



An investigation on the domestic water usage pattern by the tribal communities of Northern part of Meghalaya

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ABSTRACT

Water always plays multiple roles in our day to day activities, hence its sectoral domestic usages pattern plays a significant role towards its sustainable management. Anthropogenic activities like agriculture, urbanization, and climate change have increased freshwater extraction in recent times, making water management crucial. With progressive decline in per capita water availability the countries like India falls prey to the strategic problems in water domain. North Eastern states of India like Meghalaya, faces post monsoon water scarcity despite receiving very high annual precipitation. This present study is an attempt to address the dearth of micro level data on the water use pattern across four blocks- Bhoirymbong, Jirang, Umling, and Umsning- located in the Ri-Bhoi district of Meghalaya. The water usage was further classified into five categories- drinking, bathing and washing, kitchen gardening, livestock maintenance, and other domestic activities. The results indicate that hygiene activities take up the largest relative share of water usage in all four blocks- with values ranging from 64% in Bhoirymbong to 74% in Umsning. Moreover, the relative percentage taken up by drinking water is marginal with values ranging from 4 to 9% in all four blocks, indicating the overshadowing by other major water needs. Furthermore, an allocation of 4-7% water towards kitchen gardening and 2-5% water towards livestock rearing shows an important pattern of delineation of water usages to micro-productive activities which was a trend observed in all the studied villages. The primary findings emphasized that infrastructure planning in the respective villages may be taken up in a manner that the micro-productive activities and hygiene demands can be sustainably accommodated.

Keywords: Hilly water management, Kitchen garden water usage, Livestock water usage, Potable water usage and water poverty

INTRODUCTION

Growing concern on fresh water availability has made it a dwindling resource and day by day the pressure on the water sector by various sectoral water users is increasing (Ray *et al.*, 2009; 2014). The population pressure in the 21st century has put a direct impact on water and agriculture for subsequent

sustainable usage. Similarly during past century also there was heavy exploitation of natural resources (Krausmann *et al.*, 2009). The usage of freshwater has also increased significantly with the global consumption rising from 500 km³ during 1990s to roughly 4,000 km³ in 2000, nearly an eight fold increase (Zhu *et al.*, 2024). This increased water

consumption has also driven the extraction of groundwater by more than 50% during 1960 to 2010 (Niazi *et al.*, 2024). The main reasons for this enhanced water usage are increased population, agricultural demand, urbanization, water pollution and natural calamities such as climate change and drought (Biswas *et al.*, 2025).

The minimum amount of water requirement for human survival is around 50 lpcd (liters per capita per day) (Gleick, 1996; JMM, 2020). However, the actual requirement for optimum domestic hygiene far exceeds 100 lpcd or more (Howard and Bartram, 2003). Under JMM, Govt. of India, there has been a provision for providing 55 liters of potable water per person (JMM, 2020). In recent times, the pattern of global domestic water use has seen a significant change driven primarily due to rapid urbanization, increased incomes in both developing and developed countries, and also the proliferation of water intensive appliances (Wong and Mui, 2005).

Similarly, during COVID-19 pandemic, there has been a shift in domestic water use due to the awareness on hygiene and lockdowns forcing people to remain indoors. The water usage in certain urban centers increased from 151 lpcd before the pandemic to 158 lpcd during and after the pandemic (Kalbusch *et al.*, 2020; Tan, 2022).

Most populous country, India faces a unique situation of water scarcity among major Asian countries of the globe. The annual utilizable water resource is 1,123 billion cubic meters (BCM), resulting from the combination of surface and groundwater, contributing 630 and 433 BCM, respectively (Press Information Bureau, 2013). There has been a drastic reduction in the per capita water availability amounting to 1,545 m³ putting the nation into the water stressed category (Aslam *et al.*, 2021; Jain *et al.*, 2019). The country is projected to be pushed into outright water scarcity by 2050 when the availability is projected to decrease to 1,191 m³. As reported by Shaban and Sharma, (2007), the average per capita water consumption was just 92 lpcd, below the standards prescribed by the World Health Organization (WHO) with a maximum value of 100 lpcd across major Indian cities. Similarly, multiple usage of water has also been highlighted by several researchers (Prein, 2002; Al-Lahham *et al.*, 2003; Wood *et al.*, 2005; Dhawan, 2017; Respikius *et al.*, 2020). The Multiple-Use Water Services is a framework which argues that water isn't fixed into rigid categories under domestic alone; it should have

multiple usages (Hall *et al.*, 2013; Stellbauer *et al.*, 2025).

The water consumption pattern has been found to be multifold, and for survival of human as drinking water it plays a major role (Jequier and Constant, 2010). As per WHO guidelines, human needs 5 to 7 liters of water for drinking and cooking purposes and it may be treated as an absolute amount of water required for drinking per person. This value is generally treated as static for water security planning (Popkin *et al.*, 2010). However, the share of drinking water under total domestic water usage has been seen to decrease in recent years both in India and world due to the increased usage of water for other purposes like sanitation, hygiene and household appliances (Sadr *et al.*, 2016).

Various researchers studied the water usage pattern under tempo-spatial scale. In urban regions, drinking water accounts for less than 1% of the total per capita water consumption (Mayer *et al.*, 1999). Bathing and washing encompass the largest volumetric share of water use and both the absolute and relative percentage share of it is increasing in the recent years (Chen, 2020). In developed nations, per capita water consumption in bathing alone accounts for 45 to 60 liters (Makki *et al.*, 2013), while washing using modern washing machines require 56 to 102 liters of water per load (Pakula and Stamminger, 2010). The percentage share of it is seen increasing as well, with hygiene activities consuming nearly 47% of total water used (Mudashiru *et al.*, 2021). For kitchen gardening, the amount of water required accounts for 30% of total water consumption in temperate regions to over 60% in arid or urban and semiurban regions (Mini *et al.*, 2014). For livestock, the volume of blue water used increased from 145 cubic kilometers in 1971 to 270 cubic kilometers in 2012 with a steady growth rate of 1.36% per year (Heinke *et al.*, 2020). As global food preference shifts towards livestock and dairy, the relative percentage share which currently stands at 10% (excluding the amount of water used for growing fodder crops) continues to increase steadily (Hoekstra, 2012). Similar variations among domestic water usages have been reported at national and regional domain.

Meghalaya, a state located in North Eastern India faces major challenges due to its land topography as well as climate variability. The state, despite receiving an average precipitation of more than 2,600 mm faces acute water scarcity as most of

this rainfall is concentrated in the monsoon months, leaving the post monsoon months dry (Ray *et al.*, 2012). This makes the study of water resources essential as people face water scarcity in these months of the year. Even though the severity of water scarcity is widely studied upon in the global level, there is a dearth of micro level data of water usage pattern in the villages of Meghalaya.

The present study seeks to offer insights on the domestic water usage pattern with an emphasis on how the tribal communities in the hilly regions are affected by the global phenomena of water scarcity. Within the framework, domestic water use has been segregated into five domains, *viz.*, drinking, bathing and washing, other domestic activities, kitchen garden and livestock maintenance.

MATERIALS AND METHODS

Among the declared 112 numbers of aspirational districts by Govt. of India (NITI Ayog), Ri-Bhoi

district is one of the aspirational districts of Meghalaya. Many of the Government of India schemes focusing on the enhancement of livelihood of the tribal communities are being implemented in these districts. Hence, it is emphasized to assess the domestic water usage pattern of tribal communities of Northern part of Meghalaya. It reveals all sort of domestic water usage patterns, *viz.*, drinking water usage, bathing and washing water usage, kitchen garden water usage, water usages by livestock and other domestic water usages.

Site description

The site description and the surveyed villages are shown in Fig. 1. The water spread areas under four (04) blocks of the Ri-Bhoi district is shown in Fig. 2. The raw primary data was tabulated and converted into percentage distributions at both the village and block levels. Pie diagrams were included to map the water use pattern of the selected villages.

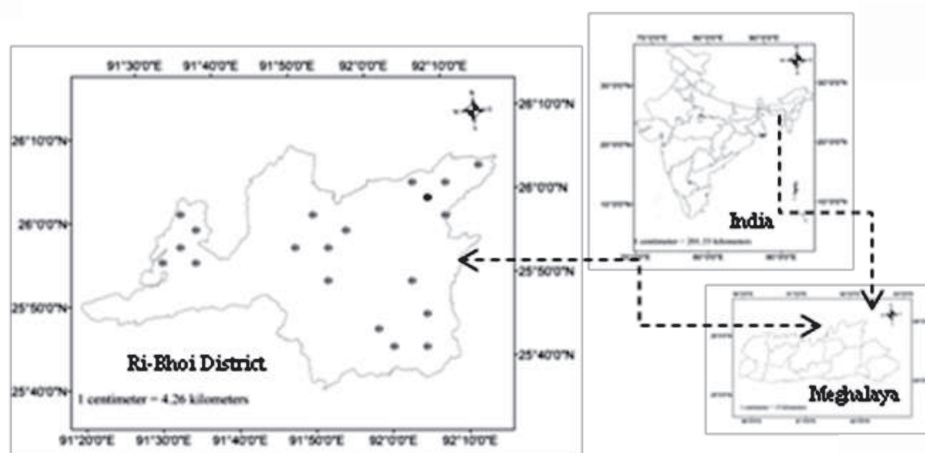


Fig. 1. Description of the experimental site

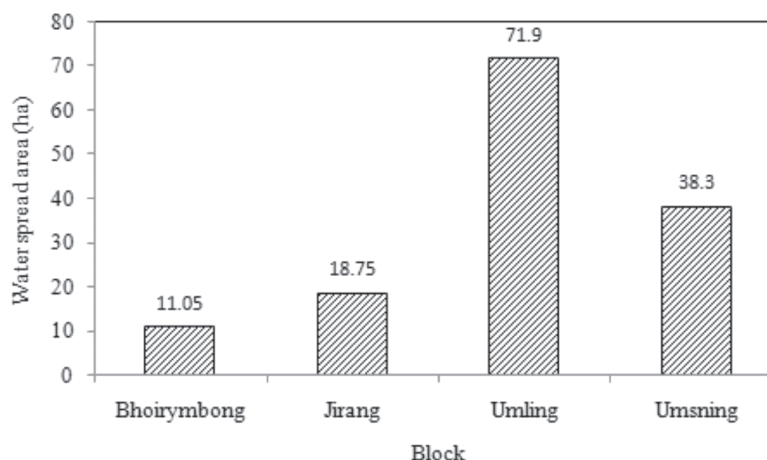


Fig. 2. Existing water spread area of different block

These four (04) blocks differ in terms of topography, settlement size, altitude, population concentration, infrastructure, and availability of natural resources. For water consumption the villagers are mostly dependent on natural springs, streams, and open dug wells, while the educational and healthcare facilities like the availability of primary schools, primary health centers *etc.* vary significantly among the blocks.

Climatic parameters of the study area

The climate of Ri-Bhoi is classified as subtropical humid type with high rainfall and cold winters. The monsoon rainfall is normally sets in during the first fortnight of June and extends up to end of September. Withdrawal of monsoon takes place mostly during October first week with a decreasing rainfall trend from September onwards. Ri-Bhoi district experiences an average annual rainfall of 2617.10 mm with some pre-monsoon showers during March to May (Ray *et al.*, 2012). This region also experiences high relative humidity and low sun-shine hours as compared to other parts of the country. The maximum temperature rises up to 30°C in the months of July-August and minimum falls down to 5 to 6°C during the first week of January. Similarly, the weekly variation of meteorological parameters in Ri-Bhoi district, Meghalaya is shown in Fig. 3.

Sampling design and primary data collection

Agriculture is the primary occupation for the most of the people (more than 80%) of Ri-Bhoi

district. This district spread over an area of 2,448 km² with a total cropped area of 27,039 ha (Statistical Hand Book, 2004). The study included four community and rural development (C&RD) blocks within the Ri-Bhoi district: Bhoirymbong, Jirang, Umling, and Umsning. A randomized sampling technique was employed and five villages were selected from each block, making the total number of twenty (20) studies villages. The water consumption pattern of the villagers has been assessed through structured questionnaires, the major domain of domestic water consumption were, drinking, washing and batching, kitchen garden water usage, livestock water requirement and other miscellaneous water usages.

RESULTS

Domestic water usage pattern in the selected village

Through structured questionnaires the domestic water usage pattern of the villages was studied. The primary data were assessed through preliminary survey, and analysed. As per the schedule questionnaires, domestic water usages were realised under five (05) domains, *viz.*, drinking water, batching and washing water usage, kitchen garden water usage, livestock water usage and miscellaneous domestic water usage. The average domestic water usages were converted into percentage and the block level water usage pattern is presented in the following figures (Fig. 4-7).

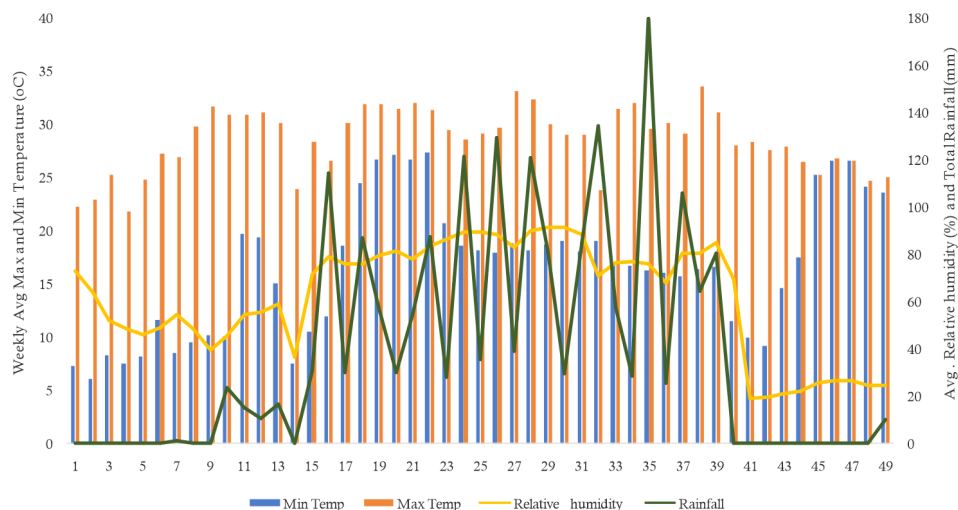


Fig. 3. Weekly variation of meteorological parameters in Ri-Bhoi district, Meghalaya

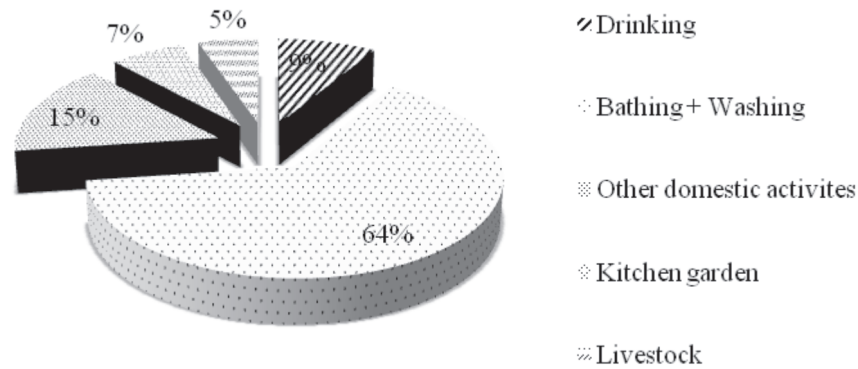


Fig. 4. Domestic water usage pattern in Bhoirymbong block

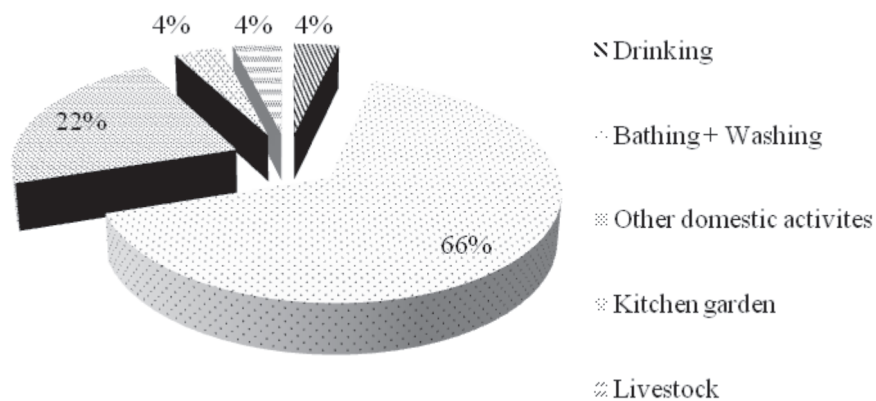


Fig. 5. Domestic water usage pattern in Jirang block

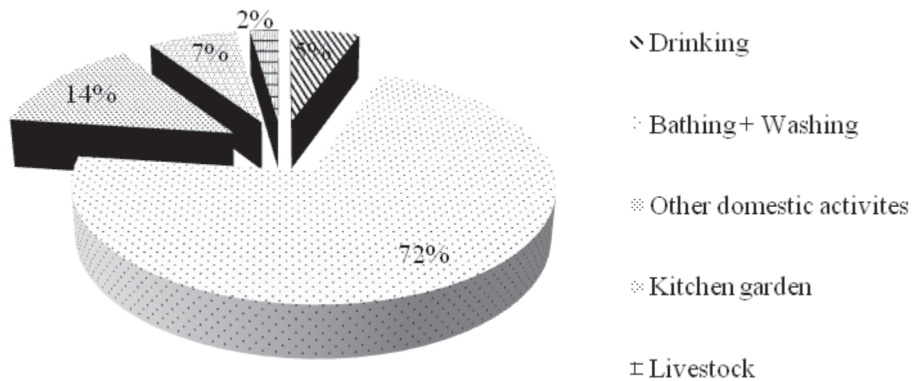


Fig. 6. Domestic water usage pattern in Umling block

Bhoirymbong block

The maximum water usage was for bathing and washing purposes for the domestic work in most of the villages, however, the minimum water usage is carried out for livestock maintenance purpose. The drinking water need by the villages under Bhoirymbong block is on an average 10% of the total water usage. It may be noted from Fig.4 that, around 64% of water usage is for bathing and washing purposes, 15% of other household activities,

9% of water consumption takes place for drinking, 7% of water is used for rearing kitchen garden plants and only 5% of water is consumed for the livestock rearing purpose.

For the Umktieh village, the quantum of water usage toward bathing and washing is almost Zero, as all the people used to go to the nearby streams for the bathing and washing (both cloth and utensil washing) work is done in the stream sides. The value varies between 44-85% for bathing and washing

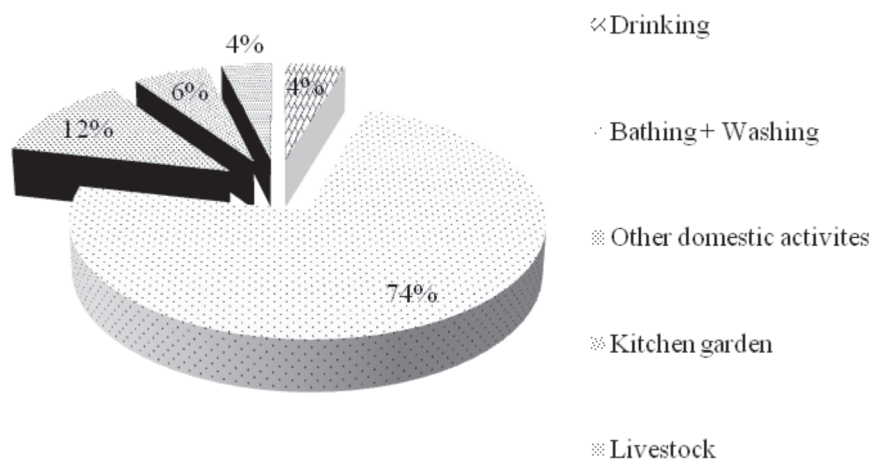


Fig. 7. Domestic water usage pattern in Umsning block

purpose water usage in the block, maximum value (85%) for Lumsyiap village; however, the least value was recorded (44%) for Palwi village. The next domain of domestic water user is “other domestic works” it mostly includes day-to-day activities of household work. Here, maximum variation is recorded ranging from 8-54%. The maximum is recorded for the Umktieh village, where as the least value is for the Lumsyiap village. The range lies between 5-29% for drinking water usage. The maximum amount of water usage for drinking purpose is by the village Umktieh.

Jirang block

The drinking water need by the villages under Jirang block is on an average 5% of the total water usage. It may be noted that around 66% of water usage is for bathing and washing purposes, 22% of other household activities, 4% of water consumption takes place for drinking, 4% of water is used for rearing kitchen garden plants and only 4% of water is consumed for the livestock rearing purpose.

The water usages towards bathing and washing are more and it varies between 54-75% for the Jirang block, maximum value (75%) for Pathorkhmahr village; however, the least value was recorded (54%) for the Umshohphria village. The next domain of domestic water user is “other domestic works” it mostly includes day-to-day activities of household work. Here, maximum variation is recorded ranging from 16-28%. The maximum is recorded for the Umshohphria village, where as the least value was for the Pathorkhmahr village. The range of water usages towards drinking lies between 2-6%. The maximum amount of water usage for drinking

purpose is by the village Umtarsen. Similarly for rearing livestock, the amount of water usage was categorised. On an average, the amount of water usage is less than 5%. The villagers mostly rear small ruminant animals like pigs, in some cases cattle rearing is also observed, local poultry rearing is also common among the villagers. The range of water consumption toward livestock rearing varies between 1-6%, maximum water consumption towards livestock rearing is recorded for the village Umtarsen. The quantum percentage of water usage toward rearing kitchen garden plants under Jirang block is less than 5%, the range lies between 2-9%. The maximum value is recorded for the village Umrit, however, less quantum of water is being used for rearing kitchen garden plants for the Umkadhar village (2%).

Umling block

It may be noted that, under Umling block the percentage of domestic water usages towards, drinking purpose, livestock rearing and kitchen gardening is less than 10% for all the villages and block as a whole. The water usages towards bathing and washing are more and it varies between 63-80% for the Umling block, maximum value (80%) for the Shangbangla village, similar type of water usage for the bathing and washing was observed for the Kongiapara village (78%); however, the least value was recorded (63%) for the Niangbarilum village. The next domain of domestic water user is “other domestic works” it mostly includes day-to-day activities of household work. Here, maximum variation is recorded ranging from 7-18%. The maximum value is recorded for the Pahammalien village, where as

the least value is for the Shangbangla village.

The drinking water need by the villages under Umling block is on an average 5% of the total water usage. The maximum amount of water usage for drinking purpose is by the village Niangbarilum, and the least recorded value is for the Kongiapara village. Similarly, for rearing livestock, the amount of water usage was categorised. On an average, the amount of water usage is less than 5%. The villagers mostly rear small ruminant animals like pigs, in some cases cattle rearing is also observed, local poultry rearing is also common among the villagers. The range of water consumption toward livestock rearing varies between 1-4%, maximum water consumption towards livestock rearing is recorded for the village Shangbangla, and the minimum recorded value was for the Kongiapara village.

Umsning block

Under the Umsning block, the percentage of domestic water usages towards, drinking purpose, livestock rearing and kitchen gardening is less than 10% for all the villages and block as a whole, similarly, it may be noted that around 74% of water usage is for bathing and washing purposes, 12% of other household activities, only 4% of water consumption takes place for drinking, and 6% of water is used for rearing kitchen garden plants and only 4% of water is consumed for the livestock rearing purpose.

The water usages towards bathing and washing are more and it varies between 53-82% for the Umsning block, maximum value (82%) for the Nongkya village, however, the least value was recorded (53%) for the Madan Mawlyngdep village. The next domain of domestic water user is "other domestic works" it mostly includes day-to-day activities of household work. Here, maximum variation is recorded ranging from 8-22%. The maximum value is recorded for the Madan Mawlyngdep village, where as the least value is for the Nongkya village. The maximum amount of water usage for drinking purpose is by the village Laiphewdiengngan, and the least recorded value is for the Mawhati, Nongkya and Umshorshor villages. Similarly, for rearing livestock, the amount of water usage was categorised. The range of water consumption toward livestock rearing varies between 3-8%, maximum water consumption towards livestock rearing is recorded for the village Madan

Mawlyngdep, and the minimum recorded value was for the Mawhati, Nongkya villages. The quantum percentage of water usage toward rearing kitchen garden plants under Umling block is around 10%, the range lies between 3-12%. The maximum value is recorded for the village Madan Mawlyngdep, however, less quantum of water is being used for rearing kitchen garden plants for the village Umshorshor (3%).

DISCUSSION

The distribution of water usages across different domains in the villages of Meghalaya indicate that water demand is primarily driven by hygiene (washing and bathing). This is in accordance with the findings of Howard and Bartram (2003) that mentioned that cleanliness takes up large amount of water as compared to drinking and other activities. The most noticeable trend across all the blocks is that the highest share of water is allocated to bathing and washing, with values ranging from 64% in Bhoirymbong to 74% in Umsning block. This confirms the study of Thompson and Cairncross (2002) that established that, hygiene takes up the bulk volume of water demand in the domestic rural households. These findings also validate the WHO guidelines, *i.e.*, "Roughly 3 lpcd for drinking while a much larger amount of 20 to 50 lpcd has been allocated to sanitation" (Crouch *et al.*, 2021). The distribution of water is one of the indicators that highlight the water stress situation of the villages which tends people to allocate more water for sanitation purposes (Sultana *et al.*, 2022).

Moreover, the allocation of water for drinking in all four blocks ranges between 4 to 9%. This is due to the fact that the amount of water required for drinking remains constant among populations around 3-4 lpcd. Since the absolute amount of water used for drinking is low, its share is represented by a lower amount and is overshadowed by larger consumers of water like hygiene (Hunter *et al.*, 2010). Even during periods of water scarcity, the absolute amount of water used for drinking remains constant. However, its share can rise or fall as the priorities shift for allocating water among different domains.

The varying percentage of water categorized under other domestic usage ranges from 12-22%. This category included unaccounted water which was used to account for the unavoidable losses and miscellaneous usages. Furthermore, studies estimate

that an estimated 45 M m³ of daily water loss occurs during water distribution and collection in developing nations (Wu *et al.*, 2024). The pattern of water allocated to other domestic usage may also prove to be an indicator of water loss, particularly in villages of Jirang block, where 22% of water is allocated to this category (Beker and Kansal, 2024).

Apart from consumption and hygiene, the villagers of different blocks also allocated 4-7% and 2-5% of their total water towards kitchen gardening and livestock rearing, respectively. This highlights the prevalence of Multiple-Use Water Services (MUS) in the studied locations where there isn't a strict delineation between domestic and productive water use (Koppen *et al.*, 2009). Adoption of small scall livestock and garden crops provide a safety net to the rural populations, providing them food security in periods of uncertainty (Dagunga *et al.*, 2023). This shows that development of water systems in the villages also means providing sufficient water for these micro-productive activities, as these activities are indispensable part of the village lifestyle (Smits *et al.*, 2010).

CONCLUSION

Majority of the household water usages is towards bathing and washing purpose constituting an average of 64-74% of total water consumption. In contrast the drinking water usage pattern almost limits to 9% of water usage and in almost three blocks it is limited to around 5% of the domestic water usages. Similarly, the localized agricultural activities, including drinking, kitchen gardening and livestock rearing, have the lowest fraction of daily water use, at less than 10%. Recognizing bathing and washing are the major local water uses, over general domestic activities, provides a precise and critical baseline water supply towards the sectoral water utilization. Hence, for the current water distribution and the prioritization of future water resource management strategies in these villages these sectoral water usages may be used as a baseline mark for possible water distribution.

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