E+11	1.70587E+11	1.84652E+11	2.03989E+11	2.2592E+11	2.49641E+11	2.74695E+11	2.99444E+11	3.25699E+11
Services, etc., value added (current LCU)	Senegal	2.37758E+12	2.58747E+12	2.89779E+12	3.21562E+12	3.14884E+12	3.31689E+12	3.58064E+12	3.82446E+12	3.90137E+12	3.98843E+12	4.15243E+12
Services, etc., value added (current LCU)	Uganda	7.2729E+12	8.58023E+12	9.94203E+12	1.14883E+13	1.62049E+13	1.98573E+13	2.28395E+13	2.77768E+13	3.07254E+13	3.37406E+13	3.78382E+13

Source: The World Bank, World DataBank: http://databank.worldbank.org/data/reports.aspx?source=2&series=NY.GDP.DEFL.ZS&country=#

Table A2. Metadata for Table A1 (definition, ISIC coding, and measurement of sectoral value added)

Sectoral value added	Definition	Source
Agriculture, value added (current LCU)	Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. Data are in current local currency.	World Bank national accounts data, and OECD National Accounts data files.
Agriculture, value added (current US$)	Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. Data are in current U.S. dollars.	World Bank national accounts data, and OECD National Accounts data files.
Industry, value added (current LCU)	Industry corresponds to ISIC divisions 10-45 and includes manufacturing (ISIC divisions 15-37). It comprises value added in mining, manufacturing (also reported as a separate subgroup), construction, electricity, water, and gas. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. Data are in current local currency.	World Bank national accounts data, and OECD National Accounts data files.
Industry, value added (current US$)	Industry corresponds to ISIC divisions 10-45 and includes manufacturing (ISIC divisions 15-37). It comprises value added in mining, manufacturing (also reported as a separate subgroup), construction, electricity, water, and gas. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. Data are in current U.S. dollars.	World Bank national accounts data, and OECD National Accounts data files.
Services, etc., value added (current US$)	Services correspond to ISIC divisions 50-99. They include value added in wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional, and personal services such as education, health care, and real estate services. Also included are imputed bank service charges, import duties, and any statistical discrepancies noted by national compilers as well as discrepancies arising from rescaling. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The industrial origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. Data are in current U.S. dollars.	World Bank national accounts data, and OECD National Accounts data files.
Services, etc., value added (current LCU)	Services correspond to ISIC divisions 50-99. They include value added in wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional, and personal services such as education, health care, and real estate services. Also included are imputed bank service charges, import duties, and any statistical discrepancies noted by national compilers as well as discrepancies arising from rescaling. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The industrial origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. Data are in current local currency.	World Bank national accounts data, and OECD National Accounts data files.

Table A3. GDP deflators* for the five POC Countries (Selected Years). Base year varies by country (highlighted in yellow)

Country Name	*1993*	*1994*	*1998*	*1999*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
Jordan	93.57	100	111.6	111.15	133.83	140.59	168.52	173.27	187.85	199.89	208.89	220.59	228.18	233.39
Netherlands	69.61	71.05	76.85	77.95	94.39	96.38	98.76	99.16	100	100.14	101.56	102.95	103.11	103.2
Peru	43.14	54.15	76.26	78.5	98.53	100	101.1	103.19	109.08	116.44	117.84	119.11	122.18	124.91
Senegal	63.37	84.85	99.66	100	116.37	122.56	130.92	128.69	131.01	136.32	139.7	136.27	134.96	135.01
Uganda	30.62	32.72	41.97	41.92	59.12	63.45	67.48	90.43	100	106.16	129.21	134.42	139.04	146.1

Source: Source: The World Bank, World DataBank). http://databank.worldbank.org/data/reports.aspx?source=2&series=NY.GDP.DEFL.ZS&country=#

***Metadata**: The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency. The base year varies by country. Inflation is measured by the rate of increase in a price index, but actual price change can be negative. The index used depends on the prices being examined. The GDP deflator reflects price changes for total GDP. The most general measure of the overall price level, it accounts for changes in government consumption, capital formation (including inventory appreciation), international trade, and the main component, household final consumption expenditure. The GDP deflator is usually derived implicitly as the ratio of current to constant price GDP or a Paasche index.

Table A4. GDP deflators for the 5 POC countries (2005=100)

Country	Currency	Measure	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Jordan	Jordanian Dinar	Implicit Price Deflator - LCU	92.24	93.09	95.09	98.03	100.00	110.65	116.24	139.35	143.27	155.35	165.27	172.71	182.38	188.67
Jordan	US dollar	Implicit Price Deflator - USD	92.24	93.09	95.09	98.03	100.00	110.65	116.24	139.22	143.07	155.13	165.04	172.47	182.13	188.40
Netherlands	Euro	Implicit Price Deflator - LCU	91.42	94.74	96.80	98.10	100.00	102.55	104.71	107.31	107.73	108.65	108.80	110.35	111.87	112.78
Netherlands	US dollar	Implicit Price Deflator - USD	65.78	71.70	87.85	97.95	100.00	103.45	115.24	126.39	120.35	115.71	121.62	114.01	119.44	120.32
Peru	Nuevo Sol	Implicit Price Deflator - LCU	89.24	89.30	90.91	96.61	100.00	107.66	109.26	110.45	112.44	118.72	126.60	128.84	129.87	134.08
Peru	US dollar	Implicit Price Deflator - USD	83.87	83.69	86.13	93.29	100.00	108.37	115.12	124.48	123.06	138.50	151.51	160.99	158.41	155.65
Senegal	CFA Franc BCEAO	Implicit Price Deflator - LCU	93.47	96.56	97.07	97.57	100.00	103.98	109.51	117.07	115.04	117.17	121.99	125.18	122.85	123.37
Senegal	US dollar	Implicit Price Deflator - USD	67.26	73.07	88.10	97.42	100.00	104.89	120.53	137.90	128.51	124.79	136.37	129.34	131.16	131.62
Uganda	Uganda Shilling	Implicit Price Deflator - NC	82.37	82.86	90.12	93.97	100.00	105.37	112.91	123.37	142.28	147.46	176.16	191.84	198.25	204.95
Uganda	US dollar	Implicit Price Deflator - USD	83.54	82.09	81.72	92.43	100.00	102.45	116.65	127.69	124.78	120.58	124.34	136.39	136.46	140.38

Source: UNSD (http://unstats.un.org/unsd/snaama/selbasicFast.asp)

Table A5. Uganda – Value-added by economic activity (Current prices, billion Ugandan Shillings)

	ISIC	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
GDP at market prices		**40,922**	**40,942**	**47,649**	**60,134**	**64,465**	**70,882**	**78,770**	**87,891**
Agriculture, forestry and fishing	A	**9,166**	**10,731**	**11,860**	**15,691**	**16,338**	**17,507**	**18,587**	**19,880**
Cash crops	AA	851	783	1,131	1,189	1,121	1,055	1,281	1,351
Food crops	AB	4,809	5,917	6,089	8,271	8,325	9,226	9,524	10,099
Livestock	AC	1,625	1,857	1,974	2,682	2,944	3,039	3,296	3,619
Agriculture Support Services	AD	10	12	16	21	23	25	30	29
Forestry	AE	1,379	1,574	1,909	2,628	2,974	3,095	3,206	3,425
Fishing	AF	492	587	741	899	951	1,066	1,251	1,358
Industry		**13,110**	**7,424**	**9,349**	**12,345**	**12,714**	**13,507**	**14,679**	**16,051**
Mining & quarrying	B	400	464	414	541	536	525	534	527
Manufacturing	C	2,956	3,481	4,581	6,205	6,050	5,855	6,565	7,187
Electricity	D	330	349	371	469	585	633	677	800
Water	E	7,623	769	829	904	969	1,141	1,284	1,580
Construction	F	1,801	2,360	3,154	4,226	4,574	5,353	5,619	5,957
Services		**16,039**	**19,857**	**23,055**	**28,065**	**30,843**	**34,752**	**39,323**	**45,426**
Trade and Repairs	G	4,722	5,298	6,679	8,732	8,904	8,911	9,709	10,981
Transportation and Storage	H	968	1,069	1,199	1,639	1,979	2,307	2,341	2,570
Accommodation and Food Service	I	626	934	1,129	1,490	1,744	1,984	1,986	2,220
Information and Communication	J	1,847	2,265	2,438	2,450	2,676	4,034	5,319	7,727
Financial and Insurance Activities	K	824	936	1,153	1,529	1,594	1,901	2,103	2,200
Real Estate Activities	L	1,220	2,194	1,850	2,264	2,753	3,126	3,477	3,943
Professional, Scientific and Technical	M	1,122	1,323	1,710	1,900	1,860	1,810	2,016	2,095
Administrative and Support Service	N	482	630	901	1,031	979	1,099	1,409	1,227
Public Administration	O	952	1,201	1,529	1,745	1,866	1,942	2,343	2,828
Education	P	1,753	2,031	2,328	2,640	3,262	3,970	4,613	5,179
Human Health and Social Work Activities	Q	949	1,231	1,358	1,611	2,058	2,361	2,592	2,917
Arts, Entertainment and Recreation	R	99	124	141	182	191	211	228	236
Other Service Activities	S	323	401	442	610	714	812	886	1,020
Activities of Households as Employers	T	152	221	199	242	265	284	301	284

Source: Ugandan Bureau of Statistics (http://www.ubos.org/statistics/macro-economic/national-accounts/)

Table A6. Uganda – GDP deflators (LCU) and sectoral deflators by economic activity (2009/10=100)

	ISIC	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
GDP deflators (2009/10=100)		**105.6**	**100.0**	**106.3**	**129.2**	**133.8**	**139.7**	**147.9**	**157.7**
Agriculture, forestry and fishing	A	**87.9**	**100.0**	**107.0**	**140.6**	**143.6**	**149.4**	**155.0**	**160.7**
Cash crops	AA	92.1	100.0	144.3	139.1	131.8	123.6	143.9	141.5
Food crops	AB	85.4	100.0	100.7	138.7	140.0	150.8	152.5	158.2
Livestock	AC	89.5	100.0	103.8	138.0	147.8	148.4	156.4	166.6
Agriculture Support Services	AD	87.5	100.0	127.6	194.3	196.9	213.0	215.8	224.5
Forestry	AE	93.7	100.0	108.9	146.8	148.4	147.6	150.3	154.8
Fishing	AF	86.2	100.0	126.6	151.1	164.8	180.2	207.4	212.9
Industry		190.5	100.0	113.1	145.0	146.2	146.0	147.2	156.3
Mining & quarrying	B	93.5	100.0	69.1	95.6	84.9	78.8	67.1	65.2
Manufacturing	C	88.7	100.0	122.1	161.0	161.0	152.4	154.0	167.8
Electricity	D	109.0	100.0	96.7	113.8	129.2	137.3	138.9	159.4
Water	E	1,050.4	100.0	101.5	104.4	105.3	116.5	123.6	143.4
Construction	F	85.9	100.0	116.3	150.0	155.8	162.0	165.9	166.5
Services		86.5	100.0	103.9	121.6	126.9	135.4	146.6	158.9
Trade and Repairs	G	90.6	100.0	115.1	149.2	148.4	150.7	157.7	173.5
Transportation and Storage	H	98.3	100.0	102.4	129.9	150.0	165.4	157.9	161.0
Accommodation and Food Service	I	77.4	100.0	113.1	136.6	152.2	159.2	159.6	166.9
Information and Communication	J	98.9	100.0	88.8	75.3	69.7	91.8	124.2	154.6
Financial and Insurance Activities	K	88.8	100.0	106.7	144.0	139.1	140.7	145.4	147.9
Real Estate Activities	L	58.3	100.0	81.9	96.0	111.4	119.0	124.3	133.0
Professional, Scientific and Technical	M	94.4	100.0	107.7	129.3	126.0	120.4	142.2	147.9
Administrative and Support Service	N	89.0	100.0	108.5	128.8	137.9	143.2	146.2	155.0
Public Administration	O	89.0	100.0	108.6	129.1	137.8	143.0	141.1	142.4
Education	P	88.6	100.0	103.7	109.3	125.0	145.6	161.4	169.6
Human Health and Social Work	Q	81.3	100.0	105.6	119.6	146.7	160.0	167.4	180.5
Arts, Entertainment and Recreation	R	89.1	100.0	108.3	128.8	138.2	143.6	147.0	155.7
Other Service Activities	S	84.5	100.0	107.1	137.2	152.6	156.8	158.6	166.9
Activities of Households as Employers	T	71.8	100.0	87.9	105.0	112.7	117.9	121.8	111.0

Source: Ugandan Bureau of Statistics (http://www.ubos.org/statistics/macro-economic/national-accounts/)