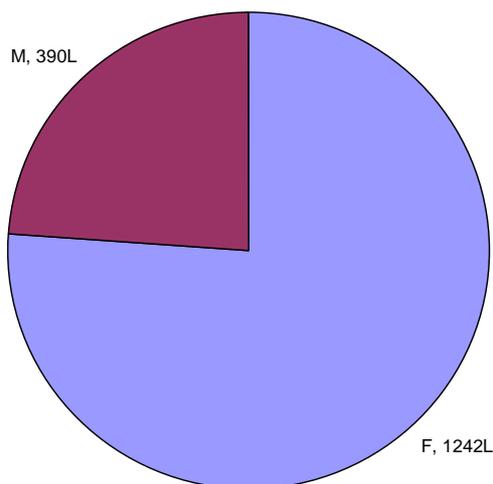


A Methodology for Differentiating (Measuring Gender) Intra-household Water Use

Water Diary 2008



Final Research Project Report
July 2009



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Acknowledgments

Dr Kuntala Lahiri-Dutt, of the Australian National University (ANU) for all the support provided prior to and throughout this project.

The Resource Management in the Asia Pacific Project (RMAP) at ANU for workshop support.

The organizations that graciously distributed the call for volunteers.

The households who willingly and generously participated.

Front Cover Figure

Household two total weekly use (L) by gender.

A two person household: 1 female and 1 male, both aged 55-60 years old.

Total meter reading: 2 000L

Average L/person/day: 143.9

Total diary estimate: 1 632L

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Executive Summary

This report presents the final results of a research project assessing an innovative approach to generating gender disaggregated intra-household water use data. This research approach combines a number of methodological approaches to garner both quantitative and qualitative data, in the guise of a water diary. The resultant data set is reliable and richly detailed. The data can also be disaggregating by a number of variables, such as age, income or location for example. As the households are required to record all reticulated water supply used in a seven day period, the water diary is a participatory process. This participation appears to have a sensitizing effect on individual participants.

Key aspects of the methodology are:

- ◆ participant self-selection;
- ◆ interview or questionnaire and gathering household information; and
- ◆ daily diary recording.

At the broadest scale, the 2008 water diary results indicate a roughly equitable water consumption to gender population ratio. When viewing data at the household scale, this broad equity in gendered consumption is not replicated. Analysis of water chore consumption rates, as a proxy for domestic duties participation, indicates approximately 75% of applicable households' recording women performing a greater range of water chores, and, therefore, consuming relatively high volumes of water. That is, women tend to record higher water consumption rates as they participate in a higher number of water uses, notably water chores. Men consume relatively less water undertaking absolutely less water uses.

A number of additional features are recommended for inclusion in further versions. The most significant features are:

- ◆ daily water meter readings & diary reconciliations (where water meters are available);
- ◆ estimate training to enhance estimation accuracy; and
- ◆ the formal identification of a household champion to encourage on-going diary participation within the household.

The changes recommended in this report represent a tweaking, not a reworking, of the research approach. Apart from location specific, modifications, primarily for language and to reflect local sensitivities, this approach is readily applicable to many urban areas of the economic south. Given issues of low literacy rates and earnings and unreliable water supply in rural locations of the economic south, the water diary presentation is likely to require further modification prior to use in such areas. Again, these changes are more likely to be presentational rather than conceptual. However, the nature of some required modifications, including local language and cultural sensitivities about personal hygiene, means the production of a definitive water diary for use in a development context is unviable. The diary as presented in appendix one provides a sound template for use in any geographical or socio-cultural context, for those interested to do so.

The water diary has proven a robust, reliable and transferable method to generate gender disaggregated data. The results presented in this report demonstrate this research approach to be an effective and efficient means to pry open the black box of intra-household water use. Indeed, the approach is capable of expanding not only the frontier of intra-household water use knowledge but the knowledge frontier of intra-household resource use more generally. I commend the approach to the Gender & Water Alliance. Please distribute, modify and apply it freely.

2008 Water Diary Record of Total Reticulated Supply Use

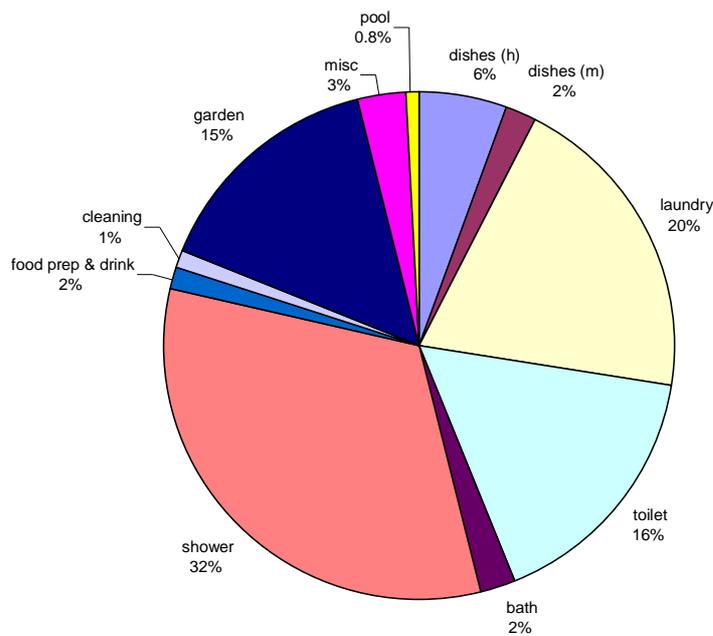


Figure One Total use of reticulated supply¹

¹ One pool, in 23 households, accounted for 0.8% of total recorded water use, almost three times the water use required for pets in 14 households (0.3%).

Introduction

The 'water diary' was developed to provide a reliable, robust and transferable method to collect gender disaggregated intra-household water use data. Such data is required to better understand household resource allocation processes generally (Haddad, Hoddinott & Alderman, 1997; Bolt & Bird, 2003) and water allocation processes specifically (Smith, 1998; Jones, 2007). The water diary represents a blend of quantitative and qualitative research techniques to capture the data required to open the black box of intra-household water use to critical investigation.

A pilot trial conducted in the Australian Capital Territory (ACT) region in December and January 2007-08 indicated the method's usefulness (Lahiri-Dutt & Harriden, 2008). Given the gender implications of the research approach, the Gender & Water Alliance (GWA) was successfully approached to fund a larger trial, again in the ACT region to more deeply assess the effectiveness of the research approach. This report is the final output required from the research project supported by GWA into an innovative approach to collecting reliable intra-household water use data. An interim report was provided electronically in December, 2008.

This report primarily details the methodological approaches of the water diary and their effectiveness. The initial portion of this report outlines the methodology. Data and results from the 2008 survey are then presented. Given this project's primary research purpose of testing the methodology, this section is relatively limited in detail. A discussion of the methodology, including presenting some changes for the 2009 survey follows the data and results. The nature of the changes required to the water diary for use in a development context are considered prior to the report's conclusion.

The appendices provide important additional information. The diary format used in 2008 is provided at Appendix One. Attachment Two is a table of the basic household data for all participating households. A financial report is provided at Attachment Three and an outline of information dissemination activities as Attachment Four.

The symbols, and their meaning, as used throughout the text are:

hh = household

F1 = household's head female

s = shared water use

M1 = household's head male

u/a = unaccounted water use

Water consumption is considered 'shared' if it falls within a 60-40 ratio.

Methodological Approach

The water diary offers a robust, flexible and transportable method to generate gender disaggregated intra-household water use data. All household² members recording their water use, according to activity, for seven days provides the quantitative data. Qualitative information is gathered through a short (two – three pages) questionnaire on a topic, or topics, relevant to the project's focus.

A fundamental methodological approach of the water diary is the self-selection of participants. That is, participation is voluntary, with households electing to respond to a call for volunteers. General calls for participants were advertised on the National Water Week activities database and through "Community Connect" a community activity advertising service provided by a local television station. Specific groups, including the three catchment committees in the ACT region, local Landcare and Parkcare groups, the ANU Water Initiative and ANUGreen, agreed to send a call for volunteers through their electronic mailing lists. Self-selecting represents an important identifier of an appropriate level of motivation within the household.

Twenty nine households received a spiral bound, clear plastic covered diary with a stamped addressed envelope. The decision to provide a physical copy of the diary, and a method to return it, comes from the experience of the initial trial where the researchers felt the sole use of electronic distribution contributed to the low return rate (33%). It was thought, for example, that the task of printing the document may have been prohibitive for cost or time reasons. Further, the inconvenience of keeping the printed pages in order and returning the completed diary was considered to have compounded the difficulties of working from an electronic version. Due to its size, a copy of the diary used for this trial has been provided to GWA electronically. Details are provided at attachment one.

The front section of the water diary booklet included information about the project and using the water diary, researcher contact details and a consent statement. A series of questions seeking household information such as location, property size and dwelling type, water sources and the age, gender, occupation and income range of residents were asked. A space, and instructions, for recording any leakage on the household side of the water supply system and water meter readings for the beginning and end of the diary period was also provided. The difference between the measured and estimated consumption was used, as available, to provide a percentage (%) error figure to aid researcher assessment of the estimation error.

A questionnaire followed the household information. Questions relevant to the research project focus or topics important to local household water use allow deeper investigation of household attitudes to relevant water concerns.

² Household is broadly defined in this research as an individual, or a group of people living as a coherent unit, in one dwelling. That is, this definition covers families, share houses and sole occupant dwellings but not boarding houses, hotels or university residential halls.

The 2008 questionnaire explored households' knowledge of, and attitudes towards, water conservation measures and restrictions, including any water use changes in response to restrictions. Questions of water authority and allocation processes within the household were also presented. These topics represent two research needs. The first need was to investigate household responses to supplier imposed water restrictions, an important local water issue. The second need was to ensure the data sets adequately reflected household water allocation attitudes and practices. The water diary could be run without a questionnaire however the overall richness of the results would be impoverished as questionnaire responses provide valuable qualitative data about the ideal water practices and values of each household. Contrasting the ideal behaviours with the actual water practices, as recorded in the diary, for example, provides information on the differences between household water values and practices.

The questionnaire can be answered independently by the participants or in an interview situation. Interviews were introduced in response to the brief answers provided to the questionnaire in the pilot trial. In 2008, 11 households (48%) answered the questionnaire in semi-structured interviews conducted by the researcher before and during the diary period. The interview selection process was to ask every second household agreeing to participate for an interview. If they declined, the next household to respond was asked and then every second household then on. The bulk of the interviews were conducted in the participants' dwelling. This provided an excellent opportunity to see household water practices and culture in action. Interviews also provided the opportunity to outline diary use and ensure the household wished to continue participating. Two households were interviewed about the ease of using the diary at the completion of the diary period. The remaining households (10) provided self-paced, written responses.

An information page, including a table of standard water consumption rates to aid estimation accuracy and space to record the make, model and water consumption rates of water using appliances marks, aids participant recording. The researchers used the water appliance make and model information to find the manufactures specifications for households that did not know the consumption rates of their water using appliances or could not use the standard rates provided in the table. A demonstration page outlining the recording conventions and how to calculate the household's daily consumption was also included.

The diary itself consisted of seven days; each dated and divided into 30 minute blocks over 24 hours. Water uses are recorded in minutes, litres or the number of uses, depending on the activity. This approach did not appear to cause any confusing in recording or interpreting data. Each day required two pages, with space for notes, comments and observations and daily calculations provided at the bottom of the second page. The 'whose authority' and 'who used' columns provide the tools to collect the authority and allocation data. The remaining 14 columns represent the various water uses: dish washing (by hand and machine), washing machine, toilet (full and half

flush columns provided), separate shower and bath columns, food preparation and drinking, evaporative air-cooler and cleaning, pets, pool/spa and a miscellaneous column.

An important element of managing the diary participants was regular communication with the participants. In 2008 this consisted mainly of regular email contact and prompt responses to participant's queries and concerns. Every participant received a 'welcome' email providing further information about the research project, researcher contact details, a reminder of the voluntary nature of their participation and key dates. A email was sent to all participating households the evening prior to the diary week, reminding them of the imminent start to water use recording, to test for water leaks and to take the first of the two required water meter readings. A further email was sent toward the end of the diary week, encouraging on-going participation and a reminder to take the final meter reading. Another email was sent the day after the survey period, reminding participants to return the diary in the stamped, addressed envelope. Follow-up emails were sent, to individual households as required, for two weeks following the nominated return date. All post-survey emails made it clear that the diaries did not need to be 'complete' to be useful to the research.

This research method represents a participatory approach to data collection. The willingness of the household, or at least the majority of its members, is required to collect reliable intra-household water use data. As with self-selection, the participatory aspect of this approach provides another test of the willingness and motivation of participating households. Additionally, through interviews and house visits, researchers are able to gain valuable insights about water use, particularly reuse, within the house. An important outcome from participation in the water diary is the potential for participants to become sensitized to their water use. While possibly a more significant consequence in high water consuming environments, this effect was not initially considered by the researchers and could have useful educative implications. This aspect of the water diary will be considered further in the discussion.

Water Diary 08: Data & Results

The data has been analysed to a relatively simple level – mostly on a weekly basis, generally by all households and with an emphasis on gendered use. The data are as readily analysed on an individual, hourly or daily basis; within and between households; by age, location, income or occupation; by water use or a combination of any of these variables. Given this project's emphasis on testing the methodological approach, a detailed data analysis was not necessary. The data is available for GWA to analyse further if required. The data presented here are limited by space and as such are exemplars, rather than definitive representations. The results discussion often incorporates more data than presented here. The graphs were created in Microsoft excel.

This section begins with a summary of the household information and basic consumption figures. Attachment Two presents more household information. Participants' gender attitudes to water allocation, using both questionnaire responses and diary data, are examined through water chore performance before briefly considering the diary data more generally. Three case studies provide a more detailed presentation of the nature of the data range possible from the water diary. The first details laundry and dishes by hand water on a gender basis; the second explores an individual household's water use and the third outlines the changing nature of the water use rank. This section of the report concludes with an overview of the participating households water conservation practices and attitudes towards water restrictions.

Participant/household data

Twenty seven diaries were delivered. Twenty three households returned diaries, giving a return rate of 85%. The diaries represented 57 people: 31 women (including six girls under 18) and 26 men (including six boys under 18). Ages ranged from two and a half to 72 years, with both genders having an average age of 38. There are four single person households, one composed of a single male, and one single gender household (all female). Nine households have people under 18, on a full or part-time basis. Fourteen households have pets; one a pool.

Thirteen households provided a seven day water meter reading: the highest metered use was 7 779.1L; the lowest was 404.6L. Both these households were composed of one female and one male resident, each in the 55-65 year age range. The highest metered use, 8 000L, was from a four person household (one women, one girl, one man, one boy), representing six days of consumption.

The estimated total weekly water use recorded in the diaries did not exhibit the same range as the metered readings. The highest estimate was 4 454.5L (three person household) and the lowest estimate was 358.5L (two people). The % error figure for the 13 households with both a meter reading and diary estimate shows the households to be fairly split in terms of over or underestimating their water use – seven households overestimated and six underestimated. All four low water using households (<1 000L) overestimated

their use. Four of the six high using households (>2 500L) underestimated their weekly water use.

As indicated in Figure Two, the total estimated water use across the 23 households was 47 432.65L. Women’s use accounted for 22 783.68L (48%); men’s 16 562.37L (35%). The balance was unaccounted or shared (including guest) use. The average daily individual consumption across the 23 households, using water meter reading where possible and diary data for the remaining households, was 169.2L/person/day, representing an average daily use range from 28.9L (1 person household) – 555.7L/person/day (2 people). The median water consumption was 104L/person/day, well within the water supplier allocation of 200L/person/day.

Total Weekly Water Use by Gender

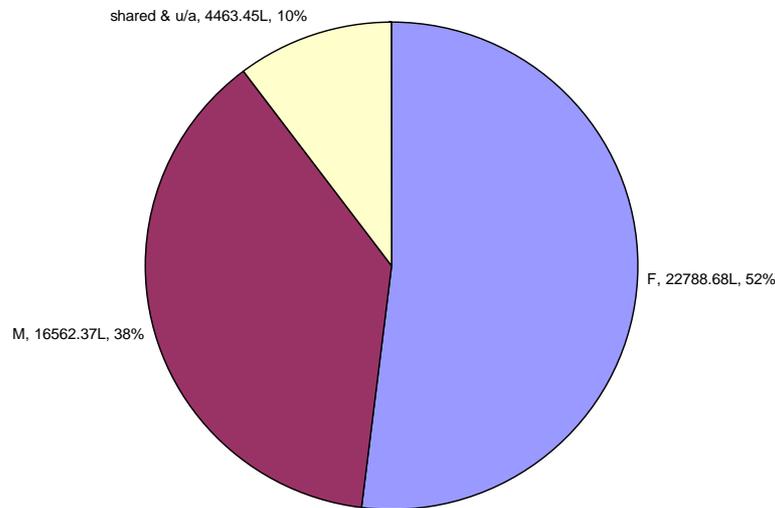


Figure Two Total water use (L) by gender

The water use split in Figure Two shows men use less water than women. Women account for 54.6% of the survey population and 52% of water use. Men, accounting for 45.4% of the population, use 38% of the household water. The balance is shared or unaccounted by gender water use. Close to the outer boundary of the 60/40 ratio representing ‘shared’ household water use for the purposes of this research, Figure Two suggest the households enjoy reasonably shared water use on a gender basis. It is not till the data is reviewed on a household basis that the variety in gendered water use patterns becomes evident.

Allocation

Diary entries and questionnaire responses recording the allocation of water within each household directly reflect the water diary’s conceptual link to understandings of intra-household resource flows gained in development contexts. The five single gender households are excluded from this

discussion, leaving 18 households represented. The interviewed households provided the most fulsome responses to the questionnaire.

A broad observation about water allocation from the questionnaires is that few households regarded gender as integral to establishing their habitual household water practices. Rather, the participants' comments pointed to expertise and household culture as more relevant than gender in authority and allocation matters. For example:

- ◆ expertise: "initiated depending on expertise" (hh19); "people's expertise respect in debate" (hh6); and
- ◆ household culture: "guests know to use water carefully" (hh11); "we and extended family agree on conservation" (hh16); "become much more aware in the country" (hh13).

The most obvious cases of a household member having clear authority for water allocation raised in the questionnaire related to parental/offspring relationships. Most notably, bathing and chores were often done by children at their parent's behest. Even in this situation, the educative authority parents' possess, to teach children a household specific water culture, for example, tempered questions of decision making and enforcement authority: "restrictions provide family bonding/communication opportunities to achieve both best practice with family building" (hh10).

Other interesting comments in relation to parent/child authority were provided. One household noted water restrictions provided an opportunity for "family bonding/communication to achieve both 'best practice' with family building; can approach water saving issues as family/learning practice" (hh10). This same household noted the conflict between childhood development needs and water restriction requirements such as no lawn watering. One household noted they "should be asking more of older (male) child" (hh15), pointing to role of household in reproducing cultural practices and social values. Households with shared custody arrangements noted the difficulty in enforcing their particular household water culture on children moving between different water cultures "having boys part time makes enforcement difficult" (hh15) and "what of those with shared custody?" (hh4). These comments all provide evidence of the importance of the household in reproducing water cultures.

Water Chores

As household water supply and access are not major issues in the ACT region, gendered water allocation is more readily explored through water chore performance indicators. In this way water consumption rates become a proxy to articulate intra-household gender relations. Gender inequities in the range of, and time spent on, domestic duties performed remains an important marker of gender relations in Australia (Baxter, Hewitt & Western, 2005). The seven water chore categories in the 2008 water diary were: dishes (by hand), dishes (by machine), food preparation and drinking, garden, cleaning and pets.

Three households responded in the questionnaire that F1 performed most of the water chores, with the diary records largely reflecting that response. Eleven households indicated that water chores were allocated on an “as required” or “shared” basis. One share house reported everyone did their own water chores. The four remaining responses (not all households responded) recorded an individual pattern of water chore responsibilities. The gender involvement in water chores, as recorded in the diary, is indicated in the following graphs.

Female Water Chore Participation (% use) by Household

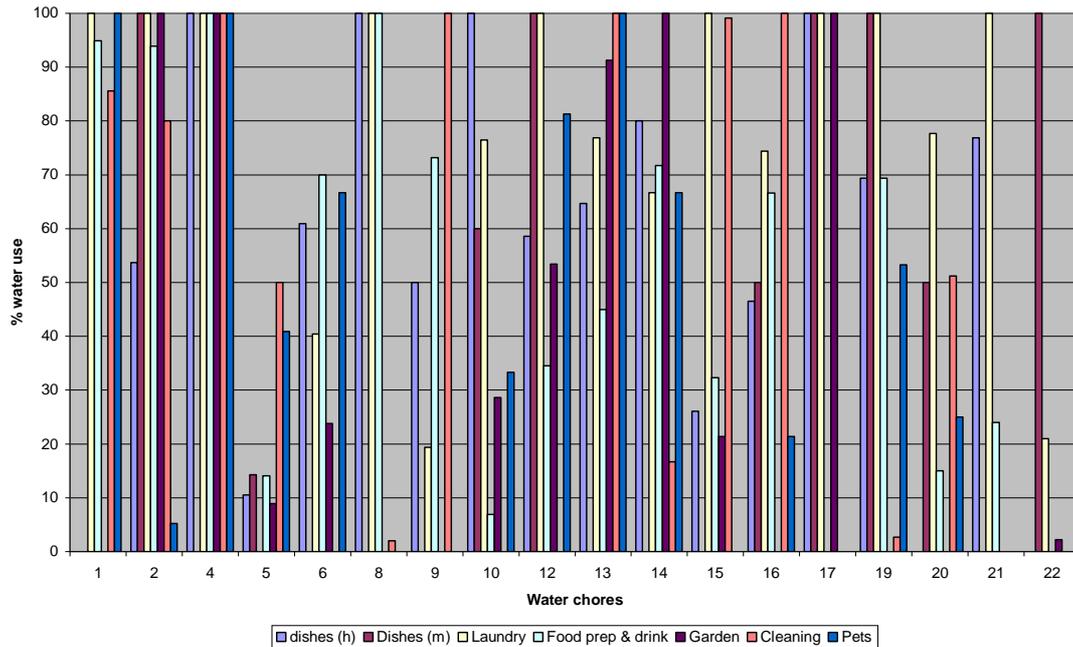


Figure Three Female water chore participation

Male Water Chore Participation (% use) by Household

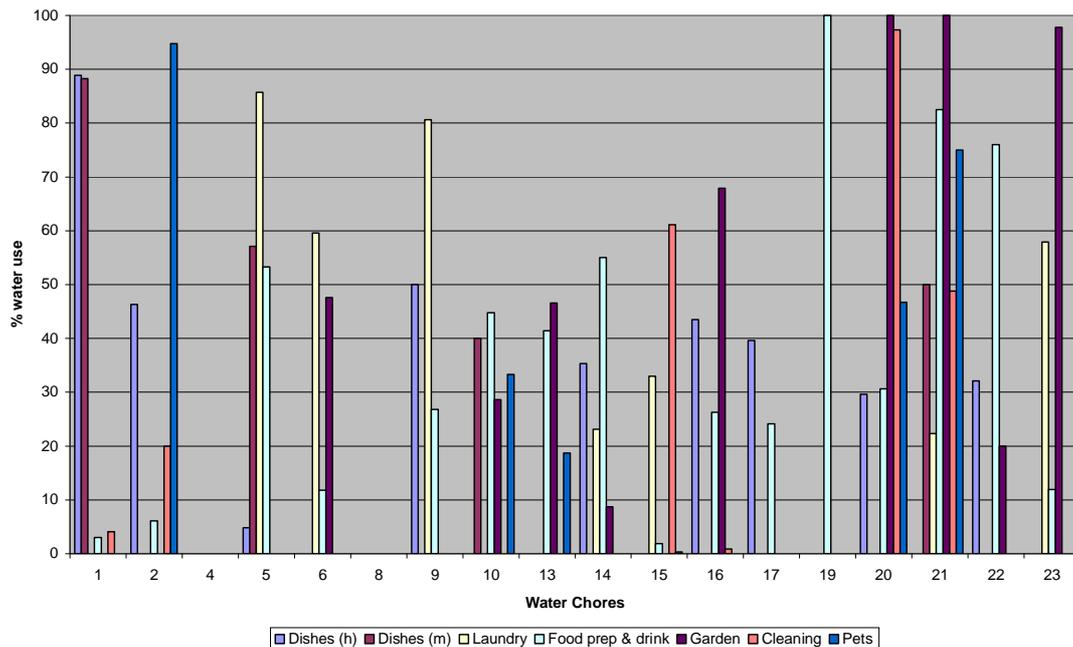


Figure Four Male water chore participation

The number of water chores women performed ranged from three to seven (Figure Three). The average was five; the most common was six. In approximately 50% of households women use 100% of the water required in at least one water chore category. The consumption of 100% of all the water required for a water chore can suggest 100% of that chore performed by that gender. Men's participation (Figure Four) ranges from no water chores to six. The average number of water chores performed by men is 2.9; the most frequent is four. In four households (22%) men consume 100% of the water in at least one water chore category.

Although the questionnaire responses pointing to largely non-gendered allocation of household water chores, the diary records indicated differently. Fewer household diaries than questionnaire responses had male participation on a "50/50", "shared" or "as required" basis. Women performed a greater range of water chores than men, accounting to a large extent for their relatively larger water consumption overall. Many households followed a rough pattern of women doing the majority of laundry, cleaning, dishes (m) and pets and men doing a reasonable share of dishes (h), food prep and garden. Men appear more willing to be involved in washing dishes (by hand), garden and food preparation with the clear majority of the water used to perform laundry, cleaning, looking after pets or dishes (washing machine) chores generally being accounted to F1. The gendered participation in laundry and dishes (h) is examined in the following case study.

Case Study: Gendered Water Chores

To further explore gendered water allocation through water chore participation, this case study examines the weekly laundry and dishes by hand water use, across the 18 dual gender households. Some household water use does not equal 100% as not all water use was recorded by gender.

Laundry

Seven households (39%) recorded both men and women doing laundry. As indicated in Figure Four, in four (22%) of the applicable households men do the either the majority or share equally the water use for the laundry. This suggests those men are doing majority of the loads of washing. Given the emphasis on water, the diary is silent on who dries, folds and stores the clean laundry. In the remaining 14 (78%) households, women use the majority, often all, the water consumed in the laundry.

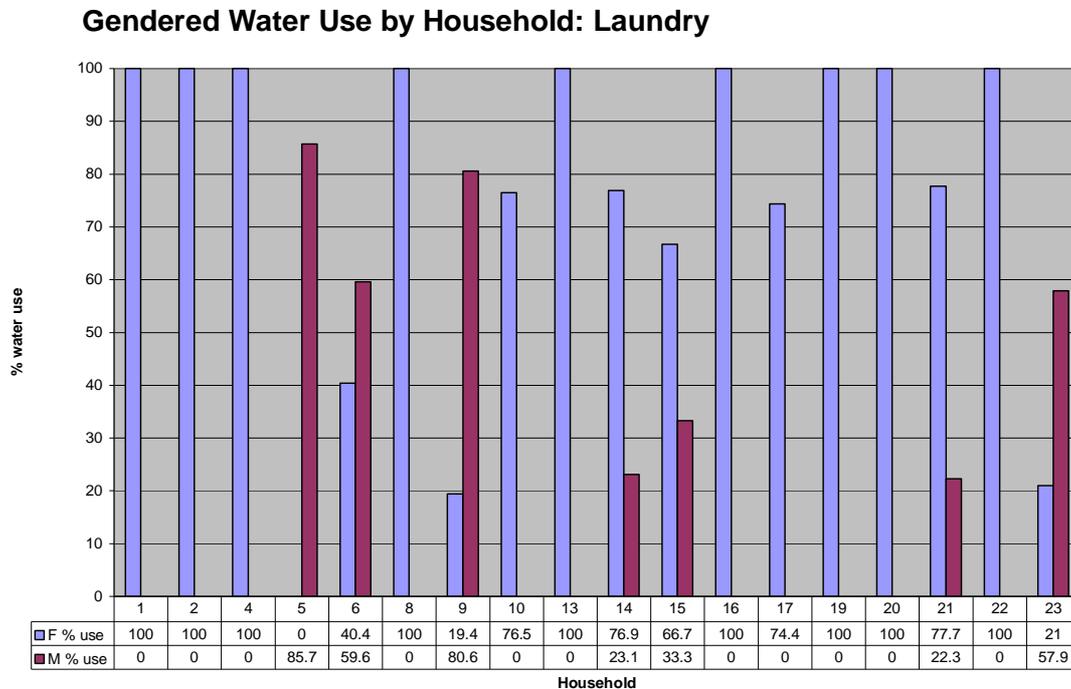


Figure Five Laundry water use by gender

Dishes (h)

Two households recorded no dishes cleaned by hand, thus the sample size for this water use category is 16. Eight households (50%) recorded male and female participation washing the dishes by hand - one household recorded an exact 50/50 split. One household recorded 100% male water use. Seven (44%) household recorded only women using water for, and therefore doing, the dishes.

Gendered Water Use by Household: Dishes (h)

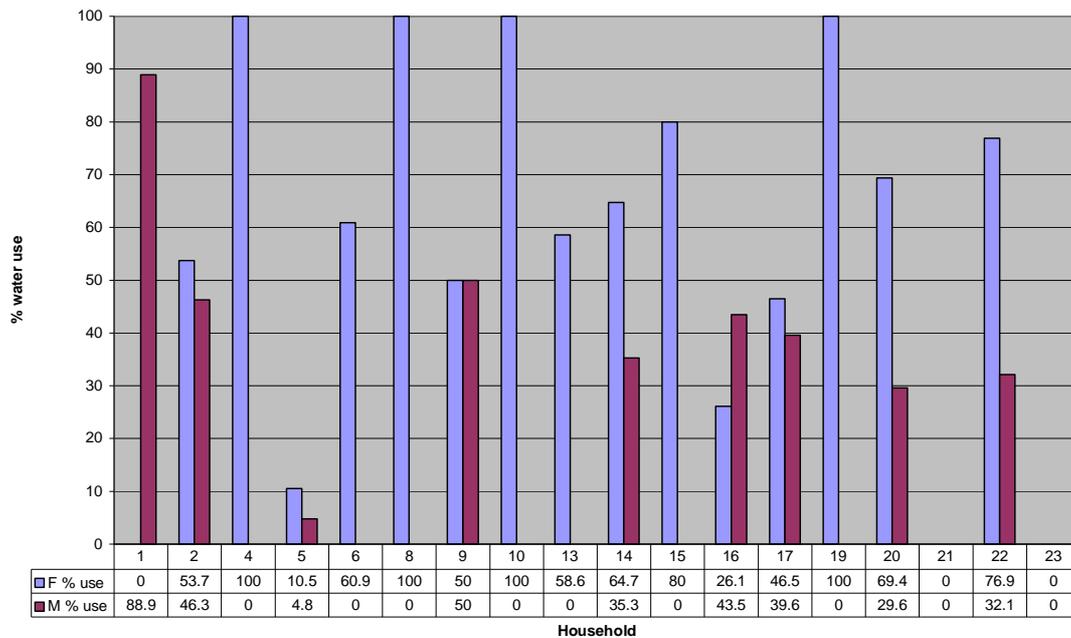


Figure Six Dishes (h) water use by gender

Even though men are more likely to be doing the dishes by hand than the laundry, they generally consume less water than women in the performance of these water chores. This suggests that men perform a smaller portion of the total water chore responsibilities in these households than women. These graphs also hint that in those households where men participate in water chores, they participate on a roughly shared basis in the chores they choose to participate in.

Within Households

As suggested previously, looking at the gendered consumption across the gross weekly total hides the diversity of gendered water consumption patterns at the household scale. The gender variation in intra-household water consumption across the households is clearly demonstrated in Figure Seven Excluding the single gender households:

- ◆ approximately one quarter of households have water use split between genders on a shared basis (ie within 60/40 range);
- ◆ four households represent an extreme gender division, that is greater than an 80/20 split, in the percentage of water consumed. In all these households, women are using the greater volume of water; and
- ◆ in five households (~22%) men’s water use is higher than women’s. These households are considered in more detail shortly.

This analysis gives another layer of understanding to the Figure Two, providing a more nuanced picture of the nature of intra-household water allocation. The following case study looks at the weekly water use of household 16 in more detail.

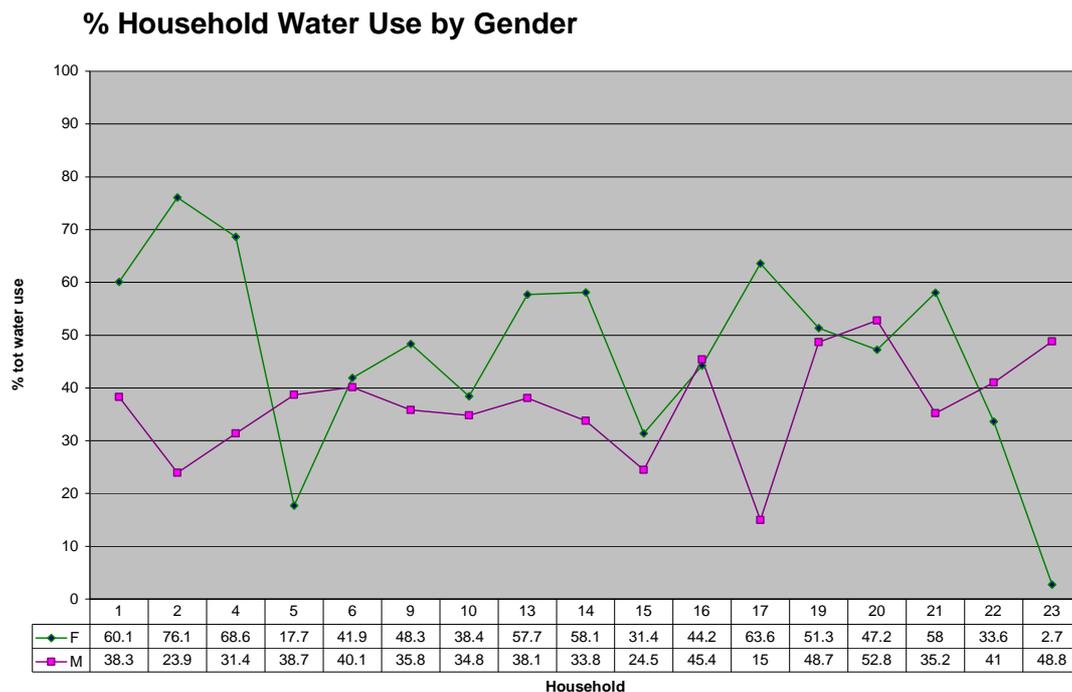


Figure Seven Percentage household water use by gender

Of the five households with higher male water use, only one has a gender imbalance – one more man than women. Two households fit the research project’s definition of shared water use. The household with more men is one of three where male water use exceeds both women’s and the definition of shared. In this household, and one other, the higher male water use is largely accounted for by their performance of the laundry water chores. Showers account for the remaining household’s higher male water use.

Case Study: Household Sixteen

This two member (1F, 1M) household on a rural grazing property has no reticulated supply. Water is sourced from rain water or ground water bores and there is no water meter. 2 330.15L of water use was recorded in the diary. Gendered water consumption was shared and the daily average use per person was 166.8L. Figure Eight indicates the volume (L) used by gender. Some of the shared water appeared to be shared morning or afternoon drinks, judging by the timing, regularity and volume of water consumed.

Household 16: Gendered Weekly Water Total Litres

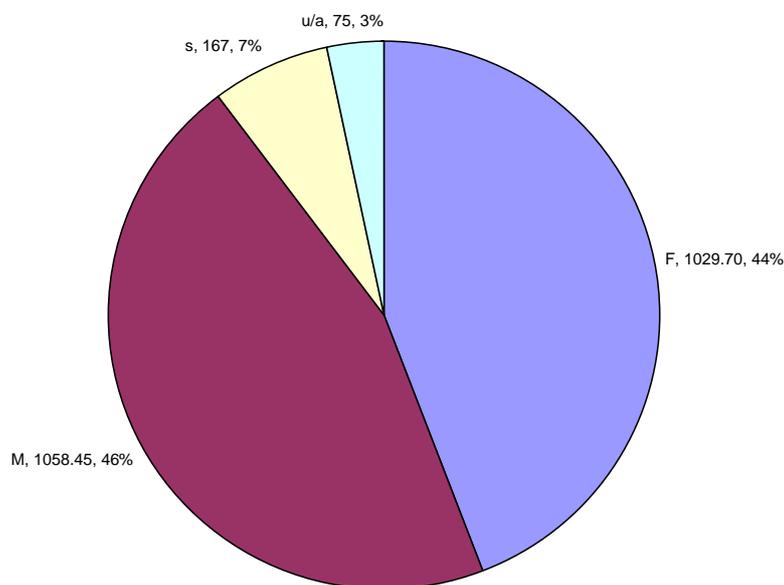


Figure Eight Household 16 water use, in L, by gender

This household exhibits a unique water use order of shower, garden, kitchen (dishes and food prep), laundry, toilet, misc, cleaning. As indicated in Table Two, the female resident participates in five water chores: dishes (h), laundry, food preparation & drinking, garden, cleaning; the male four: dishes (h), food preparation & drinking, garden and cleaning. This household responded in the questionnaire that water chores were not designated, but “shared as needed”. The diary record shows that while the female did all the laundry and the bulk of cleaning and the male the more garden and dishes (h).

Use	Tot (L)	Tot (%)	F(L)	M(L)	% F use	% M use
dishes (h)	230	9.9	60	100	26.1	43.5
dishes (m)						
laundry	200	8.6	200	0	100	0
toilet	123	5.7	69	54	56.1	43.9
bath						
food prep	49.5	2.1	16	13	32.3	26.3
shower	902	38.7	440	396	48.8	43.9
garden	700	30	150	475	21.4	67.9
cleaning	60.5	2.6	60	0.5	99.1	0.9
pets						
misc	65.15	2.8	34.7	19.95	53.3	30.6

Table Two Household 16 weekly gendered water use by activity

Although not subject to supplier enforced water restrictions, this household reported “self-imposed conservation measures”. These included not flushing with every use, even though they have dual flush toilets, washing up in a bowl in the sink, choice of low water using washing machine, restricting shower time and car washing, use household grey water in garden, the use of low water consuming cleaning methods and changed gardening practices.

Daily data is readily available for analysis. Table Three presents the highest water consuming and lowest water consuming days of household 16 and is provided as an example of the detailed data available for analysis. The diary data also allows for intra-daily and cross household analysis of intra-household water use. Figures Nine and Ten present the female and male water chore consumption rates for these two days.

Day	dishes (h)	dishes (m)	laundry	toilet	bath	food prep	shower	garden	cleaning	pets	misc	gender total
Mon 20/10												
F	10		100	9		1.5	44				3.3	177.8
M	20			12		1.5		250			1.7	285.2
shared						2						2
u/a												
Total	30		100	21		5	44	250	10		5	465
Tue 21/10												
F	10			9		1.5	88				1.5	110
M				12		1	44				1.5	58.5
shared	10					1.5					4	15.5
u/a												
Total	20			21		4	132				7	184

Table Three Household 16 highest and lowest water using days

Household 16: Female water chore 2 day consumption (L)

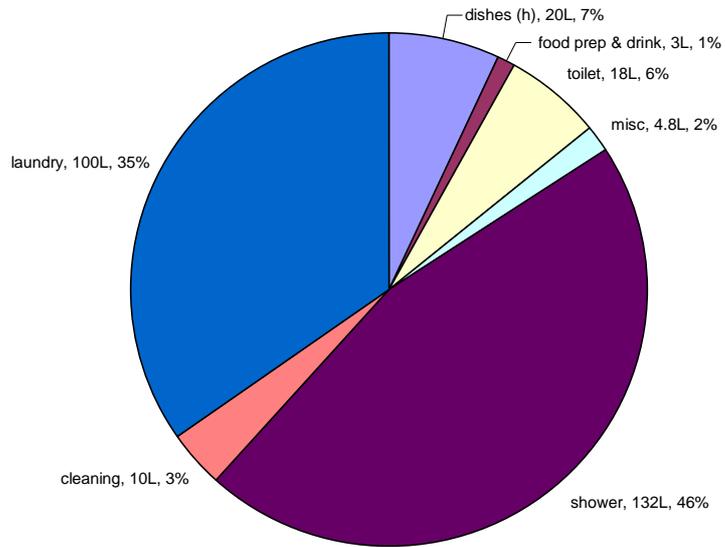


Figure Nine Female water chore water consumption (L) – 2 days

Household 16: Male water chore 2 day consumption (L)

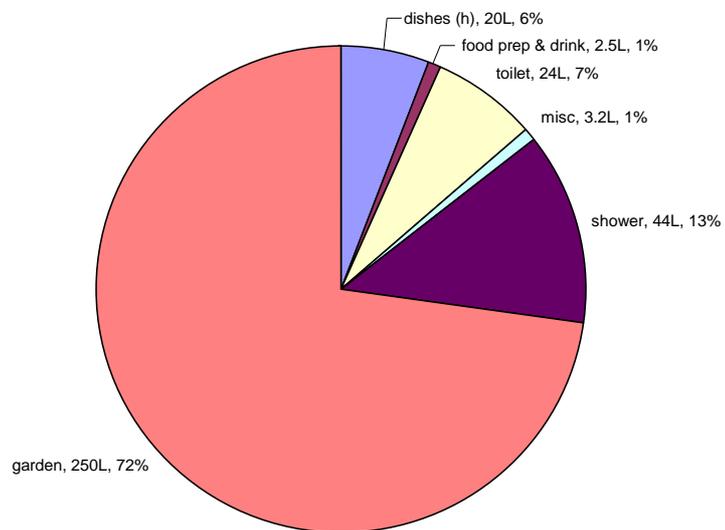


Figure Ten Male water chore water consumption (L) – 2 days

Water Conservation Attitudes & Adaptations

Participants were very aware of the current restrictions, particularly those activities performed in their own household. That is, no lawn watering, no car washing, no window washing and no hosing paved areas were commonly cited as the meaning of level three restrictions. Other than two references to pools, there was no mention of the other relevant restrictions. One household had the current restrictions posted in the house and another commented they check “suspicious behaviour before proceeding...if not allowed, then won’t do it” (hh17).

Twenty one households reported water behaviours being affected by restrictions. Many had made substantial changes in response, such as changing to native and/or smaller gardens, a significant increase in reusing potable supply and rainwater collection. Some households also reported being motivated by a personal ethos, rather than water provider restrictions and that many of the behaviours noted were practiced before restrictions were applied.

Each household reported at least one water saving device and one water conservation practice. Table Four indicates all the water saving devices recorded and the common water saving practices employed in the participating households. Five households reported F1 as the most likely to suggest water conservation practices or the adoption of water saving devices. In these households M1 was generally responsible for sourcing or installing the necessary bits and pieces to effect F1’s suggestions. Three households listed F1 as the enforcer of household water culture and practices; one noted M1. Eight households responded that enforcement was a “joint” or “everyone’s”, responsibility. Two household’s (both the share households) responded that nobody enforced a household water culture.

The entrenched influence of on-going high level water restrictions is indicated by a number of households reporting many of the practices adopted are unlikely to be abandoned when restrictions are eased. Only one household reported one practice reduced due to restrictions would be reinstated (car washing). This result is a positive indication of the ability to influence well-established water cultures.

A fundamental feature of water conservation practices not noted in the table is water reuse. Although beyond the scope of the research project, it is raised briefly in the discussion section as it is significant enough to consider incorporating it into the water diary.

Water Saving Devices	Water Conservation Practices
water efficient dishwashers and washing machines	selecting appropriate water levels on washing machines and dishwashers
dual flush toilets	not flushing toilet with every use
water saving shower heads	Showers – shorter: use of timers; – fewer: not daily; and – ‘dry’: water off for soaping etc
installation of dripper systems	not washing dishes daily
sub-surface grey water distribution system	no taps running while cleaning
trigger nozzles on hoses	sweep outdoor paved areas
timed shower monitor that turns water off	clothes not washed until dirty
‘enjo’ products	good tap/plumbing maintenance

Table Four Household water saving devices and conservation practices

In spite of the strong support for water conservation policies widely indicated in the diaries, there is clear dissatisfaction with the rigidity of the current water restriction practices where dictating water uses and personal behaviour is perceived to be the pre-dominant approach. Parents, for example, commented on the need to balance responsibilities with water restrictions: “happy with odds and evens [days watering allowed] but time [of day to water] difficult with young child” (hh14). Further, it was seen as inequitable and punitive that a household staying below the water supplier’s daily usage guideline could not decide for itself how to use the water. While agreeing water conservation to be an important social and environmental goal, there was a broad sentiment among the participants for the need for more flexible approaches. Five households suggested some sort of allocation approach, where households make their own decision about how a set amount of water is used, as an alternative to a simple list of prohibited behaviours. All approaches “aim is to get people responsible and self-managing” (hh14).

In spite of the awareness of, and support for, water restrictions, the diaries provided evidence of some household practices not matching household knowledge or rhetoric. For example, the stated intentions to follow restrictions for garden water use were contrasted with the recorded behaviours. Of the 16 households recording garden water use, and being aware of water restrictions in the garden, less than 20% intended, and managed, to follow them; the same percentage did not intend to follow them. Twelve and a half percent intended to but did not follow them. That is, the high levels of awareness about water restriction requirements recorded in this survey, matched with the low level of compliance – intended or otherwise – suggests the restrictions approach is not as effective as the local water supplier would anticipate.

Case Study: Changing Water Use Rank Order

As well as identifying intra-household water use, this research approach can identify large scale water use patterns. One example from the 2008 diary was the patterns, and variation, noted in the water use rank order. It appears the large scale water use rank order is in flux. Three obvious patterns were identified (Table Five), yet no one pattern dominated with most households represented by these three rank orders. What could be regarded as the traditional intra-household water use rank order for Canberra comes from Mitchell, Mein & McMahon (1999:7). The other two rank orders are results from the 2008 diary data.

Only one household strictly followed the traditional order. When garden use is disregarded, eight households (~35% of survey group) exhibited this rank order. There is no doubt ACT region households use significantly less water outdoors in 2008 than in 1997. For example, more than 50% of households reported no potable water use outdoors. Of the 11 households recording garden water use, seven recorded 20% or less of the total household water consumed in the garden. Further garden use appears randomly throughout individual households rank order. These variable outdoor water use rates reflect the changing garden watering behaviours in response to an extended of water restrictions, as confirmed by many participants in questionnaire responses. For these reasons garden water use is best disregarded for this comparison as it appear garden water practices are changing, with a greater variety in garden water consumption demonstrated in 2008 that is suggested by the Mitchell et. al figure.

The standard pattern was evident in seven (~30%) households. 'Standard' comes from the sense that this water use order is probably replacing the traditional order in ACT households. It is also the rank order shown for the total combined household water use at Figure One. The difference between the two rank orders is that laundry water use is higher than toilet water use in the standard rank order. This change in relative water use can be attributed to:

- an increase in dual flush toilet installation: more dual flush toilets installed now than in 1997, partly due to successful retrofitting programs. As increasingly lower flush rates are introduced, the water savings continue to increase;
- the widespread practice of not flushing with every toilet use. 17 households reported not flushing every time, including those with dual flush toilets; and
- the increasingly high social standards about the cleanliness of clothes generating more laundry.

Traditional	Standard	Future?
Garden (55%)	Bath & Shower (34)	Laundry
Bath & Shower (16%)	Laundry (20)	
Toilet (14%)	Toilet (16)	
Laundry (10%)	Kitchen (11)	
Kitchen (dishes, drink & food prep) (4%)		

Table Five 2008 Water diary common water use rank orders

Five (22%) households demonstrated the final rank order, where the clear dominance of laundry was the only common feature. Titled ‘future?’ this rank order suggests the dominate water use of future households. The potential dominance of laundry reflects not only the effects of the actual and potential water savings in toilet and shower use and technologies, but also the increasing cultural demands for squeaky clean clothes (Shove, 2003). It is possible reductions in washing machine water consumption will not counteract this trend.

Discussion

It is widely acknowledged that the time has come to investigate resource allocation in the most intimate and small scale setting of human relations, the household. No longer can the role of households and their individual water cultures in the water cycle be ignored or dismissed. Increasing urbanization and decreasing supply certainty means no area of water consumption can be cocooned from intellectual exploration or governance concerns. This research approach provides a participatory method to investigate the household, which includes and informs the participant while providing layered data sets for researchers. The range of possible uses of such information shows the importance of collecting both attitudinal and numerical information about intra-household water use, including, but not limited to:

- ◆ understanding the role of households in producing and reproducing water cultures;
- ◆ informing demand management policies,
- ◆ effectively targeting education/advertising campaigns,
- ◆ assessing infrastructure requirements; or
- ◆ understanding attitudes and values to water.

Further such information may help foster appropriate changes to household water cultures, encourage the adoption of non-water based technology (such as ecosan practices) and contribute to meaningful reductions in household/domestic water demand.

Water Diary Useability

The diaries appear generally easy to use, with few problems in recording noted by participants or noticed by the researchers. The high return rate (85%) suggests participants were comfortable with their level of compliance. The post-survey interviews indicated no major concerns. Minor recording issues such as column ordering and units of measurement (seconds instead of minutes) were raised.

A difficulty experienced by a small number of participants was recording multiple water users simultaneously; for example, how to record F1 washing the dishes while M2 showers. The affected households' consistent use of recording techniques in these situations however, allowing interpretation their water use. A slight change in the diary format will remove this point of confusion entirely. In future, participants will be asked to record their resident code (eg F1) in the water use column, along with the volume of use. This will allow the removal of the 'who' column, giving more space to the water uses columns.

The most common comment from participants concerned the difficulty in remembering to record all water use, particularly early in the recording period and especially for small squirts. Reminder emails were sent strategically throughout the diary period. However, the inability to remember to record all water use is probably a reflection of the difficulty of incorporating any new behaviour into a daily routine, rather than a lack of interest in or ability to

participate. Households interviewed post-diary indicated they managed this by making a concerted effort to review their water use daily, and jointly.

Recording small squirts of water, such as rinsing out a wash cloth or washing hands, could be managed by allocating a certain amount of water to each participant's daily total. However, this fails to account for participant's who do record their daily squirts. Another solution could be to offer ways to manage this issue during the estimate training. For example, participants could be asked to establish an average 'squirt' value (L or secs). This average could then be used to establish a daily squirt total by multiplying it by the number of squirts. The resultant figure can then be added in the miscellaneous column at the end of the day. A notepad or similar next to taps could be used to tally each squirt. It is yet to be decided if this situation will be managed through estimate training, or better managed by allocating participant's a daily 'squirt allowance', or if the volumes under consideration are significant enough to warrant greater attention.

Motivation

As noted there are external checks of household motivation to participate. However household dynamics ensure disparate levels of individual motivation. This disparity was quite noticeable in the two share houses. The participation of these individual's can not be compelled and the opportunity for researcher contact, to discuss their participation, is limited. There are two obvious management strategies in this case. The first strategy is to ignore them entirely by not including them in any of the calculations or discussion, even if they are accounted for in the household information page. This would have the effect of rendering any water meter reading for these households ineligible for analysis, given it would represent the water use of more people than represented in the water diary. The second strategy is to give non-participating members an average consumption figure. Some researcher discretion would be required at this point as the water uses used to generate an average consumption figure depends to some extent on what is shown in the diary and questionnaire responses. Clearly the non-participating individual would be given an average toilet and shower/bath use average. However their laundry, gardening, cleaning and cooking volume use would also need to be accounted for. This is a time where the strength of combining attitudinal and numerical data becomes evident as the ability to read inferences into the diary data is important. For example, if the household responded each resident did their own water chores, the non-participating resident would require an average figure for these activities.

For households that are also families, the diary entries indicate that usually one parent records for the younger children and the teenagers record their water use themselves. This and interview experiences strongly suggests each household has one member who motivates the others, picking up the slack as able. Interviews provide an excellent opportunity to identify this unofficial household champion. The champion is likely to be the one who responded to the call for volunteers or is the most active during interviews. Formal recognition of this role could provide a valuable link for the researcher into the household. Not only does it provide a consistent point of contact, a

household champion is also an advocate for the research. Properly informed and adequately recognized, household champions have the potential to positively contribute to a water diary project's overall success.

The variable levels of participation possible within each household during the diary period are accommodated for by the diary structure and the information provided. For example, households with enough motivation to participate are required to answer a questionnaire, at their own pace; take two water meter readings; and record all water use over seven days. More motivated households can calculate their daily and weekly water use totals in the space provided, following the example calculation and using data provided in the diary and by them. The most motivated households in the 2008 water diary spontaneously took daily water meter readings and measured their water using applications consumption against the water meter.

Self-selection

As articulated in the methodology section, self-selection provides a cornerstone of the research approach and provides one 'test' of a household's willingness to participate in an effective manner.

Self-selection can generate sample groups with a predominance of self-identified water conscious households. However this does not directly correlate to a predominance of low water using households in the sample group, as a water conscious household is not necessarily a water conserving household. From the questionnaire responses it was evident the majority of the household considered themselves water conscious. The data however showed high water users (>2 500L) are likely to significantly underestimate their water use. All the low water users (<1 000L) overestimated their water consumption. It is uncertain whether this effect will be replicated in a development context, given the different household water situations to those of the ACT.

Gender

As indicated in the data and results section, the water diary provides wide scope for gender disaggregated data. This data can be compared within or between households, on a number of temporal scales. The "who used" column is a built in mechanism generating gender disaggregated data, even if the primary research focus is another variable. This structural strength affords the diary approach wide applicability in water planning processes as it can gather detailed gender information simultaneously with other water user information.

It may be useful to investigate the intra-household dynamics of those household's identify with high male water chore participation rates, to see if there is anything to be learnt and shared.

Water Diary 2008

While the questionnaire data may appear muted, or neutral, on the question of gender equity within the participating households, the diary data does expose disparities in practice. Generally, women continue to use more water,

performing a greater range of water chores than men. This difference is starkly demonstrated by one household's M1 using water entirely for personal hygiene purposes. No women recorded a similar water use pattern. Although the large number of household with both genders participating in water chores is in contrast to some of the more bleak analysis of the division of household labour. This more encouraging analysis of the gender division in household labour may reflect the research approach emphasis on a resource, rather than activity.

In light of the high participation rate of women in household water chores, questionnaire references to 'expertise' regarding how decisions about household water conservation practices and water saving devices are made can be reconsidered. It may be that her high involvement in water chores affords F1 a strong influence in associated decision making and enforcement processes. That is, the expertise referred to in the questionnaire may be the household's recognition of F1's performance of water chores.

Allocation

As noted in the data and results section, the most obvious expressions of water allocation/authority in the water diary was those found in child/parent relationships or were said to be based on expertise. One implication of the tendency of water users to see allocation decisions in terms of expertise is that gender approaches to water education and the promotion of a preferred water conservation culture will not be enough to encourage the desired water behaviour changes. An approach based on increasing water users' knowledge of the water saving practices and devices is likely to be more effective.

Methodological Successes

Water Diary Transferability

The research approach represented by the water diary is transferable between rural and urban environments. Rural households, with no access to reticulated supply, generally have no water meters. Although the impacts of different water supply are reflected in both water use and attitudes, no changes to the structure of the diary or how the participant's use it is required. However rural households can not provide a measured total consumption figure or individual water appliance consumption rates. All their data are estimated water volumes.

Interviews

The interviews proved a successful addition to the research approach, with highly detailed responses being provided. Additionally, the individual contact appeared to establish a researcher/subject relationship encouraging careful diary recording and an increased chance of the diary being returned. Other benefits of interviewing include:

- an opportunity to clarify diary use; and
- a chance to see how participant's use water in and around the house. This information is useful to understanding water diary notes or interpreting recorded water use behaviours.

It is recommended that those using the water diaries keep interviews a part of their research approach. Although the research approach will still generate good data without interviews, they do offer an opportunity to provide a nuanced context to the diary numbers. Although a time consuming exercise, aspiring to survey 50% of the households before or during the diary period would ensure sufficient qualitative data. Large numbers of households could be interviewed in suitably structured groups to effectively catch a range of values, opinions and responses. The structure of such groups would need to account for different the communication and participation styles, as set by local gender, class and cultural conventions.

Sensitization

Participation in the water diary appears to have a sensitizing effect on participants. A number of participant's noted a heightened awareness of their water practices as a result of "being under monitoring" (hh18). Some participant's reported changed water use behaviours "especially in the shower" (hh 11). Certainly some of this heightened awareness could be accounted for in terms of the Hawthorne effect. However the sustained nature of the heightened awareness suggests something more substantial than the short-term Hawthorne effect.

There are a number of reasons why this sensitizing effect may be more than a passing heightened awareness. For example, some households were effected when they calculated their daily consumption, rather than in response to recording their use. Additionally, each participating household received a table of all households' essential water consumption data, providing an opportunity for households to compare their water use with other, similar, households. From personal communication, I am aware that these comparisons have prompted changes in water use practices in some households. Conducting post diary interviews or focus groups exploring the range and nature of this sensitization process could be beneficial. If proven to be significant, this effect could be exploited for domestic water education campaigns or water policy development or management purposes.

Methodological Changes

Earlier commentary has already recommended some changes, including the formal identification of a household champion, use of interviews and how to record non-participating household members water use. Some minor modifications to column titling and ordering to future diary surveys is required. For example, shower and bath columns will appear consecutively and evaporative air-cooler use, which seems uncommon locally, will be recorded as a total daily number of minutes near the space provided for water using appliances make and model information. As noted in the initial report, there was some unanticipated concern about data sharing between the researchers and water supply agencies. The information provided about the diary will in future clearly express the anonymous nature of any data sharing. The following activities will also be incorporated into the research approach.

Estimate training

Identifying changes in water use rank order shows how the methodology remains effective, in spite of any estimation errors, as the relative consumption information remains consistent given people's tendency to (mis)estimate consistently. However it is important to mitigate estimation errors where possible, thus some estimate training, such as a series of measuring (volume and time) exercises, could be provided to improve estimation skills. This type of approach is easily incorporated into interviews or focus groups, but they would also need to be understandable and possible to undertake independently. These exercises could also be designed to motivate children's participation.

Daily Meter Reconciliations

Where water meters are available, daily meter reconciliations are highly desirable to increase the rigor of the quantitative data and as a standard for assessing the estimates. Daily reconciliations appear to encourage more accurate estimation of water consumption. Two households independently chose to do daily reconciliations and recorded the best % error values of all households (hh 11 underestimated by 1% and hh 17 overestimated by 4.3%). Further, the households interviewed post-diary felt daily reconciliations would improve their recording accuracy and indicated a willingness to read the water meter at the same time every day during the water diary period.

It is also recommended that participants record all water using appliances consumption against the meter for at least one use. By having the individual water appliance consumption rate, rather than the manufacturer provided theoretical rate, the accuracy of usage estimates are further enhanced.

Recycled, Non-reticulated and Diverted Water Use

Recycles, non-reticulated and diverted water uses are beyond the formal scope of the research project. However their importance to the household water cycle is significant enough to warrant a brief mention. Recycled (grey) water use refers to the multiple uses accorded a single quantity of water. Figure Eleven shows the variety of paths water may take from the tap to the drain or, as is more likely, the garden. The interviews and diary suggest a high rate of water reuse by households in the survey. One household, for example, runs the toilet entirely on grey water. Currently, however, there is no mechanism to quantify the volume of reuse. Future versions of the water diary may attempt to capture this important aspect of the intra-household water cycle

The use of non-reticulated supplies, particularly tank and ground water, is increasing. This methodology could be applied to any water source. The use of such sources may be of interest to water policy officers but is unlikely to concern domestic water suppliers.

Diverted water use refers to water activities that occur at alternative sites. In terms of households, the most common forms of diverted water use include food preparation, cooking and showers. Showering at the gym instead of at

home, for example, is a common practice that may reduce water consumption at a private dwelling but not actually reduce individual consumption rates.

Intra-household Water Reuse

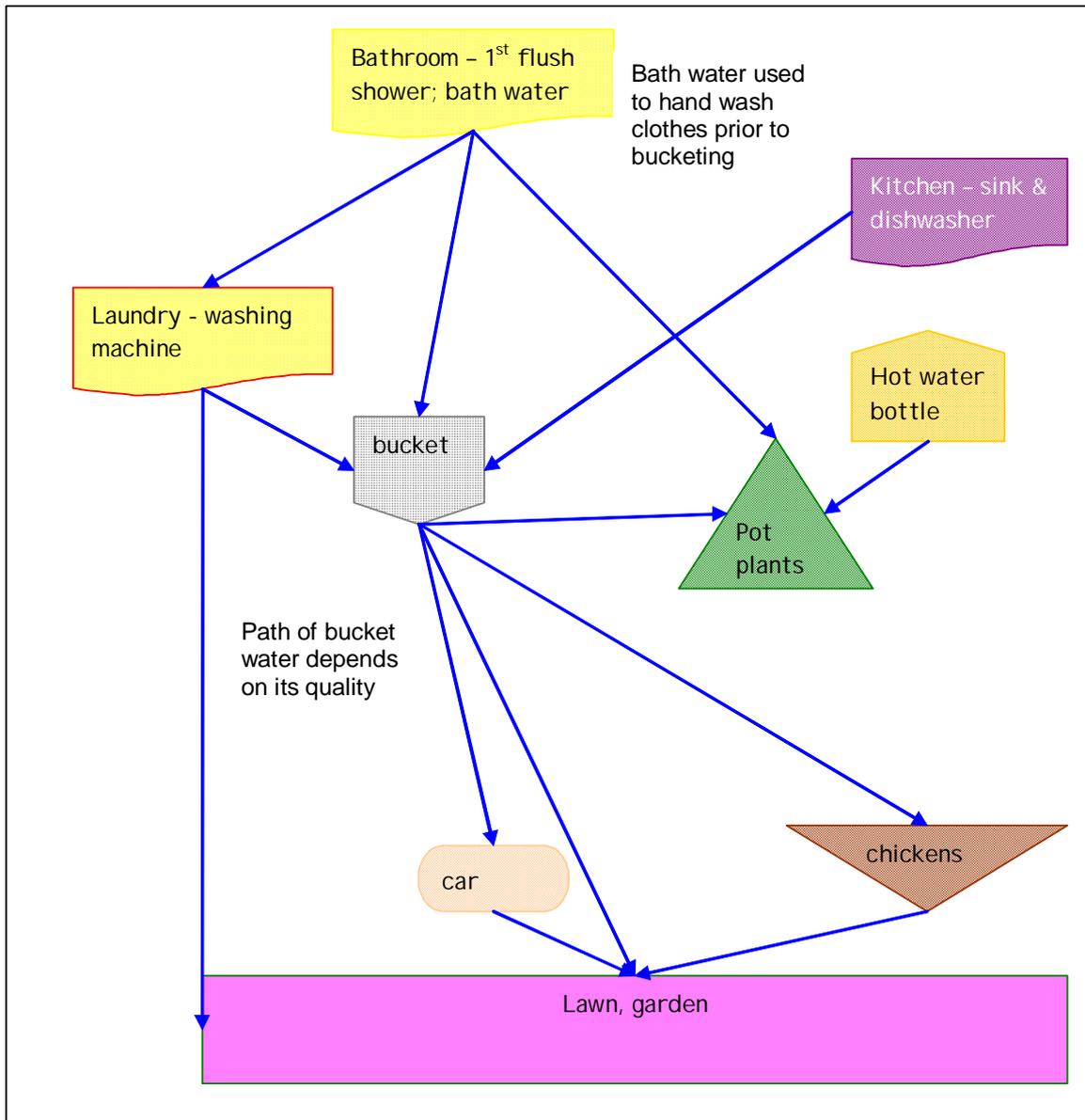


Figure Eleven Intra-household water reuse

Use in development context

Although the sensitizing aspect evident in the 2008 water diary may not be as pronounced in a development context, given the supply issues often demand users are consumption conscious, benefits of the water diary in a development context include:

- ◆ identifying gendered resource allocation within household. The questionnaire explores attitudes to allocation and the diary records allocation practices;
- ◆ contributing to household time use studies;
- ◆ provide data to strengthen gender mainstreaming efforts in water resource management practices
- ◆ providing data for infrastructure planning and urban design, including WSUD; and
- ◆ provide participants with household water use data to support their claims to adequate water provision.

There are many similarities to urban living, regardless of state of economic or industrial development. In spite of any similarities, changes additional to those outlined in the discussion section would be required to use the water diary in urban areas of the economic south. For example, presentation changes to reflect local understandings or a variety of water supplies. Matters of supply reliability may also have to be accounted for. The nature of the household questionnaire would certainly differ, with questions recording water access, supply reliability and storage more relevant than questions about the impacts of water restrictions.

While the water diary has been developed so no major conceptual changes are required for its use in a development context, to adopt the approach in a rural development location certainly adds a layer of operational complexity, due to low literacy rates for example. Further, it is realistic to anticipate unreliable water supply, often remote from the household dwelling. Combined with less automation of water chores, it is reasonable to expect significant time is spent securing household water supplies and performing household water chores. In situations where water must be manually brought into the dwelling, the questionnaire could be designed to investigate who brings how much water to the dwelling, and how. Questions about water allocation processes and priorities could also be asked. Again, the nature of the questionnaire reflects the key research questions of individual water diary surveys. Not only do these, and other, factors need to be reflected in the water diary questionnaire and presentation, they represent obstacles to widespread participation.

Certainly there are hurdles to water diary participation in a development context, such as low-literacy, low-income or higher priorities for the time. These concerns are evident in so-called developed nations, particularly rural environments. Australia, for example, has significant pockets of rural socio-economic disadvantage, including lacking reliable water supply. This comparison is not to trivialize the domestic water situations of the economic south but to highlight how any household asked to participate may have

legitimate obstacles to participation. An important strength of self-selection is that it works the same in both a developed and development context – if households want to participate they will; if not, they won't. Of course, self-selection could be encouraged by participation incentives such as a refund on water costs during the diary week or rebate vouchers for water saving devices. Self-selection allows researchers to seek participants without causing discomfort or creating an obligation, while affording the household the opportunity to decline with dignity or informed participation.

As indicated in the discussion section, participation in the water diary can vary according to participant motivation. Comments in the diary and from the post-diary interviews suggest the primary requirements are not particularly onerous. The most common difficulty – remembering to record everything, especially 'squirts' – is likely to be a phenomenon common across cultures. One change that could be made to reduce the participant's administrative burden is to produce the physical diary in two detachable parts: one part household information/questionnaire; the second the water diary. The researcher could take the household details and questionnaire responses from the participant directly, either by phone or in person and retain this portion. The water diary itself would remain with, or be forwarded to, the participating household. This approach would also provide an opportunity to:

- clearly reiterate the level of involvement required;
- identify a household champion; and
- outline the diary structure and recording practices.

An example of an observational, rather than participatory, approach which could be adopted in low-literacy environments is for a volunteer or researcher to provide intensive, short-term diary recording assistance to individual households. Such an approach seems inappropriate from many perspectives:

- the self-selecting nature of diary participation already identifies interested households thus a lack of motivation is not at issue;
- the time and financial costs of such an approach would be high, even if each household had a volunteer for only one eight hour period; and
- it reduces the involvement of household members.

In terms of potential diary presentation changes, the 'who used' column could be replaced with a 'sources' column, allowing multiple water sources to be identified on a use-by-use basis. Who used the water will still be recorded, directly into the relevant water use column. It may also be more appropriate for symbols to represent water uses. The identification of meaningful symbols for appropriate water use categories and sensitive language use, particularly for personal hygiene water use, is location dependent, and critically important. The involvement of a researcher familiar with the region, language and culture would greatly enhance the success of the water diary design.

Given the wide variety of development contexts, providing a prototype water diary for use in a development context is an overly ambitious goal. Although the nature of the water diary use is unchanged, the presentation would be different. For example, even if it were to use a written language, it is unlikely to be English and the terms used would need to be appropriate. The degree

of sensitivity required to articulate personal hygiene terms for example, would need to come from some one familiar with the specific culture. Appropriate symbolic representations of water use categories would change from culture to culture. It is the author's intention to develop diaries for use in (rural and urban) Thailand and India in 2010. The final versions will be forwarded to GWA for their information.

Conclusion

The methodology presented here extends the frontier of knowledge on intra-household water use by detailing rural and urban domestic water use beyond household meter readings. It provides a detailed account of the variety of household water uses and cultures, reinforcing the understanding households as heterogeneous entities with unequal flows of resources.

Water diaries readily generate gender disaggregated data, as well as a range of other data, without demanding any more, or less, involvement from the participants. This quantitative data, representing a variety of temporal scales and capable of being compared across and within households, supported by qualitative data, offers water researchers unprecedented insights into the mechanics of intra-household operations.

The qualitative data from the 2008 water survey was largely silent on the issue of gender, however water chore data recorded in the diaries clarified the dominate role of women in water chores. Questionnaire format and local cultural values will influence the stated gender behaviours or expectations of participating household's responses. Accurately completed water diaries will show who is using how much water, for water. That is, water diaries provide valuable insights into the diversity of water cultures, and how they are produced and reproduced within the household.

The quantitative data collected by the water diaries has proven reliable and robust. Additional controls on estimation error, to increase the reliability of household estimates, have been recommended. The range of data generated could contribute to new understandings of intra-household water use and resource allocation practices. Such data could be used to inform water management policy development, aid the effective targeting of education campaigns and provide comparative information. The data could also be used to improve gender mainstreaming in water resources management, in both the economic north and south.

With results of the 2008 water diary proving the effectiveness of this research approach, the next application of the water diary will be to generate data, further prising open the black box of intra-household water use.

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