Dirty laundry in Manila: Comparing resource consumption practices for individual and shared laundering

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Summary

Changing lifestyles in developing and emerging economies entail a shift in technology use, everyday practices and resource consumption. It is important to understand the sustainability consequences of these changes and the potential for policy to guide practices towards more sustainable lifestyles. In this study we investigate laundry practices in the City of Manila, the Philippines, and compare the resources consumed in three different modes of laundering. We examine (1) traditional washing by hand, (2) washing by machine at home, and (3) using a laundry service. In addition to comparing the consumption of water, energy and detergents, we also examine the social aspects of laundering using the lens of social practice theory. We use empirical data gathered in interviews with laundry service operators and people laundering at home to undertake qualitative and quantitative analyses of laundry practices and resource consumption. We find that hand washing uses the least water and energy, but large quantities of detergents. Machine washing and laundry services are comparable for water consumption, but energy use is much higher for services as they use dryers. Social changes such as an increase in work available for women and the nature of future housing are likely to influence the dominance of either shared or individual laundering methods. These findings illustrate the social complexity of transitions to product-service systems, and the interdependencies between their social and environmental impacts.

Introduction

In emerging and developing economies laundering practices have been steadily shifting from traditional hand washing towards greater use of semi-automatic and automatic washing machines (Wang et al. 2014; Lin and Iyer 2007). In addition to technological changes, there are a variety of alternatives to home laundering, including laundry services, coin-operated self-service laundries, and communal laundries. Studies suggest that shared access to goods or services (known as product-service systems) uses fewer resources than individual consumption options (Heiskanen and Jalas 2003; Tukker et al. 2006). Product-service systems are also increasingly being cited as a strategy for implementing the circular economy (for example, Mendoza et al. 2017; Ness and Xing 2017). However, studies regarding PSS are often theoretical and are focused on high-income industrial countries. While these technological and social transitions are occurring in emerging economies, there is an important opportunity to understand which options can enable lifestyle improvements in a resource effective way.

Changes to everyday household practices which are occurring in developing and emerging economies, such as the increasing use of household appliances and cars have direct implications for the consumption of energy, water, detergents and other products (Wilhite 2008). This growth in resource use and the consequent environmental impacts are important for industrial ecology. The 2010 special issue on sustainable consumption (Tukker et al. 2010) left aside the important changes that happen in developing countries where an emerging middle class increasingly engages in resource- and emissions-intensive consumption. The 2016 special issue on the supply chain consequences of consumption explores social practices in the food sector (Burger Chakraborty et al. 2016) and has articles on China, India and Thailand demonstrating a shift in focus in the industrial ecology of consumption towards issues in developing countries. Studies investigating consumption in developing countries are also relevant to the emerging discourse regarding sustainable lifestyles (UNEP 2016; Akenji and Chen 2016). According to a recent UNEP report, shifting towards sustainable lifestyles will require changes to the systems that determine lifestyle choices as well as changes to social practices (Akenji and Chen 2016).

In an editorial, Lifset (2008) highlighted the importance of integrating industrial ecology's strength in quantitative analysis with more qualitative studies, particularly to address the complex issues around consumption. Changing consumption practices interact with technological and social changes. For example, new housing types tend to require more

cooling appliances, and greater use of detergents mean that more water is needed for cleaning (Wilhite 2008). Wilhite clarifies the interdependencies of laundering:

> "Concerning clothes washing and the consumption of washing machines, a perspective on gender relations and the social organization of work is absolutely essential to understanding change" (Wilhite 2008, 6).

Sahakian and Steinberger (2011) combined quantitative data on electricity consumption with qualitative social science methods to understand household energy consumption in Manila. However, these types of multidisciplinary studies remain uncommon in industrial ecology. As Sahakian and Wilhite (2014) explain, industrial ecology approaches examine consumption using material flow analysis or life cycle analysis, however "too often these environmental management tools fail to consider the dynamic relation between people, things and social contexts" (Sahakian and Wilhite 2014, 39). Moreau et al (2017) and Blomsma and Brennan (2017) have also recently called for greater focus on the social dimensions within industrial ecology and circular economy studies. We therefore set out to examine laundering as a social practice and to also quantify the resource consumption embedded within these practices.

In this research we compare the social practices and resource use associated with three laundering methods: hand washing, machine washing and laundry services, in the City of Manila, the Philippines. We use social practice theory (SPT) to examine different laundering methods, in terms of the participants' material consumption, personal perspectives, and social context. We have predominantly used qualitative methods to understand these social practices, however we have also drawn on quantitative data to develop estimates of resource consumption associated with different laundry methods. Our aim is to understand the environmental consequences of changes in practices and the social dynamics that underpin them. Through this study, we provide new empirical data regarding the use of water, energy, detergents and plastics and information regarding the costs and time associated with each of the three laundering methods. We also provide insights on the participants' perceptions and preferences regarding laundry options and the potential social mechanisms for change. Drawing on our results we identify the socio-economic contexts in which various laundering methods are embedded. These are critical for understanding how change in laundering methods is likely to occur and is particularly relevant for policy makers seeking to guide more sustainable lifestyles.

Background

Resource consumption in laundering

Changing laundering practices have implications for energy consumption, such as doing laundry at home or externally, using a machine or hand-washing, using cold or hot water and drying by line or with a machine (Anderson 2016). Laundry services are expected to use less resources than using a washing machine at home due to significantly reducing the number of machines required and through the use of larger, more efficient machines with the potential to recycle heat, water and detergents (Roy 2000). Quantitative analyses have been undertaken of the impact of laundry services compared to individual machine washing, however many of these are theoretical and based on modeling, rather than actual consumption. For example, Haapala et al. (2008) modeled the difference between a laundry service and machine washing at home based on US laundry habits and found that home machine washing used 1.5 times more resources than a laundry service. Komoto et al.'s (2005) life cycle simulation of a clothes washing product-service system (PSS) compared four options ranging from individual machine use to coin laundries and laundry services; they found that the machine sharing options could achieve a tenfold reduction in environmental impacts.

Roy (2000) describes a Dutch study where a large neighborhood laundry was found to enable a tenfold reduction in resource use through water and detergent recycling. Hirschl's (2003) study was largely empirical (based on surveys) and found that laundrettes use 50% less resources than home laundering, when including actual consumption of heat, light and transport to the laundry. However, this study was based on German conditions and self-service laundry operations. There is very little empirical research comparing laundry services and home laundering. There is also a lack of research examining operational product-service systems in less developed and transition economies.

Laundry practices in the Philippines

Metro Manila has a population of approximately 12 million with an annual average family income of approximately 7600 USD/capita[1] (PSA 2015). An estimated 40.9% of the city's population live in slums (UN-Habitat 2013). Washing machine ownership in the Philippines differs markedly according to income level. In the highest quintile ownership rates are at 70%, while in the lowest quintile only 3% own a washing machine; the average

[1] Calculated from (PSA, 2015), draws on 2012 data

is 32% (data sourced from PSA 2012). This contrasts with more industrialized countries in the region: in Japan washing machine ownership reached 90-100% in the 1970s (Oya 2009) and in China machine ownership reached 90% in the mid 1990s (Wang et al. 2014). In the Philippines, lower income groups predominantly do their laundry by hand. The availability of low waged labor also means that wealthier households can afford to employ a maid for laundering.

The first commercial laundry in the Philippines was established in 1946, when a local businessman bought a mobile laundry trailer from the departing US forces (Wikipilipinas 2007). By the 1960s, commercial laundries were operating to service the hotel and shipping industries; however, they only started offering laundry services to households from 1993 (Metropole 2016). The oldest laundry service company in the Philippines suggests that this shift to consumer services was driven by changing lifestyles, including smaller living quarters, a lack of household helpers and "changing environmental conditions" (Metropole 2016).

'Changing environmental conditions' is likely to refer to the changing urban form. Condominium towers have been rising in height in Metro Manila, from original tower heights of eight stories up to forty stories in the 1990s (Saloma and Akpedonu 2016). Condominiums are often built on top of malls or otherwise have retail shops on the ground floor. They are typically inhabited by the middle and upper classes and particularly young professionals who want to reduce their commuting time, as traffic is notoriously bad in Metro Manila. Inside, condominiums are particularly small, ranging from 15-50 square meters and all rooms are compact (Saloma and Akpedonu 2016). As a consequence, laundry must be undertaken in special communal areas such as roof decks or basements ((Saloma and Akpedonu 2016), or otherwise use a laundry service.

Theoretical foundations

To examine and compare laundering activities we draw on Social Practice Theory (SPT). Social practice theory emphasizes that consumption activities are socially embedded (Jaeger-Erben and Offenberger 2014) and often involve shared routines and habitual activities (Spaargaren 2011; Røpke 2009). This means that the consumption of tools, appliances, water and energy in the household is unconsciously incorporated into routines (Shove, 2003). SPT builds upon Bourdieu's (1990) theory of practice, where an individual's consumption practice is influenced by their social environment (social field) and their own

system of dispositions (habitus). "Habitus" refers to the skills and practical know-how that is acted out habitually, which Bourdieu (1990) refers to as a person's "embodied history". Habitus helps us to understand not just everyday actions or practices, but can also explain social skills and social mobility (Galvin and Sunikka-Blank 2016). Bourdieu (1990) emphasized the importance of social standing or socio-economic position as an influence and constraint to social practices.

In neoclassical economic theory, consumption is framed as a choice made by rational individuals maximizing their utility (Stilwell 2006). Social practice theory contrasts with this view and aligns with the work of Veblen (1899), Polanyi (1944) and Duesenberry (1962), who all highlight the importance of social and cultural influences on consumption.
Several authors have applied social practice theory to examine resource consumption in the Philippines; in relation to food consumption (Saloma and Akpedonu 2016), and energy for cooling (Sahakian 2011; Sahakian and Steinberger 2011). Shove (2003a), uses social practice theory in her analysis of laundry transitions in the US and the UK. These studies have provided insights for the framework applied in this study.

Our approach in this study is to use social practice theory (SPT) to understand the personal, social and material factors that underpin laundering practices. This approach broadly aligns with the SPT framework proposed by Sahakian & Wilhite (2014), focusing on "the body", "the material world", and "the social world". Where "the body" refers to individual skills, competencies, dispositions and cognitive processes; "the material world" refers to material resources consumed within practices as well as technology and infrastructure; and "the social world", which refers to social and cultural norms and institutions (Sahakian and Wilhite 2014). Social practice theory emphasizes that these three dimensions are interacting and influencing people's practices on an ongoing basis. For example, available technology influences our skills and competencies and our social experiences influence our physical dispositions. Within "the material world", we examine the resource consumption associated with each laundering method in quantitative terms.

Methods

To investigate laundering practices and their environmental impact in Manila, we undertook a qualitative study drawing on Social Practice Theory and incorporated quantitative aspects to estimate resource consumption. We compared three laundering

methods: washing by hand, washing by machine and using a laundry service. Through interviews and participant observation we compared these three methods in terms of their resource consumption, their social context and the personal perspectives of the users / practitioners. We undertook structured interviews with six people who wash by hand, five people who use a machine at home and seven laundry service operators. In Appendix A1, we have set out the characteristics of each of these participants. All study participants operated their business or lived in the City of Manila, a densely populated area in the center of Metro Manila. We recruited laundry service businesses through door knocking and individual participants through a snowballing method, where initial recruits asked their friends and neighbors to participate. Interviews typically lasted 30 to 45 minutes.

Our analytical approach broadly followed the framework of questions set out in Shove (2003), "A whirlpool model of laundry" (Shove 2003a, 134) (see Appendix A2), which was used to examine laundering using social practice theory. This framework includes questions related to routines, skills, personal dispositions and material consumption. All participants were asked for their opinions on the various laundry methods and their perceptions of how things might change in the future. The qualitative aspects of these interviews were initially collated according to question and perspective and were then analyzed according to emergent themes.

We adapted Shove's framework to include the quantitative aspects needed to understand resource consumption. For example, at laundry service shops, participants provided their water and electricity bills and told us the number of gas tanks and sacks of detergent that they used each month, in addition to other operational details. In some cases we were able to observe the hand-washing process in action, other participants demonstrated their methods by showing us their buckets, sinks, machines and detergent packaging. We noted the brands and volumes of detergents used and measured the dimensions of containers to calculate volumes. Participants estimated the weight of washing they usually wash, and most participants also showed us the volume of clothing so that we could crosscheck their estimates. For participants using machines, we noted the brand, model and capacity and the level to which it was filled. The scope of questions is listed in Appendix A2.

Estimates of resource use were limited to operational resource consumption, in particular for water, electricity, gas, petrol, detergents, plastic bags and labor time. The nature of the quantitative data used is explained in Appendix A3. Following the interviews, we collected

secondary information to help determine the quantities of resources used by each method. This included:

- Water and electricity rates to calculate the total volume of water and electricity consumed by each laundry service business
- Weight and volume of standard scoops or sachets for various brands of detergent, fabric conditioner and laundry soaps
- Specifications for washing machines and dryers, including program time, power draw and water consumption. This was used to calculate the electricity consumption of individuals washing by machine and the electricity consumption of dryers used by laundry services[2].

We used the quantitative information to estimate resource use per kilogram of clothing washed, which enabled comparison between the three methods.

Results and discussion

Through interviews and participant observation, we estimated the resource consumption associated with three laundering methods and explored the personal perspectives of participants and their social context. We present the findings for these three aspects in order, starting with the findings for resource consumption.

Material consumption

Participants washing clothing by hand used buckets and laundry basins filled with cold tap water to clean clothing manually with the aid of washing powder, fabric softener and laundry soap. Some participants used plastic boards to apply laundry soap. Participants used a variety of different types of washing machines, including manual (wash only) machines, twin tubs (wash and spin separately) and fully automatic machines. Those using machines also used washing powder and fabric softener. All individuals interviewed hung their clothes out to dry. Laundry service shops typically used domestic sized washing machines and dryers, as well as irons and drew their detergents from bulk supplies. In this section we have benchmarked the resource consumption for each business and individual

[2] Participants provided details of the brand and capacity of their machines (and the way they use them) and we researched the specifications for those machines as much as possible. However, in several instances locally based washing machine brands could not provide specifications for their washing machines and in these cases we used specifications for similar machines.

participant. These include: the water, energy and detergents consumed in the laundering process. We also estimated the associated labor time and financial costs, as these are likely to be important factors for participants when considering alternative washing methods.

Water

Access to water can be an important factor for deciding on a laundering method. Amongst our participants, we find that hand washing uses the least water on average, while laundry services and machine-washing at home appear to use a similar volume of water (see Figure 1). However, it should be noted that the results for laundry services were determined from actual water bills, whereas water consumption for machine-washing at home was estimated from product specifications and participant responses. We nevertheless assume both data strategies to be sufficiently robust to allow for comparison.

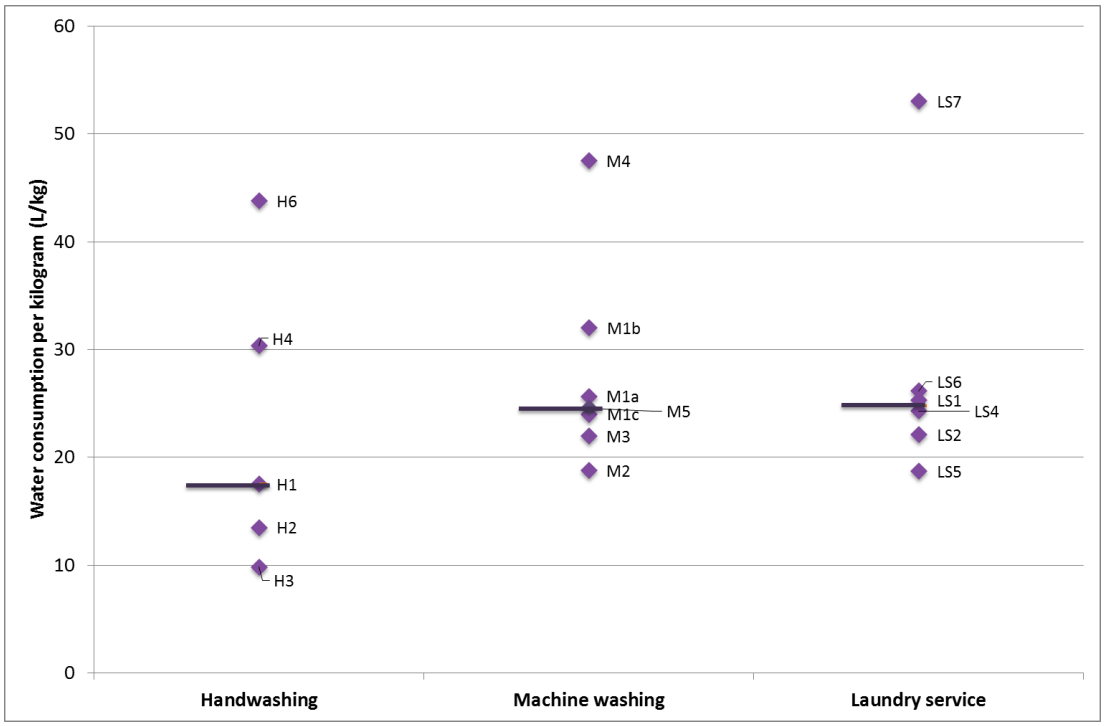

Figure 1: Water consumption per kilogram of clothing for three laundry methods in the Philippines in liters per kilogram (L/kg). Horizontal bar indicates median. See Appendix A4 for tabulated results.

Water use results for laundry services are fairly consistent; five out of six laundry service shops used between 19 and 26 liters per kilogram of laundry. These results fit within benchmarks from Australian studies, which show that institutional laundries use 9 to 27 liters of water per kg of clothing (Brown 2009). Laundries in Manila are at the less efficient

end of the spectrum and this is unsurprising as they typically use domestic-sized machines, which limit the efficiency that can be gained by laundering large volumes. Only one of the laundry service shops used industrial-sized washing machines (20 or 50 kg capacity), the remainder used domestic-sized machines (7–11 kg capacity) and one shop even used very small machines between 3.5 and 5 kg capacity.

The bulk of machine-washing users were estimated to use between 17–32 L/kg, which reflects the widespread use of top-loading washing machines. Based on data[3] from Pakula and Stamminger (2010), we estimate the average water consumption for washing machines is 25 L/kg in China, 30 L/kg in Japan and 35 L/kg in Korea. In China the highest water efficiency grade for a top-loading washing machine is <20 L/kg, with the lowest grade being <36 L/kg (Wang et al. 2014). However, this is much less efficient than front-loading (or drum) washing machines that are used extensively in Europe. A German study reports that average water consumption in washing machines shifted from 31 L/kg in the 1980s to 10 L/kg in 2004 (Rüdenauer et al. 2005). Currently in Australia (and elsewhere) the highest efficiency machines use 6.5–8 L/kg (Australian Government 2016).

Considering these much lower water efficiency benchmarks from elsewhere in the world, both individual washing machines and laundry services have the potential to significantly improve water use efficiency in the future if they were able to make the upfront investment in more efficient appliances. However, due to the use of old machines in households, it will take much longer for individuals to catch up with water efficiency advances. In hand washing there is more variability due to the different size of vessels used for washing, different practices regarding the number of rinses and the amount of water used in rinsing. The hand-washing results are also subject to greater uncertainty as the results relied upon participants estimating the weight of clothing they normally wash.

Detergents

In Figure 2, we have aggregated the quantities of laundry powder, laundry soap and fabric softener used by each of the study participants to give an overall view of detergent use. On average, participants washing by hand tended to use more detergent than laundry services or those using a machine at home. Note that this comparison does not take into account whether detergents are concentrated or otherwise. All of the participants in the hand-

[3] Data from Pakula gives average water used per cycle, and assumes 4kg washing per cycle.

washing study used fabric softener, while this was less consistently used amongst machine washers and at laundry shops. In addition to fabric softener, around half of the people hand washing used laundry soap in addition to powder detergent and fabric conditioner.

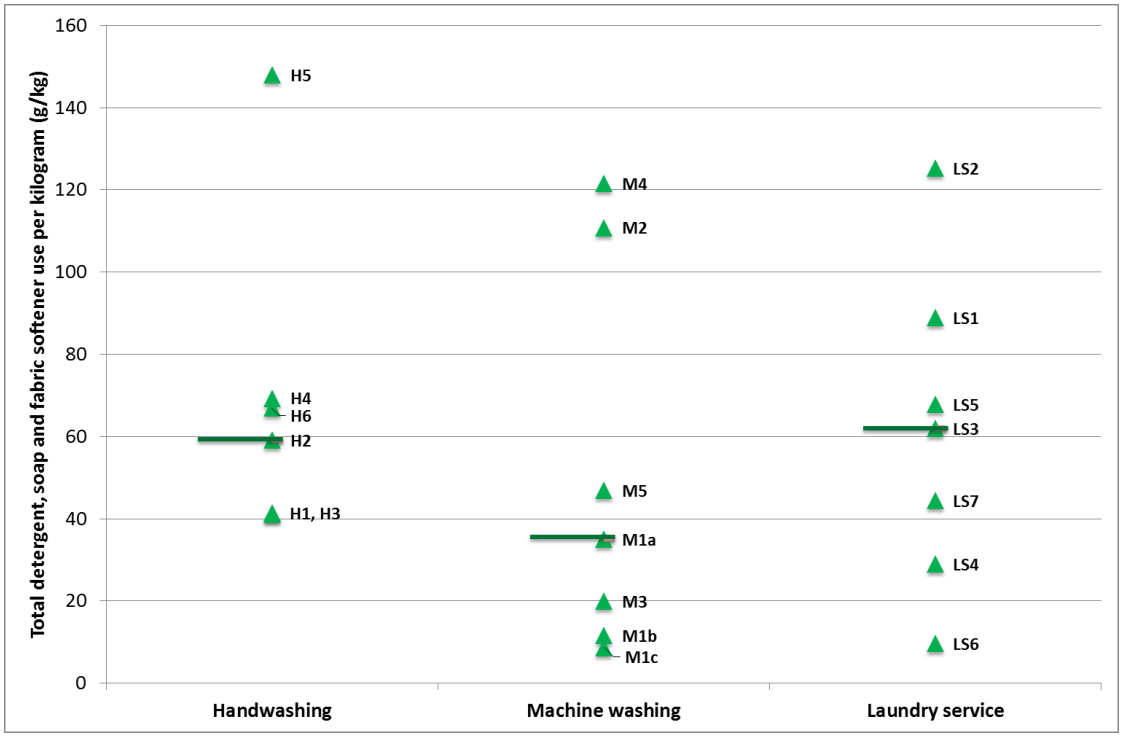

Figure 2: Consumption of clothes washing products (powder, soap and fabric softener) per kilogram of clothing for three laundry methods in the Philippines (g/kg). Horizontal bar indicates median. See Appendix A5 for tabulated results.

The spread of results regarding laundry powder consumption across the three laundry modes shows that user behavior is a major factor in addition to other contextual issues. For example, people washing by hand tended to come from lower socio-economic groups and used small sachets of laundry powder that could be purchased cheaply on an individual wash basis. These prepackaged amounts for a single wash can dictate the amount of powder that people use, whereas for machines and at laundry shops people were using scoops of powder from larger bulk supplies and their use was more variable.

Energy

The operational energy use associated with each laundry method includes the amount of electricity used for washing and drying, gas used for drying within laundry services and petrol used for transport of laundered cloth by laundry services. We find that laundry services use significantly more energy than machine-washing at home and this is primarily

due to the need for dryers (see Figure 3). All participants laundering at home hung their clothes to dry.

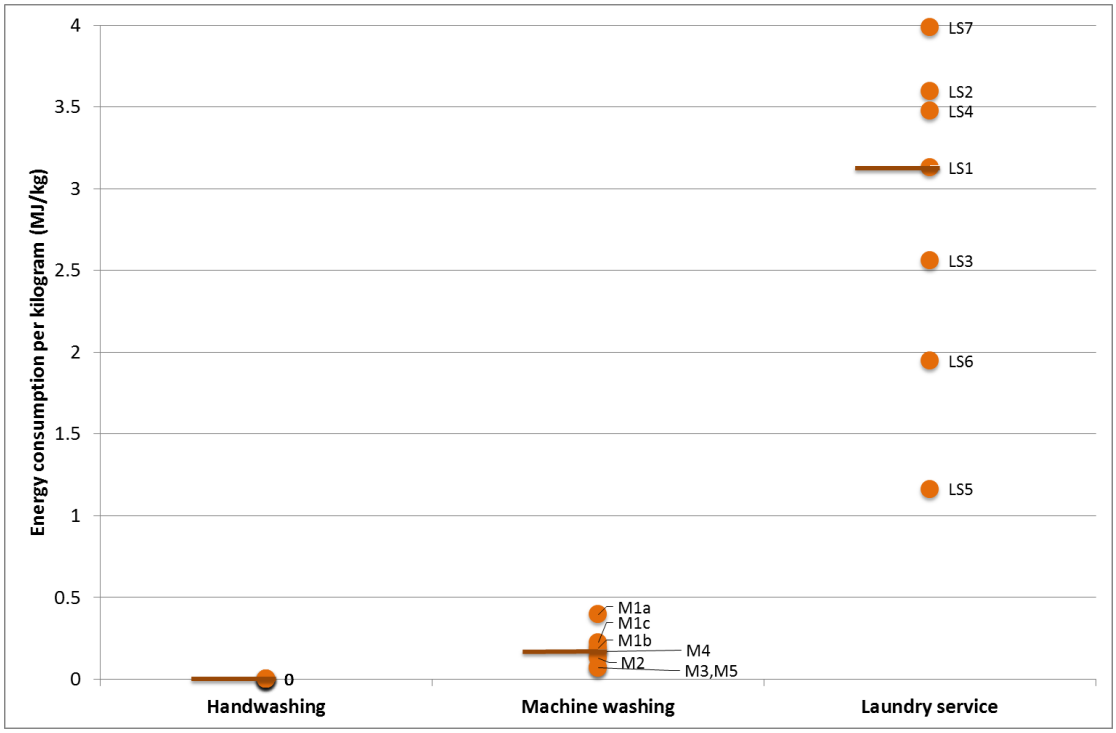

Figure 3: Energy consumption per kilogram of clothing for three laundry methods in the Philippines in megajoules per kilogram (MJ/kg). Horizontal bar indicates median. See Appendix A6 for tabulated results.

Another reason for the substantial difference in energy consumption is that the results for laundry services are more complete. The electricity consumption for the laundry service shops was calculated from their average electricity bills, which means they included not only washing machine operation, but also ironing presses, lights and any other appliances in use in the shops. The electricity consumed by machines used at home was calculated from machine specifications for power draw and program time, and therefore only reflects the electricity consumption of the machine itself. Transport was only a minor contribution to overall energy use. All of the laundry service shops collected and delivered laundry to their customers on foot whenever possible as their customers were typically located near to or within the same condominium building and were able to transport the laundry by walking with trolleys. Five of the seven shops interviewed conducted their washing and drying on-site. The two shops dealing with the greatest quantity of laundry carried out their operations elsewhere. One of these two shops explained that their laundry operations were

located a three minute drive away and we have therefore included an estimate of the transport required in their total energy consumption.

The results for machine-washing at home reflect the use of older style top-loading machines, most of which were semi-automatic. Of seven machines in the study, one was a twin-tub, five were wash only (no spin function) and only one machine was fully automatic. Most of these machines used between 0.07 and 0.23 MJ/kg of clothing. Based on figures[4] in Pakula and Stamminger's (2010) study, we estimate that the average energy use for washing in China and Japan is 0.09 MJ/kg and 0.33 MJ/kg in Korea. Chinese grades for washing machine energy efficiency range from <0.04 MJ/kg to <0.12 MJ/kg (Wang et al. 2014). This suggests that the machines used by participants in this study were quite energy inefficient, however, in many cases it may be due to the way the machine is operated. For example, some people only put a small volume of clothes in the machine, and others used manual settings and set long program times. However, as these machines were older it is not surprising that they were less energy efficient. Total energy consumption at the laundry shops was significantly higher and more variable, with consumption between 1.16 MJ/kg and 4 MJ/kg. As mentioned, this is due to gas/electric clothes drying in addition to other appliances in use.

In this study we have focused on operational energy consumption, however production energy consumption or embodied energy can also be significant. While some studies have found that the embodied energy of a washing machine represents just a small component of the overall life cycle, about 1 to 4% (Bole 2006), others find the relevance of embodied energy is increasing due to operational efficiency and for more modern machines is around 16 to 25% of lifecycle energy (Garcia 2013). This is due to a shift in materials use (more electronics), changes in washing temperatures, and trends influencing load size (Rüdenauer et al. 2005). The electronic components of washing machines have major environmental impacts due to their extraction and processing (Garcia 2013).

Materials / Machine utilization

While we have not examined energy or other embodied resource intensities in this study, a useful proxy for comparing the productivity of the embodied resources in washing machines, is the intensity to which machines are utilized. We have compared the total

[4] Based on average electricity per wash cycle, assuming 4kg washing per cycle

number of washing loads carried out per month by the participants washing clothes at home with the total number of loads carried out by the laundry service shops. We have also determined a utilization rate for each machine in the study[5], and found that people using machines at home use them for 1 to 3% of their useful time, while laundry services use them significantly more, with utilization rates between 16% and 87%. The detailed results for each participant are provided in Appendix A7.

These results can be considered in conjunction with the expected lifetimes of machines. Interviewees at laundry shops and people using machines at home were asked how long they expected their machines to last. People using machines at home estimated machine lifetimes of 5 to 10 years. Operators at laundry shops seemed to have similar expectations with five (out of seven responses) anticipating machine lifetimes between 5 and 12 years. Just two laundry shops had low, but perhaps more realistic, expectations for machine lifetime of around 2 to 3 years. This suggests that the higher machine utilization in laundry service shops does not necessarily reduce the lifetime of machines.

Another material and waste issue for laundry services is the use of disposable plastic bags. In this study, we found that laundry services use one plastic bag for every 3 to 10 kg of washing. We did not quantify packaging for detergents or other products; however, we note that people hand-washing use many small plastic sachets. These sachets represent a significant waste issue, such that Unilever is now trialing technology to recycle them in Indonesia (Kaye 2017). People using machines use medium sized plastic containers and laundry services often used sacks of detergents. Bulk purchasing of detergents may reduce packaging waste.

Cost and time

In Manila, laundry shops are ubiquitous and compete for customers in densely populated areas. As such their rates are very similar and are generally between 25 and 35 Philippine pesos (PhP) per kilogram (~0.5–0.7 USD/kg). We can compare this with the cost of doing laundry at home either by hand or by machine. In Table 1 we have calculated two estimates for the costs associated with each laundry method. In the first row, the "cost to consumer" is the apparent cost of detergent, water, electricity and machines or the cost of the service.

[5] For this we have assumed a maximum machine use time of once per hour, for fifteen hours a day, seven days a week, which we establish as 100% utilization equal to 450 uses per month.

The second estimate draws on information from participants regarding the time spent washing, as well as our own estimates regarding the time spent hanging, collecting and folding laundry. In the second row, we add our estimates for labor costs to the "cost to consumer" to provide an overall comparison of the three methods adopted by participants. Detailed results and assumptions relating to these calculations are provided in Appendix A8 and A9.

Table 1 – Cost estimates for three laundry methods in Philippine pesos (PhP)**

	Hand washing	**Machine washing**	**Laundry services**
Cost to consumer (PhP/kg)	6–11	3–5 (old manual machine), 10–26 (semi-automatic and auto machines)	25–35
Cost + labor value (PhP/kg)	29–66	10–12* (old manual machine), 16–32* (semi-automatic and auto machines)	25–35

*Note that labor estimates for old manual or semi-automatic washing machines do not include in-process labor such as carting water to fill the machine or manual rinsing or wringing

**In 2017, 1 USD is worth approximately 50 PhP

We find that while laundry services have the highest apparent cost to the consumer, if we incorporate the value of the labor time, washing by hand becomes as expensive as a laundry service and can be much higher at 29 to 66 PhP/kg. Washing with a machine at home can also be as expensive as a laundry service (up to 32 PhP/kg), especially considering that these estimates do not include the labor associated with using an older style machine, such as manual rinsing or wringing. This indicates that laundry costs may be similar across the three methods. Choosing to use a service or not may partly depend on the availability of work for women. For some participants, doing the laundry was almost a part-time job. For those hand washing for a family, it is at least a day's work per week and for one woman, it was 20 hours a week. The cost of electricity is also likely to be a factor, as the Philippines has one of the highest electricity tariffs in the world (Tiglao 2014).

Personal perceptions of washing methods

In order to understand the personal aspects of laundering, such as individuals perceptions, dispositions towards different methods and their skills and competencies, we asked

participants why they choose to use a certain method of laundering, what their perceptions were regarding people who use other methods and how they thought things might change in the future. We have used codes to indicate different interviewees, where M = machine user, H = person washing by hand, LS = laundry service user. The description of each interviewee is provided in the Appendix in Table A1.

Of the six households interviewed that washed clothing by hand, five were from a lower socio-economic background, and one was a maid undertaking hand washing within a middle-upper class home. Only one participant relied exclusively on washing by hand. Other participants tended to wash their clothing by hand, but used machines for sheets and towels. Regardless of background, most participants felt that hand washing was much cleaner than using a machine and several complained that machines do not remove stains. One of the maids in a wealthy home (M1) explained that even though she washes the clothes of her employers in a machine as part of her job, she still washes her own clothes by hand so that she "can be assured of being clean". As such, she considered her hand washing skills to be superior to the work of the machine. Another participant explained that water is not piped into the machine and a lot of effort is required to fill it by carrying buckets from the tap; this means she prefers to wash by hand (H4). Another participant explained that she preferred to hand wash to avoid a large electricity bill (H5).

Participants washing by hand tended to be wary of laundry service shops as "the machine doesn't make it as clean" (H1, also H2, H5), "you can't see how they do the laundry" (H3), "they don't separate different colors" (H5), and they "might mix clothes from different people" (H3). For these reasons, the majority of people washing by hand did not want to try using a laundry service. Only one participant suggested she might use a laundry service to wash large items such as sheets. None of the participants mentioned cost as a factor, although this would also likely be a barrier. Participants washing clothes with their own machines had similar perceptions of laundry services and were mostly concerned that their clothing might get mixed with other people's clothing in the washing process. This seems to reflect a general concern about cleanliness, shared by most hand and machine-washing participants in this study, particularly with regards to clothing (rather than sheets or towels). Note that all laundry service operators insisted that they never mixed clothing from different customers.

Several observations point to the pride that participants took towards their laundered clothes. The mistrust of machines and laundry services highlights the importance of cleanliness, and the confidence participants have in their hand-washing skills. As Shove suggests, "senses of self are very much at stake in the handling of laundry" (Shove 2003a, 119). This identity is also strongly linked to judgments about standards of cleanliness, personal appearance and domestic skills (Shove 2003a). Several participants only washed clothing by hand, and used a washing machine for sheets and towels. This may be due to the difficulty of hand washing larger items, but also may be due to the greater importance of cleanliness and caring for clothing. Four of the six hand-washing participants carried out their washing in a communal area, such as communal courtyards in between apartments. People who owned washing machines also placed these in the common courtyards. This means that the laundering method and energy expended in laundering were readily observable by their neighbors, adding an element of performance and pride.

Social context

To understand the social context of different laundering methods we drew on individuals perceptions of different laundry methods and asked laundry service operators how people perceived their service and who their customers were. The laundry shop owners indicated their customers tend to be university students and younger people working in offices, all of whom live in high-rise buildings and are likely to be middle to upper class in Filipino society. Around half of the laundry service shops thought that people perceived benefits in using a laundry service, such as saving time, "saving on the water bill" (LS8) (as "water in the tower is expensive") (LS3), or because "it's cheaper than doing it at home" (LS3). Other shops pointed to necessity as people in Manila lacked space or lived in buildings with no facilities. One said, "it's cleaner and cheaper to do it yourself. Students don't have time to do it themselves" (LS2). Several thought that families tend to have a maid do their clothes washing and that it was cheaper to have a maid wash clothes by hand. One participant thought the main benefit was the fact that it is hassle free "it's like instant noodles" (LS6).

All individual study participants were women and were either laundering for their jobs as maids or laundered for their families. The majority of laundry service shops were also operated by women, with just two exceptions. This aligns with the literature which finds that laundry is gendered and has a long association with female domestic labor and the

housewife's identity (Shove 2003a; Shehan and Moras 2006). A study in the UK found that women contributed 92% of household laundry time in 1985 and this lowered only slightly to 84% in 2005 (Anderson 2016). Laundry is still gendered in the Philippines as it is elsewhere in the world, however, similar to the history of commercial laundries in the west, men are more involved when laundry becomes a business (Watson 2015).

One interviewee highlighted class distinctions, where "Class A and B[6] don't use laundry shops… they have their own maids" (LS7). This and other interviewee comments throughout this study confirm a relationship between income levels and laundering methods, where low income households wash clothing by hand, the middle class use their own machines or laundry services and the upper middle classes employ maids to wash their clothes by hand. We have described this socio-economic relationship in more detail in the discussion and in Table 2.

Triggers for change

We are interested in whether urban Filipinos in the future are more likely to use laundry services or to buy their own washing machine and dryer. To examine this, we have drawn on participants' responses regarding their perceptions of the future as well as historical information regarding the drivers for changing laundering practices elsewhere in the world. In Table 2, we summarize the various aspects of laundering social practices, including the material, personal and social aspects, and we use this to identify the potential drivers of change.

Most of the people operating laundry services thought that more people would be using their services in the future for several reasons: the number of laundry shops has been growing rapidly in recent years, more high-rise condominiums are being built, "people are busy and working" (LS6) and there are likely to be more university students and working people. However, several interviewees thought that families and people owning a house would be unlikely to use a laundry service. "If people own their own house, they would want their own machines" (LS2). Several service operators thought that they were likely to continue to serve a niche of students and working people. As one explained, "In the long run, people will want to have their own machines, there are certain savings. But there will still be people using laundry shops" (LS8). Only one of the hand washing participants

[6] Filipinos commonly refer to people of different socio-economic classes as A, B, C, D and E. PinoyMoneyTalk (2012) suggests that A, B = 1%, C = 9%, D = 60% and E = 30% of the population.

could envision change in the future, she said that maybe "in the future when people are busy and going to jobs, they will use laundry shops, but poor people will want washing machines" (H5).

Table 2 – Social practice dimensions and potential change mechanisms for laundering practices in Manila, the Philippines

Income level	Household type	Laundry method	Material	Personal	Social context	Potential mechanisms of change
Low income	Individual	Hand washing	Low cost equipment, low cost to consumer Soap, powder and fabric softener are accessible Small living space	Hand-washing seen as cleaner Pride in washing skills Pride in appearance Mistrust of services Sense of self-sufficiency	Lack of work for women Traditional gender roles Washing performed in communal areas	Higher workforce participation for women Inexpensive washing machines more common
	Family	Hand washing, Home machine use	Old second hand machines are accessible Electricity available Small living space			
Middle class	Individual	Hand washing, Laundry services	Condominium living - lack of space and facilities Condo building regulations High equipment and electricity costs	Pride in appearance Hand-washing seen as cleaner Indifference	Work, lack of time Changing gender roles High-rise lifestyle Urban migration for university or work	New housing is built with self-contained (rather than shared) laundries Lack of space
	Family	Home machine, Maid	House ownership or condominium living Housing has space Machines are affordable	Pride in appearance Hand-washing seen as cleaner	Work, lack of time Labor is affordable	Shift from houses to more apartment and condo living Lack of available maids
Upper middle class	Individual & family	Maid	House ownership condominium living Housing has space	Pride in appearance Hand-washing seen as cleaner Skills of household helpers Service orientation	Labor is affordable	Higher workforce participation of women Lack of available maids

In the future, the most important factors for changing from hand washing to machine washing or laundry services will be increased workforce participation of women, increased affordability of machines, changes in housing style and urban design and the availability of dedicated spaces for privately owned washing machines. Shove (Shove 2003a) refers to the "collapse of the servant workforce" as a key driver of changes in laundering practices in the UK and US. When this occurs in the Philippines, maids will no longer service wealthy households. Whether higher incomes will drive private ownership of appliances or whether there is a preference for laundry services may depend on housing form and the relative wage-earning potential of laundry service workers. The pride taken in appearances of cleanliness and the long history of gender roles may keep laundering as a practice that occurs within the home, particularly with the strong economic interests of machine and detergent producers in "putting a machine in every home" as was the case in the US (Shove 2003a).

Domestic washing machines are becoming more common and less expensive in the Philippines, and this is likely to lead to all lower and middle class families aspiring to own a machine. However, the potential dominance of individual washing machines depends on housing type, urban form and building regulations. If more families begin to live in apartments and condominiums there could be an expansion of laundry services due to space limitations in apartments. If newer condominiums begin to include space for a washing machine, they will also need to include a dryer as drying space is rare in small apartments and typically air-drying is not allowed on balconies. The second scenario with individual washers and dryers represents a significant increase in embodied energy and resources.

Our analysis of the time and costs associated with each laundering method found that if labor is considered, hand washing is equal to or more expensive than the unit cost of laundry services. This suggests that if more work becomes available for women, it will be more economical or time saving for them to begin using a machine in the household or a laundering service. However, our qualitative analysis suggests that decisions to use a washing machine or laundry services will not be purely economic, as laundering skills, pride and identity play an important role in hand washing. A shift towards machine use is likely to influence the meaning of laundering and may change standards of cleanliness. As Shove explains, the washing machine can "rescript the meaning of clean" (Shove 2003b, 405).

If change in the Philippines is similar to elsewhere, once workforce participation for women increases further, there will be fewer household helpers. The middle-upper classes will have the choice of purchasing a machine/s and doing this labor themselves, or using external laundry services. However, both people washing at home and laundry service operators felt that people used laundry services due to necessity, where people lack space or time, and were primarily for use in high-rise condominiums. This suggests that if future housing is lower density, people may be unlikely to use laundry services.

Intervention points

There are several potential points of intervention to improve resource consumption associated with laundering in the future. As centers of laundering, laundry services present an excellent opportunity to improve resource efficiency by adopting more efficient machines, using renewable energy, rainwater supplies or even enabling synergies with other businesses or cooling systems. Some laundries we observed already co-operate with neighboring water-bottling businesses. New condominium buildings could provide a communal laundry space or laundry services, rather than equipping each apartment with individual laundering facilities. In high-density settings, laundry services can work particularly well due to minimal transport requirements. In medium density neighborhoods, such as those where many of the hand-washing participants lived, there is also an opportunity to facilitate communal laundries, as participants already use shared courtyards for laundering. In the future shared machines could be placed in these communal spaces. In medium and lower density neighborhoods, it may be more resource effective to discourage ownership of individual dryers (through monetary disincentives), and to include efficiency standards and warranties for washing machines, to ensure that individual machines are more durable and more water and energy efficient. In medium and lower density areas, operators of laundry services could be encouraged to localize their services. Policies and decisions regarding infrastructure have potential to influence social practices and contribute to reducing the impact of laundering in the future.

Conclusions

In examining laundry practices in Manila, the Philippines, we find that each laundry method is associated with different socio-economic classes and household and housing types. The overview of material, personal and social factors associated with different laundry practices provides insights into likely drivers of change in the future. Social factors

such as women's workforce participation will be important for shifting away from hand-washing. Female work is also significant at other income levels, particularly if more work for women means that maids become unavailable. In addition, material factors such as housing form, building regulations and available space may be significant factors influencing laundering methods. Changes in laundry practices will result in differing impacts on resource consumption depending on laundry method. Washing clothing by hand uses the least water and energy, but significant amounts of women's time. Laundering at home with a washing machine uses a similar quantity of water to laundry services in Manila, but far less energy due to the ability to air-dry clothes at home, rather than using a dryer. However, we can assume that embodied resource use is significantly higher for individual machine-washing at home, as utilization rates are much lower compared to laundry services, particularly if individual households also own dryers. Key intervention points to reduce resource consumption of laundering include: standards for new machines, assistance for laundry service shops to improve efficiency, and requirements for buildings to enable communal laundering spaces. These findings illustrate the social complexity of transitions to product-service systems, and the interdependencies between their social and environmental impacts.

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