Method to assess Water Scarcity of Product based on ISO14046 for Thailand : A case study of 44 products in Thailand

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***Abstract* — Water and Environment Institute for Sustainability (WEIS) under The Federation of Thai Industries (F.T.I.) cooperated with Groundwater Development Fund of Department of Groundwater Resources (DGR) conduct the project to assess groundwater use throughout the product life cycle or water footprint of product. The objective is to promote the water footprint in accordance with ISO 14046 and Life Cycle Assessment (LCA) for industrial sector and develop Thai experts of water footprint. As well as developing the appropriate certification system of water footprint for Thailand.**

There are 15 pilot industries (companies) participating in this project and the experts join the consultation with the pilot industries to evaluate the water footprint of products and also to study the ways to reduce groundwater use (including surface water) from the manufacturing process. In addition, the technical committee has been appointed to develop the appropriate water footprint assessment and verification guideline for Thailand (in accordance with ISO 14046) and also appointed the water footprint certification committee to certify water footprint of product.

Outcomes of the project, we can develop a appropriate guideline of water footprint assessment and verification, water footprint certification system that suitable for Thailand and there are 44 products (15 products from 15 companies under the project and 29 products from 13 companies outside the project) from 12 product groups (corrugating medium, drinking water, soft drink, alcoholic beverages, portland cement, rubber, sugar, fresh chicken and products processed from chicken meat, polymer car accessories, electricity and steam, industrial water, aromatics) that have been certified for Water Scarcity Footprint (WSF).

Keywords — ISO 14046, Water Scarcity Footprint (WSF))

Water and Environment Institute for Sustainability (WEIS) has adopted and applied the Water Footprint Assessment Tool, an environmental tool to assess the amount of direct and indirect water use and degradation water (considering only fresh water) to assess the amount of water demand in the industrial process. Also include the hot spot of water use to determine the best ways to maximize water efficiency and to find ways to reduce the amount of water used in the production process. This is to prepare the waterproof footprint certification system for Thailand. WEIS got funding from the Groundwater Development Fund, Department of Groundwater Resources (DGR) to implementing the project to assess groundwater use throughout the product life cycle (or Water Footprint of Product). The project has the following main objectives:

(1) To promote Water Footprint Assessment in accordance with ISO 14046 to be concrete in the industry.

(2) To develop water footprint specialists and establish the Water Footprint network in Thailand.

This project covers the activities scope of work as follows:

(1) To appoint Project director committee, Working committee and Technical committee

(2) Public relation of the project and pilot industries recruitment.

(3) Pilot industries selection.

(4) Training and workshop on Water Footprint Assessment.

(5) In-depth consultation to pilot industries.

(6) Preparation of Water Footprint Assessment Report and guidelines of water use reduction.

(7) Verification of data from third party.

(8) Water Footprint Certification.

(9) Evaluating the value of the project. (environment, economic and social)

(10) Seminar to public the success of the project.

There are 34 industries apply to participate, including sugar industry, petrochemical industry, cement industry, ethanol production industry, textile and dyeing industry, electrical and electronic industry, rubber industry, automotive parts industry, pulp and paper industry, food and beverage industry, feed industry and broiler farms. Finally, it was selected as a pilot industry from 15 companies.

In-depth consultation with pilot industries to assess Water Footprint

Project implementation, there will be experts in depth consultation with the pilot industries and also study on ways to reduce groundwater use (Including surface water) from the manufacturing process or form use phase of product. The project experts consulted with each pilot industry for 4 times, as well as WEIS established the technical committee meeting to develop a guideline of Water Footprint Assessment in accordance with ISO 14046 for Thailand. The Water Footprint Assessment guideline will be used for consulting the pilot industries.

(1) Technical Committee Meeting

WEIS organizes the Technical Committee meetings to develop guideline of Water Footprint Assessment and Water Footprint certification system in accordance with ISO 14046 for Thailand. Also discuss for the technical comments and suggestions about the Water Footprint Assessment. The Technical Committee consists of 21 members, representatives from industry sectors, academics, educational institution and related organizations.

(2) Development of Water Footprint Assessment Guideline

This project, Water Footprint Assessment is implemented in accordance with ISO 14046 which consists of 4 main steps, similar to Life Cycle Assessment (LCA).

- Step 1 Goal and Scope Definition: The assessor must determine Functional Unit, Product Unit and form of assessment before proceeding to collect data and process the water footprint inventory.

- Step 2 Water Footprint Inventory Analysis: It is a step to establish Water Footprint Inventory by collecting quantitative and qualitative data. Water Balance of the whole organization is required.

- Step 3 Water Footprint Impact Assessment: Assessment is related to the amount or shortage of water (Water Scarcity Footprint) in the unit of H_2Oeq. In the case of direct water use from nature, Water Footprint is calculated by multiplying the amount of water use by the factor called Water Stress Index (WSI). In the case of indirect water through technological processes or water integrated to raw materials or water used for the acquisition of raw materials, Water footprints is calculated from the activity data multiplied by a factor called Water Scarcity Footprint (WSF).

- Step 4 Interpretation of the Results

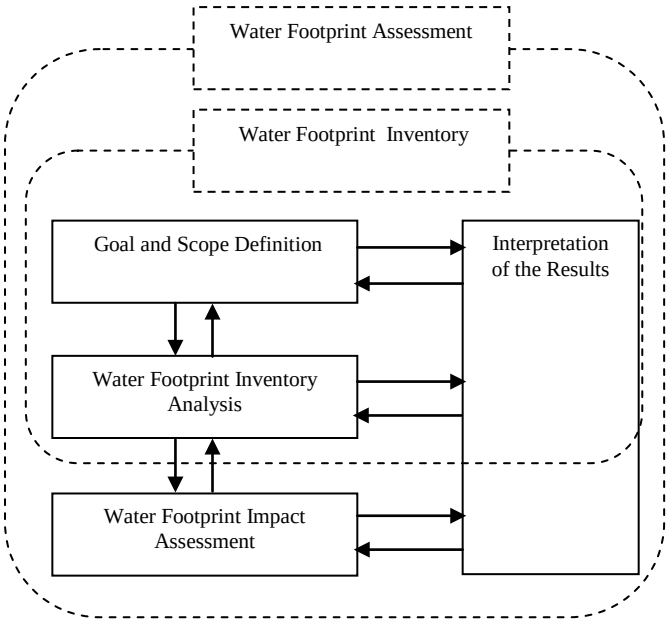

Fig. 1. Main steps of Water Footprint Assessment

(3) Product Category Rule (PCR)

WEIS has developed Product Category Rule for Water Footprint Assessment. PCR include following details such as specific product details, scope of assessment, data collection in the life cycle of the product, display of Water Scarcity Footprint (WSF) and Water Stress Index (WSI). WEIS has developed a PCR, divided into 9 groups of product that covering pilot products.

- Group 1: Corrugating medium products

- Group 2: Drinking water products

- Group 3: Soft drink products

- Group 4: Alcoholic beverages products

- Group 5: Portland cement products

- Group 6: Rubber products

- Group 7: Sugar products

- Group 8: Fresh chicken meat and processed chicken meat products

- Group 9: Polymer Car Accessories

(4) In-depth consultation

The 1st in-depth consultation, to clarify the project details, visiting the production process, determining the scope of Water Footprint Assessment in accordance with ISO 14046, as well as identifying the information to be collected from various activities such as input-output material, determining the extent assessment which depends on the type of product (Business-to-Business (B2B) or Business-to-Consumer (B2C) based on the principles of Life Cycle Inventory) and Water Balance (water consumption mapping of surface water and groundwater) for use in calculating the Water Footprint of Product.

The 2nd in-depth consultation, to provide technical advisory and technical support to collect non-collectable information or data that may require a calculation method. Also study ways to reduce water use from activities or production processes.

The 3rd in-depth consultation, to inquire and understand the details of the information received. Describe the assumption that will be used to assess Water Footprint. Including the draft measures of water reduction in the production process

The 4th in-depth consultation, to summarize the Water Footprint Assessments of product and measures to reduce the use of water from the production process or from the use phase of products.

Data Verification of Water Footprint Assessment

Under this project, the data verification of Water Footprint Assessment is required and focus on transparency, relevance, completeness, consistency accuracy and comprehensiveness for Water Footprint Assessment of product is accurate according to academic principles, respectful and acceptable The procedure of Water Footprint Verification is as follows.

- The Water Footprint Assessor delivers the documents and information of Water Footprint Assessment to the verifier.

- The verifier takes into consideration the information from the documents that sent by the assessor.

- The verifier checks the information from the site visit.

- The assessor corrected the information as notified by the verifier.

- The verifier considers the modified information that sent by assessor.

- The verifier certified the result of Water Footprint Assessment and prepare documents for certification.

- The verifier informs and sends the certificate of Water Footprint Assessment to WEIS.

Water Footprint Certification

WEIS appointed Water Footprint certification committee to certify Water Footprint Assessment and set up a committee meeting to consider the methods of Water Footprint of Product Certification and to certify Water Footprint of Product. In summary, the results of the Water Footprint of Product certification are as follows.

- To obtain a Certification of Water Footprint of Product, The industry must conduct a thorough assessment of the water footprint of product and through the verification of water footprint of product. The industry will provide the documents of Water Footprint Assessment include presentation, PCR and Verification Sheet. After that, the Water Footprint certification committee will consider the information and inquire further questions. The secretary will provide additional information or ask more questions to the verifier on matters that still have doubts. If considered and approved, the Water Footprint certification committee then certify the Water Footprint of Product. However, if not passed the certification the industry will need to correct the Water Footprint Assessment data.

- Currently, Thailand has Water Stress Index (WSI) of the 25 basins (average monthly and annual) that were provided by The Joint Graduate School of Energy and Environment (JGSEE), and also has Water Scarcity Footprint (WSF) of 8 groups (129 databases) were provided by the National Metal and Materials Technology Center (MTEC). WSI and WSF were used to support Water Footprint Assessment of Product in Thailand.

- The Verification scope of the Water Footprint of Product (under certification by WEIS) is according to ISO 14001: 2006, Environmental Management - Life Cycle Assessment - Requirements and Guidelines based on the Life Cycle Assessment (LCA).

- Currently, WEIS will certify only Water Scarcity Footprint because of the limitations of water database in Thailand that used for Water Footprint Assessment. It will broaden the coverage of certification in the future. Under this project there are 15 products from 15 pilot industries were certificated Water Footprint of Product and there are 29 products from 13 industries (outside this project) were certified. Water Scarcity Footprint of 44 products as follows

Table 1 Result of Water Scarcity Footprint of 44 products

No	Product	Scope (B2B/B2C)	Water Scarcity Footprint (H_2Oeq)
Group 1 : Corrugating medium products			
1	Corrugated Medium (CA 105 gsm.)	B2B	10.8 m^3 H_2O eq
2	Corrugated Medium (KI 125 gsm.)	B2B	11.4 m^3 H_2O eq
Group 2 : Drinking water products			
3	Drinking Water (Crystal) PET bottle 1,500 ml.)	B2C	2.49 L H_2O eq
4	Drinking Water (Crystal) (PET bottle 1,000 ml.)	B2C	1.76 L H_2O eq
5	Drinking Water (Crystal) (PET bottle 600 ml.)	B2C	1.10 L H_2O eq
Group 3 : Soft drink products			
6	Coca-Cola (PET bottle 1.25 l.)	B2C	25.8 L H_2O eq
7	Coca-Cola (PET bottle 590 ml.)	B2C	29.1 L H_2O eq
Group 4: Alcoholic beverages products			
8	Chang Beer Classic (bottle 620 ml.)	B2C	8.16 L H_2O eq
9	Blend 285 (bottle 700 ml.)	B2C	64.4 L H_2O eq
10	Sangsom Gold Medallion (bottle 700 ml.)	B2C	55.7 L H_2O eq
11	Monsoon Valley Signature Red Wine (bottle 750 ml.)	B2C	250 L H_2O eq
12	HONG THONG (bottle 700 ml.)	B2C	44.4 L H_2O eq

No	Product	Scope (B2B/B2C)	Water Scarcity Footprint (H_2Oeq)
Group 5: Portland cement products			
13	Portland Cement Type I (INSEE Petch) (Bulk)	B2B	329 L H_2O eq
14	SCG Portland Cement Type I (Bulk 1 ton)	B2B	341 L H_2O eq
Group 6: Rubber products			
15	Standard Thai Rubber 20 (STR20)	B2B	4.85 m^3 H_2O eq
Group 7: Sugar products			
16	Mitr Phol Refined Sugar 50 kg. (1 ton)	B2B	6.76 m^3 H_2O eq
Group 8: Fresh chicken meat and processed chicken meat products			
17	Fresh Chicken (fillet bag 1,000 g.)	B2C	91.8 L H_2O eq
18	Tender Chicken Breast (CP Delight) (fillet bag 90 g.)	B2C	12.9 L H_2O eq
19	Jumbo Chicken Sausage (Betagro) 1 pack (13 pieces)	B2C	87.5 L H_2O eq
Group 9: Polymer Car accessories products			
20	Fog Lamp GARNISH COVER, Toyota Hilux Revo	B2B	221 L H_2O eq
Group 10: Electricity, steam and chiller products			
21	Electricity (1 MWh)	B2B	126 L H_2O eq
22	Electricity 500 kV (1 kWh)	B2B	0.20 L H_2O eq
23	Electricity 115 kV (1 kWh)	B2B	0.81 L H_2O eq
24	Electricity 115 kV (1 kWh)	B2B	0.66 L H_2O eq
25	Electricity 115 kV (1 kWh)	B2B	0.63 L H_2O eq
26	Electricity 115 kV (1 kWh)	B2B	0.30 L H_2O eq
27	Electricity 115 kV (1 kWh)	B2B	0.29 L H_2O eq
28	Electricity 115 kV (1 kWh)	B2B	1.33 L H_2O eq
29	Electricity 22 kV (1 kWh)	B2B	0.81 L H_2O eq
30	Electricity 22 kV (1 kWh)	B2B	0.66 L H_2O eq
31	Electricity 22 kV (1 kWh)	B2B	0.63 L H_2O eq
32	Electricity 22 kV (1 kWh)	B2B	0.30 L H_2O eq
33	Electricity 22 kV (1 kWh)	B2B	0.29 L H_2O eq
34	Steam (1 GJ)	B2B	27.3 L H_2O eq
35	Steam (1 GJ)	B2B	67.8 L H_2O eq
36	Steam (1 GJ)	B2B	55.0 L H_2O eq
37	Steam (1 GJ)	B2B	52.1 L H_2O eq
38	Steam (1 GJ)	B2B	25.2 L H_2O eq
39	Steam (1 GJ)	B2B	23.7 L H_2O eq
Group 11: Industrial water products			
40	Service water 1 m^3	B2B	71.0 L H_2O eq
41	Demin water 1 m^3	B2B	145 L H_2O eq
Group 12: Aromatics products			
42	Benzene 1 kg	B2B	0.61 L H_2O eq
43	Paraxylene 1 kg	B2B	1.03 L H_2O eq
44	Orthoxylene 1 kg	B2B	1.03 L H_2O eq

Remark : B2B = Business to Business B2C = Business to Customer

Assessing value of project implementation (environmental, economic and social)

WEIS has conducted a cost-effective evaluation to project implementation that promote and support sustainable water management in the environmental, economic and social. The results are as follows.

(1) Worthiness of environmental

The implementation of this project can reduce the environmental impact because the industry has a way to reduce the use of groundwater (Including surface water) in the production, which if implemented will help to conserve groundwater. It can reduce the pollution of wastewater and discharge into public water source. It also increases the potential for groundwater to be used in areas where industrial plants are located.

(2) Worthiness of economic

At present, Thailand lacks appropriate Water Footprint Assessment methods, which require expensive international experts. The results of this project will help to build the Water Footprint Assessment expert in Thailand and reduce the cost of the foreign experts in the assessment. It encourages and support the industry to conduct a more thorough assessment of water use throughout the product lifecycle.

In addition, the results of the project make the pilot industries can consider production units that use high volume (hot spot) of groundwater (including surface water) and have ways to reduce water use. This will help the industry to improve water efficiency and reduce production costs. In addition, it can enhance both domestic and international competitiveness.

(3) Worthiness of social

This project is part of the showcase of social responsibility for water use. If the industry adopts the guidelines to reduce water use, it will reduce the water consumption from the industry and can bring the water which reduced to use for other areas such as consumption, agricultural and can help to reduce social conflict between industry and community, including agriculture. Encourage the sustainable coexistence.

In addition, groundwater which preserved can also be used as a reservoir for the community and agricultural sector during the drought crisis to reduce the impact on living and society.

The benefits that Department of Groundwater Resources receives from this project

This project is in addition to the benefits to the industry, there are also benefits that Department of Groundwater Resources receives.

- Network of industries that comply with the regulations of Department of Groundwater Resources. It also focuses on reducing the use of groundwater and improving the efficiency of groundwater use that help to regulate the responsibilities of Department of Groundwater Resources.

- There is a preliminary reference (benchmark) on the water use of each industrial sector (but may not be representative). This can be used as a baseline for determining the demand of water and the proportion of groundwater use in various industrial sectors for use as groundwater management information.

- Pilot industries have ways to reduce water consumption and improve water efficiency. If the industry takes the approach to practice, this will help to conserve groundwater and increase the potential of groundwater to be used in the area where the plant is located. It can also be used groundwater which reduced as a source of water in case of a drought crisis.

Problems, barriers and limitations for Water Footprint Assessment in Thailand.

(1) Water Footprint is relatively new to Thailand. And the water database for the calculation is quite small.

(2) Some products, such as wine, have a long production period. The wine must be fermented for a period of 20 months, so it is hard to keep track of all the information.

(3) Restrictions on access to data, such as ingredients of beverages or alcoholic drink. This information is only formulated and confidential.

(4) The industry has a lot of information to gather. Some have to gather information from the upstream factory in the supply chain.

(5) Water Footprint Assessment must be established the water balance of the entire facility. Many industrial plants do not have fully equipped water meters wherever they are used. Most industries also give priority to energy usage data rather than water use data. The reason is that energy costs are significantly higher than water, it causes of no complete information to support the establish of water balance.

The approach that should continue.

Water and Environment Institute for Sustainability (WEIS) has commented and suggested to promote Water Footprint Assessment because of the benefits and achievements from this project.

(1) Water and Environment Institute for Sustainability (WEIS) will be the main organization to certificate Water Footprint of Thailand. WEIS will encourage and expand the Water Footprint Assessments to cover all industrial sectors and continuity, so that the industry can consider the use of water in the production process thoroughly and use water efficiently.

(2) Extend the water footprint assessment to a greater area or industrial sectors. If there are enough industrial data and examples. It can be benchmarked for specific industrial sector and used as a reliable representative data. The Department of Groundwater Resources (DGR) can be used as groundwater management information to determine the demand of groundwater and the proportion of groundwater use for specific industries and also used as surface water management information, leading to overall water management in the country.

REFERENCES

[1] ISO 14001: 2006, Environmental Management - Life Cycle Assessment - Requirements and Guidelines based on the Life Cycle Assessment (LCA)

[2] ISO 14046 : 2014, Environmental management - Water footprint - Principles, requirements and guidelines