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Research Paper

Domestic Water Consumption Pattern of Lawngtlai Town, Mizoram (India)

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ABSTRACT
The main objective of the present study is to assess and analyze the water consumption pattern in Lawngtlai town.Households' survey was carried out in 7 village councils out of 12 village councils of the study area during November – December 2021. This amounted to coverage of 58.33 per cent of the total village councils. The number of sample households selected from each of the sample local councils are 30 households, thus data was collected from 210 households. The water consumption in the study area is far lower than the norms laid down by Bureau of Indian Standards. Even, in comparison to other major cities in the country, the consumption is also far deficient. The average per capita water consumption is estimated at 43.82 lpcd. The per capita water consumption varies with the mode of water sources. The per capita water consumption is also varies across the socio economic classes.

KEYWORDS: *Consumption, Per Capita, House connection, Tuikhur*

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I. INTRODUCTION

The colorless, odorless, and tasteless liquid known as water is indispensable for all sorts of growth development of human kind, animals and plants. As water is a key resource and we can never produce more water, water running deserves priority in the development and preservation of any area (Jethoo and Poonia, 2011). A standard for water was identified fourty years ago. In 1977, the United Nations determined the concept of a water used standard to meet people's basic need for water. *"all people, whatever their stage of development and their social and economic conditions, have the right to have access to drinking water in quantities and of a quality equal to their basic needs"* (United Nations 1977). There has always been a large disparity in the access to water supply and sanitation of people in different levels of consumption expenditure in urban areas. A large majority of poor people do not get the lowest quantity of water for their daily use but the progressivity in the pricing of water in most of the states and cities and as a result a large portion of this subsidized facility is used by the higher income population. The result in wastage and non-priority use of water (Kundu, 1991).

Norms for quantities of water to be supplied have been proposed for certain specific conditions. For instance, the SPHERE project sets out 15 litres per capita per day (lpcd) as being a key indicator in meeting minimum standards for disaster relief (SPHERE, 2002). WELL (1998) suggested that a minimum criterion for water supply should be 20 lpcd, whilst noting the importance of reducing distance and encouraging household connection. Carter *et al.* (1997) have suggested a similar figure. Gleick (1996) estimates 50 lpcd as a true minimum to sustain life in moderate climatic conditions and average activity levels.International organisations such as the U.S. Agency for International Development (USAID, 1982), the World Bank (2002) and the World Health Organisation recommend between 20 lpcd and 40 lpcd for the average human being. This estimate excludes water for cooking, bathing, and basic cleaning. These figures are similar to standards recommended by the United Nation International Drinking Water Supply and Sanitation Decade and Agenda 21 of the Earth Summit (*cf.* Bajpai and Bhandari, 2001).

As per the Bureau of Indian Standards (IS: 1172) minimum water supply of 200 lpcd should be provided for domestic consumption in cities with full flushing systems. The amount of water supply may be reduced to 135 lpcd for the Low Income Group (LIG) and the Economically Weaker Sections (EWS) of the

society and in small towns (BIS, 1993). The Ninth Plan (1997-2002) had advocated the requirements of water in urban areas as 125 lpcd in cities with the planned sewerage systems, 70 lpcd in cities without planned sewerage system, and 40 lpcd for those collecting water from public taps. However, in the Tenth Plan (2002-07), the cities with planned sewerage system are classified into two groups based on population i.e., metropolitan or megacities and non-metropolitan cities. In the former, the recommended minimum water supply standard is 150 lpcd and in the latter 135 lpcd (GoI, 1997, 2002).

Sandiford*et al.* (1990) investigated the effect of distance from the source of water supply on domestic water consumption of developing countries. In addition, there were major differences in the quantity of water used by piped and un-piped households (IIED, 2003). Results of the study conducted by Thompson *et al.* (2001) in Kenya, Tanzania and Uganda showed that piped households used on average almost three times more water per capita than un-piped households. Sandiford*et al.* (1990) and Hunnings (1996) found that the quantity of water used depended on the number of people used the dwelling (household size), how water is used, level of maintenance of the water supply system, and some other factors such as level of education and age of the head of household. Other factors, which affect water use, are number of households and households' size (Sandiford*et al.*, 1990; Schefter, 1990). Results of a study conducted in Israel, Jordan, and Syria from 1975 to 1994 revealed that in Israel the increase in domestic water use could be statistically better explained by the growth of the number of households than by population growth (Martin, 1999). A study conducted by Gazzinelli*et al.* (1998) revealed that certain socio-economic factors, house quality, type of water source, and a utility index were significantly correlated with water use.

Actual water consumption per capita per day varies with the mode of water connection (Dangerfield, 1983; Kirke and Arthur, 1984). David and Inocencio (1996) also reported that when water was carried only 20 lpcd was consumed while those with taps consumed an average of 78 lpcd. Elston (1996) obtained consistent results where per capita use for delivered water is about 12 lpcd, while those with tap water consume 28 lpcd to 94 lpcd. In terms of level of economic development, Falkenmark (1991) observes that in third world countries where piped connection is scarce, people only use about 4 lpcd to 38 lpcd, while in cities in developed countries; people consume about 83 lpcd to 227 lpcd.

STUDY AREA

Lawngtlai town is the district headquarters of Lawngtlai District in the state of Mizoram. It is also the headquarters of Lai Autonomous District Council, one of the three Autonomous District Councils in Mizoram (the other two being Mara Autonomous District Council and Chakma Autonomous District Council). Lawngtlai was established by HaihmungaHlawncheu, a *Lai* Chief, in 1880 at present Vengpui village council. Majority of the people belong to *Lai* group. However, nowadays most *Lai* people speak *Mizo* as their first language. It is located at latitude 22º.37612' N and longitude 92º.75072' E. Lawngtlai is a notified town in the District of Lawngtlai, it is divided into 12 village councils. According to Local Administration Department, LADC Lawngtlai town has population of 32,497 (LAD, LADC, 2021).

OBJECTIVES OF THE STUDY

The objectives of the present study are as follows:

a) to study the overall pattern of domestic water consumption in Lawngtlai, and
b) to investigate the variation of water consumption among the different households, and
c) to find out the determinants of water use pattern.

II. DATA BASE AND METHODOLOGY

The present study is based on the information obtained from primary and secondary sources. Households' survey was carried out in 7 village councils out of 12 village councils of the study area during November – December 2021. This amounted to coverage of 58.33 per cent of the total village councils. The number of sample households selected from each of the sample local councils are 30 households, thus data was collected from 210 households. The sample households have a total population of 1183 persons, children account for 31.69 per cent of the total. To conduct households' survey, few households have been identified because studying all the households in the sample local councils is usually impracticable in view of time, money involved, and other considerations. A random sampling procedure was used to select village councils for the survey, households to be surveyed were also selected based on random sampling method and it is believed that they are reasonably representative households in the study area.

The scheduled for household survey was designed to elicit information of households' economic status and type of water sources. A simple index is created to represent the economic status of the households. Self-reported total monthly income is used as the measure of households' economic status. Hence, households were categorised into three different groups such as, high-income group (HIG), middle income group (MIG), and low-income group (LIG). A total monthly income less than the threshold level of Rs.15000 are designated as LIG, between Rs.15000 to Rs.30,000 are designated as MIG and more than Rs.30,000 are considered as HIG.

About 28.7 per cent belong to Low Income Group (LIG), 39.23 per cent to Middle Income Group (MIG), and 32.05 per cent to High Income Group (HIG). Households' water sources have been classified into principal/main source of water and supplementary sources of water. Principal/main source of water refers to the water source that the households' has been obtaining the largest amount of water and the other sources is considered as supplementary sources of water supply. Therefore, data were collected through a structured schedule and an effort was made to get the relevant information from the ones that were assumed responsible for the collection and use of water. Being responsible is here understood as the one administering the water and not necessarily the ones fetching it. For this reason female household heads or other female family member and not children were preferred as respondent.

Estimates of average daily households' water consumption are based on informants recollection of the number of pots and buckets used. The volume of buckets/vessels in which households they normally used to store water is measured and the number of vessels of water used in different activities ascertained. These containers are generally, but not always, of two or three standard sizes. The quantity of water received through individual piped water connection is calculated from the size of the water tank, where they are directly connected to pipeline. Moreover, the information obtained is based not on actual observation but on recollection of the respondents. Average per capita water consumption is obtained by dividing total amount of water consumption by the number of household inhabitants, assuming that two children are equivalent to one adult unit.To examine the relationship between per capita water consumption and different variables, coefficient of correlation (r) suggested by Karl Pearson has been carried out.

III. RESULTS AND DISCUSSION

The need for domestic water supplies for basic health protection exceeds the minimum required for consumption (drinking and cooking). Additional volumes are required for maintaining food and personal hygiene through hand and food washing, bathing and laundry. Poor hygiene may in part be caused by a lack of sufficient quantity of domestic water supply (Cairncross and Feachem, 1993). The importance of adequate water quantity for human health has been recognised for many years and there has been an extensive debate about the relative importance of water quantity, water quality, sanitation and hygiene in protecting and improving health (Esrey*et al.*,1985; Cairncross, 1990; Esrey*et al.*,1991).It is important to note here, and this will be amply clear later, that the quantity of water consumed in the study area is not determined by the demand but the supply. People attempt to adjust to the quantity of water supplied. The 54th round National Sample Survey Organisation data shows that 80 per cent of the households in urban India, across different segments, consider that they have sufficient water supply (NSSO, 1999), while the present study finds that about 32.93 per cent of the householdsconsider water supply as adequate or satisfied (Table 1). Surprisingly, even households receiving poor supply also considered their present water supply enough to satisfy their needs. In fact, this shows nothing but adjustment of people to the supply so much that they do not feel that more water is required. This in turn creates hygiene and sanitation problems resulting in several health consequences.

Table 1: Satisfactory Level of Water Supply (% of households)

Satisfactory Level	Percentage
Satisfied	32.93
Not Satisfied	67.07

Per Capita Domestic Water Consumption

Table 2 shows per household as well as per capita consumption of water in the study area. It can be seen that the consumption (indication of availability) of water per capita in the study area is much lower than what the Bureau of Indian Standards (1993) recommends, and the Tenth Five Year Plan recommendation. Moreover, it is even lower than Bureau of Indian Standard (1993) recommended level for Lower Income Group (LIG) colonies and weaker section households. The data is also an indication for the lower public hygiene and sanitation conditions in the study area.The per capita daily domestic water consumption ranges from 28 lpcd to 65 lpcd. Therefore, the averageper capita domestic water consumption in the study area is estimated at 43.82lpcd(litres per capita per day).

The dispersion statistics (standard deviation) shows that wide variations in per capita consumption of water exist in the study area. The overall average per capita water consumption is lower than the WHO (2003) prescribed for basic hygiene, which is 50 lpcd. In terms of international and national comparison, the study area has far less consumption of water. For example, domestic water consumption in Munich is 130 lpcd, and in Amsterdam it is 156 lpcd. In Singapore, Hong Kong, Sydney and Tokyo, the consumptions are 162 lpcd, 203 lpcd, 254 lpcd, and 268 lpcd, respectively (Down to Earth, 2005). Shaban (2008) finds that the per capita water

consumption in Kolkata, Hyderabad, Ahmedabad, Mumbai, Delhi and Kanpur is 116 lpcd, 96 lpcd, 95 lpcd, 90 lpcd, 78 lpcd and 77 lpcd, respectively.

Table 2: Water Consumption per Household and per Capita per Day (in litres)

Per Household		**Per Capita**	
Mean	Std. deviation	Mean	Std. deviation
203.74	**69.50**	**43.82**	**8.77**

Table 3 presents category-wise distribution of per capita domestic water consumption. About 38.09 per cent of the households consume water below 40 lpcd, 35.71 per cent consume between 40 lpcd to 50 lpcd, and 26.19 per cent consume water above 50 lpcd. Inadequate water supply in the study area seems to be a rule rather than an exception. Even if we take 50 litres per capita per day as the criterion for defining water deficient and sufficient households, 73.8 per cent of the households remain water deficient.

Table 3: Category-Wise Water Consumption (% of households)

Litres per capita per day (lpcd)		
Below 40	40-50	Above 50
38.09	**35.71**	**26.19**

Principal Source-Wise Water Consumption

Actual per capita water consumption varies with the mode of water source in the study area. Table 4reveals variation of per capita water consumption according to principal source of water. The average water consumption of households with house connections is estimated at 50.85lpcd, whereas the user of *tuikhur* as principal source is about 35.33lpcd.The dispersion statistics shows that wide variations exist among the users of house connections. Comparing with the WHO and Gleick minimum norms of water consumption for basic hygiene (50 lpcd), only households getting water through house connections meet basic quantity of water. Hence, the average per capita consumption of water is relatively high when it is pipe into the home, but decreases when water is supplied to un-piped. The finding is consistent with a study carried out at different sites in Uganda by Tumwine (2002). Hefound that there are great differences in the average use of water per capita between households with and without household connections.Results of the study conducted by Thompson *et al.* (2001) in Kenya, Tanzania and Uganda also showed that piped households used on average almost three times more water per capita than un-piped households.

Table 4: Principal Source-Wise Water Consumption (in litres)

Source of Water	Per Household		Per Capita	
	Mean	Std. Deviation	Mean	Std. Deviation
Tuikhur	160.53	26.07	35.33	2.52
House Connection	238.18	30.14	50.85	4.01

Income Group-Wise Water Consumption

A much clearer pattern emerges when the levels of per capita water consumption are classified by households' monthly income (Table 5). Households' water consumption clearly increases with income. Previous studies in Jakarta and Port-au-Prince, for example, find that the non-poor use water 2 to 14 times as much as the poor use. Specifically, in Port-au-Prince, Fass (1988) estimated that households with piped connections (mostly the rich) used 156 lpcd, compared with the 11 lpcd used by poor households that rely on the vending system. For Jakarta, Crane (1994) reports that households with private connections used 62.2 lpcd, as compared with 27.5 lpcd used by those relying on hydrants and 14.6 lpcd for those relying on vendors.

Even in the study area, low income families do use less water than middle and high income groups, but the difference is nowhere near as large as the literature and conventional wisdom would suggest. The average water consumption among the Low Income Group (LIG) is about 36.75 lpcd, while consumption level increases progressively to 47.01lpcd in Middle Income Group (MIG). The difference between LIG and MIG water consumption is 10.26 lpcd. This is largely a reflection of the fact that MIG consume more for washing, bathing and toilets. In addition, the average water consumption among the High Income Group (HIG) is about 52.87 lpcd. The difference of LIG and HIG water consumption is 16.12 lpcd. The degree of variation of water use between LIG and MIG is higher than the variation between MIG and HIG. The dispersion statistics show that a significant variation of per capita water consumption exist among the MIG and HIG, it is likely the result of

uneven distribution of piped water supply in the study area. Asante (2003) found a significant statistical relationship between income and access to safe/potable water. The finding is also consistent with Iskandarani (2002) who reported that household income is a significant predictor of per capita water demand and use as well.

Table 5: Income Group-Wise Water Consumption (in litres)

Income Category	Per Household		Per Capita	
	Mean	Std. Deviation	Mean	Std. Deviation
Low Income Group	163.18	22.10	36.75	1.74
Middle income Group	221.65	39.81	47.01	5.10
High Income Group	236.68	37.66	52.87	4.97

Table 6 further highlights category – wise distribution of different income groups per capita water consumption. Among the LIG, 87.8 per cent consume water below 35 lpcd, and the rest 12.2 per cent consume between 35 lpcd to 45 lpcd. Interestingly, no families of MIG and HIG use water below 35 lpcd. Only 27.2 per cent of the households in MIG and 13.25 per cent in HIG use water between 35 lpcd to 45 lpcd. Subsequently, 65.94 per cent of households in MIG and 60.77 per cent in HIG consume water between 45 lpcd to 55 lpcd, and 6.86 per cent of MIG and 25.98 per cent of HIG use use water above 55 lpcd.

Table 6: Category-Wise Income Group's Water Consumption (% of households)

Litres Per Capita Per Day (lpcd)	Households Level of Income		
	LIG	MIG	HIG
Below 35	87.8	0	0
35 – 45	12.2	27.2	13.25
45 – 55	0	65.94	60.77
Above 55	0	6.86	25.98

Determinants of Domestic Water Consumption

The analysis of determinants of water consumption has always been of specialinterest toacademics and policy makers. Although, it is known that waterconsumption is supply constrainedin the present study, attempt has been made to findout the determinants of even this limitedsupply/consumption of water.The available evidence indicates that the quantity of water that households collect anduse isprimarily dependent on household income, standard of living, family size, and type of water source. Therefore, acoefficient of correlation (r) was run to examine the household-level determinants of water use such as household income and family size which is considered as the most determinant factors controlling the water consumption pattern. The calculated correlations and the corresponding significance levels are given in Table 7. It has been found that there is a significant correlation between water consumption and such variables as household income and family size.

Table 7: Correlation Between per Capita per Day Water Consumption and Income and Family Size

Income		**Family Size**	
CorrelationSig. level		CorrelationSig. level	
0.86	**0.00**	**- 0.34**	**3.13**

The per capita water consumption is positively highly correlated with family incomein all the village councils. The overall calculated correlation is 0.86, which is significant at all levels ($p < 0.00$). This positive correlation indicates that wealthier families usemore water per day. From the observation of the correlation between water consumption and income, it may be argued that the relatively poor families in the study area have lesser accessibility to public water supply. There are several reasons why poor people might consume less water. On the one hand, they may have fewer tools or equipment associated with water use, fewer containers and less time to draw water. On the other hand, there may be differences in hygiene practice between the wealthy and the poor. In economic theory, there is a cause and effect relationship between consumer's income and the level of consumption of most products (Crowson and Richards, 1975).

A further investigation of the data shows that as the household sizeincreases, theamount of water used per person per day decreases ($r = - 0.34$, $p < 3.13$). Though the total consumption increases with increase in family size the per person consumption decreases. This is consistent with the assumption that some water uses

are relatively independent of the size of the family (e.g. uses for cooking, cleaning, etc.), so that while total water use per household rises, per capita water use falls as family size grows. Schefter (1990) have reported similar findings, emphasizing that domestic water consumption is influenced by the increase in the number of single-family homes. The association between water consumption and household size demonstratethat increase in water consumption could be better explained by the growth of the number of households than by population growth.The inverse correlation between per capita water consumption and household size can be explained by the economies of scale in certain activitiesrequiring water, such as cooking and cleaning the house. Only a minority of water uses (e.g.drinking and bathing) can be expected to increase in direct proportion to the number of peopleliving in the house. Household sizesare consistently found inversely related to per capita water consumption in earlier studies (White *et al.*,1972, Wong, 1987).

IV. CONCLUSIONS

Water is clearly the single biggest crisis facing in Lawngtlai town and the stress is very much revealing. In fact, from being a necessity, water has now become a luxury in Lawngtlai. With pipes running empty, the town is turning into villages providing water by small services. Rapid pace of urbanisation has led to drying up of traditional water sources, like tuikhur, stream, rainwater harvesting. With more water tankers muscling their way, the situation is set to deteriorate in future. Nevertheless, the built environment of a town is a superimposition on its natural environment affecting particularly the sources of water. As the city extends itself, the direct recharge from rainfall is less and lesser recharge leads to the depletion of available fresh ground water potential at a fast rate on one hand and the increasing infiltration on other hand from diffuse pollution sources contaminate the ground water. The analysis of determinants of water consumption has always been of special interest to academics and policy makers.

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