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The nexus of agricultural water use and economic development level



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ABSTRACT

For many countries in the world, especially developing countries, the agricultural sector contributes low income to the country. However, this sector consumes the largest amount of water. Water is essential for the production of agricultural goods and services, which generate income and create national wealth. Therefore, this paper studied the relationship of water use for agricultural purposes in 154 countries and their economic development. In this study, the economic development in a country, as indicated by per capita GNI, was separated into 4 income groups, based on the World Bank criteria: (1) high income; (2) upper-middle income; (3) lower-middle income; and (4) low income. The results of the study revealed that water use for agricultural purposes usually takes the highest proportion of water consumption in low, lower-middle, and upper-middle income countries. The study also indicated that the quantity of water used for agricultural purposes gradually increased with the income of a country; that is, the greater the income, the more agricultural water was used. On the other hand, less water was consumed in high-income countries.

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Introduction

Water resources are important to economic development, as water is essential to the production of agricultural goods and services. Globally, the major use of water (70%) is in the agricultural sector. In developing countries, whose income mainly depends on agricultural products, water use in agriculture can occupy up to 90 percent of all water withdrawals (FAO, 2010). However, these agricultural products generate only a small amount of income for these countries. In developed countries—such as the countries located in North America and Europe—approximately 40 percent of water is used in the

agricultural sector, less than the amount of water used for industrial purposes (FAO, 2010). As water is a main factor in the production of agricultural products, which contribute to the national income, the hypothesis of this study is that ‘there is a relationship between the agricultural water use and the level of economic development of a country’. The research question in this paper is “what kind of relationship is there between agricultural water use and the level of development?”

Although the study of the relationship between water and economic development has been extensively pursued by several researchers and international development agencies, including ADB (2013), Berry (2011), FAO (2010), Grey and Sadoff

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(2007), HSBC (2012), Musouwir (2010), and World Bank (2010), none of them focuses on the relationship between agricultural water use and the level of economic development. To fill the gap, this paper studied the relationship of water use in the agricultural sector and the level of economic development. The scope of work covered agricultural water use in 154 countries. The economic development category was divided into four levels according to economic development indices: high income, upper-middle income, lower-middle income, and low income.

The paper is divided into six sections. Section [Review on water resources and development](#) briefly reviews the empirical literature on economic growth and water resources. Section [Data and methodologies](#) provides the data and information on the methodologies adopted in the study. Section [Limitations](#) presents the limitations. Section [Results analysis](#) presents the results of the analyses, followed by conclusions and policy implications in Section [Conclusion and policy implications](#).

Review on water resources and development

Water resources are insufficient because fresh water makes up only 0.003 percent of the total amount of water resources worldwide (45,000 out of 1,400 million cubic km). Moreover, there is only 9,000–14,000 cubic km of water for human use (FAO, 2010). The global demand for water is increasing for many reasons such as population and economic growth (Ringler, 2010), and urbanization (Biswas, 2010). By 2030, the world's population is expected to grow by 2 billion people and will require approximately 50 percent more food, compared to the data for 1998 (FAO, 2010). By 2030, more than half of the world's population will be in urban areas. Urbanization is a cause of rapid economic growth, meaning that there will be an increase in water demand. Therefore, water scarcity is going to be a big issue in the near future. Approximately two-third of the world's population will encounter water stress conditions in 2025 and about 1.8 billion people will face absolute water scarcity (UN Water, 2010). The annual water supply will drop below 1,700 cubic m per person, which means that many countries are going to face a water shortage issue. Therefore, water conflicts among all types of water users—agriculture, domestic, and industrial—are going to occur and will lead to obstacles in a country's economic growth.

Water and economic development

The water issue is now of concern worldwide. Several international organizations, such as USAID, ADB, World Bank, and UN Water, have launched many projects and arranged many conferences focused on water resources and development with the objective to address the problems and ultimately come up with solutions for the issues. Due to such concern, World Water Day has been established on 22 March every year. In addition, numerous researchers have studied the relationship between water and economic development from various aspects. For example, investment in water resources generates growth (Biswas, 2010; Grey & Sadoff, 2007; Musouwir, 2010; World Bank, 2008). Access to water and

sanitation generates growth (Berry, 2011; HSBC, 2012; World Bank, 2010), water disasters (floods and drought) disrupt a country's growth (GRID-Arendal, 2002) and the water available for agricultural and economic development (OECD, 2008, 2009).

Water resources infrastructure

There is a causality between economic development and investment in water resources. Investment in infrastructure for these resource helps to create national growth. Wealthy countries have higher ability to invest in such infrastructure and management. Grey and Sadoff (2007) point out that investment in and management of water resources in rich and poor countries make their economic development different. The rich have invested in water resources for a long time and now enjoy the benefit from the investment—a reduced poverty rate and increased economic growth. On the other hand, poor countries are still suffering from water shortage situations due to the lack of water infrastructure and good management systems. This issue is sometimes an obstacle to the development of the country and is one of the causes of poverty and famine. A report from World Bank (2008) revealed that investing in water infrastructure, especially in the agricultural sector, has resulted in poverty reduction and economic growth in the Sub-Saharan African countries. It can be seen that both water resource infrastructure and decent management support a country's growth and development. A study by Musouwir (2010) in 22 developing African countries found that there was a significant relationship between the national budget for water supply and sanitation and Gross Domestic Product (GDP) per capita, excluding rainfall. Research by Biswas (2010) illustrated the dissimilarity in the urbanization process between the mega cities in developed and developing regions. While there are effective water and wastewater infrastructure and relevant services in developed countries, those infrastructure and services in developing regions are poor. In OECD countries, the water infrastructure is usually obsolete and needs reinvestment to handle global and climate change.

Agricultural water use

Economic growth leads to high water demand (Ringler, 2010) in all sectors—agricultural, industrial, and domestic. The percentage share of use is different in different countries, depending on their economic development. For developing countries, agriculture takes the biggest proportion of water use (accounting for 70–90% of all water withdrawal). The study of agricultural water is also extensive, including various related issues, for example, the link of agricultural water use and food security (FAO, 2010) and water management in the agricultural sector (OECD, 2010). Water and food supplies have a solid connection; water is essential in agriculture, both for crop production and animal farming, which is the main resource for food supply. The process of food production requires large amounts of water, especially animal farming. For example, to produce 1 kg of daily food for a person, 2–5 cubic m (2,000–5,000 L) of water are required; to produce 1 kg of beef requires 15,500 L of water—three times the water

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