Philippine Institute for Development Studies

Policy Notes

October 1999 No. 99-11

How Much Water Do Households Require?

*Arlene B. Inocencio, Jose E. Padilla and Esmyra P. Javier**

Water requirement for drinking and sustaining human life is only a very small fraction of total water usage. This fact, however, is obscured by the knowledge that water is a necessity for life. Actually, a large proportion of water usage is for convenience, comfort and aesthetics. For example, it was found that for residential water use exceeding 400 liters per capita per day (l/c/d), nearly half is used for watering lawns and gardens and most of the remainder for flushing toilets, bathing, and washing cars.[1] While this usage may seem normal, it certainly goes beyond the basic human requirement for water.

The concern for determining the basic or minimum water requirement for a person to maintain good health and proper sanitation comes about in the light of the current state of water resources and their growing scarcity against a rapidly rising population. This growing problem of sustainability of current use has therefore become a matter of great importance and is the subject of discussion in this *Policy Notes* issue which is based on a study done by the authors.[2]

Why bother?

Available planning projections made use of varying assumptions on the per capita water usage. Estimates of water usage in Metro Manila by sources of water and quality of water service show that daily per capita consumption ranges from a low of 20 liters up to a high of 400 liters (Arellano 1994, JICA 1992, 1996, 1998, MWSS Corplan 1996, Haman 1996, David and Inocencio 1996a). While the lower end of this range may exhibit a very constrained demand for water due to nonavailability or excessively high prices, the upper bound may illustrate usage way beyond the basic water requirement and per-

*The authors are, respectively, Research Fellow at the Institute, former President, and former Senior Research Assistant of the Resources, Environment and Economics Center for Studies, Inc. (REECS).

[1] *Gleick (1993) in* Water Resources Handbook, *1996.*

[2] *This* Policy Notes *draws heavily from a report prepared for the Sectoral Task Group (STG), Water Sector, Population Policy Operations Project (PPOP) administered by the Commission on Population (POPCOM) through REECS, with the financial assistance of the United Nations Fund for Population Activities (UNFPA).*

haps sheer wastage. In light of this, it is important to have a realistic estimate of the per capita water requirement for planning purposes. This is succinctly illustrated in the following statement (Young 1996):

> *Forecasting of water use into the distant future is fraught with difficulties. The simplistic extrapolation of trends in per capita "requirements" in water system planning has resulted in many cases in which future water use was greatly overestimated.*

The country's current planning standard[3] for domestic water consumption of about 250 l/c/d may therefore need to be reexamined in the light of increasing supply constraints and growing population. Even relative to the available estimates, this figure is certainly higher due to the fact that it includes nonrevenue water or system losses which David (1997) argues is a supply side variable and should thus be excluded from demand estimates. Weakness in water demand estimation and projections is partly due to lack of data and paucity of empirical studies and econometric estimation of water demand functions typical in developing countries (David 1997). With additional relevant information on water usage, water planning may be made more realistic and responsive to current conditions.

So far, no study has objectively estimated basic water requirement by household activity such as drinking, personal hygiene, washing, cooking and sanitation, among others, for the Philippines. This paper therefore tries to address this shortcoming. Basically, it determines:

- the actual per capita water consumption by activity based on household water usage, and
- household and per capita water requirement that cuts across income classes, water sources and cost of water, and location.

The results may provide a valuable input in water sector planning (i.e., for water supply infrastructure), in allocating available water supply between domestic and other uses, and in determining the appropriate minimum water consumption block and tariff structure for domestic users.

What constitute basic water requirements

Gleick (1996) identified four components of basic water requirements, namely,

- drinking water for survival,
- water for human hygiene,
- water for sanitation services, and
- modest household needs for preparing food.

By way of adapting to local practices and situation, this paper expands Gleick's framework in the following respects: the second component is expanded to include water used for brushing of teeth and washing of face and hands while the third component, defined as requirements for sanitation, which is primarily toilet flushing, is expanded to include cleaning of toilet and the house. "Water requirements for food preparation," meanwhile, is defined to include not only cooking but also other kitchen requirements such as washing of dishes and cleaning of the kitchen. Furthermore, a fifth component is added for laundry since wearing of clean clothes is deemed as part of personal hygiene.

> "The country's current planning standard for domestic water consumption needs to be reexamined in the light of increasing supply constraints and growing population."

To validate the results of this study, estimates are compared with established standards or estimates of previous studies. Gleick's (1996) basic water requirement of 50 l/c/d is used as a reference point while the cited

[3] *The planning standard of 0.0029 liters per second per capita for domestic use provides allowance for water system losses, often termed as nonrevenue water.*

Table 1. Estimates of Basic Water Requirements

Activity	NASA		GLEICK (1996)	
	Estimated Minimum Requirement (l/c/d)	% of Sample within Minimum	Proposed Minimum Requirement (l/c/d)	% of Sample within Minimum
Drinking	1.6	97.9	5.0	100.0
Personal hygiene				
Shower/bathing	2.7	0.0	15.0	34.3
Hand/face washing	4.1	86.4	-	-
Sanitation				
Urinal/toilet flushing	0.5	0.0	20.0	94.3
Cooking and kitchen				
Food Preparation	0.8	10.0	10.0	96.4
Dish washing	5.5	82.1	-[a]	-
Laundry	12.5	71.9	-	-
Total	**27.7[b]**		**50.0**	

Notes:
[a]While Gleick did not include this activity, he indicated that in a study done of the water provided for 1.2 million people in Northern California, an average of 15 liters/capita/day was used for dish washing.

[b]Available estimate at NASA totals less than 30 liters/capita/day, but in the NASA space settlement design, 35 liters/capita/day was assumed as the more likely and conservative estimate.

Sources:
National Aeronautics and Space Administration (Internet download, 1998)
Gleick (1996)

National Aeronautics and Space Administration (NASA) minimum is treated as a lower bound.

Available estimates of basic water requirements

In Table 1, the estimated basic water requirements of NASA and Gleick (1996) are reported. It will be noted that one main difference between the two estimates is the nonprovision in Gleick of activities like the washing of hand and face, dishes and clothes. Whether these are already embedded in his four classifications of human needs is not indicated in his paper. Despite this shorter components list for Gleick's basic water requirement, however, NASA's estimate of a minimum is even much lower, with washing of clothes comprising the bulk of water use in contrast to toilet flushing in Gleick's basic water requirement. And even if this paper's expanded definitions are used, i.e., hand and face washing in personal hygiene and dishwashing in food preparation, the NASA estimates would still be much lower than those of Gleick.

To see how these estimated basic requirements compare with the data from this paper's survey, the percentages of the sample in the survey which fall within the specified minimums for each activity are shown. Almost 100 percent of the sample households are within Gleick's minimum for each type of use except for bathing where only 34 percent of the households consume at most 15 l/c/d. On the other hand, it appears that the bathing and urinal requirements set by NASA are unrealistic as none of the household respondents consumes amounts below them. Food preparation requirement by the NASA is also too small as only 10 percent of the sample fall within this consumption level. While the NASA estimates provide some bases for comparison, it should be noted that the obtained water requirements were intended for a space settlement design which may be too different from real world situations and environment. As such, said estimates should be treated with caution.

Establishing the household basic water requirement

As mentioned earlier, the study on which this *Policy Notes* is based tries to establish the basic water requirement of a household in the Philippines. The estimates are shown in Table 2.

The column for minimum requirement shows the lowest possible consumption per activity based on the survey. The minimum of 16 l/c/d for all activities combined is only about half of the NASA total but is consistent with those of water-scarce countries or areas where access to water is difficult, water is being carried for several hundred meters and many people are sharing the same source. This amount, however, is less than the

World Health Organization (WHO)-suggested minimum of 20 l/c/d for sanitation. Considering that this amount already includes all uses, it is apparent that proper personal hygiene and sanitation necessary for maintaining good health cannot be achieved.

The estimated maximum consumption (last column) for all basic uses is about 247 l/c/d. While this derived maximum value for basic water requirement is higher than the estimated average requirement for an affluent subdivision in the country, it is in fact consistent with the current planning standard for domestic water consumption specified in the Philippine Water Code of about 250 l/c/d. The estimated range of 15 to 247 l/c/d comprises the earlier estimates of Falkenmark and the World Bank technical study on the requirement for survival and maintenance of proper sanitation and good health.

Table 2. Estimated Basic Water Requirements Metro Manila and Pangasinan, 1998 (l/c/d)

Activity	Mean	Minimum	Maximum
Drinking	0.58	0.30	1.60
Personal hygiene			
Showering/bathing	19.00	5.70	105.85
Hand/face washing	2.97	0.93	23.10
Brushing of teeth	1.07	0.40	4.79
Sanitation services			
Urinal/toilet flushing	7.63	2.38	62.04
Toilet cleaning	1.71	0.50	25.20
House cleaning	1.35	0.27	12.36
Cooking and kitchen			
Food preparation	1.87	1.43	2.01
Dish washing	1.96	1.73	2.39
Laundry	4.72	1.90	7.44
Total	**42.86**	**15.54**	**246.78**

The column showing the mean values of water consumption per activity, meanwhile, has a total which is close to the suggested basic water requirement in Gleick (1996) and is also well within the minimum water consumption bracket or the first consumption block in the tariff structures of water utilities in the Philippines.

Drinking. Comparing the component activities, however, this paper's estimates are markedly different from those of Gleick. The estimated mean value of water for drinking based from the sample is so low compared to what Gleick is proposing, which is over 8 times. This consumption pattern implies that respondents may not be drinking enough as required by the body. This may have some adverse health implications.

Cooking. Even with other kitchen requirements added, estimated water requirement for cooking at 4 l/c/d is less than half of the 10 l/c/d suggested by Gleick. One way to explain this is that perhaps the type of food prepared for most of the sample households must be very simple, requiring less water. For most middle-income households which comprise the majority of the total sample, lunch is seldom eaten at home on working days while school children often do not take lunch at home on school days, thereby reducing average water requirements for cooking.

Sanitation. Estimated total for sanitation services defined to include toilet and house cleaning is also much too low than Gleick's proposed amount for toilet flushing of 20 l/c/d. It may be noted that for most of the respondents, a *pour flush* toilet, a technology requiring much less water than the standard flush toilets, is common, thereby accounting for the lower estimate relative to that of Gleick.

Personal hygiene. If the estimates for the above-mentioned activities are smaller than those proposed by Gleick, it is not, however, the case for personal hygiene. The estimated bathing requirement alone is much higher than the 15 l/c/d of Gleick. Including hand and face washing and brushing of teeth, which is not done in Gleick (1996), even raises the estimated requirement by 50 percent more. While this pattern of use may be reflective of a general consciousness for keeping the body clean, this amount is in fact only about half the estimate for an affluent subdivision in Metro Manila. It is also within the estimate for developing countries of 5 to 25 l/c/d.

Laundry. The last component which is laundry, an item not included in Gleick's proposed basic requirement, is estimated to be about 5 l/c/d. This estimate is consistent with that for other developing countries. It should also be noted that for most of the respondents, laundry is done by hand which often requires less water than machine washing which is connected to piped water.

Proposed minimum. Table 3 gives the study's proposed basic water requirements to maintain good health and proper sanitation. From the drinking pattern of respondents, it appears that a substantial number of respondents are not drinking enough water. Based on the Food and Nutrition Research Institute (FNRI)-determined daily dietary allowance for Filipinos for energy of about 2000 kilocalories and on the findings of the National Research Council – National Academy of Sciences (NRC-NAS, U.S.A.) that between one and one-and-a-half milliliters of water is required for every kilocalorie of energy, the body needs 2 l/c/d to 3 l/c/d for drinking. As such, a basic requirement of 2 l/c/d for drinking is being proposed by the study.

Table 3. Proposed Basic Water Requirements Metro Manila and Pangasinan, 1998 (l/c/d)

Activity	Proposed Requirement
Drinking	2
Personal hygiene	23
Showering/bathing	
Hand/face washing	
Brushing of teeth	
Sanitation services	20
Urinal/toilet flushing	
Toilet cleaning	
House cleaning	
Cooking and kitchen	4
Food preparation	
Dish washing	
Laundry	5
Total	**54**
Basic monthly water requirement for a household of 6 members (cu.m.)	9.7

For personal hygiene, a total of 23 l/c/d is proposed. This amount, which is about 1.5 times that of Gleick, includes usage for bathing/showering, washing of face and hands, and brushing of teeth. If maintaining proper sanitation and good health is to be seriously considered, with allowance for cultural and societal preferences, this paper adopts the 20 l/c/d for sanitation suggested by WHO, which is found to be the amount that would maximize benefits from waste disposal and related hygiene (Gleick 1996). For cooking and kitchen use, 4 l/c/d is being proposed while for laundry requirements, 5 l/c/d is recommended. This is consistent with estimates for other developing countries. The proposed total basic water requirement is 54 l/c/d (or about 10 cu.m./month per household for a family of six), not so far from the 50 l/c/d of Gleick (1996) but only about half that of Falkenmark (1991).

Some policy considerations

Lifeline rate and increasing block tariff structure

The tariff rates of all water districts in the country follow an increasing block structure, with an initial consumption block of 10 cubic meters for domestic use. This amount implicitly assumes to represent the minimum water requirement of households. In a sense, the results of this study provide an empirical basis for this minimum consumption block which in fact satisfies the basic monthly water requirements of households necessary to maintain life and promote proper sanitation and public health. The water utility can thus charge this basic consumption a lifeline rate that is below cost rate, i.e., a highly-subsidized rate per cubic meter, and then charge higher prices for use beyond the minimum volume. This increasing block tariff structure, as is often claimed, promotes equity, with the poor households assumed to be consuming within the first block and the rich households, because they have gardens to water, cars to wash annd more water-using appliances, assumed to be consuming larger amounts, thereby falling within the higher-priced blocks. As such, the rich are said to be cross-subsidizing the poor households. Moreover, under the increasing block structure, consumption beyond the basic require-

ment is charged higher rates which is intended to promote conservation and sustainable water use as the high rate discourages wasteful usage without jeopardizing public health and sanitation.

But does the present set-up in the country follow this logic? To be able to answer this, one must consider the following issues:

Households without connections. Households without access to piped water connections—often the poor households—do not benefit from the lifeline rates. On the other hand, relatively well-off households with access to the piped water system enjoy the lifeline rates. As shown in earlier studies, some households with piped water sell water to those without connections, thereby often passing on the higher-priced block to the poor.

Shared piped connections. While the 10 cu.m. figure provides a basis for setting the initial block, this minimum quantity which is priced cheaply can also be anti-poor for households which share connections with other households. The poor often obtain water through shared connections with neighbors who have private connections. They also obtain water from water vendors while middle- and upper-income households have private water connections for own use. For households sharing a metered connection, the consumption can easily exceed the initial block volume. This pushes the water use into higher-priced blocks. Poor households may then end up paying higher average prices for water than the rich. From the survey, it is shown that a substantial number of households share water connections.

> "...Issues of shared connections and households without connections at all have to be addressed first for the basic water requirement estimate to be useful and relevant or for the subsidized minimum consumption block to be effective."

Thus, these issues of shared connections and households without connections at all have to be addressed first for the basic water requirement estimate to be useful and relevant or for the subsidized minimum consumption block to be effective. While it is ideal for the water utility to provide separate connections for each household, connection fees have been found to be constraining poor households in applying for a piped connection or a separate connection. The utility may therefore devise schemes that would make the fees more affordable. Or on the other hand, it may opt to provide a common source which is free of connection charges, i.e., a public tap, which would service the need of those without private connections. Water from this public tap can then be priced differently (e.g., a flat rate) from those with privately-piped water. As such, the possible inequity of the increasing block tariff system can be addressed but not at the expense of promoting too much inefficiency. While the result of this paper does not provide direct support to the increasing block tariff structure, it is not inconsistent with marginal cost pricing which can be applied at amounts beyond the 10 cu.m. minimum requirement.

Water allocation

Allocating water resources across competing uses has become increasingly important. In times of crisis, water allocation for water sources with multiple users involves negotiation among the different users. For instance, in the case of water from Angat, negotiations have to be made among the Metropolitan Waterworks and Sewerage System (MWSS) which supplies water for domestic, commercial and industrial use, the National Irrigation Administration on behalf of the farmers, and the National Power Corporation for power generation uses, with the National Water Resources Board serving as arbiter. Historically, the basis for allocation for domestic use has been the planning standard of 0.0029 liters per second per capita or 250 liters per capita per day.

"With information on basic needs, the minimum water requirement of the population can be determined and the government would have a better sense of how much water to produce, taking into account systems losses, which may be reduced with improvements in the distribution system."

The findings of this study may be useful in providing a more realistic basis for deciding how much water to allocate for domestic use, which is given top priority in times of crisis. The study suggests a basic water requirement of 54 l/c/d, which is only about 20 percent of the current planning standard. While domestic use has priority over other uses in times of water shortage, other users like the farmers need not be totally deprived of their allocation either since no water means no produce for them. Since water has a lower value for agricultural use than for domestic use, it makes sense to just compensate farmers and give the water to domestic users in extreme cases of shortage. Thus, a compensation scheme for farmers should eventually be developed and implemented.

Water resources planning

At the minimum, the government must aim to provide all households the basic water requirement for maintaining human life and good health. Planning for water supply development and infrastructure, however, is generally based on planning standards. While planners of water resources infrastructure are concerned with meeting domestic water demand, such projections should be based on more accurate estimates to minimize overestimation (or underestimation) of water requirements and, consequently, excess (or under) investments in water supply development and infrastructure.

With information on basic needs, the minimum water requirement of the population can be determined and the government would have a better sense of how much water to produce, taking into account systems losses, which may be reduced with improvements in the distribution system. This paper thus argues for the need to refine the standard for domestic use to make it reflective of actual domestic requirements.

Selected references

Arellano, F. "Managing the Mega Water Demands of a Mega City." Metropolitan Waterworks and Sewerage System, 1994.

David, C. “Water Demand Projections for Metro Manila: A Critical Review.” PIDS Policy Notes No. 97-12. Makati: Philippine Institute for Development Studies, 1997.

David, C. and A. Inocencio. “Understanding Household Demand and Supply of Water: The Metro Manila Case.” PIDS Policy Notes No. 96-04. Makati: Philippine Institute for Development Studies, 1996a.

_____. “The Determinants of Household Demand for Water in Metro Manila.” Paper prepared for EEPSEA-IDRC Workshop, November 12-14, 1996b.

Falkenmark, M. “Approaching the Ultimate Constraint: Water Short Third World Countries at a Fatal Crossroad.” Study Week on Resources and Population, Pontifical Academy, Vatican City, 1991.

Gleick, Peter H. “Basic Water Requirements for Human Activities: Meeting Basic Needs.” *Water International* 21, 2 (1996): 83-92.

Haman, Bruno. “On Sustainability of Withdrawal from Metro Manila Groundwater System and Availability of Additional Groundwater Resource.” *Philwater International*, October 1996.

Japan International Cooperation Agency. "Groundwater Development in Metro Manila." Published Report, Vols. 1 to 3, March-June 1992.

_____. *Water Supply and Sewerage Master Plan of Metro Manila*. Quezon City: Metropolitan Waterworks and Sewerage System (MWSS), February 1996.

National Aeronautics and Space Administration. “Space Settlement Design.” Internet download, 1998.

Young, Robert. “Chapter 3: Water Economics.” In *Water Resources Handbook* edited by Larry W. Mays. U.S.: McGraw-Hill, 1996.

List of Policy Notes for 1999

99-01 Inter-LGU Cooperation: The Key to the Issues of a Devolved Health Care System
Orville Solon

99-02 Closing the Urban Fiscal Gap: Some Considerations
Rosario G. Manasan

99-03 Loan Guarantee Programs for Small-Scale Borrowers: Are They Working?
Gilberto M. Llanto and Aniceto C. Orbeta, Jr.

99-04 Rethinking Government's Role in Urban Infrastructure
Gilberto M. Llanto

99-05 Sustainable Development and the Philippine Fisheries Code: A Critique
Danilo C. Israel and Ruchel Marie Grace R. Roque

99-06 Credit Programs for the Poor: A Tale of Two Cities
Mario B. Lamberte, Magdalena S. Casuga and Doreen Carla E. Erfe

99-07 Analysis of Fishing Ports in the Philippines
Danilo C. Israel and Ruchel Marie Grace R. Roque

99-08 Credit Crunch! Credit Crunch! Credit Crunch?
Mario B. Lamberte

99-09 Philippine Credit Policy and Microfinance Institutions: Some Lessons from the Latin American Experience
Gilberto M. Llanto

99-10 Philippine Trade Policy: Reflecting on its Effects on the Environment
Erlinda M. Medalla

For further information, please contact

The Research Information Staff
Philippine Institute for Development Studies
NEDA sa Makati Building, 106 Amorsolo Street
Legaspi Village, Makati City
Telephone Nos: 8924059 and 8935705;
Fax Nos: 8939589 and 8161091
E-mail: ainocencio@pidsnet.pids.gov.ph,
jliguton@pidsnet.pids.gov.ph

The *Policy Notes* series is available online at
http://www.pids.gov.ph