System of environmental - economic accounting for water (SEEA-W): case study of the Nhue - Day river basin

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Abstract:

The system of environmental - economic accounting for water (SEEA-W) is one of efforts by international organizations to address the issue of the lack of water related data; it provides a tool for policymakers to inform decisions in a sustainable manner. In undertaking a pilot study of the Nhue - Day river basin, this research demonstrates that the river basin approach is in accordance with management institutions and available data, as well as being useful for sustainable management of water, in Vietnam.

Keywords: ***management of water, Nhue - Day river basin, SEEA-W.***

Classification number: ***6.2***

Introduction

Water accounting is a discipline that seeks to provide comprehensive, consistent and comparable policy-relevant information related to water. Based on the experience of more than fifty years of compiling national accounts, the discipline that provides the elements to calculate gross domestic product (GDP), the United Nations Statistics Division (UNSD) developed the System of Environmental - Economic Accounting for Water (SEEA-W), adopted by the United Nations Statistical Commission (UNSC) as a statistical standard in 2012. SEEA-W can assist policymakers in making informed decisions on: (i) Allocating water resources efficiently; (ii) Improving water efficiency; (iii) Understanding the impacts of water management on all users; (iv) Getting the most value for money from investing in infrastructure; (v) Linking water availability and use; (vi) Making available a standardized information system, which is capable of harmonizing information from different sources, is accepted by stakeholders and is used for the derivation of indicators; (vii) Getting stakeholders involved in decision-making.

Currently, over 50 countries are developing or plan to develop SEEA-W [1]. The application of SEEA-W will gradually improve the quality of data and contribute to develop sustainable policies on water resources. However, the applicability of the framework in practice is much reliant on a country's institutional and organizational structure and especially the approach to relevant SEEA-W information sources [2]. Viewed from existing conditions and potential of the framework's application in Vietnam, the study has revealed that adopting a river basin approach to SEEA-W is fundamental to implementation of the framework at national level. In this study, the pilot application on the Nhue - Day river basin will prove the relevance and feasibility of implementation of this approach, while demonstrating it has certain impacts on State management on water resources. In addition, the gained results of the pilot study will point out the deficiencies and limitations that need to be improved.

Methodologies

The methodologies adopted in this research were:

(i) Desk study to review, collect data and related information, and search for published data sources.

(ii) Systems analysis to describe the relationship between economic and household activities and other problems related to water resources in the Nhue - Day river basin.

(iii) Consultation survey of views of local authorities in the Nhue - Day river basin and experts from the relevant backgrounds such as water resources

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planning; water pollution; remote sensing and GIS professionals.

(iv) Statistical analysis to gather and process Nhue - Day river basin data. The following table describes the main sources and methodololgies used to collected data for Nhue - Day river basin case study (Table 1).

Results and discussions

SEEA-W framework

The framework of SEEA-W is presented in simplified diagrammatic form in Fig. 1, which shows the economy, the system of water resources and their interactions [9]. The economy and the inland water resource system of a territory, referred to as "territory of reference", which can be a country, an administrative region, or a river basin. The given "territory of reference" includes (i) The inland water resource system of a territory is composed of all water resources in the territory (surface water, groundwater and soil water) and the natural flows between and among them (absorption, evapotranspiration, etc.) which are separately reflected in the form of water assets and volume; (ii) The economy of a territory consists of resident water users that abstract water for production and consumption purposes and put in place the infrastructure to store, treat, distribute and discharge water.

State agencies, enterprises, and households play their particular roles in socio-economic activities in the territory of reference. These entities act as the producers and consumers, and use water resources as a "sink". In this regard, these entities use water in different ways by abstracting groundwater, surface water and rainwater, and by reusing water, etc. In the other words, economic entities can directly abstract water from the environment to carry on activities involving production and consumption or use water without physically removing it from the environment (recreational uses of water). To depict the relationship of water-related activities within the economy, SEEA-W adopts International Standard Industrial Classification (ISIC)

Table 1. Data collection methodologies.

No	Types of data	Sources or methods to collected
1	Precipitation	Collected from the report of National Center for Water Resources Planning and Investigation (NAWAPI) [3] in 2016 - Monre.
2	Evaporation	Download the average evaporation map from Moderate Resolution Imaging Spectroradiometer (MORIS) and processing for the Nhue - Day river basin by Geographical Information System (GIS) expert.
3	Water use and wastewater	- Wastewater data was extracted from the data system of the Centre for Environmental Monitoring Portal of the Vietnam Environment Administration (VEA), the website Portal managing environmental monitoring of the Nhue - Day river basin. - Water use was estimated according to the guide from the Decree on drainage and wastewater treatment (article 39 - Determination of wastewater volumes, no 80/2014/ND-CP). - In particular, wastewater and water use for agriculture (cultivation and livestock) was collected from data in VEA reports [4].
4	Pollution parameters in wastewater	The study only adopts COD parameters in water to compile the emission accounts table in the Nhue - Day river basin. Due to data restrictions, the following assumptions have been made: (i) Wastewater after treatment meets the standards for surface water in Vietnam at column A1; accordingly, the COD amount after treatment remains at 0.00001 ton/m^3 [5]. (ii) The ratio of treated wastewater and wastewater directly discharged into the environment are calculated on the data of Center for Environmental Monitoring 2017 [6]. Additionally, some ratios are referenced by published researches [7] or the National Strategy on environmental protection to 2020 and the orientation towards 2030 [8].
5	Socio-Economic activities	From the provincial statistical yearbooks of Hoa Binh, Ha Noi, Ha Nam, Nam Dinh, and Ninh Binh in 2015.

(Sources: authors, 2017).

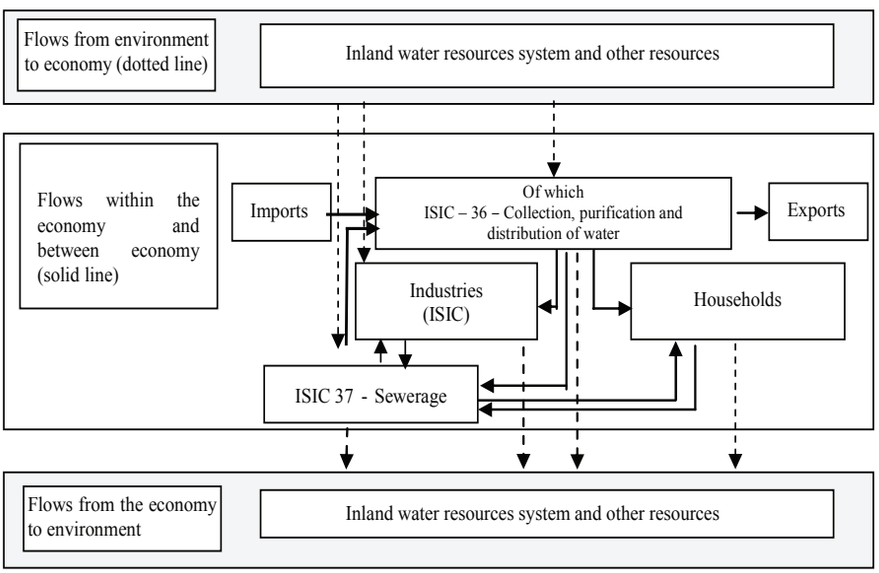

Fig. 1. Detailed description of physical flows within the economy. (Sources: UN, SEEA-W, 2012).

to develop relevant accounting tables listed in Table 2 [10].

The SEEA-W accounting framework showing interaction between the inland water system and the economy is divided and presented in the five categories corresponding to these accounting tables: (i) Physical water supply and use table (PSUT); (ii) Water emission accounts; (iii) Hybrid accounts for economic activities and water resources; and (iv) Asset accounts. These tables reflect different aspects of water in a given period of accounting. Two important parts of SEEA-W are PSUT and emission accounts. PSUT describes water flows in physical units (m^3, million m^3, etc.) to reflect water interaction between the environment and the economy and among industries within the economy. Emission accounts seek to show the water pollutants in the economy, the role of the entities to reduce these pollutants though on-site treatment, or through water treatment facilities (ISIC 37).

PSUT and emission accounts tables respectively contribute to:

- (i) Assessment and monitoring of the pressure on water quantities that is exerted by the economy; (ii) Evaluation of alternative options for reducing the pressure on water; (iii) Reflect the information on water collection, treatment, distribution, and reuse of water by the industries; and (iv) Link other economic information such as value added and production yield of each industry, to calculate useful indicators such as intensity, productivity and efficiency of water use by industry, emission situation, water footprint, and water use in households.

- Support policy makers, water managers measure the current situation and control the pollutants in the water resources (e.g. BOD, COD, nitrogen, phosphorus, etc.) based on discharges of water and pollutants into the environment from households and economic activities (Fig. 2 [9]).

Table 2. Classification of socio-economic activities in SEEA-W.

International System Industry Code (ISIC)	Description of Socio - economic activities
1-3	Agriculture, forestry and fishing
5-33, 41-43,	Manufacturing, mining and quarrying and other industry activities
35	Electric power generation, transmission and distribution
36	Water collection, treatment and supply
37	Sewerage, including treatment of wastewater
38, 39, 45-99	Services activities
No code	Households as customer

(Sources: UN, SEEA-W, 2012).

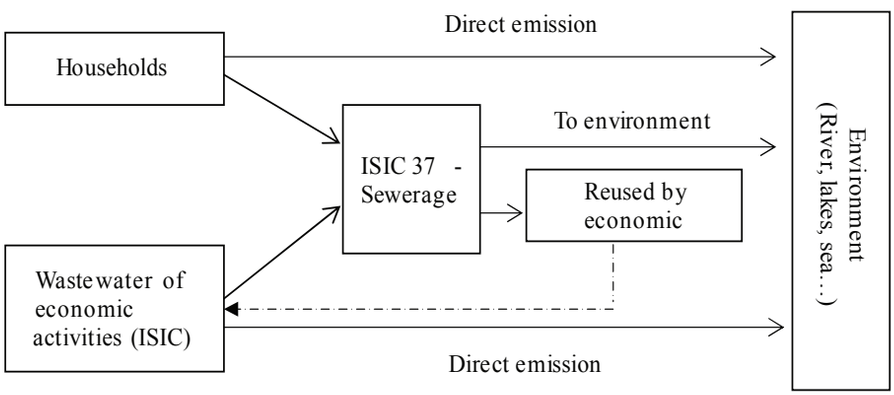

Fig. 2. Wastewater and associated pollution pathway.
(Sources: SEEA-W, 2012).

Table 3. Total GDP at current price of provinces in Nhue - Day river basin by economic activities.

ISIC	2010	2011	2013	2014	2015
Total	***361,877***	***464,685***	***642,032***	***735,801***	***822,582***
1-3	43,784	56,024	63,079	65,441	70,642
5- 33, 41-43	181,285	235,740	331,451	382,602	432,358
35	14,537	14,104	19,811	23,658	26,914
36, 37	1,758	2,404	3,484	3,977	4,171
38, 39, 45-99	120,513	156,413	224,207	260,123	288,497

Unit: billions of VND.

(Source: extracted from the provincial statistical year books of Ha Noi [11], Ha Nam [12], Nam Dinh [13], Ninh Binh [14] and Hoa Binh [15]).

Hybrid supply and use tables juxtapose results from PSUT and emission accounts tables with information about related economic activities in the system of national accounts (SNA) such as gross output (GO), intermediate consumption (IC), value added (VA), etc. They contribute development indicators to illustrate the relation between water resources and economic, households' activities in each country, territory [9]. In particular, such types of combination make it possible to review the contribution of water resources to socio-economic development and provide indicators to reflect the efficiency and cost of water use and distribution within the economy, the polluting pressures on the environment created by water, and so on.

Application of SEEA-W in the Nhue - Day river basin

An overview of the Nhue - Day river basin:

- Natural conditions: Being a sub-basin of the Red River, the Nhue - Day river basin is located on the right bank of Red River and accounts for a large part of the southwest Red River delta. The basin encompasses 5 provinces and central cities including: Hoa Binh, Hanoi, Ha Nam, Ninh Binh, and Nam Dinh with total area of 7,388 km^2 (in which the Day river basin is 6,965 km^2). The basin has a variety of geographical structures in which two thirds of the area is delta; the West-to-East geographical picture can be divided into three main regions: Mountainous region, delta, and coastal/ mouth region. The basin's river network has a rather high density at 0.7-1.5 km/ km^2 including main rivers, tributaries and distributaries such as Day river, Tich river, Thanh Ha river, and Chau river [4].

- Socio-economic conditions: In 2010, the total population in the basin was 8,191,739 people with average density of 1,108 people/km^2 [4]. Due to the impact of the strong urbanization process, the population in the basin has increased over time along with positive changes in economic activities. The results of GO in the basin's provinces

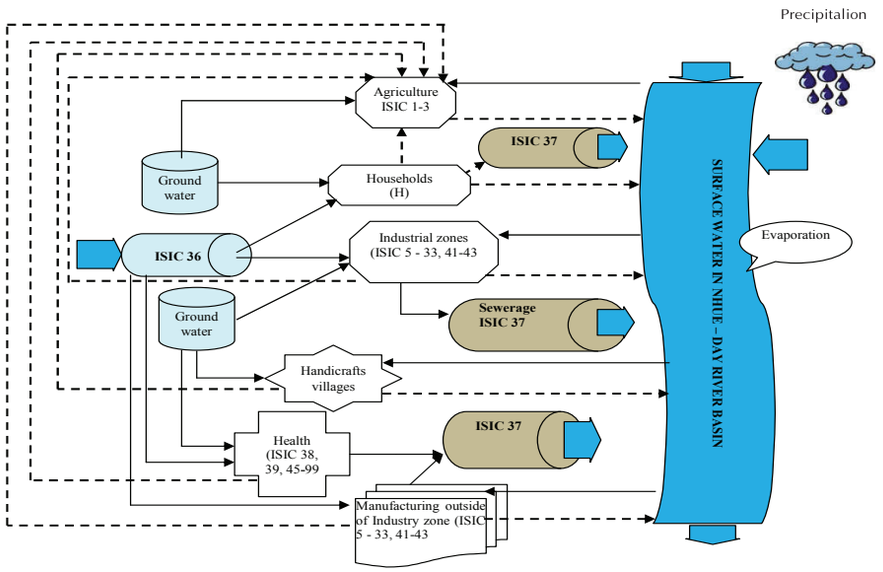

Fig. 3. The relationships between socio-economic activities and water resources in the Nhue - Day river basin.

(Sources: authors, 2017).

Table 4. Estimated wastewater from main wastewater sources in the Nhue - Day river basin from 2009 to 2015.

No	Types of wastewater sources	2010	2012	2014	2015
1	Agriculture	933.34	N/a	N/a	N/a
-	*Cultivations*	341.67	N/a	N/a	N/a
-	*Livestock*	591.67	N/a	N/a	N/a
2	Handicraft villages	26.81	128.31	14.92	32.65
3	Industrial zones	21.79	15.85	8.19	17.13
4	Health facilities	91.67	4.21	1.37	0.51
5	Manufacturing outside of industrial zones	86.84	1241.78	4.90	1.27
6	Households	223.03	N/a	N/a	N/a

Unit: millions of m^3; N/a: not available data.
(Source: extracted and calculated as described in Table 1).

Table 5. The volume and ratio of water use, water emission of economic activities, households in the Nhue - Day river basin in 2010.

Indicators	Unit	H	Agri (1-3)	Industries ISIC (5-33, 41-43)			Health facilities (38, 39, 45-99)
				Industrial zones	*Manufacturing outside of Industrial zones*	*Handicraft villages*	
1. Total of water use	Mil.m^3	223.03	1,166.68	27.23	108.55	33.52	114.59
Ground water	%	33.55	45.63	42.22	5.21	71.27	7.44
Surface water	%	0	40.60	1.01	83.35	24.02	0
From ISIC 36	%	66.46	13.78	56.76	11.43	4.71	92.56
2. Total of wastewater	Mil.m^3	223.03	933.34	21.79	86.84	26.81	91.67
Agriculture	%		0	14.16	0.062	2.83	4.945
To ISIC 37	%	30,00	0	4.23	2.34	15.42	50.48
To Environment (rivers, lakes, sea…)	%	70,00	100	81.61	97.60	81.75	44.58

H: households.
(Source: extracted and calculated as described in Table 1).

has constantly increased, particularly in the sectors of industry, commerce, and service. In 2015, the population of the river basin reached 11,989.3 thousand people (Table 3).

- Pressures on water resources: The Nhue - Day river basin maintains its important roles in supplying water for socio-economic development activities in the related provinces. Nevertheless, the rapid socio-economic development in the recent years has resulted in many pressures on the water resources in the basin such as uncontrolled water abstraction and use; increased environmental pollution, which lead to the severe polluted conditions of the water resources in the basin [4].

Table 6. Physical use 2010 in the Nhue - Day river basin.

A. Physical water use table (millions of m^3)	Industry (by ISIC)							H	ROW	Total
	1-3	*5-33, 41-43*	*35*	*36*	*37*	*38, 39, 45-99*	*Total*			
I. From the environment										
I.1. Sources of abstracted water										
1. Total water abstraction (= 1.a +1.b = 1.2.1 + 1.2.2 + 1.2.3)	1,005.95	139.85	0	481.52	6,865.60	8.52	8,501.44	93.52		8,594.96
1.a. Abstraction for own use	1,005.95	139.85	0	0.00	6,865.60	8.52	8,019.92	93.52		8,113.45
- Agriculture	1,005.95						1,005.95			1,005.95
- Industries		139.85					139.85			139.85
+ Industrial zones		11.77					11.77			11.77
+ Manufacturing outside of Industrial zone		96.14					96.14			96.14
+ Handicraft villages		31.94					31.94			31.94
- Health facilities						8.52	8.52			8.52
- Urban run-off					6,865.6		6,865.60			6,865.60
- Households							0.00	93.52		93.52
1.b. Abstraction for distribution				481.52			481.52			481.52
I.2. Abstraction sources										
I.2.1. From inland water resources	1,005.95	139.85	0	481.52	0	8.52	1,635.84	93.52		1,729.36
- Surface water	532.30	98.808	0	481.52	0	0	1112.63	0		1,112.63
- Ground water	473.65	41.046	0	0	0	8.52	523.22	93.52		616.74
I.2.2. Collection of precipitation	0	0	0	0	6865.6	0	6,865.60	0		6,865.60
1.2.3. From sea	0	0	0	0	0	0	0.00	0		0.00
II. Within the economy										
2. Use of water received from other economic units	21.176	27.87	0	0	120.28	106.07	275.39	185.27	0	460.66
- Reused water	8.363	0	0	0	0	0	8.36	0	0	8.36
- Wastewater to sewerage	0	0	0	0	120.28	0	120.28	0	0	120.28
3. Total use of water (= 1+2)	1,027.13	167.72	0.00	481.52	6,985.88	114.59	8,776.83	278.79	0.00	9,055.63

ROW: rest of the world (outside the Nhue - Day river basin).
(Sources: authors, 2017).

Table 7. Physical supply 2010 in the Nhue - Day river basin.

B. Physical supply table (millions of m^3)	Industry (by ISIC)							H	ROW	Total
	1-3	*5-33, 41-43*	*35*	*36*	*37*	*38, 39, 45-99*	*Total*			
Within the economy										
4. Supply of water to other economic units	0	10.99	0	481.52	0	50.81	543.32	66.913		610.23
- Reused water	0	3.90	0	0	0	4.53	8.43	0		8.43
- Wastewater to sewerage	0	7.09	0	0	0	46.28	53.37	66.913		120.28
Into the environment										
5. Total returns (= 5.a + 5.b)	933.34	124.45	0	0	120.28	40.86	1,218.94	156.12		1,375.06
- Agriculture	933.34						933.34			933.34
- Industries		124.45					124.45			124.45
+ Industries zones		17.78					17.78			17.78
+ Manufacturing outside industrial zones		84.75					84.75			84.75
+ Handicraft villages		21.92					21.92			21.92
- Health facilities						40.86	40.86			40.86
- Urban run-offs							0.00			0.00
- Waste water					120.28		120.28	156.12423		276.40
5.a. To inland water resources (= 5.a.1 + 5.a.2)	933.34	124.45	0	0	120.28	40.86	1,218.94	156.12		1,375.06
5.a.1. Surface water	933.34	124.45	0	0	120.28	40.86	1,218.94	156.12		1,375.06
5.a.2. Ground water	0	0	0	0	0	0	0.00	0		0.00
5.b. To other sources	0	0	0	0	0	0	0.00	0		0.00
6. Total supply of water (= 4 + 5)	933.34	135.44	0.00	481.52	120.28	91.67	1,762.25	223.04		1,985.29
7. Consumption (= 3 - 6)	93.78	32.28	0	0	6,865.60	22.92	7,014.58	55.76		7,070.34

(Sources: authors, 2017).

Description of relationship between economy activities and water resources in Nhue - Day river basin:

Figure 3 simulates the relationships between the socio-economic activities and water resources in the Nhue - Day river basin. Accordingly, all entities involved in water abstraction and use in the basin include agriculture production activities (cultivations and livestock activities), industrial activities performed by industrial zones, traditional craft villages and households, and health services.

Based on these relationships and methodologies for collecting and calculating data in Table 1, wastewater and water use was calculated in Table 4, and Table 5. After considering the completeness of data in the Nhue - Day river basin, the relevant data in 2010 was chosen to calculate and fill in the SEEA-W's account tables.

Compiling physical supply and use table (PSUT):

The PSUT tables compiled and edited based on the standard SEEA-W framework of United Nations and the characteristics of the economic entities and households in the Nhue - Day river basin, describe the relationships between the economy and water resources within the basin (Table 6 and Table 7).

Table 8. The ratios of wastewater which are without treatment or after on site treatment by economic sectors.

Indicators	Agriculture		Industry (CEM-VEA [6])			Health facilities	H [8]
	Cultivation [4]	*Livestock* [7]	*Industrial zones*	*Manufacturing outside of industrial zones*	*Handicraft villages*		
Without treatment	100	39,9	15,63	7,69	96,9	29,55	70
After on-site treatment	0	61,1	84,37	92,3	0,96	70,45	30

(Sources: authors collected and estimated, 2017).

Table 9. Estimated the average of COD parameter by socio-economic sectors in the Nhue - Day river basin[1].

Socio - economic activities	Average COD per m^3 (Ton/m^3)
Agriculture (1-3)	
Cultivations	0.000024
Livestock	0.00063
Industries, building (5-33, 41-43)	0.00342
Industrial zone	0.00099
Manufacturing outside of industrial zones	0.00584
Handicraft villages	0.00099
Water collection, treatment and supply (ISIC 36)	N/a
Sewerage, including treatment of wastewater (ISIC 37)	N/a
Services activities (38,39, 45-99)	
Health facilities	0.00085
Other services	N/a
Households (non code)	0.001067323

(Sources: calculated from environmental protection planning report to 2020 [4]).

Table 10. Emission account for the Nhue - Day river basin in 2010.

Pollutant chemical oxygen demand (ton of COD per year)	Industry (ISIC)							H	ROW	Total
	1-3	*5-33, 41-43*	*35*	*36*	*37*	*38,39, 45-99*	*Total*			
1. Gross emissions (= 1.a + 1.b)	161.24	206,069.51	N/a	N/a	N/a	23,273.39	23,273.39	16,7304.1	0.00	930,002.99
1.a. Direct emissions to water (= 1.a.1 + 1.a.2 = 1.a.i + 1.a.ii)	161.24	357,912.26	N/a	N/a	N/a	23,273.39	23,273.39	16,6635.0	0.00	929,326.20
1.a.1. Without treatment	157.62	357,368.67	N/a	N/a	N/a	23,266.90	23,266.90	16,6635.0	0.00	928,221.37
1.a.2. After on-site treatment	3.62	541.02	N/a	N/a	N/a	6.49	6.49	0.0	0.00	1,104.83
1.a.i. To inland water resources	161.24	206,061.83	N/a	N/a	N/a	23,273.39	23,273.39	16,6635.0	0.00	777,478.34
1.a.ii. To sea	0	0	N/a	N/a	N/a	0	0	0	0	0
1.b. To sewerage (ISIC 37)	0	7.7	N/a	N/a	N/a	0	0	669.1	0	676.79
2. Reallocation of emissions by ISIC 37	0	7.69	N/a	N/a	N/a	0	0	0.0	0	7.69
3. Net emissions (= 1.a + 2)	161.2	357,919.9	N/a	N/a	N/a	23,273.39	23,273.39	16,6635.0	0	929,333.89

(Sources: authors, 2017).

[1]These indicators will be more realistic when there is actual observation data from environmental statistics agencies.

Compiling emission account table:

In this study COD, an important determinant for water quality, was selected to compile the emission account table in the Nhue - Day river basin. Tables 8, 9 and 10 illustrate the ratio of wastewater without treatment by economic sectors, estimated average of COD by economic sectors and areas, and the emission account in the Nhue - Day river basin respectively.

The integration of economic information with water resources and the policy significance:

In Table 11, a hybrid account juxtaposes information from Tables 6 and 7 with the results of socio-economic activities in the Nhue - Day river basin with accounting data gathered from PSUT and emission accounts tables to calculate descriptive indicators illustrating the relationships between the economy and water resources within the basin. The following table represents the above-mentioned relationship.

Depending on the management purposes of each sector, policy makers can select and calculate necessary indicators from the above account tables to make informed relevant decisions and policies to develop socio-economic conditions and sustainable use of water, for example, by having:

- Calculated the efficiency of water use, the contribution of water to production results of each industry within the river basin, each locality in the basin and in the whole basin.

- Identified the economic agents in water abstraction, water use and emission.

- Assessed different options to reduce the pressures on water resources.

- Reflected relevant information on water collection, treatment, distribution, and water reuse by the economic sectors and households in the economy.

- Applied the indicators in water demand forecast, emission trend when develop the socio-economic planning and water resources management scheme, etc.

In case of the sufficient data, the results of SEEA-W also help to calculate the values of water resources, the changes in asset of water resources in the physical or monetary aspects in the Nhue - Day river basin.

Limitations:

There are some limitations of this case study, which include (i) the lack of available data, with some data sources available but incomplete and fragmented leading to development of estimates and assumptions; (ii) statistical data on water

Table 11. Hybrid account for the Nhue - Day river basin in 2010.

Indicators	Industries (by ISIC category)							Rest of the world	Actual final consumption		Total
	1-3	*5-33, 41-43*	*35*	*36*	*37*	*38, 39, 45-99*	*Total*		*H*	*G*	
A. The results of Economic activities											
1. Total Gross Domestic Products (billions VND)	361,877.51	43,783.66	14,537.25	1,758.38		120,512.91	542,470	N/a	N/a	N/a	542,469.70
2. Value Added (VA)	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a	N/a
B. Water Resource Information											
3. Total use of water (millions of m^3)	1,027.13	167.72	0.00	481.52	6,985.88	114.59	8,776.83	N/a	93.521	N/a	8,870.35
3.a. Total abstraction	1,005.95	139.85	0.00	481.52	6,865.60	8.52	8,501.44			N/a	8,501.44
- Abstraction for own use	1,005.95	139.85	0.00	0.00	6,865.60	8.52	8,019.92	N/a		N/a	8,019.92
3.b. Use of water received from other economic units	21.18	27.87	0.00	0.00	120.28	106.07	275.39	N/a	185.27	N/a	460.66
4. Total supply of water (millions of m^3)	0.00	10.99	0.00	481.52	0.00	50.81	543.32	N/a	66.91	N/a	610.23
4.a. Supply of water to other economic units	0.00	3.90	0.00	0.00	0.00	4.53	8.43	N/a	0	N/a	8.43
- Wastewater to sewerage	0.00	7.09	0.00	0.00	0.00	46.28	53.37	N/a	66.91	N/a	120.28
4.b. Total returns	933.34	124.45	0.00	0.00	120.28	40.86	1,218.94		156.12	N/a	1,375.06
5. Total (gross) emissions of chemical oxygen demand (tons)	161.238	357,919.9	N/a	N/a	N/a	23,273.387	381,354.57	N/a	166635	N/a	547,989.57
C. Water resource management and policy indicators (example)											
Average annual GDP per m^3 by sectors in the provinces in the Nhue - Day river basin (billions of VND per millions of m^3)	352.32	261.05	N/a	N/a		1,051.69	61.807	N/a	N/a	N/a	61.16

resources are incompletely reported by economic sectors. Therefore, to implement this toolkit, it is necessary to develop a comprehensive statistical reporting system in the river basin.

Conclusions

While water problems are increasing, information useful for decision makers within the water sector and related to the water sector appear to be decreasing. Therefore, it is vital that the SEEA-W framework in water-related policies and water resources management strategy in Vietnam be applied. A periodical application of SEEA-W will assist policy makers and water resources managers to reflect the present status of water resources and the relationship between economic activities and water resources. In this way, proper decisions will be made to ensure achievement of water-related sustainable development goals.

Although the pilot study of SEEA-W in the Nhue - Day river basin reveals many difficulties at the initial steps in terms of data and structural organization, it demonstrates the feasibility and significance of the river basin-level approach when viewed from the perception and orientation of water resources management in Vietnam. In order to improve the results of this pilot study, the following activities need to be undertaken: (i) complete the organization of river basins in Vietnam with special emphasis on environmental monitoring, water-related (water abstraction, water use, emission) statistics and reporting schemes at basin level; (ii) develop a water-related information system and system for sharing information among line ministries, agencies in the river basins.

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