



Physical Supply and Use Tables: Data sources and methods

Training Course on Water Accounting

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Outline

- Data sources
 - Survey
 - Administrative records
 - Other
- Considerations when surveying
- Administrative surveys
- Coefficients
- Data quality



Data sources

- Surveys
- Administrative data
 - e.g. Licensing data bases
- Company reports
 - In some countries companies have reports that include information on the environment (e.g. water and energy use, pollution control measures)
- Academic sources
 - Can be government or non-government
- Use of Coefficients

Overview of data sources

ISIC 1-34

1. Specialist or addition of questions to existing surveys
2. Administrative data (e.g. licensed water use)
3. Research reports, coefficients, etc

Adding of questions to household survey or population census

Adding of questions to existing surveys, research reports, coefficients

Administrative data. (e.g. licensed users and discharges of water)

ISIC 36&37
Specialist surveys, reports to government or company reports

ISIC 36&37
Specialist surveys, reports to government, or company reports

		Industries (by ISIC categories)						Total		Milli	
		1-3	5-33, 41-43	35	36	37	38,39, 45-99				
Water resources:											
1.1.1	Surface water										
1.1.2	Groundwater										
1.1.3	Soil water										
1.ii	From other sources										
1.ii.1	Collection of precipitation										
1.ii.2	Abstraction from the sea										
2. Use of water received from other economic units											
3. Total use of water (=1+2)											
Physical supply table											
		Industries (by ISIC categories)						Total		m ³	
		1-3	5-33, 41-43	35	36	37	38,39, 45-99				
Supply of water to other economic units											
of which:											
4.a. Reused water											
4.b. Wastewater to sewerage											
5. Total returns (=5.a+5.b)											
5.a. To water resources											
5.a.1	Surface water										
5.a.2	Groundwater										
5.a.3	Soil water										
5.b. To other sources (e.g. sea water)											
Total supply of water (=4+5)											
Consumption (=3-6)											
consumption % of total use		###	####	###	###	###	#DIV/0!	####	####		



Typical data sources

Specialised surveys are used for

- Water Supply industry
- Sewerage industry
- Agriculture
- Electricity industry (especially of hydro-electric power generators)

Adding questions to existing surveys is used for

- Mining industry
- Manufacturing industry
- Household surveys or population census

Other sources are used for other industries



Surveys

- Surveys are used as the primary way for obtaining data on water supply in the majority of countries.
- Statistical offices are familiar with running surveys
- We will examine a few issues specific to water surveys
 - Questionnaires
 - Survey options
 - Adding questions to existing surveys
 - Running specialized surveys
 - Issues of sample design and weighting



Designing questionnaires

- Good questionnaire design will help minimize response biases.
 - Forms should be attractive and easy to understand and fill in.
 - Develop a draft of form based on data requirements and knowledge of survey respondents, using terms and concepts familiar to survey designers and survey respondents. Test on a small number of respondents (15-30)
 - Develop 2nd draft of form and test on a larger number of respondents (60-90)
- Reference
 - Don. A. Dillman. 2007. Mail and Internet Surveys: The Tailored Design Method 2007 (see <http://www.sesrc.wsu.edu/dillman/>)



Water questionnaires

- Target populations may not be familiar with answering questions on water supply and use
- When wording questions be clear and do not use accounting “jargon” (abstraction for own use, abstraction for distribution).
- Clearly separate water questions from financial questions
- Provide definitions or clarification of terms underneath the questions
- Exact answers may not been known, so respondents may have to estimate
- Ask for a contact person for the water questions



Example question

Examples are provide
in the question

Water questions separated from
financial questions

Part 9 – Measures of water use

Note

- If exact figures are not readily available, please provide estimates.
- 1 kilolitre (kL) = 1,000 litres (L).

35 Please estimate the intake of water by this business

Estimates are required, not
metered use

Volume of water supplied
by other organisations
(e.g. via mains)

kL

Volume of water extracted
by this business
(e.g. from bores, rivers,
reservoirs and dams)

kL

Total - Australia

Units are those in common use



Personal interview, mail-out/mail-back or internet?

- Personal interview are more expensive but provide the opportunity to collect higher quality data. Preferred method if the sample size is small or data is complex
- Mail-out/mail-back is most useful if the sample size is large and the data are simple
- Can use a combination of both for different survey populations (e.g. use personal interviews for hydro-electric power generators and mail-out/mail back for the manufacturing industry)
- Internet not commonly used for the collection of water data, but is being used in some countries for the collection of data from water suppliers



Specialized Surveys

Advantage

- Can collect a range of data need for the accounts as well as additional data to aid interpretation and understanding
- Can select sample to represent total water use (not total economic activity)

Disadvantage

- Costly to develop and run



Adding questions to existing surveys

Advantage

- Direct link to the other data collected in the survey
- Cheaper than running specialized surveys

Disadvantage

- Financial officers or business accountants who typically fill in business survey forms may not be familiar with environmental data
- Sample selection and weighting of sample may not be ideal



Intensive follow-up

- Business surveys will often be filled in by a financial officer or business accountant who may not have easy access to the data required or is unfamiliar with water use
- In these surveys include space for respondents to provide the name of a person that may be contacted specifically about the water data
- Intensive follow-up should be targeted at large water using industries. For example:
 - Electricity generation
 - Pulp and paper manufacturing,
 - Food and beverage manufacturing
 - Metals manufacturing
 - Mining



Data checking / input editing

- Identification of outliers or improbable results (that is very large or very small numbers) are identified for each industry (or region).
- Double check very large numbers with the data supplier
 - units may be wrongly reported, e.g. m^3 reported not 1,000 m^3 or acres not hectares
- Check blank cells – they may be zero or unavailable/unknown
- This goes hand-in-hand with the intensive follow-up



Sample selection

- In business surveys the sample will be stratified and selected to estimate total economic activity, not total water use or supply
- As such large water using industries (e.g. food and beverage manufacturing, metal manufacturing, paper manufacturing, electricity generation) may be under-represented in sample design.
- This problem can be overcome by stratifying according to water use and adding sample in appropriate strata



Stratification of sample

By Value added or
output

Sample size
(n)

Large businesses
(N=50)



50

Medium businesses
(N=500)



200

Small businesses
(N=10,000)



500

Total businesses
(N=10,550)

By Water Use

Sample size
(n)

Large businesses
(N=20)



20

Medium businesses
(N=3,000)



600

Small businesses
(N= 6,980)



350

Total businesses
(N=10,550)

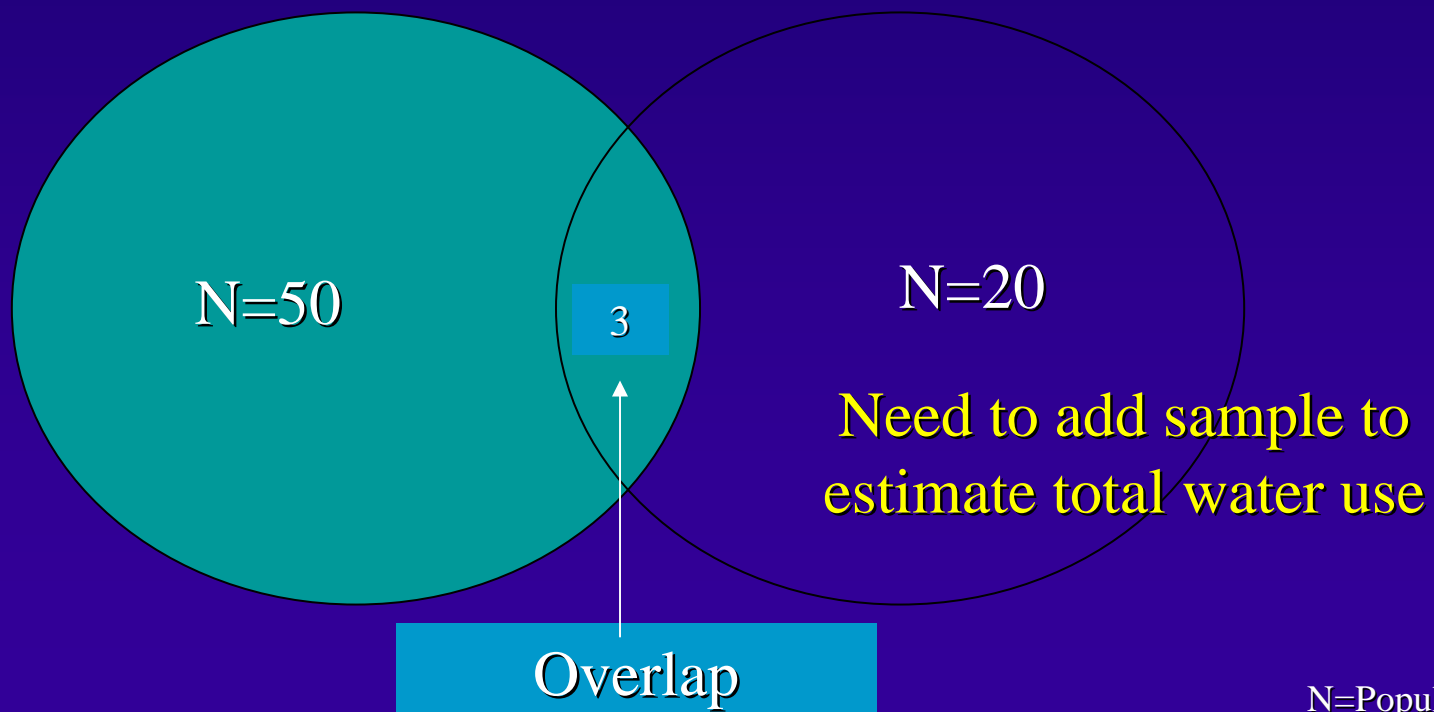
N=Population
n=Sample size



Overlap of stratified populations

Large business
by value added or output

Large business
by water use



N =Population
 n =Sample size



Sample weighting may be inappropriate

- Sample stratification and selection are closely linked to weighting
- For business surveys the sample weighting will be developed and applied to estimate total economic activity, not total water use or supply
- This weighting will not be appropriate for estimating total water use or supply
- Re-weighting is needed (but may be difficult)



Example of sample weights

By Value added or output	Sample size (n)	Sample weight for economic activity	Sample weight for water use
Large businesses (N=50)	→ 50	1	?
Medium businesses (N=500)	→ 200	2.5	?
Small businesses (N=10,000)	→ 500	20	?
Total businesses (N=10,550)			

N=Population
n=Sample size



Administrative data sources

- Water rights registers
 - E.g. Licensed water users/abstractors
- Customer records from water suppliers
- Water monitoring data (e.g. of flows)
- Tax registers
 - E.g. payments for water may be tax exempt and records of this may be available



Registers of water rights

- In many countries water users are required by law to have a license or permit to abstract or use water
- These registers may be operated by departments of water resources or departments of agriculture or industry
- Departments of environment or environmental protection agencies may also have registers but these are usually related to licenses or permits to discharge water



Access to water rights registers

- Access to a water rights register may provide you with:
 - A list of water abstractors or uses for which there is a legal amount of water which may be abstracted or used
 - This list may be used as a population (or frame) for a survey
 - Often the register will also record the purpose for which the water may be used (e.g. for irrigation)

Water abstraction or use recorded on permits will probably not reflect actual abstraction or use of water.

The are, however, likely to be correlated.



Customer records from water suppliers

- Water suppliers will keep records of the amount of water supplied
- Where there are payments for water, water suppliers will have data on their customers
 - Name of person or business
 - Volume of water used
 - Payments for water used

The customer lists can also be used as a population (or frame) for survey, while data may be able to be used in water accounts



Coding administrative data

- In some cases water suppliers and the agencies holding the water registers will code the users or abstractors of water
- Often the coding will be relatively simple. E.g. household, agricultural, all other industries
 - Usually water suppliers and other agencies are happy to provide this information in aggregate. It is often include in their own public reports
 - This is an excellent source of data for the use of water received from other economic units by agriculture and households
- Additional work is usually required to get a more detailed industry breakdown
- When there is an additional breakdown of data, it is often possible to concord this with ISIC



Coding the water supply industry's customers or licensed users and abstracters

- Coding of other industries to more detailed ISIC categories is not routine
- Water suppliers should be encouraged to adopt the ISIC classification and report data according to this
- If this is not possible then water suppliers may allow access to their list of customers for the purposes of coding to ISIC
- If coding is done by either the water supply industry or the compilers of the water accounts, then the industry breakdown required by SEEAW for the use of water from other economic units can usually be achieved. Often the breakdown can go beyond that required by SEEAW



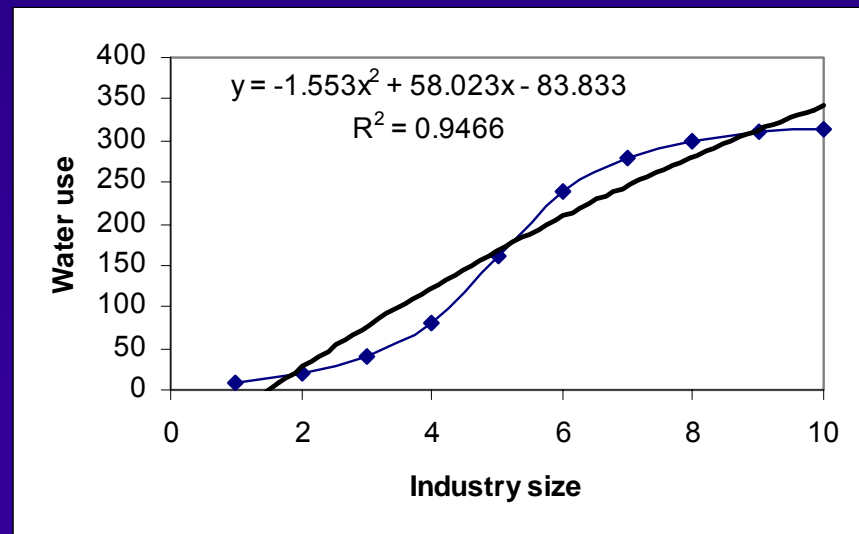
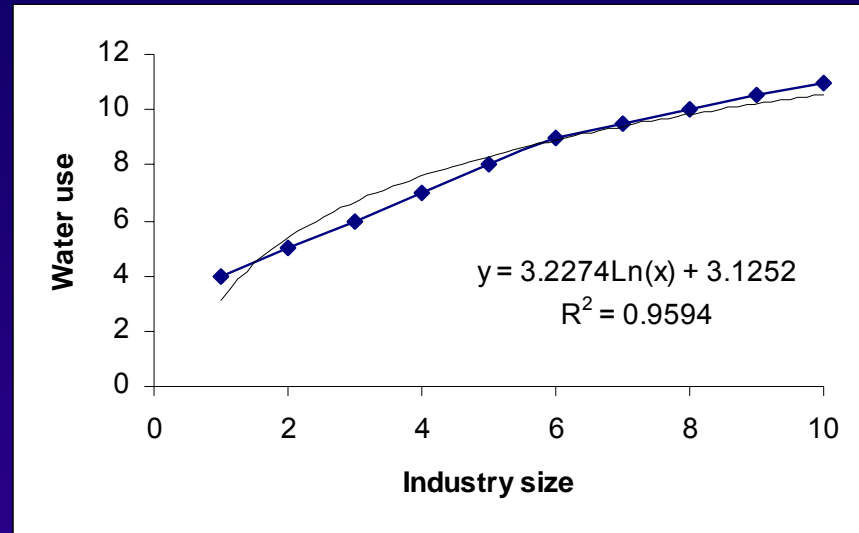
Water monitoring data

- Flows of water may be measured by agencies responsible for water management or pollution control (e.g. for monitoring and compliance with laws and permits or for public health and safety)
- Flows monitored might include
 - Water abstracted from surface water by users
 - Water flows in rivers (for water management, flood prediction)
 - Water quality in water used for human consumption
- Data from such monitoring can be used



Use of coefficients

- Water use may be correlated with other data.
- In some cases direct observation or reporting of water use is not possible or does not occur
- Coefficients of water use may be applied to other data in order to estimate water use
- Relationships can take many forms – simple linear, logarithmic, complex polynomial
- Relationships may be strong or weak high (e.g. r^2 value)





Potential sources of coefficients

- Government offices (national, provincial or municipal)
 - The Statistical Offices
 - The Water Ministry
 - The Agriculture Ministry
 - The Environment Ministry
 - The Public Works Ministry
 - The Treasury/Finance Ministry
- Results from previous statistical surveys
- Universities
- Research centers
- Non-Government Organizations (NGOs)
- Industry Associations
- Company reports
- International agencies
 - FAO
- Neighboring countries



Coefficients for agriculture

- The amount of water used per hectare by a particular crops (e.g. rice, wheat, grass for livestock) is often calculated by Departments of Agriculture, agricultural research agencies
- As such the area of a particular crop may be converted to a use of water by a particular crop via the application of an appropriate coefficients
- Water use may be calculated for irrigated crops (as a use of inland water) and non-irrigated crops (as a use of soil water)



Caution: crops water use requirements vary greatly

- It is best to contact and work with experts on crop water in your country if you are going to use water use coefficients for estimating agricultural water use.
- Use FAO data as a general check on calculations. See

http://www.fao.org/nr/water/aquastat/water_use/index.stm



Calculating coefficients for agriculture

- It is important to recognise that water use of crops varies between regions and years, depending on range of factors: climate – (e.g. amount of sun and wind, soil type); different strains of crops; different cropping methods (e.g. convention, minimum till); different irrigation methods (e.g. flood or spray)
- A detailed, data intensive methodology is provided the Food Agriculture Organisation (FAO) via AQUASTAT see:

<http://www.fao.org/nr/water/aquastat/main/index.stm>

<http://www.fao.org/docrep/X0490E/X0490E00.htm>



Finding coefficients for crop water requirements

FAO

- http://www.fao.org/nr/water/infores_databases.html
- <http://www.fao.org/docrep/X0490E/x0490e0b.htm#crop%20coefficients>

Agricultural departments or research agencies

e.g. USA

<http://pubs.usgs.gov/tm/2007/tm4e1/pdf/tm4-e1.pdf>

http://www.dnr.ne.gov/LB962/AnnualReport_2006/AppendixC.pdf



Water use by livestock

Ministry of Food Agriculture and Rural Affairs Ontario (Canada)

<http://www.omafra.gov.on.ca/english/engineer/facts/07-023.htm>

For example, beef cattle

Beef Cattle Type	Weight Range	Water Requirement Range ^a	Average
	(kg)	(L/day)	Typical Water Use ^b (L/day)
Feedlot cattle:	181–364	15–40	25
Backgrounder	(400–800 lb)		
Feedlot cattle:	364–636	27–55	41
Short keep	(800–1,400 lb)		
Lactating cow s w ith calves	—	43–67	55
Dry cow s, bred heifers & bulls	—	22–54	38



Coefficients for households

Water is used by households for

- Drinking and cooking
- Showering and bathing
- Flushing toilets
- Washing clothes
- Watering gardens
- For private swimming pools



German household water use coefficients (Mutschmann et al., 2002)

Activity	Water use (l/inhabitant/day)
drinking and cooking	3
washing the dishes	8
personal hygiene (without bathing)	8
showering and bathing	39
washing clothes	16
toilet flush	40
watering the garden/ washing the car	8
cleaning of the house	8
sum	130

130 litres per day x 365 = 47.45 m³ per year



Australian household water use coefficients

Water Account, Australia

<http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4610.02004-05?OpenDocument>

Water use per person per year, by state

	<i>NSW</i>	<i>Vic.</i>	<i>Qld</i>	<i>SA</i>	<i>m³</i>	<i>Tas.</i>	<i>NT</i>	<i>ACT</i>	<i>Australia</i>
	<i>m³</i>	<i>m³</i>	<i>m³</i>	<i>m³</i>	<i>m³</i>	<i>m³</i>	<i>m³</i>	<i>m³</i>	<i>m³</i>
2004–05	84	81	124	94	180	143	153	95	103
2000–01	97	97	143	110	191	125	162	115	120

Range 81-180

103 m³ per year per person in 2004-05

120 m³ per year per person in 2000-01



Coefficients for industries

- Coefficients for industries are generally based on one of the following
 - Volume of the output of goods and service
 - Value of the output of goods and services
 - Number of employees



Germany: Production based water use coefficients

Industry sector	Produce	Unit	Water use/unit
food industry	cereals	1 t cereals	1.5 - 8 m ³
	canned fruits or vegetables	1 t cans	4 - 14 m ³
	candies	1 t product	6 - 26 m ³
	sugar	1 t beets	10 - 30 m ³
	meat and fishproducts	1 cattle and horses or 2.5 pigs	0.3 - 0.4 m ³
	abbatoir		
	creamery (fresh milk)	1000 l milk	4 - 6 m ³
	creamery	l milk	1 - 1.5 l
	cheese dairy or butter production	1000 l milk	10 m ³
	margarine	1 t margarine	20 m ³
	brewery	1000 l beer	5 - 20 m ³
	wine and liqueur distillery	1000 l corn	4 - 6 m ³
leather and textile industry	shoes	1 pair of shoes	5 l
	leather, tannery	1 t of skins	40 - 60 m ³
	woollaundry	1 t wool	20 - 70 m ³
	bleachery	1 t product	50 - 100 m ³
	dyeing factory	1 t product	20 - 50 m ³

Germany: employees



(students and hotel guests as well)

Mutschmann et al. 2002 Hosang et al., 1998

User	Unit	Water use/ur
School	per student/day	10 l - 15 l
School with showers	per student/day	20 l - 40 l
School with showers and swimming pool	per student/day	30 l - 50 l
University: faculty for humanities	per student/day	150 l
University: faculty for chemistry	per student/day	1000 l
University: faculty for physics	per student/day	500 l
University: faculty for biology or water management	per student/day	400 l
Students' dormitory	per student/day	150 l
Hospital	per patient or employee and day	350 l - 600 l
Nursing home	per patient or employee and day	180 l
Indoor swimming pool	per user	200 l
Office building (without canteen)	per employee/day	40 l - 50 l
Office building (air-conditioned and with canteen)	per employee/day	140 l
Campsite	per stand/day	≥ 200 l
luxury hotel (employee: guest ≥ 1)	per guest or employee and day	600 l
hotel (employee: guest = 0.5)	per guest or employee and day	375 l
simple hotel (employee: guest = 0.25)	per guest or employee and day	150 l

See also: <http://www.ec.gc.ca/water/en/info/pubs/sss/IN96.pdf>



Data methods and data quality

- What ever method is used it is important that it is described and available to users of the data
- Because decisions and policies will be based on the data quality must be assessed and accurately reported
- Decision makers and policy developers can then decide if it is appropriate for use. Often decision makers have to use poor quality data.
- Consider ways that data quality can be improved for future compilations of water accounts



Data quality guidelines

- Relevance
- Accuracy
- Timeliness
- Accessibility
- Interpretability
- Coherence

Statistics Canada – Quality Guidelines 4th Edition 2003

<http://www.statcan.ca/english/freepub/12-539-XIE/12-539-XIE03001.pdf>



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