How much water do we eat?

Virtual water consumption of students in Germany

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Gymnasium der Stadt Alsdorf

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1 Abstract

Our Going Green Team of the "Gymnasium der Stadt Alsdorf" (Grammar School) quantifies the virtual water consumption of students when only eating a typical German breakfast.

We present the first study of the water consumption of students at our school. Before calculations can be done, a "typical German breakfast" needs to be identified. Our Going Green Team started the survey on what a typical German breakfast contains by creating a questionnaire for all students of our school. The evaluations show that depending on age and gender food preference and amount varies a lot. The alarming amount of virtual water consumption will be analyzed and diagrammed.

The main purpose of this project is to create awareness and understand social responsibility. The impact our consumption can have on the environment is revealed in a few examples and can be taken for further studies or for education in school.





2 Introduction

Around the world, human activities as well as natural forces are reducing available water resources. Pressures on water resources are increasing for example by human activity such as urbanization, population growth, increased living standards, growing competition for water, and pollution. Moreover, climate change increases discussions about social, economic and ecological water conflicts especially in dry areas. Many people, especially in developed countries, are not confronted with their own water consumption and its consequences are not obvious to them. Water seems to be an unlimited product which is accessible everywhere and at any time. Though in general public awareness of the need to better manage and protect water has grown over the last decade, the average person often only considers and identifies few fields of wasting of water in daily life. For example, things that are evident to consumers and of course have a positive impact on the environment are :

- taking shorter showers
- turning off the water after you wet your toothbrush
- not using the toilet as an ashtray or wastebasket (five to seven gallons of water is wasted)
- rinsing your razor in the sink
- using your dishwasher and clothes washer for only full loads
- not leaving the water running for rinsing when washing dishes by hand
- and so on

There are few examples of acting locally when it comes to hidden water in products. This virtual water is often neglected and unnoticed. This is why the awareness for the topic virtual water must increase.

This discovery is how and why our study "How much water do we eat? Virtual water consumption of students in Germany" started.

Do you know how much virtual water you drink and eat daily for breakfast?

Yet no certain results on how much water we as students use were published. Together, we decided to deal with this problem in the Going-Green-course of our school. The investigation and its result will be illustrated in the following main part. So it is the indirect water use we will focus on.

3 Virtual Water

What exactly is virtual water? "The term refers to the hidden flow of water if food or other commodities are traded from one place to another. For instance, it takes 1,600 cubic meters of water on average to produce one metric tonne of wheat. The precise volume can be more or less depending on climatic conditions and agricultural practice. Hoekstra and Chapagain have defined the

virtual-water content of a product (a commodity, good or service) as the volume of freshwater used to produce the product, measured at the place where the product was actually produced". It refers to the sum of the water use in the various steps of the production chain." ¹ The following pictures show the average virtual water content of some selected products.





It becomes clear that water consumption is much more than we see. If one wants to learn more about his or her water consumption, the water footprint is an indicator which does not only consider the volume of water use and pollution but also the location. The water footprint of an individual is defined" as the total volume of freshwater used to produce the goods and services consumed by the individual."² "Water use is measured in water volume consumed (evaporated) and/or polluted per unit of time."³ A water footprint can be calculated for an individual, a family, or like in our case for a school. Virtual water trade and water footprint can be seen as part of a bigger story: the globalization

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of water.⁴ So the water footprint is related to what people eat. "For example, it is a common thought that the water involved in a cup of coffee is just the water in the cup. There is actually 140 litres of water involved. The 140 litres of water is the amount of water that was used to grow, produce, package, and ship the coffee beans."⁵



4 Ouestionaires

In our school we started a survey. We asked all stundents what they eat for breakfast on a normal school day. Therefore we set up a questionnaire, which was competed by 549 students out of 661 students.

We divided the survey into six sections:

³ Ebd.

¹ https://en.wikipedia.org/wiki/Virtual_water

² https://en.wikipedia.org/wiki/Water_footprint

⁴ https://en.wikipedia.org/wiki/Virtual water

⁵ http://waterfootprint.org/en/

- Which kind of food/bread do you eat?
- What bread spread do you use?
- Which side dishes do you eat?
- What do you drink in school?
- What do you drink after PE?
- How often would you drink from a drinking fountain?

In the first section we distinguish between bread slice, - roll, cereals and yoghurt. After that the choice is between slices like cheese or sausage and spread like cream cheese, nutella and jam. The next section is divided into vegetables like cucumber, carrots and tomatos, fruits like apples, pears and bananas, sweets like corny, chocolate bars and sweets and eggs. The drinkes are listed in water, water with flavor, juice, spritzer, soft drinks, tea, milk and ice tea in section five and six. Added to that the studends had to specify if they brought their breakfast from home or bought it from school.

The last section is asked, because we will have a fountain in our new school and we would like to know how many students would use it.

But we had a lot of dificulties by producing this survey.

First of all we had to think about what the students could probably bring to school. There is such a big selection for each section, that we wrote down the typical variety and also the choice for 'other' in every segment. Added to that we could not know the portion of bread spread or how much water exactly, so we gave the opportunity to choose between 'thick' and 'thin'. Another problem was that the students had to write down 'how much/many' of everything they eat/drink in one day and it could have been that they thought about the whole week, but we explained everything and answerd every question in each class.



5 Evalution of quetsionaires

There were some difficulties when we evaluated the questionnaires. We had to decide how thick or thin a slice of bread was or how much liter one average bottle contains. Here we researched for figures online but also weight things ourselves. Second of all we asked the students if there is other food or drink they have at school so we had to calculate it separable. Sometimes this other food or drinks were hard to define and the virtual water was not easy to find out.

Furthermore we could not ask all of the students (83%) due to the fact that some were absent (sick) or took an exam. Moreover few students (overall 6) answered the questionnaire incomplete. Grade 5 to 9 is most accurate (see picture of Excel chart below).

Basisinformat	ionen zur Umfra	ge	
Umfragezeitraum:			
Stufe	Anzahl Schüler/innen	Anzahl ausgefüllte Fragebögen	Anteil Teilnahme [%]
Klasse 5	98	88	90%
Klasse 6	85	79	93%
Klasse 7	91	81	89%
Klasse 8	74	67	91%
Klasse 9	61	55	90%
Klasse EF	90	65	72%
Klasse Q1	86	68	79%
Klasse Q2	76	46	61%
Gesamt (Summe)	661	549	83%
Insgesamt weiblich	276		
Insgesamt männlich	385		

After receiving 549 questionnaires back out of 661 we estimated how much virtual water our school eats and drinks for breakfast. We immediately started evaluating 549 questionnaires.

First we calculated how much virtual water is needed for a single gram of a roll for example. For a single gram of a roll 800 ml



of water are needed. Another example is apple juic: 1 l contains 1140 l virtual water.

To define one gram was essential to our evaluation because one person does not eat a whole bread but a slice. A student does not eat 1 kg cheese but a slice. We weight and calculated how much grams are one portion of a product in average. The slice of bread for example weight 50 g. Here of course some inaccuracy might occur





because one slice of bread may be bigger, thinner or thicker than we figured.

Although fruits have different sizes we weight them, too. For example a banana: 200g which contains 171 l virtual water. Sometimes we also found average portions online.

This inaccuracy is true for the toppings,too. For example a student could answer that he or she eats a slice of bread with chocolate cream. He or she then could tick whether the topping was spread thick or thin.



Here we set 60g for thick and 30g for thin. This might not be the exact gram actually used but more or less.

This way we calculated the virtual water amount for all things you normally eat and drink for breakfast.

The results of the experiment were shocking for all of us. Our school needs as much

water for breakfast as a normal four-persons-household for a year - including everything.⁶

All together we use 15 000 000 I of water daily for our breakfast – and this number is only calculated for the 549 participants out of 661 students (83%). 15 000 000 I of water are like 1 666 667 boxes of 0,75 I bottles.

But we did not only look for how much virtual water our school uses for breakfast, but also we were interested in which class is using the most virtual water and which the least. The differences of water consumption could have a relation to age. That is why we showed the typical breakfast of the different grades and evaluated how much virtual water the grades use per person.

We found out that students in class seven eat and drink a lot of virtual water for breakfast; nearly 100 000 l virtual water is it they use for their breakfast daily. The students in the twelfth grade in

⁶ www.eltern.de/forum/2009-clauderforum-neu/1130360-wasserverbrauch-4-koepfigerfamilie.html

comparison use the least virtual water in our school; they 'even' use 46 000 l virtual water. Nevertheless this sum is too high for only one grade.

Our last step was to discover what the typical German breakfast for the students in our school is. Because within the grades the typical breakfast slightly varies we chose to divide this part into three sections.



Students from grade five to seven eat bread instead of rolls and they love to eat their bread with either a slice of meat or with some chocolate spread. Most of them will have an apple with it and a chocolate bar. Their favorite drink is apple spritzer or something similar. From grade five 90% participated, from grade six 93%

participated and from grade seven 89% participated. So the three grades together eat 3540g Nutella and 252 slices of bread. Every student uses 3005 I virtual water what can be explained by their silentium. Three times a week they have seven lessons, so they snack more.



Students out of classes eight to nine like rolls more than bread and normally eat their roll with cheese. They will also have an apple or a banana with it. Furthermore their favorite drink is water with flavour. From grade eight participated 91% and from grade nine participated 90%. So they eat 145 rolls

and 59 slices of cheese. Every student uses 587 l virtual water for their breakfast what is less than the other grades. One reason could be that they do not have long school days.



Students from the grades ten to twelve also like rolls more than bread. They eat it with sausage slices. In their breaks they snack a banana or a chocolate bar. Their favorite thing to drink is water and ice tea. From grade ten 72% participated, from grade eleven 79% participated and from grade twelve 61%

participated. All together they eat 177 rolls and 152 sausage slices.

So a sum of 2738 I virtual water per student comes up. A reason for this sum might be that they also have longer schooldays like the grades five to seven.

The main purpose of this analysis is to create awareness and understand social responsibility. If you want to learn more about our specific data and calculations, please go to our own website (green.analytic-systems.de). We publish everything on our blog. There you can also read more about our actions.



6 Acting locally

There are ways to improve the individual water footprint and also the water footprint of our school. To give some ideas of what change can have an effect on the volume of water consumption you can inform yourself online. We recommend the following website: virtuelles-wasser.de & https://facebook.com/pages/viwaka-virtuelles-wasser-kampagne/192751244106837

Here are some thoughts, too: Take regional food instead of international food in the supermarket because regional food does not take as much virtual water as international food for the transportation/import.

To reduce your own virtual water consumption one can eat more fruits and vegetables and less chocolate bars and sweets. This is also healthier. Besides that we can reduce our meat consumption. A slice of cold sausage is a product which has 75l of virtual water in it. In cheese there is even more virtual water. 150l water are used to produce a slice of cheese. Compared to the cold sausage and the cheese chocolate spread has a low amount of virtual water to produce 90g of chocolate spread 32l of water are needed. We can also only buy as much food as we need. A lot of products become waste in our fridges. This is especially a problem of developed countries. Since we can afford much food, we often do not have a clear shopping list and calculation of what we really need. From these results we can conclude that meat and cheese need a lot of water for the production because you have to feed the animals that are needed for the production. We found out that 171l are needed for a single banana, so there is also a lot of virtual water in bananas and other exotic food which is needed to grow the plants and for the transport and import.

Some idea we came up with was to install a water drinking fountain, so that students drink more water then juice. We have managed to gather enough money to install the fresh water drinking fountain at our school in June. 62% of the students said in the questionnaire that they would use the drinking fountain on a regular basis. Others (38%) have doubts due to hygienic matters but here an informative flyer will be published at school to reassure cleanness. This will reduce the water footprint of our community. In the following bar chart you can see how much virtual water is in different drinks.



7 Conclusion

All in all, there were 549 students who participated on the questionnaire to test how much water we eat when only having breakfast. Unfortunately, the sum of virtual water amount can be imprecise due to inaccuracies when gathering data to determine the virtual water of a product. Here rounding errors and other mistakes can blur the results as mentioned before. For example few students misunderstood and filled in what they eat during the whole week (6 slices of bread, 4 slices of cheese, and so on) and not what they eat on one ordinary day. So then we had to find an average of this sum to get again the portions for only one day.

However, we calculated that all students from our school (Gymnasium Alsdorf) "drink and eat" 15.000.000l virtual water only for breakfast. This sum equals 1.666.667 boxes with 0,75l bottles.

Confronted with this large consumption of water, one realizes this cannot be sustainable. Especially when we take a look at where most of the products come from. For example fruits like bananas have a very long transportation route, for which also water is needed. Furthermore you have to remember that this high number of virtual water only comes up for our breakfast! So you can imagine how much virtual water is used during the hole day.

Because our going green team was very surprised about the results, it appeals to everyone to think globally and act locally. Water is one of the most precious resources on earth and there is not enough to waste it. So our team also read about things everybody can change to save water which is mentioned in the mainpart but will also be considered in a later paper. When 549 students use 15 million liters of virtual water it means that each student of our school uses 27.322 liters virtual water only for breakfast. It can be seen as a warning for everybody because the world only has 2,5% freshwater and from this 2,5% there is only one third of water what can be drunk.

Summarized the going green team would do a questionnaire again anytime with the goal to change something and to convince other people to act locally. But the next time the questionnaires would be more accurate with more information on specific products. So the evaluation would become more easy to evaluate and more precise.

Excel was a big help for our evaluations because of the amount of data we needed to consider (549 participants answered six questions with each seven answers in average). We had to set up the formulas (rule for computing) of course but then the evaluation was quicker than our manual calculators.

8 Acknowledgements

We are very grateful to our school, which opened up the opportunity for the students to take part in this project. We would like to thank our teacher, Anissa Schiffer, for the advice, time and help she gave to us, to make this project possible. Furthermore, without the booster club, who helped to finance the trip to the Water Conference, we couldn't spread news about our finding. We are confident, that we can raise more awareness for water consumption if we present and talk about our results like we did at the Going Green project. If you want to learn more about want we did and publish, please go to our own website (green.analytic-systems.de).

We also want to thank the participants for filling out the questionnaires. We have never taken part in a project of this size before and are looking forward to learn more about why "Water is life" at the conference.





9 References

Content

https://en.wikipedia.org/wiki/Virtual_water

https://en.wikipedia.org/wiki/Water_footprint

https://en.wikipedia.org/wiki/Virtual_water

http://waterfootprint.org/en/

www.eltern.de/forum/2009-clauderforum-neu/1130360-wasserverbrauch-4-koepfigerfamilie.html

Pictures

http://www.virtuelles-wasser.de/uploads/pics/3og_banane.jpg http://www.virtuelles-wasser.de/uploads/pics/2tp_schwein.jpg http://www.virtuelles-wasser.de/uploads/pics/2tp_kaese.jpg http://static.guim.co.uk/Guardian/environment/gallery/2008/aug/18/1/coffee-6640.jpg

10 Attachment

Virtual water consumption: Angabe in Liter/ data in litre

Klasse	Klasse	Klasse	Klasse	Klass	Klasse
5	6	7	8	е 9	10

Brötchen	2280	2680	2720	2800	3000	1120
Brot	3480	2880	3720	720	2600	2680
Müsli	1600	1000	1000	2800	1200	800
Joghurt	500	200	400	600	400	400
Wurst	4800	3225	5100	2175	3450	2850
Käse	-	4050	5850	5850	3000	5850
Frischkäse dünn	-	900	2700	2700	1260	1980
Frischkäse dick	-	1440	1440	1440	2520	2520
Nutella dünn	352	320	416	416	256	96
Nutella dick	576	1344	768	512	704	256
Marmelade dünn	82,5	-	45	37,5	22,5	7,5
Marmelade dick	30	60	30	15	30	30
Apfel/Birne	5040	6230	5180	2170	1330	2240
Banane	1197	1539	1881	2223	855	3078
Anderes Obst	861	451	861	656	533	410
Gurke	80	55	50	35	25	40
Möhre	208	143	351	78	78	104
Tomate	300	210	486	216	78	180
Anderes Gemüse	240	120	240	180	30	120
Müsliriegel	3240	2160	3060	2340	1800	2160
Schokoriegel	26000	40000	42000	30000	2000	24000
Süßigkeiten	6000	6000	8400	3200	0	1600
Ei	-	200	200	400	5600	800
					600	
Wasser	33,5	24	34	25,5	22	26
Wasser+Geschm	13	12	10	16	9	11
ack	3800	1425	6175	3325	1425	2850
Saft	4000	2600	3400	1800	1800	2200
Schorle	2,6	1,3	5,2	9,1	6,5	7,8
Softdrink	210	300	150	60	90	90
Тее	400	-	200	1200	200	200
Milch	24	10	24	18	6	24
Eistee	240	240	480	960	120	120
sonstiges						
Durchschnittlich	745,34	1010,3	1202,1	1072,4	964,5	905,39
pro Person		7	8	9	5	

Insgesamt	65589,	79819,	97376,	71857,	5305	58850,
	6	3	2	1	0	3

Virtual water consumption: Angabe in Liter/ data in litre

	Klasse 11/Q1	Klasse 12/Q2
Brötchen	3640	2320
Brot	3040	2120
Müsli	800	400
Joghurt	100	600
Wurst	5325	3225
Käse	3450	5850
Frischkäse dünn	2340	3600
Frischkäse dick	1800	1440
Nutella dünn	256	192
Nutella dick	896	320
Marmelade dünn	22,5	22,5
Marmelade dick	30	-
Apfel/Birne	2240	1680
Banane	3249	2394
Anderes Obst	410	287
Gurke	25	35
Möhre	65	65
Tomate	30	12
Anderes Gemüse	270	180
Müsliriegel	-	1260
Schokoriegel	30000	18000
Süßigkeiten	2400	400
Ei	-	200
Wasser	30,5	18,5
Wasser+Geschmack	9	4
Saft	2850	475
Schorle	1600	600
Softdrink	1,3	3,9
Тее	330	90
Milch	-	200

Eistee	12	2
sonstiges	120	360
Durchschnittlich pro	960,9	1007,74
Person		
Insgesamt	65341,3	46355,9

Using of the water fountain in our new school

