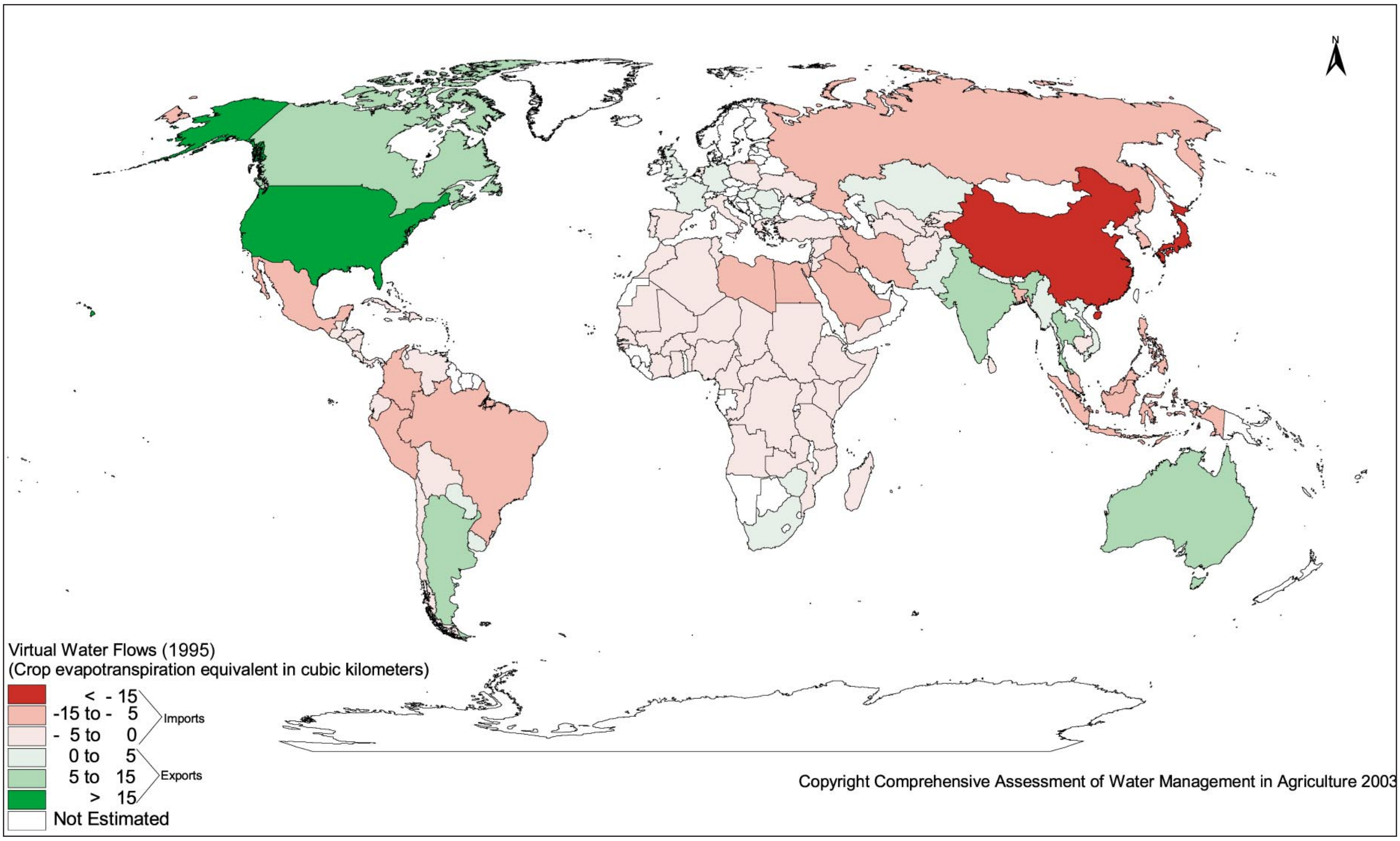
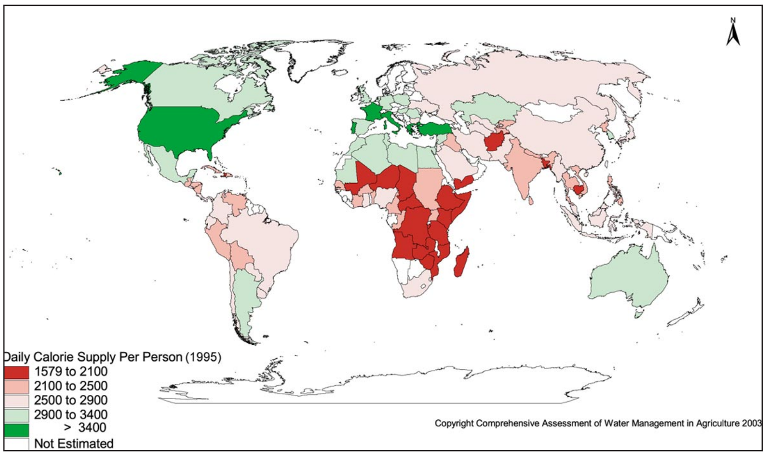
Water Resources eAtlas

19. Virtual Water Flows

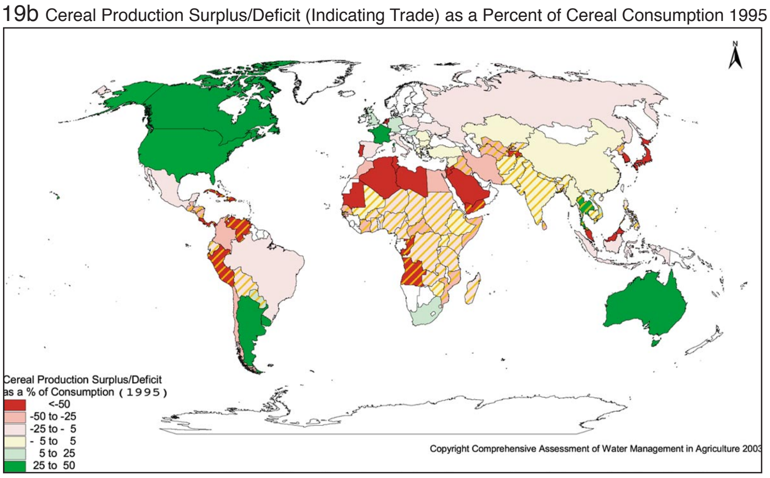
19c Virtual Water Flows



19a Daily Calorie Supply Per Person 1995



19b Cereal Production Surplus/Deficit (Indicating Trade) as a Percent of Cereal Consumption 1995



IUCN The World Conservation Union

IWMI

Ramsar CONVENTION ON WETLANDS (Ramsar, Iran, 1971)

WRI

19. Virtual Water Flows

Map Description

Virtual water is defined as water embedded in commodities (Allan 1998). As a rule of thumb, a grain crop transpires about 1 cubic meter of water in order to produce 1 kilogram of grain. Thus importing 1 kilogram of grain is approximately equivalent to importing 1 cubic meter of water. Virtual water flows, the flows of water embedded in commodities, have relevance to water stress, water scarcity, and food security, as they reduce the need to use water for food production in importing countries and increase water use in exporting countries. At present, cereals comprise the majority of the trade in agricultural products, and therefore tracking trade in cereals is a good indicator of overall virtual water flows. The map series presented in this section focuses on cereal trade and virtual water flows to help gain a better picture of the current global situation with respect to water scarcity and food security.

The first map in this series (Map 19a) presents the calorie supply per person by country for 1995. National-level calorie intake is used as an indicator of food security. For example, in much of sub-Saharan Africa (areas in red in map), people do not consume a sufficient amount of calories, a sign of malnourishment and hence food insecurity. In countries of food insecurity, countries do not import enough food to make up the deficit in supplies. Calorie supply per person is important to understand virtual water flows because population and dietary requirements drive the need to use water to produce food.

The second map in this section (Map 19b) indicates the trade in cereals as a percentage of total consumption by country. Cereals include wheat, rice, maize, millet, barley, sorghum, etc. It does not include pulses or tubers. The map highlights the small number of cereal-exporting countries, namely Argentina, Australia, Canada, France, Uruguay and the United States. Other countries produce enough grains for their own consumption, a condition of self sufficiency, but not a surplus for export. If maps 19a and 19b are combined, we note that some countries produce almost enough to match consumption, but that consumption is insufficient to meet minimum dietary requirements. For example, India has a small surplus of cereal production (2 percent) but consumes only 2400 calories per day, and Ethiopia has a small deficit of cereal production (-0.4 percent) and consumes only 1780 calories per day. Within countries, poor distribution of food can exacerbate food insecurity problems.

Finally, Map 19c indicates the corresponding virtual water flows in terms of cereal trade. The virtual water flows are estimated as the amount of crop evapotranspiration equivalent— the amount of water directly consumed by plants or evaporated in the production process on irrigated and rainfed land required to produce cereals. While there are certainly virtual water flows into water stressed countries of North Africa and the Middle East (see map 15 on average annual water supply per person), there are also virtual flows into other countries like Japan or much of sub-Saharan Africa where water scarcity is not severe, indicating that there are several economic, political, and food situations beyond scarcity that drive the flows of virtual water.

Striking on the map is China. Although more or less self-sufficient in cereal production (only 4 percent cereal production deficit), China imports a significant amount of virtual water (16 km^3) in cereals. This is because the population is significant and the consumption level is high (2766 cal/pc/day). Small changes in China can shift the global water and food equation. Another interesting case is Japan. While Japan is not water scarce, the country imports a substantial amount of its cereal requirements (76 percent of the total consumption) and hence is a big virtual water importer (25 km^3). Most Northern African and West Asian countries are physically water scarce but have high daily calorie supplies due to substantial food imports and hence virtual water flows into these countries are large. Finally, many countries in sub-Saharan Africa import small amounts of virtual water, even though malnutrition is prevalent and there is no physical water scarcity. In these countries the stakes are high for food and environmental security. Producing more food within these countries can help food security but this option has high water-related environmental costs. How far can virtual water flows be used to provide food security?

Mapping Details

Map 19a and 19b were created using country-level data derived from FAO's Statistical Database (FAO 2000). The FAO database provides estimates of per capita food supplies available for human consumption by country. Per capita supply figures represent only the average supply available for the population as a whole and do not necessarily indicate what is actually consumed by individuals. Even if these measures are taken as approximations to per capita consumption, it is important to bear in mind that there could be considerable variation in consumption between individuals. Per capita supplies are derived from the total supplies available for human consumption (i.e. food) divided by the total population actually partaking of the food supplies during the reference period, i.e. the present in-area (de facto) population within the present geographical boundaries of the country.

In other words, nationals living abroad during the reference period are excluded, but foreigners living in the country are included. In almost all cases, the population figures used are the mid-year estimates published by the United Nations Population Division. Map 19b was created by taking cereal trade figures by country from the FAO statistical database. The map represents cereal production, either surplus or deficit, as a percent of cereal consumption in 1995.

The virtual water flows on Map 19c were created using estimates of crop evapotranspiration equivalents – the amount of water evapotranspired on both irrigated and rainfed land required to produce cereals. This information was derived from estimates of crop evapotranspiration and yields by country based on information from the Podium database (IWMI 2000), and information collected through the IFPRI-IWMI global water-food security modeling effort through the Comprehensive Assessment of Water Management in Agriculture (Rosegrant et al. 2002; http://www.iwmi.org/ Assessment/).

Map Projection

Robinson

Sources

FAO (Food and Agriculture Organization). 2000. FAOSTAT Database, Rome, Italy: FAO. Rosegrant M.W., X. Cai, and S. Cline. 2002. *World Water and Food to 2025: Dealing with Scarcity*. Washington DC: International Food Policy Research Institute (IFPRI) and Colombo, Sri Lanka: International Water Management Institute (IWMI).

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