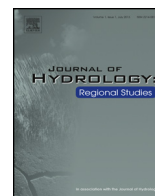




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# Water, energy, and food security in the Asia Pacific region

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### ABSTRACT

Security measures of three resources; water, energy and food are analyzed for thirty two countries in the Asia Pacific region which are faced to Pacific Ocean, in terms of amounts of the resource, self-production, and diversity of sources of each resource. Diversity for all the three resources is also analyzed using surface water and groundwater for water sources; hydro power, geothermal power, solar, and biomass for energy; and cereals, vegetable, fruit, meat, and fish for food. We see high diversity of sources of water in the US and the Philippines, and a low diversity of sources of food in the US, Canada, and Indonesia. These security measures including water security show new hydrological insight for Asia-Pacific region.

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## 1. Introduction

Water, energy, and food are the most important resources for societies around the world. Demands for these resources are increasing rapidly due to increasing population, increasing income, and changing lifestyles. The Asia Pacific region is made up of thirty two countries including the US, Canada, Russia, China, Japan and others, where large-scale human activities occur including economic, agricultural/fishery, industrial, and commercial activities. In addition to these human activities, this area is a hot spot for drivers of environmental change such as global carbon emissions. The population in this area was 3 billion in 2013 (Fig. 1), which is 42% of the global population (The World Bank, 2014). GDP in this area was  $4.3 \times 10^{13}$  USD in 2013 (Fig. 1) which is 58% of global GDP (The World Bank, 2014). Global carbon emissions which are partially responsible for global warming in this area were 18,990 million tons in 2010, comprising 62.7% of global emissions (IEA, 2012).

These large population numbers and their related activities require vast amounts of water, energy and food as resources to support this level of activity. Fig. 2 shows the self production ratios which are the ratios of consumption to production of water, energy and food within the Asia-Pacific 32 countries. Total water production in this area was  $1.82 \times 10^{12}$  m<sup>3</sup> in 2010 (FAO, 2014a,b) and 46.6% of global water production (Fig. 2). Total energy consumption was  $7.55 \times 10^9$  t of oil equivalent in 2010 (IEA, 2014) which is 61.2% of global energy consumption (Fig. 2). Total food production was  $2.37 \times 10^9$  t in 2010 (FAO, 2014a,b) which is 54.6% of global food production (Fig. 2).

Water, energy, and food securities have been discussed separately, however these three securities should be considered in an integrated manner, because water-energy-food are inherently connected and their utilization may result in important tradeoffs such as water consumption for cooling power generator and energy consumption for water allocation. The objec-

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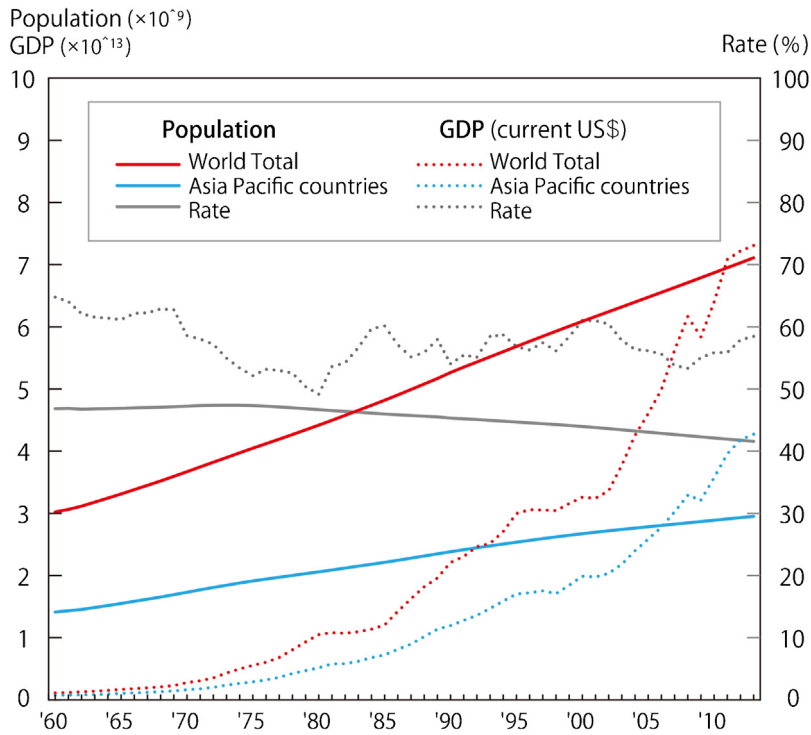


Fig. 1. Population and GDP for the world versus the Asia Pacific 32 countries (The World Bank, 2014).

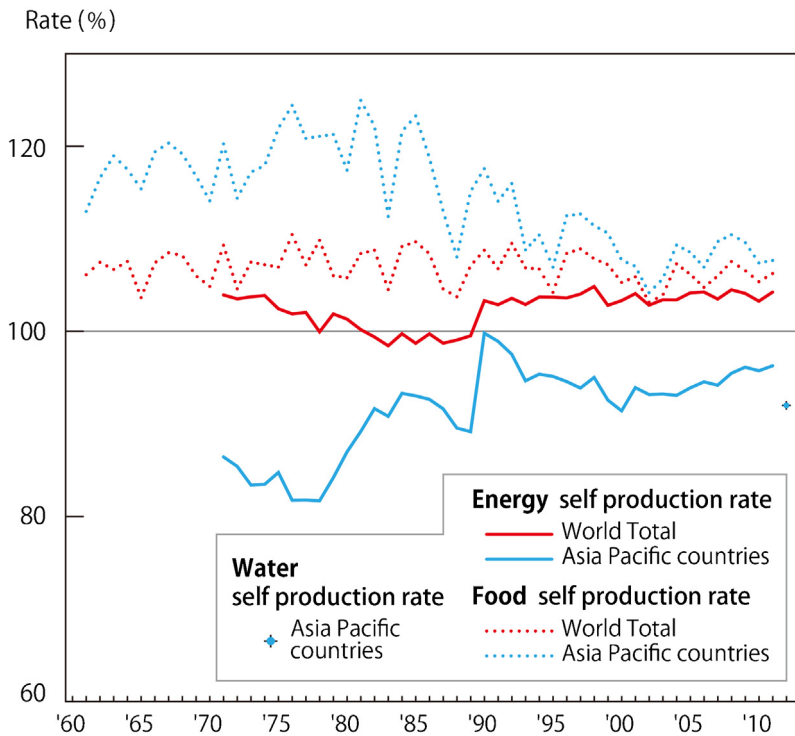


Fig. 2. Self-production rates of water, energy and food in the Asia-Pacific 32 countries (FAO, 2014a,b; IEA, 2014).

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