

## Internal Renewable Water Resources (IRWR), 1977-2001, in cubic km

	Bhutan	Asia (excl. Middle East)
Surface water produced internally	95	10,985
Groundwater recharge	X	2,472
Overlap (shared by groundwater and surface water)	X	2,136
Total internal renewable water resources (surface water + groundwater - overlap)	95	11,321
Per capita IRWR, 2001 (cubic meters)	43,214	3,241

## Natural Renewable Water Resources (includes flows from other countries)

	Bhutan	Asia (excl. Middle East)
Total, 1977-2001 (cubic km)	95	X
Per capita, 2002 (cubic meters per person)	43,214	X
Annual river flows:		
From other countries (cubic km)	X	X
To other countries (cubic km)	95	X

## Water Withdrawals

	Bhutan	Asia (excl. Middle East)
Year of withdrawal data	1987	
Total withdrawals (cubic km)	0.0	X
Withdrawals per capita (cubic m)	13	X
Withdrawals as a percentage of actual renewable water resources	0.0%	X
Withdrawals by sector (as a percent of total) {a}		
Agriculture	54%	X
Industry	10%	X
Domestic	36%	X

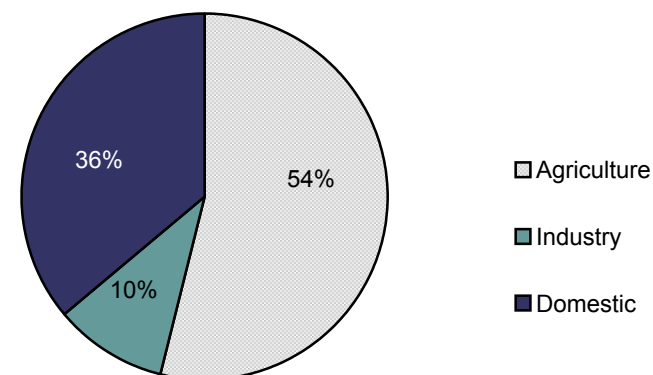
## Desalination (various years)

	Bhutan	Asia (excl. Middle East)
Desalinated water production (million m <sup>3</sup> )	0	X

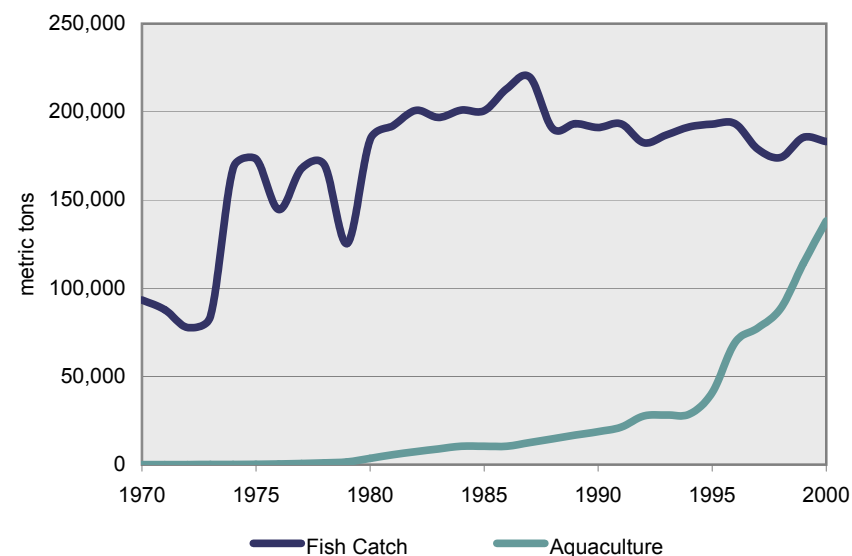
## Freshwater Fish Species, 1990s

	Bhutan	Asia (excl. Middle East)
Total number of species	44	X
Number of threatened species	0	X

Surface Water Withdrawals by Sector, Bhutan, 1987



Freshwater Fish Catch & Aquaculture Production, Bhutan, 1970-2000



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## Water Resources and Freshwater Ecosystems-- Bhutan

	Bhutan	Asia (excl. Middle East)
<b>Freshwater Seafood Production</b>		
Freshwater fish catch {b}		
1990 (metric tons)	300	3,783,743
2000 (metric tons)	300	5,959,055
Freshwater aquaculture production		
1987 (metric tons)	X	5,029,515
1997 (metric tons)	30	15,469,848

### Other Resources:

Water and Food Security Country Profiles of the Food and Agriculture Organization of the United Nations:

<http://www.fao.org/countryProfiles/water/default.asp?search=search&iso3=BTN>

AQUASTAT Information System on Water and Agriculture Country Profiles

<http://www.fao.org/waicent/faoinfo/agricult/agl/aglw/aquastat/countries/index.stm>

### Footnotes:

- a. Totals may exceed 100 percent due to groundwater drawdowns, withdrawals from river inflows, and the operation of desalinization plants
- b. Freshwater fish production data refer to freshwater fish caught or cultivated for commercial, industrial, and subsistence use (catches from recreational activities are included where available).

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## Water Resources and Freshwater Ecosystems—Sources and Definitions

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Most Freshwater resources data were provided by AQUASTAT, a global database of water statistics maintained by the Food and Agriculture Organization of the United Nations (FAO). AQUASTAT collects its information from a number of sources--national water resources and irrigation master plans; national yearbooks, statistics and reports; FAO reports and project documents; international surveys; and, results from surveys done by national or international research centers. In most cases, a critical analysis of the information was necessary to ensure consistency among the different data collected for a given country.

AQUASTAT was developed by FAO in 1993; data have been available on-line since 2001. Most freshwater data are not available in a time series, and the global data set contains data collected over a time span of up to 30 years. AQUASTAT updates their website as new data become available, or when FAO conducts special regional studies. Studies were conducted in Africa in 1994, the Near East in 1995-96, the former Soviet republics in 1997, selected Asian countries in 1998-99, and Latin America & the Caribbean in 2000. Data from the Blue Plan on Mediterranean water withdrawals were last updated in 2002. Most data updates include revisions of past data.

When possible, cross-checking of information among countries was used to improve assessment in countries where information was limited. When several sources gave different or contradictory figures, preference was always given to information collected at the national or sub-national level. This preference is based on the assumption by FAO that no regional information can be more accurate than studies carried out at the country level. Unless proven to be wrong, official rather than unofficial sources were used. In the case of shared water resources, a comparison among countries was made to ensure consistency at river-basin level.

For more information on the methodology used to collect these data, please refer to the original source or: Food and Agriculture Organization of the United Nations (FAO): Water Resources, Development and Management Service. October, 2001. *Statistics on Water Resources by Country in FAO's AQUASTAT Programme* (available on-line at [http://www.fao.org/ag/agl/aglw/aquastat/water\\_res/index.stm](http://www.fao.org/ag/agl/aglw/aquastat/water_res/index.stm)). Rome: FAO.

### Water Resources

Internal renewable water resources (IRWR) include the average annual flow of rivers and the recharge of groundwater (aquifers) generated from endogenous precipitation--precipitation occurring within a country's borders. IRWR are measured in cubic kilometers per year (km<sup>3</sup>/year). Since data were collected in different years for different countries, they may not be directly comparable.

**Surface water produced internally** includes the average annual flow of rivers generated from endogenous precipitation and base flow generated by aquifers. Surface water resources are usually computed by measuring or assessing total river flow occurring in a country on a yearly basis.

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**Groundwater recharge** is the total volume of water entering aquifers within a country's borders from endogenous precipitation and surface water flow. Groundwater resources are estimated by measuring rainfall in arid areas where rainfall is assumed to infiltrate into aquifers. Where data are available, groundwater resources in humid areas have been considered as equivalent to the base flow of rivers.

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**Overlap** is the volume of water resources common to both surface and groundwater. It is subtracted when calculating IRWR to avoid double counting. Two types of exchanges create overlap: contribution of aquifers to surface flow, and recharge of aquifers by surface run-off. In humid temperate or tropical regions, the entire volume of groundwater recharge typically contributes to surface water flow. In karstic domains (regions with porous limestone rock formations), a portion of groundwater resources are assumed to contribute to surface water flow. In arid and semi-arid countries, surface water flows

recharge groundwater by infiltrating through the soil during floods. This recharge is either directly measured or inferred by characteristics of the aquifers and piezometric levels.

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**Total internal renewable water resources** is the sum of surface and groundwater resources minus overlap; in other words, IRWR = Surface Water Resources + Groundwater Recharge – Overlap. Natural incoming flow originating outside a country's borders are not included in the total.

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**Per capita internal renewable water resources (IRWR)** are measured in cubic meters per person per year (m<sup>3</sup>/person/year). Per capita values were calculated by using national population data for 2001. For more information about the collection methodology and reliability of the UN data, please refer to the technical notes in the population data table at [http://earthtrends.wri.org/searchable\\_db/variablenotes\\_static.cfm?varid=363&themeid=4](http://earthtrends.wri.org/searchable_db/variablenotes_static.cfm?varid=363&themeid=4)

**Natural renewable water resources**, also known as Actual Renewable Water Resources, is the sum of internal renewable water resources and natural flow originating outside of the country. Natural Renewable Water Resources are computed by adding together both internal renewable water resources (IRWR—see above) and natural flows (flow to and from other countries). Natural incoming flow is the average amount of water which would flow into the country without human influence. In some arid and semi-arid countries, actual water resources are presented instead of natural renewable water resources. These actual totals, labeled with a footnote in the freshwater data table, include the quantity of flows reserved to upstream and downstream countries through formal and informal agreements or treaties. The actual flows are often much lower than natural flow due to water scarcity in arid and semi-arid regions.

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**Per capita natural renewable water resources** are measured in cubic meters per person per year (m<sup>3</sup>/person/year). Per capita values were calculated by using national population data for 2002. For more information about the collection methodology and reliability of the UN data, please refer to the technical notes in the population data table. View full technical notes on-line at

[http://earthtrends.wri.org/searchable\\_db/variablenotes\\_static.cfm?varid=694&themeid=2](http://earthtrends.wri.org/searchable_db/variablenotes_static.cfm?varid=694&themeid=2)

**Annual river flows from other countries** is the total volume of surface water that would flow into a country under natural conditions, i.e. without human influence.

**Annual river flows to other countries** is the total volume of surface water that would flow out of a country under natural conditions, i.e. without human influence.

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### Sources

Food and Agriculture Organization of the United Nations (FAO): Water Resources, Development and Management Service. 2002. *AQUASTAT Information System on Water in Agriculture: Review of Water Resource Statistics by Country*. Rome: FAO. Available on-line at [http://www.fao.org/waicent/faoinfo/agricult/agl/aglw/aquastat/water\\_res/index.htm](http://www.fao.org/waicent/faoinfo/agricult/agl/aglw/aquastat/water_res/index.htm).

Population Data (for per capita calculations): Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2002. *World Population Prospects: The 2000 Revision*. New York: United Nations. Data set on CD-ROM.

## Water Withdrawals and Desalination

**Water withdrawals (annual)**, measured in million cubic meters, refers to total water removed for human uses in a single year, not counting evaporative losses from storage basins. Water withdrawals also include water from nonrenewable groundwater sources, river flows from other countries, and desalination plants.

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**Per capita annual Withdrawals** were calculated using national population data for the year the withdrawal data were collected.

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**Water Withdrawals as a Percent of Renewable Water Resources** is the proportion of renewable water resources withdrawn on a per capita basis, expressed in cubic meters per person per year (m<sup>3</sup>/person/year). The value is calculated by dividing water withdrawals per capita by actual renewable water resources per capita; data are usually from different years. While this ratio can indicate that some countries are depleting their water resources, it does not accurately reflect localized over-extraction from aquifers and streams. In addition, the calculation does not distinguish between ground and surface water.

Sectoral Share of water withdrawals, expressed as a percentage, refers to the proportion of water used for one of three purposes: agriculture, industry, and domestic uses. Sectoral Withdrawal Data may not add to 100 because of rounding. Evaporative losses from storage basins are not considered; users should keep in mind, however, that in some parts of the world up to 25 percent of water that is withdrawn and placed in reservoirs evaporates before it is used by any sector.

All water withdrawals are allocated to one of these three categories.

**Agricultural** uses of water primarily include irrigation and, to a lesser extent, livestock maintenance.

**Domestic** uses include drinking water plus water withdrawn for homes, municipalities, commercial establishments, and public services (e.g. hospitals).

**Industrial** uses include cooling machinery and equipment, producing energy, cleaning and washing goods produced as ingredients in manufactured items, and as a solvent.

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**Desalinated Water Production**, expressed in million cubic meters, refers to the amount of water produced by the removal of salt from saline waters--usually seawater--using a variety of techniques including reverse osmosis. Most desalinated water is used for domestic purposes.

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### Sources

Food and Agriculture Organization of the United Nations (FAO): Water Resources, Development and Management Service. 2002. *AQUASTAT Information System on Water in Agriculture*. Rome: FAO. Available on-line at <http://www.fao.org/waicent/faoinfo/agricult/agl/aglw/aquastat/dbase/index.htm>.

Data for Mediterranean countries were provided directly to WRI from: J. Margat, 2002. *Present Water Withdrawals in Mediterranean Countries*. Paris: Blue Plan.

Population Data (for per capita calculations): Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2002. *World Population Prospects: The 2000 Revision*. New York: United Nations. Data set on CD-ROM.

## Freshwater Fish Species

**Total number of freshwater fish species** includes all fish catalogued by the World Conservation Monitoring Center (WCMC). The total number of known species may include introductions in some instances. Most marine fish are excluded from country totals. Figures are not necessarily comparable among

countries because taxonomic concepts and the extent of knowledge vary (for the latter reason, country totals of species and endemics may be underestimates). In general, numbers of freshwater fish are not as well known compared to other taxonomic groups such as birds and mammals. The world total for the number of known fish species includes marine species. Of this total, around 40-45% are estimated to be freshwater species. View full technical notes on-line at [http://earthtrends.wri.org/searchable\\_db/variablenotes\\_static.cfm?varid=139&themeid=7](http://earthtrends.wri.org/searchable_db/variablenotes_static.cfm?varid=139&themeid=7)

**Total number of threatened freshwater species** includes only fish catalogued by the World Conservation Union (IUCN) in their "Red List" publication. Figures reported here are in all likelihood smaller than the actual number of threatened species; in many regions of the world, freshwater fish species have not been assessed. Other estimates place the proportion of threatened freshwater fish as high as 20 percent for all countries combined. View full technical notes on-line at [http://earthtrends.wri.org/searchable\\_db/variablenotes\\_static.cfm?varid=140&themeid=7](http://earthtrends.wri.org/searchable_db/variablenotes_static.cfm?varid=140&themeid=7)

#### **Sources**

World Conservation Monitoring Center (WCMC). April 1997. Unpublished data. Cambridge, U.K: WCMC

World Conservation Union (IUCN). 1996. *1996 IUCN Red List of Threatened Animals*. Gland, Switzerland: IUCN, 1996.

#### **Freshwater Seafood Production**

Freshwater seafood production includes freshwater fish caught in inland waters and in low salinity seas (cyprinids, cichlids, miscellaneous freshwater fishes), freshwater molluscs, freshwater crustaceans, and diadromous fish caught in inland waters. For a more detailed listing of the species mentioned above, please refer to the original source or FAO's classification of fish species, on line at <http://www.fao.org/waicent/faostat/agricult/fishitems-e-e.html>. Production is expressed in live weight--the nominal weight of the aquatic organisms at the time of capture. Data exclude discards.

**Freshwater Fish Catch.** Fish catch (capture) is defined by FAO as "the nominal catch of fish, crustaceans and molluscs, the production of other aquatic animals, residues and plants and catches of aquatic mammals, taken for commercial, industrial, recreational and subsistence purposes from marine waters." Freshwater capture totals exclude harvest totals from mariculture and aquaculture. Figures are national totals which include fish caught by a country's fleet anywhere in the world.

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**Freshwater Aquaculture Production.** Aquaculture is defined by FAO as "the farming of aquatic organisms, including fish, molluscs, crustaceans, and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. [It] also implies ownership of the stock being cultivated." Aquaculture production of freshwater fish includes all freshwater fish cultivated in marine and inland waters; and in freshwater and brackish environments.

#### **Source**

Fishery Information, Data and Statistics Unit, Food and Agriculture Organization of the United Nations (FAO). 2002. *FISHSTAT Plus: Universal software for fishery statistical time series, Version 2.3* (available on-line at <http://www.fao.org/fi/statist/FISOFT/FISHPLUS.asp>). Aquaculture Production dataset. Rome: FAO.