Country survey on water use for agriculture and rural development

(Version 28 February 2014)
Checklists

Checklist for the consultant

Please check that you have done the following tasks before sending back your results:

1. Read instructions completely and very carefully
2. Collect information (including maps)
3. Fill in the Excel questionnaire, including references (sheet 1), national data (sheet 2), sub-national data (sheet 3), institutions (sheet 4) and crop areas (sheet 5)
4. Check consistency of data and information
5. Prepare country profile
6. Explain the calculation methods in the comments of the questionnaire or in an annex to the country profile
7. Review the irrigated crop calendar table attached, which was prepared by AQUASTAT within the framework of the thematic study “Irrigation water requirement and water withdrawal by country” based on information available
8. Review the irrigation map attached, which was prepared by AQUASTAT within the framework of the thematic study “Global map of irrigation areas”
9. Review the water resources sheet attached, which was prepared by AQUASTAT based on information available
10. Review and update the large dams data sheet attached
11. Give your comments on the survey in the “survey assessment form” provided in the annex of this document
12. Explain any difficulties/problems met in the survey assessment form
13. Send the questionnaire and country profile to FAO by e-mail, together with all additional tables and comments in Excel and Word format
14. Send hard copies and diskettes/CD-Roms with maps and documents to FAO by mail
15. Provide the list of the country counterparts that should be contacted for final review and clearance of the country profile and data

Checklist of the documents provided by the AQUASTAT programme

Please let us know if any of this material is missing:

- Instructions and explanations (this document)
- The questionnaire in Excel format
- Irrigated crop calendar table prepared by AQUASTAT
- Sub-national irrigation areas prepared by AQUASTAT
- Table on water resources prepared by AQUASTAT
- Table on large dams
- List of references used during the previous survey
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Note

These guidelines have been prepared with the objective of providing all necessary information to fill in the questionnaire and to prepare the country profile. However, if further assistance is required, it may be obtained from:

AQUASTAT - NRL
FAO - Rome, Italy

Fax: 39 06 570 56275

E-mail: aquastat@fao.org
Web: http://www.fao.org/nr/aquastat
Introduction

This survey is part of FAO’s efforts to update AQUASTAT, its global water information system. It concentrates mainly on water use in agriculture, i.e. irrigation, but includes also information on water resources, water use by other sectors, drainage, environment and other relevant issues.

The AQUASTAT programme, developed by FAO’s Land and Water Division (NRL), has been operational since 1994. Its main purpose is to systematically select the most reliable information on water resources and water use in each country and make it available, in a standard format, to users interested in global or regional perspectives. The focus is on developing countries in Africa, Asia, Latin America and the Caribbean. All results produced by AQUASTAT are public and made available as published reports, on the Web (http://www.fao.org/nr/aquastat) or on CD-Rom.

Objective of the survey

The objective of this survey is to update AQUASTAT in order to provide a clear picture of the situation of water resources and uses, with an emphasis on agriculture, at a national and sub-national level, featuring its major characteristics, trends, constraints and perspectives. The results of the present survey are expected to be two-fold:

- To provide users with comprehensive information on the state of agricultural water management at country level across the world
- To help support continental and regional analyses by providing systematic, up-to-date and reliable information on water in agriculture and serve as a tool for large-scale planning and predictive studies

Description of the different elements of the survey and methodology

To reach the above objective, it has been decided to proceed as follows, with two surveys:

- **Every 5-10 years: a detailed global survey** to prepare/update country profiles and regional syntheses. This document refers to this survey, which is prepared on the basis of a detailed questionnaire filled in at country level by national and regional experts, under the supervision of FAO/NRL.
- **Every year: a small global survey** to ensure regular updating of the existing country profiles, of key changes at country level, especially on the area equipped for irrigation and on the institutional and policy aspects. It is done by concerned institutions, which are willing to participate, and is managed in the regional and central offices of FAO.

The 5-10 year survey aims at preparing national country profiles in a homogeneous way. It ensures participation of national experts, in charge of the information collection and report drafting at the country level, and validation by FAO experts. The experts are provided with:

- A detailed questionnaire to be completed for each country at national level (and sub-national level for some variables) on the basis of existing available information
- Detailed guidelines for preparing a country profile and gathering qualitative information
- Explanatory notes and definitions to ensure consistency in the use of concepts and words and facilitate computation

Please note that the most important part of this survey is to get as many clear and reliable data, facts and figures as possible in the questionnaire.

The methodology used in the survey is regularly reviewed to improve its efficiency and effectiveness. Feedback from surveyors and users is thus particularly appreciated and encouraged.
Terms of reference of the consultation

The consultant in charge of the AQUASTAT survey will, under the technical guidance of the Land and Water Division (NRL), contribute to updating the information system on water and agriculture. The consultant will be informed of the existing AQUASTAT information and will ensure a complete revision.

For that purpose, s/he will have to fill in a detailed questionnaire (see guidelines in Part 1) and will have to prepare a country profile (see guidelines in Part 2) for the country surveyed.

Tasks

The specific tasks of the consultant will be as follows:

1. Contact resources persons in the fields of water resources, water uses, irrigation and environment in the country (national and international)
2. Collect recent literature on water resources, water uses and irrigation in the country (seek mostly master plans, sector reviews, national statistics, etc)
3. Compile relevant maps available, such as administrative maps, river basin maps, maps showing irrigation schemes, etc. (when possible, in electronic form)
4. Critically analyse the references and complete the questionnaire accordingly, carefully considering the definitions given in part 1 of this document
5. Prepare in electronic form a country profile (5 to 10 pages) according to the standard guidelines, given in Part 2 of this document, and send it together with maps and questionnaire by e-mail
6. Provide an electronic copy of the references used or, if not available, a hard copy
7. Provide the list of the country counterparts that could be contacted for review and clearance

After receiving the results, the AQUASTAT programme will analyse the consultant’s contribution, and may request additional information or explanation from the consultant.

Qualifications required

An agricultural, irrigation or water resources engineer with a broad experience in the problems related to water resources development and management for agriculture in the country.
Part 1

The questionnaire

Explanatory notes and definitions
Guidelines for answering the questionnaire

The questionnaire in Excel format is designed to be answered at the national or country level, and for some variables at sub-national level. This Part 1 of the guidelines provides all necessary explanations on the variables in the questionnaire and in the country profile, such as definitions, units and relevant calculation methods. The headings and sub-headings in Sections I-V below are the same ones as those in the questionnaire.

Please note that the structure of the questionnaire is such that, once verified and corrected, it can be introduced automatically in the computerized database. In order to be able to do this, it is important that the consultant uses the questionnaire as it is and does not change the structure of it nor copy the different sheets into other files.

Layout of the questionnaire

The Excel file contains five sheets, which are organized as follows:

Sheet 1: References:
All references used in filling in the questionnaire (the number is the same as the one reported in column J of the “national data” sheet)

Sheet 2: National-level data:
- Land use
- Water resources
- Water withdrawal (by sector, by source, groundwater depletion, municipal wastewater)
- Irrigation and drainage development (area under agricultural water management, source of water, power irrigated area, irrigation schemes by size, investment in irrigation, irrigated crop area, drainage, water harvesting)
- Environment and health

Sheet 3: Subnational-level data:
- Sectoral water withdrawal
- Full control irrigation and total irrigation

Sheet 4: Institutions:
Addresses of institutions dealing with water resources and irrigation development in the country

Information in sheet 2 and 3 is required in a numerical format (quantitative values). The four-digit codes in the first column refer to the variable codes in the database and can be ignored. Quantitative values are given in the unit given in the ‘Unit’ column. For each value needs to be provided:

- the year (meaning the year of the value, which can be different from the year of publication of the reference used)
- the reference number specified in sheet 1 of the Excel file

If you have detailed data at sub-national level for other variables than the ones indicated in sheet 3, then please provide the desegregated figures in a separate Excel file and attach it (see below under ‘Adding new data and comments to the questionnaire’).

If the value consists of decimals use point and not comma, for example 0.0001 and NOT 0,0001.
Data collection

Data must be collected at national level (sheet 2) and for some variables at a sub-national (provincial, district, basin) level (sheet 3). The type and number of sub-national subdivisions (provinces, districts, basins, etc.) can vary from one country to another. They should be chosen on the basis of data availability, and should preferably be between 5 and 20. A map of the country showing the administrative boundaries (provinces or districts) and basin boundaries must be provided with the questionnaire. In order to simplify data collection, only 5 variables are asked at the sub-national level in the questionnaire. However, if data asked only at national level are also available at sub-national level and used for illustration in the country profile, please add them in a separate Excel file and attach it.

No field survey is expected to be necessary to answer the questionnaire. A complete field survey would involve too much time and would be too costly to be generalized on a global basis. Information must be collected through an in-depth scanning of all existing reports and maps dealing with water resources and water use in the country.

Data quality

As a general rule, the most recent available data must be provided and always with its reference source. Some data become outdated faster than other do and judgement with regards to the reliability of a source will have to be made on a case by case basis. In some cases, if the latest data are known to be outdated, it should be mentioned in the “comments” column. All information judged to be relevant must be provided in the “comments” column. If there is not enough space in the “comments” column, use a separate file (in Word or Excel) containing more explanations or clarifications.

If different sources give significantly different figures (especially for the same year), a critical analysis will be necessary 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. Several checks are possible and must be performed. The sum of areas equipped for irrigation at sub-national level, for instance, must add up to the total area equipped for irrigation at national level. In some cases, double counting may occur if not enough attention is paid while filling in the questionnaire.

Finally, a problem may occur when categories presented in the questionnaire do not correspond to the situation of the country. An example would be that some irrigation schemes do not fall into the categories of public or private or small, medium and large schemes (Sections Irrigation and drainage development below). As a general rule, the best possible judgement must be made to choose between existing categories, the most important point being that no double counting be made. The categories used in the countries should be explained in the “comments” column or included as an attachment to the questionnaire.

Time series

The questionnaire is presented in such a way that for all variables only one figure can be inserted for one given reference and one given year. When times series are available, which would be very much welcomed, they should be included as an attachment to the questionnaire, mentioning the reference(s).

Adding new data and comments to the questionnaire

The questionnaire format can not be modified as it has been blocked to facilitate its completion and

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1 If breakdown by river basin, by climatic zone, or by other administrative units (instead of province or district) is more relevant and allows a better quality of data, use this breakdown and provide a detailed list and map, showing this breakdown, attached to the country profile.
limiting typing errors and to be able to upload it in the computerized database.

- If you wish to add new variables (sub-national data sets used in country profiles, time series, irrigation schemes data, etc.), you should prepare a ‘data annex’ in a new Excel workbook and name it ‘new data-your country name.xls’.
- If you wish to comment more extensively than allowed in the comment column in the questionnaire, please do it under the annex ‘survey assessment’ and save that annex as a separate file as ‘survey comment-your country name.doc’.

**Note:** The items listed in the questionnaire have been prepared for all countries in the world. Some items may not be relevant in the case of your country. If it is the case please indicate it in the comments.

**Units**

**Units of population**

1000 inhabitants

**Units of area**

1 acre = 4 047 m² = 0.4047 ha = 4.047 x 10⁻⁴ x 1000 ha
1 are = 100 m² = 0.01 ha = 1 x 10⁻⁵ x 1000 ha
1 aliquiere = 24 200 m² = 2.42 ha = 2.42 x 10⁻³ x 1000 ha
1 caballeria = 450 000 m² = 45 ha = 4.5 x 10⁻² x 1000 ha
1 decatine = 10 900 m² = 1.09 ha = 1.09 x 10⁻² x 1000 ha
1 feddan = 4 200 m² = 0.42 ha = 4.2 x 10⁻⁴ x 1000 ha
1 ha = 10 000 m²
1 koh = 9 900 m² = 0.99 ha = 9.9 x 10⁻⁴ x 1000 ha
1 km² = 1 000 000 m² = 100 ha = 1 x 10⁻¹ x 1000 ha
1 m² = 0.0001 ha = 1 x 10⁻⁷ x 1000 ha
1 morgen = 8 560 m² = 0.856 ha = 8.56 x 10⁻⁴ x 1000 ha
1 mu = 667 m² = 0.0667 ha = 6.67 x 10⁻⁵ x 1000 ha
1 square inch = 0.00064546 m² = 0.00000064516 ha = 6.4516 x 10⁻¹¹ x 1000 ha
1 square foot = 144 square inches = 0.09290304 m² = 0.00009290304 ha = 9.290304 x 10⁻⁵ x 1000 ha
1 square yard = 0.84 m² = 0.00084 ha = 8.4 x 10⁻⁶ x 1000 ha
1 square mile = 2 590 000 m² = 259 ha = 2.59 x 10⁻² x 1000 ha

**Units of volume**

1 acre-foot = 1 234 m³ = 1.234 x 10⁻⁶ km³
1 cubic foot (ft³) = 0.02832 m³ = 2.832 x 10⁻¹¹ km³
1 cubic yard (yd³) = 0.7646 m³ = 7.646 x 10⁻¹⁰ km³
1 dm³ = 1 liter = 0.001 m³ = 1 x 10⁻¹² km³
1 hm³ = 1 million m³ = 1 000 000 m³ = 10⁶ m³ = 1 x 10⁻³ km³
1 km³ = 1 billion m³ = 1000 million m³ = 10⁹ m³
1 m³ = 10⁹ km³
1 UK gallon = 4.546 dm³ = 0.004546 m³ = 4.546 x 10⁻¹² km³
1 US gallon = 3.785 dm³ = 0.003785 m³ = 3.785 x 10⁻¹² km³

[volume]/hour = 24 x [volume]/day = 8 760 x [volume]/year
[volume]/day = 365 x [volume]/year

**Units of costs**

**Costs** should be expressed in US$ (United States Dollars) in the questionnaire and country profiles. The conversion used to pass from the local currency to US$ should be the one that was valid in the year to which the value refers and should be indicated in the comments.
References

For all the information provided in the questionnaire, a corresponding reference must be given. A column is given in the sheet 2 and 3 to write a reference number. In sheet 1 all the details of the reference should be provided, as shown in the example below.

**Number:** Number used in the questionnaire sheet 2 and 3  
**Title:** Title of the reference  
**Personal Author(s):** Names and initials, separated by semi colons (;)  
**Corporate Author:** Generally an institution, if any.  
**Title of journal:** (only if reference is an article)  
**Publication date:** Year (or date if periodical)  
**Editor:** It can be the authority responsible for its publication

**Example:**

**Number:** 3  
**Title:** Water Resources of the Socialist People's Libyan Arab Jamahiriya  
**Personal Author:** Pallas, P.  
**Corporate Author:**  
**Type of document:** 3  
**Title of journal:** The Geology of Libya, Proceedings of the second symposium on the Geology of Libya  
**Publication date:** 1980  
**Editor:** London Academic Press

Preference should be given to published publications. However if, in some exceptional cases, a value originates from an expert opinion that is not referenced in any publication, please provide an A instead of a reference number. These estimates (A) should obligatory hold additional information in the “comment” column to indicate from whom, when, on which grounds, etc. Also, if the final figure is a compilation of several data, then the A should be written and in the comments the references from which the data are compiled.

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 and where complementary information can be obtained. For each institution, you should indicate the organization types and the fields of activity. At least two fields of activities must be covered: water resources and agricultural hydraulics (irrigation and drainage). Other fields could be agriculture, water development and management, environment. Further details can be given on the types of activities such as research, development, planning, training, extension and education, monitoring and statistics.

Organization types

a = UN organizations and bodies  
b = Multilateral bodies/organizations  
c = Regional development organizations  
d = Regional watershed/catchment/river basin development institutions  
e = Bilateral donors and technical agencies  
f = International research and development institutes/bodies  
g = Regional research and development institutes/bodies  
h = National research and development institutes/bodies  
i = International networks/information centres
Regional networks/associations
International non-governmental organizations (NGOs)
Civil society organizations (CSO)/NGO consortiums/networks
Private sector networks/organizations
Universities/educational organizations
Professional associations
Government institutions

Fields of activity
1 = Land resources
2 = Land management
3 = Soil fertility and plant nutrition
4 = Water resources
5 = Water development and management
6 = Irrigation and drainage
7 = Environment
8 = Other

If possible, attach at the end of the questionnaire a copy of the visiting cards of people met.
The variables

All definitions and more information are available in the AQUASTAT online glossary at http://www.fao.org/nr/water/aquastat/data/glossary/search.html?lang=en.

I. Land use

At a national level, the figures of FAOSTAT (http://faostat.fao.org) will be used, which is the official figure of the United Nations, for the variables 4100, 4101 and 4102 below. In the text of the country profile, only these FAOSTAT figures should appear. However, should reliable sources give other figures, they can be introduced in the questionnaire below and a photocopy of the source should be attached. In that case, it would also be good if the country wrote officially to FAOSTAT to give the new information, since as long as FAOSTAT does not change its data, AQUASTAT cannot change them either.

Please note that for each variable below a four-digit number is given, which is the same as the one in column B of the Excel questionnaire. You can ignore this number. It corresponds to the code in the computerized database.

4100 : Total area of the country (1000 ha)
   Total area of the country, including inland water. It is thus higher than or equal to the total land area of the country.

4101 : Arable land (1000 ha)
   Land under temporary crops (double-cropped areas are counted only once) + temporary meadows for mowing or pasture + land under market and kitchen gardens + land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is not included in this category. Data for “arable land” are not meant to indicate the amount of land that is potentially cultivable.

4102 : Permanent crops (1000 ha)
   Land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee and rubber; this category includes land under flowering shrubs, fruit trees, nut trees and vines, but excludes land under trees grown for wood or timber.

II. Water resources

II.1. Renewable water resources

A printout of the data on water resources already available in the AQUASTAT database is provided. It refers to national long-term annual averages of the renewable water resources. It includes the Internal Renewable Water Resources (IRWR), which is the long-term average annual flow of rivers and recharge of aquifers generated from endogenous precipitation (resources produced within the territory), taking into consideration the overlap between them, and the External Renewable Water Resources (ERWR), which is that part of the country’s renewable water resources, which is not generated within the country. The ERWR include inflows from upstream countries (groundwater and surface water), and part of the water of border lakes or rivers. Total Renewable Water Resources (TRWR) are the sum of internal and external renewable water resources. These data are based on official national sources compiled during the previous AQUASTAT survey and revised recently. They are considered to be the best available for the moment. More information on water resources and definitions can also be found on the AQUASTAT water resources page at http://www.fao.org/nr/water/aquastat/water_res/index.stm.

Total Actual Renewable Water Resources (TARWR) are the sum of internal and external renewable water
resources, taking into consideration the quantity of flow reserved for upstream and downstream countries through formal or informal agreements or treaties and reduction of flow due to upstream consumption. Their computation is referring to a given period and not to an inter-annual average.

These general data on water will be directly used in the country profiles. They do not need to be collected in the questionnaire; however they should be checked, compared with more recent references and, if considered more relevant, any changes, comments and updating should be indicated in an attached note. For each country these data that should be verified are available in the water resources data sheet on the following website: http://www.fao.org/nr/water/aquastat/water_res/index.stm. The file is also attached to the questionnaire.

Some additional information is necessary to have a good assessment of the water situation in the country.

II.2. Exploitable water resources

In general “exploitable water resources” are significantly lower than the natural water resources. Preferably the national data of exploitable water resources should be completed by an indication of the set of criteria considered by the country². Being dependent on the choice of a set of criteria (practical, socio-economical, environmental, or geopolitical), this concept can not be unique from one country to the other, or standard. It can also evolve according to the pressure of water demands. However, it represents a realistic vision of the renewable resources currently available for use in a given situation.

Exploitable water resources may be subdivided in three sub-components: regular renewable surface water, irregular renewable surface water, and regular renewable groundwater.

4193 : Exploitable: regular renewable surface water (km³/year)
Annual average quantity of surface water that is available with an occurrence of 90 percent of the time. In practice, it is equivalent to the low water flow of a river. It is the resource that is offered for withdrawal or diversion with a regular flow.

4194 : Exploitable: irregular renewable surface water (km³/year)
Irregular resources are equivalent to the variable component of water resources (such as floods) and exceptional groundwater levels (flooding of karstic aquifers). It includes the seasonal and inter-annual variations, i.e. seasonal flow and/or flow during wet years. It is the flow that needs to be regulated (by dams for example).

4195 : Exploitable: regular renewable groundwater (km³/year)
Regular or permanent resource refers to the surface water or groundwater that is available with an occurrence of 90 percent of the time. In practice, it is equivalent to the low water flow of a river and the flow of groundwater that are often mixed. It includes the flow of groundwater not collected by watercourses flowing into the sea, enclosed lakes and areas of evaporation. It is the resource that is offered to withdrawal, diversion or groundwater extraction with a regular flow.

4196 : Water resources: total exploitable (km³/year)
Part of the water resources that is considered to be available for development under specific technical, economic and environmental conditions. This figure considers factors such as the dependability of the flow, extractable groundwater, minimum flow required for environmental,

² Exploitable: This pluri-criteria concept varies according to: 1) Natural conditions that may ease or not the development of water resources (regularity of the water regime, fragmentation of the hydrographic or hydrogeological systems, convenience of the sites for dams, water quality); 2) Objectives of water use that will determine the acceptability of internal and external costs of development and management; it also involves arbitration for allocation between in-situ use (reservation) and ex-situ use; 3) Other constraints, such as geopolitical constraints in the case of shared resources, or according to the upstream limitation, or reservation constraint for downstream use.
social and non-consumptive use, etc. It is also called manageable water resources or water development potential.

II.3. Dam capacity

4197 : Total dam capacity (km$^3$)

Total cumulative capacity of all large dams, expressed in km$^3$. The capacity of the dams indicated here is the theoretical initial capacity; it does not change with time. The current dam capacity is the state of the dams at a given time that can have decreased due to silting.

A dam is a barrier constructed across a valley for impounding water or creating a reservoir. Dams are characterized by their purposes and construction materials used. The international large dam commission classifies the dams according to the height (above 15 m) and the water volume stored. Each country has its own definition of large dams. If possible, indicate the criteria used to define large dams in the comments.

A template is attached to this questionnaire and the consultant is requested to review, correct and update the information available for the larger dams. A geo-referenced database on large dams is also available for review at http://www.fao.org/nr/water/aquastat/dam/index.stm.

III. Water withdrawal and water use

Water withdrawal refers to the gross amount of water for a given use, either surface water or groundwater. It includes conveyance losses, consumptive use and return flow. It does not include water to be reserved for uses with a low consumption rate, such as for example hydropower, navigation or recreation.

II.1. Water withdrawal by sector

4475 : Water withdrawal for irrigation (km$^3$/year)

Annual quantity of water withdrawn for irrigation purposes. It includes water from primary renewable freshwater resources and secondary sources of water, as well as water from over-abstraction of renewable groundwater or withdrawal of fossil groundwater, direct use of agricultural drainage water and (treated) wastewater, and desalinated water. The amount of water withdrawn for irrigation by far exceeds the consumptive use of irrigation because of water lost in its distribution from its source to the crops. The term “water requirement ratio” (sometimes also called “irrigation efficiency”) is used to indicate the ratio between the net irrigation water requirements or crop water requirements, which is the volume of water needed to compensate for the deficit between potential evapotranspiration and effective precipitation over the growing period of the crop, and the amount of water withdrawn for irrigation including the losses. In the specific case of paddy rice irrigation, additional water is needed for flooding to facilitate land preparation and for plant protection. In that case, irrigation water requirements are the sum of rainfall deficit and the water needed to flood paddy fields. At scheme level, water requirement ratio values can vary from less than 20 to more than 85 percent

4476 : Water withdrawal for livestock (watering and cleaning) (km$^3$/year)

Annual quantity of water withdrawn for livestock purposes. It includes water from primary renewable freshwater resources and secondary sources of water, as well as water from over-abstraction of renewable groundwater or withdrawal of fossil groundwater, direct use of agricultural drainage water and (treated) wastewater, and desalinated water. It includes livestock watering, sanitation, cleaning of stables, etc. Depending on the country, water withdrawn for livestock sometimes is included in municipal water withdrawal. As far as livestock watering is concerned the ratio between net consumptive use and water withdrawn is estimated between 60 and 90 percent.
4477: **Water withdrawal for aquaculture (km³/year)**
Annual quantity of water withdrawn for aquaculture. It includes water from primary renewable freshwater resources and secondary sources of water, as well as water from over-abstraction of renewable groundwater or withdrawal of fossil groundwater, direct use of agricultural drainage water and (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.

4250: **Agricultural water withdrawal (km³/year)**
Annual quantity of self-supplied water withdrawn for irrigation, livestock and aquaculture purposes. It includes water from primary renewable freshwater resources and secondary sources of water, as well as water from over-abstraction of renewable groundwater or withdrawal of fossil groundwater, direct use of agricultural drainage water and (treated) wastewater, and desalinated water. Water for the dairy and meat industries and industrial processing of harvested agricultural products is included under industrial water withdrawal.

4251: **Municipal water withdrawal (km³/year)**
Annual quantity of water withdrawn primarily for the direct use by the population. It includes water from primary renewable freshwater resources and secondary sources of water, as well as potential over-abstraction of renewable groundwater or withdrawal of fossil groundwater and the potential use of desalinated water or direct use of treated wastewater. It is usually computed as the total water withdrawn by the public distribution network. It can include that part of the industries, which is connected to the municipal network. The ratio between the net consumption and the water withdrawn can vary from 5 to 15 percent in urban areas and from 10 to 50 percent in rural areas.

4460: **Water withdrawal for cooling of thermoelectric plants (km³/year)**
Annual quantity of water withdrawn for the cooling of thermoelectric plants.

4252: **Industrial water withdrawal (incl. for cooling of thermoelectric plants) (km³/year)**
Annual quantity of water withdrawn for industrial uses. It includes water from primary renewable freshwater resources and secondary sources of water, as well as over-abstraction of renewable groundwater or withdrawal of fossil groundwater and potential use of desalinated water or direct use of (treated) wastewater. This sector refers to self-supplied industries not connected to the public distribution network. The ratio between net consumption and withdrawal is estimated at less than 5 percent. It includes water for the cooling of thermoelectric plants, but it does not include hydropower.

4253: **Total water withdrawal (km³/year)**
Annual quantity of water withdrawn for agricultural, industrial and municipal purposes. It includes water from primary renewable freshwater resources and secondary sources of water, as well as water from over-abstraction of renewable groundwater or withdrawal of fossil groundwater, direct use of agricultural drainage water and (treated) wastewater, and desalinated water. It does not include in stream uses, which are characterized by a very low net consumption rate, such as recreation, navigation, hydropower, inland capture fisheries, etc.

**III.2. Water use by source**

Water can be withdrawn or abstracted from surface water, from groundwater or from produced (non-conventional) water sources like reused treated wastewater and desalinated water.
Conventional water resources
These are surface water or groundwater resources:

4261 : Surface water withdrawal (primary and secondary) (km³/year)
Annual gross amount of water extracted from rivers, lakes and reservoirs. It includes withdrawal of primary renewable surface water resources and secondary freshwater sources (water previously withdrawn and returned, such as wastewater and agricultural drainage water).

4262 : Groundwater withdrawal (primary and secondary) (km³/year)
Annual gross amount of water extracted from aquifers. It includes withdrawal of renewable groundwater, water extracted from deep fossil aquifers (non-renewable water) and potential over-abstraction of renewable groundwater. It can include also secondary freshwater sources if used to recharge the aquifer.

4263 : Total surface water and groundwater withdrawal (km³/year)
It is the sum of surface water withdrawal and groundwater withdrawal.

Non-conventional water
These sources should be accounted for separately, as they are artificial productions normally used by specific users. They should be indicated in terms of production capacity at a given time rather than as production statistics. This category gathers essentially:

4264 : Desalinated water produced (km³/year)
Water produced annually by desalination of brackish or salt water. It is estimated annually on the basis of the total capacity of water desalination installations.

4265 : Direct use of treated municipal wastewater (km³/year)
Treated municipal wastewater (primary, secondary, tertiary treatment) directly used, i.e. with no or little prior dilution with freshwater during most of the year.

4451 : Direct use of agricultural drainage water (km³/year)
It refers to water withdrawn for agriculture but not consumed and which then is directly used again for irrigation purposes (such as for example cascade irrigation of rice cultivated on terraces).

III.3. Groundwater depletion
Status of aquifers with intensive withdrawal and which are not replenished (overexploitation of renewable aquifers or extraction from fossil aquifers).

4266 : Depletion rate of renewable groundwater resources (km³/year)
Annual amount of water withdrawn from renewable aquifers and which is not replenished (average overexploitation of aquifers). When the action is continuous, it is a form of overdraft of rechargeable aquifers or mining. Over a long period of time, there is a risk of depleting the aquifer when the abstraction exceeds the recharge.

4267 : Abstraction of fossil groundwater (km³/year for a given period)
Annual amount abstracted from deep aquifers with a very low rate of renewal (less than 1 percent per year) so considered being non-renewable or “fossil”.

4268 : Expected time that the fossil groundwater will last (years)
The amount of time fossil groundwater resources are expected to last if extraction continues at the current rate (or the rate of change if withdrawals follow some pattern).

Wastewater

4269: Produced municipal wastewater (km\(^3\)/year)
Annual quantity of wastewater produced in the country by municipalities, in other words, the quantity of water that has been polluted by adding waste. The origin can be domestic use (used water from bathing, sanitary, cooking, etc.) or it refers to wastewater from commercial or industrial facilities located within the municipalities.

4493: Collected municipal wastewater (km\(^3\)/year)
Municipal wastewater collected by municipal wastewater sewers or other formal collection systems. This category considers the following collection systems:
- Independent: Wastewater collected by individual private systems in place to evacuate and collect domestic and other wastewater in case where an urban collection system is not available. This includes the collection of wastewater by pit latrines and septic tanks. This also includes the transport of wastewater to treatment plants by means of trucks.
- Collective: Wastewater collected from dwellings, commercial or industrial facilities by planned municipal sewer systems.

4270: Treated municipal wastewater (km\(^3\)/year)
Treated wastewater (primary, secondary and tertiary) annually produced by municipal wastewater treatment facilities in the country. Wastewater treatment is the process that makes the water acceptable according to environmental and other recycling and reuse standards. In general three types of treatment can be distinguished: primary, secondary and tertiary. It is useful to indicate in the comments what volume or percentage is primary, secondary and tertiary treated and what standards are applied. Wastewater treatment does not include the collection of storm water, even though no treatment is possible without collection.

IV. Irrigation and drainage development

IV.1. Area under agricultural water management

This section considers all the land to which, in addition to eventual rainfall, water is added and managed to perform agriculture. The level of management and control of the water may vary greatly between the different agricultural water management types described under the variables below. This section does not include “water harvesting”, which will be dealt with separately in Section further below. However, while sometimes spate irrigation is considered to be a type of water harvesting (called “floodwater harvesting”), AQUASTAT prefers including it in this present section, the reason for this being that spate irrigation often requires heavy structures to be built, using for example gabions or concrete.

The figures should refer to the physical area equipped. Thus, areas with double cropping are only counted once.

The classification adopted by AQUASTAT is presented the following diagram and an explanation of each of the variables is given below.
Note: the boxes in grey refer to variables to be collected in this questionnaire

4307 : **Irrigation potential (1000 ha)**
Area of land which is potentially irrigable. Country/regional studies assess this value according to different methods. For example, some consider only land resources, others consider land resources plus water availability, others include economical aspects in their assessments (such as distance and/or difference in elevation between the suitable land and the available water) or environmental aspects, etc. Details of the computation method should be included in the comments. In any case, the figure includes the area already under irrigation [4313] or under agricultural water management [4317].

4308 : **Area equipped for full control irrigation: surface irrigation (1000 ha)**
Surface irrigation systems are based on the principle of moving water over the land by simple gravity in order to moisten the soil. They can be subdivided into furrow, borderstrip and basin irrigation (including submersion irrigation of rice). Manual irrigation using buckets or watering cans is also included. Surface irrigation does NOT refer to the method of transporting the water from the source up to the field, which may be done by gravity or by pumping.

4309 : **Area equipped for full control irrigation: sprinkler irrigation (1000 ha)**
A sprinkler irrigation system consists of a pipe network, through which water moves under pressure before being delivered to the crop via sprinkler nozzles. The system basically simulates rainfall in that water is applied through overhead spraying. These systems are also known as overhead irrigation systems.

4310 : **Area equipped for full control irrigation: localized irrigation (1000 ha)**
Localized irrigation is a system where the water is distributed under low pressure through a piped network, in a pre-determined pattern, and applied water as a small discharge to each plant or adjacent to it. There are three main categories: drip irrigation (where drip emitters are used to apply water slowly to the soil surface), spray or micro-sprinkler irrigation (where water is sprayed to the soil near individual plants or trees) and bubbler irrigation (where a small stream is applied to flood small basins or the soil adjacent to individual trees). The following other terms are also sometimes used to refer to localized irrigation: micro-irrigation, trickle irrigation, daily flow irrigation, drop-irrigation, sip irrigation, diurnal irrigation.
If you have detailed statistics per type of localized irrigation, please give them in the comments column.
4311 : Area equipped for full control irrigation: total (1000 ha)
This is the sum of surface irrigation [4308], sprinkler irrigation [4309] and localized irrigation [4310]. If pastures are irrigated using one of the above irrigation techniques, they are included under them and here, even though pasture is a land use category which is different from arable land and permanent crops.

4461 : Area equipped for full control irrigation: part actually irrigated (1000 ha)
Part of the area equipped for full control irrigation [4311], which is actually irrigated, in a given year. Often, part of the equipped area is not irrigated for various reasons, such as lack of water, absence of farmers, land degradation, damage, organizational problems etc. It only refers to physical areas. Irrigated land that is cultivated twice a year is counted once. If figures on actually irrigated area are also available for each or some of the variables [4308], [4309], [4310], please put them in the comments column.

4312 : Area equipped for irrigation: equipped lowland areas (1000 ha)
It includes: i) Cultivated wetland and inland valley bottoms (IVB), which have been equipped with water control structures for irrigation and drainage (intake, canals, etc.); ii) Areas along rivers, where cultivation occurs making use of water from receding floods and where structures have been built to retain the receding water; iii) Developed mangroves; iv) Developed deltas.
If separate figures for these three different categories are available, please put them in the comment column.

4316 : Area equipped for irrigation: spate irrigation (1000 ha)
Spate irrigation can also be referred to as floodwater harvesting (see section Water harvesting below). It is a method of random irrigation using the floodwaters of a normally dry water course or riverbed (wadi). These systems are in general characterized by a very large catchment upstream (200 ha - 50 km²) with a ‘catchment area:cultivated area’ ratio of 100:1 to 10 000:1. There are two types of floodwater harvesting or spate irrigation: 1) floodwater harvesting within streambeds, where turbulent channel flow is collected and spread through the wadi in which the crops are planted; cross-wadi dams are constructed with stones, earth, or both, often reinforced with gabions; 2) floodwater diversion, where the floods - or spates - from the seasonal rivers are diverted into adjacent embanked fields for direct application. A stone or concrete structure raises the water level within the wadi to be diverted to the nearby cropping areas.

4313 : Area equipped for irrigation: total (1000 ha)
Area equipped to provide water to crops. It includes areas equipped for full control irrigation [4311], equipped lowland areas [4312], and areas equipped for spate irrigation [4316]. It does not include non-equipped cultivated wetlands and inland valley bottoms [4315] or non-equipped flood recession cropping areas [4314].
If pastures are irrigated using one of the above categories, they are included under them and here, even though pasture is a land use category which is different from arable land and permanent crops.
As definitions and classifications on irrigation may vary between countries, please add any relevant comment in the comment column.

4318 : Area equipped for irrigation: part actually irrigated (1000 ha)
Part of the area equipped for irrigation [4313], which is actually irrigated, in a given year. Often, part of the equipped area is not irrigated for various reasons, such as lack of water, absence of farmers, land degradation, damage, organizational problems etc. It only refers to physical areas. Irrigated land that is cultivated twice a year is counted once. If figures on actually irrigated area are also available for each or some of the variables, please put them in the comments column.
4315: Cultivated wetlands and inland valley bottoms non-equipped (1000 ha)
Wetland and inland valley bottoms (IVB), which have not been equipped with water control structures but are used for cropping when covered with water. They are often found in Africa. They will have limited (mostly traditional) arrangements to regulate water and control drainage.
- In some countries, a distinction is made between the part of wetlands and IVB that are equipped and the part of the wetlands and IVB that are cultivated but are not considered equipped. In that case, put the figure relative to the first part in the category ‘equipped lowland areas’ [4312], and the figure relative to the second part in this category ‘cultivated wetlands and inland valley bottoms non-equipped’ [4315].
- In other countries, no distinction is made between the wetlands and IVB that are equipped and those that are not. In that case, put the total figure in this category: ‘cultivated wetlands and inland valley bottoms non-equipped’ [4315].

4314: Flood recession cropping area non-equipped (1000 ha)
Areas along rivers where cultivation occurs in the areas exposed as floods recedes and where nothing is undertaken to retain the receding water. The special case of floating rice is included in this category.

4317: Total agricultural water managed area (1000 ha)
It is the sum of total area equipped for irrigation [4313] and areas with other forms of agricultural water management ([4315] and [4314]).

IV.2. Area equipped for irrigation by source of water

This refers to the total area equipped for irrigation (variable [4313]).

4321: Area equipped for irrigation by surface water (1000 ha)
Part of the area equipped for irrigation irrigated from rivers or lakes (reservoirs, pumping, diversion).

4320: Area equipped for irrigation by groundwater (1000 ha)
Part of area equipped for irrigation irrigated from wells (shallow wells and deep tube wells) or springs. As much as possible distinguish the part irrigated from deep-fossil aquifers and indicate the figure in the comment column.

4322: Area equipped for irrigation by mixed surface water and groundwater (1000 ha)
Part of the area equipped for irrigation irrigated from mixed surface water and groundwater.

4465: Area equipped for irrigation by direct use of treat. municipal wastewater (1000 ha)
Part of the area equipped for irrigation that is irrigated by direct use (i.e. with no or little prior dilution with freshwater during most of the year) of treated wastewater.

4513: Area equipped for irrigation by direct use of non-treated municipal wastewater (1000 ha)
Part of the area equipped for irrigation that is irrigated by direct use (i.e. with no or little prior dilution with freshwater during most of the year) of non-treated wastewater.

4526: Area equipped for irrigation by direct use of agricultural drainage water (1000 ha)
Part of the area equipped for irrigation that is irrigated by direct use (i.e. with no or little prior dilution with freshwater during most of the year) of agricultural drainage water.
IV.3. Power irrigated area

4326: Area equipped for power irrigation (1000 ha)

(Lift irrigated areas) Part of the area equipped for irrigation [4313], where pumps are used for water supply from the source to the scheme. It also includes areas where water is drained out with human- or animal-driven water lifting devices. If a separate figure is available for human- or animal-driven water lifting devices, please indicate it in the “comments” column. It does NOT refer to pumping required for the technology used within the field (such as sprinkler irrigation or localized irrigation, which require pressure and thus pumping).

IV.4. Irrigation schemes by size (full control irrigation)

Irrigation schemes can be described in different ways. In this questionnaire, schemes are distinguished by size and the total area of the different schemes should be equal to the area equipped for full control irrigation [4311]. If you wish to use another classification also, please describe it in the country profile. Give in the “comments” column the national criteria used to distinguish large, medium and small irrigation schemes. If there is no national criteria, adopt one and don’t forget to tell in the comments the criteria is yours. Use only quantitative criteria. The schemes may be under individual or collective control.

4332: Area equipped for full control irrigation: total area of small schemes (1000 ha)

Total area of small irrigation schemes where water is fully controlled. These schemes may be under individual or collective control. The upper size limit of the schemes may vary per country. Often private schemes fall under this category of small schemes.

4333: Area equipped for full control irrigation: total area of medium schemes (1000 ha)

Total area of medium irrigation schemes where water is fully controlled. These schemes may be under individual or collective control. The lower and upper size limits of the schemes may vary per country. Often these types of schemes can be public, private or mixed.

4334: Area equipped for full control irrigation: total area of large schemes (1000 ha)

Total area of large irrigation schemes where water is fully controlled. These schemes may be under individual or collective control. The lower size limit of the schemes may vary per country. Often public schemes fall under this category of large schemes.

IV.5. Investments in irrigation (full control irrigation)

Countries may use different methods of calculations: countries may or may not include the costs of the preparation of the identification and feasibility studies, the supervision, the monitoring, etc. Please indicate in the “comments” column what has been included in the figure you provide.

The data for variable [4343] and [4344] focuses on on-farm investments; please indicate it in the comments if there is a difference between the private and public sector.

The costs of irrigation or drainage development and of operation and maintenance (O&M) often depend on two criteria: the size of the scheme and the method used. Therefore, it would be useful to add any related comments. It could also be interesting to distinguish between pumped irrigation schemes, gravity irrigation schemes, schemes for which a dam has been built (normally the cost of the dam is not included in the per hectare cost of a scheme development), etc. and any information on this is also useful. If you have more precision on these issues, please add them on the separate attachment.

The costs should be given in United States Dollars (US$). Please provide the exchange rate used between your currency and the US$ for the year to which the figures refer.
Average cost of development of surface irrigation schemes (US$/ha)
Average costs related to the construction of physical infrastructure for irrigation, not including the cost of dam construction. If possible, distinguish the on-farm (small developments done by the farmer such as the tertiary network...) and off-farm investments costs. Give those details in the “comments” column or on a separate sheet, if there are many (see introductory remarks in this section).

Average cost of O&M in surface irrigation schemes (US$/ha per year)
Total management, operation and maintenance cost of providing the irrigation and drainage service, excluding capital expenditure and depreciation/renewals. The costs include the following: withdrawal (extraction, pumping), treatment before use (food, industrial) if needed, distribution, operation (service, maintenance of the equipment...).

Average cost of rehabilitation of surface irrigation schemes (US$/ha)
Includes the costs of rehabilitation and modernization of old systems. It should also address the issues, which have lead to a bad performance and/or deterioration of the schemes. These are commonly lack of an adequate management organization, no or little farmer’s involvement in operation & maintenance and environmental problems.

4343 : Average cost of sprinkler irrigation for an on-farm installation (US$/ha)
Average in-field cost of sprinkler equipment per ha. The comparison of investments for sprinkler irrigation is country specific and will depend on the crops to be irrigated and also on whether the equipment has to be imported or not.

4344 : Average cost of localized irrigation for an on-farm installation (US$/ha)
Average in-field cost of localized irrigation equipment per ha. The comparison of investments for localized irrigation equipment is country specific and will depend on the crops to be irrigated and also on whether the equipment has to be imported or not.

IV.6. Harvested irrigated crop area (full control irrigation)

4469 : Full control harvested irrigated crop area: permanent pasture (1000 ha)
Total area of permanent meadows and pasture that is irrigated. The land used permanently (five years or more) to grow herbaceous forage crops and actually irrigated in a given year. It refers to full control irrigation. Permanent meadows and pasture do not fall under permanent crops ([4102]) and cultivated area ([4103]), since it is a separate category in FAOSTAT.

4379 : Full control harvested irrigated crop area (1000 ha)
Total harvested irrigated area for the crop for the given year. It refers to the crops cultivated under full control irrigation. Areas under double cropping should be counted twice. Total should be written only if all irrigated crops have been taken into account and written in the previous cells. If data for different years are available, they should be attached.

IV.7. Drainage

Drainage is the natural or artificial removal of surplus surface water and groundwater and dissolved substances from the land in order to enhance agriculture production.

In the case of natural drainage the excess water flows from the fields to lakes, swamps, streams and rivers.

In an artificial drainage system surplus surface water or groundwater is removed by means of surface or
subsurface conduits. This latter category is the one we are interested in.

4303 : Area equipped for irrigation drained (1000 ha)
Irrigated area where drainage is used as an instrument to control salinity, pounding and waterlogging. This refers mainly to the area equipped for surface irrigation and to the equipped lowlands. Areas equipped for sprinkler irrigation and for localized irrigation do not really need a complete drainage system, except perhaps some small structures to evacuate the water in case there might be heavy rainfall. Flood recession cropping areas are not considered as being drained.
A distinction can be made between areas drained with surface drains (a system of drainage measures, such as natural or human-made drains meant to divert excess surface water away from an agricultural area in order to prevent inundation) and the area drained with subsurface drains (a human-made system that induces excess water and dissolved substances to flow through the soil to open wells, moles, pipe drains and/or open drains, from where it can be evacuated for final disposal). If data on each available, please provide them in the “comments” column.

4304 : Non-irrigated cultivated area drained (1000 ha)
Area cultivated and not irrigated, where drainage is used to remove excess water from the land surface and/or the upper soil layer to make humid/wet land more productive.
A distinction should be made here between drainage in humid countries and drainage in semi-arid countries. Depending on the climate of your country, please reply either to the first part or to the second part of the question.
In humid countries, it refers mainly to the areas which normally are flooded and where flood mitigation has taken place. In that case, please indicate which part of the flood mitigated area is drained in the wet season to allow crop growing. A distinction could be made between ‘pumped’ drainage, ‘gravity’ drainage and ‘tidal’ drainage. If you have figures for each of these categories, put them in the “comments” column.
In semi-arid countries, it refers to the area cultivated and not irrigated where drainage is used to remove excess water from the land surface and/or upper soil layer to make humid/wet land more productive. Here again, a distinction could be made between surface drains and subsurface drains. If you have figures available for each category, put them in the “comments” column.

4300 : Total cultivated area drained (1000 ha)
This is the sum of variable [4303] and [4304]. If you don’t have detailed figures for variable [4303] and [4304], but only one figure for drained area, then put it here.

IV.8. Conservation agriculture, water harvesting

4454 : Conservation agriculture area (1000 ha)
Conservation Agriculture (CA) is an agricultural practice, whereby the disturbed area is be less than 15 cm wide or 25% of the cropped area (whichever is lower). AQUASTAT distinguishes between 30%-60%, 61-90% and 91% ground cover. Groundcover must be measured after planting time. Groundcover less than 30% is not considered CA. Rotation must involve at least 3 different crops. Rotation is not a requirement for CA at this time, but AQUASTAT reports whether rotation is being carried out or not.

4306 : Water harvesting area (1000 ha)
Areas where rainwater is collected and either directly applied to the cropped area, and stored in the soil profile for immediate uptake by the crop (runoff irrigation) or stored in a water reservoir for future productive use (for example used for supplementary irrigation). Rainwater harvesting includes: (i) Roof water harvesting is mainly used for domestic purposes and sometimes as water
supply for family gardens; (ii) Micro-catchment water harvesting is characterized by a relatively small catchment area $C (< 1000 \text{ m}^2)$ and cropping area $CA (< 100 \text{ m}^2)$ with ratio $C:CA = 1:1$ to $10:1$. The farmer usually has control over both the catchment area and the target area. These systems are used for the irrigation of a single tree, fodder shrubs or annual crops. The construction is mainly manual. Examples are pits, semi-circular bunds, Negarim micro-catchment, eyebrow terrace, contour bench terrace, etc.; (iii) Macro-catchment water harvesting collects water that flows over the ground as turbulent runoff and channel flow. These systems are characterized by a large catchment area $C$ (‘external’ catchment area of $1000 \text{ m}^2 – 200 \text{ ha}$), located outside the cultivated area $CA$, with a ratio $C:CA = 10:1$ to $100:1$. The systems are mainly implemented for the production of annual crops. The construction is manual or mechanized. Examples are trapezoidal bunds, large semi-circular bunds, stone bunds, etc.

V. Environment and health

V.1. Environment

Water resources development in general and irrigation development in particular can cause serious and adverse environmental impacts if not properly planned, executed or managed. Some major environmental issues are soil degradation (salinization, waterlogging, etc.), dam siltation, water pollution and other undesirable ecological impacts. For practical reasons, only few of these environmental issues are considered.

Salinization

4400 : Area salinized by irrigation (1000 ha)

Irrigated area affected by salinization, including formerly irrigated land abandoned because of declining productivity caused by salinization. It does not include naturally saline areas. In general, each country has its own definition of an area salinized. Write in the comment the method used to compute salinized areas.

Waterlogging

Waterlogging is the state of land in which the water table is located at or near the surface resulting in a decline of crop yields. If the land is not cultivated, it cannot be put into its normal use because of the high sub-soil water table. Drainage can be used to solve the problem. Write in the comments the definition and method used in your country to assess waterlogging.

4401 : Area waterlogged by irrigation (1000 ha)

Part of the land that is waterlogged because of irrigation. Waterlogging is the state of land in which the water table is located at or near the surface resulting in a decline of crop yields. Irrigation can contribute to the raising of the level of the aquifers. The non-saturated area of soils can become too small and the soils are over-saturated with water. If recharge to groundwater is greater than natural drainage, there is a need for additional drainage to avoid waterlogging.

4402 : Area waterlogged not irrigated (1000 ha)

Part of the land in non-irrigated cultivated areas that is waterlogged. Waterlogging is the state of land in which the water table is located at or near the surface resulting in a decline of crop yields.

V.2. Health

In spite of a net positive effect on human health by improved nutrition, there are also a number of hazards associated with irrigation development. The main ones are the spread and intensification of
water related vector-borne diseases (for example malaria, bilharzias or schistosomiasis...). Safe drinking water supply and sanitation facilities are key determinants for the diarrhoea disease situation, including cholera. Water supply and sanitation also influences the transmission risks of schistosomiasis. The availability of sanitary facilities prevents water contamination.

**4403: Population affected by water related diseases (1000 inhab)**

Three types of water-related diseases exist: (i) water-borne diseases are those diseases that arise from infected water and are transmitted when the water is used for drinking or cooking (for example cholera, typhoid); (ii) water-based diseases are those in which water provides the habitat for host organisms of parasites ingested (for example shistomasomiasis or bilharzia); (iii) water-related insect vector diseases are those in which insect vectors rely on water as habitat but transmission is not through direct contact with water (for example malaria, onchocerciasis or river blindness, elephantiasis).

If you have separate figures for each of the three categories, please indicate them in the “comments” column.
Part 2

The country profile

Guidelines for its preparation
Introduction

Country profiles should be brief and provide all the necessary elements to understand the situation and the perspective of water use in agriculture in the country. They focus on water management and irrigation, but key background information on the physical, socio-economic and agricultural context is also given. The country profile should cover between 8 and 12 pages, depending on the size of the country and the importance of irrigation for the country. If relevant, put source or reference in brackets after a statement in the text.

The format of the country profiles is highly standardized to help readers finding easily the information they need. The sections 1-9 below list all possible types of information that should be collected and presented in the country profile. Only those elements that are relevant to the specific situation of the country should be discussed.

Country data are collected through the AQUASTAT questionnaire (see Part 1) and will be included in the on-line database, after verification and validation, and used to produce standard tables and graphs to be inserted in the country profile. Country profiles can be used to provide additional information, which cannot be reported in the questionnaire (for example a different classification of irrigation or a different typology of irrigation schemes used in the specific country), and be illustrated with boxes, other tables and graphs (give data used for the graphs in a ‘data annex’, preferable in Excel format), especially to stress sub-national situations. If different terminologies, definitions, classifications are used, these should be mentioned and explained in a ‘comments annex’ of the country profile, in order for the AQUASTAT programme to be able to clearly understand the situation in the specific country.

Kindly mention wherever gender-disaggregated information is available.

Maps are required to complete the country profiles. They should be provided as attachment on hard copy and in digital format if available (preferably JPEG or TIF):

- **Administrative boundaries** of provinces and major towns
- **Major river basins** within the national and sub-national boundaries; indicate basin boundaries, and the major rivers network; indicate dam locations, inflows from and outflows to neighbouring countries (arrows with volume) and the volume of internal renewable water resources per basin (see Section 2 below).
- **Major aquifer boundaries** (if groundwater is an important water source or if there is a potential for its use) within the national and sub-national boundaries; indicate groundwater inflows from or outflows to neighbouring countries
- **Irrigated areas** within the national and sub-national boundaries; when possible distinguish between the different types of irrigation (variables [4311], [4312], [4316] in the questionnaire); if available give areas equipped for irrigation (variable [4313]) as percentage of total cultivated area ([4101] + [4102]).

1. **Geography, climate and population, (3 paragraphs)**

- Geography: location and extent of the country\(^3\), major features, land cover, land use distribution\(^4\), soil

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\(^3\) **Total area of the country**: UN-statistics at national level are available in FAOSTAT [http://faostat.fao.org/] and should be used. At sub-national level, no figures are available in FAOSTAT, and this information could be provided as an attachment to the country profile. When adding up, the total might not be the same as the figure obtained from FAOSTAT for national level. Discrepancies should be explained whenever possible.

\(^4\) **Total area of arable land and total area of permanent crops** (see definitions of variable 4101 and 4102 in the questionnaire): UN-statistics at national level are available in FAOSTAT [http://faostat.fao.org/] and should be used. At sub-national level, no figures are available in FAOSTAT, and this information could be provided as an attachment to the country profile. When adding up, the total might not be the same as the figure obtained from FAOSTAT for national level. Discrepancies should be explained whenever possible. If available, please give also the area of cultivable land, which is the land potentially fit for cultivation. Since the exact definition varies from country to country (for example it may or may not
and terrain main characteristics (salinity, slopes, etc.)

- Climate: climate zones; variation in time/space of precipitation, evapotranspiration, temperature; climatic limitations for crop production
- Population: total, density, % rural/urban, annual growth, unemployment rate, poverty, water supply and sanitation coverage

2. Economy, agriculture and food security (3 paragraphs)

- Gross Domestic Product (GDP), share of agriculture in the country’s economy (population involved, male and female population economically active in agriculture, share of GDP); food security situation of the country, trends and major constraints
- Level of food self-sufficiency and trends, food imports, exports in percentage of food demand; trade issues related to agriculture (agreements, etc.)
- Brief presentation of the different agricultural systems: relative importance of rainfed and irrigated agriculture in the country
- Describe the prevalence of HIV/AIDS in your country, its impact on the labour force, etc.

3. Water resources (3-4 paragraphs)

Water resources

- Major river basins and aquifers
- Wetlands: role in water resources, importance/conservation status
- Renewable water resources: surface water, groundwater, internal and external water resources, variability of renewable resources (resources in a dry year of a 10-year frequency)
- Actual renewable water resources and exploitable water resources (see variables [4193]-[4196])

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5 Total, rural and urban population: UN-statistics at national level are available in FAOSTAT (http://faostat.fao.org/) for every year and should be used. At sub-national level, no figures are available in FAOSTAT, and this information could be provided as an attachment to the country profile. When adding up, the total might not be the same as the figure obtained from FAOSTAT for national level. Discrepancies should be explained whenever possible.

6 Water supply coverage: Figures provided by WHO/UNICEF (http://www.wssinfo.org/en/welcome.html) on improved access to water sources are used. According to their definition, access to an improved water source refers to the percentage of the population with reasonable access to an adequate amount of water from an improved source, such as a household connection, public stand-pipe, borehole, protected well or spring, and rainwater collection. Unimproved sources include vendors, tanker trucks, and unprotected wells and springs. Reasonable access is defined as the availability of at least 20 litres/person per day from a source within one one kilometre of the dwelling.

7 Gross Domestic Product (GDP): The World Development Indicators (WDI) is the World Bank’s premier annual compilation of data about development and data from that database are used in the country profile (http://www.worldbank.org/data/). GDP there is defined as the sum of the value added in the agriculture, industry and services sector. If the value added of these sectors is calculated at purchaser values, total value added is derived by subtracting net product taxes from GDP. Data are in constant 1995 US$.

8 Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food for a healthy and active life (World Food Summit Plan of Action, par. 1). This involves four conditions: (i) adequacy of food supply or availability, (ii) stability of supply, without fluctuations or shortages from season to season or from year to year, (iii) accessibility to food or affordability, (iv) quality and safety of food.

9 Internal Renewable Water Resources (IRWR): Average annual flow of rivers and recharge of aquifers generated from endogenous precipitation (km³/year). Detailed information on methodology, definitions and water resources can be found on http://www.fao.org/nr/water/aquastat/water_res/index.stm.

External Renewable Water Resources (ERWR): That part of the country’s renewable water resources, which is not generated within the country (km³/year). The ERWR include inflows from upstream countries (groundwater and surface water) and part of the water of border lakes or rivers.

10 Total Actual renewable Water resources (TARWR): The sum of internal and external renewable water resources, taking into
• Lakes, dams and reservoirs; flood control, surface water regulation
• Others sources of water: non-conventional water sources (desalinated water, wastewater produced and treated, drainage water), non-renewable (fossil) water sources. Give rate of groundwater depletion, if available

International water issues
• International rivers: conflicts, treaties, agreements, shared management, ongoing cooperation

4. Water use (3-4 paragraphs)
• Main water use sectors (agricultural -irrigation and livestock and aquaculture-, municipal, industry, other), level of pressure on water resources, conflicts (competition between economic sectors and with the environment), trends, projection for the future (agriculture, total), groundwater extraction. Wastewater and drainage water: direct reuse in agriculture

5. Irrigation and drainage development (8-12 paragraphs)

Evolution of irrigation development
• Irrigation potential: Indicate criteria used for it assessment (see also description of variable [4307])
• Evolution of irrigation in the country (in particular its development and type of management)
• Area equipped for irrigation and areas under other forms of agricultural water management: spatial distribution; area actually irrigated; status on maintenance, for example area equipped that is being rehabilitated, area equipped that is not functional
• Distribution according to type of water control: area under different forms of irrigation (see explanations under variables [4308]-[4313] and [4316]), Cultivated wetlands and inland valley bottoms non-equipped ([4315]), flood recession cropping area non equipped ([4314]), rainwater harvesting ([4306]), etc.
• Distribution according to the irrigation technique (surface, sprinkler, localized)
• Distribution according to the source of water (surface water, groundwater, mixed sources, desalinated water, wastewater, drainage water).
• Distribution according to specific typologies and management types used in the country\textsuperscript{11}: traditional/informal\textsuperscript{12}/formal irrigation; public/private irrigation; urban/peri-urban/rural or other typologies as used in the country
• Distribution according to energy use to bring the water from the source to the scheme: gravity systems, pumped systems, energy requirements: extent of pumped irrigation, types of water lifting systems, etc.

\textsuperscript{11} Irrigation schemes can be described in different ways:
- \textit{Irrigation schemes by size}: small/medium/large scale irrigation (see definition of variables [4332]-[4334])
- \textit{Irrigation schemes by type of management}: a breakdown can be given according to the type of the schemes (for example: public schemes, self-help smallholder schemes, commercial schemes, etc.). The criteria are qualitative and should be explained in the text.

\textsuperscript{12} Informal irrigation: It can be defined as schemes which are under local responsibility, controlled and operated by local people in response to their felt needs (smallholder initiated schemes). In many areas with potential, farmers have attempted to enhance food production by introducing some form of irrigation, for example small earth dams, simple diversion structures and self-made conveyance canals, water harvesting, shallow groundwater abstraction. These schemes are often not registered in the figure given for area equipped for irrigation, although they should. Please provide an estimate of the actual extent of this type of system in your country.
In each case, when possible indicate the number of beneficiaries, the management system, the performance of the system, the cropping intensity, the economic aspects (fees...), etc.13

**Role of irrigation in agricultural production, economy and society**

- Main irrigated crops: area, yield and production, added value of irrigated production; comparison rainfed/irrigated yields for major crops
- Return from irrigation, comparison of the benefits (fee/average price per user) to the cost of operation and maintenance (O&M), and provision for future investments and rehabilitation
- Cost of investments (irrigation development), permanent costs (costs of operation and maintenance), costs of rehabilitation and modernization
- Relative importance of irrigation and rainfed crops in the agricultural and the national economy
- Description of role and extent of urban and peri-urban irrigation; of informal irrigation; of rainfed farming improved with water harvesting, etc.
- Role, potential and extent of supplementary irrigation (give explanation of this type of irrigation)
- Water use: design values of irrigation water requirement per ha (ranges); typology according to the agricultural system, season, crop, soil type (including supplementary irrigation); estimations of water use efficiency at conveyance and field level
- Gender issues: distribution of roles of men and women in activities of agricultural water management

**Status and evolution of drainage systems**

- Detail the typology used in the country and linkages with irrigation management, distribution according to the drainage systems: only flood control, main drainage systems only, on farm-drainage (surface, subsurface -open, tile, vertical) (see explanations under variables [4303], [4304] and [4300])
- On farm-drainage in rainfed lands: role, importance, extent, state of maintenance, needs, key issues, costs
- On farm-drainage in irrigated land: role, importance, extent, state of maintenance, needs, key issues, costs

**6. Water management, policies and legislation related to water use in agriculture (4 paragraphs)**

**Institutions**

- Main institutions in water management: description and mandates, transfer, delegation and decentralisation, with particular attention to irrigation and drainage development: planning, investments, operation and maintenance, quality control of the service; status of these institutions (if possible, indicate when it concerns a privatisation of infrastructures - capital and/or authority, and when it concerns only a delegation of services)
- Key players in the irrigation and drainage development: planning, investments, creation / management, operation and maintenance, control of the quality of the service, fixing and control of

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13 Description of the irrigation schemes: In order to get a good understanding of the irrigation system in your country, additional descriptive comments could be added in the text for the major types of schemes and more detail in an attached document in order to be used in the country profile. For each category of schemes, for example indicate the:
- Total number of households (or farmers) living directly from irrigation
- Most common land property system: Choose only one and add in the comments the other types, if any. Use the following classification: 1. private farmer-owned, 2. private landlord-owned, 3. commercial, 4. public state-owned, 5. community-owned, 6. other (explain)
- Major water pricing method: Choose only one and add in the comments the other types, if any. Use the following classification: 1. by volume of water, 2. by irrigated area, 3. by crop and irrigated area, 4. no water pricing, 5. other (explain)
- Average water charge (currency of money used should be given)
prices

- System of control of water use, of pollution, and of drainage water disposal; is the role of water supply and pollution control under the same body or separated?

**Water management**

- Water user associations (WUAs) and other local management bodies/mechanisms: status and role, relations with other coordination structures
- Organization of management of water in agriculture and territorial level of competencies: local, provincial, regional and national: degree of management transfer of water and irrigation, trends
- Training, extension, capacity building; information management

**Finances**

- Level of financial autonomy of authorities in charge of irrigation
- Modalities for funding and cost recovery of irrigation: fees (fee/tariff principle - according to demand, to offer, by volume, by area, etc.)
- System of financial incentives, subsidies in agriculture and irrigation

**Policies and legislation**

- Water policy, irrigation policies and their main orientation (date approved)
- Agriculture-related policies having an effect on water management; main principles and goals (food security, equity, economic development, liberalization, privatization etc.)
- Main elements of the water and land regulations (access to water and land, fiscal regime) status, implementation, changes; role of traditional ruling systems in water management

7. **Environment and health (2 paragraphs)**

- Water quality issues; general quality of water, in particular for agriculture; impact of irrigation/drainage and agriculture in general on water quality
- Irrigation induced waterlogging and salinization: extent, estimated costs, trends (% of land salinized, or waterlogged)
- Pollution due to irrigated agriculture (% of aquifer polluted); evolution in the use of pesticides and nutrients
- Change in water regime due to agriculture, sedimentation in dams (% of dam silting\(^{14}\))
- Health: positive and negative impacts of irrigation, water-related diseases, etc.

8. **Prospects for agricultural water management (4-6 paragraphs)**

Present the current trends and challenges in agricultural water resources management in the near future with respect to:

- Performance of irrigation, competition or integration with other sectors (for example integration of irrigation with aquaculture), directions for progress, constraints or opportunities to irrigation development and management: environmental, social, economic
- Impact of recent policy changes in water resources, irrigation management, integration of irrigation in other sectors, and in the role of irrigation in food production/food security
- Existing policies/strategies for natural hazards mitigation (drought or floods)

\[^{14}\text{Dam silting}\] refers to the accumulation of sediments inside a reservoir, which leads to a reduction of its useful capacity.
- Policies for funding of irrigation infrastructure, donor involvement
- Institutional changes (irrigation sector reform, irrigation management transfer)
- Impact of international initiatives on national policies

Indicate the long-term trends (future total water demands, future agricultural water demands). List the main factors that may influence future agricultural water use and irrigation in the country such as: free trade on agricultural products, reallocation of water due to the competition with other sectors, decrease of agricultural irrigated product prices, change in consumer diets, disengagement of the state, strengthening of environmental protection.

9. References and additional information

Main sources of information - reports
Put the main references used for the preparation of the country profile. If the reference is already used in the Excel questionnaire, provide the number used in the Excel questionnaire (sheet 1) between brackets.

Websites containing relevant information on water management in the country
Relevant country institutional sites for more information.
Annex:
The survey assessment form

The questionnaire is provided under Excel format.

This form should be used to indicate all problems encountered in answering the questionnaire. General comments about the questionnaire, its relevance, difficulties in collecting data and recommendations on presentation, format, or missing information, should be reported.

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