

Water in Artificial Reservoirs as a Produced Asset

Issue D4 SEEA CF update

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Australian
National
University



Working Group: Michael Vardon (ANU), Michael Nagy (UNECE), Sjoerd Schenau (Statistics Netherlands), Steve May (Australian Bureau of Statistics), Ken Bagstad (ex-United States Geological Survey), Mark Henry (StatsCan)

Overview



Water is in artificial reservoirs because of major human interventions

- Artificial reservoirs are fundamentally different from other surface water (lakes, rivers and streams, snow, ice and glaciers)
- Current accounting treatment hides the economic and environmental significance of reservoirs.

Solution

- Recognise the human intervention
- Record water in reservoirs as a produced asset

Affects:

- Update Physical Supply and Use Tables (PSUT) to include Inventories
- Losses from artificial reservoirs are a use by the owner/manager
- No change to the asset account

Why is it important?

Management of water is essential in countries and regions with

- Low water availability
- Variable water availability
- Changing availability with climate change
- Growing demand

Accounts allow assessment and management of supply and demand

Current PSUT does not fully describe the system, limiting its usefulness

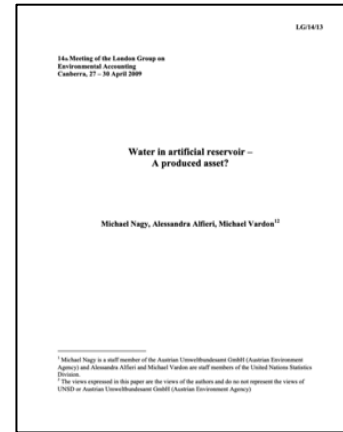


History

Proposed for the 2012 Central Framework

- Nagy et al. 2009
- Accepted in outcome paper for global consultation
- Ultimately, not adopted to maintain consistency with the 2008 SNA

2024 London Group



Not our first time at the rodeo



Recommendations and questions to the 2024 London Group Meeting (support)



1. That concordance tables and diagrams for the definitions of water flows and assets in the SEEA-Water, SEEA-CF, and SEEA-EA are added to the Central Framework
2. Water in reservoirs should be treated as a produced asset
3. The water supply use tables in the Central Framework be updated to reflect reservoir water as a produced asset, and to accommodate this:
 - a. The water supply industry is split into water distribution and water storage, and
 - b. The product natural water (CPC 1800) is split into distributed water and stored water
 - c. A column for inventory is added
4. That text is added to Central Framework, clarifying that losses in water distribution and, if accepted that water is a produced asset, losses from evaporation in reservoirs, are treated as use of natural water (CPC 1800) by the water storage industry (a sub-category of the water supply industry).
5. That physical and monetary supply use tables integrating the Central Framework and Ecosystem Accounting are developed along the lines suggested in this paper
6. That the water quality accounts from the SEEA-Water become part of the Central Framework.
7. That the methods from the SEEA Ecosystem Accounting be used to value water abstractions and water assets in the Central Framework.
8. That alternative representations of water values are recognised in the Central Framework update
9. That the SEEA-Water is updated, integrating the relevant parts of the Central Framework and Ecosystem accounting, more guidance on values and valuation, and with material on how water accounting can be used for water policy and management

Water terminology and definitions

Lots of terms and definitions in water accounting

- SEEA is not the only water accounting system (but the most dominant)

A glossary of terms

- SEEA-Water (developed by an expert working group)
- International Dictionary of Hydrology
- etc

SNA, SEEA-CF and SEEA-Water

- Water as a natural resource
- SNA product “natural water” CPC 1800
 - Makes discussions very confusing!
- SNA product bottled waters CPC 2441
 - Important in many low- and middle-income countries

SEEA-EA

- Water as an abiotic flow or ecosystem service
- Many water-related ecosystem services

Accounting identities

- Water consumption (is it net water use?)

<https://unesdoc.unesco.org/ark:/48223/pf0000221862>



Defining artificial reservoirs

SEEA-CF:

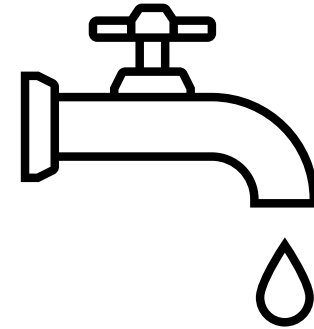
- purpose-built reservoirs used for the storage, regulation, and control of water resources (para 5.477).

International Commission on Large Dams (ICOLD)

- an artificial barrier that has the ability to impound water for the purpose of storage or control of water.

Artificial reservoirs can have more than one purpose

Other human-built infrastructure, such as pipes, canals and drains, are connected to artificial reservoirs and water treatment facilities



Scope is water stored for supply (e.g. drinking and irrigation water)

2025 SNA, assets, and production

“An **asset** is a store of value representing a benefit or series of benefits accruing to the economic owner by holding or using the entity over a period of time. It is a means of carrying forward value from one accounting period to another. All assets in the SNA are economic assets.”

“**Produced non-financial assets (excluding produced natural resources)**. Non-financial assets that have come into existence as outputs from production processes that fall within the production boundary of the integrated framework of national accounts, excluding produced natural resources. They consist of fixed assets, inventories and valuables.

“**Production** is an activity, carried out under the responsibility, control and management of an institutional unit, that uses inputs of labour, capital, and goods and services to produce outputs of goods and services.”

“**Production boundary**. Boundary of what constitutes production, including the production of goods and services supplied, or intended to be supplied, to units other than their producers; the own-account production of goods and knowledge-capturing products retained by their producers for their own final consumption or gross capital formation; the own-account production of housing services by owner occupiers; and the production of domestic and personal services by employing paid domestic staff.”



Reservoir water as a produced asset

SNA Assets

Water is held in reservoirs and supplied or held over time with benefits accruing to the economic owner. The water volume and water value is carried forward from one accounting period to another.

Produced asset

- Reservoir water (natural water CPC 1800) is an output of production (see below).
- Without human intervention there would be no reservoir water.
- The water has not come into existence, but it would not be in the reservoir without a production process that stores water (like minerals taken from the ground)
- At present production is recognised when water leaves the reservoir (it didn't come into existence at the dam wall)
- **The question is not whether it comes into existence , but when it is produced**

Production

- Production of reservoir water (natural water CPC 1800) is an activity carried out under the responsibility, control and management of an institutional unit (e.g., enterprises and establishments classified to Water Supply Industry ISIC 36), it uses inputs of labour (dam operation and maintenance), capital (e.g. dam walls), and goods and services (electricity, concrete, chemicals) to produce outputs of goods and services (i.e. natural water CPC 1800).

Produced boundary

- Reservoir water is produced in the current period (inflow in current year) or in an earlier period (inflows from previous years) held in storage as an inventory for distribution
- Reservoir water may be distributed or stored for use at a later date



Links in SEEA CF update

Issues D2. Water Quality and D7 Water valuation.

- If water in reservoirs is a produced asset, then the water in storage is an inventory of CPC 1800 Natural Water.
- Part of the reservoir (i.e., the dam wall) is also a produced asset which is relevant for valuing the ecosystem assets Artificial reservoirs (F3 in the Global Ecosystem Typology).
- D7 mentions the value of hydro-power but notes it is likely to be discussed in the valuation of renewable resources. Water quality has an impact on water value.

Issue B2 Further clarifying treatment of losses (e.g. energy, water).

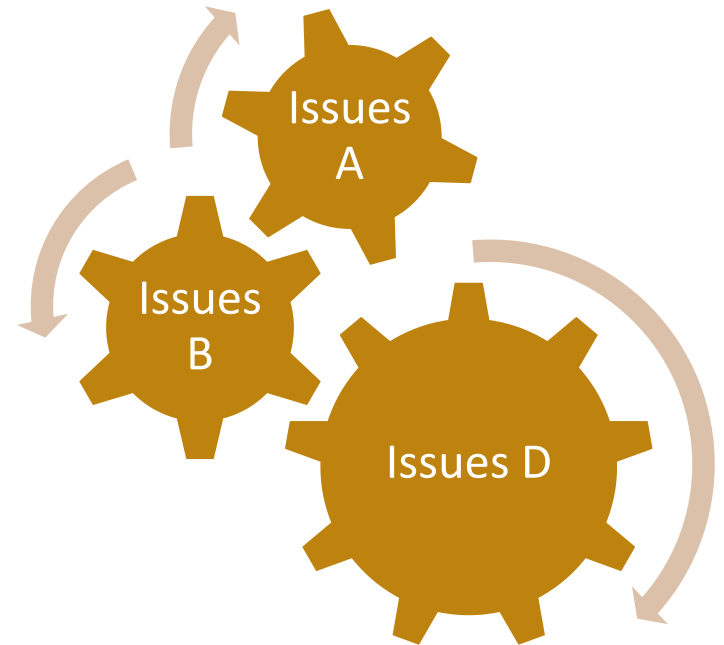
- There are several related to losses which are not fully described in the SEEA-CF, including water losses. Evaporation for artificial reservoirs is one type of loss. Treatment of these losses would also affect valuation.

Issue A1. Overview of the links between SEEA CF and SEEA EA:

- Water is recognised in the SNA, SEEA-CF and SEEA-EA and the effects of the proposed change must be considered (e.g., the definition and treatment of stocks and flows).

Issue A4. How SEEA CF accounts can be made spatially explicit:

- A key feature of water is that its availability changes between places and over time. The reason for artificial reservoirs is to collect water (produce water) where and when it is abundant and store it for where and when it is needed.



Consistency of treatment of natural resources and production

Plantation forests vs. natural forests

Aquaculture vs. wild fish

- Production of recorded at different times, depending on the degree of human intervention



Mining

- Minerals are displaced in space and time via extraction, but not physically transformed



Options

Keep current treatment:

- water in reservoirs = non-produced, natural resource
- Production occurs when water is **leaves** artificial reservoirs

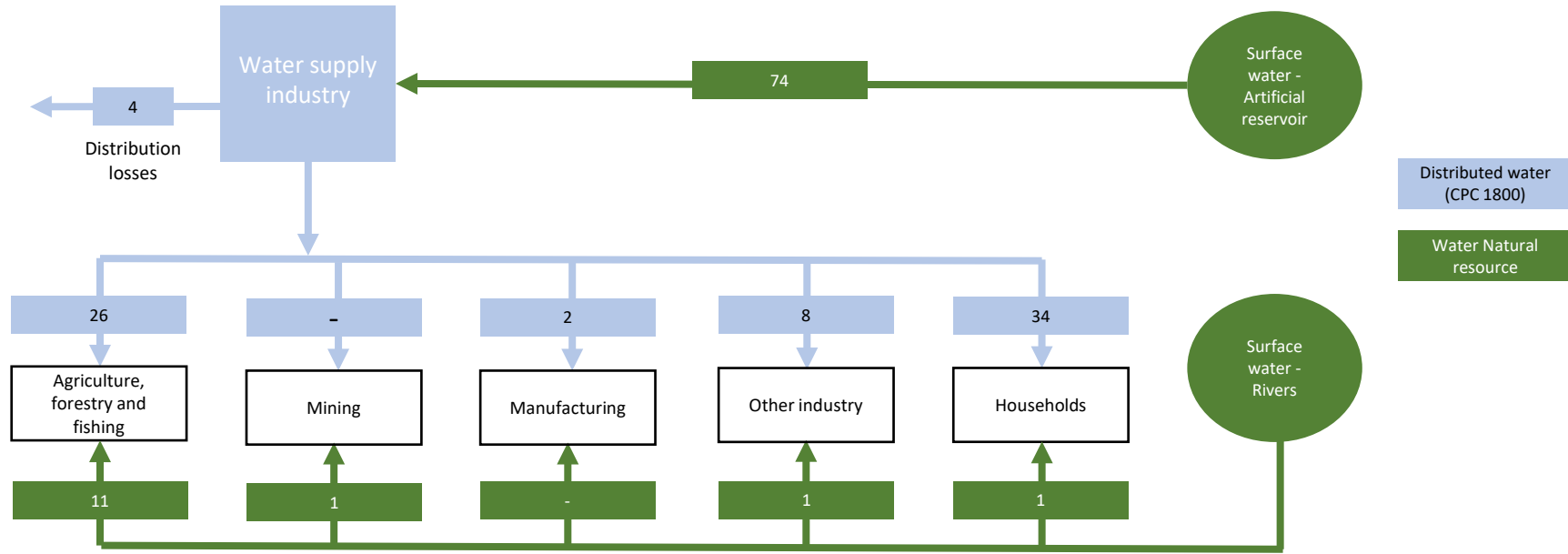
Proposed treatment:

- Reclassify as a produced asset
- Record changes in inventory in PSUT
- Production occurs when water **enters** artificial reservoirs



Current treatment - graphic

Reservoir water as a non-produced asset (million m³) – wet year



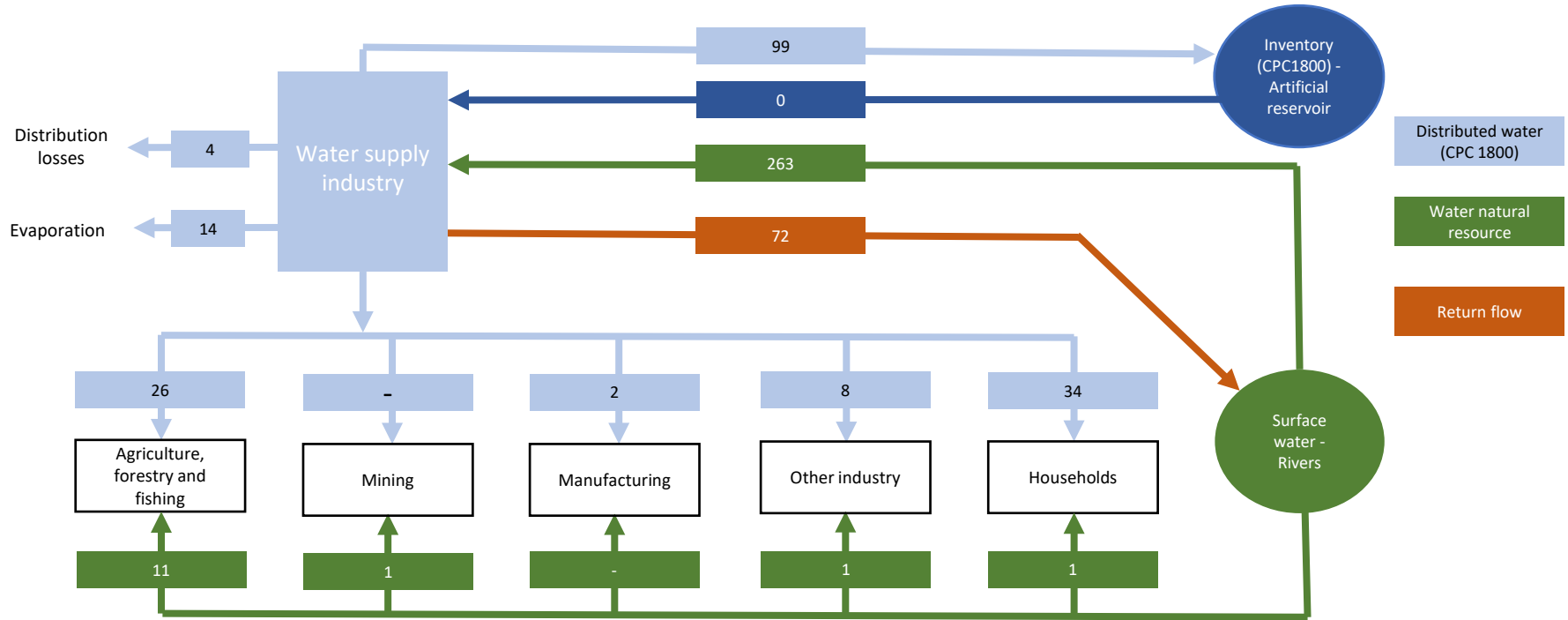
Current treatment - PSUT

		Economy							Environment	Total
million m3		Agriculture, forestry and fishing	Mining	Manufacturing	Water supply in industry	Other industry	Households	ROW Import (supply) / Export (use)	Rivers, lakes, artificial reservoirs, soil groundwater,	
Supply										
Natural resource										
	Water								88	88
Products										
	Distributed water								74	74
Use										
Natural resource										
	Water	11	1		74	1	1		88	
Products										
	Distributed water	26		2	4	8	34		74	



Proposed treatment - graphic

Reservoir water as a produced asset (million m³) – wet year



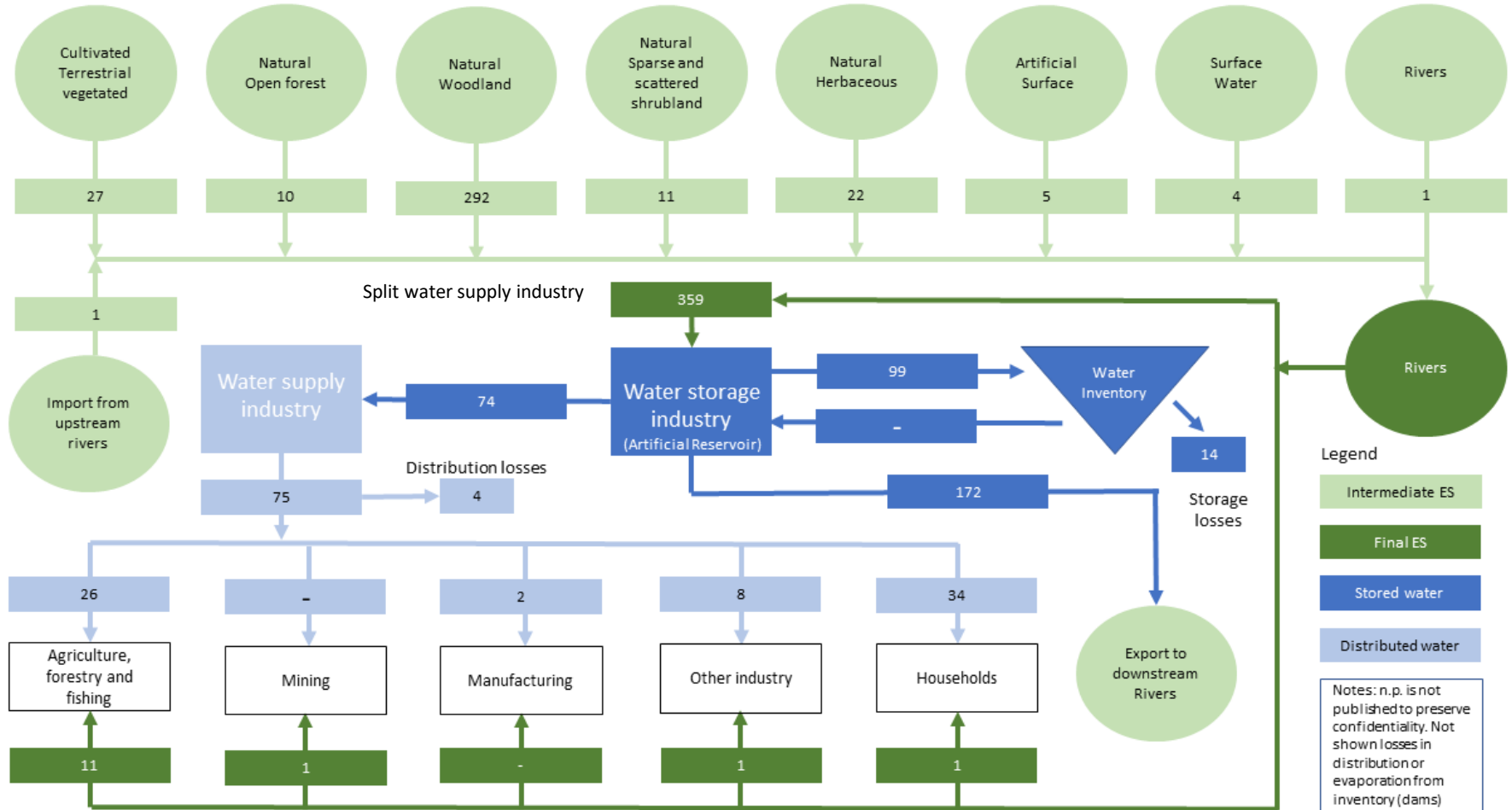
Proposed treatment - PSUT

		Economy								Environment	Total
million m3		Agriculture, forestry and fishing	Mining	Manufacturing	Water supply	Other industry	Households	Inventory	RoW Import (supply) / Export (use)	Rivers, lakes, soil groundwater,	
Supply											
Natural resource											
	Water									277	277
Products											
	Distributed water									187	187
Return flow											
	Water									72	72
Use											
Natural resource											
	Water	11	1		263	1	1			277	
Products											
	Distributed water	26		2	18	8	34	99		187	
Return flow											
	Water									72	72



Reservoir water as a produced asset (million m³)

The full treatment!



Split natural water (CPC 1800)

Reservoir water as a produced asset

ES or product	Units	Economy									Environment									Total
		Agriculture, forestry and fishing	Mining	Manufacturing	Water storage industry	Water distribution industry	Other industry	Households	Inventory	Import (supply) / Export (use)	Cultivated terrestrial Vegetated	Natural Open forest	Natural Woodland	Natural Sparse and scattered shrubland	Natural Herbaceous	Bare Surface	Surface Water	Rivers	Import (supply) / Export (use)	
Supply																				
Intermediate ES																				
Water supply	million m3										27	10	292	11	22	5	4	1	1	373
Final ES																				
Water supply	million m3																	373		373
Products																				
Stored water	million m3				359															359
Distributed water	million m3					74														74
Use																				
Intermediate ES																				
Water supply	million m3																	373		373
Final ES																				
Water supply	million m3	11	1		359			1	1											373
Products																				
Stored water	million m3				14	74				99	172									359
Distributed water	million m3	26		2		4		8	34											74

Losses from storage

Losses in distribution

Final ecosystem water supply service supplied to the water storage industry when it enters the reservoir (and to other industries and household when it is abstracted)

Recommendation 3. The water supply use tables in the Central Framework be updated to reflect reservoir water as a produced asset

Recommendation 4. That text is added to Central Framework clarifying treatment of water losses



Other implications

- Evaporation and seepage for artificial reservoirs are explicitly recorded as losses and a use by the owner/operator of the reservoir (e.g., water supply industry, ISIC 36)
- Rainwater tanks and farm dams are also inventories
- Aquifer recharge may also be an inventories
- Reservoir water included in national balance sheets



Practicalities

- Lots of countries produce water PSUT, and asset accounts (some of the most commonly produced accounts in the world)
- The updated PSUT uses data currently included in the asset account
- The PSUT only records changes in inventory (i.e. a total inventory is not needed for the PSUT)
- Large reservoirs typically measure inflows and outflows
- Evaporation is relatively easy to calculate
- Smaller artificial reservoirs like farms dams and rainwater tanks, are more difficult to estimate



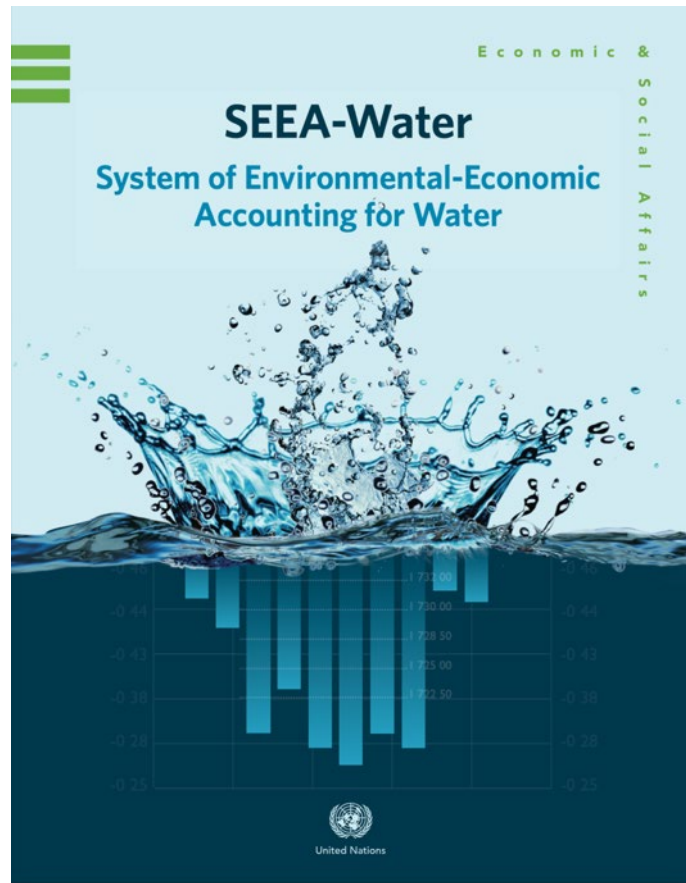
Other water issues

Inclusion of other types of accounts in the SEEA-CF

- Water quality
- Simplified PSUT

Update the SEEA-Water

- Predates SEEA-CF (i.e. the original and best)
- Many advances
- Need to integrate SEEA-CF and SEEA-EA



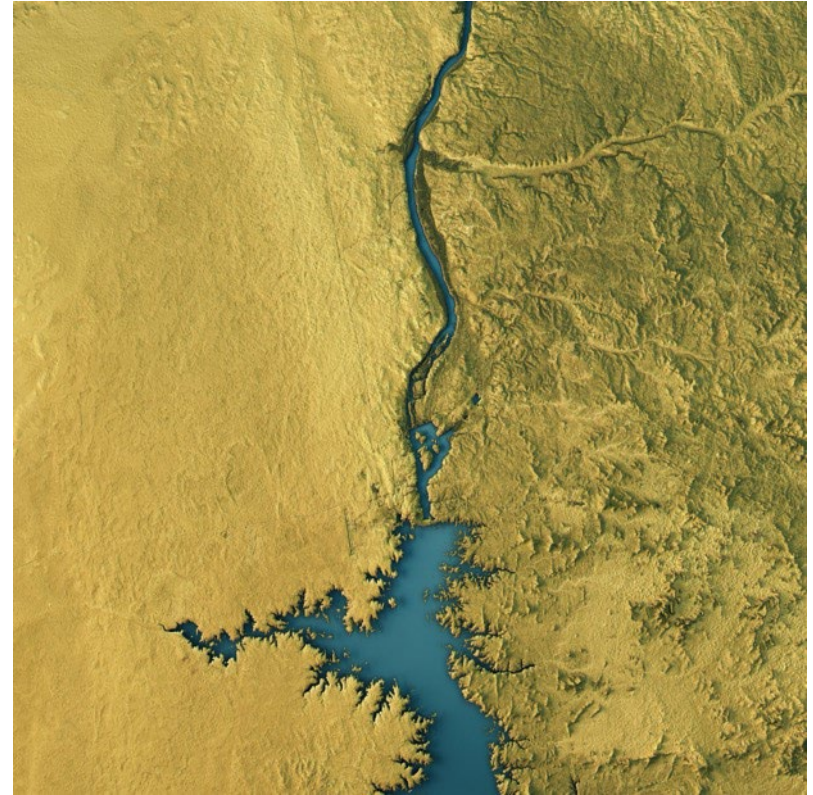
Conclusion

Water in artificial reservoirs

- Aligns with the SNA definition of production, hence a produced asset (inventory)

Treatment

- Production occurs when water **enters** artificial reservoirs
- Record changes in inventory in PSUT
- Brings water into alignment with other natural resources (e.g. timber, fish and minerals)



THANK YOU



Contact

Michael Vardon
Associate Professor
Environmental Accounting
Fenner School of Environment and Society
T +61 (0)447 825 351
E michael.vardon@anu.edu.au
T <https://twitter.com/MichaelVardon>



Australian
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