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World Water Resources and Global Climate Change

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The 21st century is called the "century of water." That is because there are regions where water scarcity results in poverty, poor sanitary conditions, and disease, and anticipated population growth will increase the demand for potable water in urban areas and irrigation water for crop production. Economic growth will induce an increase in the consumption of cereal crops and also increase the water demand.

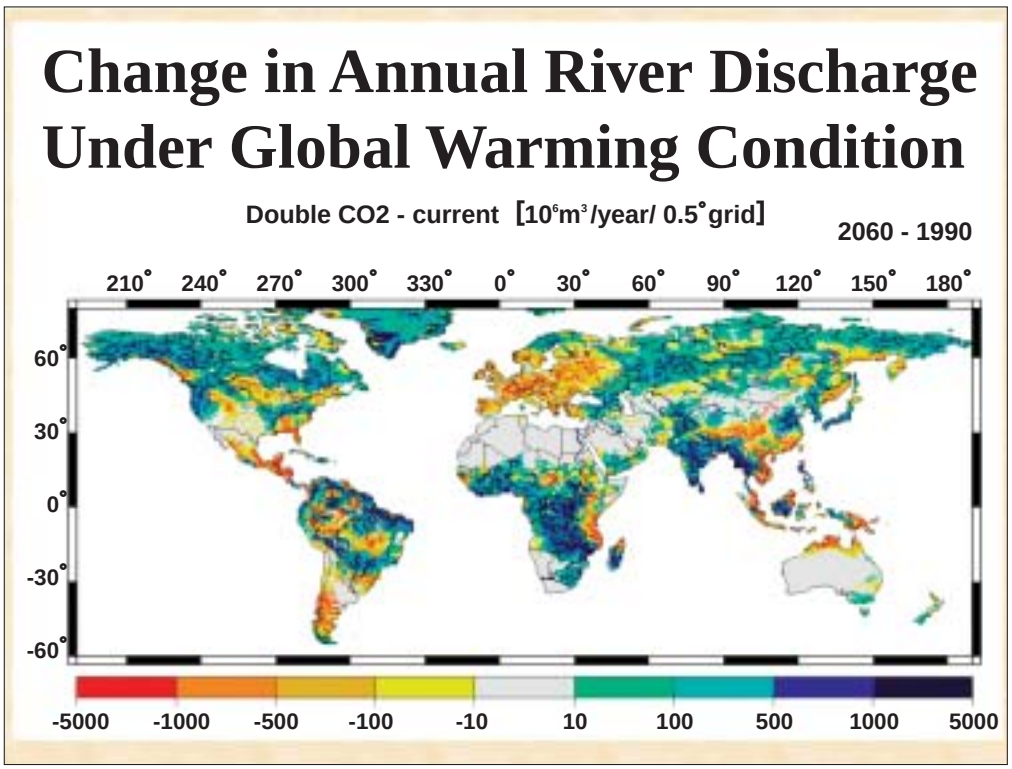

Figure 1 Estimated change in annual river discharge based on the runoff simulation under global warming conditions in 2060 using an atmospheric general circulation model of CCSR, Uni. of Tokyo and NIES. A global river channel network and a river routing model was used.

An accurate future projection for the supply and demand of water is essential for the adoption of suitable alternatives to cope with such concerns. Water demand in the future is estimated by considering the increase of unit demand of water that accompanies population growth and economic development. On the other hand, nowadays, water supply in the future is commonly estimated using general circulation models that consider climate change such as global warming.

Figure 1 illustrates the change in annual river discharge estimated from the results of the general circulation model of the Center for Climate System Research, University of Tokyo and the National Institute for Environmental Studies. The runoff from the model is used to calculate the river discharge using a global river channel network and a river routing model (Saruhashi, 2001). Primary factors affecting the future water crisis are believed to be the societal ones such as population growth, with the effects of climatic change as secondary factors. However, a slight increase in precipitation and runoff is estimated for the northern part of China, close to the Yellow river basin, as shown in Figure 1, and the future water stress in the region is estimated to be less than it would be without climate change. Conversely, water stress will increase due to climate change in the west of the Black Sea and around the Florida Peninsula in North America.

In this result of global warming simulation, global mean precipitation and runoff increase , and the water stress in the future is estimated to be alleviated on a global scale. However, there is another research result that suggests future water stress will become more serious due to global warming. Eliminating the uncertainty in

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the prediction of detailed geographical distribution and quantity of increase and decrease in precipitation and runoff is much anticipated.

On the other hand, upstream water withdrawal, deterioration of water quality, and the shortage of social infrastructure limit the availability of water resources (Oki, 2001), and such social factors should be considered in an assessment of world water resources.

Even though future projections of the water supply in some areas of the world seem very serious, in Japan, no population growth is predicted, agricultural production is decreasing, and industrial water use is not increasing, so there is no concern about a future water crisis on the whole. However, Japan should still care about the anticipated water crisis in the world. One of the major reasons is that Japan imports many agricultural and industrial products from abroad, and these products consume local water resources in the country of origin. In a sense, importing goods and using them is just like importing and consuming "virtual water."

Miyake (2002) estimated that 8m³ of water is used to produce 1kg of polished rice and 4m³ of water is used to produce 1kg of flour if produced in Japan using irrigation. Considering the water required to cultivate feed cereals, livestock for meat needs several times more water resources by weight. Based on the estimates of unit water consumption, the total annual import of virtual water to Japan is illustrated in Figure 2. The total annual import of virtual water to Japan accounts for approximately 100 billion m³ and it is comparable with total national water use of 90 billion m³ per year. It is not surprising since the self-sufficiency ratio for food in Japan is 40% by calorie base. However, Figure 2 shows that Japanese should consider the world water problem as an issue close to home and Japan should encourage research on the current and future situation of global water resources.

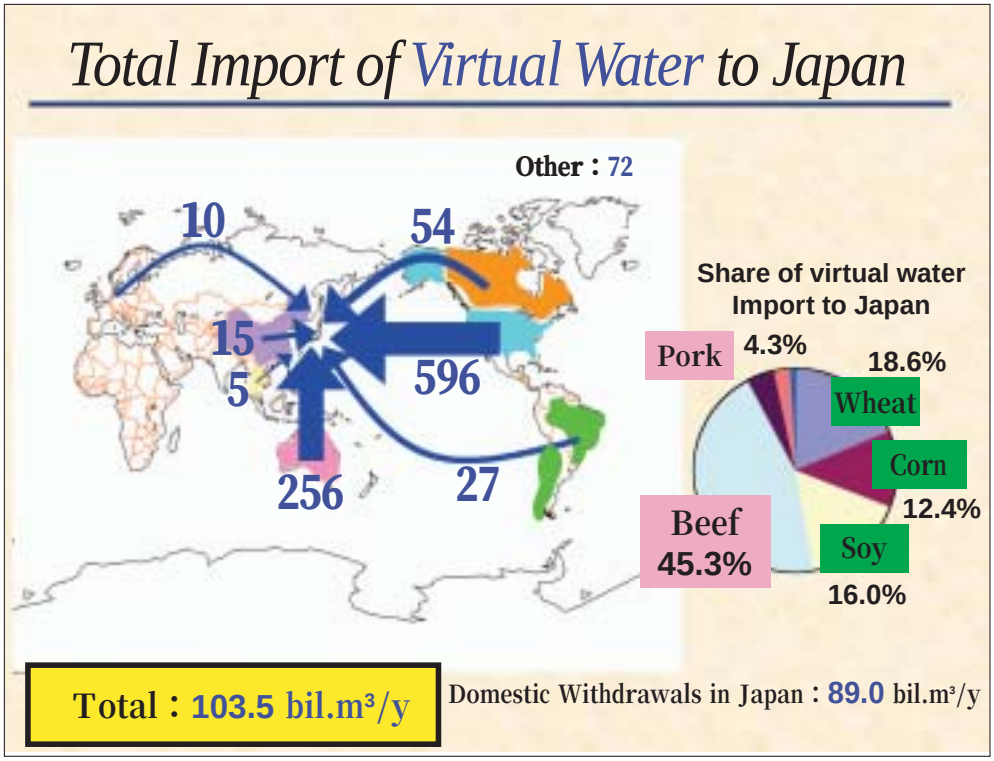

Figure 2 Import of virtual water to Japan. The figures illustrate how much water would be required if these goods were produced in Japan.

References

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