

### III RESEARCH DESIGN

Research is an academic activity as well as a systematic effort to gather new knowledge; it is one method for finding answers to unanswered questions in the field of science, (Gupta and Gupta, 2011). Exemplifying facts are things like opinions, historical facts, those that have been documented in records and reports, test results, questionnaire responses, experimental data of any kind, and so on. The plan outlines all of the tasks that the researcher must undertake during the research procedure (Thakur, 2009). According to Kothari and Garg (2014), a research issue may be methodically addressed and solved through the use of a methodology. It is the study of the processes involved in doing research in a scientific manner. With regard to the context of academic research, Singh and Nath (2010) described it as a kind of inquiry.

The study titled "*Exploration of Domestic Water Management Practices and Paradigm Shift using IoT Enabled AI System for Devising Water Conservation in Ingenious Homes*" was undertaken to create awareness of the water quality while storage and to improvise the current status of water conservation by developing a tool and raising responsiveness on the perception of water, how to handle and use it for effective management of the resource - *Water*.

The current research used a multi-methodological approach (also known as a multi-phase approach). It is a method where part of the information is collected from the whole sample and part from the sub-sample (Goyal, 2013). The study consisted of the following stages.

**Phase I: Descriptive Study - Homemakers' Socio-demographic Characteristics**

**Phase II: Experimental Investigation: Water's Qualitative and Quantitative Status Quo**

**Phase III: Knowledge Germination and Dissemination**

**Phase IV: Designing the IoT Enabled AI System for Devising Water Conservation**

The next paragraphs offers a detailed overview of the research methods that was used in each step of the research process.

## **Phase I: Descriptive Study: Homemakers' Socio-demographic Characteristics**

The purpose of this section of the research was to compile information or data on the following aspects:

- *Feasibility study (or the pilot study)*
- *Descriptive study (or Ex post facto research)*

*For the feasibility study:* Smith *et al.* (2015) opined that, before beginning a full-scale field experiment, a pilot study was always recommended on a small scale. Everything from finding suitable individuals to enrolling them, collecting their data, and processing it should be put through their paces in this pilot study. The pilot survey was carried out in the sub-areas located within the five zones (North, South, East, West and Central) of Coimbatore, namely Town Hall, Gandhipuram, Vellakinar, Thudiyalur, Kavundampalayam, Singanallur, Edayerpalayam, Kovilmedu and Podanur.

Regarding a general thumb rule stated by Ruel *et al.* (2016), pilot testing is to survey on a minimum of 30 – 100 pilot participants. This *feasibility study* had covered 100 homemakers from the above-mentioned areas. This study encompassed the socio-demographic background of the selected families, house details, water distribution system, from the point of supply to the free-flowing outlets of the distribution network, water consumption profile, water collection and storage methods. The sampling method chosen was the convenience sampling technique. According to Gupta (2010), *Convenience Sampling* is also referred to as accidental, unsystematic, careless, or opportunistic sampling. A sample was picked based on the researcher's convenience. This convenience may relate to the accessibility and availability of data and units. Twenty samples from each zone were selected with the acceptance and the willingness expressed by the samples that they are involved in the pilot study. A preliminary study conducted first, undertaken on a smaller scale of samples is called a pilot study (Kadasah *et al.*, 2022) and (Ulen, Robinson and Tolley, 2012).

Using the *survey method* adopting *personal interview, an interview schedule* was used to obtain the first hand data, which was acquired from the samples. Based on answers given by the homemakers, final revisions to the survey process was made and it was ready to launch for the main descriptive study after the completion of a pilot study.

***For the descriptive study:*** A household survey was conducted as part of Phase I of this study to understand more about the selected families' attitudes toward domestic water management. It was an ex-post facto study that was mostly descriptive and cross-sectional in character as opined by Nisha (2017). As defined by Kothari (2004), Mishra and Alok (2011), descriptive research included surveys as well as a variety of other sorts of fact-finding inquiries. Additionally, the phrase Ex post facto research was used to describe research that reports on what has already occurred or is now occurring and analysis consumer habits.

As the name implies, descriptive research is conducted with a specific goal in mind, and as a result, it produces data that is easy to understand. The intention of this study was to get additional information about the characteristics of the participants regarding significant product or practice/culture claimed Panneerselvam (2014). The Household survey was conducted from March 2018 to January 2019 to acquire the data needed for this part of the study. Methods that were used in this first phase of the study are detailed in further depth in the consecutive topics as follows:-

- A. Choice of Area
- B. Sample Preference
- C. Sampling Procedure
- D. Technique used to Acquire Data
- E. Formulation of Research Instrument
- F. Conducting the Primary Research and
- G. Analysis of the Collected Data

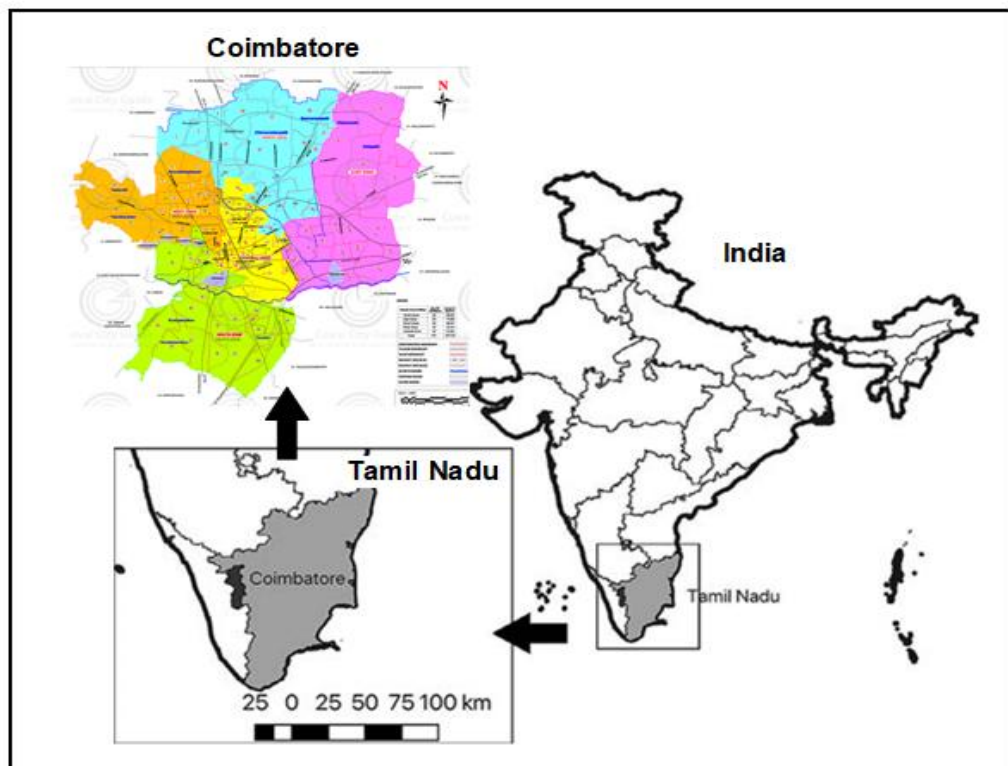
#### **A. Choice of Area**

Why Coimbatore? Bali *et al.* (2013) described Coimbatore as the administrative centre and a significant textile and engineering powerhouse of Southern India, popularly known as Manchester of South India. According to the latest current estimates, the expected population is 1.5 million people.

Coimbatore is known for its excellent weather and friendliness, in addition to textile mills, industries, engineering firms, and car parts manufacturers. Coimbatore is a historic, culturally diversified city that invites visitors from all over the world. Textile industry mainly thrives on water. Drinking water in Coimbatore City is sourced primarily from the Siruvani and Pilloor schemes. Even though water's

chemical properties claim that it has no taste, not just a Coimbatorean, everyone who had tasted Siruvani water will agree that it was the tastiest water they've ever had. It was said to be the world's second-tastiest water, after the Nile's water, which was the first. According to scientists, the taste of water was caused by the mineral content that was present in it.

While many bottled drinking water companies try to attain the optimal mineral balance to ameliorate water's taste and nutrient content, Siruvani water has been discovered to have this 'optimal balance' by itself, without the need for any improvisation. The River Siruvani in Coimbatore is a tributary of the Bhavani, which is a tributary of the Kaveri.

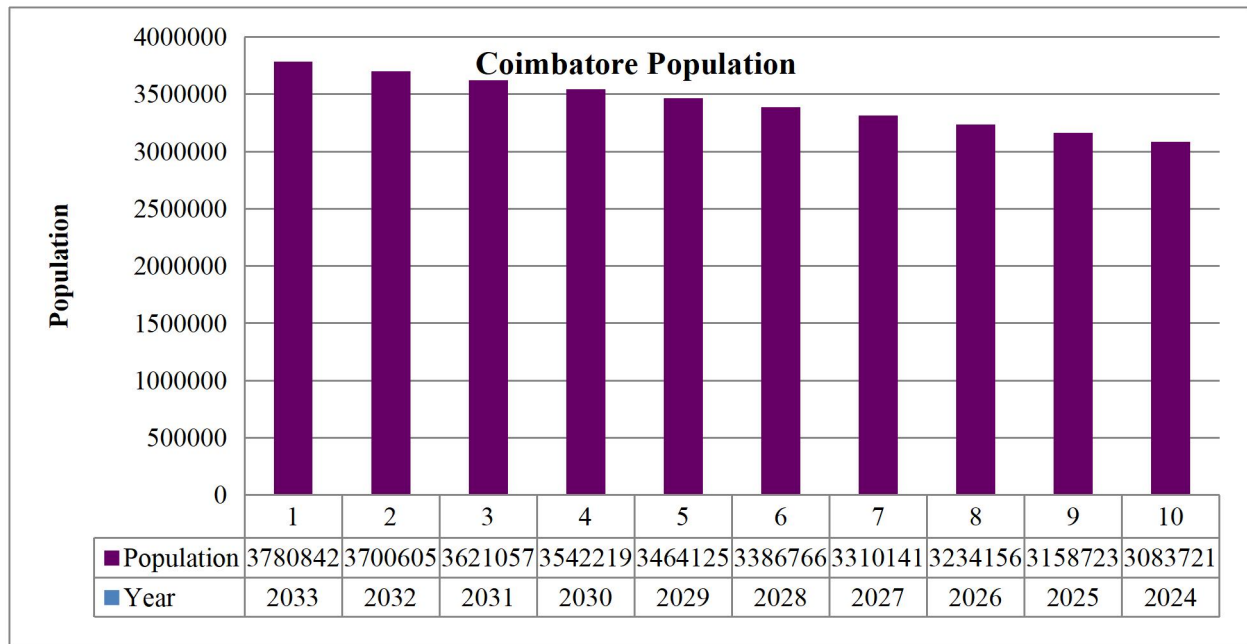


*Exhibit 2: Map Showing the Location of the Study - Coimbatore*

There was a popular belief that the taste of Siruvani was gained by the vegetation and minerals found in the Attappadi valley, through which it runs. The maintenance of the water supply was performed by City Corporation. In contrast to the Pilloor scheme, where water was pumped, all of Siruvani's supply was supplied by gravity (<https://www.ccmc.gov.in/ccmc/index.php/department/water-supply>).

It was clear from the below Figure: 6 that Coimbatore's population had grown at a rapid rate every decade since the 1950s, and so has the demand for water

for both residential and non-domestic purposes, which in turn had led to an increase in the amount of water needed.



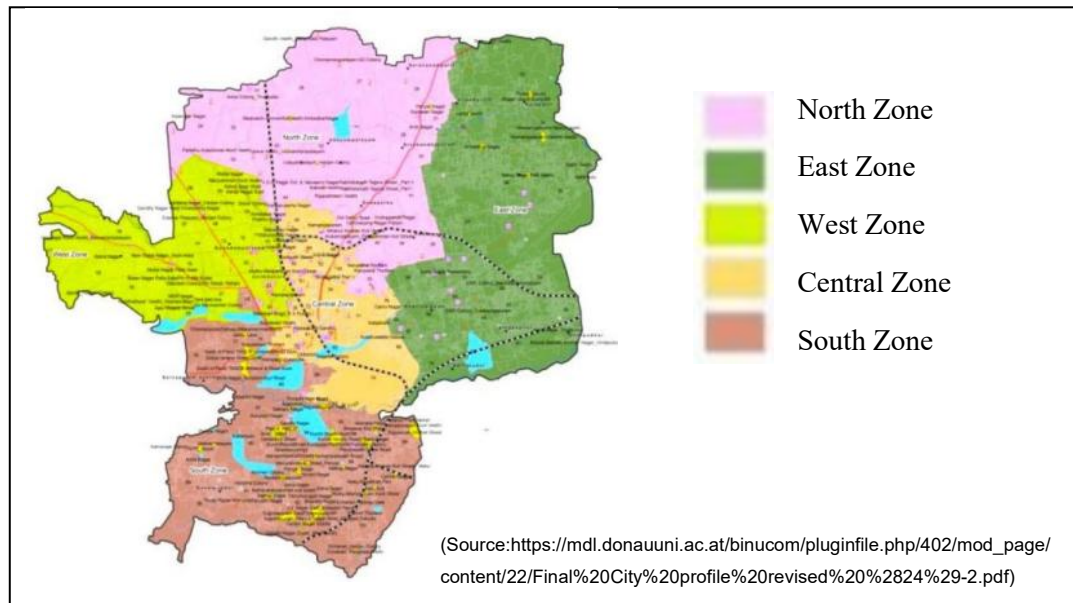
Source: <https://worldpopulationreview.com/world-cities/coimbatore-population>

**Figure 6: Coimbatore Population**

Suseela *et al.* (2014) quoted that the geographical proximity of Coimbatore to towns in Kerala through roadways further contributed to the city's high population density. There has been a recent surge in interest in IT hubs, engineering, enterprises and manufacturers. In light of these factors, the demand for land and water would rise in future as more people migrate to these areas. In spite of the city's abundance of unsecured water sources, such as reservoirs and underground aquifers, the demand for a secure supply grows daily.

The Coimbatore City Municipal Corporation (CCMC) was one the oldest and largest Corporation in the Indian state of Tamil Nadu. The city was classified into five zones, namely, Northern, Southern, Eastern, Western and Central zones. It was further divided into 20 wards in each zone, consisted of 100 wards totally. Though it was the second most developed city in Tamil Nadu, after Chennai, in terms of infrastructure, job opportunities and lifestyle, significant civic amenities in the city still had to fill a lacuna in areas, especially *water supply*. The justification for picking this city was based on the previously established rapport as it was the researcher's hometown and workplace.

The survey of households was conducted in all five zones of the city namely North, South, East, West and Central. The socio-demographic study of the selected samples was undertaken in all five zones of the city. Kothari (2004) stated that it was recommended to carry out field observation; hence, the researcher decided to carry out some kind of preliminary survey, which was also often referred to as a pilot survey. Figure: 8 displayed the five zones of the city: North, South, East, West and Central.



**Figure 7: Coimbatore City Zones Map Showing – North, South, East, West and Central Zones**

### **B. Sample Preference**

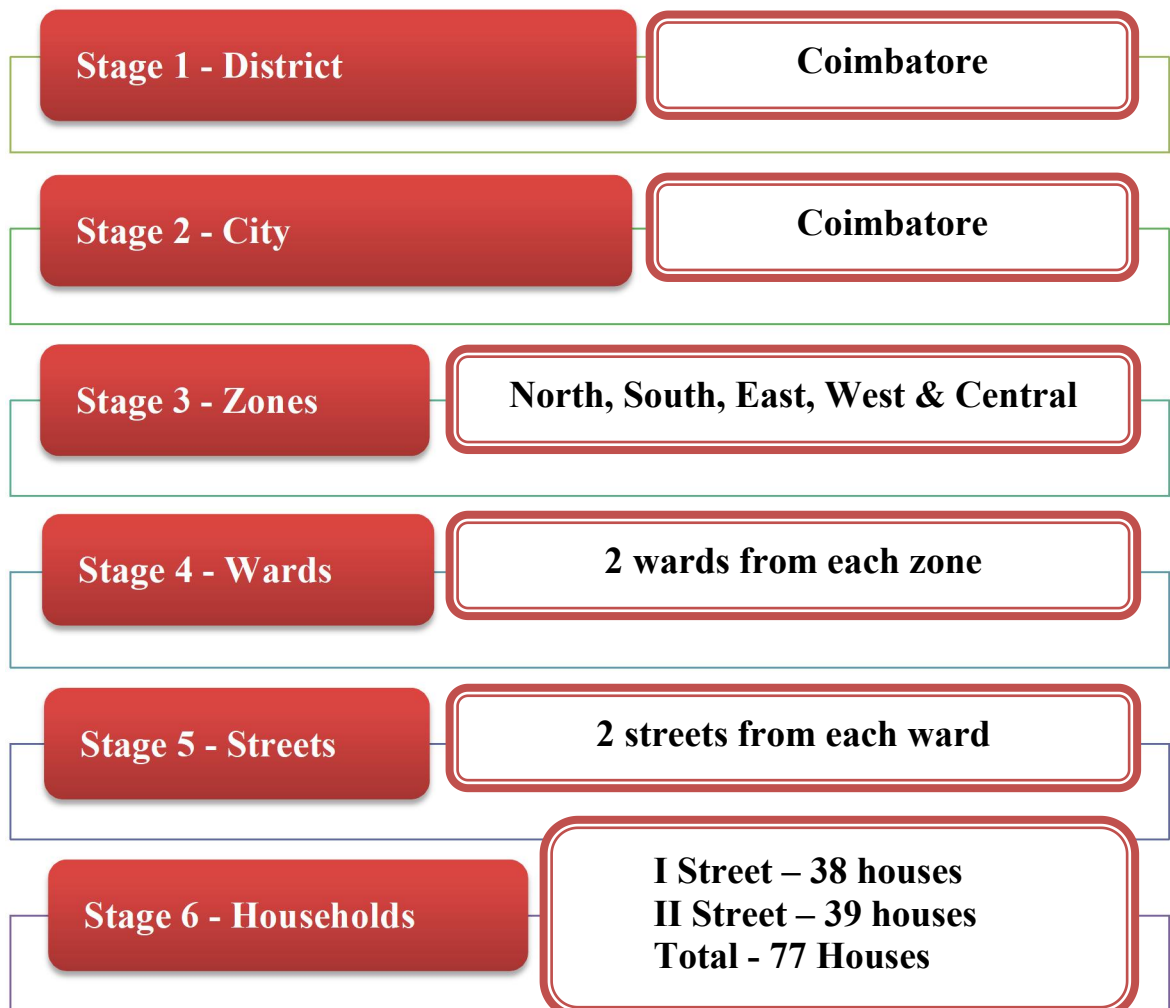
Cultural adaptation to changes in water supply brought about by technological advances in water conservation had enabled the egalitarian and sustainable use of water throughout millennia. Homemakers from Coimbatore were chosen as the sample. The researcher chose homemakers as the research sample, because, women bear the majority of the responsibility for managing water supplies, sanitation systems, and health concerns in their houses, and were eager to engage in activities that would enhance their living circumstances.

### **C. Sampling Procedure**

The samples for the research were chosen by the use of a Multistage Sampling Strategy. The samples were chosen in stages. The number of phases varied based on convenience and the availability of sampling frames at various stages as

mentioned by Jan (2022). This phase was intended to include all five zones of Coimbatore city. The stages of the study were enumerated below:

As indicated earlier, the city of Coimbatore served as the investigation's location. The *first and the second stage* involved the selection of the district and city since the selected Coimbatore District and city, being the hometown of the researcher, chose the convenience sampling method. *The Third stage* comprised the selection of zones. Areas that come up to the corporation limit were selected for the study. The Coimbatore Corporation divided the city into five zones: North, South, East, West and Central. Each zone was then sub divided into 20 wards, resulting in a total of 100 wards.



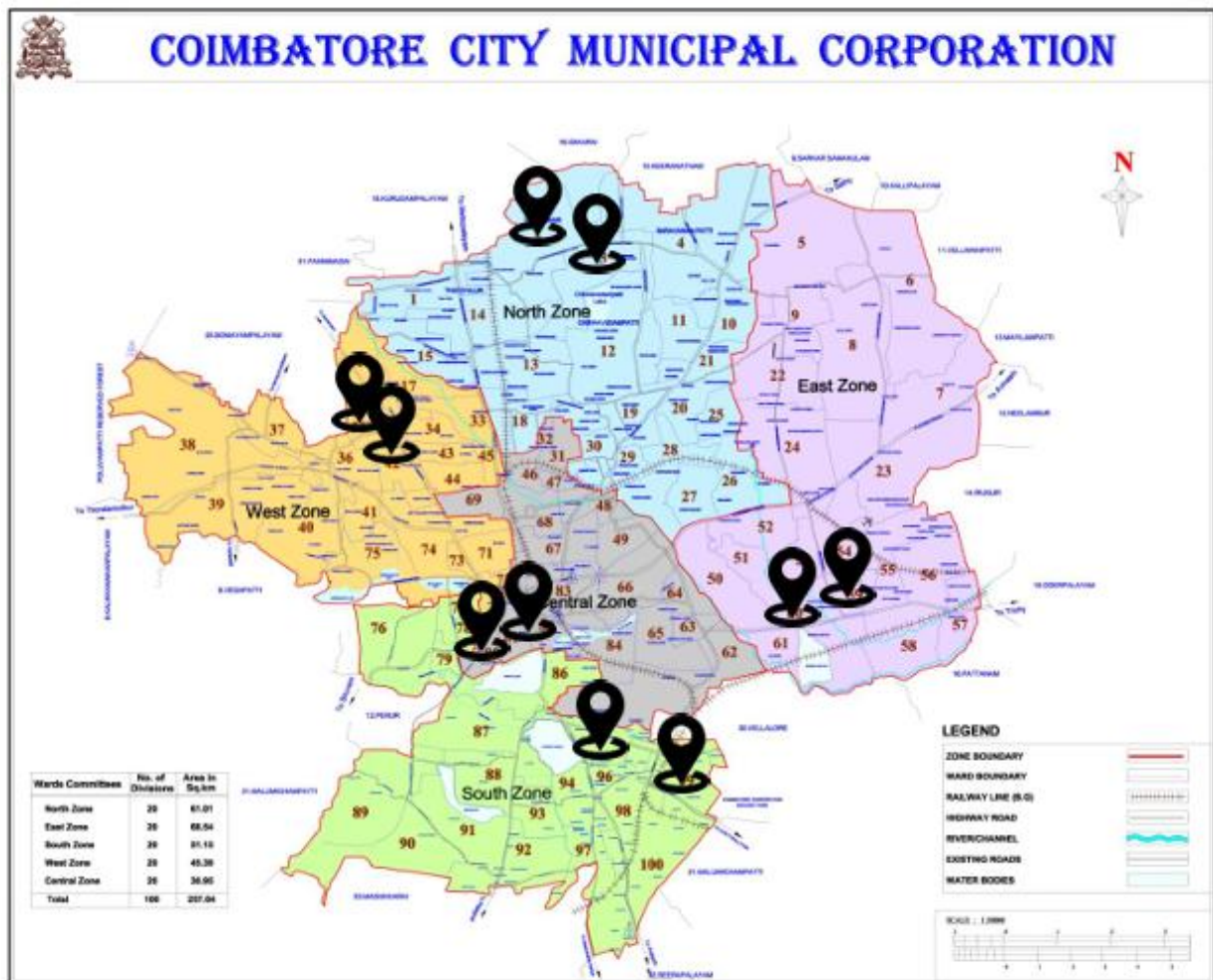
**Figure 8: Zone/Ward/Street-wise Multi-stage Framework of the Study Samples**

Using Cochran's approach, (Das and Bhattacharya, 2023) the minimum sample size for the chosen region was computed to be 385 at a confidence level of 95 per cent.

$$\text{Minimum sample size} = S = (Z)^2 (p) (q) / (e)^2 = 384.16$$

In the **fourth stage**, the researcher using simple random sampling chose two wards from each of the five zones, for a total of ten wards (Total 5 zones x selected 2 wards).

For a total sample size of twenty streets (10 wards x 2 streets = twenty streets) the **fifth stage** involved randomly selecting two streets from the entire list of streets within each selected ward. In the **sixth stage**, convenience sampling was used to choose 39 and 38 homes from each street [(38 X 1<sup>st</sup> street) + (39 X 2<sup>nd</sup> street) = 77 samples]. Each household's homemaker was picked as a study sample based on her interest to participate and engage in the interview. There were 77 houses from the city's North, South, East, West and Central zones, respectively resulting in an overall total of 385 samples. Figure: 10 depicted the chosen wards from each zone of Coimbatore city, and Table: 1 provides the sample distribution for the current study.



Source: <https://www.ccmc.gov.in/ccmc/img/upload/Zone%20Map.pdf>

**Figure 9: Selected Wards from Each Zone of Coimbatore City**

**Table 2: Zone/Ward/Street-wise Selection of Samples**

| <b>Zone</b>        | <b>Existing Wards</b>                   | <b>No. of Selected Wards</b> | <b>Name of the Selected Ward</b> | <b>No. of Streets Selected</b> | <b>Selected No. of Households</b> | <b>Total No. of Samples</b> |
|--------------------|-----------------------------------------|------------------------------|----------------------------------|--------------------------------|-----------------------------------|-----------------------------|
| North Coimbatore   | 01 – 04<br>10 – 15<br>18 - 30           | Ward - 02                    | Thudiyalur & Vellakinar          | 2 Streets                      | 38                                | 77                          |
|                    |                                         | Ward - 03                    | Thudiyalur & Vellakinar          |                                | 39                                |                             |
| South Coimbatore   | 76 – 79<br>85 - 100                     | Ward - 95                    | Podanur                          | 2 Streets                      | 38                                | 77                          |
|                    |                                         | Ward - 99                    | Chettipalayam Road               |                                | 39                                |                             |
| East Coimbatore    | 05 – 09<br>22 – 24<br>50 - 61           | Ward - 59                    | Ayyer Layout                     | 2 Streets                      | 38                                | 77                          |
|                    |                                         | Ward - 60                    | Uppilipalayam                    |                                | 39                                |                             |
| West Coimbatore    | 16, 17<br>33 – 45<br>71 - 75            | Ward - 35                    | Thadagam Road                    | 2 Streets                      | 38                                | 77                          |
|                    |                                         | Ward - 42                    | Thadagam Road                    |                                | 39                                |                             |
| Central Coimbatore | 31, 32<br>46 – 49<br>62 – 70<br>80 - 84 | Ward - 80                    | Town Hall                        | 2 Streets                      | 38                                | 77                          |
|                    |                                         | Ward - 81                    | Town Hall                        |                                | 39                                |                             |
| <b>Total</b>       |                                         |                              |                                  |                                |                                   | <b>385</b>                  |

**D. Technique used to Acquire Data**

Blair *et al.* (2014) opined that surveys are used to gather information by interviewing a representative sample of a population that has been clearly defined. For the purpose of obtaining the primary information that was required, a structured interview was used as the method for collecting the benchmark data regarding the social economic pattern, knowledge, attitude, level of understanding and current habits of the household's residential water management.



**Plate 1: Researcher Conducting Household Interview**

### **E. Formulation of Research Instrument**

According to Taylor *et al.* (2008) an interview schedule is a systematic list of questions that are asked in interviews to help collect information in a systematic way. The researcher primarily created a well-structured interview schedule with eight sections. As referred by Kumar (2011), the schedule was submitted to a pre-test, and revisions were made as needed before moving on to the main research. It was meticulously designed with subject matter specialists and enhanced through numerous administrations. Before employing it to gather real data, it is essential to test it thoroughly. A preliminary test should be conducted in real field circumstances on a group of individuals identical to the target demographic. The developed interview schedule was put through its paces on a sample of one hundred homemakers as part of pilot research. The reliability coefficient was calculated, and the result ( $\alpha$ ) was found to fall in the range of 0.71 to 0.81. Expert advice was used to determine the face validity of the instrument. The findings indicated that the instrument has a high level of reliability as well as validity. The primary research was conducted after finalizing the interview schedule. Since Tamil was the native tongue of the sample population,

the interview schedule was translated into that language. The interview schedule is available in both English and Tamil in the appendices labelled A (i) and A (ii) respectively.

### **Description of the tool**

The following topics were covered throughout each segment of the interview schedule:

1. Socio-economic background of the homemakers
2. Housing details of the homemaker
3. Information on water distribution process
4. Collection and storage practices of water
5. Water consumption profile
6. Contribution of household appliances in the use of water
7. Water conservation analysis and
8. Willingness to participate in domestic water management programme

The following is a detailed explanation of the aforementioned sections:

#### **1. Socio-economic background of the homemakers**

The purpose of the first section was to collect information on the chosen homemakers' socioeconomic status. Name, age, residence location, and work status data were obtained from the chosen samples. Additionally, the household's monthly income, family type, and family size were also recorded.

#### **2. Housing details of the homemaker**

A comprehensive information on the housing details, including the kind and type of house, the total square footage, the length of time the house was inhabited, and the zone/area where the house was situated, was collected.

#### **3. Information on water distribution process**

Information on water sources, types of water, frequency of water delivery, length of water provision, degree of satisfaction, and challenges if any, encountered during water supply was gathered in the third phase of the interview schedule.

#### **4. Collection and storage practices of water**

In the fourth segment of the interview schedule, information gathered included existing water collection and storage techniques, tools, personnel participating in the collection, types of containers used for water storage, frequency of cleaning the vessels, utilization of old water, and the number of days water was stored till consumption.

#### **5. Water consumption profile**

This part collected data on water pricing techniques, outside water procurement, the kind of water used for specific tasks, the maximum amount of water utilized, and the appointment of any hired assistance.

#### **6. Contribution of household appliances in the use of water**

The purpose of this sixth interview segment was to elicit information on how large water appliances (such as washing machines or water purifiers) were used, and operation methods.

#### **7. Water conservation analysis**

The seventh and last component of the interview schedule was developed to assess the selected homemaker's level of water conservation knowledge and comprehension. This unit consisted of eight questions that assess homemakers' knowledge, use of water conservation items, water conservation techniques utilized, installation of rainwater harvesting, interest in conserving rainwater, and methods employed.

#### **8. Willingness to participate in domestic water management programme**

The last portion of the interview schedule was devoted to the purpose of determining if the homemakers being interviewed would be willing to take part in a variety of water conservation programmes aimed for water conservation.

#### **F. Conducting the Primary Research**

The study was carried out in Coimbatore utilizing a sampling approach consisting of many stages. To conduct an in-depth interview, the chosen sample were individually contacted at their most convenient time. The study was submitted for

human ethical review. It was approved and granted research permission with the number IHEC/RM-17-18/XPD/12 by the Institutional Human Ethics Committee, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore. Appendix B contained a copy of the Ethical Clearance Certificate. To ensure that no ethical violations occurred, signed permission from the people who participated in the research was collected. The researcher briefed the participants in the research on the goal of the investigation and then proceeded to extract the necessary information by conducting interviews using an interview schedule and recording them side by side. The languages of Tamil and English versions of the interview schedule were drafted before they were distributed. The homemakers' preferred language was taken into consideration while analyzing the data. It took around twenty to thirty minutes for each homemaker to finish the interview schedule. The interview schedule was then examined to see whether or not all of the questions had been responded to.

#### **G. Analysis of the Collected Data**

The data was statistically analyzed using Statistical Package for the Social Sciences (SPSS) (Version 27.0). Descriptive statistics such as number, percentage, mean, standard deviation, Pearson's chi-square and one-way analysis of variance (ANOVA) were computed.

Descriptive statistical analysis was used to present the socio-demographic details and also the alternate water sources available, existing water conservation practices, water distribution procedure, excessive water usage for various activities, reasons for not saving rain water, frequency of soft water supply, level of satisfaction attained from the quality and quantity of water supplied and for inadequacy of water.

Chi-Square test was used to:

Find the association between the socio-demographic variables and the awareness of water conservation among the homemakers.

Establish the relationship between the awareness of water conservation, presence of rainwater harvesting system and usage of water conservation tools towards water conservation based on their socio-demographic factors.

Discover the association between selected socio-demographic variables with the presence of rainwater harvesting system.

Understand the association between satisfaction on the distributed soft water quality (during seasonal) of the selected homemakers with Zonal division and with the frequency of water supply in Coimbatore city

Uncover the relationship between the attribute of satisfaction on the distributed soft water quantity (during seasonal) of the selected homemakers with Zonal division and with the frequency of water supply.

Realize the association between satisfaction on the distributed soft water quality (during non-seasonal) of the selected homemakers with Zonal division and with the frequency of water supply in the selected city.

Reveal the association between satisfaction on the distributed soft water quantity (during non-seasonal) of the selected homemakers with Zonal division and with the frequency of water supply in the city.

One-way analysis of variance (ANOVA) was computed to analyse the influence of educational qualification of the homemakers towards residential water wastage.

One-way analysis of variance (ANOVA) was carried out to analyse the overall satisfaction of the homemakers with the distribution of soft water based on the selected socio-demographic variables.

## **Phase II: Experimental Investigation: Water's Qualitative and Quantitative**

### **Status Quo**

The second phase of the study's research aimed to provide a comprehensive assessment of the water's quality from multiple perspectives. The purpose of this section of the research was to collect information or data pertaining to the following aspects:

There is a significant amount of variation in the quality of the water that may be consumed safely throughout the country. This difference may be due to the status of the water's source as well as the treatment that it receives. In addition, drinking water that has not been appropriately treated, or that has passed through a distribution system (pipes) that has not been regularly maintained, may cause situations that increase the likelihood of the water being contaminated. Toxins in our

water supply have been linked to a variety of health issues, including digestive disorders, reproductive difficulties, and neurological impairments. It is possible that the elderly pregnant women, young children, infants and those with weaker immune systems are more susceptible to illness as quoted by Gerba and Pepper (2019).

The quality of drinking water is essential for all living things. The water quality in a location may be affected by both natural processes, such as precipitation rate, weathering process, soil erosion, and anthropogenic factors, such as urban, industrial and agricultural activities, as well as the exploitation of water resources by people (Venkatachalam, *et al.* 2010). The examination of drinking water for physical, chemical, and biological qualities, as well as trace element concentration, is essential for public health investigations.

This phase II of the current research was devoted to determining characteristics of drinking water quality and its methodology was addressed under the subsequent titles:

- A. Evaluation of the Physical, Chemical and Biological Qualities of Water Delivered in Various Zones of the Coimbatore District that was Preserved for Drinking Purposes.
- B. Inspection of Drinking Water Quality after Common Purification Methods
- C. Monitoring and Assessing the Quality of Water Stored in Different Containers
- D. Water Consumption Analysis by Micro Components

**A. Evaluation of the Physical, Chemical and Biological Qualities of Water Delivered in Various Zones of the Coimbatore District that was Preserved for Drinking Purposes.**

The water from all of Coimbatore's five zones was taken and analyzed for its physical, chemical, and biological properties. This led to the following steps:

1. Selection of the location
2. Process of sample selection
3. Method of selection
4. Accumulation of information and
5. Analysis and interpretation of data

## 1. Selection of the location

Consumption of drinking water requires knowledge of a wide range of physicochemical and biological properties. A variety of drinking water parameters were analyzed using the appropriate analytical methods. The drinking water in Coimbatore was tested in five different zones of the city: the North, South, East, West and Central. The choice of location was encouraged since the quality of drinking water varies from area to area, depending on where the water comes from and how it was treated.

## 2. Process of sample selection

*Sampling* is the systematic selection of units from a group. It's a tiny group from a large population that reflects the total population opines Jha (2014). People from a predetermined group are specifically sought for and sampled using *purposive sampling*, quoted Gerrish and Lacey (2010). Drinking water samples were taken from all five zones. Five samples were collected from the households, one sample from each zone in this experimental study period. In this part of the investigation, residential water samples using purposive sampling were collected from the tap during the water supply from different zones of the Coimbatore district. The following precautions were taken.

- ❖ Using the appropriate safety procedures, the samples were gathered in sterilized and well-dried containers made of white plastic (Rinsed the bottle and cap three times with sample water),
- ❖ The water samples were obtained in a location that was free of dust and other potential sources of contamination,
- ❖ The water samples were collected in the container such that they were between one or two inches below the top,
- ❖ Attachments such as aeration devices, hoses, and any other purifying equipment were removed from the water discharge point,
- ❖ The water discharge points were cleaned and checked to ensure that they are not in a condition of deterioration,
- ❖ It was made sure that the water output points are high enough so that a container may be placed beneath them,

- ❖ The samples were taken in such a way that the opening of the container did not come into contact with the faucet,
- ❖ Facilitated the passage of water for five or six minutes before taking a sample,
- ❖ As per the requirement of the analyst, two litres of the sample were collected for analysis,
- ❖ The contents of the sample container as well as its lid were not touched in any way, and
- ❖ The obtained specimens were transferred before the expiration of the holding time. (Holding time starts at sample collection and ends at analysis).

To prevent any errors from occurring between the stages of collection and analysis, the collected containers containing the water samples were labelled with the collection points, the date, and the time. The samples obtained were placed in an icebox before being transported to a laboratory where they were analyzed for their physical, chemical, and biological characteristics.

### 3. Method of selection



**Plate 2: Apt to Test - Water Samples**

To decipher information from the collected water samples, *empirical research* was utilized. According to Kothari and Garg (2014), empirical research depends only on experience or observation, often disregarding system and theory. This was a

research that was based on facts, and the findings are ones that can be verified by either experiment or observation. This was also referred to as experimental investigation. In such a research, it was essential to get information directly from its source and to take proactive measures to generate relevant data.

The *experimental technique* was characterised by significantly greater control over the research environment, and in this case, specific variables were manipulated to assess their impact on other variables.

#### 4. Accumulation of information

To acquire the findings of the physical, chemical, and microbiological properties, the water samples collected with necessary precautions were evaluated in an ISO 9001 Certified Laboratory chosen based on the convenience of the researcher. In the physical parameters, tests involved a variety of water characters, namely colour, electrical conductivity, pH value, total dissolved solids, turbidity, and total suspended particles. In addition, the water was tested for its total hardness, total alkalinity, oil and grease, carbonate, bicarbonate, iron, calcium, chloride, copper, fluoride, magnesium, manganese, nitrates, sulphate, sulphide, ammonia and silica. An exhaustive experiment was carried out to ascertain the presence and absence of E. coli, coliforms, and to comprehend the total plate count.

**ABITEK TESTING LABORATORY**  
An ISO 9001 Certified Laboratory

139/6, NSR Road, Saibaba Colony, Coimbatore - 641 038 - INDIA  
Tel : +91 422 2437042, Mobile : +91 7586287725 - Email : abiteklab@gmail.com - Web : www.abiteklab.com

Date of Issue: 12.06.19

Issued To : S.SOFIA JANNET - Coimbatore  
Sample Description : Water Sample (C)  
Sample Code : 3947  
Date of receipt of sample : 08.06.19  
Technical Reference : IS - 10500-2012

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The above submitted sample/samples is/are analysed in our laboratory and the results are as follows:

| TESTING PARAMETER          | UNITS      | RESULT | ACCEPTABLE LIMITS | PERMISSIBLE LIMITS | METHOD OF TESTS  |
|----------------------------|------------|--------|-------------------|--------------------|------------------|
| <b>PHYSICAL PARAMETERS</b> |            |        |                   |                    |                  |
| Color                      | Hazen unit | 0.06   | 5 Max             | 15 Max             | IS 3025(Part-4)  |
| pH value                   |            | 6.27   | 6.5 to 8.5        | 6.5 to 8.5         | IS 3025(Part-11) |
| Turbidity                  | NTU        | 0.18   | 1 Max             | 5 Max              | IS 3025(Part-10) |
| Electrical Conductivity    | Mh/cm      | 0.02   |                   |                    |                  |
| Total Dissolved Solids     | mg/l       | 28     | 500 Max           | 2000 Max           | IS 3025(Part-16) |
| Total Suspended Solids     | mg/l       | Absent |                   |                    | IS 3025(Part-17) |
| <b>GENERAL PARAMETERS</b>  |            |        |                   |                    |                  |
| Total Hardness             | mg/l       | 31.77  | 200 Max           | 600 Max            | IS 3025(Part-21) |
| Total Alkalinity           | mg/l       | 15     | 200 Max           | 600 Max            | IS 3025(Part-23) |
| Oil & Grease               | mg/l       | Absent | 0.01 Max          | 0.02 Max           | IS 3025(Part-39) |
| Carbonate                  | mg/l       | Nil    |                   |                    | IS 3025(Part-51) |
| Bicarbonate                | mg/l       | 15     |                   |                    | IS 3025(Part-51) |
| Iron                       | mg/l       | 0.006  | 1.0 Max           | 1.0 Max            | IS 3025(Part-53) |
| Calcium(as Ca)             | mg/l       | 19     | 75 Max            | 200 Max            | IS 3025(Part-40) |
| Chloride(as Cl)            | mg/l       | 24.82  | 250 Max           | 1000 Max           | IS 3025(Part-32) |
| Copper(as Cu)              | mg/l       | 0.002  | 0.05Max           | 1.5 Max            | IS 3025(Part-42) |
| Fluoride(as F)             | mg/l       | 0.001  | 1.0Max            | 1.5 Max            | IS 3025(Part-60) |

| <b>MICROBIOLOGICAL PARAMETER</b>   |        |        |         |   |               |
|------------------------------------|--------|--------|---------|---|---------------|
| Total Plate Count(37°C for 24 hrs) | CFU/ml | Absent | <20     | - | IS 5402: 2012 |
| E.coli (37°C for 24 hrs)           | -      | Absent | Absence | - | IS 5887: 1976 |
| Coliforms                          | -      | Absent | Absence | - | IS 5401: 2012 |

Checked by: *[Signature]*  
Microbiologist

Figure 10: Sample of the Water Testing Report

#### 5. Analysis and interpretation of data

The collected data was consolidated, analyzed, tabulated and were presented under IV Results and Discussion.

Descriptive statistics was used to compare the physical, chemical and biological parameters of the collected samples from different zones of the selected

city with Indian Standard Drinking Water Specifications and the World Health Organization Drinking Water Specifications.

## **B. Inspection of Drinking Water Quality after Common Purification Methods**

This part of the research endeavours to raise a heightened awareness regarding the quality of drinking water after it has been subjected to several treatments prior to being consumed by collecting the treated water samples from certain areas to conduct an analysis. The requirements for potable water supply as given by the Indian government and the World Health Organization was given in Appendix C. The data were analyzed and compared to the WHO's guidelines for safe drinking water, and so the processes comprised the following headings:

1. Choice of area
2. Selection of representative samples
3. Choice of method
4. Data collection and
5. Data analysis and interpretation

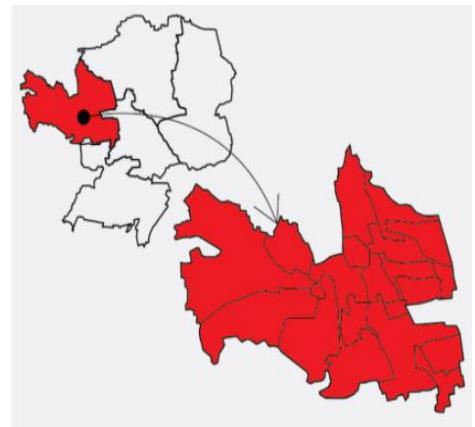
### **1. Choice of area**

Out of the five zones of Coimbatore city, the west zone was picked as the researcher dwells there and has excellent rapport, which was a piece of cake to collect the treated water samples and promote the choice of this location. From the conduct of home survey, it was evident that individuals employed a lot of water treatment procedures before consumption such as boiling (35.6%), using purifiers (membrane filters) (20.8%), RO (17.7%), purchasing packaged drinking water (12.5%) and even without any treatment too (13.5%).

### **2. Selection of representative samples**

Ahuja (2019) concluded that (i) Boiling water for drinking was still the most prevalent technique, and the water should be rolling boiled at least one minute before consumption, (ii) The membrane filtering procedure was a physical separation technique defined by the capacity to separate molecules of various sizes and properties.

### **ZONE WATCH: COIMBATORE WEST -**



The Hindu dated February 14, 2022

**Figure 11: Location Map – West Zone**  
Source: <https://www.thehindu.com/news/cities/Coimbatore/shifting-markets-developing-scheme-roads-major-demands-in-coimbatore-westzone/article 6504 8399.ece>

The difference in pressure that exists on opposite sides of a given membrane provides the impetus for its motion, (iii) The use of reverse osmosis has the added benefit of eliminating almost all dissolved chemical pollutants, (iv) Package drinking water purchased which was ozonized. They also claimed that every bottle was put through a rigorous multistage purification process that included micron filtration and ozonization with added minerals, and (v) Not utilizing any treatment method at all. On this basis, each drinking water sample that has undergone various treatments before consumption was selected to understand the physical, chemical, and biological parameters of the samples collected from the west zone of the Coimbatore district. Five drinking water samples that were chosen for the study were as follows:

- a. Boiled water (Rolling boil for one minute)
- b. Purified water (Using membrane filters)
- c. RO water (Reverse Osmosis)
- d. Packaged drinking water (Leading brand) and
- e. Directly fetched water from the distribution tap (Without treatment).

In accordance with the procedures established for use in the laboratory, appropriate safety measures were implemented throughout the process of collecting, labelling to avoid any mistakes, and transporting the samples. The recorded readings were organized and maintained for statistical analysis.

### **3. Choice of method**

The result was based on laboratory tests. As a result, it's sometimes referred to as a "laboratory study." Gupta and Gupta (2011) shared the definition for experimental study as follows: 'The core of an experiment consists of evaluating the impact that a modification of an independent variable has on a dependent variable to conclude the relationship between the two.'

Mistry (2022) explained that 'An experiment is the proof of a hypothesis that tries to find out how two factors in a casual relationship are related by studying contracting situations in which all factors except the one of interest, which is either the hypothetical case or the hypothetical effect, have been controlled'.

### **4. Procedure of data collection**

Beri (2000) quoted that the most important thing about judgement sampling is that parts of the population are chosen on purpose. Using judgement sampling, only

those samples were chosen for the study that could be narrowed down to people who had used different ways to treat drinking water in their homes, such as boiling water, purifying water, Reverse Osmosis (RO) water, buying packaged drinking water, or getting water straight from the tap.

Wegner (2008) explained that judgement sampling is used when a researcher relies only on his or her judgement to pick the most relevant sampling units to include in the sample to give data to solve the management issue under investigation. All the collected samples were subjected to monitor for their collection date, time, and specific number for quick and facile identification of the samples for maintenance of records.

## **5. Data analysis and interpretation**

The acquired data were collected, evaluated and tabulated, and the results were discussed in IV Results and Discussion.

Descriptive statistics using pictorial graphs, charts and tables was adopted to explain the existed water filtration procedures and analysis of drinking water quality after common purification methods was compared with the Indian Standard Drinking Water Specifications and the World Health Organization Drinking Water Specifications.

### **C. Monitoring and Assessing the Quality of Water Stored in Different Containers**

An attempt was made by the researcher to bring forth facts on qualitative data of the chosen water samples that had been held for a specified amount of time (i.e. the frequency of drinking water distribution) for its consumption. The researcher made an effort to profoundly find the

- (i) Qualitative facet – ameliorate/deteriorate qualities, and
- (ii) (ii) Affiliation if any that persists between the frequency of water distribution and the water storage containers by allowing the gathered water samples through chemical, biological and physical analysis.

The collected data were examined and evaluated comparing with the WHO's recommendations for safe drinking water, and Indian Standards of Drinking Water, and therefore the procedures were discussed based on the following sub-headings:

1. Selection of area and sampling
2. Selection of samples
3. Choice of method
4. Collection of data and
5. Analysis and interpretation of data

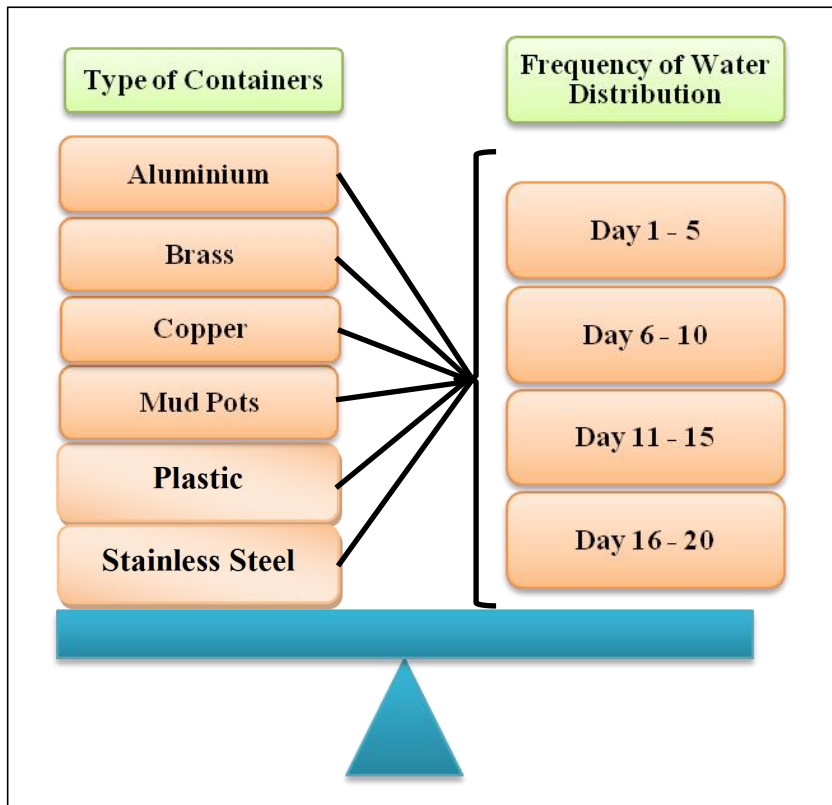


Figure 12: Water's Qualitative Status Quo

### 1. Selection of area and sampling

The specific locality selected for the study was also the *West zone of Coimbatore city* since the access and approachability to the household for repeated visits, and the willingness expressed by the household to be a part of the research motivated the researcher to opt this locality. The important factor that was well understood from Phase – I, that this particular zone: West zone received water from the Corporation in the frequency of once in even 20 days during seasonal periods, but the least once in five–ten days during non-seasonal periods. Table 3 displayed the commonly found type of containers involved in water storage.

**Table 3: Type of Containers Involved in Water Storage**

| Sl. No   | Variable                | Frequency (250) | %    |
|----------|-------------------------|-----------------|------|
| <b>1</b> | <b>Source</b>           |                 |      |
|          | Piped Connection        | 80              | 32   |
|          | Public Standpipe        | 78              | 31.2 |
|          | Borewell                | 16              | 6.4  |
|          | Well                    | 7               | 2.8  |
|          | Hand pump               | 69              | 27.6 |
| <b>2</b> | <b>Transport method</b> |                 |      |
|          | Bucket                  | 135             | 54   |
|          | Steel container         | 57              | 22.8 |
|          | Pipe                    | 58              | 23.2 |
| <b>3</b> | <b>Water storage</b>    |                 |      |
|          | Bucket                  | 46              | 18.4 |
|          | Large drum              | 62              | 24.8 |
|          | Steel utensils          | 91              | 36.4 |
|          | Ceramic pots            | 13              | 5.2  |
|          | Multiple                | 38              | 15.2 |

The research by Pradhan *et al.* (2018) declared that 36 per cent stored their drinking water in steel containers, while the remaining 24 per cent utilized big drums, 18 per cent and five per cent used bucket and ceramic pots to store water respectively. In another study conducted by Latt *et al.* (2015) revealed that clay pots (23.7 per cent), purified water-filled 20-liter plastic bottles (44.1 per cent) and ceramic jugs (28 per cent) were

observed to be used for the storage of drinking water. Observations revealed that drinking water was stored in these containers.

With this backdrop and the observed data (Household survey) revealing the type of containers that have been used for water storage as well as the frequencies of water distribution, it was decided to select a *water sample*, based on the *convenience sampling* method and the detailed procedure was given below:

## 2. Selection of samples

The fresh drinking water was collected from the distribution point during the water supply in a house located in the West zone. Adhered to the protocols to fetch water sample from the house, with utmost care the sample was transported to the testing laboratory to analyze the water's physical, chemical and biological parameters on the first day of collection. There were four intervals of time for water distribution and six types of containers. Hence four sets of six containers (clean and tidy) (aluminium, brass, copper, earthenware pots, plastic and stainless) were kept well in advance at the room temperature. The different containers were filled with the collected water (approximately 2 litres – 2.5 litres was required for water analysis and an additional 500 ml for the allowance of evaporation during the period of water storage) were covered with a suitable lid and put to start the count on the days of storage. On the fifth day of the sample collection, the required amount i.e two litres of water from respective containers were transferred into white plastic water carriers as every laboratory has its own set of sampling SOPs, there were a few general guidelines to follow while taking samples that

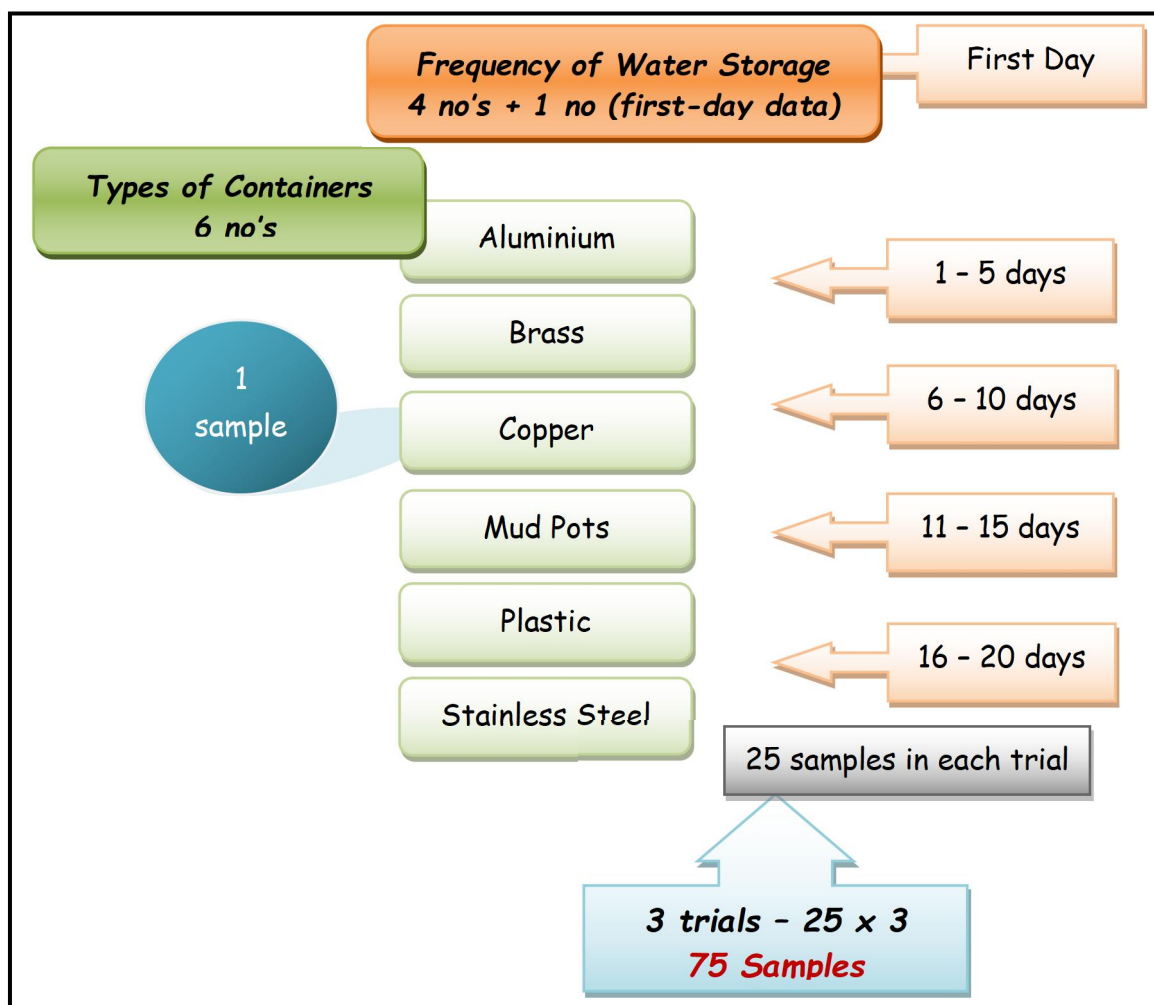
was discussed earlier. The container size was important to ensure it holds enough amounts of samples to conduct the necessary analysis. The same procedure was repeated on day 10, day 15 and day 20 of the sample water storage. The samples taken were analyzed for its physical, chemical and biological properties.

- **Physical Properties** tests involved a variety of characteristics, such as colour, electrical conductivity, pH value, TDS, turbidity and total suspended particles.
- **Chemical Properties** such as total suspended solids, total hardness, alkalinity, oil and grease, carbonate, iron, calcium, chloride, copper, fluoride, magnesium, manganese, nitrate, sulphate, sulphide and silica.
- **Biological Properties** like total plate count, E Coli and Coli forms.

Multiple trials (3 trials) were conducted following the same course of action after the completion of the first trial which was extended during the month from April – July 2019. At the end of this segment, 75 different water samples were collected in all subjected to the aforesaid examination. Plate 3 depicted the arrangement and storage of drinking water samples in different containers.



**Plate 3: Collected and Stored Water Samples**



**Figure 13: Design of Sample Selection – Monitoring and Assessing the Quality of Water Stored in Different Containers**

Figure: 13 explains the design of sample selection – monitoring and assessing the quality of water stored in different containers.

### 3. Choice of method

Experimentation was described by Cash (2016) as “documentation of examinations, qualitative or quantitative, processed by distinct and verified functions and in defined environments, followed by evaluation of the data, by suitable statistical and arithmetical rules, for the survival of important relations”. Fieldwork and experiments that can manipulate the independent variable are the emphasis of experimental research as conveyed by Bairagi and Munot (2019). In this study, the researcher wanted to look at how the quality of water changes while it is being stored to be used.

#### **4. Collection of data**

Goyal, (2013) felt that *convenience sampling* was a procedure in which the study units that just so happen to be accessible at the moment that data was being collected were chosen to be included in the sample. This was done for the purpose of convenience. Sekaran and Bougie (2015) also referred "convenience sampling" as the practise of gathering information from individuals of a population who are easily accessible to do so. *Convenience sampling* was employed to pick the water sample from a household, out of the targeted sample area (West zone). The stocked water samples were collected and examined in the laboratory and the evaluated outcome of the experiment was recorded by the researcher.

#### **5. Analysis and interpretation of data**

The data obtained for the research was properly examined to find trends and related patterns. The researcher summarised, arranged, analysed and presented the numerical data through the use of statistical methods. Analysis and interpretation were important sections of the research. Tables, figures and graphs were used to show the results visually. To conduct the analysis simple F-test and repeated measures ANOVA was done for each container to find whether the container in which the water was stored influence water's inherent physical characteristics. To check whether the properties of the stored water vary as the number of days stored increased and also whether the effect of container on water properties depends on the period of storage. The information gathered was collected, analyzed, and put into a table. The results were presented and discussed in Chapter four.

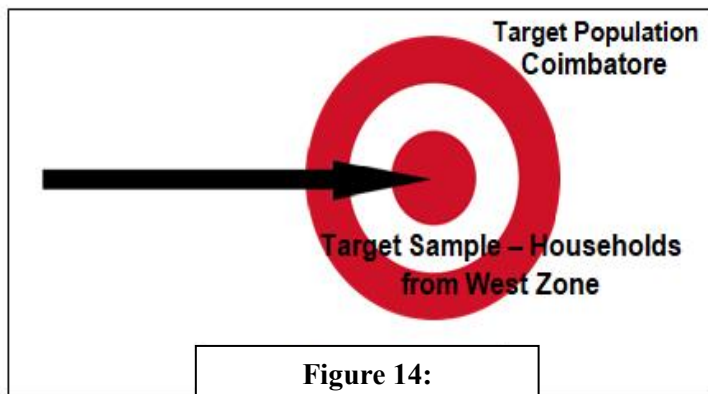
#### **D. Water Consumption Analysis by Micro Components**

Domestic water consumption comprised the majority of overall urban water consumption. In order to get a more in-depth knowledge of water consumption patterns and consumer behaviour, it is vital to grasp the various uses of water inside the house that make up the "micro components" of the water system. These uses of water might be for the purpose of personal cleaning (for instance, the use of water in baths, WCs, showers, and washbasins), or they can be for the purpose of communal usage (for instance, the use of water in kitchen sinks, washing machines, dishwashers, gardens, and vehicle washes, among others).

As pointed out by Otaki *et al.* (2013) the most accurate way to evaluate the basic factor is to break down water use per capita into micro-components. If one do not know the micro-component values of water consumption, the it would not be possible to know how much water was used in the bathroom, kitchen, laundry, and among others. Therefore, this section of the research was discussed under the following headings:

1. Selection of area
2. Selection of sample
3. Sampling procedure
4. Data collection method and
5. Analysis of data

## 1. Selection of area



**Figure 14:**  
**Selection of Study Area**

Coimbatore, which was found to be one of the exponentially growing urban cities in South India, was characterised by paucity of water supply; nonetheless, people's requirements were

addressed by a range of other means to acquire water. This part of the research was taken up targeting the parts in the Western zone of the city where the water supply is restricted and the delivery of drinking water across the area is spotty, ranging from eight to ten days during seasons other than summer and fifteen to twenty days during the summer season.

## 2. Selection of sample

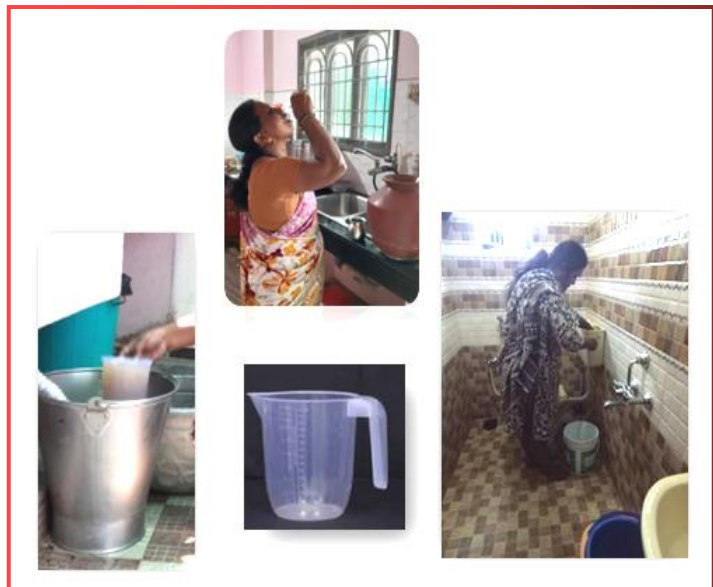
Homemakers from the Coimbatore West zone were chosen as the targeted samples for this sector of research. The researcher chose homemakers as the research samples as women directly hold the command and the responsibility for managing water-involved household activities in their houses. As common household works need a lot of water; it was important to follow up on the usage of water for various

activities. The researcher yearns to identify the amount of water that was used for all household chores that involved the usage of water like drinking, cooking, bathing, washing clothes, dishes, hand washing, toilet flushing, outdoor cleaning, among others. Thirty houses were shortlisted to be included in the sample to analyze the household member's water use behaviour.

### 3. Sampling procedure

As per Etikan *et al.* (2016) convenience sampling is a type of non-probability or non-random sampling in which members of the target population that fulfil specified practical conditions, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate, are included for the study. This type of sampling is also known as haphazard sampling or accidental sampling. It

was also used to refer to the members of the population who were selected for research purposes because they were easily accessible by the investigator. The researcher selected thirty families for the investigation of micro component water use using a convenience sample strategy. Before the actual session of the



**Plate 4: Quantifying Used Water**

experiment, the homes that was chosen for participation were contacted, the procedure explained to them and they were asked for approval to carry on the study further.

### 4. Data collection method

With the homeowner's permission, to evaluate the water flow rate, it was decided to install a water metre at the water outlet connected to the bathing outlet, toilet flush, hand wash, clothes washing outlet, sink outlet and common use outlet. Unfortunately, a significant portion of the population had voiced their opposition to have these devices installed in their sewerage system, rendered this method inapplicable. After that, the manual technique of measuring wastewater was used, in

which the wastewater from the sink, hand wash, and washing machines or by manually washing was gathered in huge containers that could be measured. The necessary instruments, such as a measuring cup (one litre of water) and a measuring container (15–20 litres of water), were used in order to measure the water that had been used.

The amount of water needed for the culinary experiment, 10 litres of water, was measured and it was put aside the day before the experiment. The homemakers were given instructions to utilize the water for cooking that would take place the following day. The similar approach was used for drinking, as well. At the end of the day, the amount of water that had been used for drinking and cooking was determined by measuring how much water was left. Accessing the volume of water that was used for flushing toilets, the *single flush* - would empty the entire capacity of the cistern water tank, whereas the *dual flush* - would discharge around 30 and 70 per cent of the full capacity of the cistern water tank, depending on which flush was selected, allowing for a significant amount of water to be saved.

A prefilled measurable water container with water was kept in the toilets for the use of the members of the household for the *manual way* of flushing toilets and the used water was computed with the amount of water remaining at the end of the day; and any excess water used was also recorded.

In a *single flush*, the whole capacity of the cistern water tank is accessible based on the amount of water it contains. The *dual flush* system was tested by first filling the cistern water tank, then turning off the water supply to the tank, and then, after performing a partial flush, measuring the amount of water that was left in the tank to provide an estimate of the volume of water that was flushed. The amount of water used for toilet flushing was determined based on the number of full flushes and dual flushes performed daily - 30% and 70%.

The homemakers were asked to fill measurable containers with water before using it. This was done so that the amount of water used for activities such as bathing, caring for pets, and gardening, as well as other activities such as washing their portico and front yard, and mopping the house, could be accurately assessed. In homes with overhead showers for bathing, the amount of consumed water was determined by the time of the bath and water discharge per minute. A hose was used

to clean the many modes of transportation owned by the family, including automobiles, motorcycles, and bicycles. A timer was used to keep track of the amount of time it took to wash the automobiles, and the rate of water outflow from the hose was measured in terms of litres per minute in order to determine how long the process took.

## **5. Analysis of data**

Data collection is the compilation of measurements, observations, and facts related to any occurrence (physical, social or economic). The presentation of data may take the form of sentences or numbers. The process of arranging and evaluating data to get information that has significance is data interpretation. It involves arranging and representing a huge quantity of data in a manner that is concise and accurate. This results in a form that is much simpler to read than the raw data. The full data must be presented quantitatively in these ordered formats, such as a table or graphical representation before it is possible to make any conclusions or deductions from the information([https://www.google.co.in/books/edition/A\\_Complete\\_Book\\_on\\_Data\\_Interpretation\\_D/3zCIDwAAQBAJ?hl=en&gbpv=1&dq=analysis+and+interpretation+of+data&printsec=frontcover](https://www.google.co.in/books/edition/A_Complete_Book_on_Data_Interpretation_D/3zCIDwAAQBAJ?hl=en&gbpv=1&dq=analysis+and+interpretation+of+data&printsec=frontcover)).

One-way analysis of variance (ANOVA) was computed to discover the difference in water consumption between traditional method and using labour-saving devices.

Two sample 't' test was employed to understand the significant difference between the quantity of water used for household chores by homemakers and paid assistants.

### **Phase III: Knowledge Germination and Dissemination**

The third phase of the project was focused on the implementation and evaluation of an intervention programme on the socio-demographic pattern, knowledge, attitude, degree of awareness, and current practices of the households in connection to residential water management. As a consequence of the findings of Phase I, the following challenges were identified as being faced by homemakers in relation to the management of water:

- ❖ Lack of ample awareness among homemakers on the principles of water administration,

- ❖ Lessened capability of housewives to recognise the practices of water conservation based on the nature of regular water use behaviour, pointing to government officials and policies for its irregularity and incompetency in water management systems,
- ❖ Poor practices in water collection, storage, and assuring the quality of drinking water, and
- ❖ Even though many housewives are interested in learning about the latest trends in water management, they are hesitant to engage in intervention or knowledge-gaining sessions.

To address these challenges, it was determined that homemakers should be educated on various elements of water management, including demand and supply situations, water conservation methods and techniques, as well as the necessity, significance, and benefits of successful household water management. Under the following categories, Phase III of the present research was described.

A. Sample and Study Area Selection

B. Creating Educational Modules for Knowledge Dissemination on Residential Water Management

C. Conducting the Residential Water Management Knowledge Dissemination Programme and

D. Effectiveness of the Residential Water Management Knowledge Dissemination Programme

#### **A. Sample and Study Area Selection**

The knowledge dissemination session was planned and conducted in Coimbatore city to improve the concern of water management through disseminating information and raising awareness. Within the boundaries of Coimbatore Corporation, Ward Number 35 and 42 from the West zone were selected for the knowledge dissemination programme, because, the proportion of persons who indicated a desire to attend the event is relatively high in comparison to other zones. Women have long been connected with a variety of water-related chores, including the collection, transport, and purification of water. They are the first to detect any physical, chemical, or biological degradation of water as they are responsible for managing all domestic

tasks, both the tidiness of the house and the well-being of the family. Testing the purity of different water sources and as well as reducing water flow with the available resource will now be the exclusive duty of women.

They were also driven by a strong sense of civic responsibility and the desire to enhance both their own level of living and the health of the members of their family by using efficient ways of water management. As a result, it was decided to carry out a campaign to disseminate information to enthusiastic homemakers wanting to participate in the community water management programme. This would assist them in becoming responsible consumers, which would help ensure household water conservation and water quality. The study was carried out in May 2021. Amid an increase in COVID 19 cases throughout the nation, the awareness session was carried out through virtual mode. It happened to be the new paradigm, where it was a place for social interactions and collaborative activities.

Over the phone, 182 households from Ward No: 35 and 42, were chosen based on the willingness they expressed during the household survey (purposive sampling), contacted, and requested their consent to find their willingness to participate in the water management knowledge dissemination program. Out of the contacted homemakers, 101 individuals expressed a strong interest in taking part in the programme. Only 65 individuals were able to engage in the online knowledge dissemination programme, because, the remaining 37 were either unavailable or unable to devote any time to it. Besides, some of the homemakers were not aware of the procedure involved in attending through virtual mode.

## **B. Creating Educational Modules for Knowledge Dissemination on Residential Water Management**

Electronic material, written material, and interpersonal activities were the three types of communication that were included in the tools for knowledge dissemination. *Written material* comprised a variety of informational tools, including leaflets, research bulletins, fact sheets, resource guides, articles, editorials, newsletters, press releases and news coverage, posters, science summary reports, booklets, storybooks, pocket cards and synopses. The term “Electronic material” was used to refer to several

types of disseminating media, including DVDs, CD-ROMs, email alerts, informational content that could be found on the internet, personalised messages delivered by email, online conferences, and websites. Events such as arts-based performances, a community of practice network, forums, information brokers, and seminars or workshops were examples of what were included in the category of *interpersonal methods of communication*, quoted Lafreniere *et al.* (2013).



**Figure 15:**  
**Written Material - Poster Developed**

The learning modules prepared for the water management knowledge dissemination program are shown in Figure: 15, 16 and Exhibit: 3, 4. Learning modules, namely, *written materials, electronic material, and interpersonal means of communication* were developed specifically for homemakers with the goals of enhancing an understanding of the concepts of water, informing them the impact of lackadaisical water use practices, and extending their knowledge of the appropriate methods of water storage to sustain its quality, as well as various water conservation measures at the household level. For the purpose of eliciting immediate and active engagement from the community, charts, posters, brochures, and puppet performances were developed. The puppet pageant produced for the program was filed for authorship (**Copyright**) and approved under Indian Law maintained by the Registrar of Copyrights. Exhibit: 5 shows the Interpersonal Means of Communication - Developed Puppet Show (**Copyright Material**). A copy of the document from the register of copyrights was given in Appendix - E.

  
**Avinashilingam Institute for Home Science and Higher Education for Women**  
 (Deemed to be University under Category A by MHRD, Estd. u/s 3 of UGC Act 1956)  
 Re-accredited with A+ Grade by NAAC, Recognised by UGC Under Section 12 B  
 Coimbatore - 641 043, Tamil Nadu, India

**நீர் மேலாண்மை நடைமுறைகள் - சமூகப்பார்வை**  
**Community Vision on Water Management Practices**

**கோவை மேற்கு மண்டலம் - இல்லத்தரசிகள் பங்குபெறும் அறிவு பரப்புதல் மற்றும் விழிப்புணர்வு கூட்டம்**

**29.05.2021 சனிக்கிழமை**  
**மாலை 3.00 மணி முதல்**

**Google சந்திப்பு**  
<https://meet.google.com/zgv-ugmq-utz7authuser=3>


**திரு.R. எழில்**

உதவி பொறியாளர்  
கோயம்புத்தூர் நகர மாநகராட்சி

**தலைமை விருந்தினர்**

**திரு.M. கலைவாணன்**

பங்கேற்பு, கல்வி கற்பதற்கான சிறந்த முறைகளில் ஒன்று - டாம் கிளாசர்

**பொம்மலாட்டம்**

**திரு. விக்னேஷ்**

நிர்வாக இயக்குனர்  
வேறுபல் ஸ்டோன் டெக்னாலஜி

**முனைவர் M.R. திலகம்**

பேராசிரியர்,  
வள மேலாண்மை துறை

**Organized By**  
 Mrs.J.Sofia Jannet - Research Scholar, Assistant Professor and  
 Dr.M.R.Thilakam - Professor and Head, Department of Resource Management,  
 Avinashilingam Institute for Home Science and  
 Higher Education for Women, Coimbatore - 641043

Figure 16: Invitation - Water Management Knowledge Dissemination Programme

  
**Avinashilingam Institute for Home Science and Higher Education for Women**  
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**Community Vision on Water Management Practices**

**29.05.2021 சனிக்கிழமை**  
**மாலை 3.00 மணி முதல்**

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**நிகழ்ச்சி நிரல்**

|                            |                                                                                                                                                                                                   |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| கடவுள் வாழ்த்து வரவேற்புரை | வேலூர் & எட்டையாட்டு முனைவர் M.R. திலகம்                                                                                                                                                          |
| முன்னுரை                   | பேராசிரியர் தலைமை வளமேலாண்மைத் துறை அகிலா ஈசுவரியம் பல்சலைக் கழகம் கோயம்புத்தூர் முனைவர் என் திரேசுவரன் பேராசிரியர் பாடலவ்லுத் துறை அறிவியல் துறை தமிழ்நாடுவேளாண்மை அமைச்சுக் கழகம் கோயம்புத்தூர் |
| தலைமை விருந்தினர்          | திரு. எழில் உதவி பொறியாளர் கோயம்புத்தூர் நகர மாநகராட்சி                                                                                                                                           |
| பொம்மலாட்டம்               | திரு.M. கலைவாணன் இயக்குனர் - தமிழ்நாடு பொம்மலாட்ட கலை அகாடமி நிறுவனர் - கலை வடிவம் மற்றும் தொழில் முத்துகள் மன்றம்                                                                                |
| சிறப்பு விருந்தினர்        | திரு. விக்னேஷ் நிர்வாக இயக்குனர் வேறுபல் ஸ்டோன் டெக்னாலஜி                                                                                                                                         |
| நன்றியுரை                  | திரு.எ.வி. சோனையார் பேராசிரியர் வளமேலாண்மைத் துறை அகிலா ஈசுவரியம் பல்சலைக் கழகம் கோயம்புத்தூர்                                                                                                    |

  
**Avinashilingam Institute for Home Science and Higher Education for Women**  
 (Deemed to be University under Category A by MHRD, Estd. u/s 3 of UGC Act 1956)  
 Re-accredited with A+ Grade by NAAC, Recognised by UGC Under Section 12 B  
 Coimbatore - 641 043, Tamil Nadu, India

**நீர் மேலாண்மை நடைமுறைகள் - சமூகப்பார்வை**  
**Community Vision on Water Management Practices**

**29.05.2021 Saturday**  
**3.00 pm onwards**

**Google Meet**  
<https://meet.google.com/zgv-ugmq-utz7authuser=3>

**Agenda**

|                 |                                                                                                                                                                |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Prayer          | Shanon & Stefford                                                                                                                                              |
| Welcome Speech  | Dr (Mrs.) M.R. Thilakam Professor and Head, Department of Resource Management Avinashilingam Institute for Home Science and Higher Education for Women         |
| Introduction    | Mr. Chandrasekaran Professor and Subject Expert Department of Soil Science Agricultural Chemistry Tamil Nadu Agricultural University Coimbatore                |
| Chief Guest     | Mr. R. Ezhil Assistant Engineer Coimbatore City Municipal Corporation                                                                                          |
| Puppetry        | Mr. M. Kalavanan Director - Tamil Nadu Puppetry Art Academy Founder: Kalai Trust & Thendral Children Forum                                                     |
| Special Lecture | Mr. Vignesh Managing Director Halistone Technology, Coimbatore                                                                                                 |
| Vote of Thanks  | Mrs. J. Sofia Jannet Research Scholar, Assistant Professor Department of Resource Management Avinashilingam Institute for Home Science and Education for Women |

Exhibit 3: Program Schedule – Water Management Knowledge Dissemination Programme



## நீர் மேலாண்மை நடைமுறைகள்- சமூகப்பார்வை

அறிவு பரப்புதல்/ விழிப்புணர்வு கூட்டத்திற்காக

ஜே .ஷோபியா ஜேனட்

(ஆராய்ச்சி மாணவி- உதவி பேராசிரியர்)

முனைவர் எம் .ஆர். திலகம்

(பேராசிரியர்- தலைமை)

வள மேலாண்மை துறை

அவிநாசிலிங்கம் பல்கலைக்கழகம்- கோயம்புத்தூர்

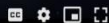
மற்றும்

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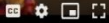


கவலை தீரும்  
நிலைமை மாறும்

0:13 / 12:45



1:55 / 12:45



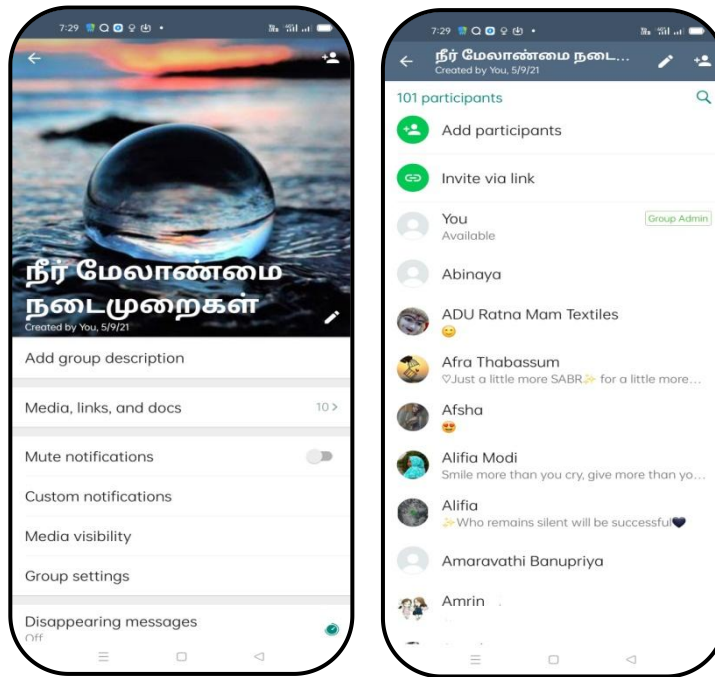
**Exhibit 5: Interpersonal Means of Communication - *Developed Puppet Show*  
(Copyright Material)**

### **C. Conducting the Residential Water Management Knowledge Dissemination Programme**

The water management knowledge dissemination program which was titled 'Community Vision on Water Management Practices' was started with the filling of pre-test form, by online submission of the replies by the homemakers. The target group for the knowledge dissemination programme was made up of 101 homemakers, where only 65 had confirmed their participation. Knowledge dissemination was imparted to increase the knowledge on the socio-demographic details, attitude, degree of knowledge, and current practice of the households in connection to residential

water management based on the learning modules established using appropriate extension approaches.

It was planned that the programme to disseminate knowledge on effective



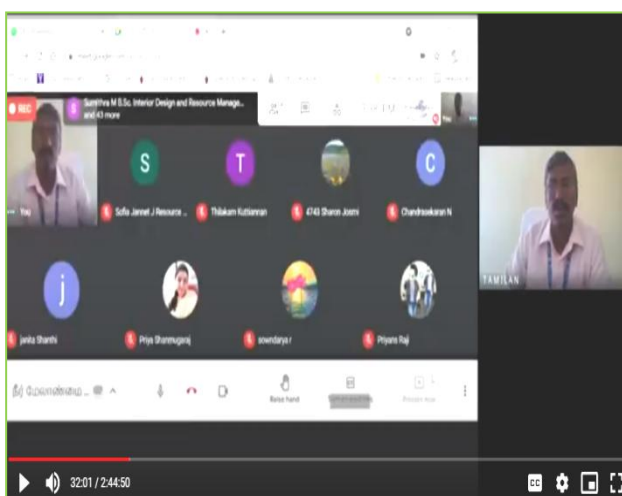
domestic water management would take place for two sessions, each of which would last for three hours on a day that was convenient for the homemakers. To disseminate information about the programme, a Whatsapp group was created with the homemakers who had committed to attend the event. Programme invitation, programme schedule,

**Plate 5: Created Whatsapp Group**

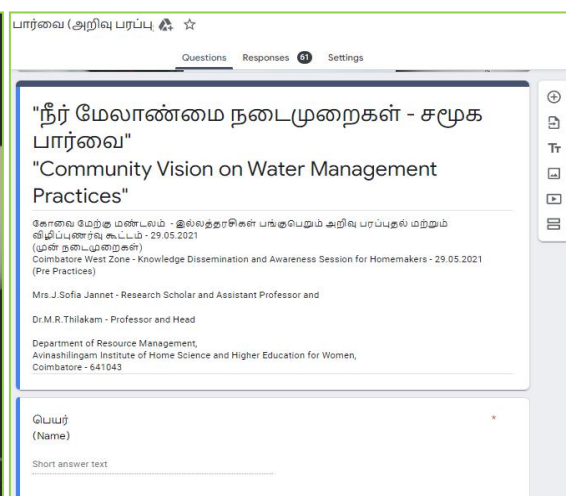
brochure in both English and Tamil, posters, the link for filling the pre and post-programme google form, etc. were shared in this group

Both a pre- and a post-evaluation Google form were designed with the intention of determining the perspectives and attitudes of the participants towards the various water management strategies. The form consisted of 14 questions each of which was scored on a Likert scale that ranged from strongly agree (5 points) to strongly disagree (1 point) and included seven general questions like period of living in the given address, type of house, number of family members, regularity of the supply of water for consumption, and the number of houses that share the available water. The ratings provided by the households were summed to generate the attitude scores for each homemaker before and after the intervention. The higher these scores are the more favourable positive behaviour among the households. Before and after the intervention, the behavioural ratings were compared using the paired sample t-test to determine whether there was a statistically significant difference. Individual consultation with subject experts, lectures, doubt clearance sessions, and group

discussions were used to educate the homemakers. The distribution of posters to all homemakers improved memory recall.



**Plate 6: Conduct of the Programme**



**Plate 7: Google Form for the Pre and Post-evaluation Form**

The approach used to communicate the knowledge dissemination programme was shown below:

**Table 4: Learning Modules Developed for the Water Management Knowledge Dissemination Programme**

| Topics Covered                                                                                                                                                        | Method Adopted                                                                                                                                        | Tools Used                                                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Introduction to domestic water management</li> <li>• The current trend in the city's water distribution procedure</li> </ul> | <ul style="list-style-type: none"> <li>• Lecture</li> <li>• Group discussion</li> <li>• Individual consultation</li> <li>• Doubt clearance</li> </ul> | <ul style="list-style-type: none"> <li>• PowerPoint presentation</li> </ul>                          |
| <ul style="list-style-type: none"> <li>• Water conservation strategies</li> <li>• water quality assurance</li> </ul>                                                  | <ul style="list-style-type: none"> <li>• Group discussion</li> <li>• Lecture</li> </ul>                                                               | <ul style="list-style-type: none"> <li>• Video show</li> <li>• Brochure</li> <li>• Poster</li> </ul> |

## **D. Effectiveness of the Residential Water Management Knowledge Dissemination Programme.**

### *Interventions are Strategies for Intentional Change*

Intervention includes making a modification – or intervening – to examine the effect of what has been changed. Immediately after the baseline period, an intervention is implemented with the intent of influencing a result. Interventions are deliberate activities that may function at the individual, family, organisational, neighbourhood, regional, national, or another level. It may consist of a single activity or a collection of acts. Using a Google form, the impact of the residential water management knowledge dissemination programme on the elements of water management, including demand and supply situations, water conservation methods and techniques, and sustenance of water purity, necessity, significance, and as well as the benefits of successful household water management were investigated before and three months after the programme's implementation. Before and after three months of the household water management knowledge dissemination campaign, the link to fill out the Google form was shared with the homemakers.

The data gathered was compiled, checked for accuracy, tabulated, and presented in Results and Discussion.

### **Phase IV: Designing the IoT Enabled AI System for Devising Water**

#### **Conservation**

In this Phase IV, an effort was made to design and create: *IoT Enabled AI System for Devising Water Conservation*. The design of this water system adhered to the ideas and procedures outlined in the researcher's review of this specific subject, which is meticulously recorded as follows:

Water consumption must be optimized and intentionally utilized to fulfil the expanding population's requirements and expectations. In this regard, we are confronted with everyday challenges like not tracking how much water is used by the family, unintentional water wastage, failing to turn off water taps, and unattended water leakages in faucets and pipes, resulting in a significant amount of water wastage.

The concept of an artificial intelligence-based water conservation system was devised to solve the aforementioned concerns. We need to address the problem

by modelling, creating, and implementing a smart water management system. It should be capable of dramatically reducing water use and managing water usage via a mobile application, designing a sensor interface that provides data on water flow, and total water consumption, and generating a detailed analysis of water consumption when needed. The design of the *IoT Enabled AI System for Devising Water Conservation* was developed with the support and assistance of an engineer. The conceptualization design of the invention was discussed elaborately under the following headings in Chapter IV. Results and Discussion.

- A. Conspectus Minutiae of the Invention
- B. Invention's Detailed Picture
- C. Block Diagram Representing the Thorough Architecture of the Invention
- D. Novelty and Highlights of the Invention and
- E. Honor of the Invention Acknowledged

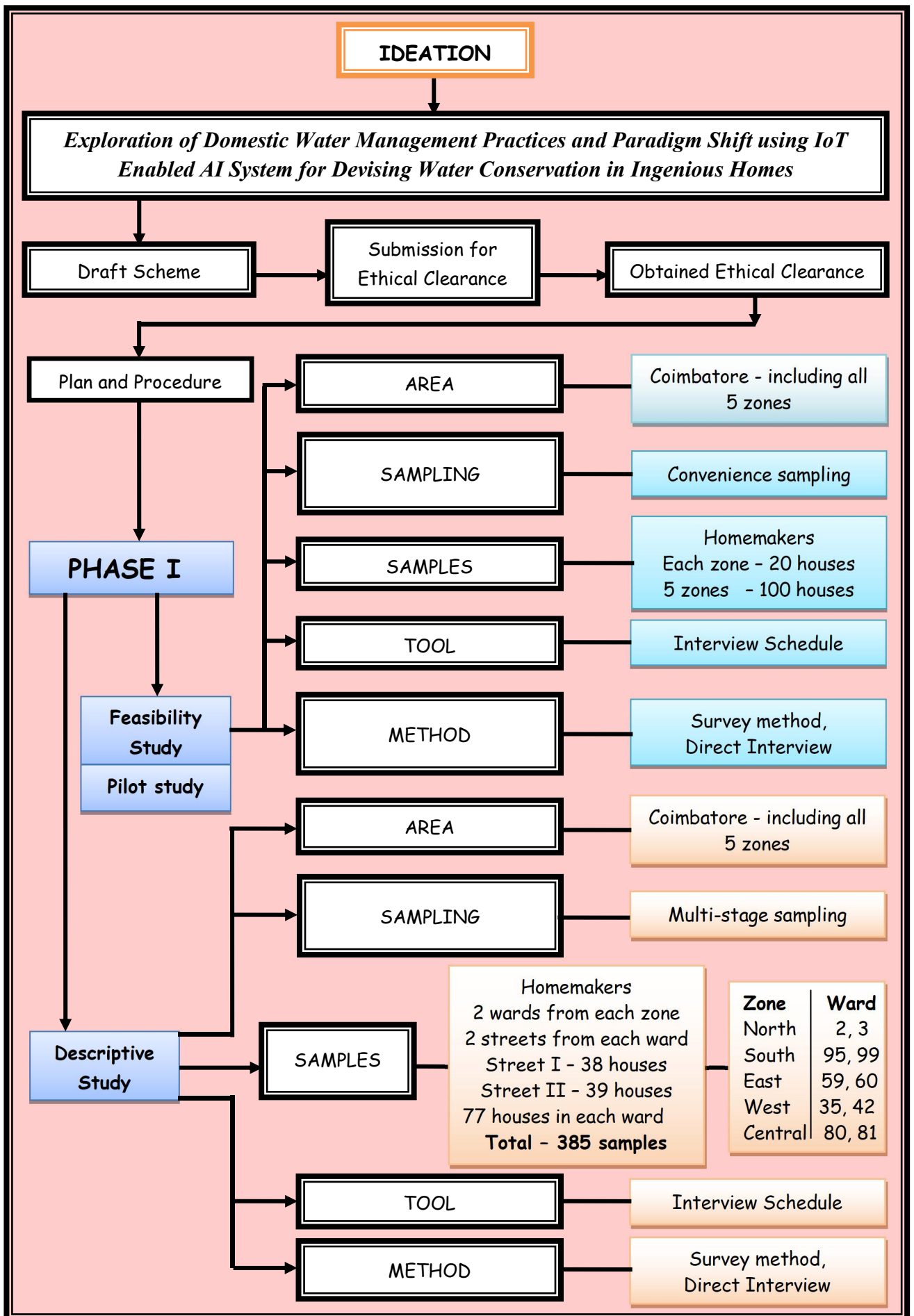


Figure 17: Phase I - Descriptive Study: Homemakers' Socio-demographic Characteristics

*Exploration of Domestic Water Management Practices and Paradigm Shift using IoT Enabled AI System for Devising Water Conservation in Ingenious Homes*

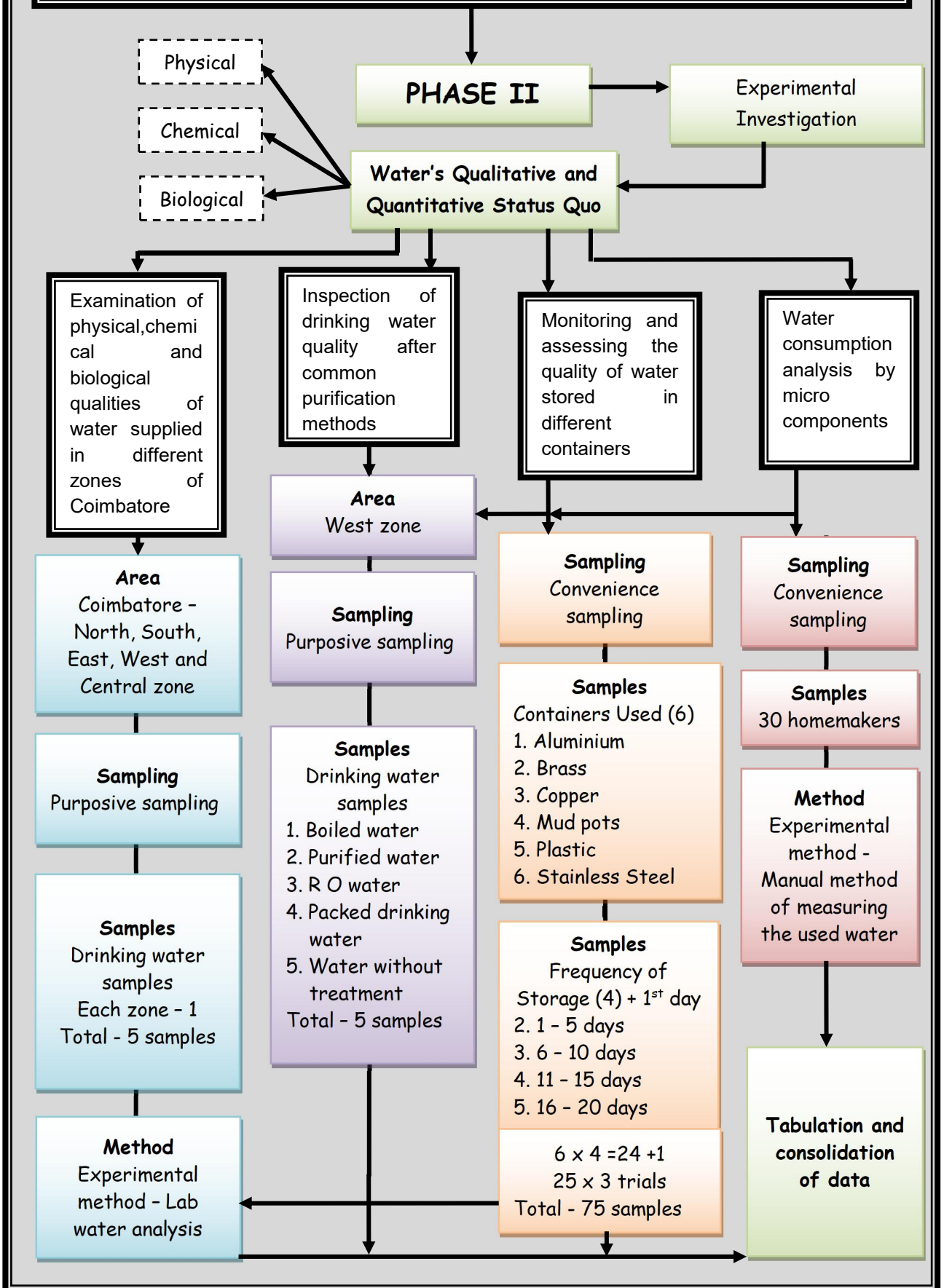


Figure 18: Phase II - Experimental Investigation - Water's Qualitative and Quantitative Status Quo

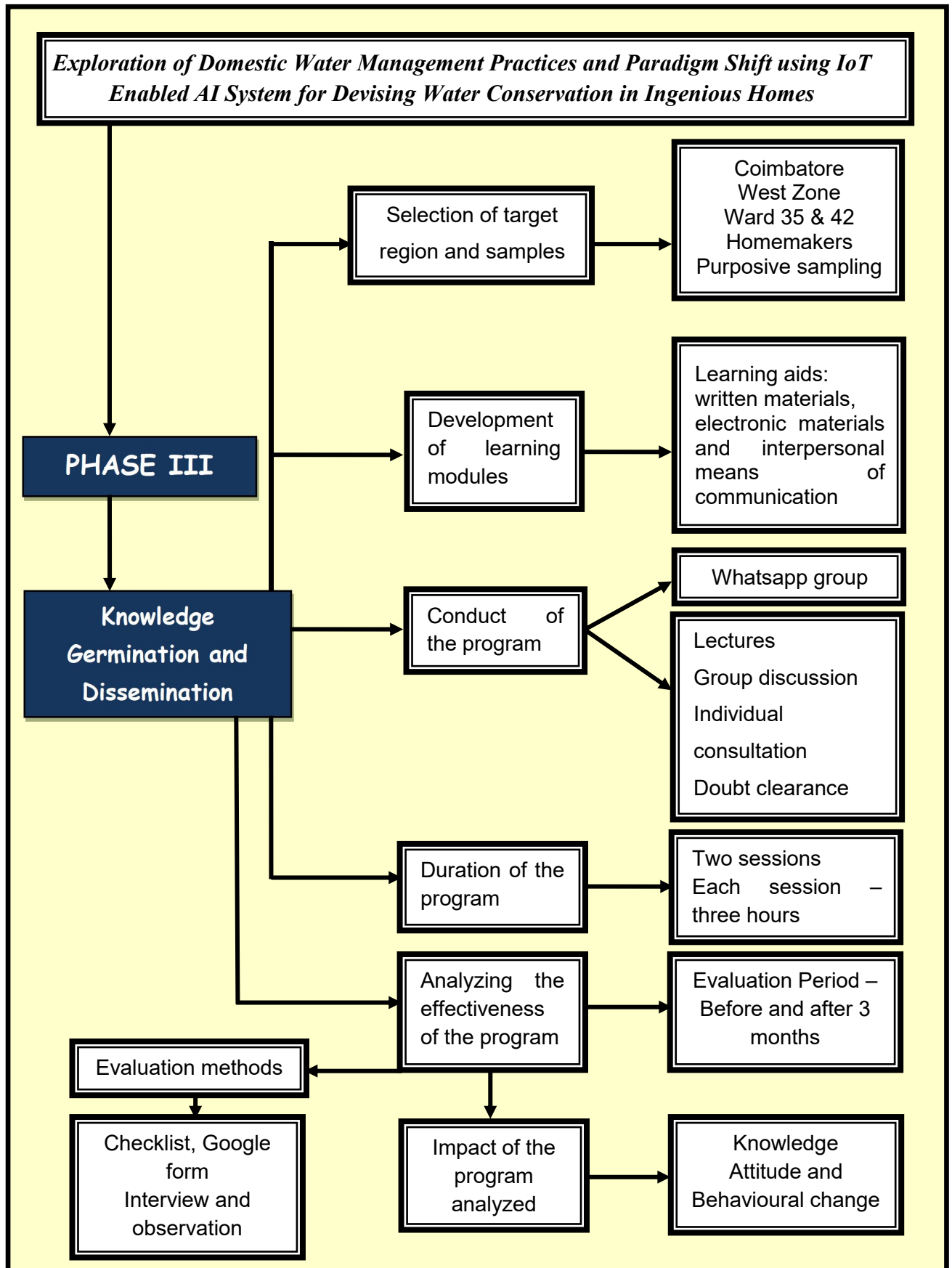


Figure 19: Phase III – Knowledge Germination and Dissemination Programme

*Exploration of Domestic Water Management Practices and Paradigm Shift using IoT Enabled AI System for Devising Water Conservation in Ingenious Homes*

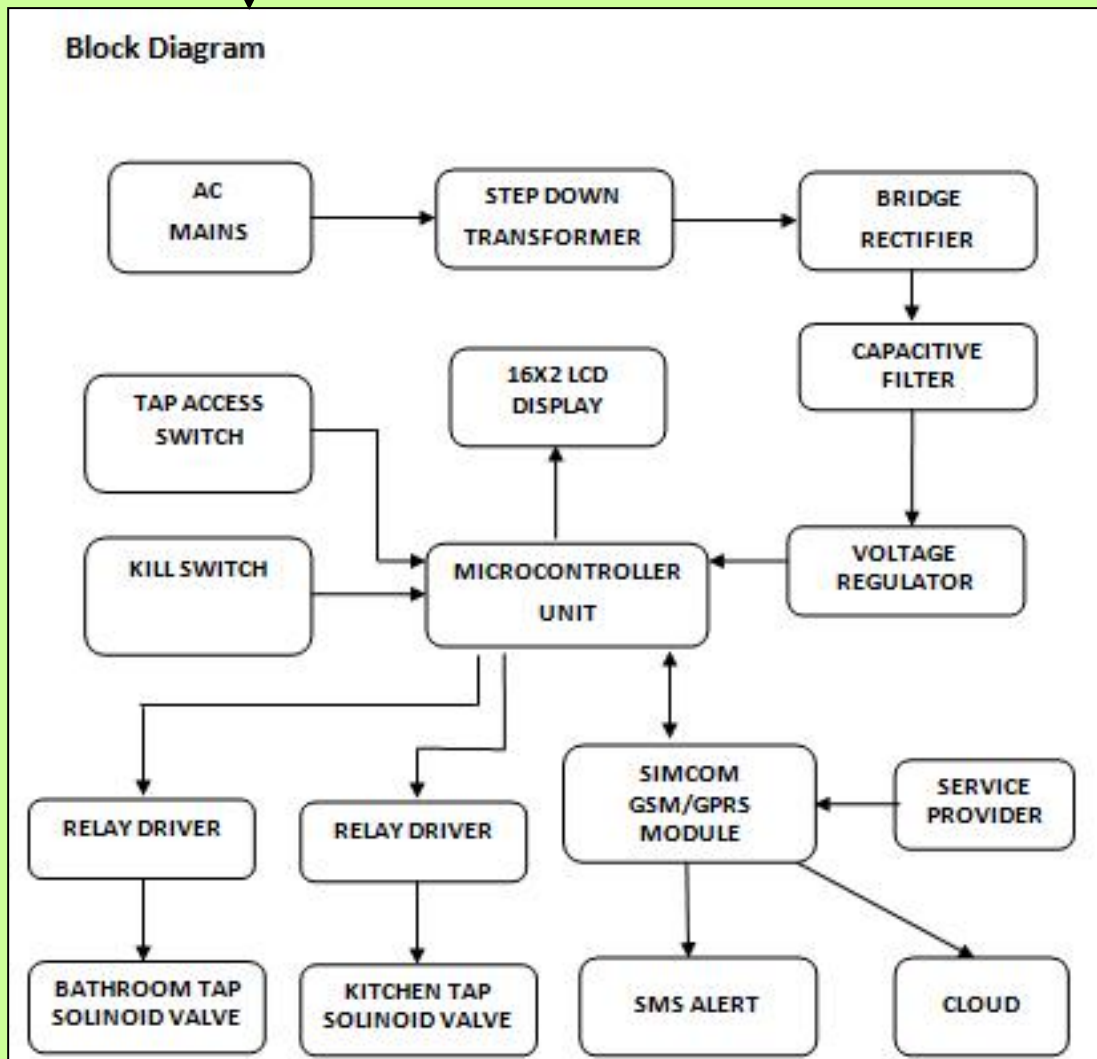
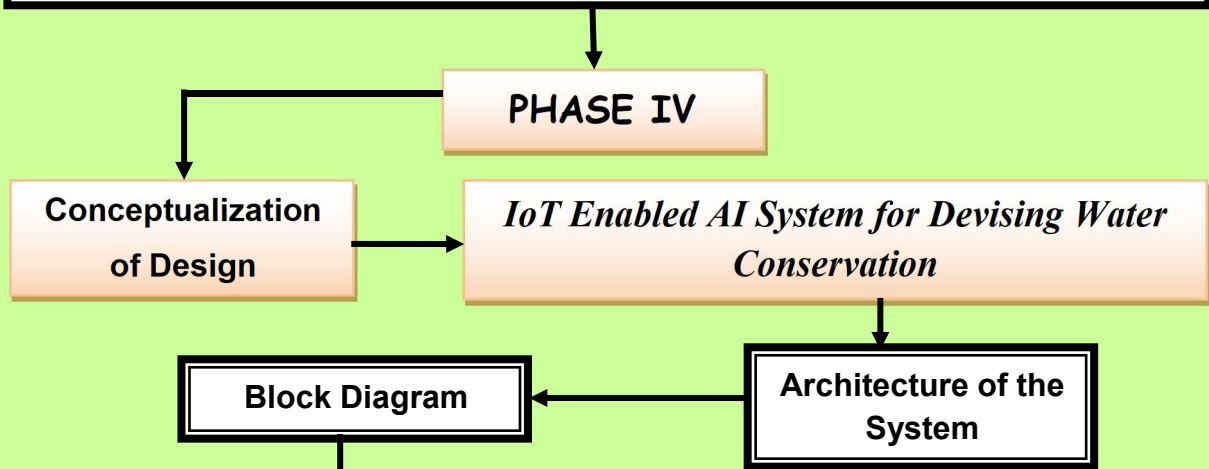


Figure 20: Phase IV – Conceptualization of Design