The Menstrual Cup Effect

An environmental impact analysis of four menstrual products and a menstrual waste scenario analysis of increasing future menstrual cup use.

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ABSTRACT

This research is dedicated to comparative environmental impact analyses of menstrual products – tampons with and without applicator, sanitary pads, and menstrual cups – used in modern "Western" societies and using six indicators of environmental impact. Additionally, a menstrual waste scenario analysis, with increasing menstrual cup use as variable, is performed. Due to environmental concern, especially for waste, the research question and the survey were formed. All indicators showed lowest impact with menstrual cups. Besides, if menstrual cup-use sextupled, a waste reduction of 84% was calculated. Consumers and researchers must identify and adjust environmental impacts of everyday products, like menstrual products.

Keywords

Menstrual waste, menstrual cup, modern "Western" societies, environmental impact analysis.

INTRODUCTION

Most women menstruate in their lives. A large part of them, especially in developed countries, but also more and more in developing countries, have access to menstrual products[1]. There is a distinction between disposable and non-disposable menstrual products. Tampons, with and without applicator, and sanitary pads are in this study covered as disposable menstrual products. Disposable sanitary pads were introduced in the beginning of the twentieth century and improved around 1965[2]. Meanwhile, around the 1930s, Earle C. Haas invented the tampon[3]. Both inventions took a huge increase in consumer's choice for menstrual products. Nowadays, the disposable pads and tampons (with and without applicator), and in all sizes and brands, are still highly popular in developed countries. These developed countries are in this study often named as modern "Western" societies.

The production of the tampon or sanitary pad from raw materials, the energy and water use for this production, the transport between all locations, the sale of the products, and the use and disposal of these by consumers, all together cause a burden on the environment[4]. Little scientific research has yet been published about these consequences.

The modern "Western" societies are becoming more aware of products' environmental impacts[5], and, as seen mainly via social media[6], this also counts for conventional menstrual products. They start considering alternatives, which are better known as non-disposable menstrual products[7]. A good example of such a product is the menstrual cup; this is a silicone cup which collects the menstrual blood, which must be emptied every 12 hours, and which can be reused up to 10 years[8].

One of the most significant reasons why consumers switch to this menstrual cup is because it is claimed to save a huge amount of waste[6]. Waste is one indicator to describe the environmental impacts of menstrual products. The study of Weir[8] is taken as a starting point for this thesis, and she describes, next to waste, five other indicators for environmental impact: abiotic depletion, fossil fuel depletion, global warming potential, acidification, and eutrophication. These indicators are used in this study as well and examined for the four following menstrual products: tampons, tampons with applicator, sanitary pads, and menstrual cups. This combination of three disposables and one non-disposable is chosen, because these are the most commonly known menstrual products in modern "Western" societies.

All in all, the motivation to study the environmental impacts of disposable menstrual products in modern "Western" societies, and the relative impact of a non-disposable option, comes from the lack of scientific research about this topic, and the increasing consumer demand to switch to a more environmentally friendly option. This results in the following research question: *'What are the environmental impacts of four menstrual products, used in modern "Western" societies, and can these societies reduce their menstrual waste by switching to the menstrual cup?'*

METHODOLOGY

Data collection and analysis

The chosen variables for this quantitative study of environmental impacts are the following six indicators: abiotic depletion, fossil fuel depletion, global warming potential, acidification, eutrophication, and menstrual waste. The study of Weir[8] discusses and examines these indicators for four clearly defined menstrual products: o.b., Tampax, Softcup, and DivaCup. Data of the o.b., Tampax, and DivaCup from the study of Weir[8] are used in this study, as well as the method used for calculating the total value of each indicator per menstrual product. The Softcup was excluded in the analysis, because already three disposable products were considered. The study of Weir[8] did not examine the environmental impact for sanitary pads. This product is also a highly used menstrual product in modern "Western" societies, and therefore essential to include in this study. Data for this menstrual product originates from a study of Leroy et al.[9].

The first five indicators

The data that was used from Weir[8] was a table presenting the values of the first five indicators (abiotic depletion, fossil fuel depletion, global warming potential, acidification, and eutrophication) for 1 kg of primary material. Next to this information, the material content, and the corresponding weight of all four menstrual products were necessary to calculate the total value of each indicator for every menstrual product. The material content and the weight of the tampon, tampon with applicator and the menstrual cup were again retrieved from Weir[8]. The material content and the weight of the sanitary pad were retrieved from Leroy et al.[9]. From this point it was possible to start the calculations of the values of five indicators of environmental impact for one unit of all four menstrual products. Then, calculations for three different time durations (one cycle, one year, and a woman's lifetime) were performed in *Microsoft Excel 2016*. The values of each indicator were calculated using the following formula:

$$I = \sum_{i=1}^{n} (\alpha_i \cdot \beta_i)$$

I = total value of an indicator per unit
n = total number of raw materials
i = the number of the raw material [1,2,3,…]
α = value of an indicator for 1 kg of raw material
β = mass per unit of raw material [kg]

The survey

To find out the average of used units of menstrual products by women in modern "Western" societies per menstrual cycle and per year, a survey was set up in the Netherlands. The survey was set up in Dutch, via an online website called *Survio*, and performed in the Netherlands. The link was spread through *Facebook*, *LinkedIn*, and mail, with the request to share it within the respondent's network. The main questions that were asked, regarded the kind of menstrual product(s) used and the quantity used per 24 hours. The Netherlands was chosen because it is the country where the researcher lives and studies, and where she could gather enough data from respondents to perform the analysis. Next to this, the Netherlands is an excellent example of a modern "Western" society. The sampling strategy of the survey was to retrieve data from a wide range of female respondents in the Netherlands, which were distinguished in subgroups by their age. This method of sampling is defined as simple random sampling. The sample of Dutch females aims to represent the population of females in modern "Western" societies.

The sixth indicator; menstrual waste

A distinction between dry weight menstrual waste and wet weight menstrual waste was made. The study by Weir[8] did lack the second waste distinction. The results about the waste by menstrual products shown in her work were therefore not realistic; it should be considered that a woman throws away a used menstrual product. Therefore, this study includes also the results for the weight of the waste of used menstrual products, or better known as wet weight menstrual waste. It was assumed that a menstrual cup is not thrown away after a cycle or a year, thus the cup does not bring any additional waste with it in these taken times ranges. The following formula was used to calculate the wet waste (ω) from the dry waste (φ) by including the absorbency level (A) of the product: $\omega = \varphi + A$

FOUR MENTSRUAL PRODUCTS

Tampons with and without applicator

The raw materials needed to produce the tampons are: rayon, cotton, polypropylene, and polyester[8]. After the use of the tampon by the consumer, it is either disposed as solid waste[5], where it ends at landfills or it is burnt in incinerators to generate energy[10], or it ends in waterways by flushing through the toilet[11]. The applicator causes more waste than the tampon itself, because the decomposing time is centuries longer than the lifespan of a women who use it. In oceans, the applicators may be harmful for marine life, and it decomposes slower under water[12].

Sanitary pads

The raw materials to produce sanitary pads are: LDPE (low density polyester), non-woven polymer, cellulose, and silicone[9]. After the use of the sanitary pad by the consumer, it is either disposed as solid waste[5], where it ends at landfills or it is burnt in incinerators to generate energy[10]. Sanitary pads decompose very slowly (500-800 years), and when bleached even more slowly. Space is needed when landfilling is the endpoint, which furthermore causes groundwater pollution[13].

Menstrual cups

The menstrual cups are made from one raw material, namely silicon[14]. The cup is a more durable product, compared to the products mentioned before, because it can be reused up to 10 years before disposing[5].

SIX INDICATORS OF ENVIRONMENTAL IMPACT

Abiotic depletion

This indicator refers mainly to the use of minerals and fossil fuels used by the production processes of the primary material of the menstrual products[10]. It is expressed in milligrams (mg) of antimony (Sb) equivalents (eq.) per milligrams of extracted material[15].

Fossil fuel depletion

This indicator addresses the energy content, expressed in mega joules (MJ), of the fossil fuel[16] that is needed as raw material for the menstrual products.

Global warming potential

Global warming potential indicates the climate impact of the greenhouse gas emissions, which are released by the production processes of the primary materials of the menstrual products[17]. The unit of GWP therefore is in grams of carbon dioxide equivalent (g CO_2 eq.).

Acidification

This indicator describes the amount of created emissions of SO_2 (g SO_2 eq.) by the production processes of the primary materials of the menstrual products[10].

Eutrophication

It indicates the amount of nitrogen and phosphorus released (g PO_4 eq.) by the production processes of the primary materials of the menstrual products[18].

Menstrual waste

Waste is expressed in kilograms (kg) or tonnes. For the calculation of the wet waste, additional information was needed, namely the absorbency level (*A*) of the menstrual products. Distinctions are made between three different absorbency levels of disposable menstrual products: light absorbency, which can hold 6 grams of menstrual blood or less, regular absorbency, which hold up to 9 grams of menstrual blood, and super absorbency, which hold up to 12 grams of menstrual blood[19]. It is assumed that these absorbency levels apply for all menstrual products discussed in this thesis.

RESULTS AND DISCUSSION

Survey

Menstrual product use

Table 1 shows adapted results of the menstrual product use. Initially, the respondents were namely asked to indicate the (combination of) product(s) they use, which first resulted in 8 categories.

Table 1: Simplified menstrual product use in percentages with n=338

Tampons	39%
Sanitary pads	37%
Menstrual cup	12%
Tampons with applicator	2%
Other products or no products	10%

Quantity purchased products per woman

Table 2 shows information about the number of disposables per woman (tampons, tampons with applicator, and sanitary pads) and the number of menstrual cups per woman for three-time durations. These data are retrieved from the survey and indicate averages. The 6.02 disposables per 24 hours results from the average of: tampons (with and without applicator), sanitary pads, or women who used them both. For the time duration 'units per woman's lifetime', it is assumed that a woman menstruates for 38 years[20]. One menstrual cup has a lifetime of 10 years[21] and thus results in one menstrual cup per women per year and 4 within a woman's lifetime.

Table 2: Averages of the number of menstrual products used by one woman with n=338

	Units per 24 hours	Menstruation cycle duration (days)	Cycles per year	Units per year	Units per woman's lifetime
Disposables	6.02	5.11	9.71	298.49	11342.50
Menstrual cup(s)	1	5.11	9.71	1	4

Representativeness of survey

The survey resulted in a quantity of 338 female Dutch respondents. This is only 0.004% of the total female population in the Netherlands. The sample of the survey is confined to the Netherlands, which makes the survey geographically limited, however the results are assumed to apply to all modern "Western" societies. The age distribution of the respondents of the survey is found to be not representative for the Dutch women population. Namely, the results of the survey showed that 50% consisted of women between the age of 21 and 30, while the statistics of CBR indicates this is only 12%. This is explainable, because the survey reached mostly women around the researcher's own age. Furthermore, questions about income, education level, or environmental awareness were not asked for, which could also explain this uneven distribution of age. All in all, it is to be expected that, as with age, the respondents do not form a representative sample of all Dutch women.

Indicators of environmental impact

From all indicators it appears that the sanitary pad causes the highest environmental impacts, compared to the tampon, the tampon with applicator and the menstrual cup (table 3). Moreover, it turns out that the values of all indicators of the menstrual cup are relative low. These values are partly found because of the assumption that one unit is reused for 10 years, and during a woman's lifetime only 4 menstrual cups are purchased and disposed. Furthermore, the tampon with applicator shows higher impact values than a regular tampon in all cases; this is explainable by the fact that the applicator, which is made of plastic, increases the use of raw materials, and increases the weight, and waste of the total unit. Specifically, for dry waste, it is found that a tampon with applicator causes 3.5 times more dry waste than a regular tampon, and a sanitary pad causes almost 6 times more dry waste than a regular tampon (table 3). Then for wet waste, the tampon with applicator causes only 1.4 times more wet waste, and the sanitary pad 1.7 times more wet waste, relative to the regular tampon on yearly basis. This means that with making considerations about the amount of menstrual waste produced by the products, it is certainly highly dependent on the absorbed menstrual blood and not on the raw menstrual product only. The study of Weir[8] did lack this consideration.

Scenario analysis

Three scenarios of menstrual cup increase were assumed: 24% (1), 48% (2), and 72% (3). The horizontal lines in figure 1 indicate the disposables with the light (left part) and super absorbency (right part). The columns indicate the disposables with regular absorbency. The current amount of menstrual wet weight waste produced by Dutch females was calculated and resulted in 54822 tonnes per year. This comes down to 4138 large trucks per year filled with tampons and sanitary pads only. Scenario 3, which assumed a reduction of 82% in menstrual waste, could reduce this number of trucks with 3388, resulting in only 750 trucks a year.

Table 3: Environmental impact per indicator per woman's lifetime							
	Abiotic depletion per woman (mg Sb eq.)	Fossil Fuel Depletion per woman (MJ).	Global Warming Potential per woman (kg CO_2 eq.).	Acidification per woman (g SO_2 eq.).	Eutrophication per woman (g PO_4 eq.).	Dry waste (kg)	Wet waste (kg)
Tampon	173.62	952.45	73.66	673.57	310.72	17.83	119.92
Tampon with applicator	304.15	5192.88	248.62	1260.12	499.91	63.17	165.25
Sanitary pad	1869.14	8994.94	397.82	2474.50	649.90	105.92	208.00
Menstrual cup	0.27	2.95	0.16	0.61	0.18	0.06	0.06

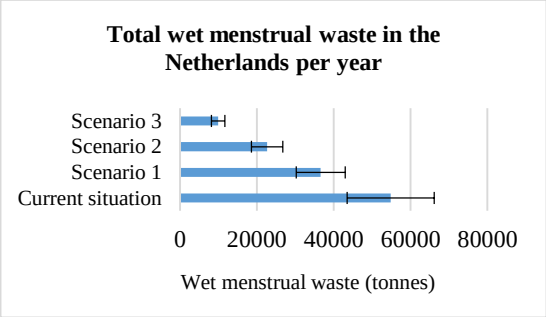

Figure 1: Total wet menstrual waste for three scenarios.

Data and calculations

No account has been taken for the different brands of menstrual products, used by women in modern "Western" societies in this study. The same applies for the different sizes of the tampons, the menstrual cups, or the sanitary pads, available for each menstrual product brand. Only for the wet weight calculations, the absorbency levels, and thus the sizes of the disposables, were included. However, these absorbency levels indicate the maximum capacity of the tampon to hold the menstrual blood, and not the exact blood loss of a woman per day. Besides, blood loss varies between women and between each woman's periods.

CONCLUSION

Menstrual products are used in large quantities by women in modern "Western" societies, and have large impacts on the environment during their whole life cycle. Due to the lack of scientific literature about the environmental impacts of menstrual products, and the increasing demand for more sustainable alternatives byconsumers, six indicators of environmental impact have been quantified for four menstrual products. All six indicators showed the highest values for sanitary pads, and the lowest for the menstrual cup. The gap of not considering the most well-known and highly consumed menstrual products in modern "Western" societies by Weir[8] has now been filled, by including the sanitary pad in the analysis. The study of Weir[8] did also lack the wet waste calculations, while the results of this research showed that the inclusion of absorbency levels of the disposables was significant.

The environmental impact caused by menstrual product users can definitely be reduced in terms of waste: if 84% of the Dutch females switch to the menstrual cup, 3388 trucks filled with tampons and sanitary pads could be saved per year in the Netherlands. Future research could consider other indicators of environmental impact.

ROLE OF THE STUDENT

Iris Flamand successfully completed her bachelor Environmental Sciences in Wageningen with the research in this report. She had always been interested in making all day routines more sustainable, and became fascinated about menstrual waste. Therefore, the topic of this research was created by herself and positively stimulated by her supervisor Jana Verboom. Some starting literature was provided by the supervisor, while the student initiated to set up and perform a survey. The processing and discussion of the results were performed by the student as well.

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