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# CHARACTERISTICS AND QUANTITIES OF DOMESTIC WASTEWATER IN URBAN AND PERI-URBAN HOUSEHOLDS IN HANOI

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## Abstract

The wastewater flows in Vietnamese HHs (HH) are greywater from kitchen, bath, and laundry, and blackwater from toilet. Black-water is treated in in-house septic tanks. Greywater is discharged directly into the drainage system. The study consisted of a literature review and a HH survey (21 HHs in urban Hanoi and 17 HHs in Lai Xa, a peri-urban village at 10 km west from the city centre). Phosphorous, nitrogen, COD and total solids loads in Lai Xa are generally lower than the loads in urban Hanoi. One exception is ammonia due to high ammonia concentrations found in groundwater in Lai Xa. The loads of mentioned parameters are rather low compared to international experience. Laundry activities produce 7% - 21% of the total greywater flow and are responsible for the highest loads of COD (30%), TP (60%) and TS (urban: 27%, Lai Xa: 38%). Showering greywater represents the highest volume but contributes only to 23% (Hanoi) and 11% (Lai Xa) of the total COD load. This study made clear that the contribution of greywater to the total domestic pollution load is significant, and in the case of COD and TP the loads discharged into the environment can even exceed 50%. The current sanitation system does not take that fact into account, greywater being discharged without treatment into the environment. Measures such as phosphorous ban in detergents or greywater treatment in septic tank could significantly reduce negative impacts on environment and public health....

*Key words: Back water, grey water, Hanoi, household, loads, wastewater.*

## Background

The wastewater flows in Vietnamese HHs (HH) are greywater from kitchen, bath, and laundry, and blackwater from toilet. Black-water is treated in in-house septic tanks. Greywater is discharged directly into the drainage system. This study aimed at characterizing and quantifying domestic blackwater and greywater in urban and peri-urban Hanoi.

## Methodology

The study consisted of a literature review and a HH survey (21 HHs in urban Hanoi and 17 HHs in Lai Xa, a peri-urban village at 10 km west from the city centre). Additionally greywater samples were taken in 4 HHs in Hanoi and 3 HHs in Lai Xa. Greywater from laundry, dish washing and showering were analysed in terms of COD, TP, TN, SS and TS.

## Water consumption

HHs in Hanoi has a relatively high water consumption of about 170 l/cap.day whereas in Lai Xa the average consumption is lower (92 l/cap.day). Greywater contributes to 68 - 90% of the total domestic wastewater amount, the rest being generated in toilets (10 - 32%). Hygiene activities (bath, showering etc) produce the highest amount of greywater, followed by laundry and kitchen activities. The water consumption for showering depends on the type of bathroom and sanitary wares, the duration of one shower and the season. The amount of greywater generated in the kitchen depends above all on kitchen installations (kitchen sink, tap water) and on the number of meals eaten at home per day. The amount of laundry water used depends on washing machine specifications or on the person who washes clothes by hand.

Less greywater is generated in Lai Xa, because most HHs does not have any kitchen sink, water heater for showering or in-house tap water.

Most people prefer to take showers in the evening, resulting in greywater production peaks at that time. In Lai Xa a lot of HHs do their laundry in the morning.

Figure 1 and 2 represent average distributions of daily greywater flows. Distributions strongly vary from one HH to another. E.g. if most HH members stay at home during day time, the water consumption is evenly distributed over the day, whereas in HHs where all members work outside their homes water is mainly consumed in the morning and evening.

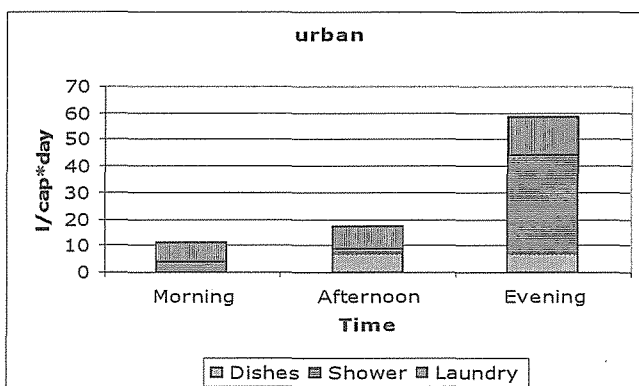


Figure 1: Daily distribution of greywater production in urban Hanoi

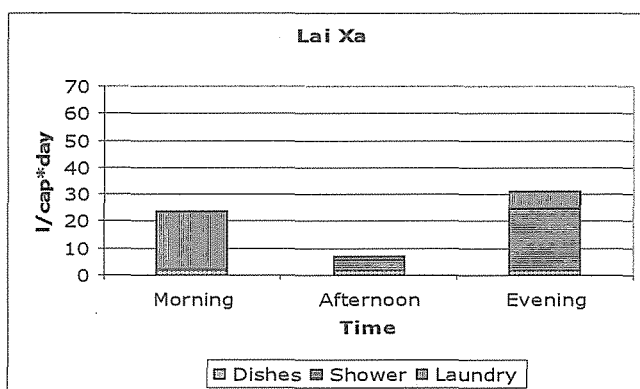


Figure 2: Daily distribution of greywater production in Lai Xa

The amount of blackwater produced depends on the flushing volume of toilets. There exist toilets in Vietnam with water saving devices such as half/full flushing. If half flushing is used when urinating a lot of water can be saved. Most toilet visits take place in the morning.

### Blackwater composition

Blackwater consists of excreta (faeces and urine), toilet paper, flushing water and some cleaning chemicals. Of note are phosphorous and nitrogen loads in excreta, which depend on eating habits. Based on the survey of eating habits of HH members, nitrogen loads of 6.3 g/p/d in urban Hanoi and 6.1 g/p/d in Lai Xa could be calculated. Phosphorous loads amount to 0.9 g/p/d in Hanoi and 1.0 g/p/d in Lai Xa. Eating habits in both investigated areas are similar.

### Greywater characteristics

The compounds present in greywater vary greatly depending on the dynamics of the HH, the number of occupants, the age distribution of the HH members, their lifestyle, HH installations, use of chemical products, etc. Substances of concern present in greywater are phosphorous, nitrogen, pathogens, organic compounds, heavy metals, persistent pollutants, grease and solids. Sources of these substances are detergents, soaps, shampoos, food remains, oil from kitchen, hair, textile fibres etc. The consequences of inappropriate management can be severe: eutrophication of surface water, clogging of soils, death of aquatic life, and increase public health threats.

Phosphorous, nitrogen, COD and total solids loads in Lai Xa are generally lower than the loads in urban Hanoi. One exception is ammonia due to high ammonia concentrations found in groundwater in Lai Xa. The loads of mentioned parameters are rather low compared to international experience. Interesting to note that phosphorous loads are in the same range as in countries where phosphorous-based laundry detergents were banned, although in Vietnam most common detergents still contain high levels of phosphorous.

Name	COD	TP	TS	Ammonia	TN
	g/d*c	g/d*c	g/d*c	g/d*c	g/d*c
Urban	37	0.6	29.9	<0.01	1.0
Lai Xa	18	0.4	16.7	0.22	0.6

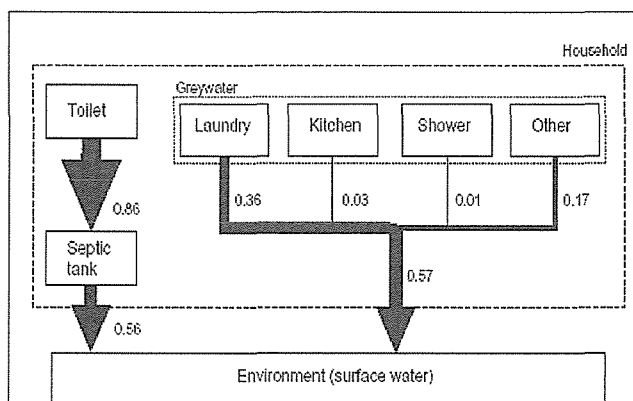
**Table 1: Loads of most relevant parameters in greywater. The amount and type of detergents used and the way of washing dishes are main factors influencing pollution loads.**

Laundry activities produce 7% - 21% of the total greywater flow and are responsible for the highest loads of COD (30%), TP (60%) and TS (urban: 27%, Lai Xa: 38%). Showering greywater represents the highest volume but contributes only to 23% (Hanoi) and 11% (Lai Xa) of the total COD load.

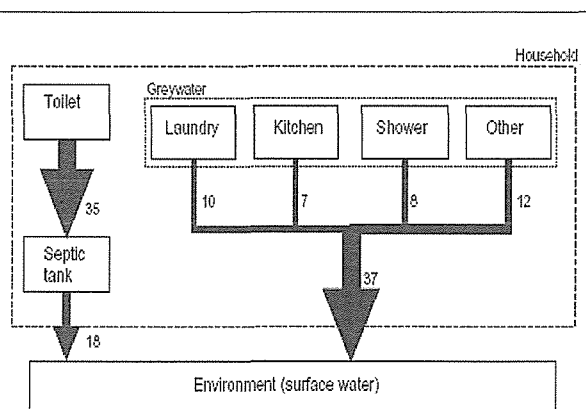
### Mass flows

Looking at the HH as a system, it is very interesting to note that phosphorous and COD loads originating from greywater leaving the HH are in the same range or even higher than those originating from septic tank effluent.

TN loads of greywater are small compared to blackwater.



**Figure 3: TP flows in Hanoi (g/p/d)**



**Figure 4: COD flows in urban Hanoi (g/p/d)**

### Conclusion

This study made clear that the contribution of greywater to the total domestic pollution load is significant, and in the case of COD and TP the loads discharged into the environment can even exceed 50%. The current sanitation system does not take that fact into account, greywater being discharged without treatment into the environment. Measures such as phosphorous ban in detergents or greywater treatment in septic tank could significantly reduce negative impacts on environment and public health.