Pipe-borne water consumption and its wastage: A study based on Panandura Urban Area in Sri Lanka

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ABSTRACT

Water is a lifeblood aspect of human being and without water, human being is impossible in the world. From time to time, people have consumed water from many sources and the ancient civilizations also emerged from river banks to meet the need of water. In this modern industrial world, technological advancements have enabled the pipe-borne water supply in widespread manner and it is not except to Sri Lanka too. Excessive consumption of water leads to water resource scarcity and hinders the even water supply to the people. In general context, water wastage is seen as 'the consumption of excessive water for the routing needs'. In Sri Lanka, the provision of water for drinking and irrigation on a sustainable basis is a national priority (Central bank of Sri Lanka, 2005). Despite, the pipe-borne water supply is considered as a method to supply water for people who are not access to the water, it has many contemporary impacts on water quantity's change and consumption pattern. Thus, this study was conducted to find the pipe-borne water consuption and its wastages in Panandura urban area. The objectives of this study are 'to evaluate the change of the quantity of pipe-borne water consumption, to find the factors for the water wastage and finding the mechanisms to reduce the water wastage and propose the proper water management plans'. This study was conducted using the primary and secondary data. As primary data, discussion, questionnaires were used and as secondary data, reports from national water supply and drainage board, Divisional Secretariat reports, books, research papers, newspaper, magazines, websites, qualitative and quantitative tools were used. Based on the analysis and using the collected data, objectives were attained as population growth, rise in income level, modern machinery utilization, urbanization are the reasons for the change of pipe-borne water consumption. And also, the main factors for the water wastages are the pattern of the water consumption of residents, water leaks and dearth of awareness among residents. To reduce the over consumption and wastage, frequently check the water leaks in households, recycle the used

water, to follow the rain water harvesting methods and to conduct the awareness programmes among people regarding the water saving and wastage, were suggested as recommendations and importance of water saving and managemet also stressed in this study considering our posterity.

1. INTRODUCTION

The available resources decide the development of any country. The nature has given many resources to the human being. Thus, water, considered as a natural resource is a key resource for the world and lifeblood for the human being and also it is considered as a socio-economic development index to the country. Ponds, lagoons, reservoirs, rivers, groundwater and ocean water are the main sources to obtain water for human needs. (Isthikar, 2011). The infrastructural development has given the pipe-borne water supply from the water treatment plants and it is a system to supply pure water to people. Water is purified and having purified with some harmless chemicals it is supplied through pipelines and this is called the pipe-borne water supply.

Increased population, urbanization, industrialization, transformation from chenna cultivation to permanent agricultural activities and changes of lifestyles have triggered the demand of water. Water is considered as a commodity for economy at this present world. Over consumption and wastage lead to the water scarcity in many countries and it is not except to Sri Lanka. Value and importance of water should be seen as gold considering our posterity because, many countries are suffering drought and water scarcity due to the wastages and excessive consumption. Due to the fact that, the United Nations Organizations has declared March 22, the day for world water to highlight the importance of water (Saratha Manokaran, 2010).

In General context, approximately, 70 percent of water is consumed for the agricultural activities and rest is consumed for the industrial activities. In western countries, per capita consumption of water is 300L. Of which, 32 percent to flush the toilet, 17 percent for bathing, 12 percent for washing machines to wash cloths and 38 percent for cooking, drinking, manual dress washing and home gardens as well (Sarath Amarasiri et al., 2015).

Sri Lanka, being a rich for water, has 40 percent pipe-borne water supply. Of which, 59.4 percent from dug wells, tube-wells, streams and springs, 10 percent from unsafe sources (Department of Census, 2012). National water supply and Drainage board (NWS&DB) supplies pipe-borne water through 170,000 lines from 325 water treatment plants. Of which, 800,000 lines are available in Colombo District. 43.4 percent residents access to pipe-borne water supply (Consumer Manual, 2014).

Landform, geology, soil type, evapotranspiration and surface runoff decide the water availability in Panandura where rivers, ponds, lagoons, and sea are seen as surface water sources and dug wells as groundwater sources. Although there is a significant quantity of other water sources availability in Panandura area, people prefer to the pipe-borne water ever more.

Due to the advancement of industry and modern machinery utilization, day by day the consumption of pipe borne water usage has been increasing. For instance, washing machines are used instead of manual dress washing and flushing the toilets also the same. These

activities cause the quantitative changes in the water usage in the study area. There should be the concern in water to conserve for the posterity. Because, without water human being is not possible in this world and without water, human cannot live more than 4 or 5 days and man survives longer without food than without water.

Therefore, to conserve the water for our posterity through reducing the water wastage and over consumption are our responsible.
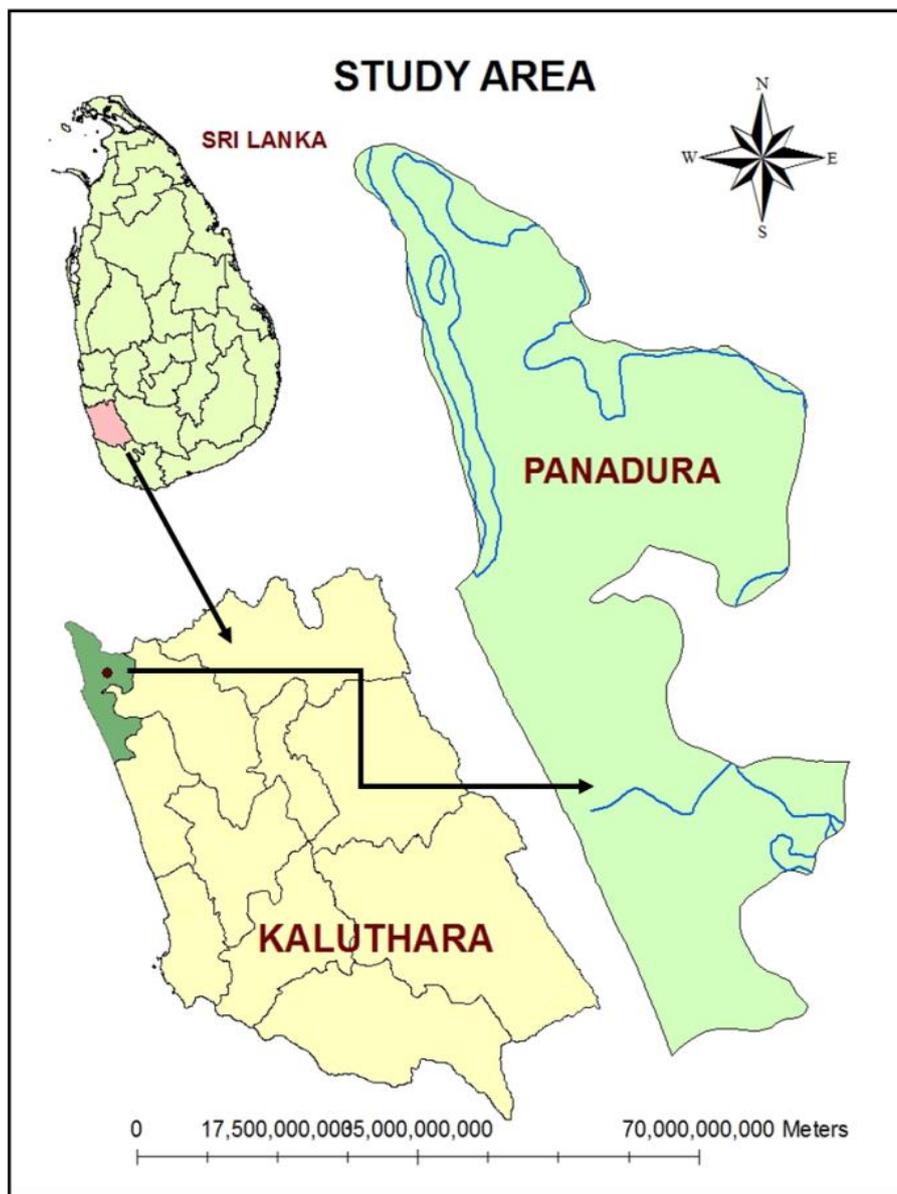
2. STUDY AREA

Figure 1. Study Area
(Source: Retrieved by the Researcher from Arc GIS 10.1)

Panandura, 44 sqkm^2 in area which is governed under the Panandura Urban council, is situated in between 6°42'47.52" North longitude to 79°54'37" East latitude in Kalutara District in Western Province. It is 24 km southward from Colombo District. The Mean sea level of the study area is (MSL) 10 m.

The physical boundaries of the study area are, in North Moratuwa area, in South Kalutara town, in East Bandaragama town and in west coastline of Indian Ocean. It is a Low wet zone having annual average rainfall as 2500-350 mm and the monthly average rainfall is 2700 mm as well as the annual average temperature is 27.3 °C.

Optimum temperature and nearness from Colombo are the main reason for the increased population in the study area. 16.7 percent population out of total Kalutara District's population is inhabited and the total population of the study area is 199,521 with 3317 to 1km population density (Census, 2014). It is becoming industrial area rather than the agriculture. Industry, commerce, service sector, self-industry and fishery are subsistence for the residents in the study area.

3. OBJECTIVE OF THE STUDY

Primary objective

- To evaluate the pipe-borne water consumption and its wastage based on Panandura area.

Secondary objectives

- To find the quantitative change in pipe-borne water consumption in the study area.
- To evaluate the factors for the water wastage in study area.
- Finding the mechanisms to reduce the water wastage and propose the proper water management plan.

4. RESEARCH METHODOLOGY

Proper methodology gives efficient result of any research. This study was conducted using the primary and secondary data having applied the simple random sampling method.

Data collection

Primary data

Direct observation and questionnaire survey methods were used to collect the primary data. 34456 household in 72 Grama Niladhari Divisions are access to the pipe-borne water supply in the study area. 100 questionnaires were distributed among users who were selected using simple random sampling considering the consuming rate in 3 zones such as Panandura zone, kesalwatte zone, and Panandura south zone (mahavial). The samples are as follows, Panandura zone 59 users, kesalwatte zone 17 users and Panandura south 24 users.

Secondary data

Published researches, books, newspapers, reports, megazines, websites, TV news, statistical reports, NWS & DB reports, topographical maps and satellite images were used as secondary data.

Data analysis

Using the SPSS and Arc, GIS collected data were analysed. Having analysed the objectives were attained.

5. RESULTS AND DISCUSSIONS

Pipe-borne water which is now considered as main source for the study area's people, faces demand by over consumption. Thus, quantitative changes in water consumption should be considered in the study area. According to the analysis based on the quantitative changes the consumption of pipe-borne water is increasing more than before. Following diagram clearly shows the quantitative changes in water consumption in the study area.

According to the Chart 1, the water consumption of each household has been increasing year by year. In 2012, the annual lower average water usage was 400L (4 units). Whereas, in 2013, this scale has been increased as 6000L (6 units). Also in 2014, this quantity was increased by 8000L (8 units). The annual higher average water consumption in 2012 was 28000L. (28 units). In 2013, this quantity has been increased as 31000L (31 units) and in 2014 this was as 36000L (36 units).

From 2012 to 2014 the quantity of pipe-borne water consumption has been increased by 8000L. Each household shows the change of quantity in pipe-borne water consumption. Thus, the pipe-borne water consumption has been increased year by year in this study area. There is no any household with decreasing quantitative change in water consumption. Nevertheless, some households keep the same quantity in 2012 and 2013.

There is an increasing water consumption from 2013 to 2014. In 2012, the annual average water consumption was increased in 2013 and 2014 in comparison with the quantity of 2012. Population growth, rise in income level, modern machinery utilization, road extension by the urbanization and easiness to access the pipe-borne water supply are the factors, influencing the increased consumption of water in the study area. The annual average water consumption of each household is calculated by the following equation.

$$\text{Annual average water consumption} \quad = \quad \frac{\text{Sum of 12 months' consumption units}}{12}$$

The Analysis of water consumption change trend 2012-2013

The results were attained in connection with water consumption in year by year. From 2012 to 2013, there is no any changes in water consumption in 20 household. At the same time, the water consumption quantity was remained without decreasing. The annual average consumption of 2013 was as same as 2012.
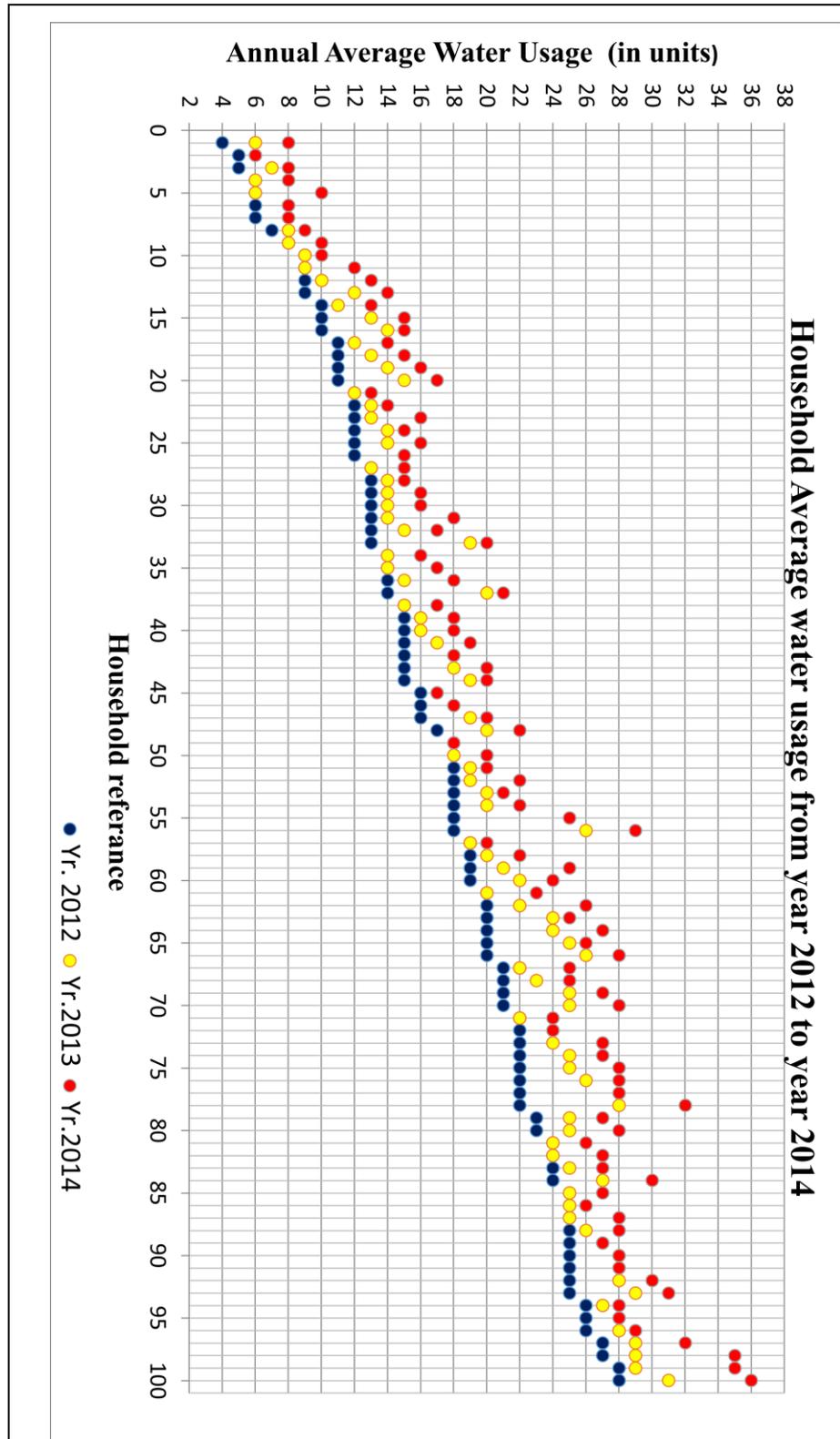
Chart 1. The annual average pipe-borne water consumption of household
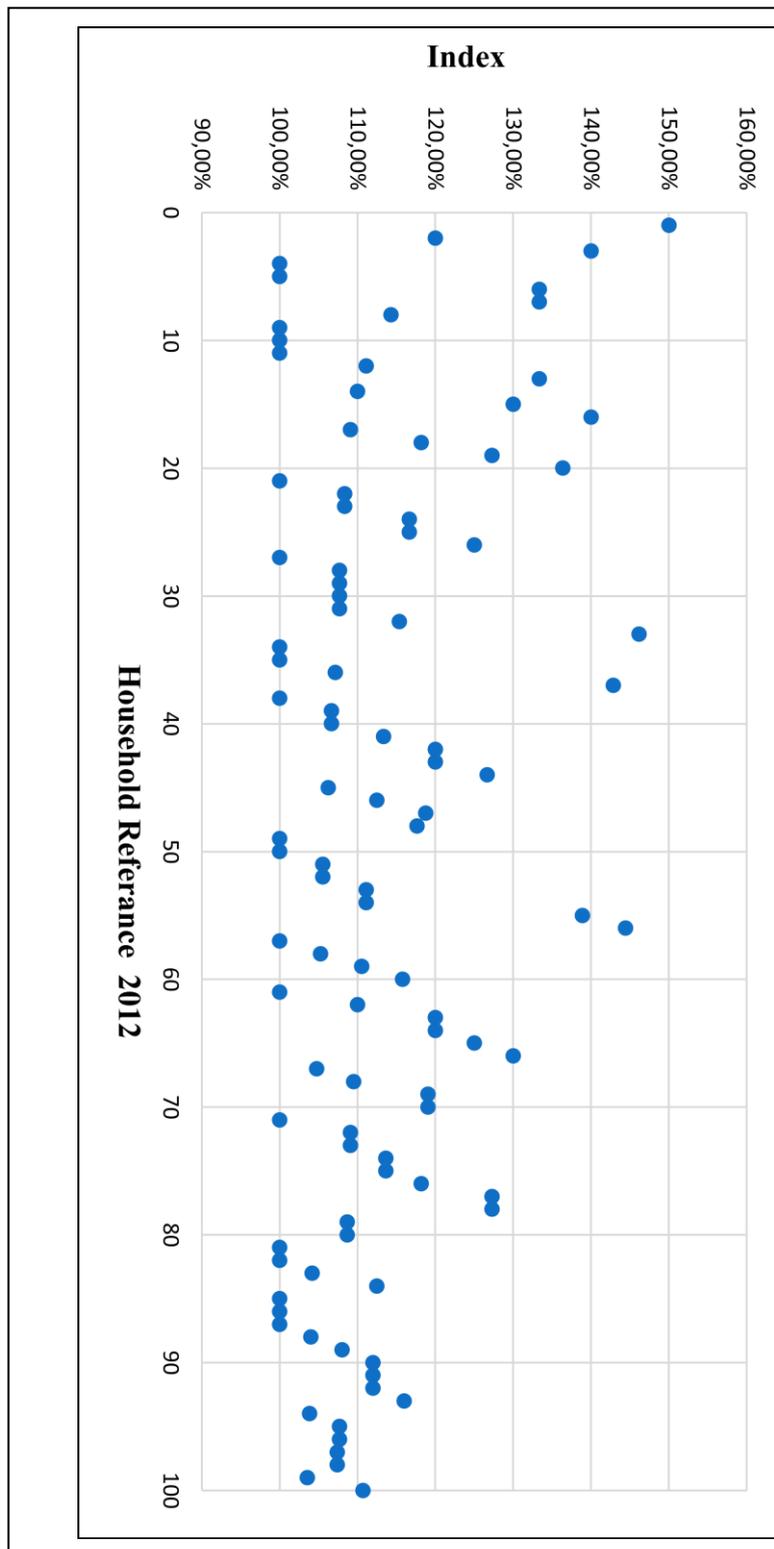(based on water tariff)

Chart 2. Water consumption index of 2013 based on 2012
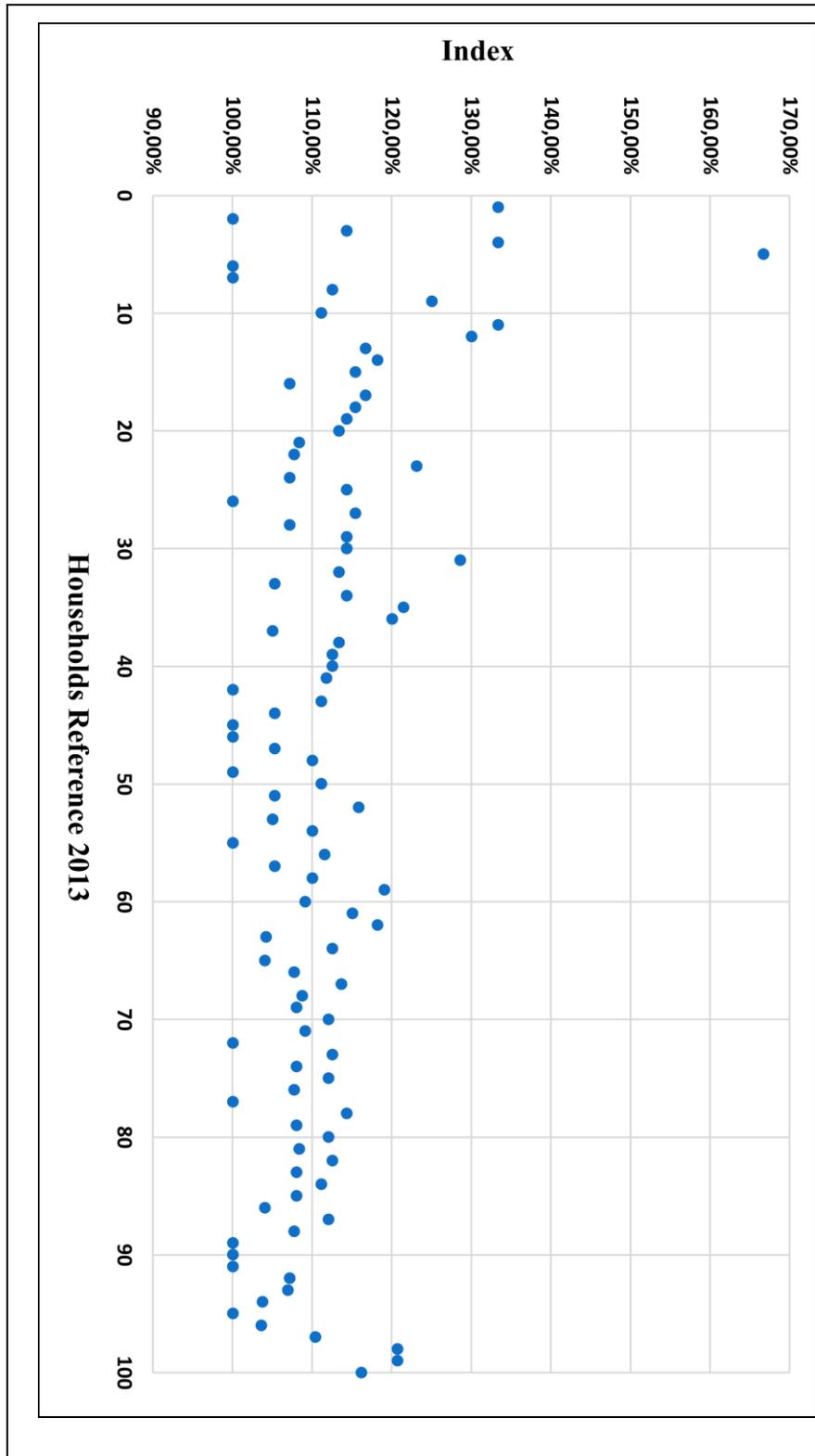*N = 100 (Source: Questionnaire Servey, 2015/2016)

Chart 3. Water consumption index of 2014 (based on 2013)
*N = 100 Source: (Questionnaire Survey, 2015/2016)

Water consumption quantitative change of 33 families is 10 percent. Likewise, 20 percent change in 28 families, 30 percent change in 8 families, 40 percent change in 7 families and 50 percent change in 4 families. According to the analysis, there is no any water consumption changes in 20 families from 2012 to 2013. Nevertheless, the change has been happened in 80 household year by year.

The analysis of water consumption change trend 2013-2014

According to the result of analysis regarding the yearly increase of water consumption of residents. The 4.3 diagram show the water consumption change. The water consumption unit has been increased without cut the consumption rate. No changes in 15 households, whereas 10 percent change in 35 household, 20 percent change in 39 household, 30 percent change in 7 household, 40 percent change in 3 household and 66 percent change in 1 household have happened.

Much families' water consumption rate has been increased by 10 percent to 20 percent. No changes in 15 households but changes in 85 household though. This shows the water consumption increase of the people in the study area.

Unit change of water consumption

The water usage trend is identified using the unit change of household in the study area. The result has been attained using the analysis of increased water consumption units.

Above diagram shows the unit changes of water consumption of households from 2012 to 2014. In comparison with 2012, we can understand the increased units of water consumption. No changes in average units of water consumption from 2012 to 2013 in 20 percent household. 23 percent household's consumption have been increased by 01 unit. Likewise, 24 percent by 2 units, 16 percent by 3 units, 9 percent by 4 units, 1 percent by 5 units, 5 percent by 6 units, 1 percent by 7 units and 1 percent by 8 units. Thus, the consumption of pipe-borne water has been increased because, 80 percent household water units' consumption has been increased.

Also, no changes in 15 percent household from 2013 to 2014. Whereas, 20 percent household's consumption has been increased by 1 unit. Likewise, 39 percent by 2 units, 18 percent by 3 units, 5 percent by 4 units, 1 percent by 5 units and 2 percent by 6 units. Thus, apart from 15 percent household, the water consumption units of 75 percent household have been increased.

Further, no changes in water consumption of 20 percent household from 2012 to 2013. In 2014, 15 percent household's water consumption was not changed. 5 percent households in 2013 which were remained without changing has been changed in 2014. In comparison of 2012 with 2014, the rate of water consumption change is 1 percent. This shows the yearly changes of water consumption of people in the study area.

In comparison of 2012 with 2014, the change of water consumption has been reduced. For 1 unit, the increasing rate was 6, for 2 units the rate was 20, for 3 units the rate was 22 and for 4 units the rate was 15. In 2-year interval, the consumption units have been increased by 10 and 11 units. The factors for the changes of units in water consumption are, rise in income level, modern machinery utilization, negligence of wells' and other water sources.
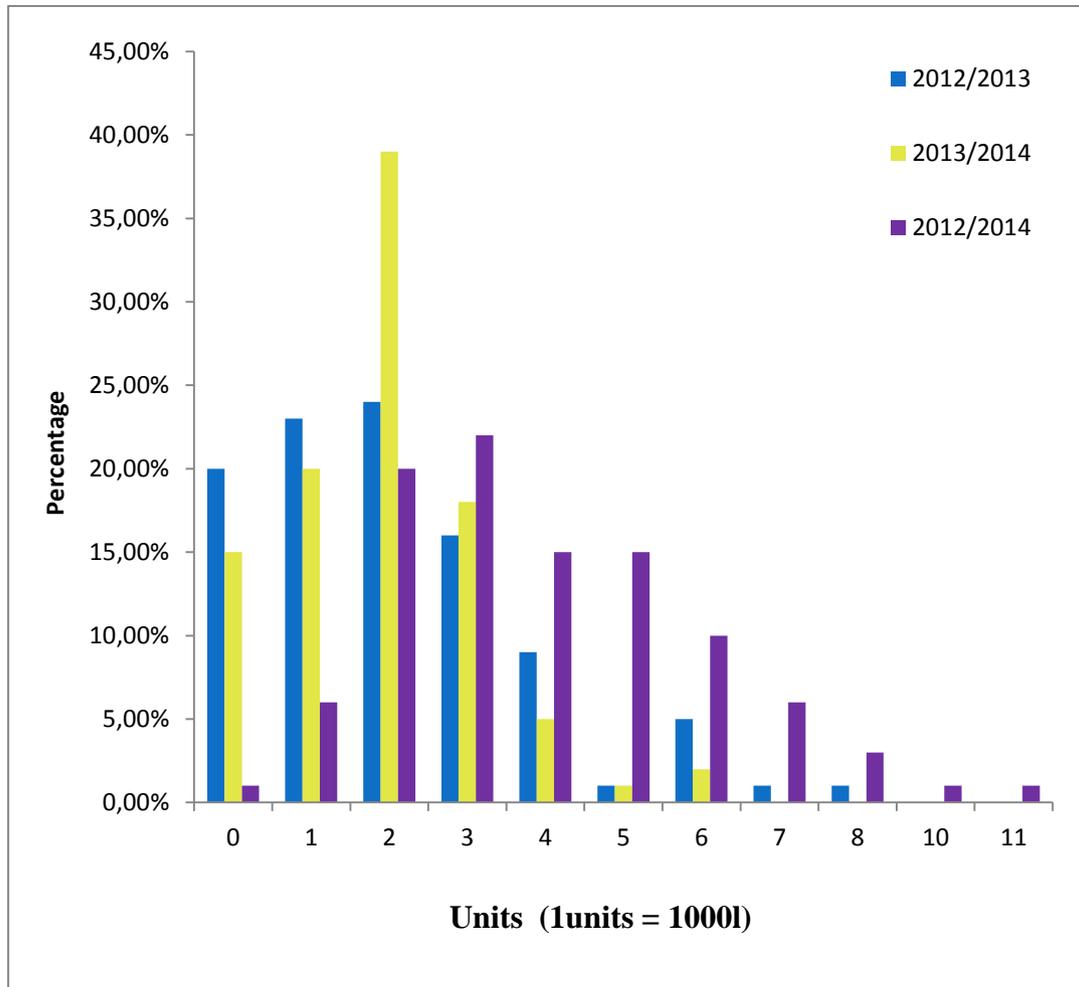
Chart 4. The increasing ratio of households' water consumption unit 2012-2014
*N = 100 (Source: Questionnaire Survey, 2015/2016)

6. CONCLUSIONS

Pipe-borne water supply that faces demand by over population, lifestyle changes, modern machinery utilization and water wastage, is one of the main sources for the fresh water for households in the study area. Therefore, this research under the title of "pipe-borne water consumption and its wastage: a study based on Panandura Urban area" conducted having the main objective as 'to evaluate the pipe-borne water consumption and its wastage based on Panandura area'.

The samples, water consuming data, questionnaire and discussion were used for analysis and result. According to the result of this study, the units of water consumption has been increased in 2014 than 2012 comparatively. 80 percent households' consumption have been changed from 2012 to 2013 and this rate became as 85 percent in 2014. Rise in income level leads to the quantitative change of pipe-borne water consumption in the study area. The households having, more than 350,000 annual income, consume the annual average pipe-

borne water units increasingly. Thus, the income level governs the units of water consumption of households in the study area.

The family members' water consumption units too deviate as per the income classes. Relatively, the households that consume water only from pipe-borne water supply and the households that consume water from the other sources (dug-wells and tube wells) with pipe-borne water supply are approximately the same. This shows the demand and preferance of pipe-borne water supply among the households. For the usual life, people in Panandura urban area consume pipe-borne water for many aspects. Of which, 23.27 percent is consumed for bathing, 22.26 percent for washing dress, 16.67 percent for washing the utensils, 15.77 percent for flushing toilets, 8.17 for cooking, 9.84 for drinking purposes and 4.03 percent for watering home garden, washing vehicles and to wash the concrete bases. This consumtion pattern was evaluated using the questionnaire survey.

The water consumption pattern causes the water wastage in Panandura area. 68 percent people wash the kitchen utensils leaving the tap opened. Likewise, 82 percent household apply the soap and 60 percent people having bathe and 72 percent people wash the vegetable leaving the tap opened. Water leaks, lack of awareness and unavailability of water saving measures were observe as main factors for the water wastage in the stud area.

Recommendations

Following recommendations are advised to use the water mindfully and to reduce the water wastage.

- Frequently check the line of water supply at home.
  This is a main agent for the water wastage and trigger the water wastage increasingly. Having identified the leaks repair them with experts. Check the leaks from water tanks and watch the meter reading to identify the leaks from pipe lines when all accesses are closed.
- To follow the rainwater harvesting methods.
- Fixing the tools to conserve the water in toilets and water carrying pipes
- Use the shower head which shower less water.
- Seldom usage of washing machines.
  Wash the dress with maximum loading and close the tap having washed the dress.
- Washing the kitchen utensils and vegetables leaving the tap closed.
- Reused the used water.
- Utilize the used water for other needs such as use the fish tank's water to the crops and make connection from kitchen effluent to the crops.
- Use the mob instead of hose for washing home.
- Watering to the home garden in early morning or late evening to reduce the evaporation.
- Reuse water for the other purposes which is only not fit for drinking purposes.
- Making awareness among residents in the study area.
- Consume water from other natural sources for other needs such as home gardening, flushing toilets, washing vehicles and washing home floors.
- Watering homegardens using the irrigation methods to reduce the water wastage.

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