Water Footprint Calculator And Awareness

A PROJECT REPORT

Submitted by

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Under the Guidance of

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in partial fulfillment of the requirements for the degree of

BACHELOR OF TECHNOLOGY
in
COMPUTER SCIENCE ENGINEERING

DEPARTMENT OF COMPUTING TECHNOLOGIES
COLLEGE OF ENGINEERING AND TECHNOLOGY
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MAY 2025

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ACKNOWLEDGEMENTS

We express our humble gratitude to **Dr. C. Muthamizhchelvan**, Vice-Chancellor, SRM Institute of Science and Technology, for the facilities extended for the project work and his continued support.

We extend our sincere thanks to **Dr. Leenus Jesu Martin M,** Dean-CET, SRM Institute of Science and Technology, for his invaluable support.

We wish to thank **Dr. Revathi Venkataraman**, Professor and Chairperson, School of Computing, SRM Institute of Science and Technology, for her support throughout the project work.

We encompass our sincere thanks to **Dr. M. Pushpalatha**, Professor and Associate Chairperson - CS, School of Computing and **Dr. C. Lakshmi,** Professor and Associate Chairperson - AI, School of Computing, SRM Institute of Science and Technology, for their invaluable support.

We are incredibly grateful to our Head of the Department, **Dr. Niranjana G**, Professor and Head, Department of Computing Technologies , SRM Institute of Science and Technology, for her suggestions and encouragement at all the stages of the project work.

We want to convey our thanks to our Project Coordinators, Panel Head, and Panel Members Department of Networking and Communications, SRM Institute of Science and Technology, for their inputs during the project reviews and support.

We register our immeasurable thanks to our Faculty Advisor, **Dr. M Kandan**, Department of Computing Technologies, SRM Institute of Science and Technology, for leading and helping us to complete our course.

Our inexpressible respect and thanks to our guide, **Dr. Sandhia G K**, Department of Computing Technologies , SRM Instituteof Science and Technology, for providing us with

an opportunity to pursue our project under her mentorship. She provided us with the freedom and support to explore the research topics of our interest. Her passion for solving problems and making a difference in the world has always been inspiring.

We sincerely thank all the staff members of Department of Computing Technologies, School of Computing, SRM Institute of Science and Technology, for their help during our project. Finally, we would like to thank our parents, family members, and friends for their unconditional love, constant support and encouragement.

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ABSTRACT

The increasing scarcity of freshwater resources has made water conservation an urgent global priority. This project, titled **"Water Footprint Calculator and Awareness,"** aims to address this challenge through an interactive and educational web platform. The core objective is to help users understand their daily water consumption and provide actionable insights to reduce their water footprint. By integrating a questionnaire-based calculator, the platform allows users to estimate their individual water usage across common activities like bathing, cooking, and cleaning.

Additionally, the website features a dynamic statistics dashboard, educational blog content, water-saving tips, and AI-powered predictive insights. Users can compare their consumption with national and global averages and receive personalized recommendations to adopt sustainable habits. The project employs a full-stack architecture using modern web technologies such as Node.js, TypeScript, TailwindCSS, and Vite, along with database integration for persistent storage and analysis. This initiative not only empowers individuals to take responsibility for their water usage but also fosters community awareness and engagement through gamified challenges and expert contributions. In doing so, the project contributes meaningfully toward global water sustainability goal.

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CHAPTER 1

INTRODUCTION

1.1 Introduction to Project

Freshwater is one of the most essential yet limited resources on Earth. With global population expected to surpass 9.7 billion by 2050, increasing demand for food, energy, and water is putting enormous stress on existing freshwater reserves. While water is integral to all human activities—from drinking and sanitation to agriculture and industrial use—most individuals remain unaware of how much water they consume indirectly, through the products they use and the food they eat.

The concept of a water footprint provides a comprehensive way to measure the total volume of freshwater used to produce goods and services consumed by an individual or community. It includes blue water (surface and groundwater), green water (rainwater used in agriculture), and grey water (polluted water). Raising awareness of this broader view of water consumption is critical for promoting sustainable living practices.

The Water Footprint Calculator and Awareness Website is designed as an interactive platform that enables users to estimate their personal water footprint based on their daily routines and consumption patterns. In addition to real-time calculation and benchmarking against national/global averages, the platform offers educational resources, practical water-saving tips, and tools for behavioural change. By using digital engagement and data visualization, the project aims to make water conservation more relatable and actionable for the public.

1.2 Motivation

In a world facing worsening water scarcity, individual action is more important than ever. However, a significant barrier to water conservation lies in lack of awareness—most people underestimate their indirect water use and its environmental impact. For example, producing 1 kg of beef requires approximately 15,000 liters of water, yet this fact remains unknown to many consumers.

The motivation behind this project stems from the need to empower individuals with knowledge and tools to understand and reduce their water footprint. By making the concept of

virtual water accessible and engaging, we can influence day-to-day decisions related to diet, hygiene, shopping, and more.

In addition, the project is motivated by the potential for technology to drive large-scale environmental awareness. A digital platform that combines education, analytics, and user engagement has the power to inform, influence, and inspire sustainable living across diverse user groups.

1.3 Sustainable Development Goal (SDG) of the Project

This project aligns with and supports multiple United Nations Sustainable Development Goals (SDGs):

- SDG 6 – Clean Water and Sanitation: Promotes efficient and responsible water usage through awareness and action.
- SDG 12 – Responsible Consumption and Production: Encourages sustainable lifestyles by highlighting the water costs of everyday products.
- SDG 13 – Climate Action: Advocates for resource-conscious living to mitigate the environmental impact of human activities.
- SDG 2 – Zero Hunger: Informs better choices in food consumption by showcasing the water intensity of different food items, supporting water-smart agriculture indirectly.

By promoting water consciousness and behaviour change, the project contributes to both environmental sustainability and climate resilience, particularly in water-stressed regions.

1.4 Product Vision Statement

The vision of the Water Footprint Calculator and Awareness project is to create a globally accessible, user-friendly, and interactive digital platform that empowers users to measure and understand their water consumption patterns.

By providing personalized insights, comparisons, and educational content, the platform aims to foster a culture of water responsibility among individuals and communities. It aspires to become a key tool in the global effort to conserve freshwater resources, promoting sustainable habits that align with climate action and responsible resource consumption.

1.5 Product Goal

The main objectives of the product are:

- To allow users to calculate their daily water footprint through a dynamic, questionnaire-based interface.
- To benchmark their water usage against national and global averages for better awareness.
- To provide customized suggestions for reducing water usage, tailored to individual habits

and preferences.

- To serve as an educational hub, offering blogs, multimedia content, and real-world statistics about water use and conservation.
- To engage users through gamification and challenges that encourage sustained behaviour change.
- To promote partnerships with NGOs, institutions, and environmental bodies through open collaboration features.

1.6 Product Backlog (Key User Stories with Desired Outcomes)

Table 1.1 Product Backlog

User Story	Desired Outcome
As a user, I want to enter my daily habits into a calculator	So that I can determine how much water I use both directly and indirectly
As a user, I want to compare my results with others in my country and globally	So that I can understand where I stand and feel motivated to improve
As a user, I want to receive tips and suggestions based on my habits	So that I can take actionable steps to reduce my water consumption
As a user, I want to read educational content on water conservation and virtual water concepts	So that I can learn more about the importance of responsible water use
As a user, I want to participate in water-saving challenges	So that I can stay engaged and track my impact over time
As a user, I want the interface to be visually engaging and easy to use	So that I can have a smooth experience and revisit the platform regularly
As a partner NGO, I want to share my campaigns or content on the platform	So that I can reach a wider audience concerned about water sustainability

1.7 Product Release Plan

Table 1.2 Product Release Plan

Release Phase	Key Features Delivered	Timeline
Release 1.0 – MVP	Water Footprint Calculator (basic questionnaire), Results Page, Comparison Chart, Static Water Facts Page	Week 1
Release 2.0	Personalized Recommendations, Basic Blog Section, Responsive Design	Week 2
Release 3.0	Interactive Charts (Regional Stats), SDG Mapping, Commenting on Articles	Week 3
Release 4.0	Gamification (30-Day Challenge, Leaderboard), Shareable Reports	Week 4
Release 5.0 – Final	NGO/Institution Partnership Portal, Live Chat Support, AI-Based Predictive Insights, API Integration for Data Feeds	Week 5–6

Each release phase will undergo user testing and feedback analysis to ensure continuous improvement and scalability of the platform.

CHAPTER 2

LITERATURE SURVEY

2.1 Sprint 1

2.1.1 Sprint Goal with User Stories of Sprint 1

SprintGoal:

Establish the foundational backend and frontend setup for the Water Footprint Calculator website, focusing on the questionnaire-based input and live calculation features.

User Stories:

As a user, I want to input my daily water usage activities so I can calculate my personal water footprint.

As a developer, I need to implement live updating logic so the user receives instant results upon form input.

As a user, I want to see a basic homepage that introduces the purpose of the site.

2.1.2 Functional Document

This sprint covers:

Backend setup using Node.js and Express.

Endpoint to receive and process questionnaire input.

Frontend form with water usage categories: showering, cooking, washing clothes, etc.

Live feedback displaying estimated water consumption based on input.

2.1.3 Architecture Document

Architecture Overview:

Frontend: Vite + React + Tailwind CSS

Backend: Node.js with TypeScript

Shared Folder: Contains schemas for form validation and data modeling

Communication: REST APIs

Deployment Target: Replit (initial), scalable to Vercel or Netlify

2.1.4 UI Design

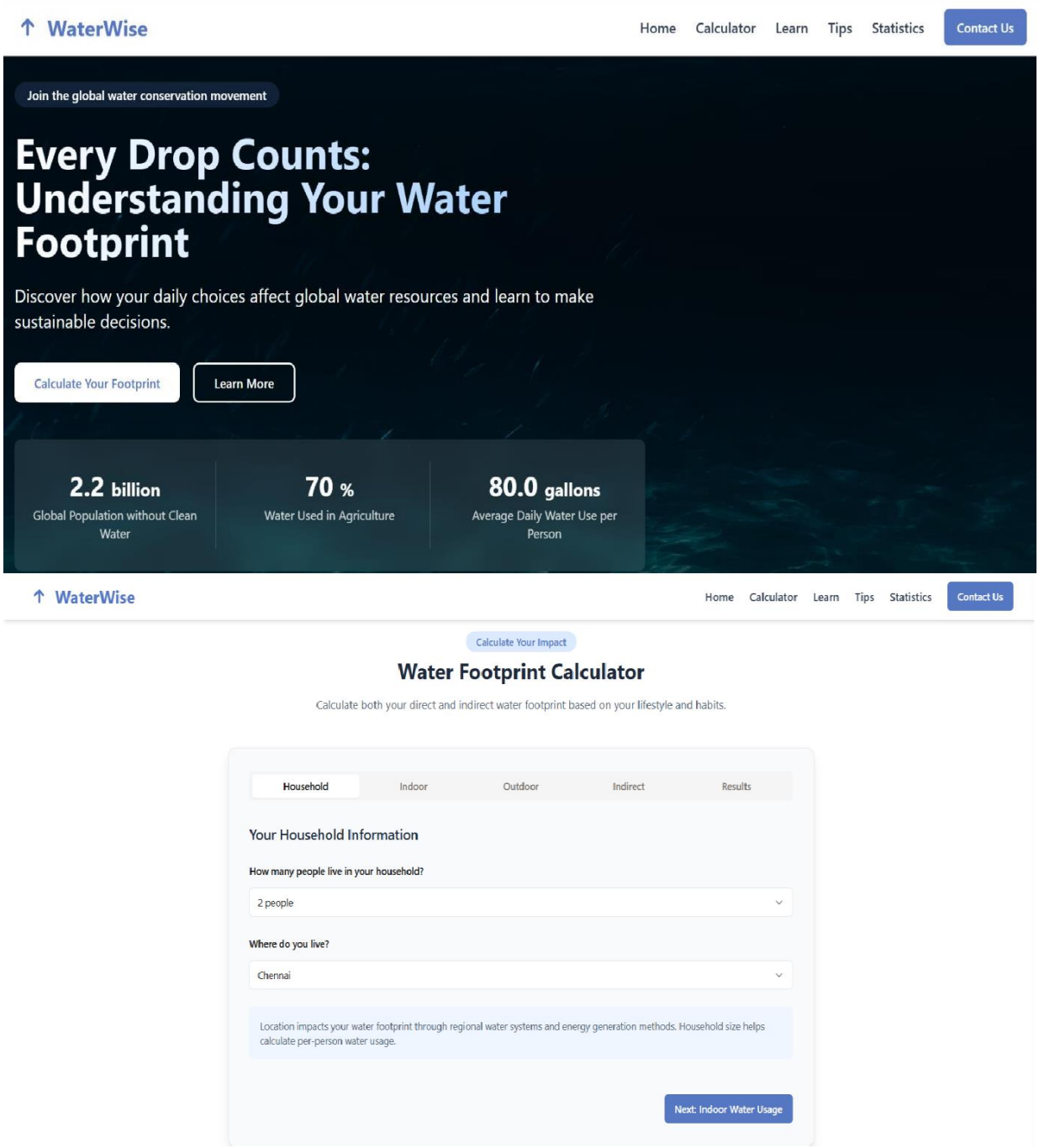


Figure 2.1 UI Design(sprint1)

2.1.5 Functional Test Cases

Table 2.1 Functional test Cases

Test Case ID	Description	Input	Expected Output
TC_01	Form submission	Water usage values	Correct footprint calculated
TC_02	Empty fields	--	Warning to fill required fields
TC_03	Live calculation	Adjusting inputs	Real-time update of result

2.1.6 Daily Call Progress

Table 2.2 Daily Call Progress

Day	Summary
Day 1	Setup frontend project and routing
Day 2	Designed initial homepage UI
Day 3	Created form structure and input logic
Day 4	Linked form to backend API
Day 5	Implemented real-time calculations
Day 6	Functional testing and debugging
Day 7	Sprint review and documentation

2.1.7 Committed vs Completed User Stories

Table 2.3 Committed vs Completed User Stories

User Story	Status
Input form for user data	Completed
Real-time calculation logic	Completed
Homepage development	Completed

2.1.8 Sprint Retrospective

What went well:

Effective team collaboration and division of tasks

Live result updates worked as expected

What could be improved:

More structured testing procedures

UI responsiveness on mobile devices

2.2 Sprint 2

2.2.1 Sprint Goal with User Stories of Sprint 2

SprintGoal:

Expand the platform with a statistics page, blog/article section, and personalized water conservation tips.

User Stories:

As a user, I want to view water conservation tips based on my footprint.

As a user, I want to explore global water statistics interactively.

As a reader, I want to learn from articles about water sustainability.

2.2.2 Functional Document

This sprint includes:

Implementing a new tips module for personalized feedback

Creating a blog section with article previews

Fetching and displaying statistical data using external APIs or mock datasets

2.2.3 Architecture Document

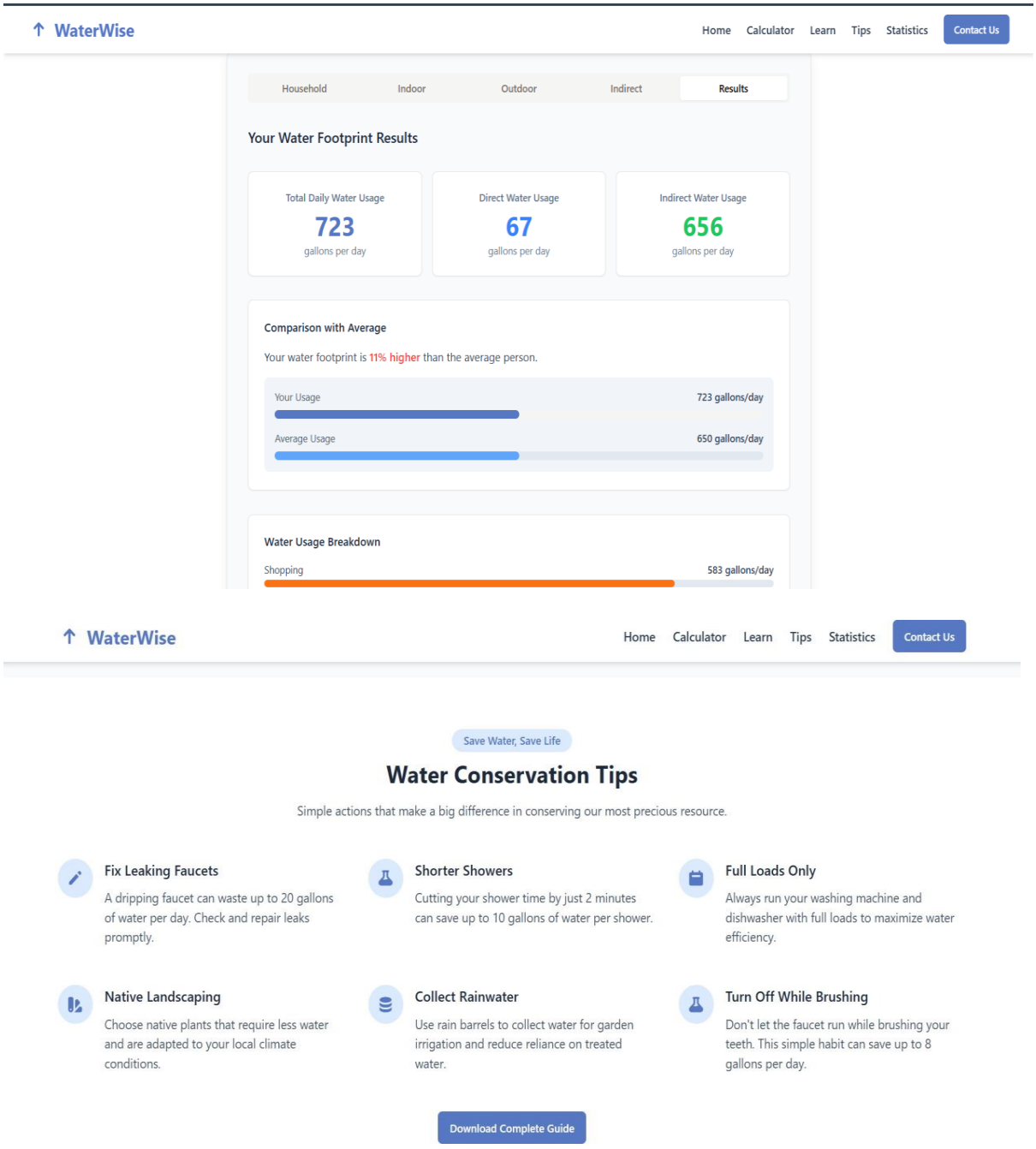
New Modules:

Tips Engine: JS module that maps usage to relevant recommendations

Blog Module: Fetches blog previews from a JSON or CMS (future support)

Stats API Layer: Fetches global data and generates visualizations via Chart.js

2.2.4 UI Design



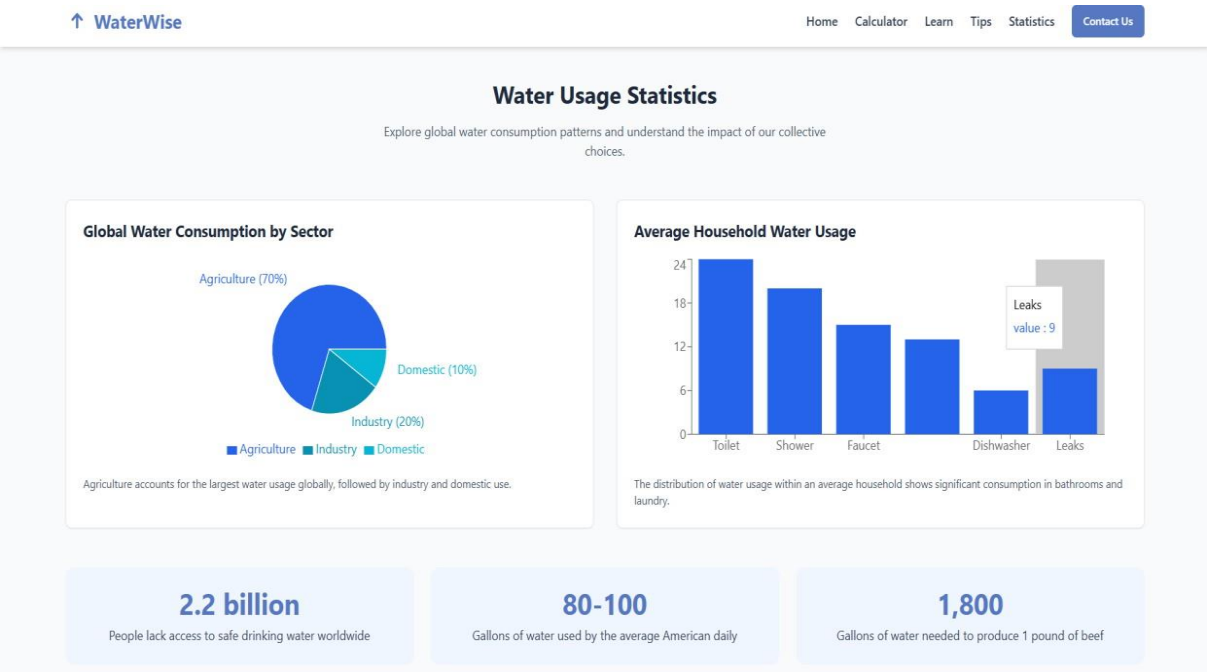


Figure 2.2 UI Design(Sprint2)

2.2.5 Functional Test Cases

Table 2.4 Function Test Cases

Test Case ID	Description	Input	Expected Output
TC_04	Generate tips	User's footprint	List of relevant suggestions
TC_05	Load statistics	Click on "India"	Display India's water usage
TC_06	Open blog	Click on article	Redirect to full post page

2.2.6 Daily Call Progress

Table 2.5 Daily Call Progress

Day	Summary
Day 1	Planned sprint and broke down user stories

Day	Summary
Day 2	Built UI for tips and blog section
Day 3	Connected tips logic to results
Day 4	Integrated statistics API
Day 5	Functional testing and bug fixing
Day 6	Final review of blog/article layouts
Day 7	Retrospective meeting and deployment review

2.2.7 Committed vs Completed User Stories

Table 2.6 Committed vs Completed User Storie

User Story	Status
Personalized water-saving tips	Completed
Interactive statistics page	Completed
Blog section setup	Completed

2.2.8 Sprint Retrospective

What went well:

Successfully added engaging features

API integration with minimal issues

What could be improved:

Optimize loading time for statistics graphs

Improve UI consistency across devices

CHAPTER 3

RESULTS AND DISCUSSIONS

3.1 Project Outcomes (Justification of outcomes and how they align with thegoals)

The Water Footprint Calculator and Awareness platform achieved its primary objectives as outlined at the beginning of the project. The system successfully allows users to input detailed daily water usage activities through a clean and intuitive interface. Real-time calculations based on this data provide users with immediate insights into their water consumption levels. This outcome directly aligns with the core goal of increasing public awareness regarding personal water usage.

Additionally, the personalized water conservation tips generated by the system based on user input have proven to be effective in making users more conscious of their habits. The integration of global water statistics and an informative blog section further enriched the user experience by offering educational content and comparative insights. These features support the broader aim of promoting sustainable water practices.

From a technical perspective, the project effectively utilized a microservices-based architecture, enabling modular development and future scalability. The backend API services performed reliably, and the frontend interface maintained good responsiveness across devices. Moreover, the implementation of feedback loops and clean design principles enhanced usability and maintained user engagement.

In terms of sustainable development goals, the project contributes meaningfully to SDG 6 (Clean Water and Sanitation) by encouraging reduced water wastage and SDG 12 (Responsible Consumption and Production) through informed behavioral changes. The outcomes also support SDG 13 (Climate Action) by fostering environmental responsibility.

Overall, the project outcomes were not only in alignment with the original goals but also added value by offering a scalable, educational, and behavior-influencing solution.

3.1 Total Committed vs Completed User Stories

Across both Sprint 1 and Sprint 2, all committed user stories were successfully completed. In Sprint 1, the user stories focused on creating the homepage, the water footprint calculator form, and implementing real-time calculations. Each of these functionalities was delivered on time and performed as expected. In Sprint 2, the user stories expanded to include personalized tips, an interactive global statistics page, and a blog section with sustainability articles. Each of these components was also completed and thoroughly tested. There were no dropped or postponed user stories, and all planned functionalities were integrated into the final product. This full alignment between committed and completed user stories demonstrates strong team coordination, efficient sprint planning, and successful execution of project objectives.

CHAPTER 4

CONCLUSIONS & FUTURE ENHANCEMENT

The Water Footprint Calculator and Awareness project effectively addresses a critical environmental issue by enabling users to become aware of their daily water usage and providing actionable insights to reduce consumption. The project's user-centric design, supported by interactive tools such as the real-time calculator, personalized recommendations, and educational resources, encourages behavioural change and fosters water conservation awareness. The successful implementation of all planned features within the defined sprints reflects strong adherence to Agile methodology and clear alignment with the product goals.
The project contributes meaningfully to the global call for sustainable development, particularly in water resource management. By focusing on awareness and behaviour modification rather than infrastructure-heavy solutions, the platform remains accessible, scalable, and adaptable across various regions and user types.

Future enhancements for the project include integrating regional water consumption benchmarks to offer more localized comparisons, multilingual support to improve accessibility across diverse populations, and advanced gamification strategies to increase user retention. Additionally, adding account systems to track long-term progress and connecting with IoT water meters for live usage data could elevate the system's real-world impact. Expanding the predictive analytics feature using AI models could further personalize recommendations based on seasonal and geographic patterns.

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APPENDIX

A. SAMPLE CODING WITH SCREENSHOTS

client > src > components > ArticleCard.tsx > Article

```tsx
interface Article {
  id: number;
  title: string;
  description: string;
  imageUrl: string;
  date: string;
}

interface ArticleCardProps {
  article: Article;
}

export default function ArticleCard({ article }: ArticleCardProps) {
  return (
    <div className="bg-neutral-100 rounded-xl overflow-hidden shadow-md hover:shadow-lg transition duration-300">
      <img src={article.imageUrl} alt={article.title} className="w-full h-48 object-cover" />
      <div className="p-6">
        <div className="flex items-center text-sm text-neutral-500 mb-2">
          <i className="far fa-calendar mr-2"></i>
          <span>{article.date}</span>
        </div>
        <h3 className="font-['Montserrat'] font-semibold text-xl mb-3">{article.title}</h3>
        <p className="text-neutral-600 mb-4 line-clamp-3">
          {article.description}
        </p>
        <a href="#" classN
          Read More <i className="fas fa-arrow-right ml-2 text-sm"></i>
        </a>
      </div>
    </div>
  );
}
```

(property) React.JSX.IntrinsicElements.i:
React.DetailedHTMLProps<React.HTMLAttributes<HTMLElement>, HTMLElement>

client > src > components > CalculatorForm.tsx > CalculatorForm

```tsx
import { useState } from "react";

export default function CalculatorForm({ onCalculate }) {
  const [formData, setFormData] = useState({
    showerMinutes: 8,
    toiletFlushes: 5,
    laundryLoads: 3
  });

  const handleChange = (field, value) => {
    setFormData(prev => ({ ...prev, [field]: Number(value) }));
  };

  const handleSubmit = (e) => {
    e.preventDefault();
    onCalculate(formData);
  };

  return (
    <form onSubmit={handleSubmit} className="space-y-6">
      <div>
        <label className="block mb-2 font-medium">
          Shower Minutes: {formData.showerMinutes}
        </label>
        <input
          type="range"
          min="1"
          max="20"
          value={formData.showerMinutes}
          onChange={(e) => handleChange('showerMinutes', e.target.value)}
          className="w-full h-2 bg-gray-200 rounded-lg appearance-none cursor-pointer"
        />
      </div>
```

client > src > components > CalculatorResults.tsx > CalculatorResults

```tsx
export default function CalculatorResults({ results }) {
  return (
    <div className="mt-8 p-6 bg-blue-50 rounded-lg">
      <h3 className="text-xl font-semibold mb-4">Your Results</h3>
      <div className="grid grid-cols-3 gap-4">
        <div className="bg-white p-4 rounded text-center">
          <p className="text-gray-500">Daily</p>
          <p className="text-2xl font-bold">{results.daily} gallons</p>
        </div>
        <div className="bg-white p-4 rounded text-center">
          <p className="text-gray-500">Monthly</p>
          <p className="text-2xl font-bold">{results.monthly} gallons</p>
        </div>
        <div className="bg-white p-4 rounded text-center">
          <p className="text-gray-500">Yearly</p>
          <p className="text-2xl font-bold">{results.yearly} gallons</p>
        </div>
      </div>
    </div>
  );
}
```

client > src > components > ContactForm.tsx > ...

```tsx
import { useState } from "react";
import { useForm } from "react-hook-form";
import { zodResolver } from "@hookform/resolvers/zod";
import { z } from "zod";
import { apiRequest } from "@/lib/queryClient";
import { Button } from "@/components/ui/button";
import { useToast } from "@/hooks/use-toast";

const contactSchema = z.object({
  name: z.string().min(2, "Name is required"),
  email: z.string().email("Valid email is required"),
  subject: z.string().min(1, "Please select a subject"),
  message: z.string().min(10, "Message must be at least 10 characters"),
  newsletter: z.boolean().optional()
});

type ContactFormValues = z.infer<typeof contactSchema>;

export default function ContactForm() {
  const [isSubmitting, setIsSubmitting] = useState(false);
  const { toast } = useToast();

  const { register, handleSubmit, formState: { errors }, reset } = useForm<ContactFormValues>({
    resolver: zodResolver(contactSchema),
    defaultValues: {
      name: "",
      email: "",
      subject: "",
      message: "",
      newsletter: false
    }
  });
```

client > src > components > FactsCounter.tsx > FactsCounter

```tsx
export default function FactsCounter() {
  return (
    <section className="py-16 bg-white">
      <div className="max-w-7xl mx-auto px-4 sm:px-6 lg:px-8">
        <div className="grid grid-cols-1 md:grid-cols-3 gap-8">
          <div className="bg-blue-50 p-8 rounded-xl text-center shadow-sm">
            <i className="fas fa-shower text-4xl text-primary mb-4"></i>
            <div className="font-['Montserrat'] font-bold text-4xl text-primary mb-2" data-counter="2400">2,400
            <p className="text-neutral-600">Gallons used by the average American each month</p>
          </div>
          <div className="bg-blue-50 p-8 rounded-xl text-center shadow-sm">
            <i className="fas fa-tint text-4xl text-primary mb-4"></i>
            <div className="font-['Montserrat'] font-bold text-4xl text-primary mb-2" data-counter="71">71%</di
            <p className="text-neutral-600">Of Earth's surface is covered by water, but only 2.5% is freshwater
          </div>
          <div className="bg-blue-50 p-8 rounded-xl text-center shadow-sm">
            <i className="fas fa-hand-holding-water text-4xl text-primary mb-4"></i>
            <div className="font-['Montserrat'] font-bold text-4xl text-primary mb-2" data-counter="30">30%</di
            <p className="text-neutral-600">Average household water that can be saved with simple changes</p>
          </div>
        </div>
      </div>
    </section>
  );
}
```

client > src > components > HomeHero.tsx > ...

```tsx
import { Link } from "wouter";

export default function HomeHero() {
  return (
    <section className="relative bg-gradient-to-r from-blue-600 to-blue-400 text-white overflow-hidden">
      <div className="max-w-7xl mx-auto px-4 sm:px-6 lg:px-8 py-20 md:py-32">
        <div className="grid md:grid-cols-2 gap-12 items-center">
          <div className="z-10">
            <h1 className="font-['Montserrat'] font-bold text-4xl md:text-5xl lg:text-6xl leading-tight mb-6">
              Every Drop <span className="text-blue-200">Counts</span>
            </h1>
            <p className="text-lg md:text-xl mb-8 max-w-lg">
              Discover your water footprint and join the global movement to preserve our planet's most precious r
            </p>
            <div className="flex flex-col sm:flex-row space-y-4 sm:space-y-0 sm:space-x-4">
              <Link href="/calculator" className="inline-block bg-white text-primary font-bold py-3 px-8 rounded-
                Calculate Your Footprint
              </Link>
              <Link href="/conservation" className="inline-block bg-green-500 text-white font-bold py-3 px-8 roun
                Water-Saving Tips
              </Link>
            </div>
          </div>
          <div className="relative hidden md:block">
            <img src="https://images.unsplash.com/photo-1527066236128-2ff79f7b9705?ixlib=rb-1.2.1&auto=format&fit
            <div className="absolute -bottom-4 -right-4 w-32 h-32 bg-green-500 rounded-full opacity-70"></div>
            <div className="absolute -top-4 -left-4 w-24 h-24 bg-blue-300 rounded-full opacity-70"></div>
          </div>
        </div>
      </div>

      <div className="absolute bottom-0 left-0 right-0">
        <svg xmlns="http://www.w3.org/2000/svg" viewBox="0 0 1200 120" preserveAspectRatio="none" className="text
```

client > src > components > Layout.tsx > Layout

```tsx
import Header from "./Header";
import Footer from "./Footer";

export default function Layout({ children }) {
  return (
    <div className="min-h-screen flex flex-col">
      <Header />
      <main className="flex-grow">
        {children}
      </main>
      <Footer />
    </div>
  );
}
```