

Indicator name	Total actual renewable water resources (TARWR)
Prepared by	UNESCO-IHP*
Example	WWDR2, Chapter 4, Table 4.3 See annexed data table
Rationale	The amount of potentially available water resources is important knowledge for planning in all sectors.
Position in DPSIR chain	State
Definition of indicator	The annualized total actual renewable water resource is the theoretical maximum annual volume of water resources available in a country.
Underlying definitions and concepts	<p>The maximum theoretical amount of water actually available for the country is calculated from:</p> <ul style="list-style-type: none"> (a) Sources of water within a country itself; (b) Water flowing into a country (c) Water flowing out of a country (treaty commitments). <p>Availability, defined as the surface and ground water resource volume renewed each year in each country, is how much water is theoretically available for use on a sustainable basis. Exploitability is a different matter. While availability undoubtedly exceeds exploitability, there is unlikely adequate data to define the degree of exploitability at this stage. In more specific terms TARWR is:</p> <p>The sum of:</p> <ul style="list-style-type: none"> • External water resources entering the country • Surface water runoff (SWAR) volumes generated in the country • Ground water recharge (GAR) taking place in the country <p>Less:</p> <ul style="list-style-type: none"> • The volume in the country of the total resource effectively shared as it interacts and flows in both the groundwater and surface water systems. Not to subtract this volume would result in its being counted twice. FAO refers to it as “Overlap” (5) and, • The volume that flows to downstream countries based on formal or informal agreements or treaties.
Specification of determinants needed	<p>The specific determinants required are:</p> <p>(1) Actual/natural: indicates whether it corresponds to a <u>natural situation</u>, i.e. a measure of the water balance without human influence, or an <u>actual situation</u>, i.e. the conditions at a given time taking into account human influence either through uptake abstraction of water or through agreements or treaties. <u>Natural conditions</u> are considered stable over time while <u>actual</u> situations may vary with time and refer to a given period. (FAO, 2003, p xi.)</p> <p>(2) Renewable water resources: Total resources that are offered by the average annual natural inflow and runoff that feed each hydro system (catchment area or aquifer). (FAO, 2003, p xi.)</p> <p>(3) Internal renewable water resources (km³/year): Average annual flow of rivers and recharge of aquifers generated from (endogenous) precipitation that originates within the countries borders. (FAO, 2003, p xi)</p> <p>(4) External renewable water resources (km³/year): That part of the country’s renewable water resources which is not generated in the country which includes inflows from upstream countries (groundwater and surface water), and part of the water of border lakes or rivers. (FAO, 2003)</p>

	(5) Overlap between surface water and groundwater resources (km ³ /year): Overlap defines the part of the country's water resources that is common to surface waters and to aquifers. Surface water flows can contribute to groundwater as recharge from, for example, river beds or lakes or reservoirs or wetlands. Aquifers can discharge into rivers, lakes and wetlands and can be manifest as base flow, the sole source of river flow during dry periods, or can be recharged by lakes or rivers during wet periods. Therefore, the respective flows of both systems are neither additive nor deductible.
Computation	TARWR (in km ³ /yr) = (External inflows + Surface water runoff + Groundwater Recharge) - (Overlap + Treaty obligations) TARWR PC = (TARWR / population) 10 ⁹ m ³ /km ³
Units of measurements	Total Annual Volume: km ³ /year Per capita measure: m ³ /capita/year
Data sources, availability and quality	Source: FAO, computed on the basis of available country water resources data sheets and country water balance computational spreadsheets. TARWR-FAO, 2003. <i>Review Of World Water Resources By Country</i> Availability: 2005 - Latest version online. Updates done in concert with FAO. Quality: FAO refers to the data as the "Best Estimate" and updates the data when further information is provided.
Scale of application	Data available at country level.
Geographical coverage	Global
Interpretation	This indicator provides an estimate of the maximum theoretical amount of water resources in a country. The available water resources will be less according various factors but it is an overall measure of the country's resources which is also normalized to provide an average annual per capita volume available to individuals within the country. Within the indicator are five important dependencies which relate to each nation's TARWR as to how much of that water resource volume is: <ul style="list-style-type: none"> • Flowing from outside the country (a security issue) • Generated surface water runoff (a precipitation issue) • Generated groundwater recharge (a sustainability issue) • Shared in both the groundwater and surface water regimes • Committed to downstream nations. Limitations on the indicator: <ol style="list-style-type: none"> 1. See extensive notes from FAO in publication and at web site. 2. Does not yet apply at the level of basins or hydrographic units although some work in this regard has been started by FAO. (Africa, Asia partial) 3. Does not include non-renewable groundwater. 4. Size of large countries can mask high range in variability. 5. Quality of data is variable by country as qualified in FAO database and country datasheets. 6. In the determinant "External renewable water resources", groundwater outflows through transboundary aquifers can be substantial in some countries even if they in general are small compared with surface water flows. Transboundary groundwater flows are difficult to quantify. Suggested future modifications: <ul style="list-style-type: none"> • Determine ratio by country where shared basins exist (significant number) • For the largest area countries (the 12 over 2 million km² or the 30 over 1 million km²) break down the distribution according to the next lower level of administrative governance. (e.g. Canada & China, Provinces, USA,

	<p>Russia – States)</p> <ul style="list-style-type: none"> • Breakdown into smaller (significant) sub-basins to assess basin-wide variability.
Linkage with other indicators	<p>Precipitation (FAO data is calculated from IPCC data unless considered not representative. Approximately 80% of FAO's precipitation data originates from IPCC).</p> <p>Water use (WU) by different sectors (is included as part of the AQUASTAT Data base)</p>
Alternative methods and definitions	<p>FAO collected statistics on water resources for most of the developing countries within the AQUASTAT programme. Data on water resources were obtained from national sources and reviewed by FAO to ensure consistency in definitions. A methodology was developed and rules were established to compute the different elements of national water balances. From those data, FAO has compiled a comparative analysis of available country water resources data.</p>
Related indicator sets	<p>FAO's AQUASTAT</p>
Sources of further information	<p>FAO. 2011. AQUASTAT online database http://www.fao.org/nr/water/aquastat/water_res/index.stm (Accessed 15 November 2011)</p> <p>Map for actual renewable surface water and groundwater resources per inhabitant (in 2005) ; FAO AQUASTAT, Available on http://www.fao.org/nr/water/art/2008/flash/aquastatmaps/gallery1.html (Accessed 15 November 2011)</p> <p>Definitions of the different water resources variables can be found in the AQUASTAT glossary, Available on http://www.fao.org/nr/water/aquastat/data/glossary/search.html (Accessed 15 November 2011)</p>
Other institutions involved	<p>*This indicator was originally developed by FAO</p>