# Domestic water sources and water storage tanks among different income group in Aizawl city

*C. Ramhnehzauva*

Department of Geography,
Govt. Lawngtlai College
Lawngtlai – Mizoram 796891
Email: chhangte14@gmail.com

## Abstract

*Water is under-supplied in the study area. The fact that water supply is almost wholly in the realm of the public sector verifies that governments are unable to provide adequate water supplies. It is characterised by poor water supply infrastructure. Services are generally poor for all sectors of society, but for poorer sector, conditions are worst because of their perceived inability to pay house connection fees. Problems in water supply are especially severe. The level of service provided by a water supply system is a function of the price, quantity, quality, reliability, and convenience that it provides to the user. As a result, poor and rich are dissatisfied with their current water supply situation. However, it was observed that the rich are better off than the poor but not dramatically so as far as their satisfactory level is concerned. The characteristics of the water sources have a number of influences on choice of a water source. One characteristic of the water sources in the study area is that an individual piped connections facility is unreliable. Piped water connection into a house, a large sum of money is necessary to pay at a time. Secondly, there are different types of other water sources available to people. These different water sources are exposed to different kinds and degrees of contamination. This significantly influences both the extent to which this source of water is used and the way it is used.*

**Keywords:** Income group, House connection, Tuikhur, Rainwater Harvesting

## Introduction

The water needs of the hilly people for generations have been met by natural sources of water. Traditionally, Tuikhur (i.e., water seepages accumulated in artificially fabricated reservoirs and springs water collected in artificial tanks) on the hill slopes and collection of rainwater is used as the main source of drinking water in Aizawl. The affordability of water has a significant influence on the use of water and selection of water sources. The high cost of water may force households to use alternative sources of water of poorer quality that may present a greater risk to health. Many claim that the poor cannot pay for water and use this argument to imply that water need not be priced. However, this

argument is not based on reality. India's relatively poorer population does pay for water, both in a monetary sense and in terms of the effort required to obtain clean water (Bajpai and Bhandari, 2001).

Cost is a major factor in determining not only which source people choose for water but also the quantity of water used from it. However, if aggregate expenditure of un-served population by piped supply is studied, it frequently shows that the poor pay more for a poorer service (Lloyd *et al*., 1991; Lewin *et al*., 1996). However, cost is not a simple issue and involves to a substantial degree the relative value placed on different goods that can be purchased with available funds. Utility services often require the payment of large sums at one time; this clearly limits the potential for poor families to have house connection, as they may not be able to access these sums easily. It also involves a commitment to long-term patterns of payment that is contrary to income patterns. This is supported by the findings of a limited study in Jakarta dealing with survey methodologies in urban areas (McGranahan, 1997). Cost is a factor significantly influencing choice of a water source. It may partly explain why many people are willing to overcome both distance and congestion in order to collect water from outside their premises. Therefore, people within reach of the piped utility may collect water from house connections if they can afford to pay connection fees and monthly bills or be forced to fetch from a distant source (Tumwine, 2002).

The World Bank (2001) reports stated that 25 per cent of the urban population of Latin America and 60 per cent of the urban population of Africa are not connected to official utility networks and rely on alternative sources for their water supply. Low-income families that construct dwellings at the urban fringe far removed from main trunk lines, providing adequate supplies of safe water will remain one of the biggest urban challenges in coming decades (Howard and Bartram, 2005). In 2004, about 3.5 billion people worldwide (54 per cent of the global population) had access to piped water supply through house connections. Another 1.3 billion (20 per cent) had access to an improved water source through other means than house connections, including standpipes, water kiosks, protected springs and protected wells. Finally, more than 1 billion people (16 per cent) did not have access to an improved water source, meaning that they have to revert to unprotected wells or springs, canals, lakes or rivers to fetch water (World Bank, 2004).

The National Sample Survey Organisation (NSSO) data for 1998 indicates that about 70 per cent of urban and 18.7 per cent of the rural households had access to piped water supply (i.e. tap as the principal source) in India. Sixty-six per cent of urban households reported their principal source within their premises, while 32 per cent had within a distance of 0.2 km. Forty-one per cent had sole access to their principal source of drinking water, which

means that 59 per cent were sharing a public source (NSSO, 1999).

Between 69 per cent and 74 per cent of India's rural population, take their drinking water from protected sources, leaving an un-served population of 26 per cent to 31 per cent. Between 91 per cent and 93 per cent of India's urban population, take their drinking water from protected sources (WHO and UNICEF, 2001). Economic condition and poverty rates are two important parameters that can significantly affect water use practices and use patterns, causing an overall increase in the demand for water in the domestic sector (WRI, 1995). Economic growth increases the demand for a wide variety of environmental services related to water (Pearce and Warford, 1993).

**Study Area**

Aizawl, the capital of Mizoram state, is situated in on the hillcrests, steep slopes and small valleys. It is located on a north-south elongated ridge, which acts as the main hill from which many small ridges and valleys are extending towards the east and west directions. The topography is highly undulating and rugged. The unique physical attributes of this rugged land are marked by extreme fragility and frequent landslides, limited land space, steep slopes and lack of accessibility. The city reveals a rapid and uncontrolled growth pattern with multi-storey settlements that has mushroomed unplanned on highly risk prone slopes. The altitude varies from 120 m to 1400 m above mean sea level. It falls between 23º 40' N to 23º 50' N latitudes and 92º 40' E to 92º 49' E longitudes. It covers an area of about 128.98 sq km, and as per Aizawl Municipal Corporation Report 2020, the population is 3,59,829 persons. There are a number of streams in and around Aizawl City, but none of them is dependable for providing adequate water. The only dependable source is river *Tlawng* located more than 1,000 m below the city.

**Objectives of the Study**

The objectives of the study are as follows:

    a. To study the households' economic determinant of water sources

    b. To probe economic determinant of households' water storage devices

**Data Base and Methodology**

    The present study is based on the information obtained from primary and secondary sources.

  (i)   Households' survey was carried out in 15 local councils out of 83 local councils of the study area during November – December 2018. This amounted to coverage of 18.07 per cent of the total local councils. The number of sample households selected from each of the sample local councils are 50 households, thus data was collected from 750 households. The sample households have a total population of

4,454 persons, children account for 32.88 per cent of the total. The mean value of households' size is 5.91, with a standard deviation of 0.90. About 69 percent of the sample households own their homes and 31 percent live in rented houses.

(ii) The scheduled for household survey was designed to elicit information of households' economic status, type of water sources and type of water storage device use to meet their daily water needs. 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.20000 are designated as LIG, between Rs.20,000 to Rs.40,000 are designated as MIG and more than Rs.40,000 are considered as HIG. About 40.66 per cent belong to Low Income Group (LIG), 38.80 per cent to Middle Income Group (MIG), and 20.53 per cent to High Income Group (HIG). sample households own their homes and 31 per cent live in rented houses.

(iii) The 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. 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 stratified random sampling procedure was used to select local councils for the survey, i.e., number of population, percentage of individual piped water connections, and geographical location were taken into considerations to give an overall view of each corner of the study area. Households to be surveyed were selected based on random sampling method and it is believed that they are reasonably representative households in the study area.

**Results and Discussion**
**Domestic Water Sources**

Households' economy is one of the most significant determinant factors on choice of water sources. Most households are not using water from only one source but from multiple sources. The pattern of households' dependence on water sources varies with monthly income. It has been observed that among the low-income group (LIG) no household gets house connection, whereas 81.09 per cent of middle-income group (MIG) and 93.52 per cent of high-income group (HIG) have access to house connections (Table 1). It is important to note that households belonging to MIG and HIG without house connection at the time of survey are due to technical problem.

All LIG families use *tuikhur* as their principal source of water supply, whereas 12.71 per cent of MIG and 1.30 per cent of HIG use *tuikhur* as their principal source of water supply. About 6.19 per cent of MIG and 5.18 per cent of HIG use rainwater harvesting as their principal source of water supply. Absence of LIG using rainwater harvesting as principal source of water reflect the limitation of physical and economical feasibility to make rainwater harvesting as their main source of domestic water supply for low economic family.

Among the LIG, cent percent have access to *Tuikhur;* 42.26 per cent have access to public taps; 91.48 per cent collect rainwater; 44.6 per cent use hand pumps and 14.1 per cent purchase water from tankers. Among the MIG, 81.07 per cent have house connections; 9.97 per cent have access to public taps; 73.89 per cent collect rainwater; 30.58 per cent use *tuikhur*; 5.16 per cent use hand pumps; 60.47 per cent buy water from tankers and 1.03 per cent have private dug wells. Among the HIG, 93.52 per cent have house connections; 1.94 per cent have access to public taps; 44.78 per cent collect rainwater; 5.18 per cent use *tuikhur;* 64.3 per cent purchase water from tankers and 1.3 per cent possess dug wells. It is important to note that no household from LIG has access to house connection and dug well, at the same time no household from HIG uses hand pump.

Table 1. Income Group-Wise Use of Water Sources (% of households)

| Name of Water Sources | Low | Middle | High |
|---|---|---|---|
| *Tuikhur* + Rainwater | 21.96 | | |
| *Tuikhur* + Rainwater + Public tap | 20.32 | 04.12 | |
| *Tuikhur* + Hand pump + Rainwater | 24.30 | | |
| *Tuikhur* + Rainwater + Tanker | 10.50 | 05.50 | 01.30 |
| *Tuikhur* + Hand pump + Public tap | 08.52 | | |
| *Tuikhur* + Hand pump + Public tap + Rainwater | 10.80 | | |
| *Tuikhur* + Rainwater + Public tap + Tanker | 02.62 | 01.03 | |
| *Tuikhur* + Rainwater + Hand pump + Tanker | 00.98 | 02.06 | |
| Rainwater + Public tap + Tanker | | 04.12 | 01.94 |
| Rainwater + *Tuikhur* + Tanker | | 01.37 | 03.24 |
| Rainwater + *Tuikhur* + Public tap | | 00.70 | |
| House connection | | 07.21 | 24.02 |
| House connection + Tanker | | 13.05 | 31.20 |
| House connection + Rainwater | | 13.40 | 09.74 |
| House connection + Rainwater + Tanker | | 30.60 | 26.62 |
| House connection + Rainwater + *Tuikhur* | | 09.96 | 00.64 |
| House connection + *Tuikhur* + Hand pump | | 03.10 | |
| House connection + *Tuikhur* + Tanker | | 02.74 | |
| House connection + Rainwater + Dug Well | | 01.03 | 01.30 |

Among the users of only one source of water, 36.21 per cent belong to MIG and 63.79 per cent belong to HIG. In fact, the number of water sources access reflects the amount of water obtained from principal source of water. Of the users of two water sources, 32.37 per cent are from LIG, 37.19 per cent are from MIG and 30.43 per cent are from HIG. Subsequently, among the users of four water sources, the largest users 83.02 per cent are LIG, 16.98 per cent belong to MIG and no household from the HIG uses four sources of water. It means that lower the income, higher the number of water sources on which households depend.

As regards to the barriers of LIG from having piped supply connection, the survey revealed three major reasons. Firstly, most of the LIG families live in the local councils where the piped water facilities are limited. Secondly, utilities connection charges hinder the LIG from getting house connection. Thirdly, despite high connection fees water supply through house service connection is unreliable so that LIG families opt for other water sources. Fourthly, for new piped water connection, proof of land ownership is required but most of the LIG live in rented houses, hence they cannot produce the land ownership certificate resulting to disqualification from getting house connection.

The characteristics of the water sources have a number of influences on choice of a water source. Firstly, piped water connection into a house, a large sum of money is necessary to pay at a time. Secondly, there are different types of other water sources available to people. These different water sources are exposed to different kinds and degrees of contamination. This significantly influences both the extent to which this source of water is used and the way it is used. It can therefore be said that the vulnerability of unprotected sources influence water related practices. Thirdly, limitation in number of sources and supply of water from these sources influence water-collecting practices. Different water sources deliver less water during the dry season causing congestion at the sources during this time. The limited number of hand pumps and public taps create congestion at the sources. These characteristics clearly contribute to making water collection a time demanding activity, thus affecting the choice of water sources. These are a few of the factors that potentially influence peoples' choice of water source; but it is important to bear in mind that such choice is not stable or inflexible.

**Water Storage Tanks**

Storage of water within house premises is usually necessary to cope with an unreliable water supply. As one would expect, storage capacity and investment vary by income, the poor rely on portable, low-cost and low-capacity storage, whereas the high class use higher cost options. Besides, materials used for storing water also differ from household to household. In fact, the choice of material depends on local availability and affordability.

The water storage tanks in the study area can be classified into three types as far as their placement is concerned, i.e., overhead storage tank, ground-level storage tank and under-ground storage tank. Most of the multi- storied buildings of RCC structure possess overhead tanks to provide uninterrupted water supply to its occupants.

People use three different types of water tanks, viz., cylindrical tank constructed with galvanised plain (GP) sheets, plastic tanks of cylindrical shape, and reinforced cement concrete (RCC) tanks constructed either in rectangular or square shape. The choice of tank capacity depends on a number of technical and economic considerations like space availability, cost of tank, labour for construction, cost of materials, and types of rainwater harvesting. The common vessels used for small-scale water storage include plastic bowls, buckets, tins, oil drums, empty food containers, etc. For storing larger quantities of water, large tank is required.

It is important to note that the water tanks capacity differs significantly by households' economic status. The low-income group's water tanks capacity ranges from 400 litres to about 7,500 litres and the average tank's capacity is calculated to 1,432.79 litres, with a standard deviation of 927.42. The tanks capacity of middle-income group's ranges from 3,000 litres to 22,000 litres and the average tanks capacity is estimated at 8,223.37 litres (S.D = 3043.92). Subsequently, the high income group's tanks capacity ranges from 5,000 litres to 25,000 litres and the average capacity is 7,853.90 litres with a standard deviation of 3506.73 (Table 2). The dispersion statistics (Standard Deviation) shows wide variations of tanks capacity in all the income groups. Interestingly, the middle-income group's tank capacity is higher than that of the high-income group, it indicates that rainwater harvesting through rooftop catchment is more suitable and popular among the middle-income group than the high-income group.

Table 2. Income Group-Wise Water Tank Capacity (in litres)

| Income Group | N total | Mean | S.D | Min. | Med. | Max. |
|---|---|---|---|---|---|---|
| Low income | 305 | 1432.79 | 927.42 | 400 | 1000 | 7500 |
| Middle income | 291 | 8223.37 | 3043.92 | 3000 | 8000 | 22000 |
| High income | 154 | 7853.9 | 3506.73 | 5000 | 7000 | 25000 |
| Overall | 750 | 5386 | 4146.37 | 400 | 6000 | 25000 |

**Conclusion**

The pattern of dependence on water sources varies with monthly income. Among the low-income group (LIG), no household has house connection, whereas 81.09 per cent of middle-income group (MIG) and 93.52 per cent of high-income group (HIG) have access to house connections. Households belonging to MIG and HIG without house connection

are those beyond reach of the network. It indicates that households' monthly income, which is a proxy for ability to pay, is a significant predictor for piped water in residence. All LIG families use *tuikhur* as their principal source of water supply, while 12.71 per cent of MIG and only 1.30 per cent of HIG use *tuikhur* as their principal source of water supply. Only MIG (6.19 per cent) and HIG (5.18 per cent) use rainwater harvesting as their principal source of water supply. As one would expect, water storage capacity and investment vary by income, the poor rely on portable, low-cost and low-capacity storage, whereas the high class use higher cost options. The average tanks capacity of low-income group is about 1,432.79 litres, whereas the average capacity of middle-income group is 8,223.37 litres and high-income group average tanks capacity is 7,853.90 litres.

## References

Bajpai, P. and Bhandari, L. 2001. Ensuring Access to Water in Urban Households. *Economic and Political Weekly,* 36 (9): 3774-3778.

Howard, G. and Bartram, J. 2005. Effective Water Supply Surveillance in Urban Areas of Developing Countries. *Water Health*, 3(1): 31-43.

Lewin, S., Stephens, C. and Cairncross, S. 1996. Health Impacts of Environmental Improvements in Cuttack and Cochin, India – Review Paper for ODA. London School of Tropical Medicine and Health, London.

Lloyd, B., Bartam, J., Rojas, R., Pardon, M., Wheeler, D. and Wedgewood, K. 1991. Surveillance and Improvement of Peruvian Drinking Water Supplies. Robens Institute/ODA, Guilford, U K, 71.

Mc Granahan, G., Leitman, J. and Surjadi, C. 1997. Understanding Environmental Problems in Disadvantaged Neighbourhoods. Urban Management Programme, Working Paper 16. UNDP/UNHCS/World Bank, Washington, DC.

NSSO (National Sample Survey Organisation). 1999. Drinking Water, Sanitation and Hygiene in India. National Sample Survey Organisation, 54th Round, Report No. 449. Government of India, New Delhi.

Pearce, D. and Warford, J. 1993. World Without End, Economics, Environment, and Sustainable Development. Published for the World Bank. Oxford University Press, London.

Tumwine, J.K. 2002. Drawers of Water II: 30 Years of Change in Domestic Water Use and Environmental Health in East Africa, Uganda Country Study. International Institute for Environment and Development, London, 121-124.

WHO and UNICEF. 2001. Access to Improved Drinking Water Sources - India. Joint Monitoring Programme for Water Supply and Sanitation, Coverage Estimates1980-2000, September 2001.

World Bank. 2001. World Development Report 2000/2001: Attacking Poverty. Oxford University Press, New York, 321.

World Bank. 2004. World Development Report 2004: Making Services Work for Poor People. Oxford University Press, New York, 268.

WRI (World Resources Institute). 1995. World Resources 1994-95: People and the Environment. Report Prepared by World Resource Institute in Collaboration with United Nations Environment Programme and United Nations Development Programme. Oxford University Press, Bombay.