

Water Security Index Concept
Thailand's Water Security Situation
in the context of world
and ASEAN

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Abstract

During RIO+20 meeting, the sustainable green economy for protecting environmental health via income increasing and poor eradication were discussed. The successful countries for sustainable green economy depend on efficiency of integrated water management and provision of water supply and sanitary services. Water security index was another issue that had been proposed to monitor the national socio-economical development which comprised of household, urban water, economic water (including irrigation water), river health and resilience.

The water security index was proposed and determined the water security status of Thailand compared with the world and ASEAN countries. The article reviewed water use per capita and grouped countries by GDP level to reflect water resources development status of both world scale and Thailand. From the analysis, the strength and weakness of Thailand water management status were discussed and the issues to be considered in the framework of secured, sustainable green economy concepts were recommended.

Keywords :-water security index, water resources, Thailand, world, ASEAN.

1. Introduction

During the RIO+20 meeting, discussions on the sustainable green development to protect environment health, enhance earnings and poor eradication had been conducted. The successful countries for sustainable green economy depend on efficiency of integrated water management and provision of water supply and sanitary services. Besides, the handling with water related disasters seemed to be more extreme in recent years.

The concept of water security index had been proposed by the ADB to monitor the water status which link to the socio-economical development of the country. The index

comprised with the securities of rural water, urban water, water for development, water quality in the basin and disaster, and can be used to measure the overall development and project implementation, together with socio-economical planning of the country.

This paper proposed the water security definition and assess the water security of Thailand by reviewing water use status correlated with population data, gross domestic product in various countries of the world, Asia and ASEAN which helped to understand the competitiveness and the strength, weakness and potential of water development of Thailand compared with the rest of the world and ASEAN countries.

2. Water security index concept

Up to now, water resources development process started with project development, implementation, monitoring and system improvement which aimed to facilitate basic needs to people and society. The other portion of water was used for economical development. In recent years, environmental issues were raised and had to be simultaneously considered during water resources planning too. The index described sufficiency, risk and was later developed to water security. The index helped to monitor the development of water management clearer and determined from various aspects, e.g., water sufficiency of both quantitative and qualitative aspects for health, life, ecology preservation, production, disaster relief (Grey and Sadoff, 2007) or the accessibility to clean and safe water with sufficient amount and payable cost for hygiene and good quality life with environment protection (Global Water Partnership, 2010).

The planning of each country normally concerned with the development of economics, society and environment. However the important element for sustainable development is still engaged with water resources. The concept of water security was developed to investigate the actual situations of these basic water developments with socio-economical and environmental development. The security dimensions proposed by ADB comprised of water security of house hold, economics, urban, river health and resilience to disaster (see Fig. 1).

This study determined the water security status from five dimensions, i.e., WSI1: basic water (renewable, supply, sanitation), WSI2: sufficient water (water supply, consumption, agricultural water), WSI3: development water (irrigation area, industrial water use, water for energy, water for aquaculture), WSI4: water disaster (loss from floods and drought), WSI5: water for future (population growth, urban population growth, water footprint). The index status

analysed were correlated with water productivity (US\$ per cubic meter of water) with the four groups of country classified by GDP per capita of the country. Based on the available data from various sources of the world (World Bank, 2014; Mackie Black et. al, 2009), the index of each country was determined comparatively by weighting equally from each dimensions and marking equally (1-5 points) of each elements with ranking from the average and standard deviation values.

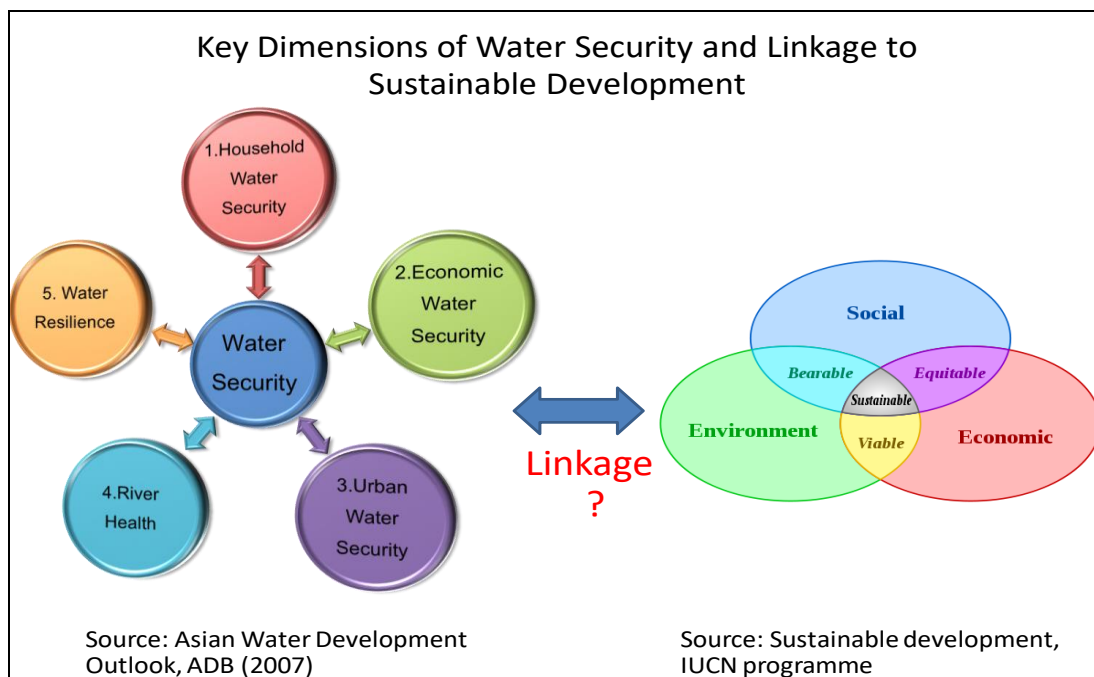


Fig 1 Water security index and linkage with socio-economical and environmental development

3. World water use status and water security

The data of water use for domestic, industry and agriculture of each country were gathered and grouped up by country income (GDP per capita) into four groups, i.e., high (> 11906 US\$), upper middle (3856-11906 US\$), lower middle (976-3855 US\$), low income (<976 US\$) group of countries with the rate of water use in each categories, i.e., agriculture, households, industry and showed in Fig. 2. It can be seen that average water use rate grows up with the GDP per capita growth up to the moderate level but becomes lower at the very high income group. The water use structure changes with the GDP per capita growth with the increase of industrial water use (as shown in Fig 3 for each dimension) except in the dimension

of water disaster which decrease in the high income country group due to the loss from water disaster (which may reflect from the data availability).

Based on the water security index proposed by the study, the distribution of water security status of each country (146 countries shown in Appendix) in the world scale can be shown in Fig. 4. The water productivity, measured by the income per capita per water use unit, was assessed (shown in Fig 5) and compares with the water security index obtained and shown in Fig 6. It can be seen that more water productivity induced better water security status.

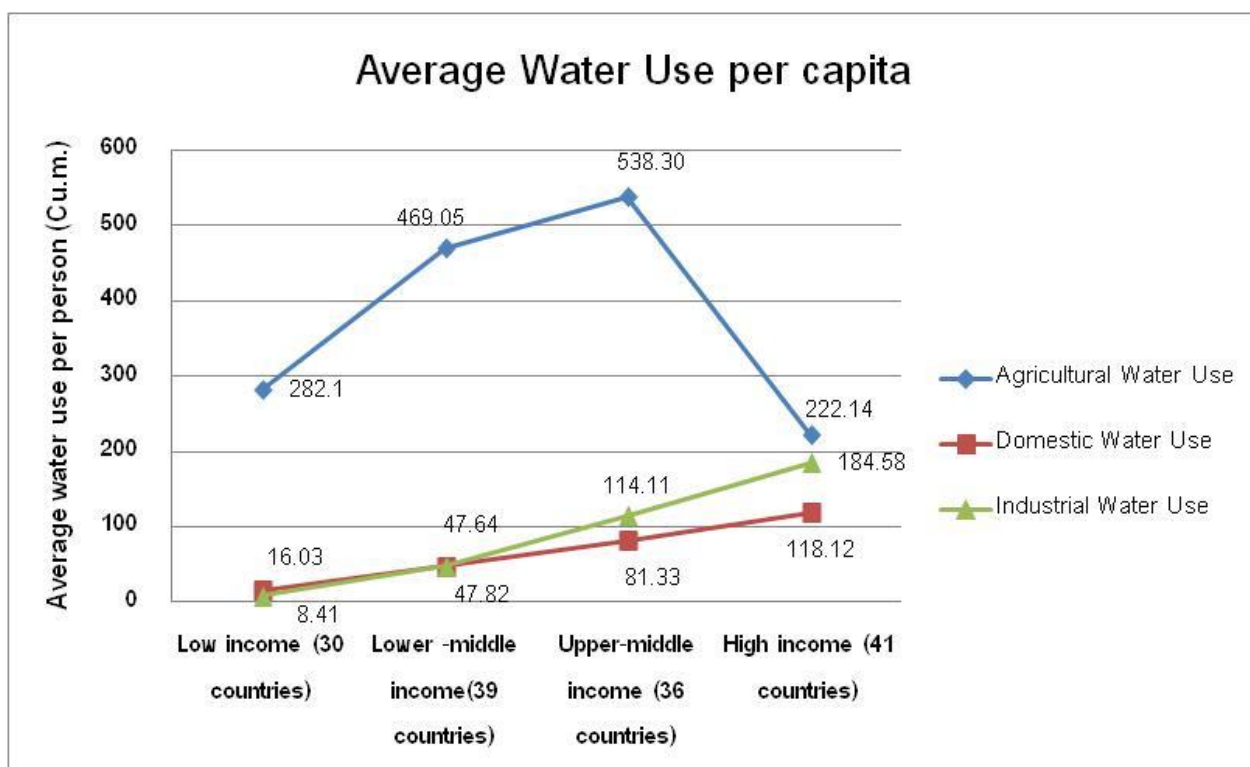


Fig 2 Water use per capita of each income country group

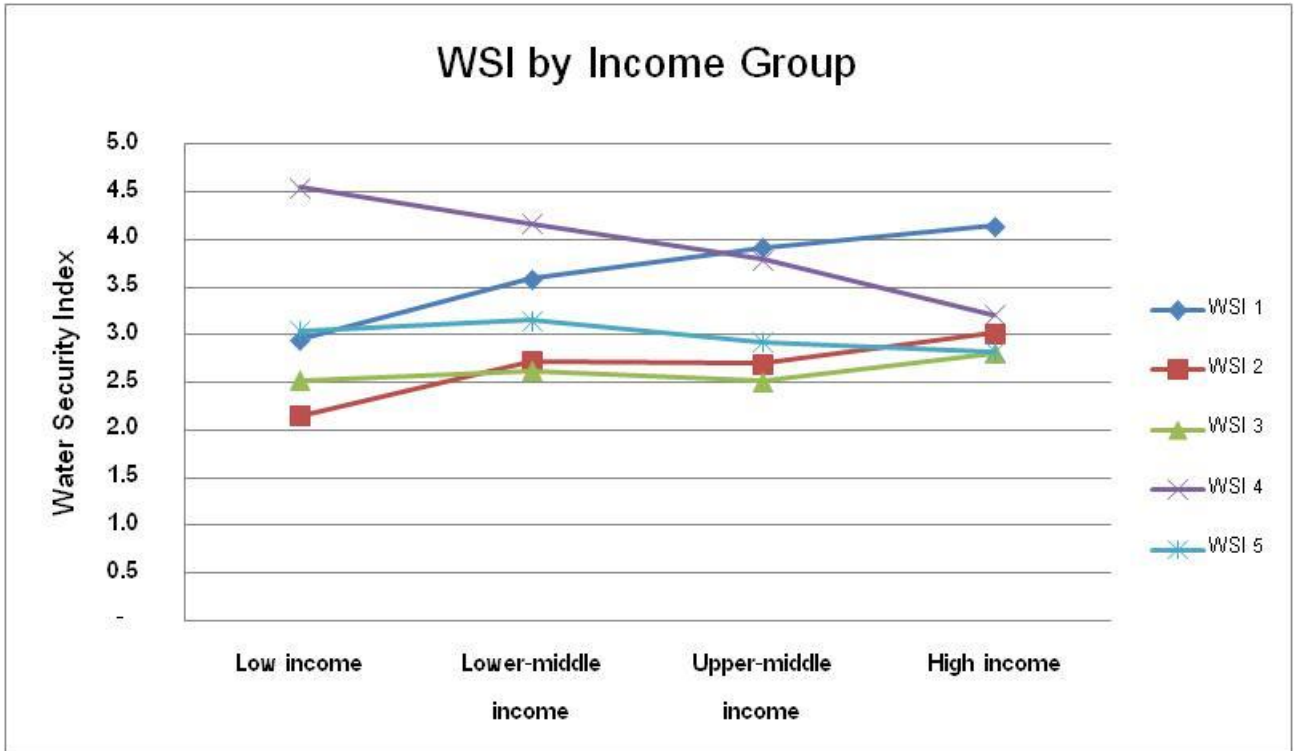


Fig 3 Water security index of the world in each dimension

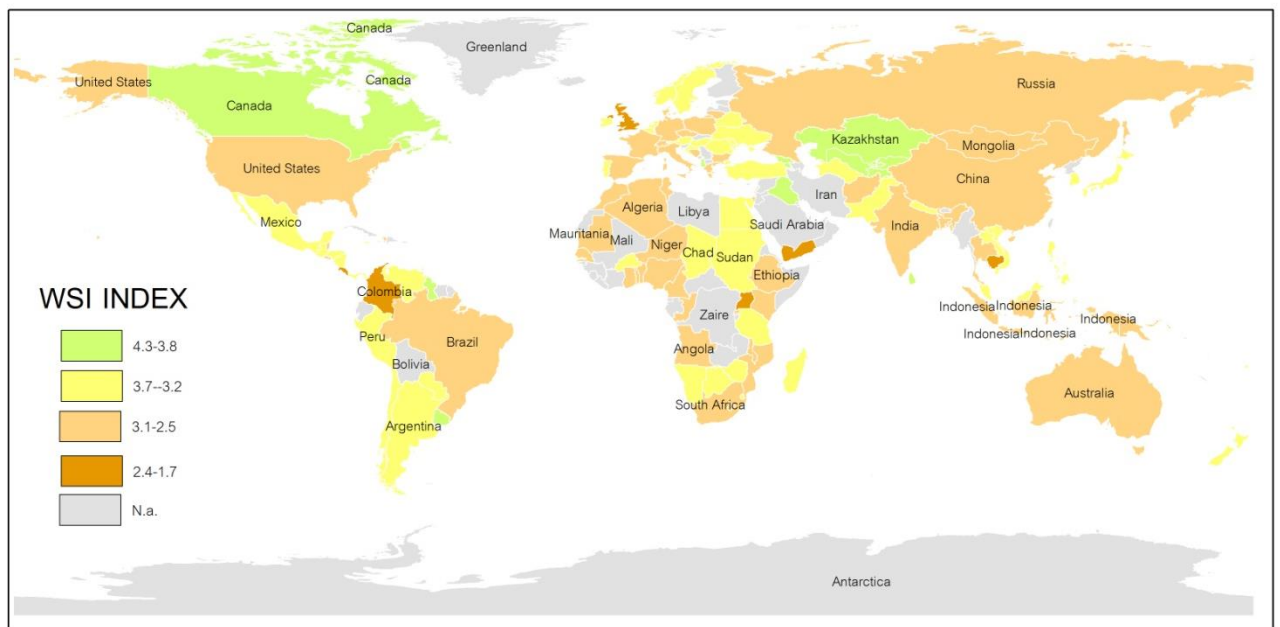


Fig 4 Distribution of water security index of each country in the world

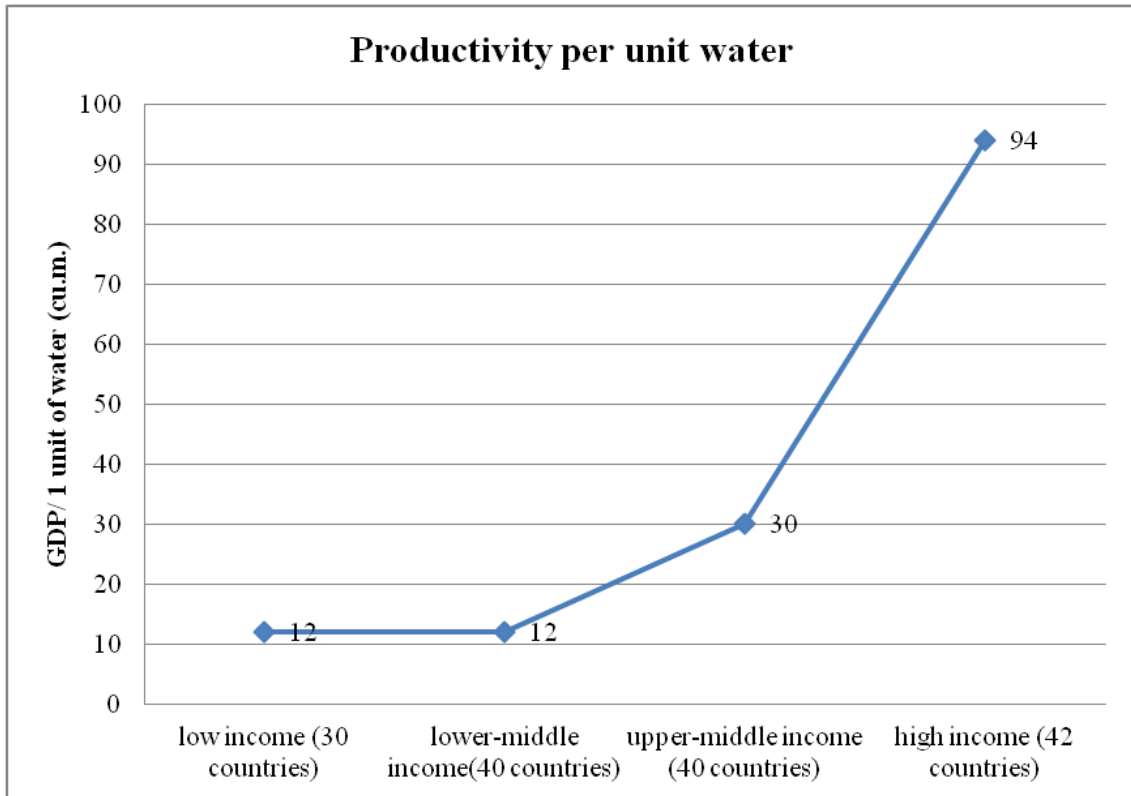


Fig 5 Water productivity of each income country group

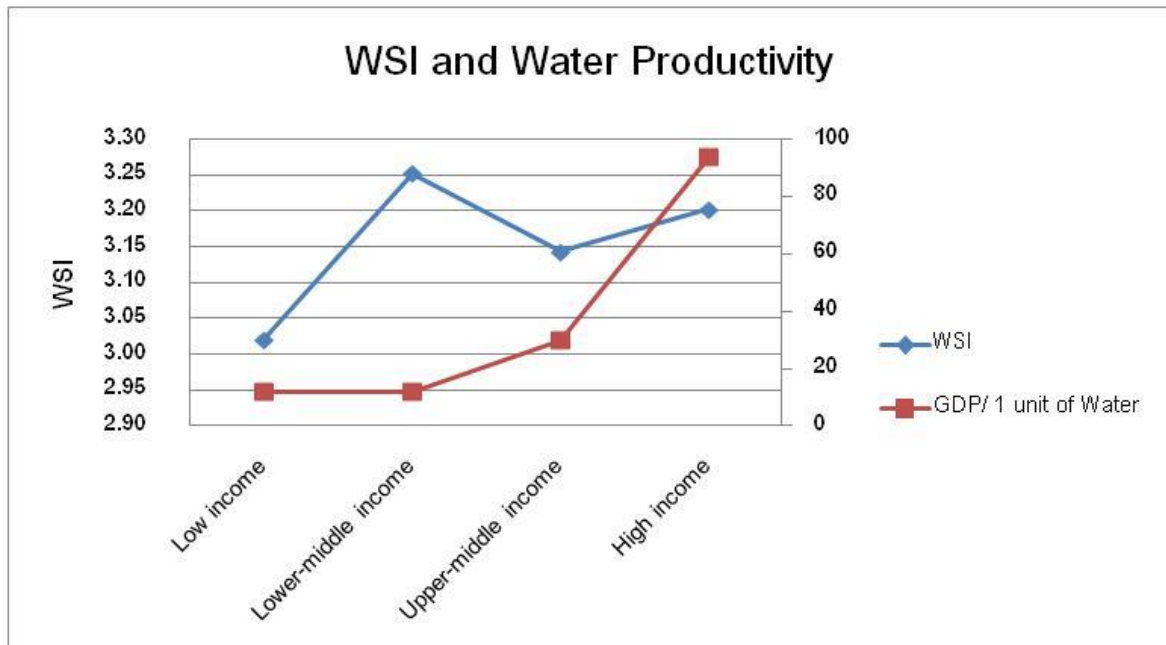


Fig 6 Water security index and water productivity

4. Thailand's water security compared with the rest of the world

The water security status of Thailand, compared with the world, Asia and Asean regions were assessed and shown in Table 1 and the ranking of each dimensions are shown in Table 2 and Fig 7. Within ASEAN countries, the water use, water productivity and water security status of each country were assessed comparatively and shown in Fig. 8, 9 and 10 in the sequence of GDP per capita which showed that Thailand has the highest water use unit, lower water productivity and moderate in water security ranking. From these figures and tables, the strength and weakness of water security status and development potential of Thailand can be analysed and discussed as follows.

Strength

- High clean water accessibility (98 %) compared with the rest of the world
- High accessible population to improved sanitation facility (96%)
- Moderate irrigation area (25 % of agricultural area) compared with world average of 19%) and ASEAN average of 18%-
- High water use for fresh water aquaculture (1.3 M cu m per capita) with fresh water aquacultural area of 3,750 sq km.

Weakness

- Low runoff amount (6,382 cu m per capita per year) compared with world, Asia, Asean countries.
- High portion of agricultural water use
- High water footprint in agricultural sector (rank 3 of the world) stated the low water use productivity (which may induce low competitiveness of the country).

Development potential

- Still low industrial water use (34 cum/year compared with world (97 cum), Asia (60 cum) and Asean (49 cum)
- Still low water use for energy (4%) compared with world (31%), Asia (20%) and Asean (14%)

The strength, weakness and potential of water resources status in Thailand compared with the rest of the world were summarized in Table 3.

Based on the analysis, it is clear that Thailand had developed and utilized moderate fresh water renewable and used in the higher rate comparatively, looking from available water

and high water use per capita especially in the agricultural sector. But when looking at GDP per water use unit, the water use efficiency is low compared with Indonesia, Malaysia and Vietnam. To increase the potential, Thailand needs to have more water storage, improve water use efficiency. Water use for irrigation should be improved in efficiency and used in the selected crops and potential area. The cultivation diversification to higher potential neighboring area should be considered together with higher technology transfer schemes.

Table 1 The average world, Asia and Asean water's use status and the ranking of Thailand's

Items	Elements	World		Asia		ASEAN		Thailand
		average	ranking	average	ranking	average	ranking	
Basic water	1. fresh water renewable (cu.m per capita)	22,167	79	10,854	15	19,205	8	6,382
	2. water supply (cu.m per capita)	84	46	84	9	85	3	98
	3. sanitation water (cu.m per capita)	67	15	70	6	71	2	96
Sufficient water	1. water use per capita (cu.m./capita)	511	12	842	9	531	7	1,391
	2. house holds (cu.m/capita)	84	46	84	9	85	3	98
	3. agricultural water (cu.m/capita)	354	159	712	7	424	1	1,322
Water for development	1.irrigation area (%)	19	49	41	30	18	3	25
	2.industrial water (cu.m/capita)	97	68	60	18	49	4	34
	3.water for energy (%)	31	89	20	23	14	6	4
	4. water for fresh water aquaculture (cu.m/capita)	346,734	4	1,241,323	4	582,458	2	1,385,801
Water disaster	1.flood damage (US\$)	3,543,108	3	8,670,092	2	6,002,888	1	41,051,592
	2.drought damage (US\$)	1,261,531	22	1,896,770	5	239,512	2	424,300
Water for future	1.population growth (%)	1.3	137	1.43	38	1.31	10	0.43
	2.urban population growth (%)	63	147	59	30	59	7	42
	3.water footprint (cu.m/capita)	1,338	7	1,304	2	1,697	2	2,223
Water productivity	1.GDP (million US\$)	343,530	29	445,799	7	151,224	2	318,907
	2.productivity(US\$ / cu.m. water)	81	132	41.3	132	117.3	6	3.6
	3.agricultural productivity (US\$ /cu.m. water)	392	124	33.8	18	162.5	7	0.32
	4.industrial productivity(US\$ / cu.m. water)	169.1	63	69.5	8	121.6	4	51.2

Table 2 Water security status of Thailand in each dimension compared with the rest

Item	Weight	World	Asia	Asean	Thailand
Basic water	5	4.0	4.0	4.0	4.7
Sufficient water	5	2.7	2.3	2.3	1.3
Water for development	5	2.3	3.0	2.5	2.8
Water disaster	5	2.5	2.0	3.0	2.5
Water for future	5	3.7	3.7	3.3	2.0
Total	5	3.04	3.00	3.02	2.66

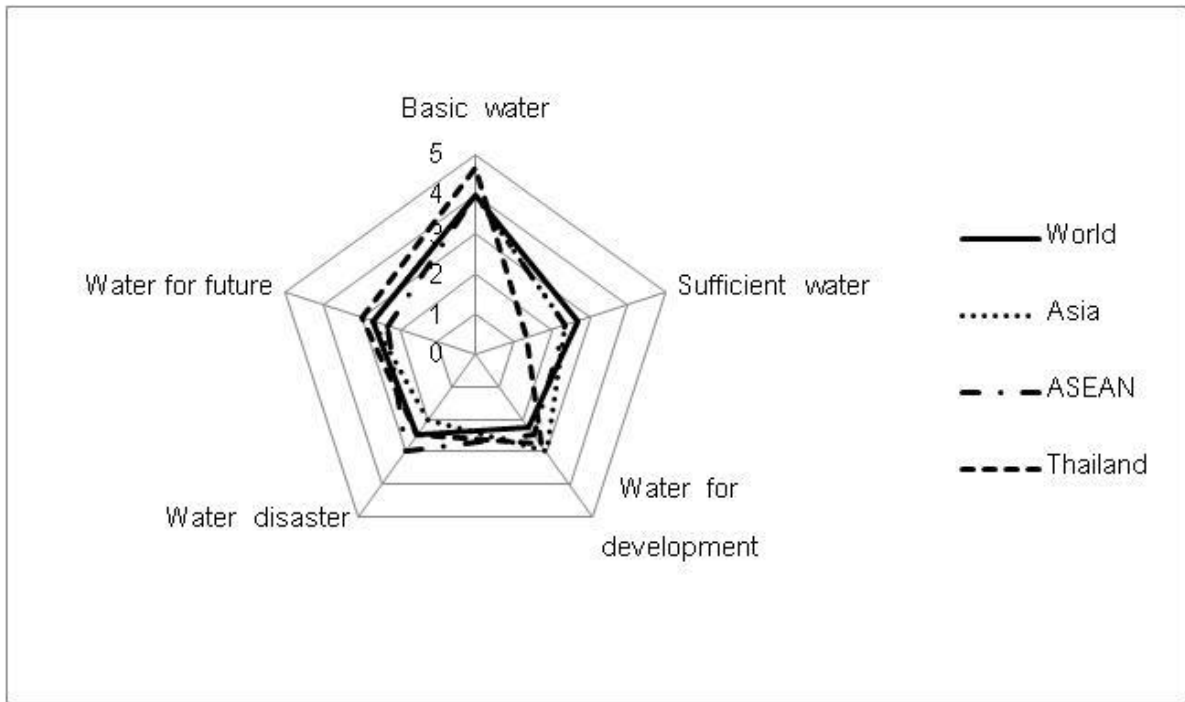


Fig 7 Thailand's water security status compared with the rest of the world

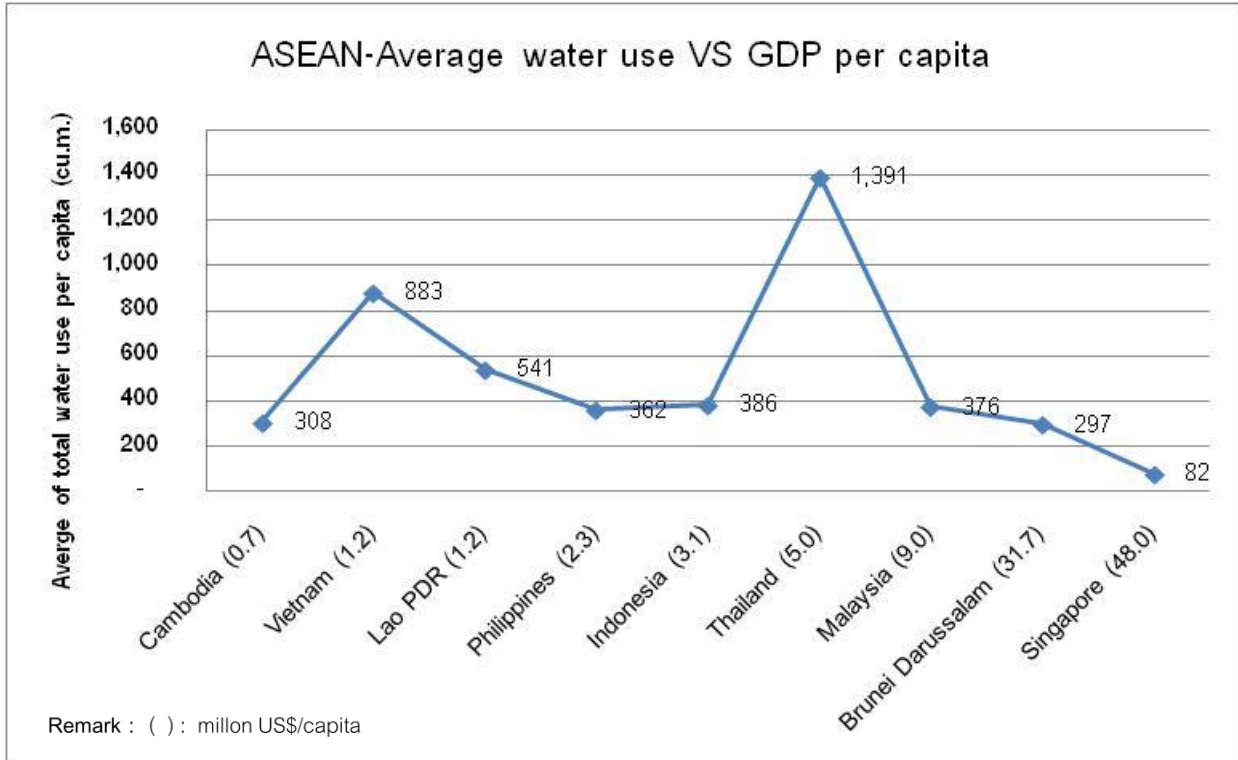


Fig 8 Water Use per capita in ASEAN countries

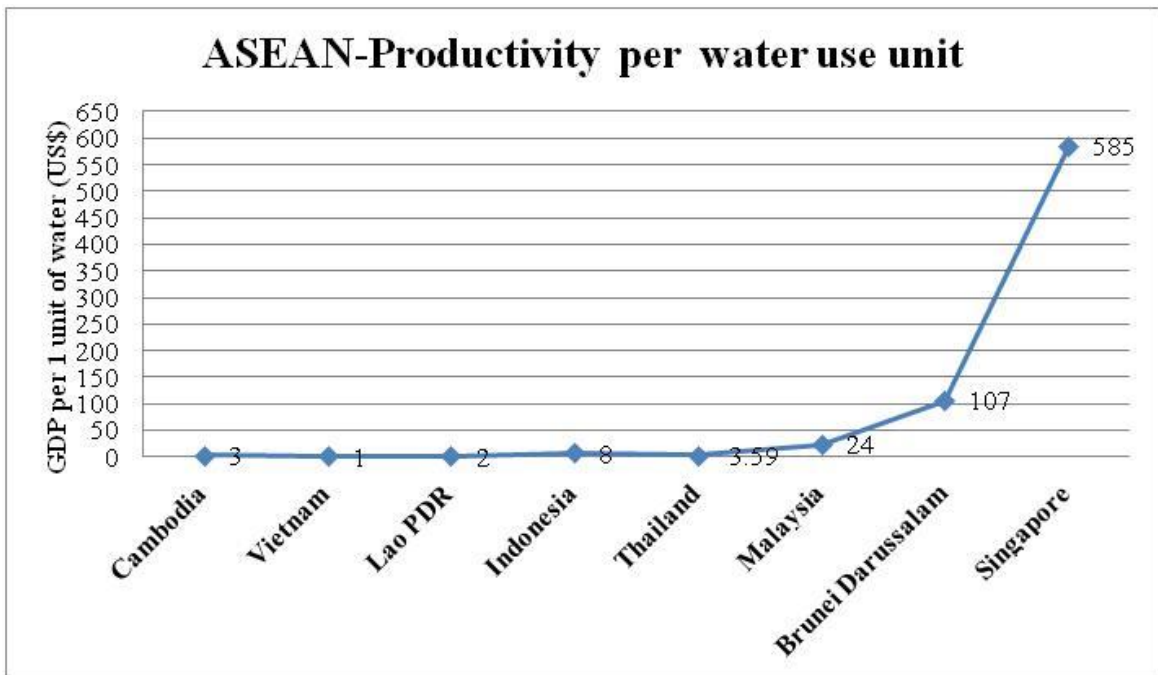


Fig 9 Water Productivity in ASEAN countries

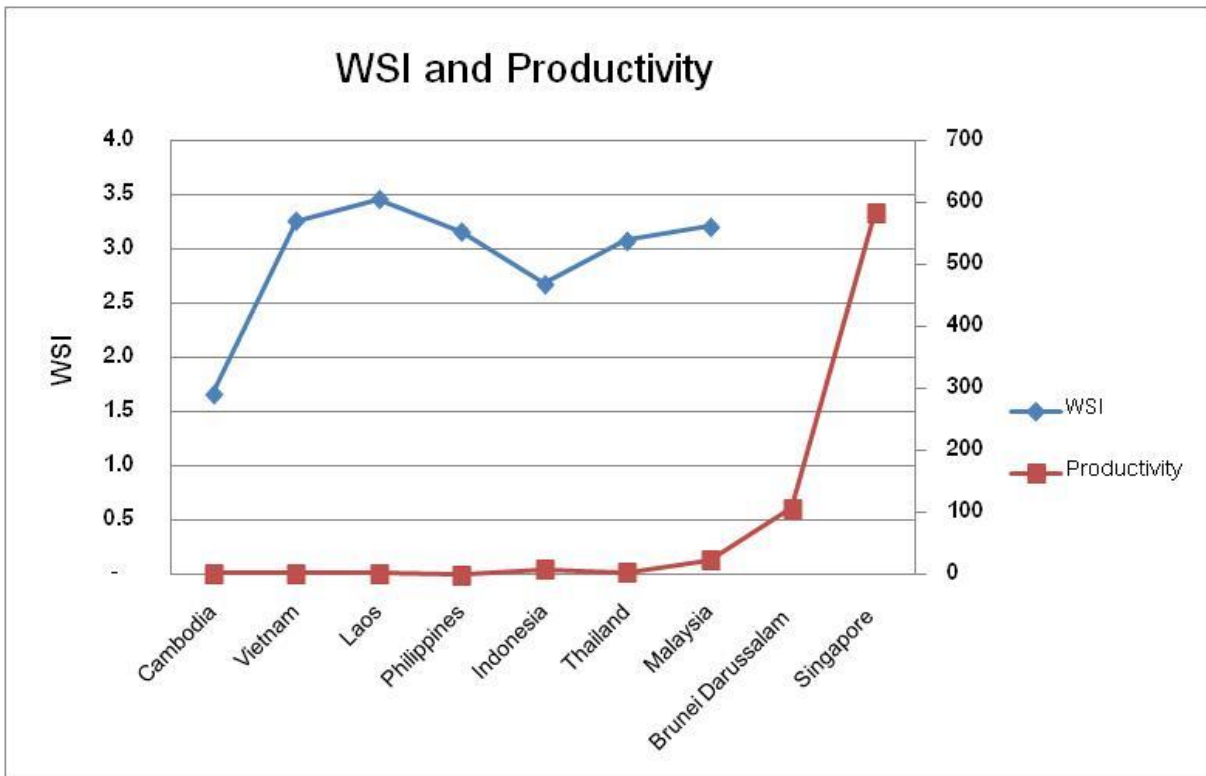


Fig 10 Water security index and water productivity in ASEAN countries

Table 3 Strength, weakness and water development potential of Thailand's water status

Strength, weakness and potential of Thailand water status		
Strength	Weakness	Potential
<ul style="list-style-type: none"> • access to clean water • access to well sanitary • irrigation area • aquacultural water 	<ul style="list-style-type: none"> • average runoff • agricultural water • water footprint 	<ul style="list-style-type: none"> • industrial water • water for energy

5. Conclusions and recommendations

This study showed the status of water use and water security of Thailand compared with the rest of the world. Thailand has strengths on clean water and sanitation water accessibility from the development investment in the past. However, water use status in fresh water renewable, agricultural sector, i.e., low efficiency, high water footprint low productivity, seemed to be a weakness compared with other country. For future socio economical development, the restructure of water use especially for industrial and urban use is needed to cope with future water demand

- From the water use status, the recommendations for possible future development in various sectors can be made as follows.

Agricultural sector

Agricultural sector consumed large portion of raw water at present. When the water demand from other sectors increases, adaptation and water use restructure measures and water should be implemented, e.g., increase water use efficiency, control, water saving etc. to cope with future water demand and reduce water conflict.

- Plan cultivation crop and location matching with water potential (agricultural zoning)
- Diversify cultivation area to other potential area

Industrial sector

- Campaign for water reuse and recycle in industry
- Locate industrial site fit to raw water potential

- Participate in fair water allocation process and increase capacity in water sourcing potential and allocation to cope with the future water demand Household sector
 - Apply private management mechanism (demand sided, corporatization etc.) to increase productivity in water management
- Reduce loss in water supply network Water Saving campaign for awareness PR, introduction of new technology system (such as smart city concept)
- Overall

This study introduced the concept of water security to analyse, evaluate the strength and weakness for future planning. If the socio-economical development increases rapidly, the restructure of water use will be needed. When compared with other ASEAN countries (to be linked under Asean Economical Community, AEC), Thailand may have constraints in water resources (limited fresh water renewable, high water use rate, low productivity). More development in water storage capacity, water use efficiency and productivity should be considered.

The introduction of secured and green economy concept into water resources management and disaster resilience with climate change can use water security index as an indicator and needs tool development (physical with socioeconomic aspects) to link measures and outputs closely which will induce clearer policy and higher confidence and also enable sustainable development environments among stakeholders.

6. Acknowledgement

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Appendix
Water Security Index of each country

Water Security Index of each country								
No.	Country	1.Basic water	2.Sufficient water	3.Water for development	4.Water disaster	5.Water for future	Total	Average
	Weight	5	5	5	5	5	25	5
1	Afghanistan	2	3	4	4	3	16	3
2	Albania	5	3	2	5	3	19	4
3	Algeria	3	3	4	2	3	15	3
4	Antigua and Barbuda	4	3	5	-	3	15	4
5	Argentina	5	3	3	3	3	17	3
6	Armenia	5	2	3	3	4	17	3
7	Australia	5	4	3	1	3	15	3
8	Austria	4	3	2	3	3	15	3
9	Azerbaijan	4	-	1	4	3	12	3
10	Bahrain	3	3	4	-	3	14	3
11	Bangladesh	4	3	3	2	4	16	3
12	Barbados	5	4	4	-	3	15	4
13	Belarus	3	4	3	5	3	18	4
14	Belgium	4	4	3	5	2	17	3
15	Belize	3	4	4	5	2	17	3
16	Benin	4	3	5	5	3	20	4
17	Bhutan	4	3	3	-	3	13	3
18	Bolivia	5	-	3	2	4	13	3
19	Botswana	5	3	3	5	3	19	4
20	Brazil	5	4	3	3	2	17	3
21	Bulgaria	2	4	4	5	2	16	3
22	Burkina Faso	4	4	4	5	3	20	4
23	Buruandi	3	4	4	-	3	14	4
24	Cambodia	2	4	5	2	1	14	3
25	Cameroon	4	3	3	4	3	17	3
26	Canada	5	3	3	5	2	18	4
27	Cape Verde	3	4	5	-	3	15	4
28	Chad	5	3	3	4	2	17	3
29	Chile	3	3	4	4	4	18	4
30	China	5	3	3	1	3	14	3
31	Colombia	3	4	5	3	3	17	3
32	Comoros	3	4	3	-	2	11	3
33	Congo, Dem. Rep.	5	-	-	-	5	10	5
34	Costa Rica	3	3	4	5	2	11	2
35	Cote d' Ivoire	5	-	3	-	3	11	4
36	Cyprus	4	3	4	-	2	13	3
37	Czech Republic	4	3	4	3	3	16	3
38	Denmark	3	3	1	3	2	12	2

Water Security Index of each country								
No.	Country	1.Basic water	2.Sufficient water	3.Water for development	4.Water disaster	5.Water for future	Total	Average
	Weight	5	5	5	5	5	25	5
39	Dominican Republic	3	-	-	5	3	11	4
40	Ecuador	5	3	4	-	3	14	4
41	Egypt	3	3	3	5	3	17	3
42	El Salvador	4	3	3	3	3	16	3
43	Equatorial Guinea	3	3	4	-	2	12	3
44	Estonia	5	3	4	-	4	16	4
45	Ethiopia	2	4	4	5	3	17	3
46	Fiji	3	3	3	5	4	19	4
47	Finland	5	4	3	-	3	15	4
48	France	5	4	4	2	2	16	3
49	Gabon	4	3	3	-	2	12	3
50	Gambia	4	4	5	5	2	19	4
51	Georgia	5	3	2	4	4	19	4
52	Germany	4	4	4	2	3	16	3
53	Ghana	3	3	3	5	2	16	3
54	Greece	5	3	4	2	3	16	3
55	Guatemala	4	3	4	5	3	19	4
56	Guinea	3	3	5	-	2	14	3
57	Guinea-Bissau	3	4	5	-	2	14	4
58	Guyana	5	3	3	5	3	19	4
59	Haiti	2	4	4	5	3	18	4
60	Honduras	4	3	4	5	3	19	4
61	Hungary	5	4	4	4	4	20	4
62	Iceland	5	3	1	-	3	12	3
63	India	3	3	4	2	4	15	3
64	Indonesia	4	3	5	3	3	18	4
65	Iraq	4	2	3	5	2	16	3
66	Ireland	5	4	4	5	3	20	4
67	Israel	3	3	3	4	2	16	3
68	Italy	4	3	3	2	3	15	3
69	Jamaica	4	3	4	5	4	20	4
70	Japan	5	3	4	2	4	17	3
71	Jordan	3	3	4	-	2	12	3
72	Kazakhstan	5	3	3	5	2	18	4
73	Kenya	2	3	3	5	3	17	3
74	Korea, South	4	3	4	5	3	19	4
75	Kuwait	1	3	4	-	2	9	2
76	Kyrgyzstan	4	3	2	5	3	17	3

Water Security Index of each country								
No.	Country	1.Basic water	2.Sufficient water	3.Water for development	4.Water disaster	5.Water for future	Total	Average
	Weight	5	5	5	5	5	25	5
77	Laos	3	4	3	5	3	18	4
78	Latvia	5	3	3	-	4	12	3
79	Lebanon	4	3	3	-	3	10	2
80	Lesotho	3	3	3	5	4	18	4
81	Liberia	3	4	5	-	2	14	4
82	Lithuania	4	3	4	3	4	17	3
83	Madagascar	3	3	3	5	2	16	3
84	Malawi	3	3	4	5	2	17	3
85	Malaysia	5	3	4	5	1	19	4
86	Mali	3	4	4	-	2	12	3
87	Malta	3	3	4	-	2	15	4
88	Mauritania	3	3	5	4	2	17	3
89	Mauritius	4	3	3	3	3	16	3
90	Mexico	4	3	4	3	3	16	3
91	Moldova	4	4	3	4	3	18	4
92	Mongolia	4	4	5	5	3	19	4
93	Morocco	3	3	4	4	2	16	3
94	Mozambique	3	4	3	5	3	17	3
95	Namibia	4	3	3	5	4	18	4
96	Nepal	3	3	3	5	3	17	3
97	Netherlands	5	4	3	5	3	20	4
98	New Zealand	5	3	4	4	3	18	4
99	Nicaragua	4	4	4	5	3	20	4
100	Niger	2	4	4	5	3	17	3
101	Nigeria	2	3	4	5	1	15	3
102	Norway	5	3	3	5	3	19	4
103	Oman	1	3	3	-	1	8	2
104	Pakistan	3	3	3	3	3	15	3
105	Panama	4	3	3	5	3	18	4
106	Paraguay	4	3	3	5	3	18	4
107	Peru	4	3	3	4	3	17	3
108	Philippines	4	3	4	5	2	18	4
109	Poland	2	4	4	2	4	15	3
110	Portugal	5	3	3	2	3	15	3
111	Qatar	4	3	3	0	2	12	2
112	Romania	4	3	3	3	3	15	3
113	Russia	5	4	4	2	3	17	3

Water Security Index of each country

No.	Country	1.Basic water	2.Sufficient water	3.Water for development	4.Water disaster	5.Water for future	Total	Average
	Weight	5	5	5	5	5	25	5
114	Rwanda	2	4	4	5	3	17	3
115	Saudi Arabia	1	3	4	2	2	11	2
116	Senegal	3	4	4	4	1	16	3
117	Seychelles	4	3	3	-	4	14	4
118	Sierra Leone	3	4	5	-	3	14	4
119	South Africa	3	3	4	2	4	16	3
120	Spain	4	3	4	2	2	15	3
121	Sri Lanka	4	3	3	5	4	19	4
122	Sudan	3	3	3	5	1	16	3
123	Suriname	5	3	2	-	3	13	3
124	Swaziland	3	4	4	5	4	20	4
125	Sweden	5	3	3	5	3	19	4
126	Switzerland	5	4	3	2	3	16	3
127	Syria	4	3	3	-	1	11	3
128	Tajikistan	4	3	2	5	3	17	3
129	Tanzania	3	3	3	5	3	17	3
130	Thailand	5	3	4	2	3	17	3
131	Togo	2	3	4	5	2	16	3
132	Trinidad and Tobago	4	3	5	-	4	13	3
133	Tunisia	3	4	4	5	3	18	4
134	Turkey	4	3	4	5	2	18	4
135	Turkmenistan	3	3	3	5	2	16	3
136	Uganda	3	4	4	5	-	15	4
137	Ukraine	5	3	3	2	3	17	3
138	United Arab Emirates	4	3	3	-	1	10	3
139	United Kingdom	3	4	4	1	3	15	3
140	Uruguay	5	3	3	4	3	17	3
141	Uzbekistan	4	3	3	4	4	17	3
142	Venezuela	4	3	3	5	3	17	3
143	Vietnam	4	3	4	3	3	16	3
144	Yemen	2	3	4	2	3	15	3
145	Zambia	3	3	3	-	3	12	3
146	Zimbabwe	3	3	3	5	4	17	3
Remarks: - means not available.								