

(Technical paper presented at KWRA2019, Yeosu, Korea, May 30, 2019)

Evaluation of Water Productivity of Thailand and Improvement Measure Proposals

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Abstracts

Thailand had issued a national strategic development master plan with issues related to water resources and water security in the entire water management system. Water resources are an important factor of living and development of the country's socio-economy to be stable, prosperous and sustainable. Therefore, water management in both multi-dimensional and multi-sectorial systems is important and will supports socio-economic and environmental development in the future. The direction of national development in accordance with the national strategic framework for 20 years requires the country to level up security level in terms of water, energy and food. To response to the proposed goals, there is a sub-plan to increase water productivity of the entire water system for economical development use by evaluating use value and to create more value added from water use to meet international standard level.

This study aims to evaluate the water productivity of Thailand in each basin and all sectors such as agricultural sector, service and industrial sectors by using the water use data from water account analysis and GDP data from NESDB during the past 10 years (1996-2015). The comparison of water productivity with other countries was also conducted and in additional, the measures to improve water productivity in next 20 years were explored to response to the National Strategic Master Plan goals.

Water productivity is defined as output per unit of water depleted. The simplest way to compare water productivity across different enterprises is in monetary terms. World Bank presents water productivity as an indication of the efficiency by which each country uses its water resources. There are two data sets used for water productivity analyses, i.e., the first is water use data at end users and the second is Gross Domestic Product. The water use at end users are estimated by water account method based on the System of Environmental-Economic Accounting for Water (SEEA-Water) concept of United Nations. The water account shows the analyses of the water balance between the use and supply of each water resource in physical terms. The water supply and use linkage in the water account analyses separated into each tiers, i.e., water sources, water managers, water service providers, water user at end user under water regulators of all kinds of water use activities such as household, industrial, agricultural, tourism, hydropower, and ecological conservation uses.

The Gross Domestic Product (GDP), a well-known measuring method of the national economic growth is not actually a comprehensive approach to describe all aspects of national economic status, since GDP does not take into account the costs of the negative impacts to natural resources that result from the overexploitation of development projects, however, at present, integrating the environment with the economy of a country to measure its economic growth with GDP is acceptable worldwide.

. The study results show the water use at each regionals and provinces, use types at end users, water productivity in each sector from 1996-2015 compared with other countries, besides the productivity improvement measures were explored and proposed for the National Strategic Master Plan.

Keywords: water productivity, water use, water account, Thailand.

1. Introduction

Thailand had issued a national strategic development master plan with issues related to water resources and water security in the entire water management system. Water resources are an important factor of living and development of the country's socio-economy to be stable, prosperous and sustainable. Therefore, water management in both multi-dimensional and multi-sectorial systems is important and will support socio-economic and environmental development. The direction of national development in accordance with the national strategic framework for 20 years that requires the country to level up security level in terms of water, energy and food. To response to the proposed goals, there is a sub-plan to increase water productivity of the entire water system for economic development use by evaluating use value and to create more value added from water use to meet international standard level.

From the past study, the report on water resources security - Thailand and international (Koontanakulvong S. et, al 2013), it was found that the production of water from the water was worth 3.59 US\$. When compared to ASEAN countries Thailand is ranked 6th, ranked 132th in the world level (world average). The country with the highest water productivity is United States of America (USA), the value is 4,656 US\$/m³. The country with the second highest water productivity is Luxembourg and the value of water productivity approximately 1,044 US\$/m³, while ranking 3rd is Singapore, about 585 US\$/m³. When compared to the Asia region, Thailand, is no. 132 (Asia average is 41. US\$/m³). This study presented that the water productivity of Thailand in the agricultural sector is 0.32 US\$/m³, which is ranked 124th in the world level (the average world level is 392 US\$/m³) and in the 18th rank in Asia (Asian average is 33.8 US\$/m³). For industry sector in 2007, water productivity is equal to 51.2 US\$/m³, ranked 63th in the world level (world average is 169.1 US\$/m³), which is ranked 8th in Asia. (Asian average is 69.5 US\$/m³). Water productivity of Thailand from the World Bank assessment in 2015 is equal to 5 US\$/m³ (Source: Food and Agriculture Organization, AQUASTAT data, and World Bank and OECD GDP estimates, 2017).

2. Objectives and methods

This study aims to evaluate the water productivity of Thailand in each basin and all sectors such as agricultural sector, service and industrial sectors. The comparison of water productivity with other countries was also conducted and in addition, the measures to improve water productivity in next 20 years were explored to response to the National Strategic Master Plan goals.

Water productivity is defined as output per unit of water depleted. The simplest way to compare water productivity across different enterprises is in monetary terms. World Bank presents water productivity as an indication of the efficiency by which each country uses its water resources. There are two data sets used for water productivity analyses, i.e., the first is water use data at end users and the second is Gross Domestic Product.

This study has 3 main steps, i.e., the first step is data collection by collecting 4 main data groups, including meteorological-hydrological data, basic physical geospatial data, geographic information and provincial gross product data. The second step is to calculate water use at end users, which is estimated by water account method based on the System of Environmental-Economic Accounting for Water (SEEA-Water) concept of United Nations. The water account shows the analyses of the water balance between the use and supply of each water resource in physical terms. The water supply and use linkage in the water account analyses separated into each tiers, i.e., water sources, water managers, water service providers, water user at end user under water regulators of all kinds of water use activities such as household, industrial, agricultural, tourism, hydropower, and ecological conservation uses. The final step is to determine the water productivity. It is calculated as Gross Domestic Product (GDP) divided by the water use resulted from the second step. The GDP data are from Office of the National Economic and Social Development Council (NESDC) during the past 10 years (1996-2015).

3. Results

3.1 Water use

From the analysis, the water use analysed from water account as shown in Figures 1-3. The water use of all sectors from 2007-2016 are 77,890-100,362 MCM Thailand and can be divided into 7 economic regions, namely, Northern, Northeastern, Southern, Central, Eastern, Western and Bangkok and its vicinities. The northeastern region is

the region with the highest water use of 26,715-37,653 MCM. The Bangkok and its vicinities region is the region with the lowest water use of 3,704-4,711 MCM. From the Figure 2, it presents that the agricultural sector is the highest water use of 77,045-96,574 MCM (95%-96% of total water use). The service sector is the lowest water use of 1,403-1,566 MCM (2% of total water use). Figure 3 presents the water use distribution by province, the highest water use in agriculture sector, industry sector and service sector are the northeastern region, central region and Bangkok and its vicinities region, respectively.

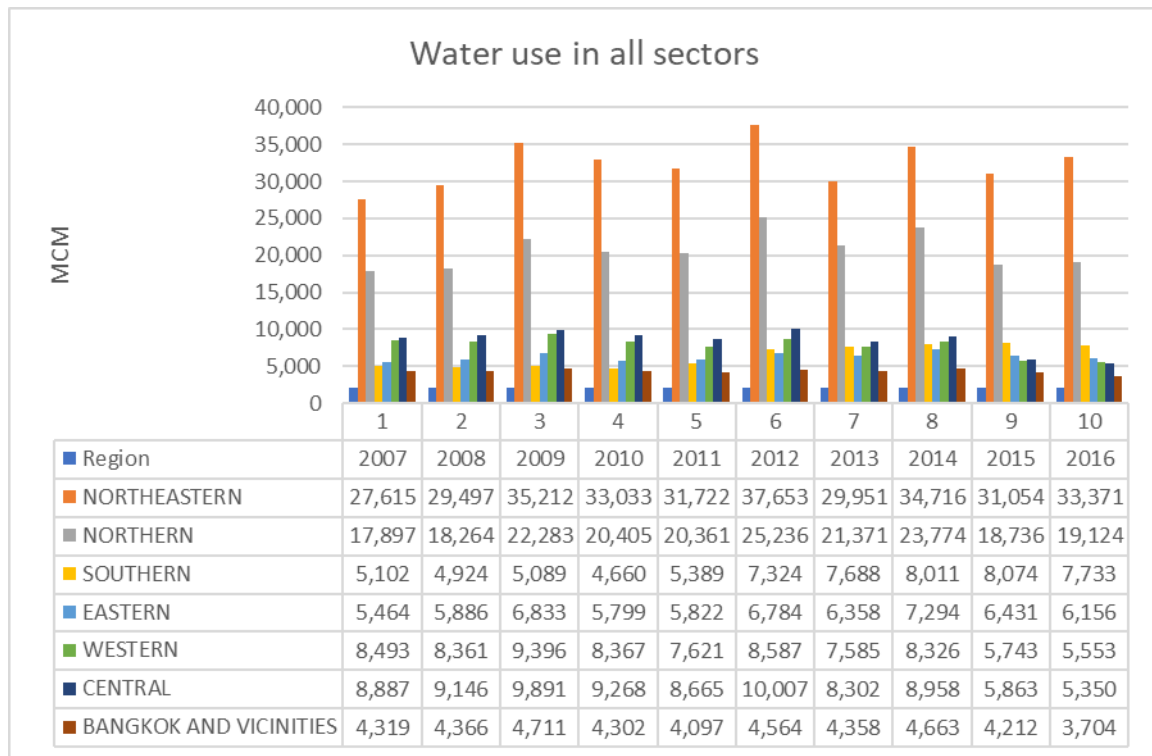


Figure 1 The water use of each regions from 2007-2016

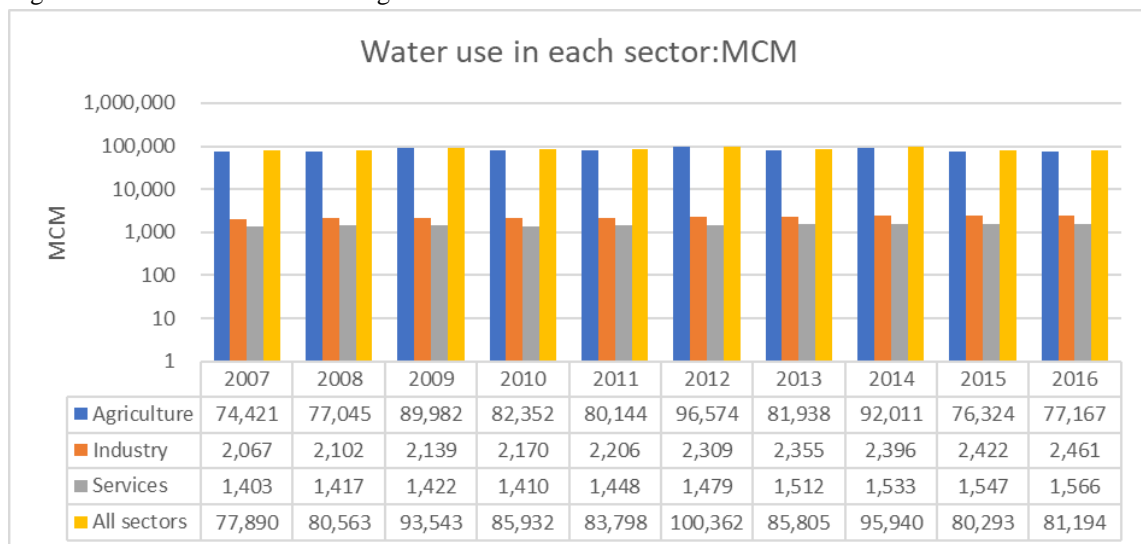


Figure 2 The water use of each sectors from 2007-2016

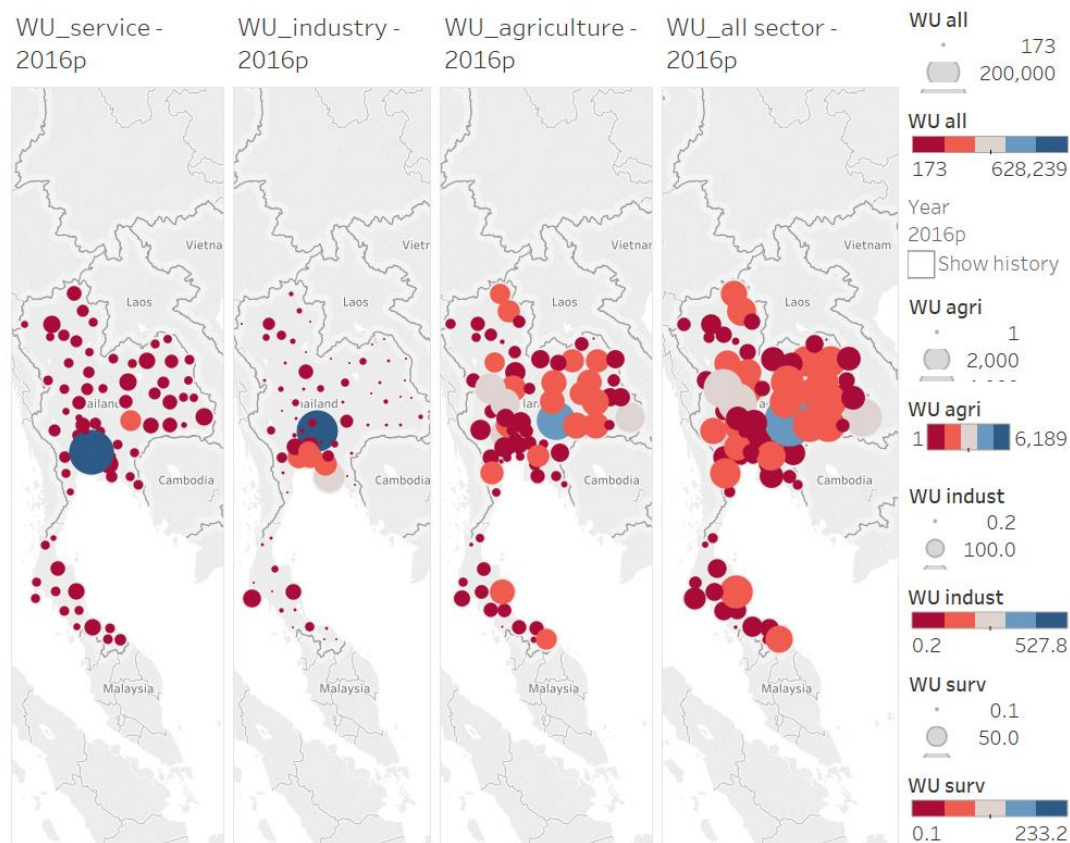


Figure 3 The water use of each sector by provinces in 2016

3.2 The Gross Domestic Product (GDP)

The GDP of all sectors from 2007-2016 are 275,039 - 440,408 million US\$. The Bangkok and its vicinities region is the region with the highest GDP of 126,410 - 204,006 million US\$. The western region is the region with the lowest GDP of 10,221- 15,683 million US\$. From Figure 6, it presents that the service sector gives the highest GDP of 156,526- 271,017 million US\$(55%-62% of total GDP). The agricultural sector gives the lowest GDP of 25,710- 44,312 million US\$. (9%-12% of total GDP). Figure 7 presents the GDP distribution by province and the highest GDP of all sector is in the Bangkok and its vicinities region.

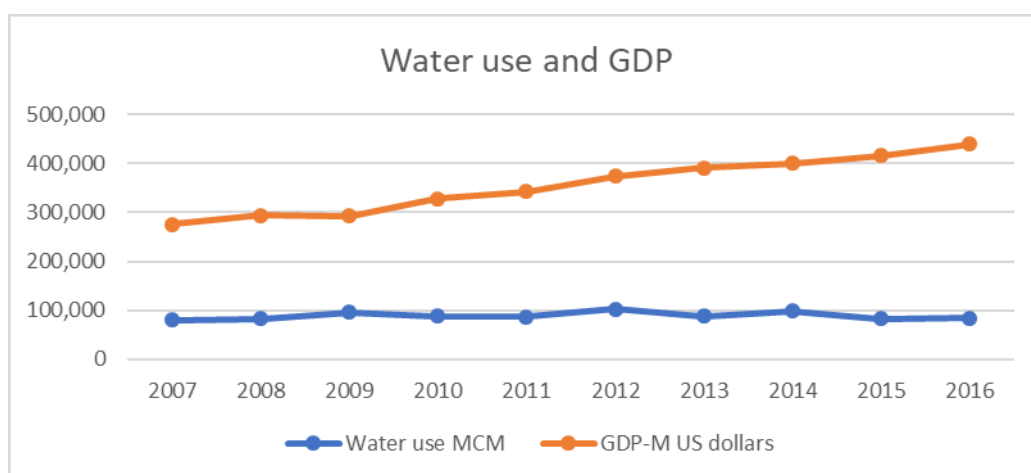


Figure 4 The GDP and the water use of Thailand from 2007-2016

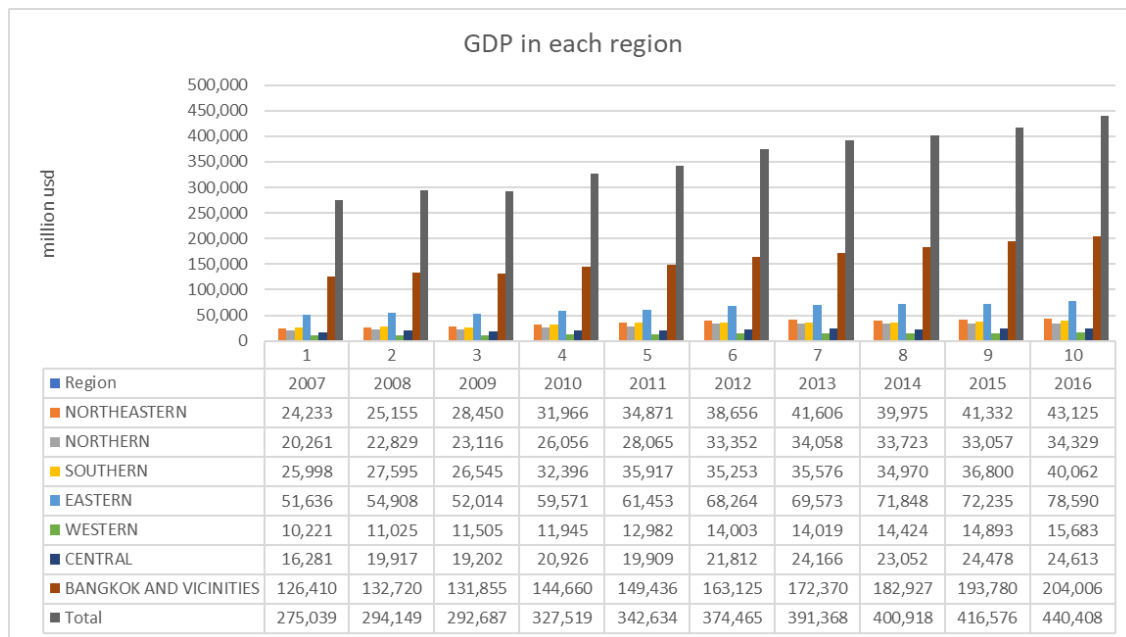


Figure 5 The GDP by regions from 2007-2016

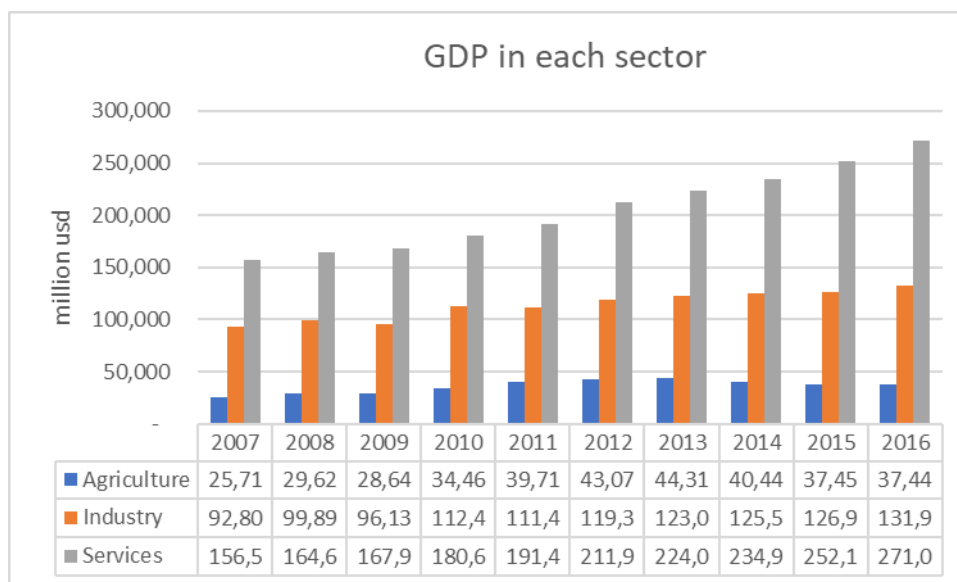


Figure 6 The GDP by sectors from 2007-2016

GPP All sectors: million usd

Sheet 1 - 2016p

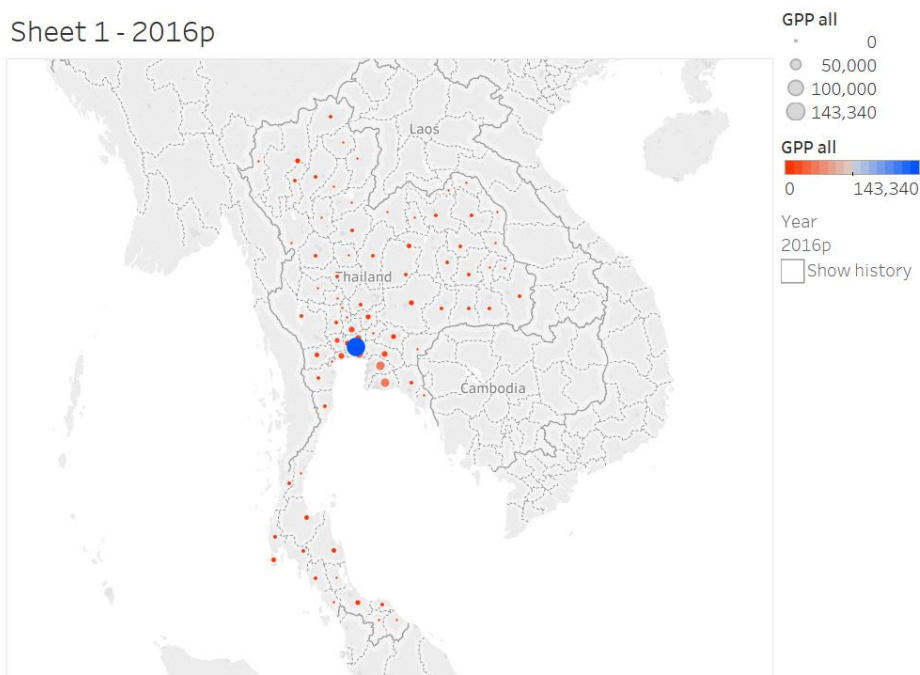


Figure 7 The GDP by province in 2016

3.3 Water productivity

From the analysis, the water productivity (WP) of all sectors from 2007-2016 are 3.0 – 5.3 US\$/m³ (Figure 8). The Bangkok and its vicinities region is the region with the highest WP of 29.2 – 54.5 US\$/m³ (Figure 10). The northeastern region is the region with the lowest WP of 0.8- 1.4 US\$/m³. From the Figure 9, it presents the service sector is the highest WP of 111.6-173.0 US\$/m³ (71%-76% of total WP). The agricultural is the lowest WP of 0.3- 0.5 US\$/m³ (0.2% of total WP). Figure 11-13 show the water productivity by region of agriculture's sector, industry sector and service sector, respectively. In agriculture sector, the southern region is the highest WP of 1.09-2.02 US\$/m³ and the central region is the lowest WP of 0.13-0.32 US\$/m³. In industry sector, the eastern region is the highest WP of 66.82-76.4 US\$/m³ and the central region is the lowest WP of 15.5-22.3 US\$/m³. In service sector, the Bangkok and its vicinities region is the highest WP of 283.8-449.3 US\$/m³, and the northeastern region is the lowest WP of 38.2-59.5 US\$/m³. Figure 14 shows the water productivity of each sectors separated by the province. The scale of water use by the size of the circle showing the amount of water use. As for the color showing the value of water productivity from red water, it means the water productivity is minimal, blue is the highest. It is found that the areas in Bangkok and its vicinities and the eastern region have high production costs, both overall and separated by the industry sector, but with use less water than other areas.

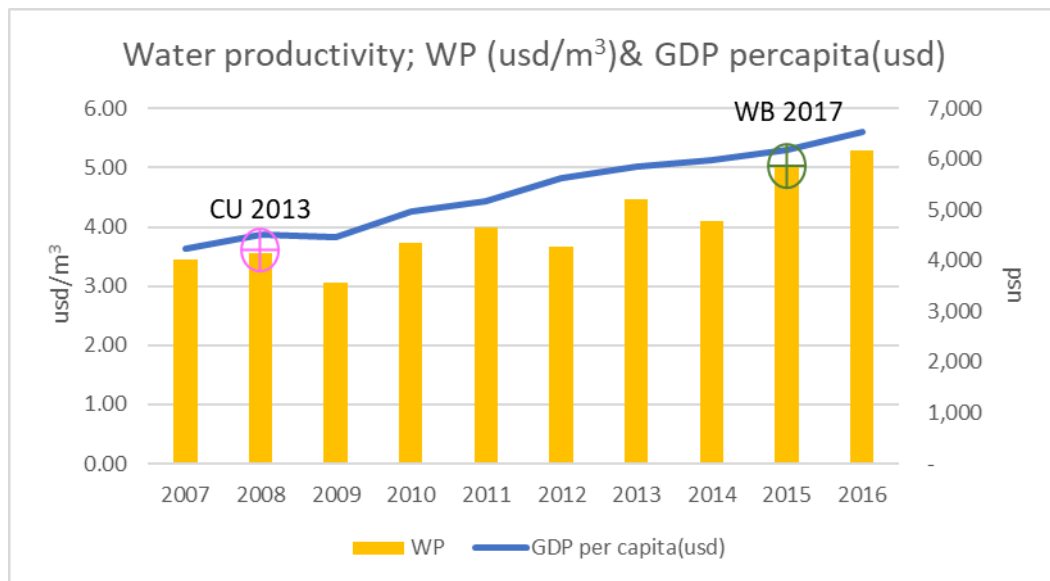


Figure 8 The water productivity and GDP of all sectors from 2007-2016

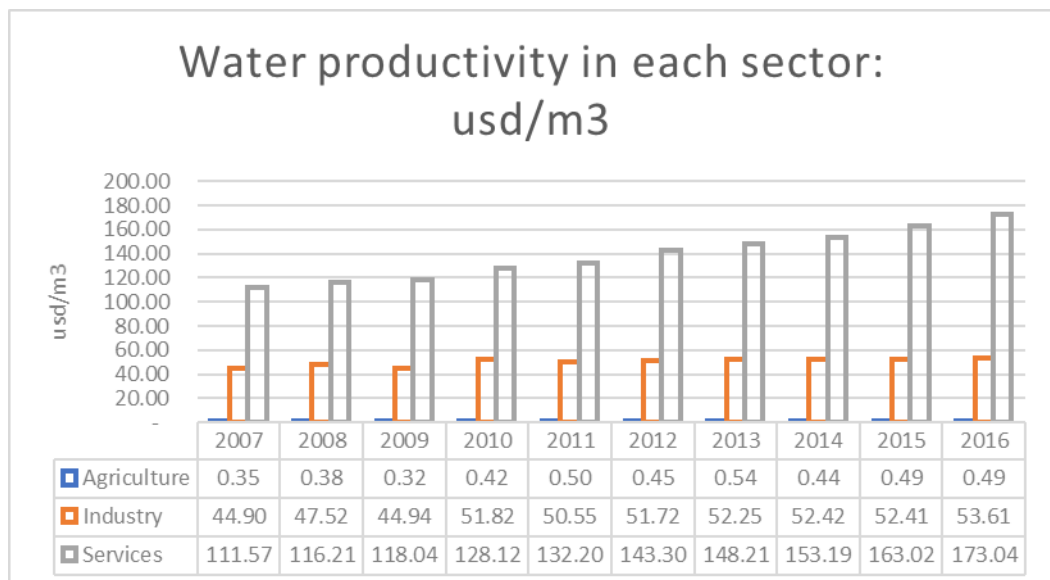


Figure 9 The water productivity of each sector from 2007-2016

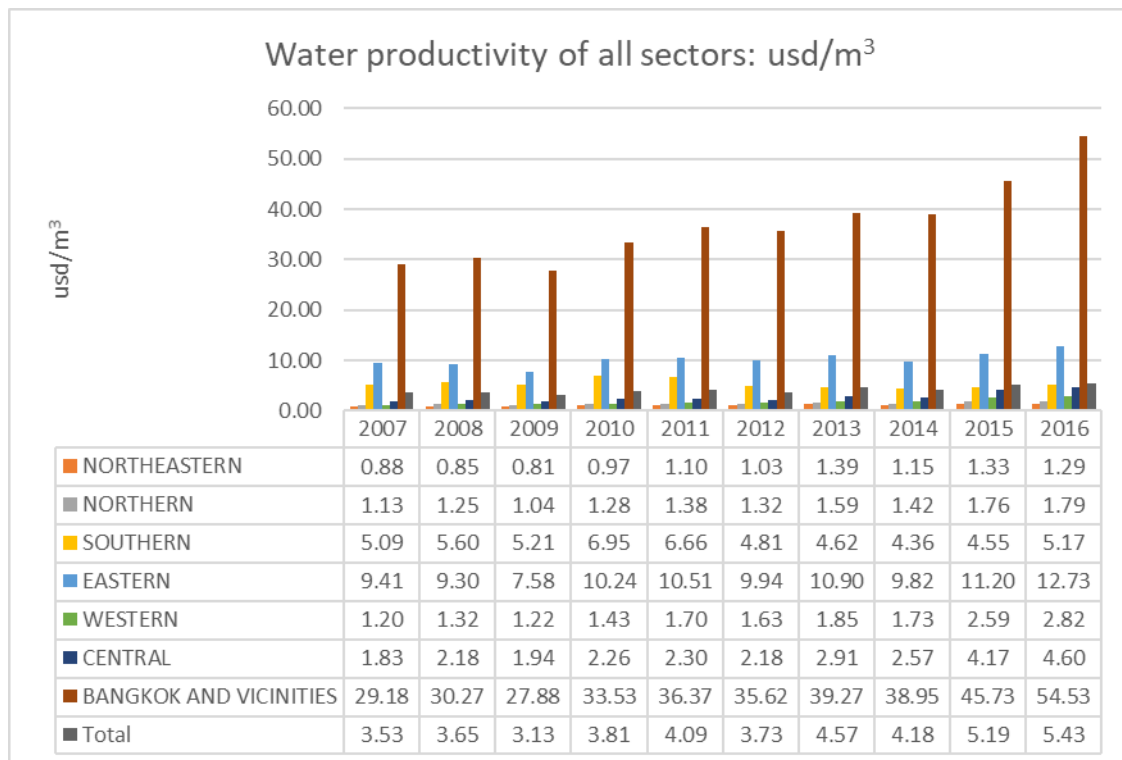


Figure 10 The water productivity by regions of all sector from 2007-2016

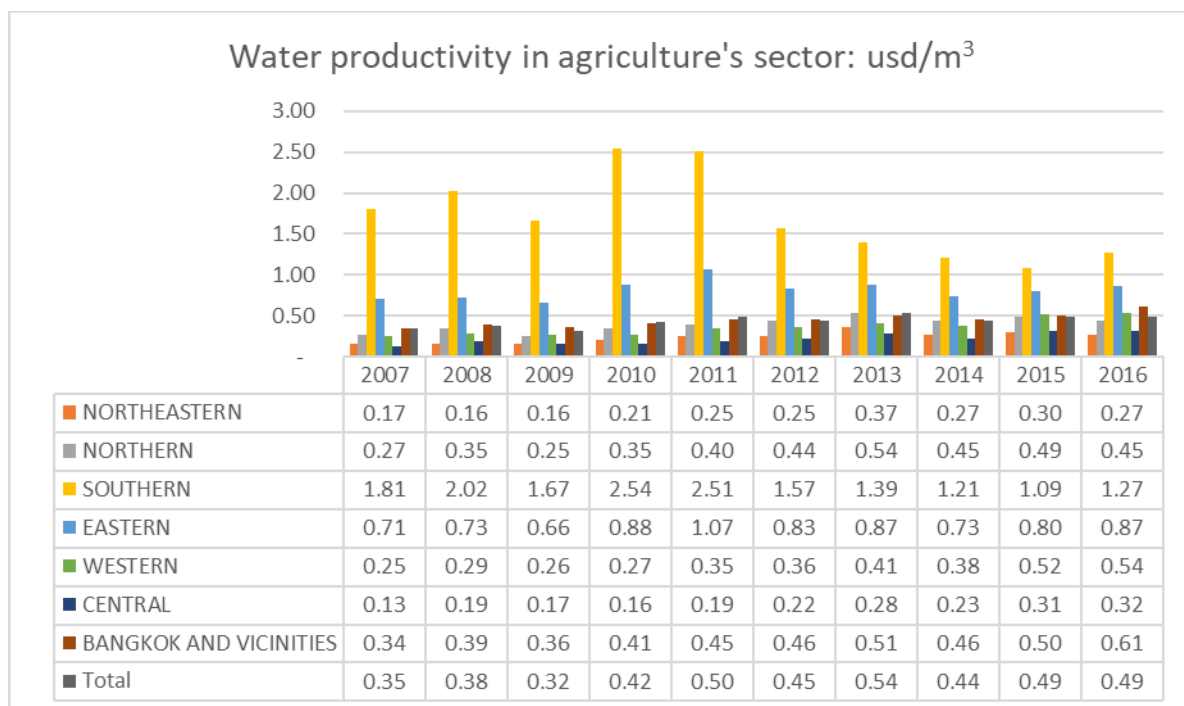


Figure 11 The water productivity in agricultural sector from 2007-2016

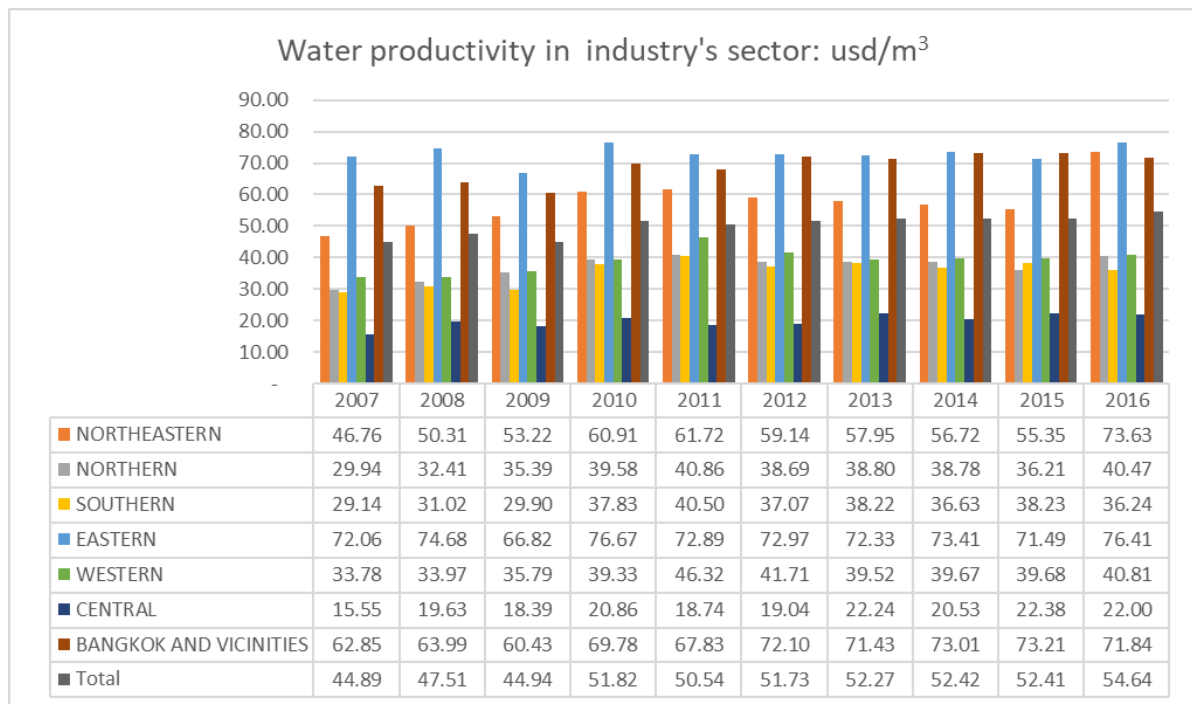


Figure 12 The water productivity in industry sector from 2007-2016

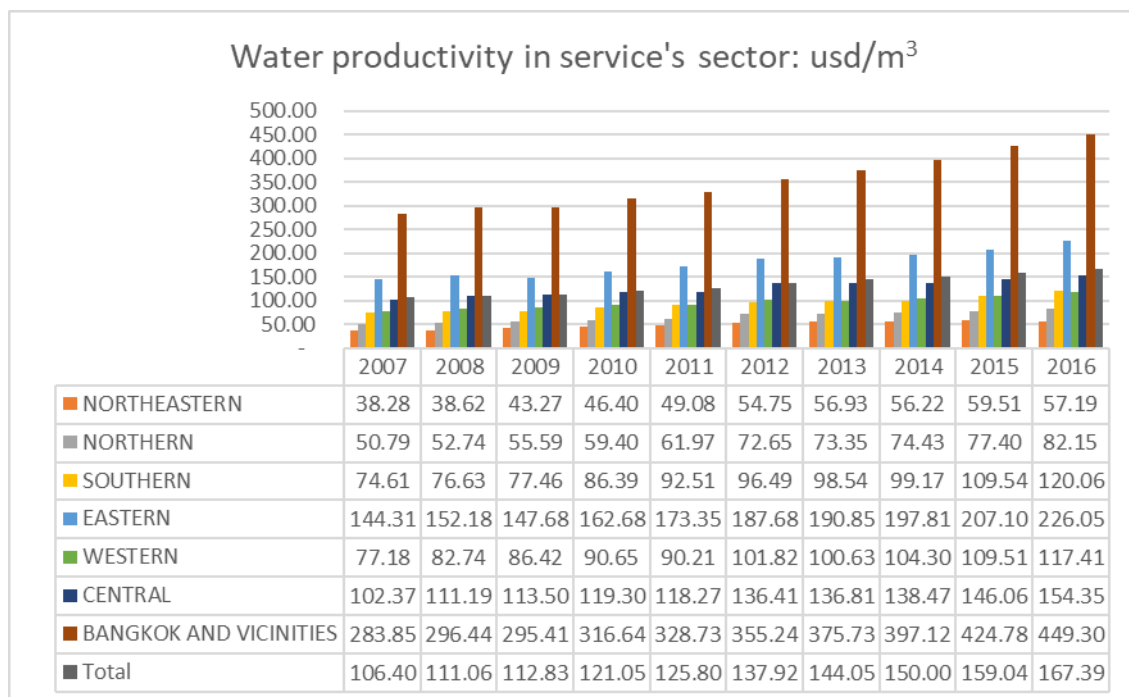


Figure 13 The water productivity in service sector from 2007-2016

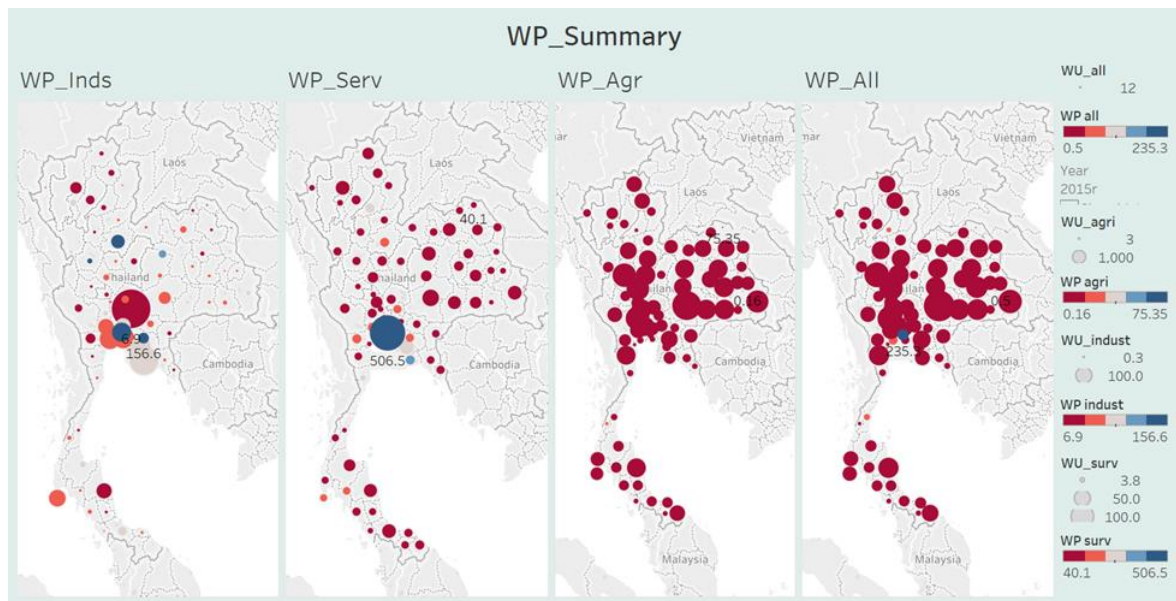


Figure 14 The water productivity by provinces and sectors in 2015

3.4 Comparison with other countries

When comparing the water productivity from the result of this study with the values obtained from previous studies and from the World Bank assessment, the data are shown in Table 1.

When compared with other regions, the water productivity of Thailand was higher than South Asia, but lower than East Asia & Pacific, Europe & Central Asia, Latin America & Caribbean, Middle East & North Africa, North America and Sub-Saharan Africa. When considered from income level, Thailand is higher than lower income but lower than lower middle income, upper middle income and high income countries.

Table 1 The water productivity in 2015 by World Bank data

Country Name	water productivity in 2015(US\$/m ³)
Thailand	5
World	16
East Asia & Pacific	17
Europe & Central Asia	9
Latin America & Caribbean	14
Middle East & North Africa	27
North America	36
South Asia	3
Sub-Saharan Africa	10
Low income	4
Lower middle income	10
Upper middle income	15
High income	78

Source: Food and Agriculture Organization, AQUASTAT data, and World Bank and OECD GDP estimates.

3.5 Improvement measure recommendations

The improvement measure recommendations, to achieve the goals in the water master plan of the National Strategic Framework of water production increase 10 times from the current year in the next 20 years, are in three

aspects, i.e., improve urban water system, manage water for development and improve water productivities with measures as follows:

- New urban water system with linkage of raw water, reserve water, waste water and drainage network with priorities setup,
- New policies and plans for increasing water productivity and restructure water use, with counter measures in each sectors/area such as to reduce or refrain from planting second rice, using technology to grow rice that uses less water, promote wet and dry rice cultivation seriously for water saving.
- Linking the plans of the Ministry of Tourism and Sports with action plan to drive sustainable and creative community-based tourism development that will increase the value of the service sector, specific marketing promotion programs to attract tourism and stimulate spending among various tourist groups.
- Linked to the Ministry of Agriculture to promote high value crops, but uses less water to replace rice, which will help increase agricultural product value and reduce water use
- Linking with the water development and management plan in the special economic zone of the country that will drive the value of industrial production and services
- Promote irrigation technology research that helps reduce water loss and reuse water in systems to increase water efficiency in production etc.

4) Conclusions

This study showed the status of water use and water productivity of Thailand by regions and sectors. The results of this study show that the water productivity of Thailand from 2007-2016 are 3.1-5.2 US\$/m³. The water productivity of service sector from 2007-2016 are 111-173 US\$/m³. The water productivity of industry sector from 2007-2016 are 44-53 US\$/m³. The water productivity of agriculture sector from 2007-2016 are 0.3-0.5usd/m³. This study proposed improvement measure recommendations in order to achieve the goals of the water master plan of the National Strategic Framework on water productivity by increasing 10 times from the current year and this study gave some measure recommendations to achieve the goals of next 20 years.

5. Acknowledgement

The article could not be concluded without data from various government agencies. We also grateful to staffs of Thai Royal Irrigation Department (RID) and Thai Meteorological Department (TMD) for observed historical rainfall data as well. This research has been partially support by Office of Thailand Research Fund (TRF). The research also done under the Water Resources System Research Unit (CU_WRSRU) of Department of Water Resources Engineering, Faculty of Engineering, Chulalongkorn University.

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