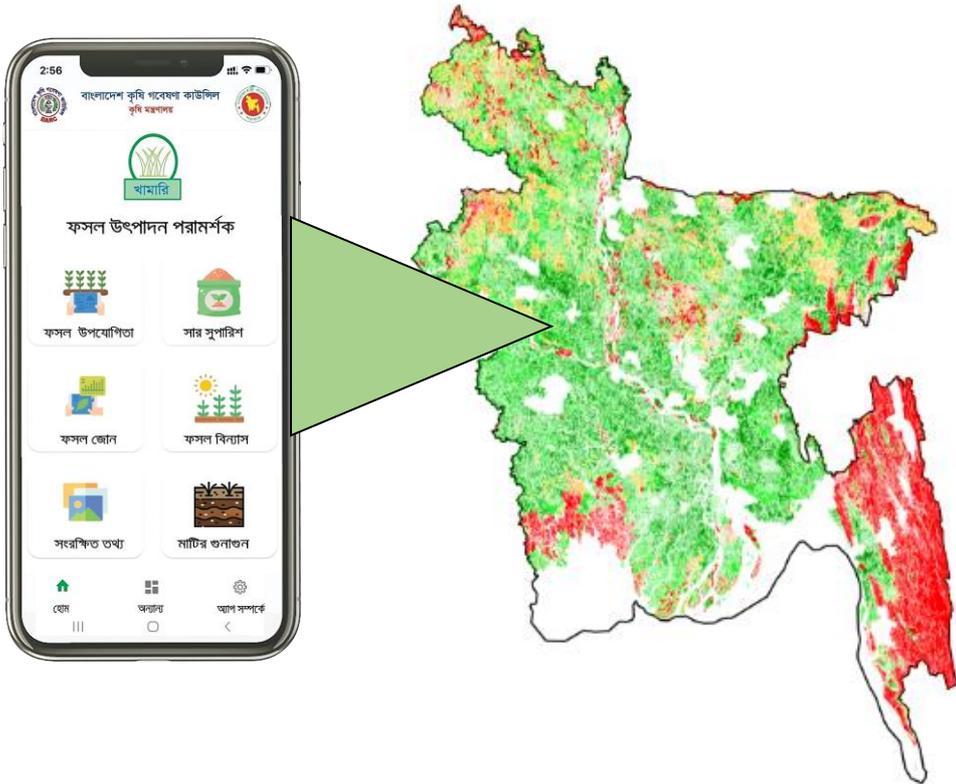


Training Manual

CROP ZONING SYSTEM OF BANGLADESH

Development of Upazila Land Suitability Assessment and Crop Zoning System of Bangladesh Project



Bangladesh Agricultural Research Council
Farmgate, Dhaka 1215

Training Manual

CROP ZONING SYSTEM OF BANGLADESH

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A. Crop Zoning System of Bangladesh

1. Background:

Agricultural zonation in Bangladesh began in the mid-1980s with the launch of a landmark study titled “**Land Resources Appraisal of Bangladesh for Agricultural Development**”, initiated by the Government of Bangladesh with support from UNDP and FAO. Conducted between **1984 and 1988**, this study resulted in the creation of the **Agro-Ecological Zone (AEZ) database**, which compiled Land Resources Inventory (LRI) data using reconnaissance soil surveys carried out from **1963 to 1975** [UNDP-FAO 1988]. The AEZ database laid the foundation for rational agricultural land use and was instrumental in formulating a national plan to produce **20 million metric tons of food grain by 1990**.

Between **1996 and 2001**, under the project titled “**Utilization of Agro-Ecological Zones (AEZ) Database and Installation of GIS for Agricultural Development**” (AEZ/GIS), Bangladesh Agricultural Research Council (BARC) digitized the AEZ maps (scale 1:250,000) and upgraded the database with GIS capabilities. The project, funded by UNDP and technically supported by FAO, aimed to establish a **GIS-based land resources system** to enable rational and data-driven agricultural planning. A key innovation of the project was the integration of **crop production potential assessment**, using FAO’s concept of **Length of Growing Period (LGP)** zones, which correlate rainfall and temperature patterns with crop growth periods. Combined with soil and crop requirement data, this model supports evaluation of potential crop productivity at the national scale.

In **2010**, BARC formally launched **crop suitability and zoning initiatives** using the AEZ database, following a directive from the Ministry of Agriculture’s Annual Development Program. This work involved land suitability assessment and zoning for **17 major crops**, using national-level AEZ data [S.G. Hussain; M.K.A. Chowdhury; and M.A.H. Chowdhury, 2012].

Alongside the national database, BARC also developed a **GIS-based Upazila Land Resources Database** during the AEZ/GIS project, utilizing data from **Upazila Nirdeshika** prepared by Soil Resource Development Institute (SRDI) through soil surveys. This semi-detailed database, based on digitized soil and landform maps at a scale of 1:50,000 for **459 upazilas**, was designed for **local-level agricultural planning**.

Recognizing its potential, a **pilot crop zoning study** was conducted between **2011 and 2014** across **11 upazilas** under a SPGR sub-project of **NATP Phase-I**. This study aimed to optimize agricultural land use through GIS-based analysis, and led to the development of an offline decision-support tool: the **Crop Suitability Assessment Model (CSAM)**. The pilot successfully demonstrated how GIS and local land data could identify optimal crops and cropping patterns for specific regions.

Building on these successes, BARC, with financial support from the **Krishi Gobeshona Foundation (KGF)**, initiated the establishment of **Crop Zoning System of Bangladesh**. The system is based on an advanced **methodological framework** (see Figure 1) that integrates **GIS, GPS, and RS** technologies for data processing and output generation.

2. Crop Zoning System:

The **Bangladesh Agricultural Research Council** is implementing the **Crop Zoning System** with the objective of formulating sustainable agricultural production plans to effectively address the current and emerging challenges facing the agriculture sector in Bangladesh. The **Crop Zoning System of Bangladesh** comprises four core components that collectively support data-driven decision-making in agriculture. These are, Crop Zoning Information System (CZIS), Khamari Mobile App, Crop Zoning Dashboard, and Agri-Advisory Portal.

The system integrates **soil and land data** from the **SRDI** and **climate data** from the **Bangladesh Meteorological Department (BMD)**. These datasets are used for comprehensive **crop suitability assessments** and informed **zoning decisions**. In addition, the system incorporates **economic profitability analysis** of different crops and cropping patterns, based on **primary data collected through Focus Group Discussions (FGDs)** at the **upazila level**. This ensures that both agronomic and economic factors are considered in recommending optimal land use. The crop varietal information and their management practices collected from **National Agricultural Research System (NARS) institutes** are also part of the system.

The **Institute of Water Modeling (IWM)** has partnered in the development of the system, particularly contributing to the **GIS-based architecture** and application development components. The entire system is **securely hosted on the National Data Centre cloud** and is publicly accessible through the official domain, <http://cropzoning.gov.bd>.

Crop zoning supports **optimization of input use, resource conservation, and environmental risk reduction**, making it a vital policy tool for Bangladesh in addressing challenges like **population pressure, declining arable land, yield gaps, and climate change**. It enables data-driven **land use planning**, enhances **agricultural productivity**, and provides farmers with **location-specific guidance** on suitable crops, helping increase both food production and farm income. Furthermore, the system includes **fertilizer recommendations** based on local soil fertility conditions to promote **balanced fertilization and higher yields**.

To date, BARC has completed crop suitability assessment, zoning, and fertilizer recommendation for 76 crops across 458 of Bangladesh's 495 upazilas.

3. Institutional Framework:

BARC serves as the **lead agency**, coordinating and implementing crop zoning activities. The **SRDI** and the **IWM** are strategic partners, providing expertise in the field of land and soil, and GIS application development, respectively. Key stakeholders include:

- **Department of Agricultural Extension (DAE)**
- **Bangladesh Agricultural Research Institute (BARI)**
- **Bangladesh Rice Research Institute (BRRI)**
- **Bangladesh Institute of Nuclear Agriculture (BINA)**
- **Bangladesh Wheat and Maize Research Institute (BWMRI)**

These institutions act as **Focal Points**, ensuring collaboration, information sharing, and coordinated efforts for the development of a robust crop zoning system across Bangladesh.

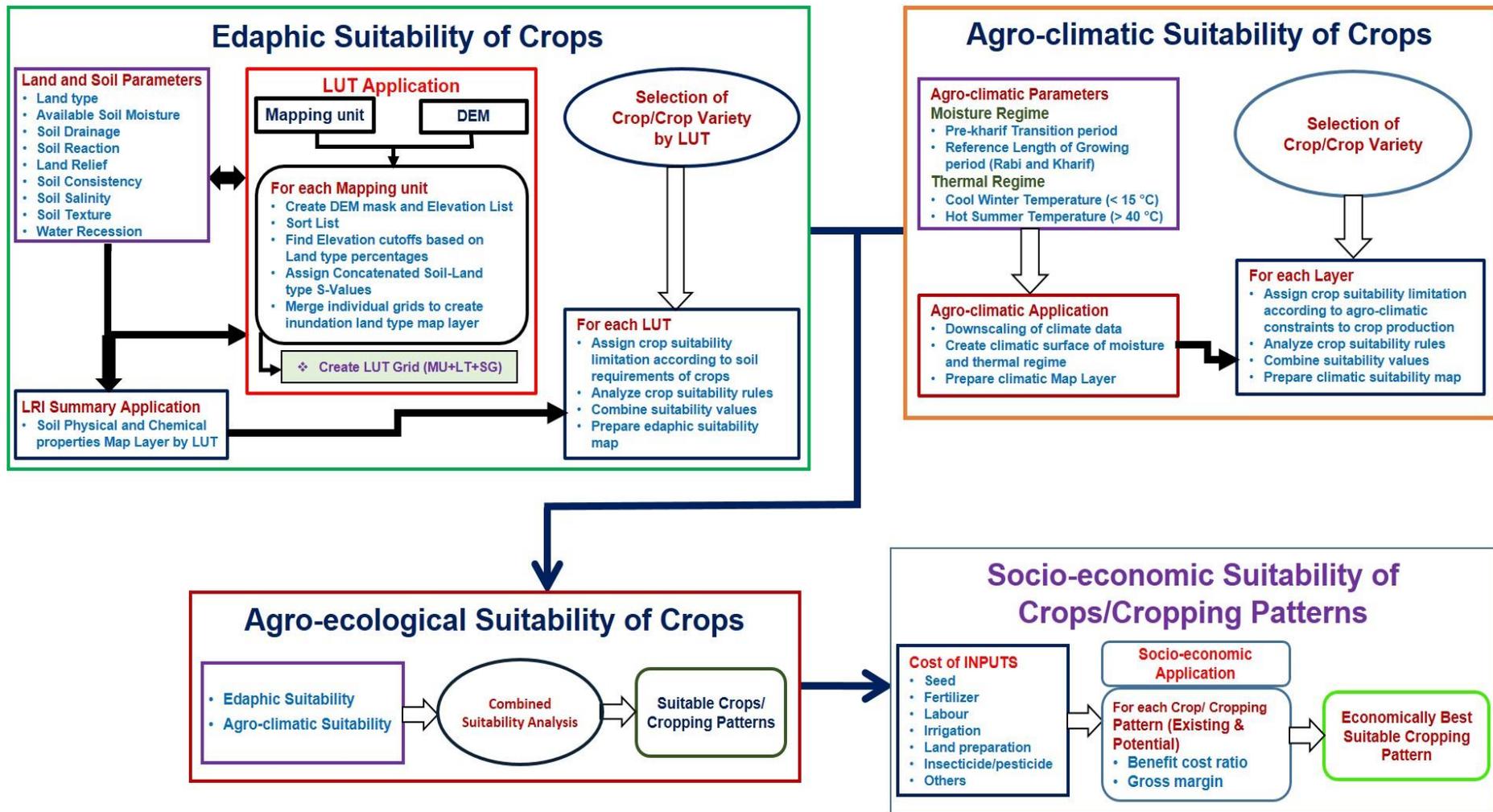


Fig. 1. Conceptual Framework and Processes of Crop Suitability Assessment

4. Objectives of Crop Zoning:

The main objective of the **Crop Zoning System** is to support the Government of Bangladesh's strategy to promote **more efficient, climate-resilient, and sustainable agricultural production systems** that contribute to the country's **food and nutritional security**.

More specifically, the system aims to:

- **Support agricultural policy and planning** by providing reliable crop zoning information to policymakers and planners, enabling the development of **farm-friendly policies** that sustain an **economically viable agriculture sector**, while conserving productive farmland for both present and future generations.
- **Enhance access to localized agricultural information** for farmers and other stakeholders by facilitating timely and accurate guidance on **suitable crops, fertilizer recommendations**, and other critical factors that contribute to **higher productivity and improved farm income**.
- **Promote awareness and adoption** of the crop zoning system through capacity building and outreach, enabling **farmers, extension personnel, and policymakers** to understand and utilize zoning information effectively as they transition toward a **more sustainable and resource-efficient agricultural system**.

5. Data for Crop Zoning System:

- **Upazila Land and Soil Data** - Land and Soil Properties (Physical and Chemical), Soil Nutrient Status, and Soil & Landform Map (Upazila Nirdeshika) (*SRDI*);
- **Weather Data** - Temperature, Rainfall, Humidity, Sunshine, Wind Speed, Cloud Cover (*BMD*);
- **Upazila Land and Soil Factor Maps** - Land Type, Land Relief, Soil Texture, Soil Moisture, Soil Consistency, Soil Drainage, Water Recession, Soil pH, Soil Salinity (*BARC*);
- **Upazila Agrometeorological Maps** - Pre-kharif, Kharif & Rabi Growing Period, Cool and Extreme Temperature Region (*BARC*);
- **Upazila Administrative Map** – Upazila, Union & Mouza boundary (*BARC, SoB, BBS Small Area Atlas*);
- **Admin Unit Name and Geocode** – Division, District, Upazila, Union, Mouza, Pourashava, Ward Name and Geocode (*BBS, Govt. Portal*);
- **Agricultural Data** – Crop Production Technology, Crop Variety with Duration, Yield and Special Characteristics (*NARS*);
- **Elevation data** – Digital Elevation Model (DEM) (*SRTM*);

- **Land Use Map** – Upazila Land Cover/Land Use Map (Agriculture and Non-Agriculture Area) (*FD, Satellite imagery-BARC*);
- **Crop Profitability Data** – Economic Indicators for Measuring Profitability of Crops (*Field survey-BARC*);
- **Crop Suitability Requirement Data** – Crop Requirements Data with Reference to Land, Soil, Climate Conditions (*BARC*);
- **Crop Suitability Rating** – Crop Yield Limitation Rating in Relation to Land, Soil, and Climatic Factors.

6. Crop Zoning System Component:

All components of the Crop Zoning System have been developed using robust, open-source GIS and web technologies, ensuring scalability, flexibility, and sustainability. Key tools include:

- **Database & Backend:** PostgreSQL, PHP (Laravel Framework)
- **Frontend:** JavaScript, Vue.js, jQuery, Bootstrap
- **GIS Tools:** OpenLayers, GeoServer
- **Server & OS:** Nginx, Ubuntu
- **Mobile Platforms:** Android Native, iOS

This integrated technological ecosystem enables seamless access, analysis, and dissemination of crop zoning information across platforms and user groups.

a. Crop Zoning Information System (CZIS)

A centralized, GIS-based analytical platform that serves as the backbone of the crop zoning system. **CZIS** enables:

- **Data management:** Entry, update, and storage of geospatial and attribute data.
- **Crop suitability assessment:** Application of suitability rules and limitation ratings based on soil, climate, and economic parameters.
- **Map management and visualization:** Interactive GIS-based tools for viewing spatial patterns.
- **Output generation:** Automated crop zoning maps and analytical reports for planning and decision-making.

This component supports spatial analysis and land evaluation critical for zoning decisions at various administrative levels.

b. Crop Zoning Dashboard

A real-time **decision-support interface** tailored for policymakers, extension workers, researchers, and agricultural planners. The **Dashboard** provides:

- **Quick access to zoning data** for agricultural planning and development.
- **Interactive visualizations** including maps, graphs, and charts.
- **Scenario analysis tools** for understanding the impacts of crop choices, resource allocation, and nutrient variability.

This tool facilitates data-driven policymaking and monitoring of agricultural trends across regions.

c. Khamari Mobile App

A user-centric mobile application developed to deliver **localized agricultural advisory services** directly to farmers in the field. Key features of the **Khamari App** include:

- **Crop suitability recommendations** based on land and soil characteristics.
- **Fertilizer guidelines** customized to soil nutrient status and crop needs.
- **Information on agricultural technologies**, crop varieties, crop management, and nutrient management.
- **User-friendly interface in Bengali**, ensuring accessibility for mostly non-literate or semi-literate farmers.

By empowering farmers to make informed decisions, the app contributes to **optimized crop selection, improved yield, and sustainable soil management**.

d. Agri-advisory Portal

A comprehensive, web-based platform for disseminating **agricultural guidance and knowledge**. The **Agri-Advisory Portal** serves:

- **Farmers, extension agents, and agricultural professionals**, with content available in both **Bangla and English**.
- **Dynamic crop recommendations** based on zoning and climate data.
- **Content management and expert advisory systems**, enabling timely delivery of validated agricultural information.
- **Knowledge databases** on best practices in crop production, soil health, pest management, and climate resilience.

This portal acts as a bridge between research, extension, and farming communities, fostering informed agricultural development.

7. Benefits and Expected Outcomes of Crop Zoning:

The **Crop Zoning System** identifies the potential of different areas; across regions or the entire country; for cultivating specific crops that maximize economic returns. When recommended crops are cultivated in suitable areas and the limiting factors (e.g., nutrient imbalance, soil pH) are addressed, farmers can achieve significantly improved yields and profitability. The system brings wide-ranging benefits, summarized as follows:

1. Strategic Land Use Planning

- Provides a robust framework for **agricultural land use planning**, ensuring a profitable and sustainable production system aligned with both short and long-term development goals.
- Helps identify and preserve **high-potential agricultural land**, reducing the risk of conversion to non-agricultural uses.

2. Resource Optimization

- Promotes **efficient utilization of land and water resources**, integrating social, economic, and environmental considerations into sustainable agricultural development.
- Enables **lower production costs** by guiding farmers to cultivate crops in areas naturally suited to them, avoiding high input costs in marginal lands.

3. Yield Maximization

- Narrows the gap between **potential and actual crop yields** by guiding farmers to cultivate recommended crops under optimal conditions.
- Facilitates **maximum yield potential** through alignment of crop selection with land suitability parameters.

4. Crop Diversification and Soil Health

- Supports **crop diversification** by identifying areas where multiple crops can be grown, improving **soil fertility** and overall **farm resilience**.
- Encourages year-round crop cultivation, including **high-value crops** such as vegetables, spices, flowers, and selected fruits.

5. Market-Linked Sustainable Production

- Lays the foundation for **zoning-based agricultural production systems**, linked to market demand and supply chains, supporting **commercial agriculture** and **value chain development**.
- Promotes the growth of **agro-based industries** and **agro-processing enterprises**, creating **employment opportunities** and ensuring **fair prices** for farmers.

6. Climate-Responsive and Landscape-Based Farming

- Facilitates **climate-resilient agriculture** by recommending crops suited to agro-ecological and climatic zones.
- Assists in identifying suitable lands for cultivation in **hilly regions** based on slope and landscape stability, helping mitigate **land degradation**.

7. Urban and Peri-Urban Agriculture

- Identifies areas for **peri-urban agriculture**, supporting the emerging demand for localized food systems in growing urban centers.

8. Research and Innovation

- Provides a scientific basis for initiating **research programs** focused on evaluating potential crop productivity, land suitability, and adaptive management practices.

9. Enhanced Food and Nutritional Security

- Contributes to **increased cropping intensity, higher yields, diversification, and improved soil health**—all of which underpin the country's **food and nutritional security goals**.

10. Agricultural and Economic Stability

- Supports the **preservation of agricultural land** for farming, enhancing long-term stability and sustainability in rural economies.
- Helps **reduce land use conflicts** by clearly defining farm and non-farm zones, promoting the co-location of **support businesses** such as suppliers, processors, and logistics services.

8. Implementation and Sustainability:

The **Crop Zoning System** provides strategic insights into the agronomic and economic potential of different regions across Bangladesh for cultivating specific crops. By identifying suitable crops for diverse agro-ecological zones, it enables informed decisions that can enhance agricultural productivity, efficiency, and profitability.

However, the successful implementation and long-term sustainability of this system rely on several critical factors:

1. Policy and Institutional Commitment

- The adoption and mainstreaming of crop zoning outputs into **land use planning, subsidy distribution, and agricultural development programs** require strong policy backing.
- **Government leadership** and sustained institutional support are essential to embed crop zoning into national and local planning processes.

2. Stakeholder Engagement and Collaboration

- The system's effectiveness hinges on active participation from **research institutions, extension services, agri-inputs and financial services providers, and farmers.**
- Key stakeholder contributions include **data sharing, field validation, capacity development, and dissemination of information** to end-users.

3. Role of Agricultural Scientists

Agricultural scientists play a foundational role in generating the **technological backbone** required for effective crop zoning. Their responsibilities include:

- Developing **crop varieties** and **management practices** suited to specific zones, including **agro-ecologically constrained areas**, to ensure sustainable productivity.
- Creating and validating **climate-resilient technologies** that address seasonal variability and climate change impacts.
- Making **up-to-date agricultural technologies** and innovations available through the crop zoning system, empowering farmers with informed choices.
- Conducting **on-farm trials** to test potential crops in identified zones, providing empirical data to validate and refine zoning outputs.
- Supplying detailed **crop-growing requirements**, including parameters such as **soil type, landform, moisture, pH, salinity, planting time, and climatic conditions**, to support accurate **suitability assessments and limitation ratings.**

4. Role of Agricultural Extension Personnel

As frontline facilitators, agricultural extension personnel are crucial to **operationalizing crop zoning at the field level.** Their key roles include:

- Developing **extension plans** aligned with crop zoning data to support national production goals.
- Disseminating information from the '**Khamari**' **mobile app** to farmers, helping them understand and adopt crop recommendations by location.
- Providing **crop-specific advisory services**, including information on profitable cropping patterns, recommended varieties, and production technologies thru the Khamari app.
- Promoting **balanced fertilization** by sharing **site-specific fertilizer recommendations** via the Khamari app, a cornerstone of sustainable soil and crop health.
- Organizing **trainings** for farmers and stakeholders on using the Khamari app and the adoption of crop zoning strategies.
- Facilitating **field demonstrations** with farmers to promote adoption of potential crops, which can lead to **crop selection for higher yields, agro-industrial development** and the **commercialization of agriculture.**

5. Policy Support Requirements

The long-term sustainability of the crop zoning system requires **enabling policies and institutional support**. Key policy needs include:

- **Institutionalize and implement crop zoning** through national policies and local-level enforcement mechanisms.
- Development of **market access policies and supporting infrastructure** that ensure **fair and profitable pricing** with a view to stimulate farmers to grow the crops recommended for their zones.
- Implementation of **training, motivation, and awareness programs** to build farmer confidence and promote adoption.
- Organization of **national-level demonstration programs**, including field days and farmer exchange visits, to showcase the benefits and impacts of zoning.
- Use of **mass media (both electronic and print)** to raise public awareness and build confidence in the crop zoning approach.
- **Integration of crop zoning concepts into academic curricula**, ensuring that future agricultural professionals are equipped with knowledge of spatial planning and resource optimization.

9. **Conclusions:**

The **Crop Zoning System** holds significant strategic importance for the **Government of Bangladesh**, particularly in light of critical national challenges such as **rapid population growth, shrinking arable land, yield gaps**, the need for **efficient resource utilization**, and the growing urgency to build **resilience against climate change**. Recognizing its relevance, the Government has incorporated **crop zoning and land use planning** into the **National Agriculture Policy (2018)** and the **Smart Bangladesh Vision**. Furthermore, the system aligns with the **Sustainable Development Goals (SDGs)**, particularly those focused on **sustainable agriculture, natural resource management, and ecosystem conservation**.

Once fully prepared, the crop zoning system will serve as a **critical decision-support tool** for policymakers, planners, and practitioners; enabling evidence-based agricultural strategies, optimized land use, and strengthened food and nutritional security.

In conclusion, the crop zoning system represents a **transformative approach** for optimizing land use, increasing agricultural productivity, and building a resilient, sustainable food system in Bangladesh. Its success depends not only on the strength of the technical framework but also on the **collective will and coordinated action** of government, scientific communities, extension networks, and farmers alike.

B. Building Blocks of the Online Crop Zoning System

The development of the **online crop zoning system** relies heavily on the integration of **geospatial technologies**—GIS (Geographic Information Systems), GPS (Global Positioning System), and RS (Remote Sensing)—for data processing and output generation. Both **spatial and non-spatial datasets** are core inputs for conducting comprehensive **land suitability assessments** and **crop zoning studies**.

Key datasets include updated information on:

- **Land and soil characteristics**
- **Climatic conditions**
- **Socio-economic factors**
- **Crop-specific requirements**

Additionally, spatial datasets such as:

- **Upazila soil and landform maps**
- **Land-use/land-cover maps**
- **Administrative maps** featuring **settlements, waterbodies, forests, rivers, and roads** are essential for accurate zoning and analysis.

Another critical component of the system involves:

- Developing a **methodological framework**
- Defining **crop-specific rules** based on soil, climate, and water requirements
- Establishing **suitability limitation ratings** for each crop
- Identifying **appropriate algorithms and methods** for processing data and calculating key **indicators** for land suitability

At the core of the initiative is the development of a **cloud-based GIS software**, the **Crop Zoning Information System (CZIS)**, which enables seamless data processing and output generation. For dissemination, several digital tools have been developed:

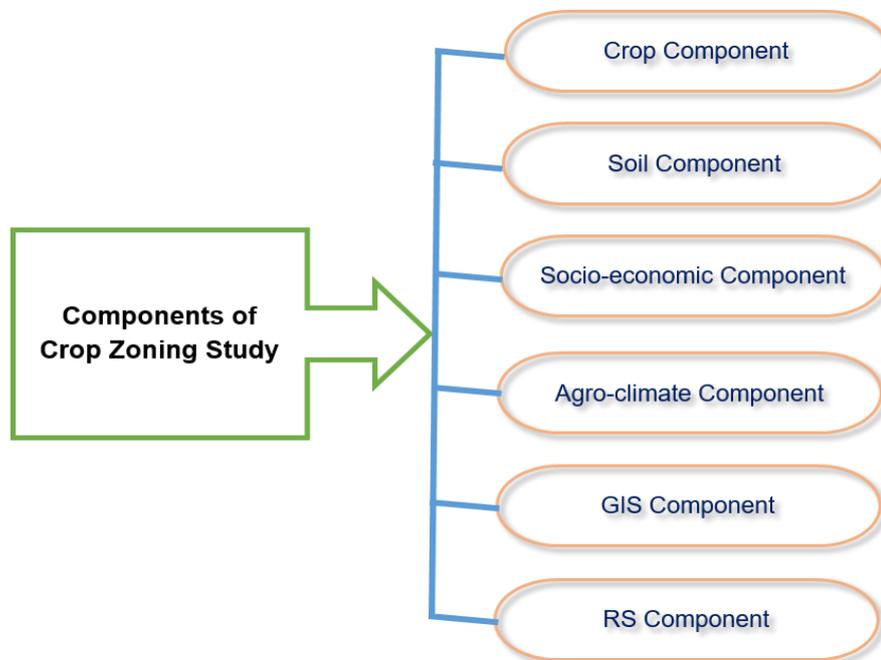
- **The Khamari Mobile App**
- **The Crop Zoning Dashboard**
- **An Agri-Advisory Portal**

These tools ensure that the output reaches relevant stakeholders, especially farmers, in an accessible and actionable format.

The study comprises six main components:

1. **Crop**
2. **Land and Soil**
3. **Socio-economic**
4. **Agro-climatic**
5. **Geographic Information System (GIS)**
6. **Remote Sensing (RS)**

Each component involves critical tasks such as **data gathering, verification, validation, and compilation**, followed by the **validation of outputs** to ensure accuracy and relevance in decision-making.



1. Crop Component

1. Introduction

The **Crop Component** plays a critical role in the crop zoning system by focusing on the collection and analysis of crop-specific biophysical information. The major functions under this component include:

- **Collation of biophysical requirements** for each crop (e.g., temperature, rainfall, soil type);
- Compilation of data on **crop varieties**, including their **growth duration** and **yield potential**;
- Documentation and analysis of **existing cropping patterns**;
- **Formulation of crop-specific rules** based on the soil, climate, and water requirements essential for optimal crop growth;
- Development of **suitability limitation ratings** for each crop, identifying constraints that may impact successful cultivation in specific areas.

This component ensures that the zoning system reflects realistic, science-based conditions for effective land use planning and crop selection.

2. Objectives

The objectives of crop component are:

- a) Select crops for crop zoning study and develop crop growth requirement based on land, soil and climatic for those selected crops;
- b) Formulate land and soil factor wise suitability limitation ratings for each crop and stress tolerant varieties upon which agro-edaphic suitability will be determined;
- c) Collate crop information in relation to yield and farming practices;
- d) Assist in validating crop suitability outputs.

3. List of crops selected for crop zoning system

Crop group	Crop	No. of crops
Cereal	Rice, Wheat, Maize, Kaon, Cheena, Barley	6
Tuber & Root crops	Potato, Sweet potato, Taro (Pani kochu), Eddo (Mukhi kochu)	4
Sugar crops	Sugarcane, Date palm, Palmyra palm	3
Fibre crops	Jute, Cotton, Kenaf, Mesta	4
Oilseeds	Mustard, Ground nut, Linseed, Sesame, Soybean, Sunflower	6
Pulses	Lentil, Gram, Mung bean, Black gram (Mash), Grass pea (Khesari), Cowpea (Felon)	6

Crop group	Crop	No. of crops
Spices & Condiments	Chilli, Onion, Garlic, Ginger, Turmeric, Coriander, Betel leaf	7
Vegetables	Brinjal, Tomato, Cauliflower, Cabbage, Broccoli, Lady's finger, Pointed gourd, Radish, Carrot, Country bean, Long yard bean, Spinach, Indian spinach, Stem amaranth, Red Amaranth, Bottle gourd, Pumpkin, Ridge gourd, Teasle gourd, Sponge gourd, Bitter gourd, Cucumber, Khira, Ash gourd, Snake gourd	25
Fruits	Mango, Jackfruit, Banana, Papaya, Pineapple, Litchi, Guava, Jujube (Ber), Coconut, Golden apple, Lemon, Water melon, Musk melon, Malta	14
Beverage	Tea	1
Total		76

4. Activities

The main activities of the crop component are to gather information on crops, crop varieties, crop production technologies, cropping patterns, crop requirements i.e. soil, climate, water and validation of software generated output. In addition, selection of crop, crop inventory development, identification of crop varieties suitable for stress situation and formulation of crop growth requirement and agri-edaphic and agri-climatic suitability limitation ratings for each crop are also important activities of crop component.

Activity 1: Development of crop inventory

Activity 2: Selection of crops

Activity 3: Collection of information on varietal characteristics of crops and varieties suitable for stress situation

Activity 4: Development of crop growth requirements

Activity 5: Agro-edaphic suitability limitation ratings for crops

Activity 6: Agro-climatic suitability limitation ratings for crops

Activity 7: Compilation of cropping pattern information

Activity 8: Compilation of information for agri-advisory portal

Activity 9: Validation of outputs

Processing and uploading crop data in crop zoning system

Processing and uploading crop data in CZIS software:

Step1: www.cropzoning.gov.bd

Step2: Select



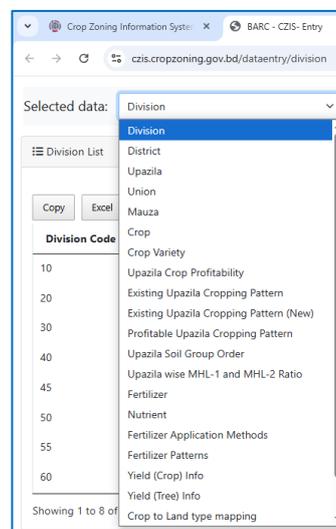
Step3: Login with admin Id (email & password)



Step4: Click on the pen mark (Data table)



Step5: Click on the dropdown list



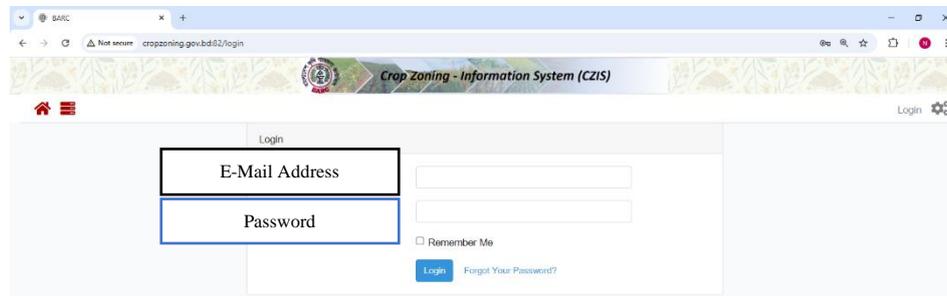
Outputs are displayed in Crop zoning dashboard, 'Khamari mobile app' & 'Agri-advisory portal'

- ➔ To add or edit or delete any information regarding **Division, district, upazila, union mouza**, select the specific menu bar
- ➔ To add or edit or delete crop related information select **Crop, Crop variety, Crop to land type mapping** menu bar
- ➔ To add or edit or delete fertilizer related information select **Fertilizer, Nutrient, Fertilizer application method, Yield (crop) info, Yield (tree) info** menu bar
- ➔ To add or edit or delete crop profitability related information select **Upazila crop profitability** menu bar
- ➔ To add or edit or delete cropping pattern related information select **Existing upazila cropping pattern (new), Profitable upazila cropping pattern, Fertilizer patterns** menu bar
- ➔ To add or edit or delete soil group order related information select **Upazila soil group order** menu bar
- ➔ To add or edit or delete MHL-1 & MHL-2 ratio related information select **Upazila wise MHL-1 & MHL-2 ratio** menu bar
- ➔ To add or edit or delete soil health related information select **Soil health** menu bar

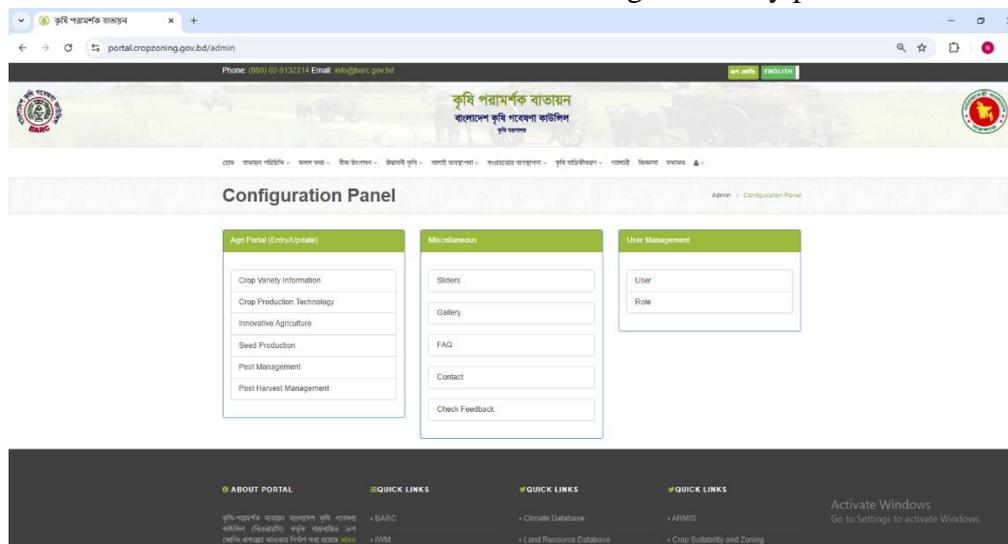
Processing and uploading crop data in Agri-advisory portal:

Step1: Agri-advisory portal data entry link: <http://cropzoning.gov.bd:82/login>

Step2: Login with E-mail and password



Step3: Select different menu to add or edit or delete Agri-advisory portal information.



Agri Portal (Entry/Update)

- Crop Variety Information
- Crop Production Technology
- Innovative Agriculture
- Seed Production
- Pest Management
- Post Harvest Management

Miscellaneous

- Sliders
- Gallery
- FAQ
- Contact
- Check Feedback

User Management

- User
- Role

2. Soil Component

1. Introduction

Soil is one of the most vital life-supporting natural resources, as it underpins food production essential for human survival. A clear and comprehensive understanding of soil types and their spatial distribution is a critical prerequisite for developing effective local-level land use plans for agriculture, forestry, and other sectors. Systematic soil surveys provide the foundational information required for interpreting land use potential and planning for sustainable agricultural productivity.

In the context of **crop suitability assessment** and **crop zoning**, land and soil resources—along with climatic data—form the core datasets. Among these, **edaphic factors** (physical and chemical soil properties) are especially influential on crop growth and performance. Nine edaphic factors generated by the **Soil Resource Development Institute (SRDI)** through its semi-detailed soil survey are utilized:

- **Land type**
- **Land relief**
- **Soil water recession**
- **Soil drainage**
- **Soil texture**
- **Soil moisture**
- **Soil Consistency**
- **Soil pH**
- **Soil salinity**

In addition, a set of **soil chemical parameters** is used for generating **location-specific fertilizer recommendations**, supporting precise nutrient management, including:

- **Organic Matter**
- **Total Nitrogen**
- **Phosphorus (Bray & Kurtz method)**
- **Potassium**
- **Sulphur**
- **Zinc**
- **Boron**
- **Calcium**
- **Magnesium**

- **Copper**
- **Iron**
- **Manganese**

Data Processing and Validation

Before integrating edaphic and soil chemical data into the system, **validation** is performed to identify and correct inconsistencies. Edaphic data are typically extracted from the **map legends of the Upazila Nirdeshika**, while **soil chemical data** are geospatially referenced based on their mapped locations.

Validation is carried out using a combination of:

- Established **principles and rules of thumb**
- **Logical interrelationships** between soil physical and chemical characteristics

Once validated, the data are **coded** using predefined classifications for each individual parameter. These coded datasets are then used to generate various thematic maps of edaphic factors.

These maps are digitally produced using the **Crop Zoning Information System (CZIS)** software, and the corresponding **fertilizer recommendations** are disseminated to end-users via both the **Khamari Mobile App** and the **Crop Zoning Dashboard**.

2. Objectives

The objectives of soil component are:

- a) Integration of land and soil information for crop suitability assessment;
- b) Preprocessing of upazila land and soil properties data for preparing input file needed for crop suitability assessment;
- c) Preparation of policy recommendation for implementation of crop zoning in Bangladesh;
- d) Preparation of policy guidelines on the use and management of land and soil for sustainable agricultural development;
- e) Preparation of document on ‘Land, soil and water resources for sustainable agricultural production’;
- f) Formulation of limitation ratings and crop growth requirement for crop suitability assessment and zoning;
- g) Determining fertilizer requirement of crops/ cropping patterns based on soil fertility status;
- h) Validation of outputs related to suitability assessment of crop.

4. Activities

The collection of Upazila Nirdeshika from SRDI with soil and landform map, validation and coding of soil physical and chemical properties data, formulation of suitability limitation ratings for each crop are major activities of soil component. In addition, providing support to document preparation and validation of software generated output are important tasks for the group. The activities performed under soil component are enumerated elaborately in the following section:

Activity 1: Selection of Upazila for crop zoning study

Activity 2: Validation and coding, and compilation of land and soil properties data

Activity 3: Validation and compilation of soil chemical data (analytical results of soil samples collected from different location through semi-detailed soil survey at upazila level)

Activity 4: Framing suitability limitation rating for crops

Activity 5: Validation of outputs

Activity 6: Preparing document on recommendation for implementation of crop zoning, soil management, etc.

Processing and uploading soil data in crop zoning system

Processing and uploading land and soil edaphic data in CZIS:

Step1: Collection of Upazila Nirdeshika from SRDI

Step2: Validation, compilation and coding of land and soil properties data presented in Upazila Nnirdeshika

Validation of edaphic data based on-

Relation between land type, drainage and water recession.

Relation between soil texture, consistency, residual soil moisture and organic matter.

Step3: The coded data of 9 lands and soil factors are compiled and organized in an Excel file.

upz_code	aez	physio	mu	mu_area	nc_area	land form	land_type	lt_area	soil_group	soil_group name	sg_area	texture
456122	28	31	1	645	37	3	1	541	2010	Tejgaon	444	4
456122	28	31	1	0	0	3	1	0	233	Belabo	65	4
456122	28	31	1	0	0	3	1	0	1930	Sayek	32	4

consistency	drainage	reaction	moisture	salinity	recession	relief	c_area	forest	fallow	edaphic_code
2	1	2	2	1	1	1	444	0	0	
2	2	2	2	1	1	1	65	0	0	
2	2	2	1	1	1	1	32	0	0	

Step4: www.cropzoning.gov.bd

Step5: Select



Step6: Login with admin Id (email & password)

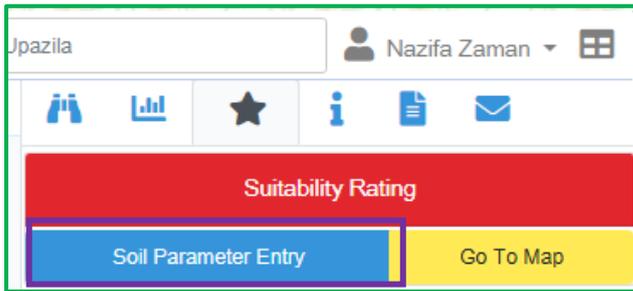
Step7: Select



Step8: Select 'Suitability Rating' option



Step9: Select 'Soil Parameter Entry'



Step10: Select upazila → Select **Show** to see the parameters

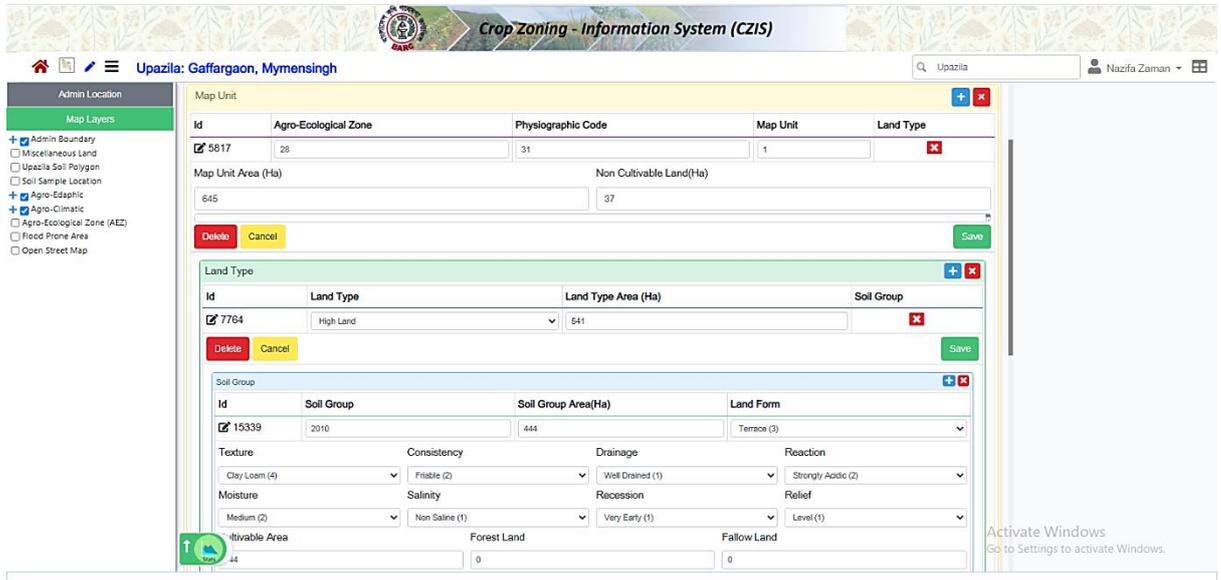
Select **+** to Add new information

Select edit  option to edit information

Id	Agro-Ecological Zone	Physiographic Code	Map Unit	Land Type
5817	28	31	1	
5818	28	31	2	
5820	28	31	3	
5821	28	31	4	
5822	9	9	5	
5823	9	9	6	
	9	9	7	
	9	9	8	

Continue

Step11: Select Land type  and then  to add or edit or delete land and soil properties data
 Select Soil group  and then  to add or edit or delete land and soil properties data



Step12: Select  to save the data.

Step13:

- Analyze and generate Agro-edaphic map (Land type, soil texture, soil moisture map etc)
- Coded data used for preparing maps of individual land and soil factors.
- These map layers are used for agro-edaphic suitability assessment crop(s).

Processing and uploading upazila soil group order in CZIS:

Step1: www.cropzoning.gov.bd

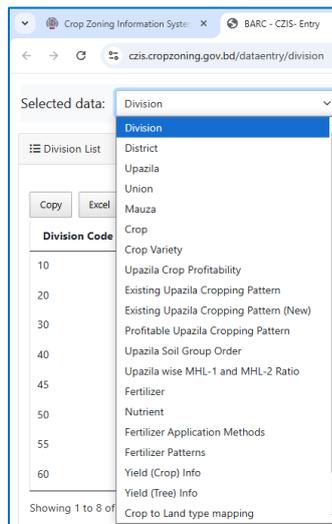
Step2: Select 

Step3: Login with admin Id (email & password)



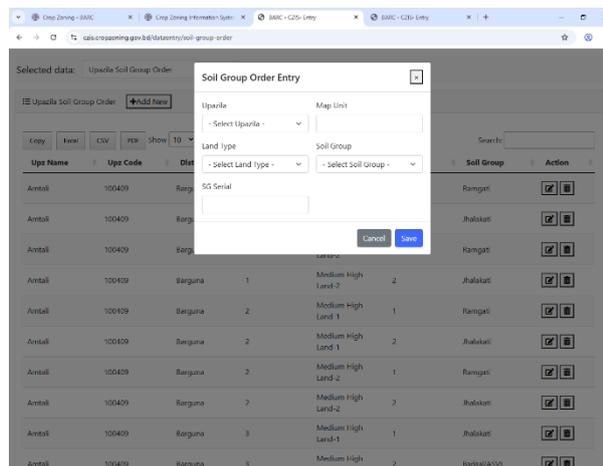
Step4: Click on the pen mark (Data table) 

Step5: Click on the dropdown list



Step6: Select Upazila Soil Group Order

Step7:



Click +Add New to add soil group order entry

Step8: Click Save

Processing and uploading MHL-1 & MHL-2 ratio in CZIS:

Step1: www.cropzoning.gov.bd

Step2: Select 

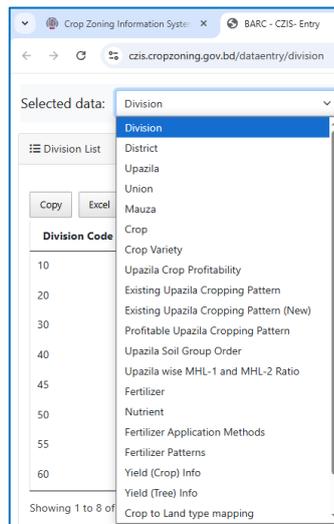
Step3: Login with admin Id (email & password)



Step4: Click on the pen mark (Data table)



Step5: Click on the dropdown list



Step6: Select Upazila wise MHL-1 and MHL-2 Ratio

Step 7: For Upazila wise MHL-1 and MHL-2 Ratio entry:

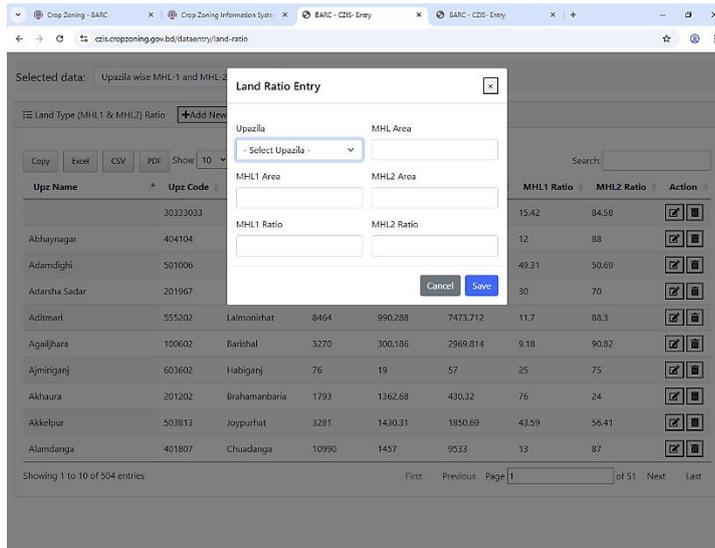
MHL area: Total MHL2 area

MHL1 Area: MHL1 Ratio division of 100 (MHL1 Ratio/100)

MHL2 Area: MHL1 area Subtraction of MHL area (MHL1 area-MHL area)

Continue

Step8:



Click +Add New to add Upazila wise MHL-1 and MHL-2 Ratio

Step9: Click Save

Step 10: In the soil group order entry, in case of land type-2, both Medium Highland-1 and Medium Highland-2 must be entered. In the soil group order entry, in case of land type-2, both Medium Highland-1 and Medium Highland-2 have to be entered. In case of multiple soil groups, the soil group serial will start with 1,2,3 in case of Medium Highland 1 and 1,2,3 in case of Medium Highland 2 and if there is only one soil group, it will be 1 in case of both.

Processing and uploading soil chemical data in Land use map:

Step1: Collection of Upazila Nirdeshika from SRDI

Step2: Validation, compilation and coding of soil chemical data presented in Upazila nirdeshika

Validation of soil chemical data based on-

Relation between parent material and soil pH

Relation between soil pH, macronutrient and micronutrient availability

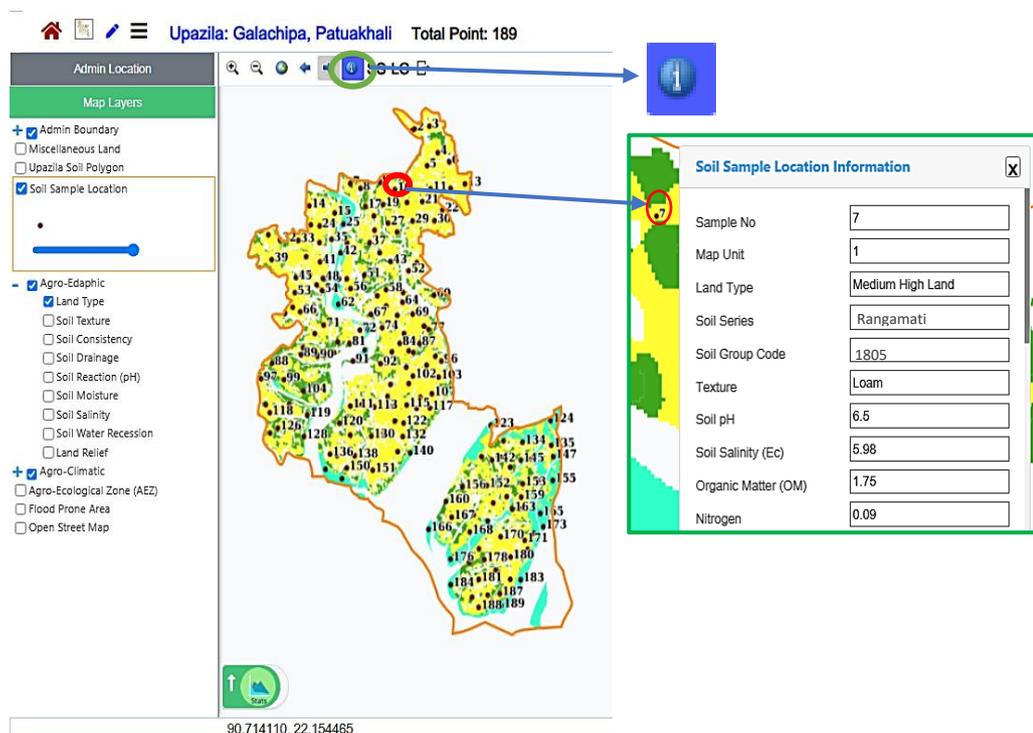
Step3: These data include N, P, K, S, Zn, B, Ca, Mg, Fe, Cu, Mn, Soil reaction (pH), organic matter, and Soil salinity (EC) and organized in an Excel file.

MU	Smpl No.	Soil Series	Texture	Landtype	Soil group	pH	EC	OM	N	P (O)	P(B)	K	S	Zn	B	Ca	Mg	Cu	Fe	Mn	Upz_code
1	7	Rangmati	Loam	MHL	1805	6.5	5.98	1.75	0.087	0	3.9	0.25	16.7	0.31	0.33	22.22	10.72	4.58	30.86	39.8	107857
	32	Rangmati	Loam	MHL	1805	5.1	5.34	1.48	0.074	0	4.1	0.3	36.9	0.67	0.04	19.6	11.98	6.86	34.7	44.43	107857

Step4: Chemical test data provided by soil expert was joined with the digitized sample point layer using the 'Join' tool in ArcGIS. This join was based on a common field (e.g., sample No.). The joined attributes (e.g., pH, Nitrogen, Phosphorus) enabled spatial analysis of soil quality across upazila.

Step5: Select Upazila → Soil sample location and keep open the layer → Select  icon

Click on the soil sample location point to display the information



The screenshot shows the ArcGIS interface for Upazila Galachipa, Patuakhali. The map displays various layers including Admin Boundary, Miscellaneous Land, Upazila Soil Polygon, and Soil Sample Location. A pop-up window titled 'Soil Sample Location Information' is open, showing the following data for sample number 7:

Field	Value
Sample No	7
Map Unit	1
Land Type	Medium High Land
Soil Series	Rangamati
Soil Group Code	1805
Texture	Loam
Soil pH	6.5
Soil Salinity (Ec)	5.98
Organic Matter (OM)	1.75
Nitrogen	0.09

3. Socio-economic Component

1. Introduction

The **socio-economic component** plays a pivotal role in the **Crop Zoning**, as it directly influences farmers' decisions regarding the adoption of agricultural technologies. Recognizing that technology alone does not guarantee adoption, this component has been integrated to reflect the **real-life decision-making processes of farmers**, particularly in Bangladesh's diverse rural context.

In Bangladesh, crop selection by farmers is often driven not solely by agronomic suitability, but also by **household consumption needs, market demand, and profitability**. A farmer's choice of crops and cropping patterns is thus significantly shaped by economic incentives, market accessibility, input affordability, and potential returns on investment.

Incorporating these socio-economic realities into the crop zoning framework ensures that the **recommended crops and cropping patterns** are not only agro-ecologically viable but also **economically attractive and practically adoptable**. This alignment increases the likelihood of farmer adoption, ultimately contributing to the broader goals of **increased agricultural productivity, income generation, and rural economic development**.

By factoring in market trends, profitability data, and farmers' preferences, the **Crop Zoning** promotes the selection of **profitable and sustainable cropping patterns**, empowering farmers to make **informed and beneficial choices** tailored to both their environment and livelihood needs.

2. Objectives

The objective of socio-economic component is to collect data on crop production and analyze financial suitability of crop/cropping pattern providing options to the farmers in choosing right crop/cropping pattern. However, objectives of socio-economic component follow;

- a) Analyze profitability of crops/cropping pattern cultivated by the farmers; and
- b) Provide information on profitability of crops/cropping patterns supporting better decision making both at micro and macro-economic level.

3. Activities

The activities undertaken by socio-economic component are as follows:

Activity 1: Formation of Socio-economic Expert Committee

Activity 2: Develop methodology

Activity 3: Develop questionnaire and checklist

Activity 4: Field testing of questionnaire

Activity 5: Assist to develop data management software

Activity 6: Selection of profitability indicators

Activity 7: Develop guideline for enumerators (SSO & SO's)

Activity 8: Define terms used in questionnaire/ methodology

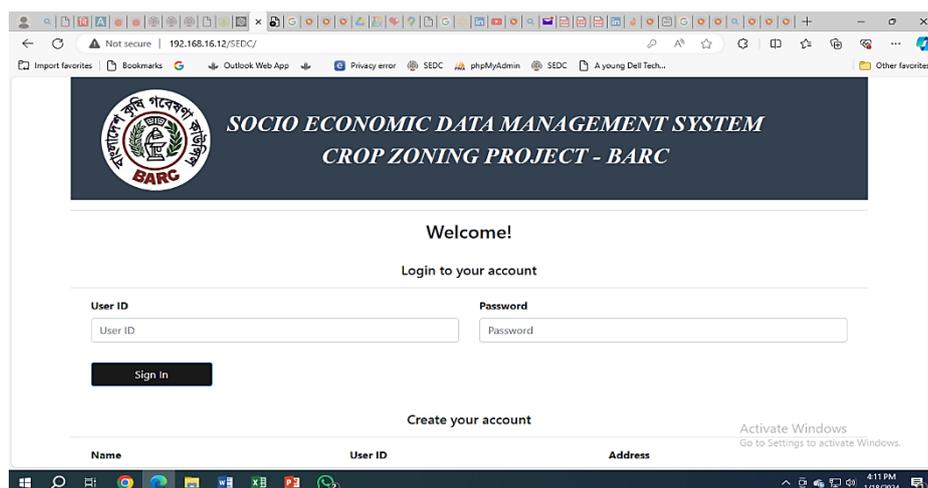
Activity 9: Collect information related to cost and return info of different crops

Activity 10: Edit, entry, compile and analyze socio-economic data

Socio-economic data management, processing and uploading

Step1: Collect socio-economic data through Focus group discussion from upazila level using structured questionnaire

Step2: Login to **Socio Economic Data Management Software** (hosted in LAN)



Step3: Entry socio-economic data into the SEDC software collected from upazila level

Step4: Generate report of crop and cropping pattern profitability (GM, BCR) from SEDC software

Step5: Cross-check output data and correct in SEDC software if there is any error/ anomalies found and generate final report for uploading

Step6: www.cropzoning.gov.bd

Step7: Select 

Step8: Login with admin Id (email & password)



Step9: Click on the pen mark (Data table)



Click on the dropdown list

Step10:

10	Upazila Crop Profitability
20	Existing Upazila Cropping Pattern
	Existing Upazila Cropping Pattern (New)
30	Profitable Upazila Cropping Pattern

Step11: To add or edit or delete crop profitability related information select **Upazila crop profitability** menu bar

Step12: To add or edit or delete cropping pattern related information select **Existing upazila cropping pattern (new), Profitable upazila cropping pattern, Fertilizer patterns** menu bar

Step13: Output will be displayed in Khamari Mobile App, Agri-advisory Portal and Crop Zoning Dashboard

4. Agro-climate Component

1. Introduction

Agriculture is the main driving force of the economy of Bangladesh. This agriculture is highly dependent on climatic phenomena. Despite technological improvements such as improved crop varieties and irrigation systems, weather and climate are still key factors in agricultural productivity. Changes in temperature, erratic behavior of rainfall, temporal changes in cropping seasons, increasing frequency and intensity of weather-related extreme events including floods, droughts, cyclones and storm surges, salinity intrusion into inland water and soil are the major climate change related threats to agriculture. For ensuring optimal production of crops, it is necessary to rationally manage the lands and choose the most suitable crops considering the soil, topography, environment and climate.

Zoning of climate provides a better know how to the farming community to grow their crops according to the agro-climatic potential of different regions for maximum harvests. The need for such analysis becomes more relevant when uncertainties related to climate variability and climate change dominate over the normal weather patterns. In crop zoning study, AEZ methodology for agro-climatic zoning is followed for crop suitability assessment. The agro-climatic zoning is a quantification of the temperature and moisture regimes of Bangladesh, including the year to year variability. The moisture regime is quantified in terms of reference growing periods by using a water balance model (FAO/UNDP, 1988). The moisture growing period is the period during a year when precipitation exceeds half the potential evapotranspiration, plus a period required to evapotranspire an assumed 100 mm of water from soil storage for the kharif season and an assumed 250 mm for the rabi season. The thermal regimes are described in terms of duration of critical temperature periods in the rabi (winter) and pre-kharif (summer) season.

2. Objectives

The objectives of agro-climate component are as follows:

- a) Gathering, editing, formatting and compilation of weather data;
- b) Characterizing thermal and moisture regimes for crop suitability assessment;

3. Agro-climatic Factors

Moisture Regime	Thermal Regime
Pre-kharif transition period	Cool Winter Temperature ($\leq 15^{\circ}\text{C}$)
Kharif Length of Growing period	Hot Summer Temperature ($\geq 40^{\circ}\text{C}$)
Rabi Length of Growing period	

4. Activities

Activity 1: Preparation of agro-climatic database

Activity 2: Thermal regime analysis

Activity 3: Potential evapotranspiration (PET) calculation

Activity 4: Characterization of moisture regimes

5. Moisture and Thermal Regime Characteristics

Pre-Kharif Transition Period	This period is considered to start on the first date after end of February when precipitation first exceeds 0.5 PET (potential evapotranspiration). The period ends on the date from which precipitation continuously exceeds 0.5 PET (i.e. the beginning date of the Kharif growing period). Characterized by unreliable rainfall and providing only an intermittent supply of moisture for crop growing.
Kharif Growing Period	In this period moisture supply from rainfall plus soil storage is sufficient to support non-irrigated kharif crops. The period begins on the date from which precipitation continuously exceeds 0.5 PET and ends on the date when the combination of precipitation plus an assumed 100 mm of soil moisture storage after the rainy season falls below 0.5 PET.
Rabi Growing Period	When plants are dependent on 250 mm of stored soil moisture after precipitation falls below PET i.e. the period between the end of the humid period and the time when 250 mm of soil moisture have been exhausted by evapotranspiration.
Cool Temperature	No. of days in Rabi with minimum temperature less than 15 °C
Extreme Summer Temperature	No. of days maximum temperature exceeds 40 °C. The extremely high temperature usually occur in April-May, occasionally in early June. The significance is that it creates a very high PET demand which plant roots may not be able to satisfy, especially in kharif crops at the seedling stage.

6. Data Source used in crop zoning activity

- BMD has been operating 56 weather stations, from where point based data (rainfall, temp, RH etc.) have been collected for utilization in Forecasting and sectoral use.
- These data are very important for farmers and farming communities.
- As per earlier practice Climate Data base of BARC is having 34 BMD Stations data upto 2019 with data gaps.
- To overcome this situation and to upgrade the data base the following initiatives have been taken:
 - a. Collection Global gridded rainfall data- Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS), Climate Prediction Center (CPC) Morphing Technique (CMORPH), Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks- Climate Data Record (PERSIANN-CDR);
 - b. Collection of Point based observation data of BMD and ENACT data of BMD;
 - c. BMD's 56 point based data are extracted utilizing different softwares/ programmes and techniques;
 - d. Compare the extracted data with observation to check the quality of data;
 - e. Prepare a qualitative rainfall data base for 1981-2021 at all 56 locations;
 - f. After refining the rainfall data of 56 locations have been prepared.

5. GIS & RS Component

GIS Component

1. Introduction

A **Geographic Information System (GIS)** is a powerful framework for **gathering, managing, analyzing, and visualizing spatial data**. Rooted in the science of geography, GIS integrates a variety of data types—both spatial and non-spatial—so long as they are tied to geographic locations. This technology provides critical support for **evaluating land suitability and capability**, estimating and predicting outcomes, interpreting patterns, and enhancing understanding of complex interactions between natural and human systems. Through **spatial analysis**, GIS enables informed decision-making by offering insights into historical, current, and future scenarios.

In the context of **crop zoning**, GIS technology is employed to develop an **online, GIS-based land suitability assessment and crop zoning system** to support sustainable agricultural planning. This system facilitates **rapid generation, synthesis, and analysis of data** across various geographical areas and time frames, helping to evaluate the impacts of different land management practices.

Sustainable agricultural production is closely tied to the **judicious use of natural resources**—such as soil, water, climate, rainfall, and topography—and the adoption of context-appropriate technologies. Therefore, the **systematic collection, updating, and analysis of relevant data using GIS** forms the backbone of the Crop Zoning Project. The resulting outputs—such as crop suitability maps, thematic layers, and zonal recommendations—are used in decision support tools like the **Crop Zoning Information System (CZIS)**, the **Khamari Mobile App**, and the **Crop Zoning Dashboard**, ultimately guiding stakeholders toward **data-driven and sustainable land use decisions**.

2. Objectives

The **primary objective** of the GIS component in the Crop Zoning Project is to **gather, manage, update, and analyze geospatial data** to support the development of a **land suitability assessment and crop zoning system for Bangladesh**.

GIS technology is instrumental in the **generation of thematic maps** representing key **agro-edaphic** (soil-related) and **agro-climatic** (climate-related) factors. These include variables such as landform, soil type, pH, salinity, organic matter content, rainfall, temperature, and growing period. By integrating these datasets, GIS enables the **spatial analysis of crop requirements** against land characteristics and climate variability, leading to the classification of land areas based on their **suitability for different crops**.

The agro-edaphic and agro-climatic suitability assessments are executed through **overlay analysis and spatial modeling** using GIS, producing **location-specific maps and suitability information**. These outputs are essential for guiding **crop selection, fertilizer recommendation**, and broader **agricultural planning** at both local and national levels.

4. Activities

The activities undertaken by GIS component are as follows:

- Activity 1: Conversion of existing ArcInfo coverage files and projection transformation
- Activity 2: Creation of administrative, soil polygon (SoP) and soil sample location (SoL) map layers for newly established upazilas
- Activity 3: Scanning and georeferencing of upazila soil and landform maps
- Activity 4: Spatial adjustment for updating of existing upazila soil polygon (SoP) maps
- Activity 5: Digitization of upazila soil sample locations data
- Activity 6: Joining of soil chemical analysis data with upazila SoL map layers
- Activity 7: Preparation of map layers from SoB geodata
- Activity 8: Updating of administrative boundary (district, upazila, union and mouza)
- Activity 9: Field validation of land type
- Activity 10: Preparation of spatial interpolated upazila nutrient status map

RS Component

1. Introduction

Remote sensing is the science of collecting information about objects or phenomena from a distance—typically using sensors mounted on satellites, aircraft, or drones—without direct physical contact. These sensors detect and record reflected or emitted energy, which is then analyzed to derive insights about an object’s physical characteristics, environmental interactions, and temporal changes.

In the context of agriculture, **remote sensing enables continuous and large-scale monitoring** of crop health, land use, and productivity. Devices capture multispectral and hyperspectral imagery over time, allowing for the analysis of critical parameters such as vegetation indices, soil moisture, crop growth stages, and yield estimations. These insights help guide decision-making for optimizing crop performance and land use.

In the **Crop Zoning System of Bangladesh**, remote sensing plays an **integral and strategic role** in the development of the zoning system. It is primarily used to generate and update **Land Use and Land Cover (LULC) maps, crop type maps, and a crop monitoring system**.

The most recent **LULC maps** derived from Earth Observation data enhance the accuracy of land suitability assessments by clearly identifying **agricultural land areas**, thereby confining suitability analysis to relevant zones. This significantly improves the reliability of outputs generated by the **Crop Zoning Information System (CZIS)**.

Moreover, satellite-based monitoring enables the **detection of crop types, planting dates, growth progress, and overall crop health**. This real-time data supports not only **national-**

level planning and policymaking but also offers practical applications for **farmers, agribusinesses, and agricultural advisory services**. These datasets feed into various downstream systems such as **agricultural subsidies, insurance, certification, and digital advisory platforms** including the **Khamari Mobile App**.

Thus, the **remote sensing component** is vital for providing **accurate, timely, and location-specific agricultural intelligence**, supporting both field-level decisions and national strategies for sustainable agriculture in Bangladesh.

2. Objectives

The main objectives of remote sensing activity is to generate required LULC information and crop informatics by utilizing earth observation data for facilitating and contributing in developing crop zoning systems for Bangladesh. The major goals are as follows:

- a) Preparation of land use and land cover (LULC) map of Bangladesh
- b) Crop mapping for the whole country
- c) Develop a crop monitoring system

4. Activities

The main activities of remote sensing are preparation of recent land cover, and land use map from satellite acquired data (earth observation data) providing the country's agricultural areas (agricultural mask). Further, the earth observation data within the agricultural mask areas are analyzed using machine learning techniques to identify the crops for crop mapping. Besides crop mapping, a crop monitoring system is developed based on spatiotemporal analysis within the different crop areas of the crop map. These activities are carried out progressively based on top-down and empirical approaches.

The main activities of the remote sensing component are as follows.

Activity 1: Designing and implementing strategies for remote sensing data processing

Activity 2: Preparation of land cover and land use map

Activity 3: Identification of orchard areas

Activity 4: Developing statistical analytics for land use and land cover change detection

Activity 5: Crop mapping

Activity 6: Crop monitoring

Activity 7: Performing field validation

GIS & RS-Based Workflow for Crop Zoning

ArcGIS Desktop version 10.8 is used for performing the GIS tasks. The workflow steps are discussed sequentially in the following section.

Georeferencing the Soil and Landform Map

High-resolution scans of upazila-level soil and landform maps were georeferenced using the administrative boundary of the upazila as the base layer. The 'Georeferencing' toolbar in ArcGIS was used for this task. Ground Control Points (GCPs) such as road intersections, pond edges, and railway crossings were selected to improve spatial accuracy. The transformation method typically used was '1st Order Polynomial (Affine)', ensuring the scanned maps align with other spatial datasets for precise geospatial analysis.

Below are the steps involved in georeferencing the soil and landform map:

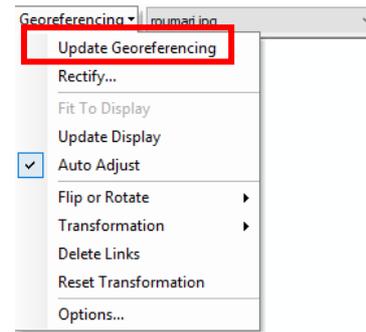
1. Open ArcMap and load the upazila boundary shapefile.
2. Go to **Customize > Toolbars > Georeferencing** to activate the Georeferencing toolbar.



3. Click Add Data to add the scanned soil and landform map (raster image).
4. On the Georeferencing toolbar, choose the raster layer from the dropdown.
5. Click **Georeferencing > Fit to Display** to bring the raster into view.
6. Click on the Add Control Points tool.



7. Click on a known point (e.g., road intersection) on the soil and landform map, then click the same point on the base layer (satellite imagery).
8. Add 4–6 such Ground Control Points (GCPs) at well-distributed locations.
9. In the toolbar, go to Georeferencing > Update Georeferencing to save the transformation.
10. Use 1st Order Polynomial (Affine) as the transformation method (set in the Georeferencing options).



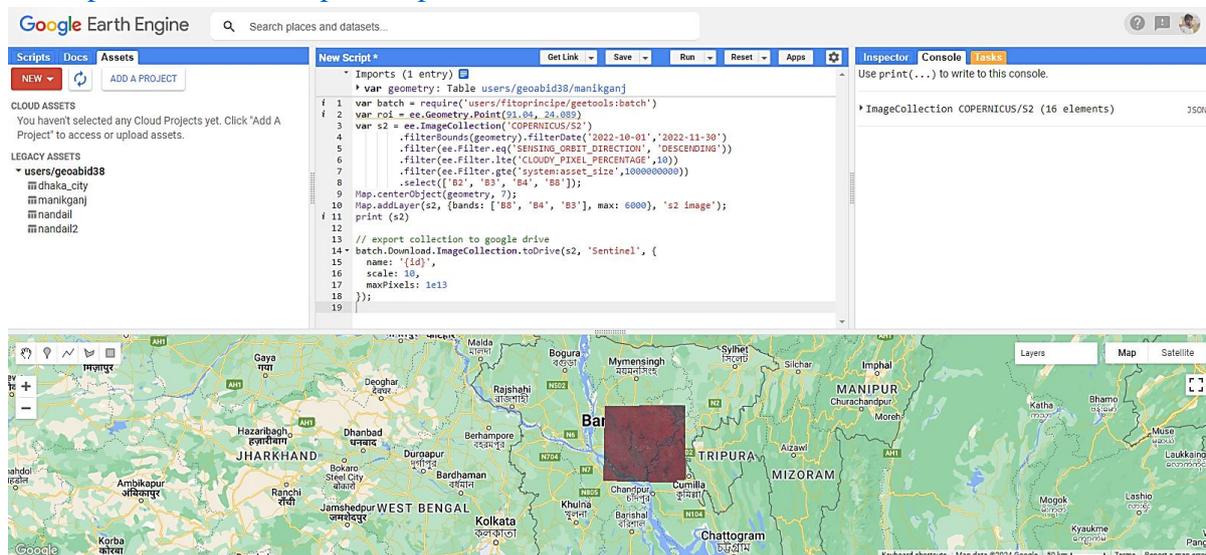
Land use data preparation

Land use data was generated from recent Sentinel-2 satellite imagery. Preprocessing was performed using ArcGIS's 'Composite Bands' tool for layer stacking, and 'Stretch' functions for image enhancement. Following this, non-agricultural features such as settlements, rivers, brickfields, and ponds were manually digitized using the 'Editor Toolbar' and 'Create Features' pane in ArcMap. This digitization was guided by visual interpretation of the imagery, distinguishing non-agricultural land from areas available for cropping.

Following are the steps of preparing land use data:

11. Download the recent year sentinel-2 satellite image of dry season (March-April) from Google earth engine platform or from the following website:

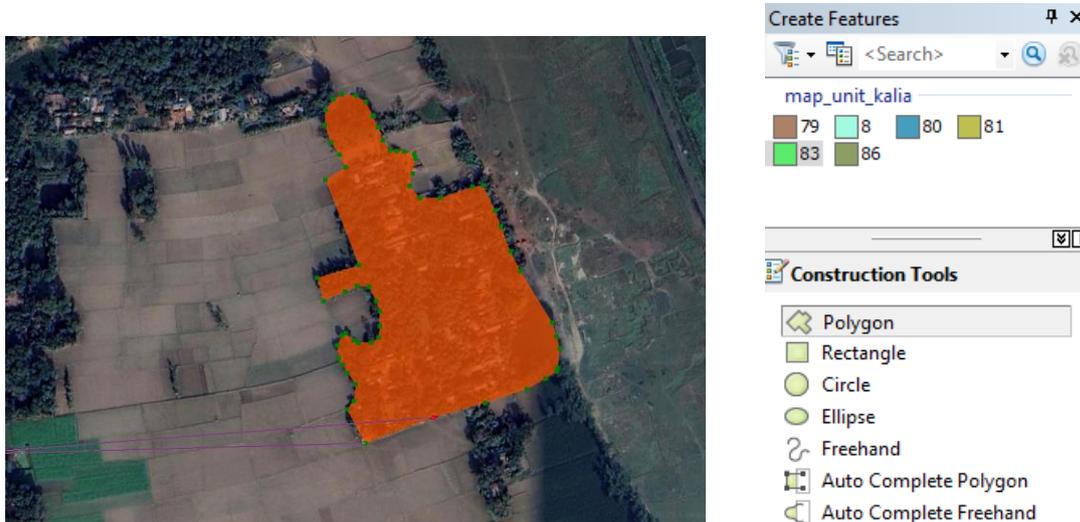
<https://browser.dataspace.copernicus.eu>



12. Add Sentinel-2 satellite image bands to ArcMap.
13. Use Composite Bands (**Data Management Tools > Raster > Raster Processing > Composite Bands**) to stack the bands.
14. Use Stretch in the Symbology tab for visual enhancement.
15. From Arc Catalog create a new Polygon Shapefile
16. Activate the Editor Toolbar (**Customize > Toolbars > Editor**).



17. Click Start Editing and select the newly created polygon shapefile for digitizing.
18. Open the Create Features pane (**Editor Toolbar > Create Features**).
19. Digitize visible non-agricultural features (e.g., settlements, rivers, ponds, brickfields).



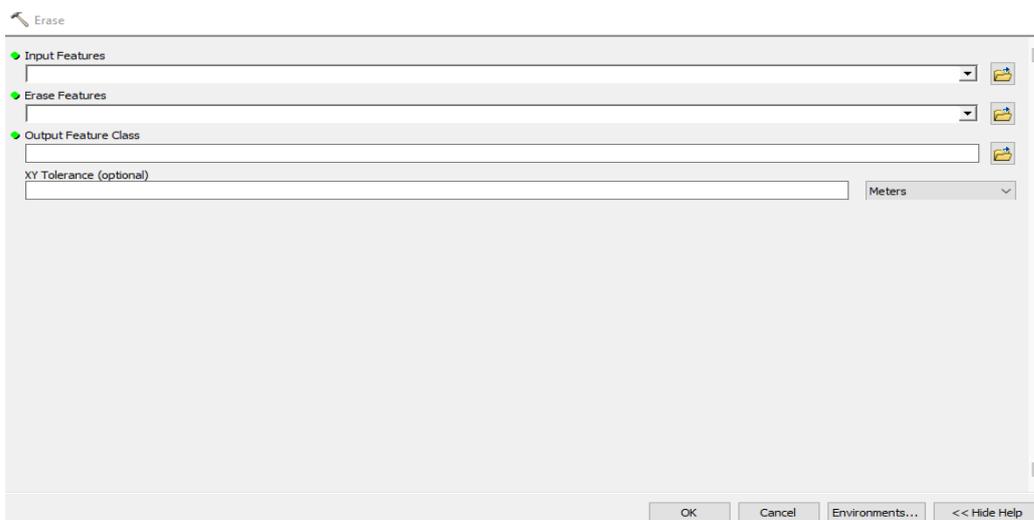
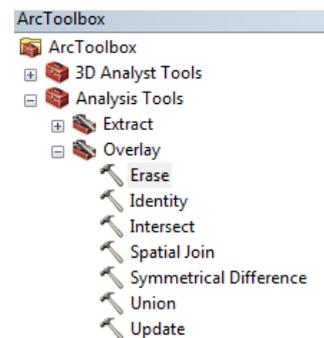
20. Click Save Edits, then Stop Editing when digitizing is complete.

Delineation of Agricultural land

Agricultural land was derived by subtracting the digitized non-agricultural features from the total upazila land area. This was done using the 'Erase' tool in ArcToolbox, which removes the non-agricultural polygons and retains the remaining agricultural areas for further analysis.

The steps are given below:

21. Open **ArcToolbox > Analysis Tools > Overlay > Erase**.
22. Set: Input Features = Total upazila boundary, Erase Features = Non-agricultural layer, Output Feature Class = Agricultural land layer.



23. Click **OK** to execute. The resulting layer represents agricultural land.

Digitizing Soil Boundary

Within the agricultural land, soil boundaries from the soil and landform map were digitized using ArcGIS. The 'Editor Toolbar' was applied to trace and digitize each soil map unit. Each polygon was attributed with the corresponding soil unit code. This creates a spatial representation of different soil types within the agricultural land.

The steps are given below:

24. Add georeferenced soil and landform map.
25. Add the Agriculture Land Polygon shapefile which was created by Erase tool.
26. Start editing the agricultural land layer.
27. Use **Cut Polygons Tool** to divide each soil map unit boundary manually.

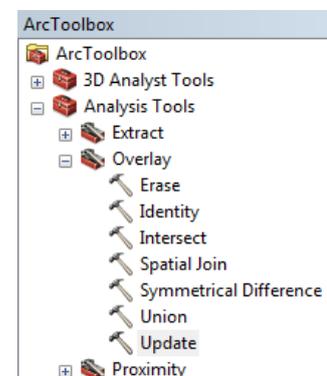


28. Assign the correct map unit code in the attribute table for each polygon.
29. Save and stop editing when complete.

Integration of Agricultural and Non-Agricultural Land Features

The digitized agricultural soil polygons were merged with the non-agricultural features using the 'Update' tool available in ArcToolbox. This creates a single unified feature class that accurately represents all land uses and soil units, which is essential for comprehensive zoning and analysis.

30. Open **ArcToolbox > Analysis Tools > Overlay > Update**.
31. Set: Input Features = Agricultural soil layer, Update Features = Non-agricultural layer, Output Feature Class = Merged land use layer.
32. Click OK to generate the integrated land use layer.

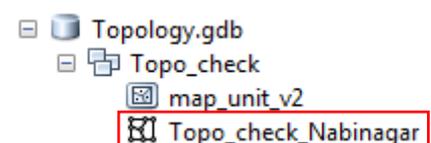


Topology check

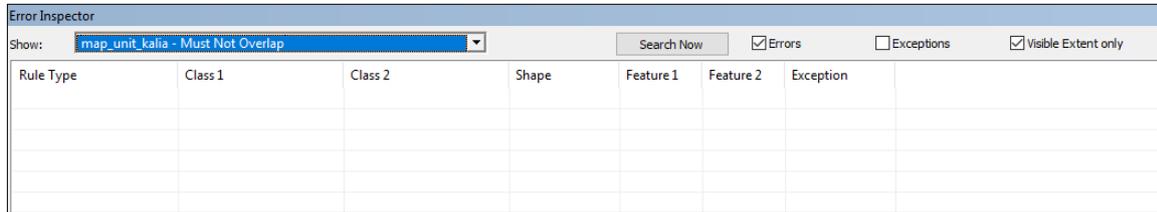
A topology check was conducted using ArcGIS's 'Topology Rules' in a geodatabase feature dataset. The two primary rules applied were: 'Must Not Overlap' and 'Must Not Have Gaps'. These rules were defined in a topology layer and validated using the 'Error Inspector' tool, which flags errors like overlapping or missing polygons. Corrections were applied using the topology editing tools to ensure data integrity.

The steps are given below:

33. Create a new Feature Dataset in a file geodatabase with the desired projection.
34. Import the integrated layer into this feature dataset.
35. Right-click on the **Feature dataset > New > Topology**.
36. Add the layer and set the rules: Must Not Overlap, Must Not Have Gaps.



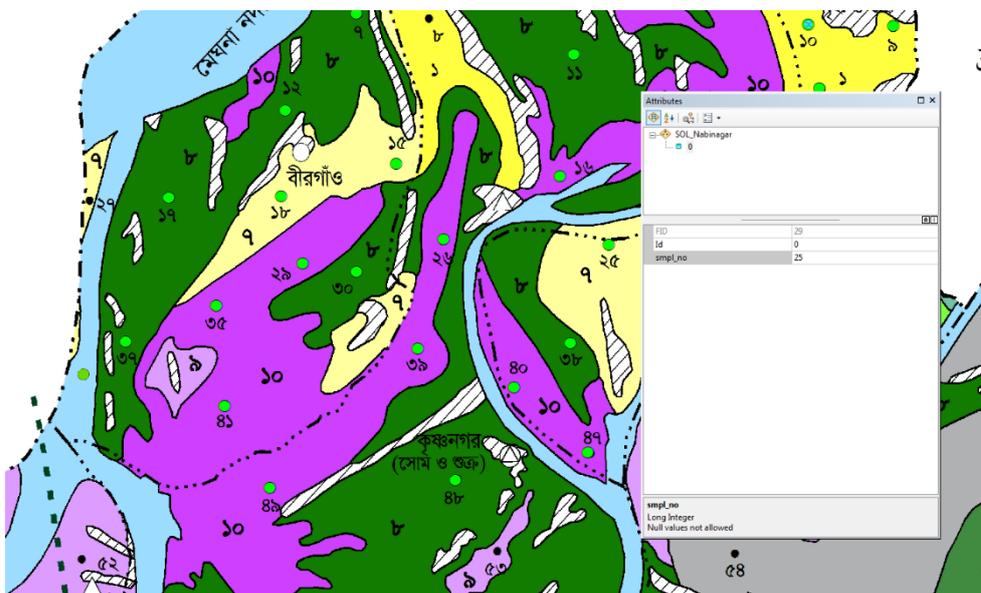
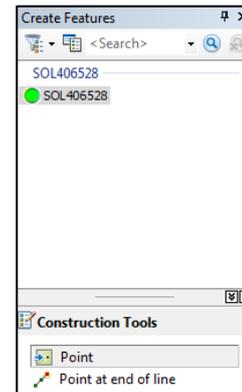
37. Finish topology setup.
38. Add the topology layer to the map.
39. Open Error Inspector (from Topology Toolbar) to detect errors.
40. Fix errors using the **Editor Tool**.



Extract the Location of Soil Sample Collection

Soil sample points were digitized using the 'Editor Toolbar' by interpreting the soil and landform map. Each point was manually placed at the appropriate location and given a sample number. Attributes were added via the attribute table to ensure unique identification and linkage with provided soil chemical data.

41. Load the soil and landform map and relevant base layers.
42. From Arc Catalog create a new **Point Shapefile**
43. Activate Editor Toolbar and start editing the soil sample point layer.
44. Manually place points at sample locations based on map interpretation.
45. Open the attribute table and add unique sample number
46. Save edits and stop editing.



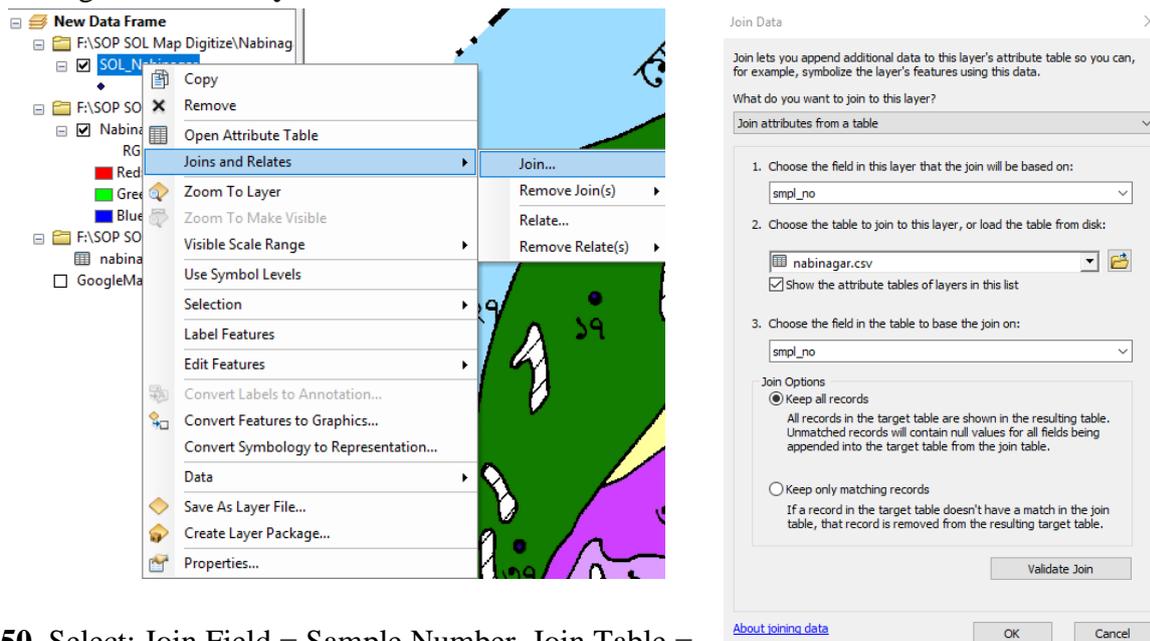
Soil Chemical data joining

Chemical test data provided by soil expert was joined with the digitized sample point layer using the 'Join' tool in ArcGIS. This join was based on a common field (e.g., sample No.). The joined attributes (e.g., pH, Nitrogen, Phosphorus) enabled spatial analysis of soil quality across upazila.

47. Add the excel or csv file of soil chemical data

48. Open the attribute table of the soil sample points layer.

49. Right-click the layer > Joins and Relates > Join



50. Select: Join Field = Sample Number, Join Table =

Excel or CSV file with chemical data, Join Field in Table = Matching Sample Number.

51. Click OK to join.

52. To make the join permanent, export the shapefile.

FID	Shape *	smpl_no	mu	land_type	soil_serie	soil_group	texture
0	Point	1	3	MLL	Ghior	714	Clay
1	Point	2	4	MLL	Ghior	714	Clay
2	Point	3	3	MHL	Ishurdi	907	Clay
3	Point	4	3	MLL	Ghior	714	Clay
4	Point	5	5	MLL	Ghior	714	Clay

ph	ec	ea	om	n	po	pb	k	s	zn	b	ca	mg	cu	fe	mn	upz_code
7.2	1.58	0	4.82	0.25	11.66	0	0.43	36.1	1.7	1.62	41.82	11.64	7.8	78.08	12.93	406528
7.2	1.27	0	3.21	0.17	19.4	0	0.42	13.2	1.69	1.78	37.17	7.74	3.24	35.94	11.81	406528
7.4	0.28	0	1.43	0.08	18.9	0	0.26	5.29	0.78	0.78	33.75	10.78	3.21	34.36	6.82	406528
7.6	1.75	0	4.13	0.22	10.14	0	0.48	32.3	0.05	1.66	39.9	14.43	3.22	9.11	3.11	406528
7.7	0.97	0	2.9	0.15	12.14	0	0.31	5.89	1.18	1.12	43.77	18.1	4.73	54.16	3.62	406528

DEM data processing

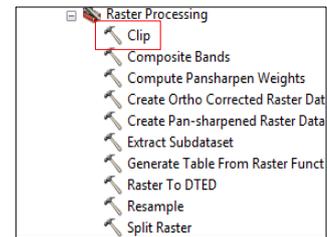
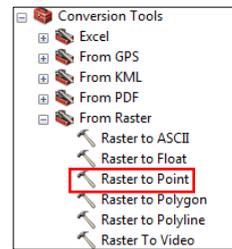
SRTM DEM data at 30m resolution was downloaded and resampled to 20m using the 'Resample' tool (Data Management Tools > Raster > Raster Processing > Resample). Each

upazila DEM was clipped using the 'Extract by Mask' tool, and then converted to point format using the 'Raster to Point' tool for further analysis. These elevation points help with terrain-based interpretation and suitability mapping.

53. Add the SRTM DEM (20m Resolution) raster file.

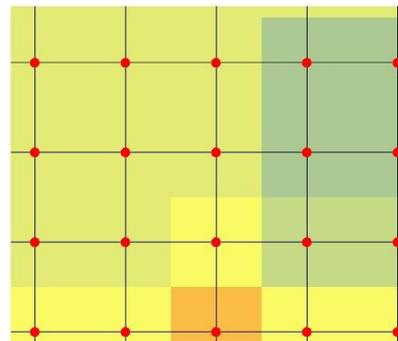
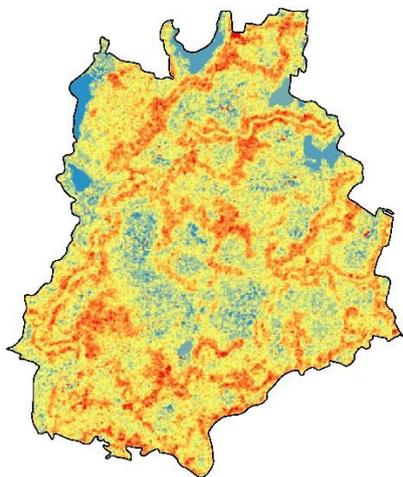
54. Add the Upazila boundary shpfile and Query the desired Upazila

55. Go to the **Arc Toolbox > Data management Tools > Raster > Raster Processing Clip**



56. Clip the DEM layer according to Upazila boundary extent

57. Use **Conversion Tools > From Raster > Raster to Point** to convert DEM to elevation points.



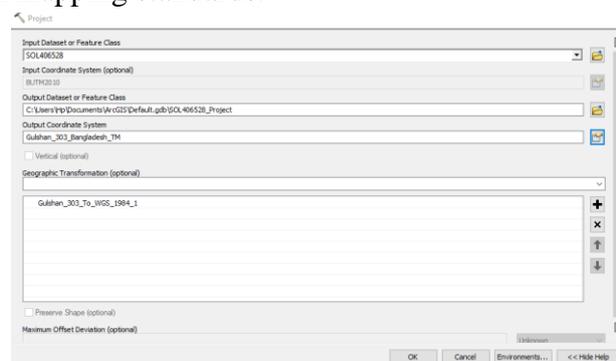
Projection Change

All shapefiles (SOP, SOL, and DEM points) were reprojected to the Bangladesh Transverse Mercator system (BTM, Gulshan 303) using the 'Project' tool. This ensures all datasets are spatially aligned and compatible with national mapping standards.

58. Open **ArcToolbox > Data Management Tools > Projections and Transformations > Project**.

59. Set: Input Dataset = Each shapefile (SOP, SOL, DEM Points), Output Coordinate System = BTM (Gulshan 303).

60. Run the tool separately for each shapefile.



Data upload and processing

The final shapefiles (SOP, SOL, and DEM points) were compressed into three separate ZIP archive. File naming followed the format protocol specified by the Crop Zoning Information System (CZIS). This ZIP file was uploaded to the CZIS web platform, which automatically processes and integrates the layers into the central spatial database for analysis and visualization.

61. Ensure the final shapefiles are: SOP (Soil Polygons), SOL (Soil Sample Points), DEM Points.
62. Go to: <http://cropzoning.gov.bd:82/preprocess>.
63. Log in using your credentials.
64. Select Division, District and Upazila
65. Select DEM to SRTM
66. Upload the respective ZIP files for automatic integration.
67. Make sure the naming convention: xxxxxx_SOP_, xxxxxx_SOL_, xxxxxx_SRTM_, where xxxxxx = 6-digit Upazila Code.
68. Click each button sequentially, from ‘Process Upazila Data’ to ‘Clear Map Cache Data’.

The screenshot displays the 'Suitability Analyst' web interface. The main form is titled 'Upazila Shape file & Suitability Assessment'. It includes dropdown menus for 'Division' (Dhaka), 'District' (Kishoreganj), and 'Upazila' (Pakundia). There are radio buttons for 'Using DEM: SRTM (selected) or National'. Below that are dropdowns for 'Season' and 'Crop' (set to 'All'). There is also a 'Crop Environment' dropdown. An 'Upload Shape Files' section contains a 'Choose file' button, the text 'No file chosen', and an 'Upload' button. A note states: '** All files must be in a compressed (.zip) file ** File name must start with "xxxxxx_SOP_" or "xxxxxx_SOL_" or "xxxxxx_SRTM_", here xxxxxx is 6 digit Upazila Code'. To the right of the form is a vertical column of buttons: 'Delete Upazila SOL Data (Sample Point)', 'Delete Upazila SOP Data (Soil Polygon)', 'Upload Upazila Data (SOL, SOP, SRTM shape file)', 'Process Upazila Data', 'Assess All Suitability', 'Assess Profitable Pattern', 'Assess Fertilizer Demand (Land Type)', 'Assess Fertilizer Demand (Crop)', 'Generate Upazila Separated Data', 'Publish Upazila Separated Maps', and 'Clear Map Cache Data'.

C. Development of Crop Zoning System and Khamari Mobile App

1. Introduction to the GIS application

What is GIS?

GIS stands for Geographic Information System

A framework for gathering, managing, and analyzing spatial and geographic data

Combines maps, data, and technology to solve real-world problems

What is a GIS Web Application?

A browser-based tool that allows users to access GIS functionalities online

Integrates maps, spatial data, and interactive tools

Enables real-time access to geographic information from any location

Core Features of a GIS Web Application

- Interactive Map Viewer (Zoom, Pan, Layers)
- Search and Filter Capabilities
- Layer Management (toggle visibility, custom styles)
- Attribute Data Display (popups, tables)
- Geo-spatial Querying and Analysis
- User Authentication (optional)

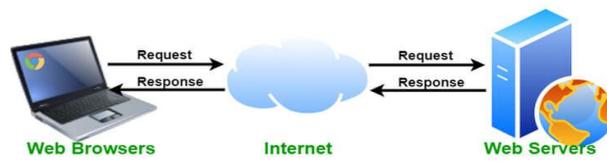
Common Technologies Used

- Frontend: HTML, CSS, JavaScript (React, Vue, or Angular)
- Mapping Libraries: Leaflet, OpenLayers, Mapbox, or ArcGIS JS API
- Backend: PHP, Node.js, Python, etc.
- Databases: PostGIS, Oracle Spatial
- Web Map Services: WMS, WFS, REST APIs

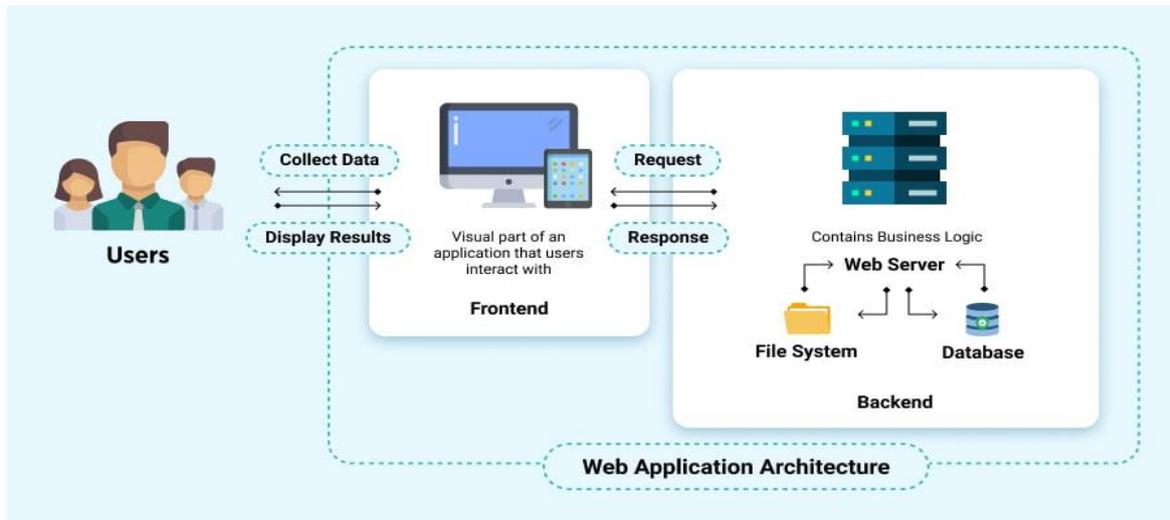
GIS Application Workflow

- Data Collection
- Data Input & Validation
- Visualization on Map
- Spatial Analysis
- Reporting and Decision Making

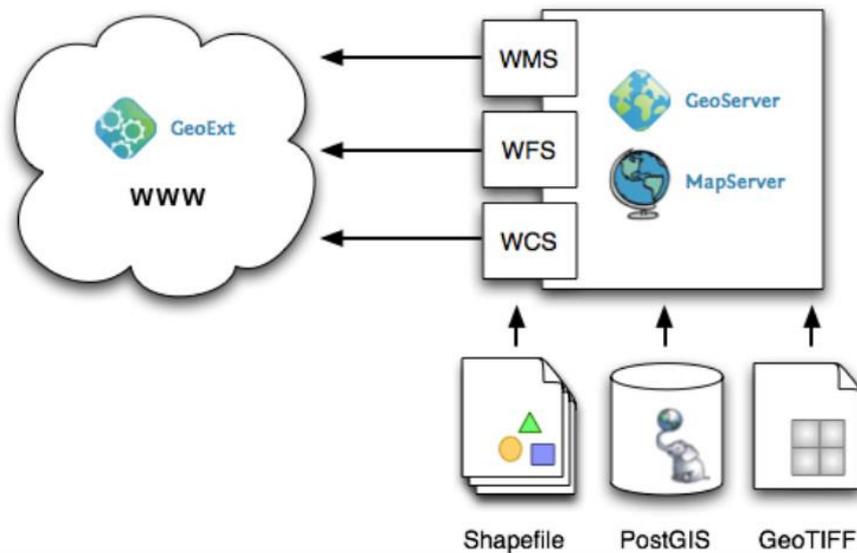




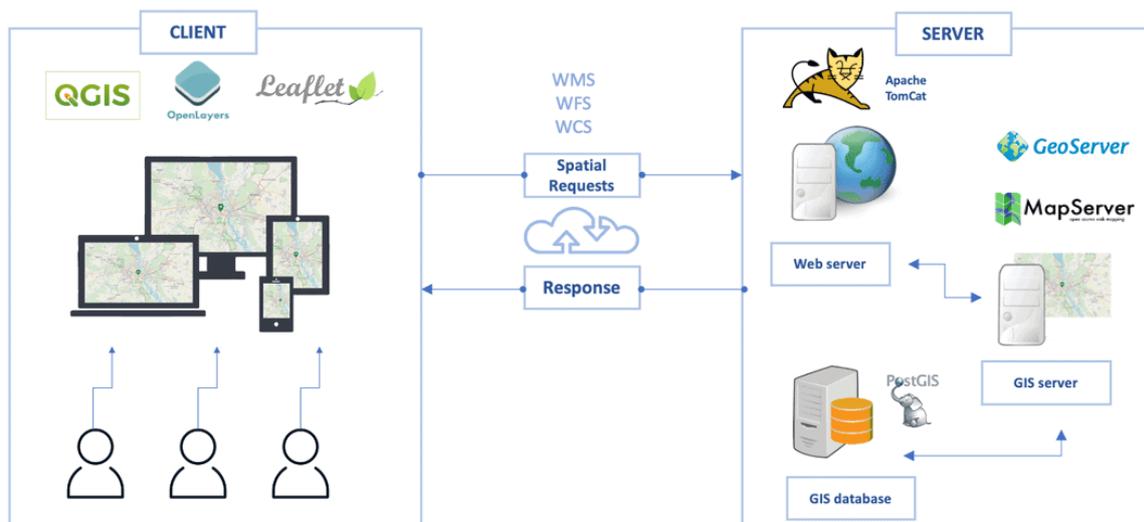
Basic Architecture of Web Application



Common Architecture of Web Application



Common Architecture of Web GIS Application



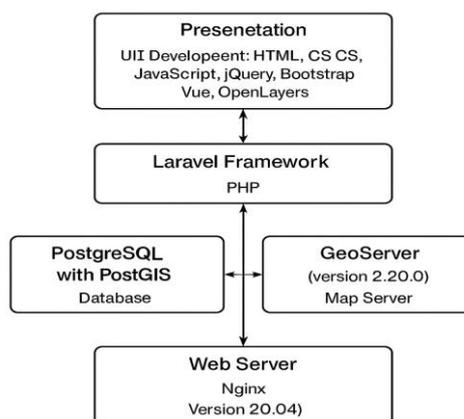
Common Architecture of Web GIS Application with Tech Stack

System Architecture of CZIS Application

Type: Web-based Client-Server Architecture

Pattern: MVC (Model-View-Controller) via Laravel

Deployment: Multi-Layered Monolithic



Layered Architecture

A. Presentation Layer (Client Side)

Technologies:

- Laravel Blade Templates (HTML, Blade)
- CSS, Bootstrap
- JavaScript, jQuery, Vue.js
- OpenLayers (for map rendering and interaction)

Functions:

- User interface rendering
- User input collection
- Map display and interaction (OpenLayers)
- AJAX calls to backend APIs
- Vue components (optional reactive UI)

B. Application Layer (Backend - Laravel Framework)

Technologies:

- PHP (Laravel 5.7)
- RESTful API endpoints
- Routing, Controllers, Services, Middleware

Functions:

- Handles HTTP requests (via controllers)
- Business logic (via services or directly in controllers)
- Communicates with PostgreSQL/PostGIS database
- Provides GeoJSON/map data to OpenLayers via APIs
- Handles authentication, sessions, and user roles

C. Data Layer (Database and GeoServer)

1. PostgreSQL with PostGIS

- Stores spatial and non-spatial data
- Executes spatial queries
- Used by Laravel via Eloquent/Query Builder and raw SQL

2. GeoServer (v2.20.0)

- Publishes spatial data (WMS/WFS/WCS services)
- Reads from PostgreSQL/PostGIS (via JDBC/GeoTools)
- Serves raster/vector layers to OpenLayers frontend

Server and Networking

A. Web Server: NGINX

- Handles HTTPS requests and serves Laravel app
- Reverse proxy to PHP-FPM for Laravel
- Serves static files (JS/CSS/images)
- Can proxy specific paths (e.g., /geoserver/) to GeoServer

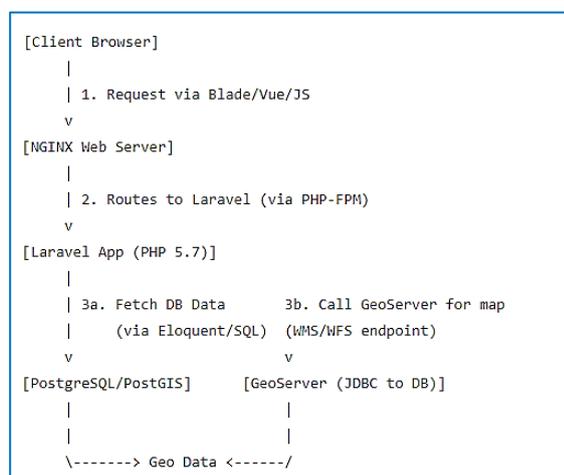
B. PHP-FPM

- Executes Laravel application
- Connects to PostgreSQL for data queries

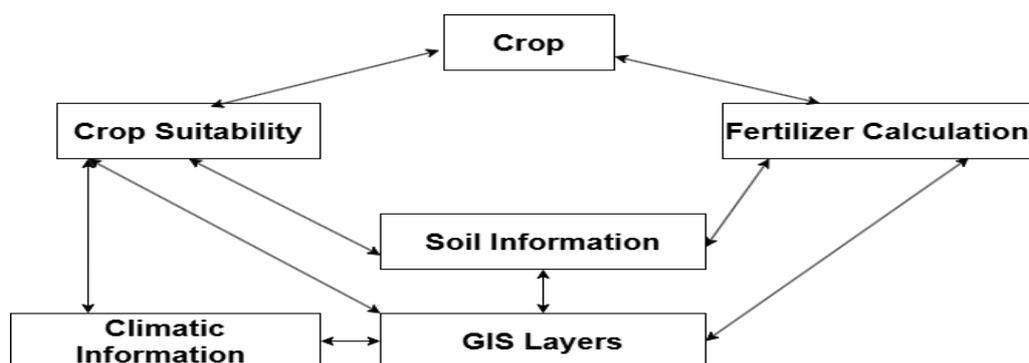
C. GeoServer (Separate VM)

- Accessed via subdomain or path (/geoserver)
- Interacts with database and serves map data

Data Workflow



Major Modules of CZIS



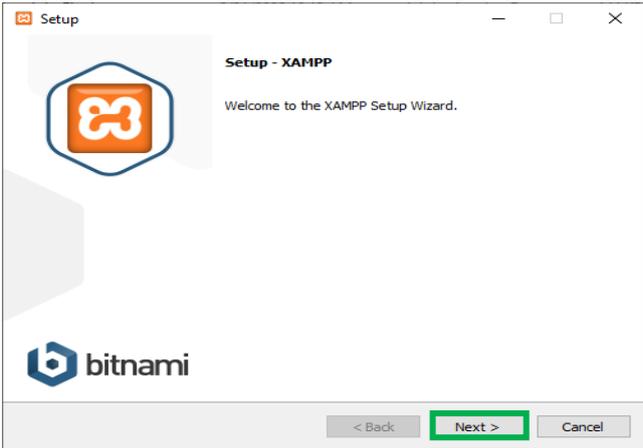
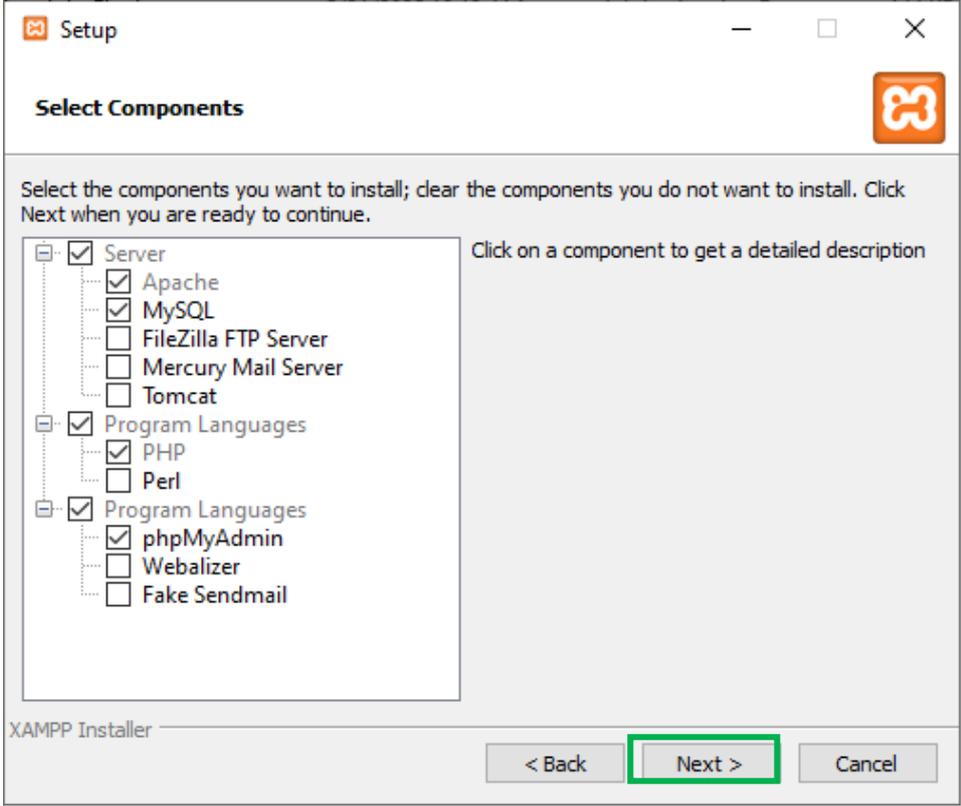
Technology Stacks of CZIS

Technology	CZIS Web Application	Agri Web portal	Khamari Mobile App (Android)	Khamari Mobile App (iOS)
Database	PostgreSQL (version 11.10) with PostGIS extension	PostgreSQL (version 11.10)	PostgreSQL (version 11.10)	PostgreSQL (version 11.10)
Programming Language	PHP with Laravel Framework (version 5.7)	PHP with Laravel Framework (version 5.7)	PHP with Laravel Framework (version 5.7) for API service, Java for Android native languages	PHP with Laravel Framework (version 5.7) for API service, JavaScript for react native
UI Development	Laravel blade template with HTML, CSS, JavaScript, jQuery, Bootstrap, Vue, Openlayer	Laravel blade template with HTML, CSS, JavaScript, jQuery, Bootstrap	Android Native	React (version 17.0.1), React Native (0.64.3)
Map Server	GeoServer (version 2.20.0)	-	GeoServer (version 2.20.0)	GeoServer (version 2.20.0)
Web Server	Nginx	Nginx	Nginx	Nginx
Server OS	Ubuntu (version 20.04)	Ubuntu (version 20.04)	Ubuntu (version 20.04)	Ubuntu (version 20.04)
Development Tool	Visual Studio (version 1.63.2), pgAdmin (version 6.5)	Visual Studio (version 1.63.2), pgAdmin (version 6.5)	Visual Studio (version 1.63.2), pgAdmin (version 6.5), Android Studio (version 2021.2.1)	Visual Studio (version 1.63.2), pgAdmin (version 6.5)

2. Development Tools and Environment Setup

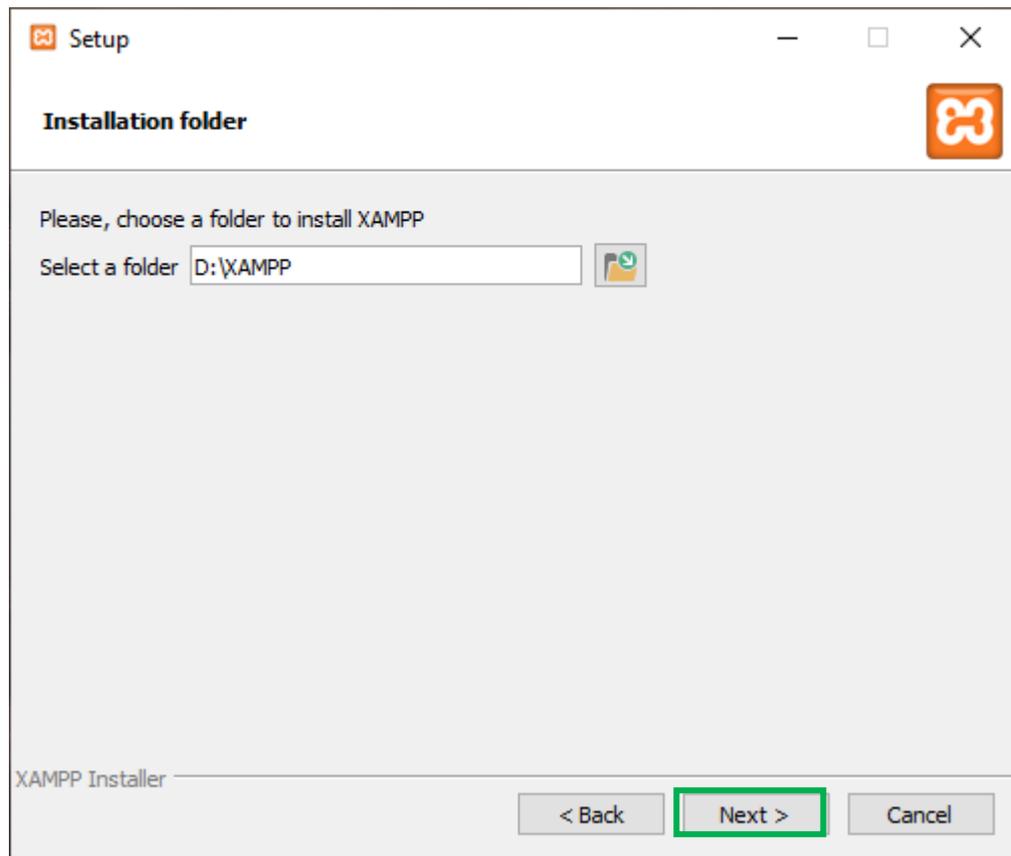
Installation of software required for crop zoning system development

How to install: 1_xampp-windows-x64-7.4.28-0-VC15-installer

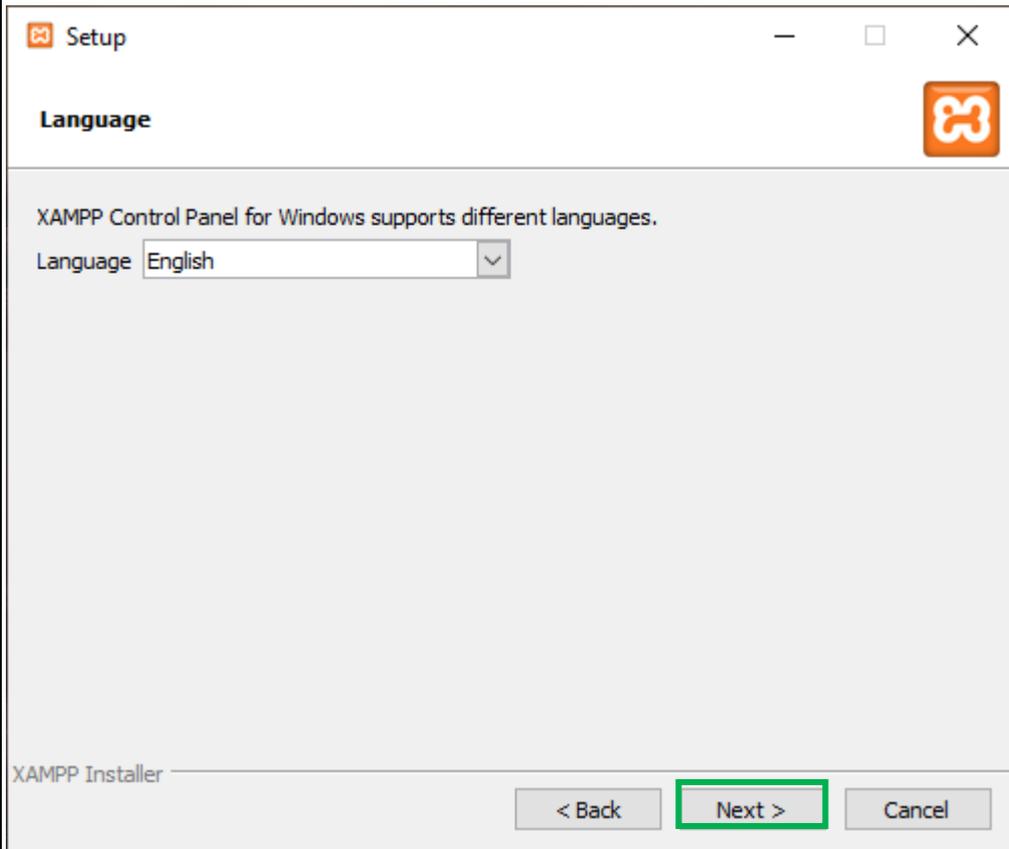
Step 1:	Click on the software link
Step 2:	Click Next > 
Step 3:	Put Tick mark in Apache, MySQL, PHP, phpMyAdmin Click Next > 

Step 4:

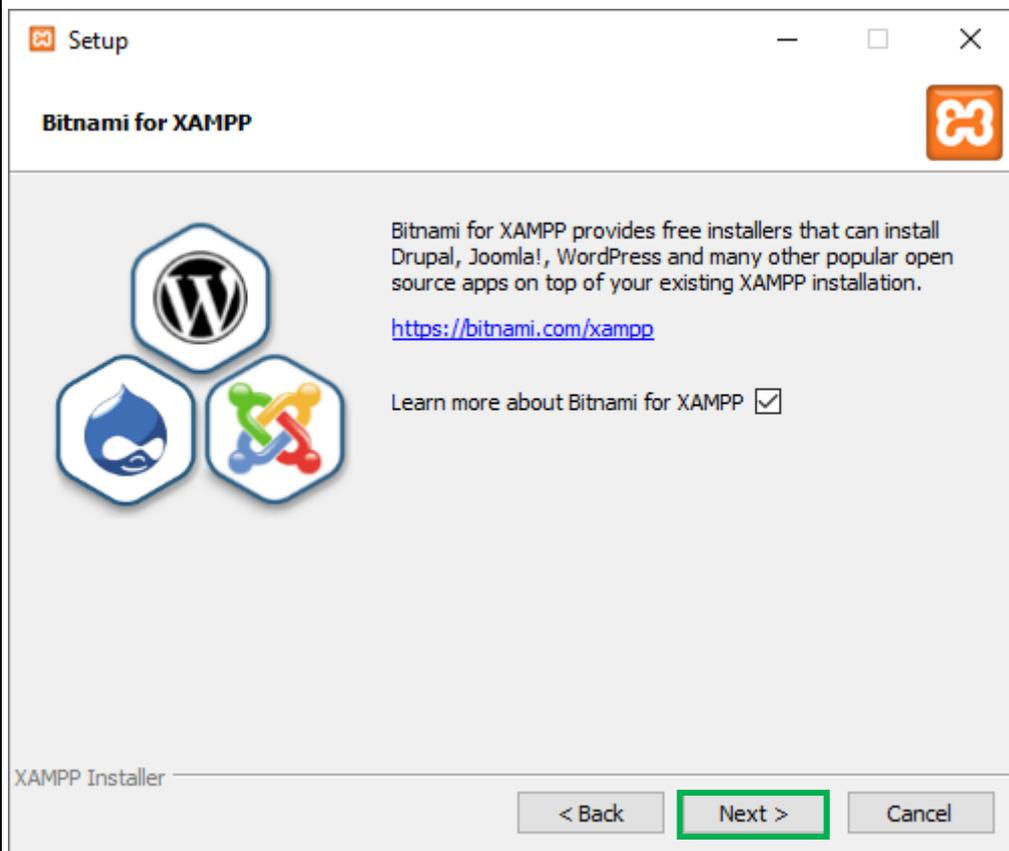
Select a folder (except C drive) and name the folder



Step 6: Language 'English' and click Next >



Step 7: Click Next > and wait for some moment and click Finish



Step 8:

Click on Apache Start button

XAMPP Control Panel v3.3.0 [Compiled: Apr 6th 2021]

Service	Module	PID(s)	Port(s)	Actions
<input type="checkbox"/>	Apache			Start Admin Config Logs
<input type="checkbox"/>	MySQL			Start Admin Config Logs
<input type="checkbox"/>	FileZilla			Start Admin Config Logs
<input type="checkbox"/>	Mercury			Start Admin Config Logs
<input type="checkbox"/>	Tomcat			Start Admin Config Logs

12:00:58 PM [main] Initializing Control Panel
12:00:58 PM [main] Windows Version: Enterprise 64-bit
12:00:58 PM [main] XAMPP Version: 7.4.28
12:00:58 PM [main] Control Panel Version: 3.3.0 [Compiled: Apr 6th 2021]
12:00:58 PM [main] You are not running with administrator rights! This will work for most application stuff but whenever you do something with services there will be a security dialogue or things will break! So think about running this application with administrator rights!
12:00:58 PM [main] XAMPP Installation Directory: "d:\xampp\
12:00:58 PM [main] Checking for prerequisites
12:01:39 PM [main] All prerequisites found
12:01:39 PM [main] Initializing Modules
12:01:39 PM [main] The FileZilla module is disabled
12:01:39 PM [main] The Mercury module is disabled
12:01:39 PM [main] The Tomcat module is disabled
12:01:39 PM [main] Starting Check-Timer
12:01:39 PM [main] Control Panel Ready

Step 9:

XAMPP Control Panel v3.3.0 [Compiled: Apr 6th 2021]

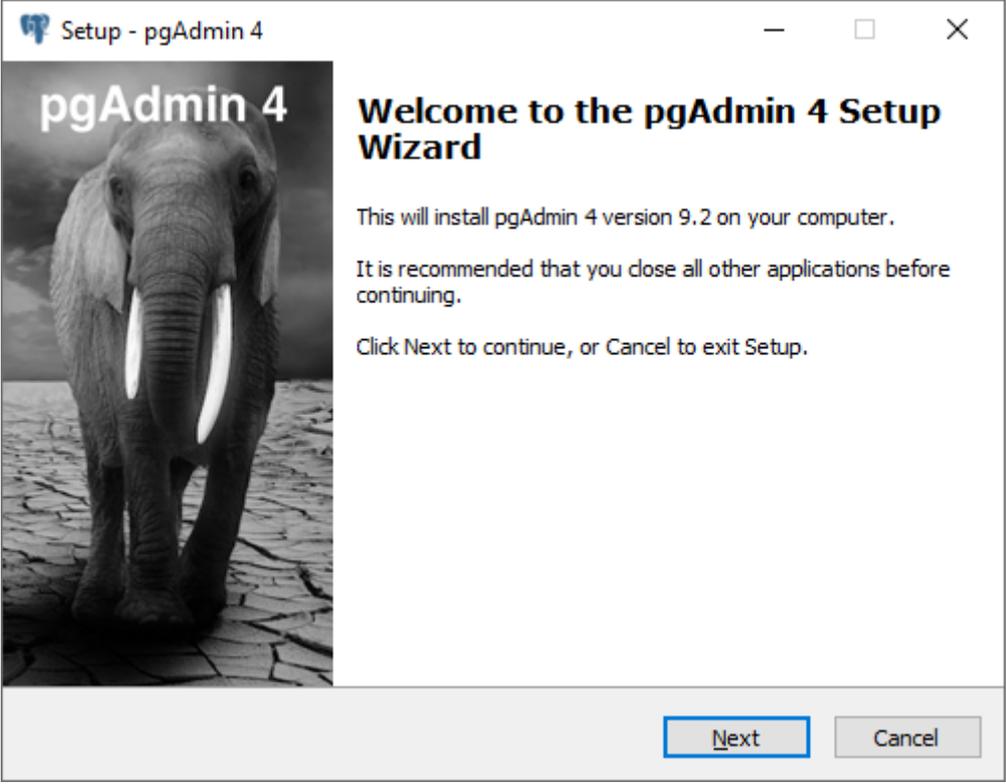
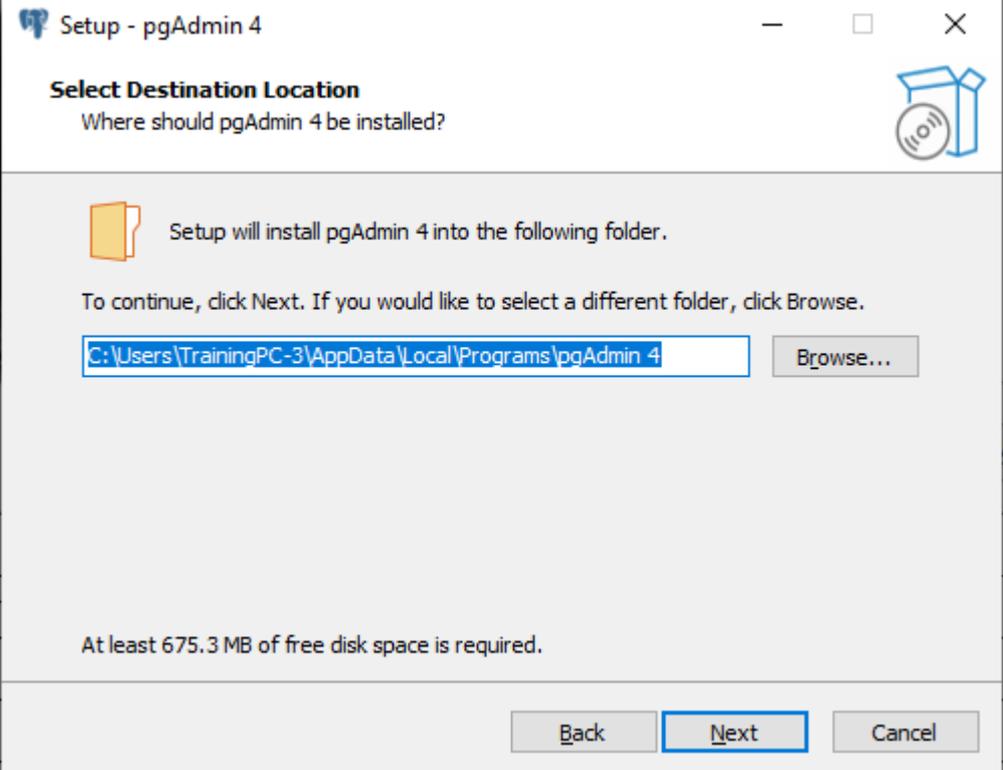
Service	Module	PID(s)	Port(s)	Actions
<input type="checkbox"/>	Apache	1864 1956	80, 443	Stop Admin Config Logs
<input type="checkbox"/>	MySQL			Start Admin Config Logs
<input type="checkbox"/>	FileZilla			Start Admin Config Logs
<input type="checkbox"/>	Mercury			Start Admin Config Logs
<input type="checkbox"/>	Tomcat			Start Admin Config Logs

12:01:39 PM [main] Initializing Modules
12:01:39 PM [main] The FileZilla module is disabled
12:01:39 PM [main] The Mercury module is disabled
12:01:39 PM [main] The Tomcat module is disabled
12:01:39 PM [main] Starting Check-Timer
12:01:39 PM [main] Control Panel Ready
12:06:30 PM [Apache] Attempting to start Apache app...
12:06:30 PM [Apache] Status change detected: running

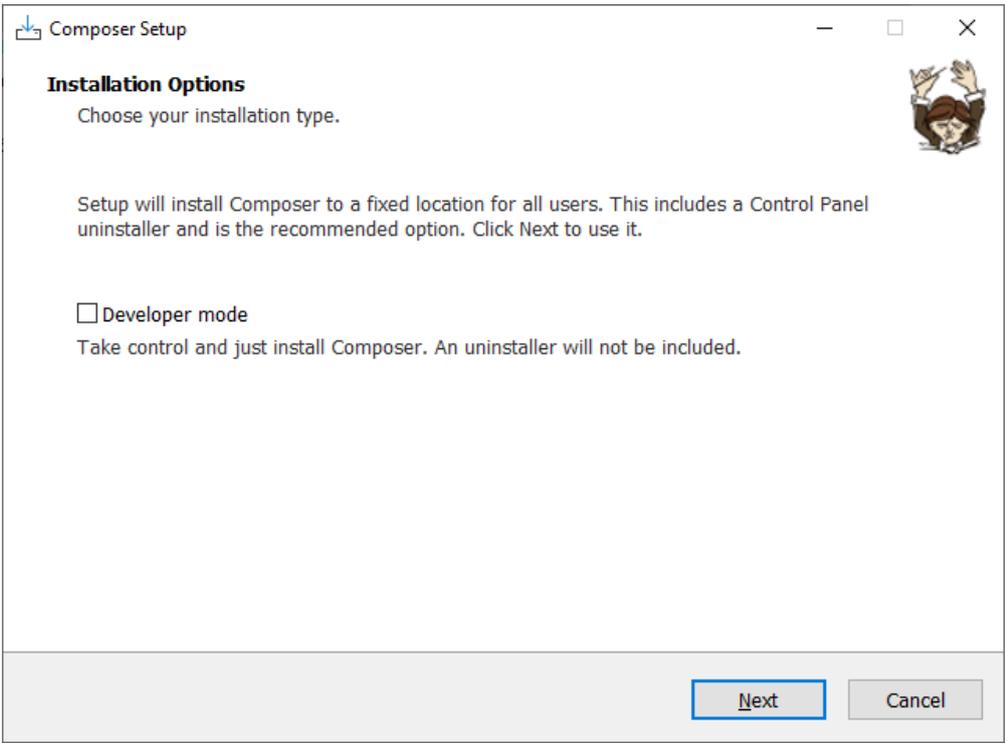
Step 10:

Apache need to be running in backend to work further

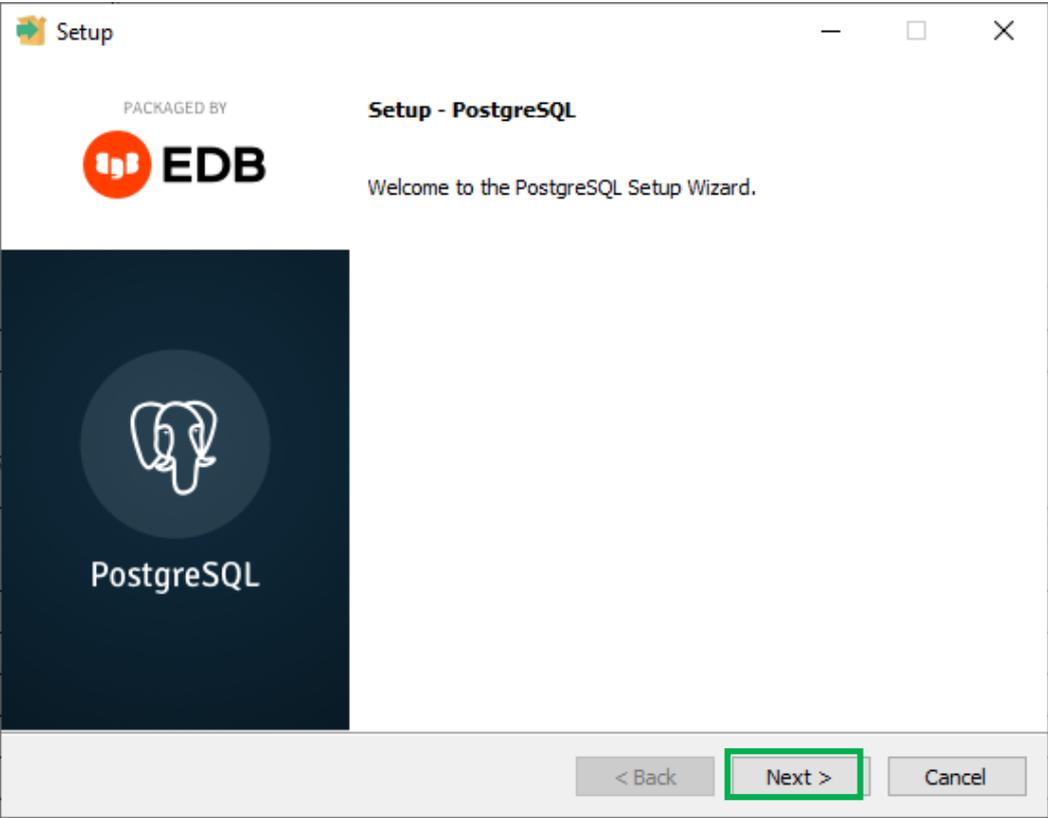
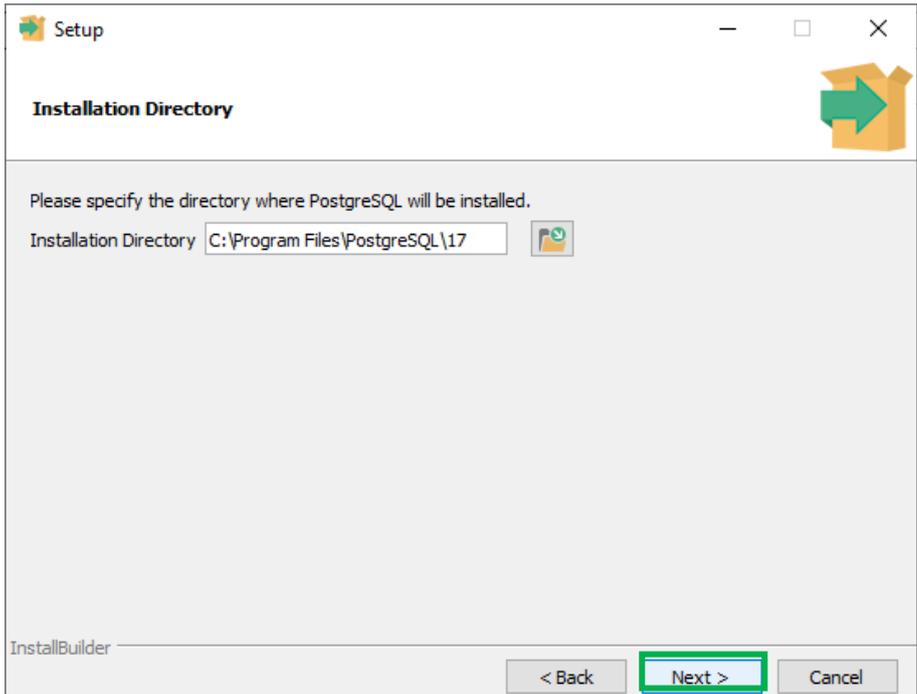
How to install: 2_pgadmin4-9.2-x64

Step 1:	Click on the software link, select for me only and then click Next > 
Step 2:	Select 'I accept to the agreement' and click Next >
	
Step 3:	Click Next then Install

How to install: 3_Composer-Setup

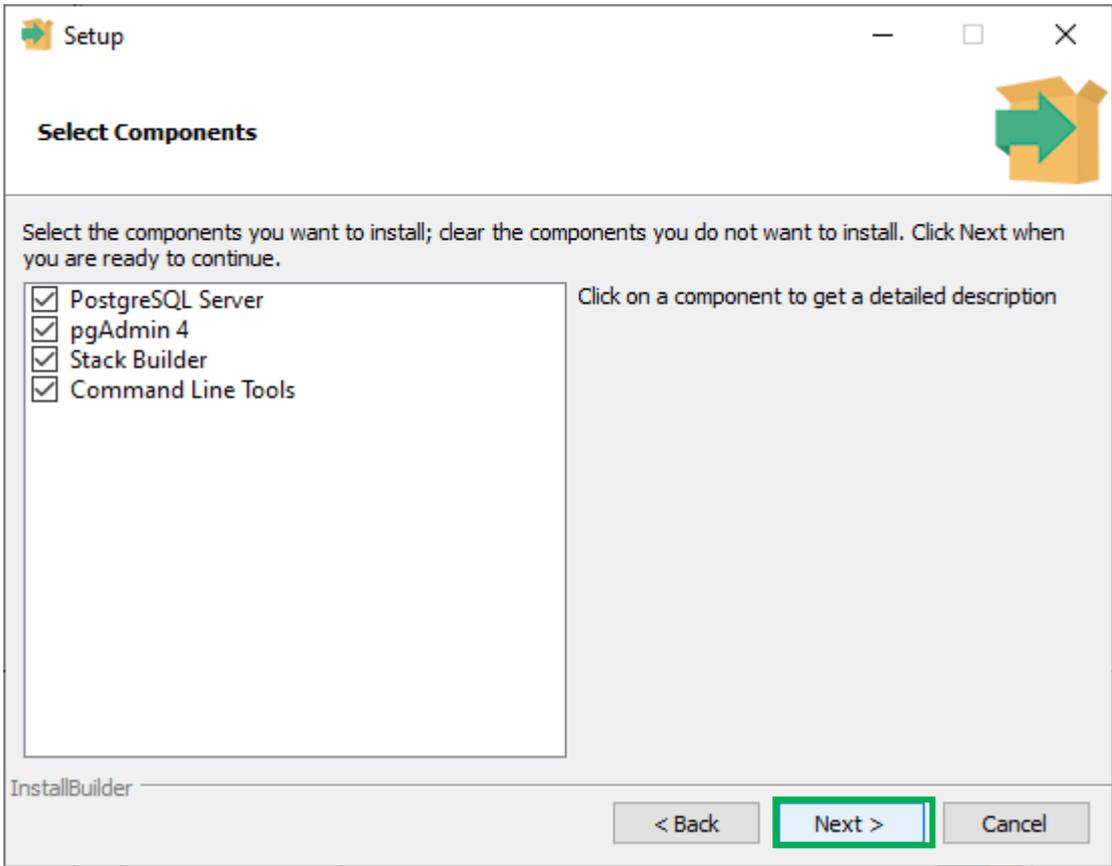
Step 1:	<p data-bbox="384 255 1053 291">Click on the software link and select for installation</p>  <p>The screenshot shows a window titled "Composer Setup" with a standard Windows window control bar (minimize, maximize, close). The window content includes:</p> <ul style="list-style-type: none">Installation OptionsText: "Choose your installation type."Text: "Setup will install Composer to a fixed location for all users. This includes a Control Panel uninstaller and is the recommended option. Click Next to use it."A checkbox labeled "Developer mode" which is currently unchecked.Text below the checkbox: "Take control and just install Composer. An uninstaller will not be included."At the bottom right, there are two buttons: "Next" (highlighted with a blue border) and "Cancel".
Step 2:	Select php browser and install and finish

How to install: 4_(optional)_postgresql-17.5-1-windows-x64

<p>Step 1:</p>	<p>Click on the software link and select for installation</p> <p>Click Next></p> 
<p>Step 2:</p>	<p>Select installation directory and Click Next></p> 

Step 3:

Select component and Click Next>

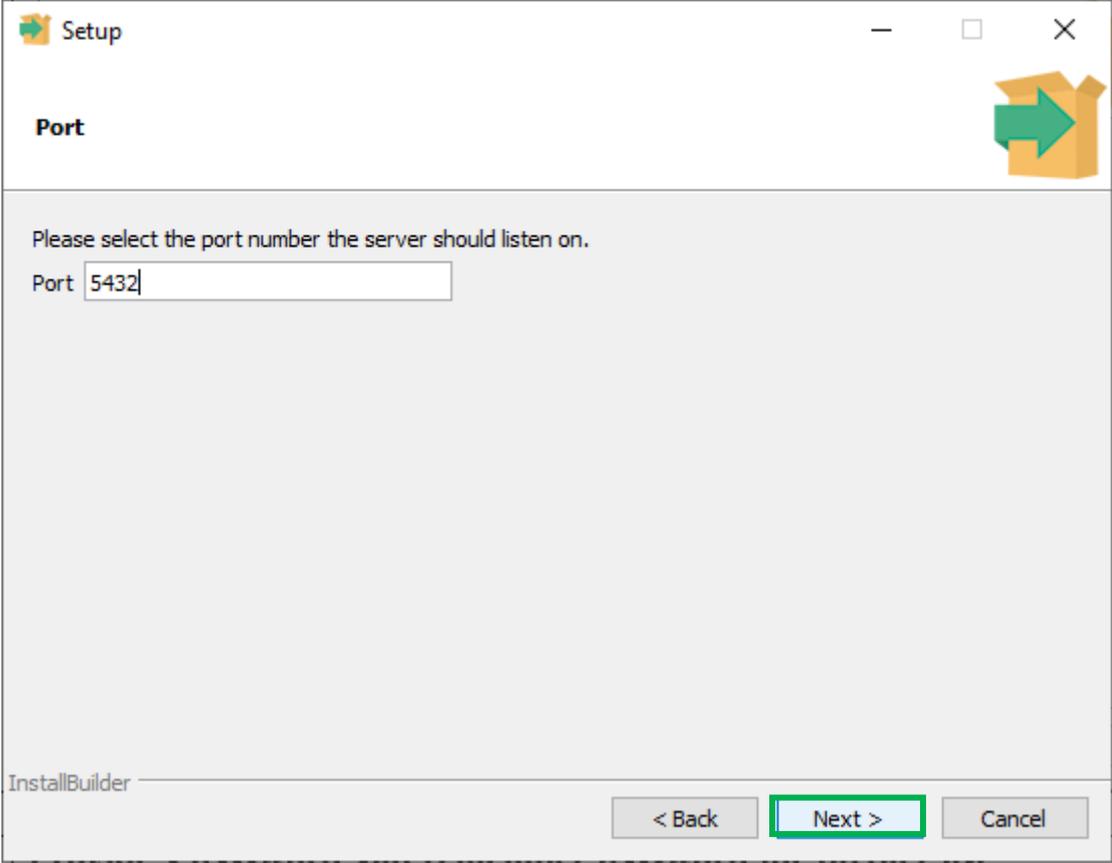


Step 4:

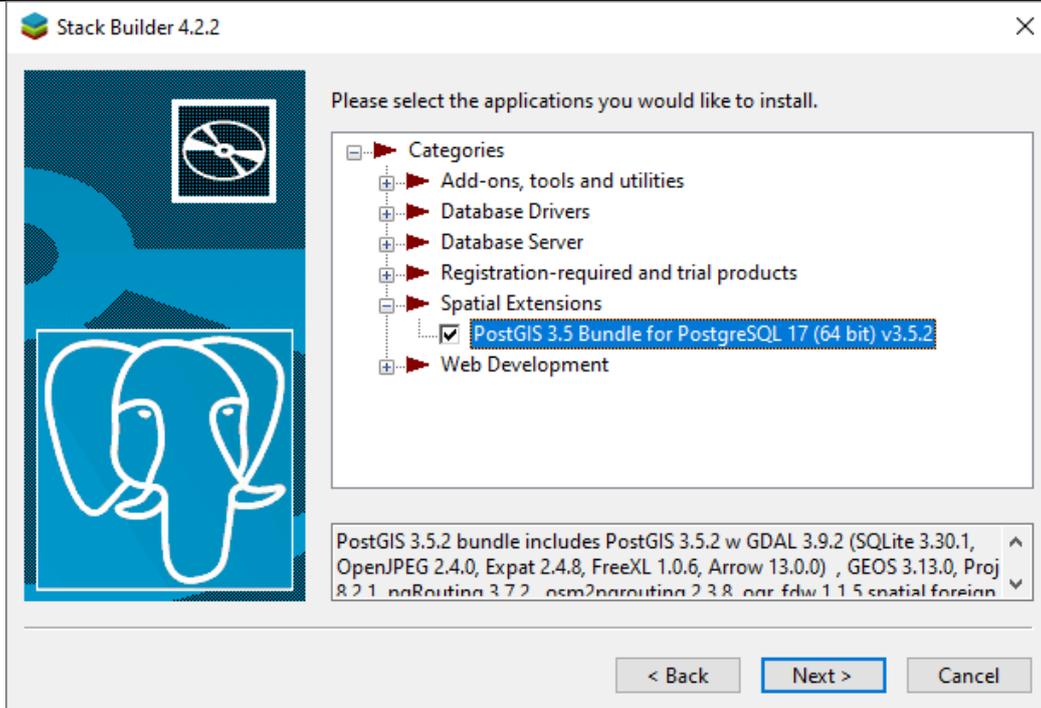
Select data directory and Click Next>

Step 5:

Provide a password and remember password for further use

Step 6:	<p>Select the port number and remember the port number the server should listen on</p>  <p>Click Next></p>
Step 7:	Select the locale to be used by the new database duster and Click Next>
Step 8:	Click Next> and Finish
Step 9:	Install Stack builder 4.2.2
Step 10:	Select applications- Spatial Extensions- PostGIS

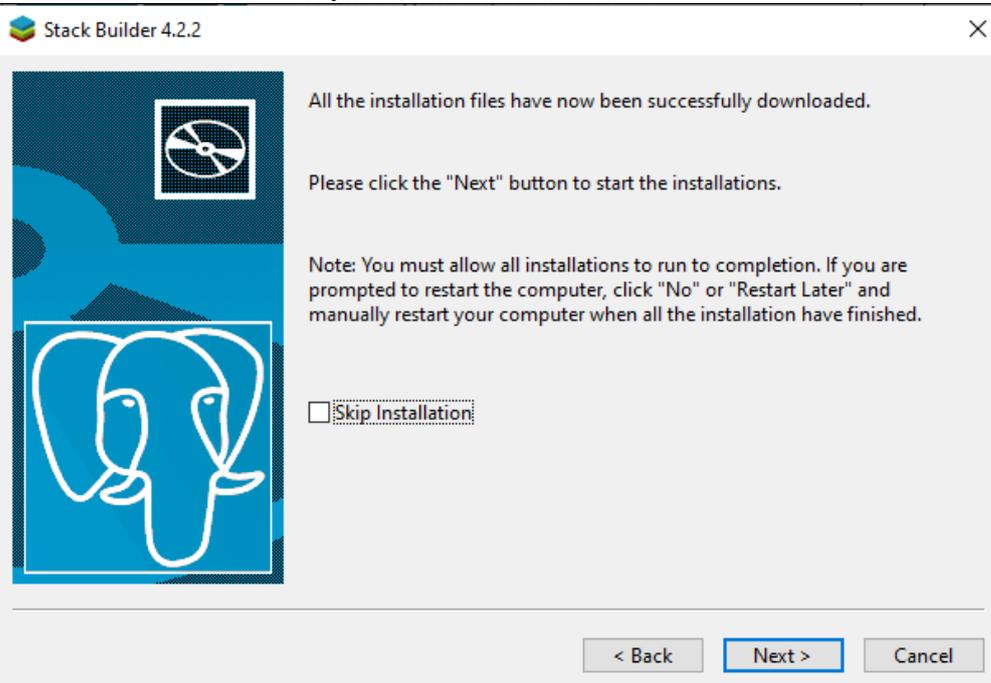
Step 11:



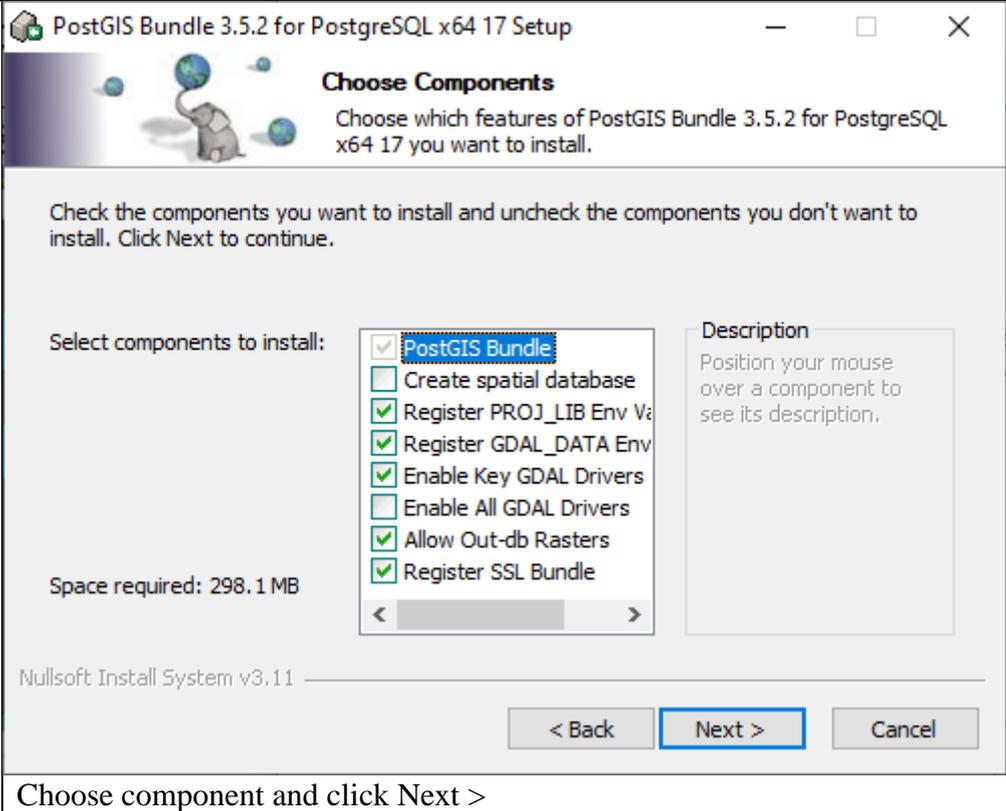
Click Next>

Step 12: Select download directory and Click Next>

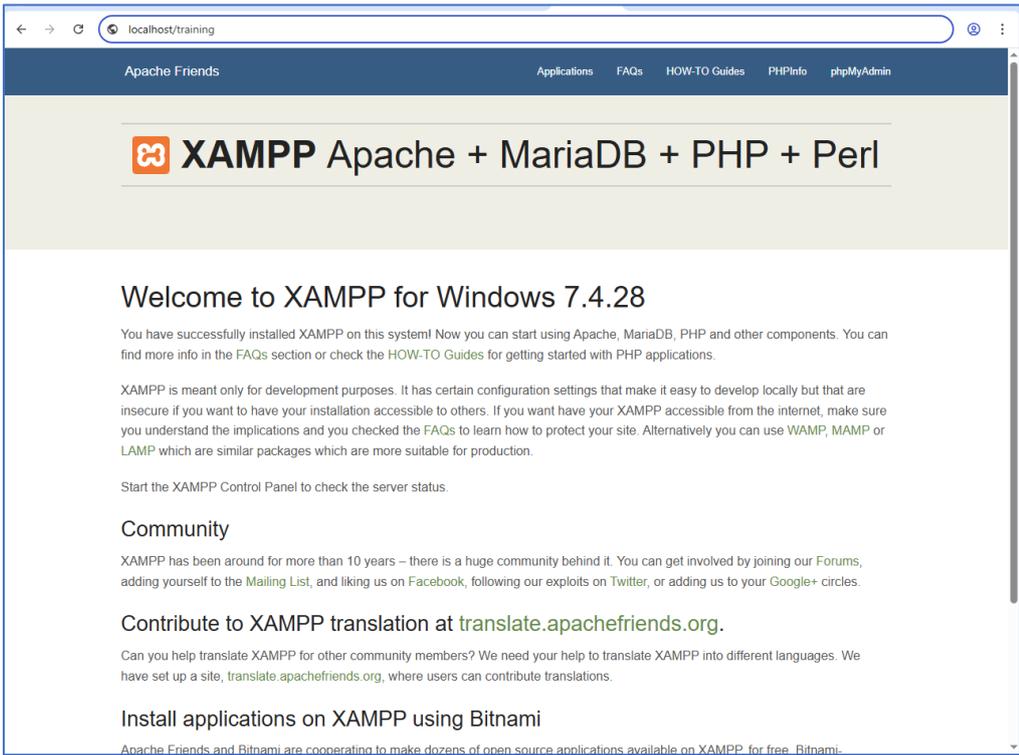
Step 13:



Click Next>

<p>Step 14:</p>	 <p>PostGIS Bundle 3.5.2 for PostgreSQL x64 17 Setup</p> <h3>Choose Components</h3> <p>Choose which features of PostGIS Bundle 3.5.2 for PostgreSQL x64 17 you want to install.</p> <p>Check the components you want to install and uncheck the components you don't want to install. Click Next to continue.</p> <p>Select components to install:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> PostGIS Bundle <input type="checkbox"/> Create spatial database <input checked="" type="checkbox"/> Register PROJ_LIB Env Va <input checked="" type="checkbox"/> Register GDAL_DATA Env <input checked="" type="checkbox"/> Enable Key GDAL Drivers <input type="checkbox"/> Enable All GDAL Drivers <input checked="" type="checkbox"/> Allow Out-db Rasters <input checked="" type="checkbox"/> Register SSL Bundle <p>Space required: 298.1 MB</p> <p>Nullsoft Install System v3.11</p> <p>< Back Next > Cancel</p> <p>Description Position your mouse over a component to see its description.</p>
	<p>Choose component and click Next ></p>
<p>Step 15:</p>	<p>Choose install location and click Next ></p>
<p>Step 16:</p>	<p>Click close and click finish.</p>

3. Application of Development Tools

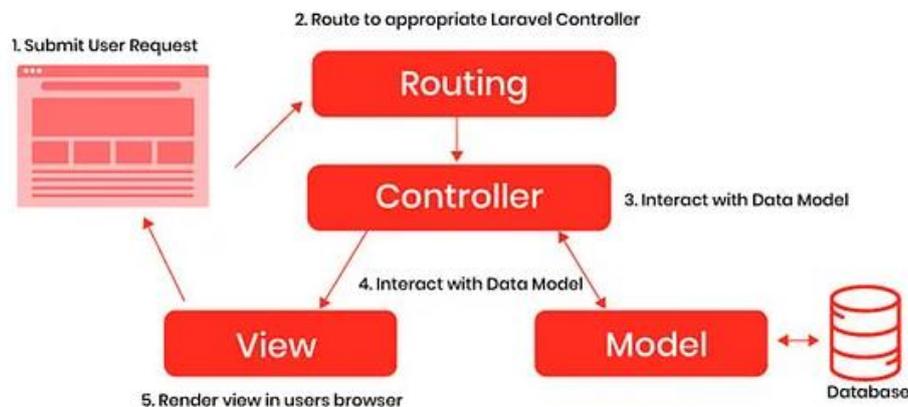
Step 1:	Open XAMPP software and start Apache
Step 2:	Open folder of XAMPP from downloaded directory
Step 3:	Open htdocs folder and create a folder (for example: Training)
Step 4:	Create a index.php file and open with Visual Studio Code
Step 5:	Search 'localhost'; in browser
Step 6:	Type localhost/training (file name)
	
Step 7:	Output will be displayed according to input in VSCode file.
Step 8:	

4. Laravel Overview

What is Laravel

Laravel is a free, open-source [PHP-based](#) web framework for building web applications. It's designed to simplify the development process, offering features like a clean syntax, dependency injection, database abstraction, and more. Laravel is particularly known for its elegant syntax and its focus on providing a great developer experience.

- ✓ A PHP web application framework.
- ✓ Follows the MVC (Model-View-Controller) architectural pattern.
- ✓ Designed for elegant syntax and developer productivity.



- Routing System: Clean and expressive URL routing.
- Eloquent ORM: Powerful and intuitive Object Relational Model.
- Blade Templating Engine: Simple and reusable templates with control structures.
- Artisan CLI: Built-in command-line tool for automation.
- Security: CSRF protection, hashing, and authentication mechanisms.
- Database Migrations & Seeders: Version-controlled DB schema management.
- Queues & Jobs: Background processing using queues.
- Testing Support: Integrated testing tools for unit and feature tests.

Laravel 8.x folder architecture

├─ app/		├─ resources/	
│ └─ Console/	→ Artisan commands	│ └─ js/	→ Frontend JS (often for Vue/React)
│ └─ Exceptions/	→ Exception handling	│ └─ lang/	→ Language files for localization
│ └─ Http/		│ └─ sass/	→ Styles (SCSS/CSS)
│ │ └─ Controllers/	→ Controller classes	│ └─ views/	→ Blade templates
│ │ └─ Middleware/	→ Middleware classes		
│ │ └─ Kernel.php	→ HTTP kernel config	├─ routes/	
│ └─ Models/	→ Eloquent models (can also be directly in `app/`)	│ └─ api.php	→ API routes
│ └─ Providers/	→ App service providers	│ └─ web.php	→ Web routes
│ └─ ...	→ Other custom app logic	│ └─ console.php	→ Artisan command route bindings
		│ └─ channels.php	→ Broadcast channel routes
├─ bootstrap/			
│ └─ app.php	→ Bootstraps the Laravel framework	├─ storage/	
		│ └─ app/	→ User and app file uploads
├─ config/	→ Configuration files (app, database, cache, etc.)	│ └─ framework/	→ Cache, sessions, views compiled
		│ └─ logs/	→ Application log files
├─ database/			
│ └─ factories/	→ Model factories for testing/seeding	├─ tests/	→ Unit and feature tests
│ └─ migrations/	→ DB migration files		
│ └─ seeders/	→ DB seeder files	├─ vendor/	→ Composer dependencies (auto-generated)
├─ public/	→ Entry point for web (index.php, assets like images, JS, CSS)	├─ .env	→ Environment configuration file
		├─ artisan	→ Command line interface
		├─ composer.json	→ Composer dependencies and autoload config
		└─ package.json	→ Node dependencies (if using frontend tooling)

Starting a Laravel Application

Run this command to create a Laravel project (example uses Laravel 8):

```
composer create-project --prefer-dist laravel/laravel:^8.0 myLaravelApp
```

Run the Laravel Development Server:

```
php artisan serve
```

Configure the .env file in your project folder:

```
CONNECTION=postgres
HOST=localhost
DB_PORT=3306
DB_DATABASE=my_laravel_db
DB_USERNAME=root
DB_PASSWORD=
```

Create Model:

```
php artisan make:model Employee
```

Create Controller:

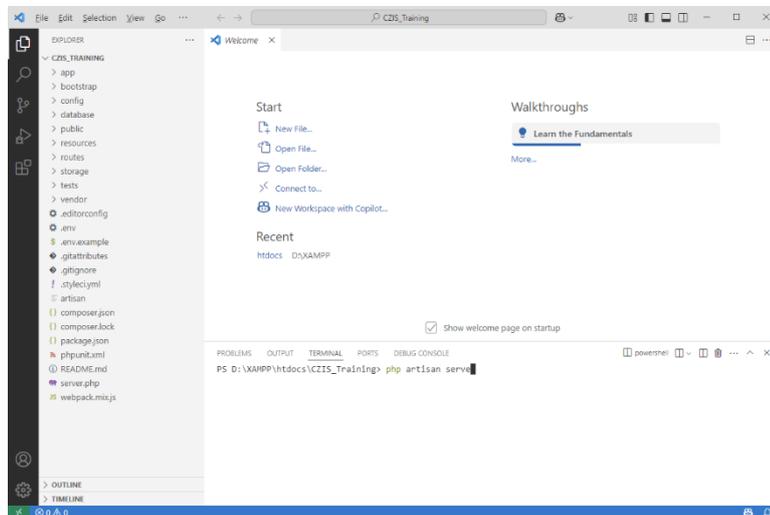
```
php artisan make:controller EmployeeController
```

Define Route

```
In routes/web.php:
```

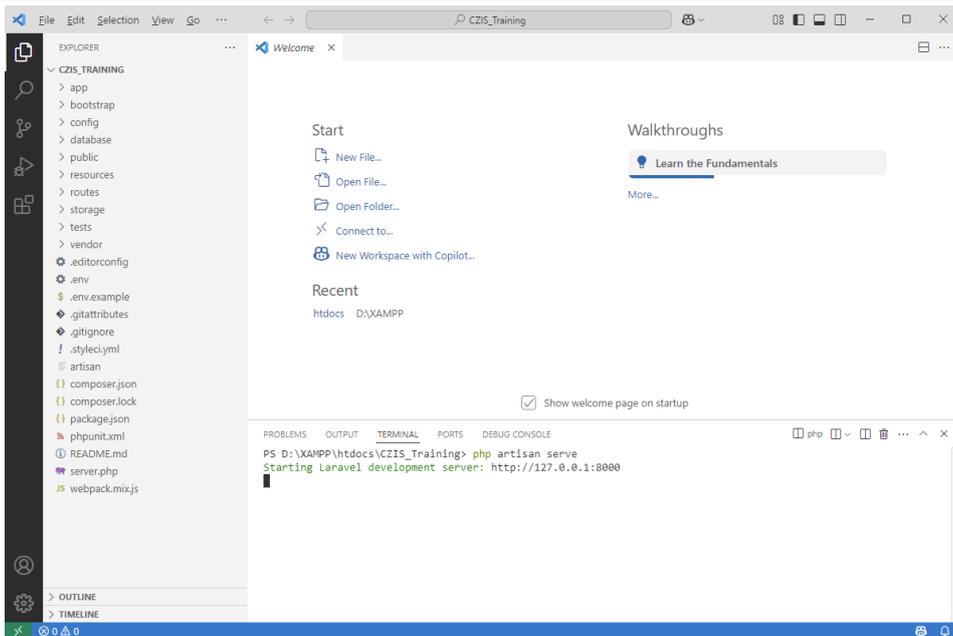
```
use App\Http\Controllers\EmployeeController;
Route::get('/employees',[EmployeeController::class,
'index'])>name('employees.index');
```

Step 1: Open Visual Studio Code



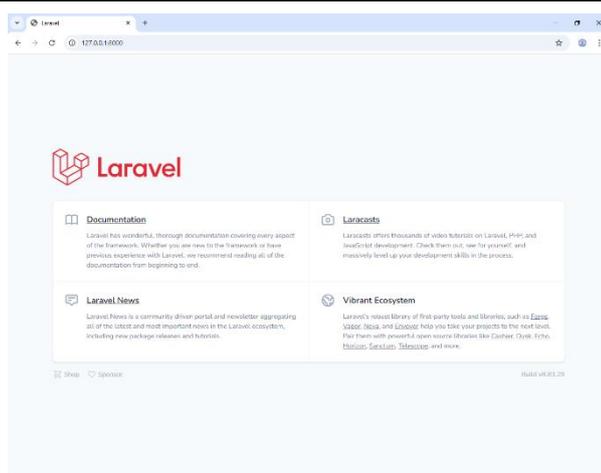
Click enter

Step 2:



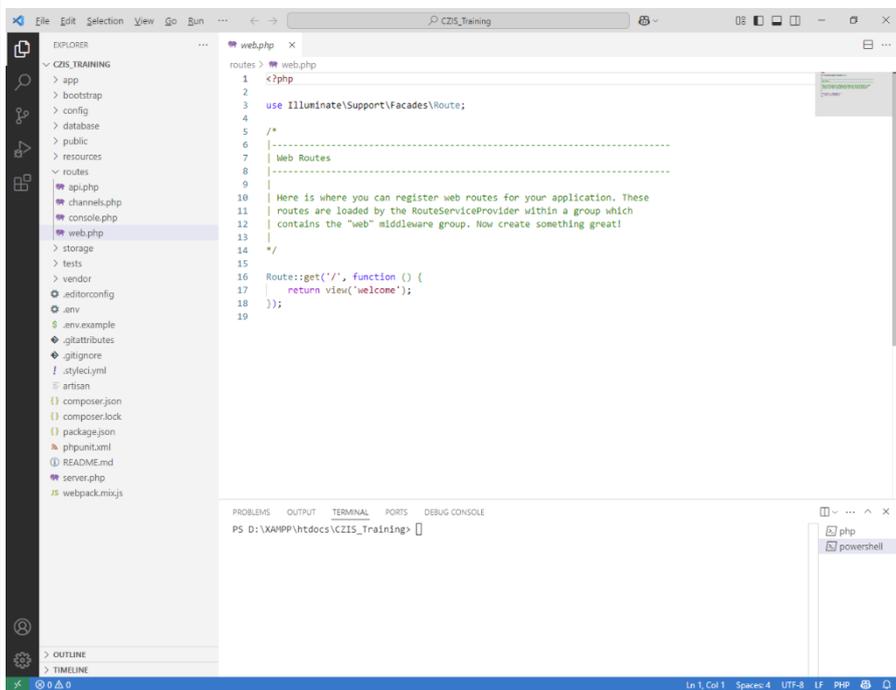
Copy the link: <http://127.0.0.1:8000/> and paste in browser

Step 3:



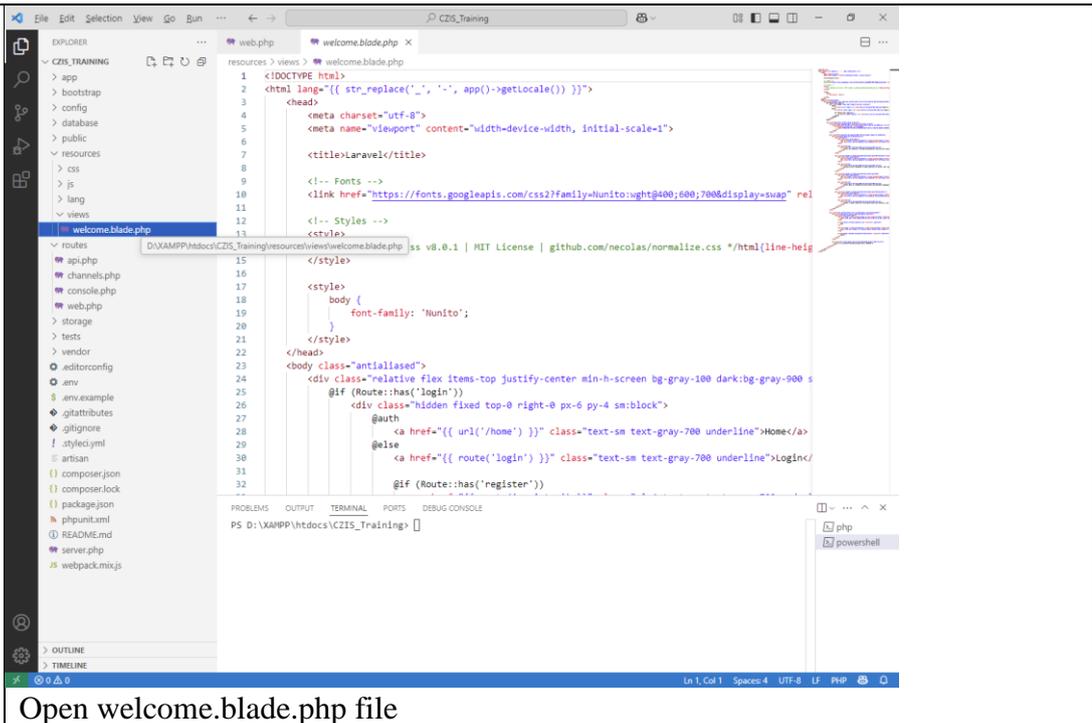
Open Lavarel

Step 4:



In vs code, open web.php file

Step 5:



Open welcome.blade.php file

5. PostgreSQL (PostGIS) Overview

Introduction to PostgreSQL

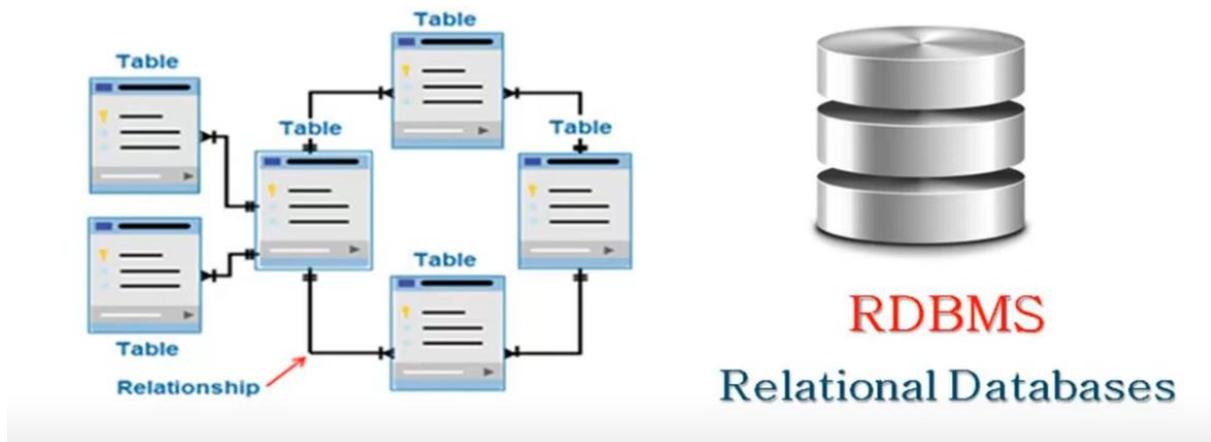
Core Components of RDBMS:

- ✓ SQL (Structured Query Language): Standard language for querying and managing databases.
- ✓ Schema: Defines the structure of tables, relationships, and constraints in a database.
- ✓ Indexing: Helps speed up data retrieval by creating an index on columns commonly used in queries.
- ✓ Transaction Management: Ensures database operations are completed successfully with ACID (Atomicity, Consistency, Isolation, Durability) properties.

Advantages of RDBMS:

- ✓ Data Integrity: Enforces accuracy and consistency through primary and foreign keys, constraints, and ACID compliance.
- ✓ Data Security: User roles and permissions protect sensitive data.
- ✓ Data Relationships: Easy to define and enforce relationships between different data points.
- ✓ Scalability: Supports large amounts of data and multiple users concurrently.

RDBMS Structure



What is PostgreSQL?

- ✓ PostgreSQL, often referred to as Postgres, is an open-source relational database management system (RDBMS) known for its robustness, flexibility, and advanced features.
- ✓ Initially developed at the University of California, Berkeley, it has evolved into one of the most widely used RDBMS systems globally, especially popular for complex data processing.

Uses and Applications

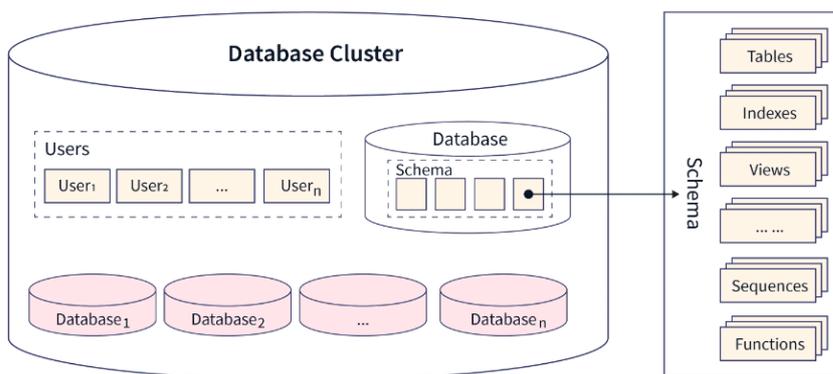
- ✓ PostgreSQL is suitable for applications in finance, geospatial data, data warehousing, and more.
- ✓ Popular in web development, analytics, and data science due to its support for various data types and powerful querying capabilities.

Key Features and Advantages

- ✓ ACID Compliance: Ensures data integrity and reliability through atomicity, consistency, isolation, and durability.
- ✓ Open Source: Free to use and continuously improved by a large community.
- ✓ Extensibility: Allows users to add custom functions, data types, and languages.

- ✓ **Advanced Data Types:** Includes support for JSON, arrays, XML, and geospatial data through the Post-GIS extension.
- ✓ **Concurrency Control:** Uses MVCC (Multi-version Concurrency Control) to handle multiple transactions effectively.
- ✓ **High Performance:** Offers indexing, partitioning, and other tools to optimize performance.

PostgreSQL Architecture



Data Types in PostgreSQL

- ✓ **Numeric:** INTEGER, SMALLINT, BIGINT, NUMERIC, DECIMAL, REAL, DOUBLE PRECISION.
- ✓ **Text:** VARCHAR, CHAR, CHARACTER VARYING, TEXT.
- ✓ **Date/Time:** DATE, TIME, TIMESTAMP, INTERVAL.
- ✓ **Boolean:** TRUE or FALSE.
- ✓ **Array:** Multi-dimensional arrays supported for various data types.
- ✓ **JSON:** Supports JSON and JSONB for semi-structured data storage.

Basic SQL Operations

- ✓ `CREATE DATABASE my_database;`
- ✓ `psql -d my_database;`
- ✓ `CREATE TABLE employees (`
`id SERIAL PRIMARY KEY,`
`name VARCHAR(100),`
`age INTEGER,`
`department VARCHAR(50)`
`);`
- ✓ `INSERT INTO employees (name, age, department) VALUES ('John Doe', 30, 'Sales');`
- ✓ `SELECT * FROM employees WHERE department = 'Sales';`
- ✓ `UPDATE employees SET age = 31 WHERE name = 'John Doe';`
- ✓ `DELETE FROM employees WHERE name = 'John Doe';`

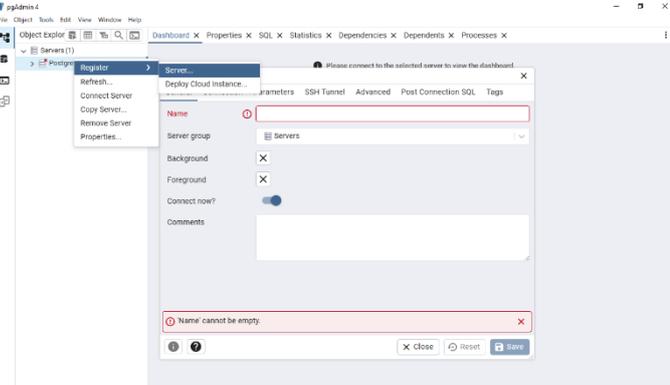
Advanced Features

- ✓ Views: Stored queries that act as virtual tables.

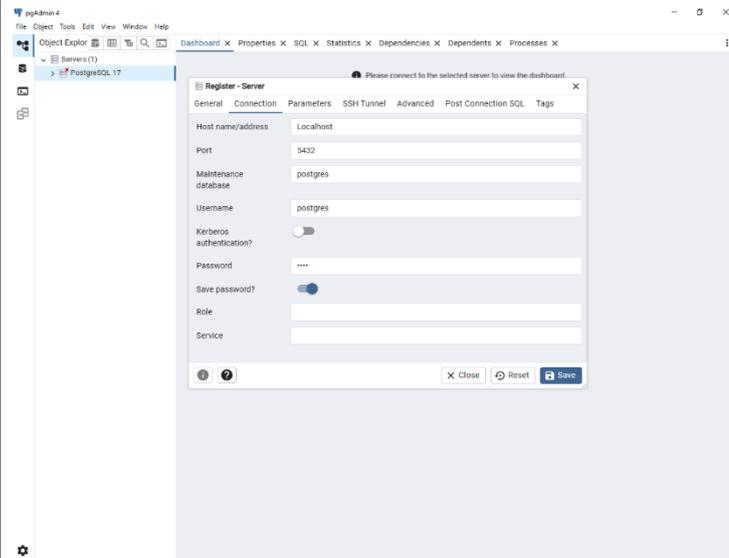
sql-

```
CREATE VIEW sales_view AS SELECT name, department FROM employees WHERE department = 'Sales';
```

- ✓ Stored Procedures and Functions: Custom functions and procedures for reusability.
- ✓ Triggers: Automate actions before/after specific operations on a table.

Step 1:	<h3>Open pgAdmin 4</h3> 
Step 2:	<h3>Click on 'Servers'</h3> 

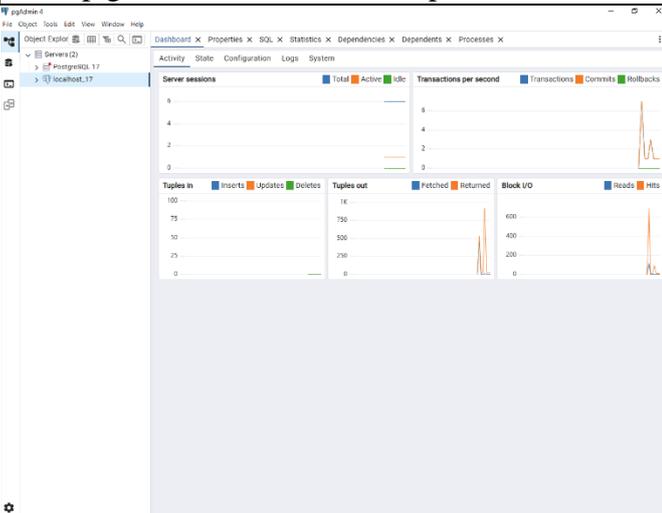
Step 3: Select the server and give password (the password was saved during installation)



Step 4: Select server location > Click on the right button of mouse and select register and then server

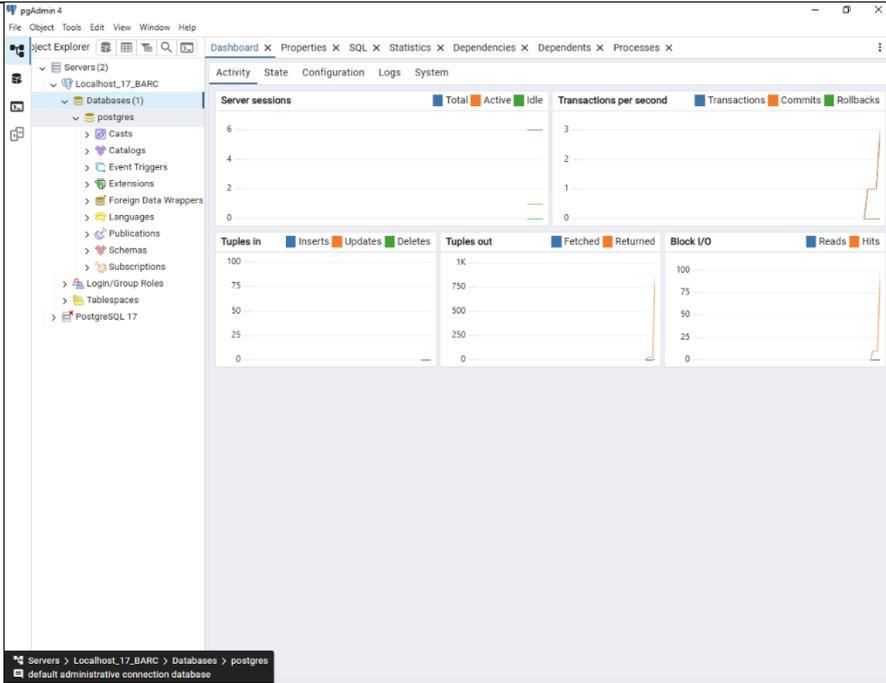
Step 5: Fill up general and connection options

Step 6:



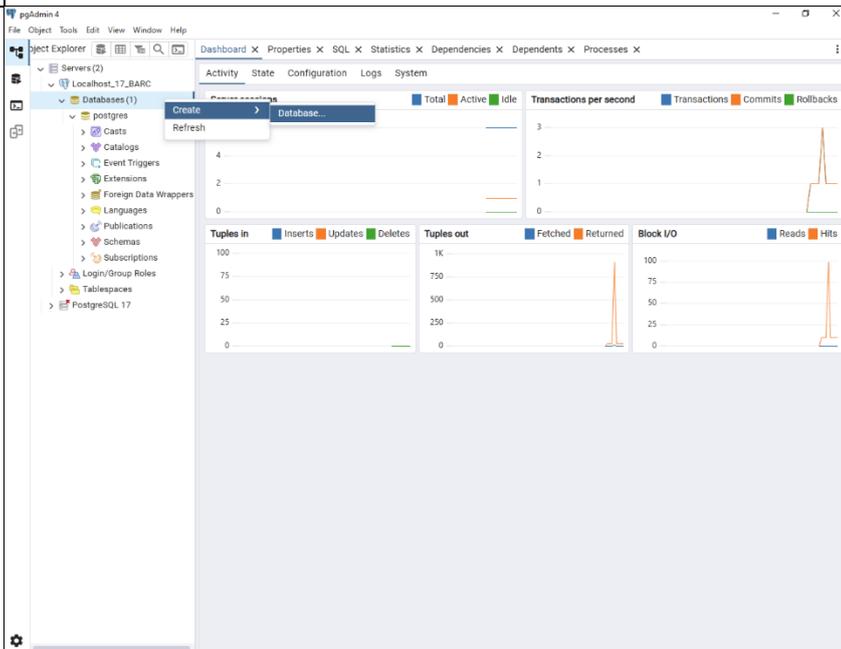
Server will be added

Step 7:



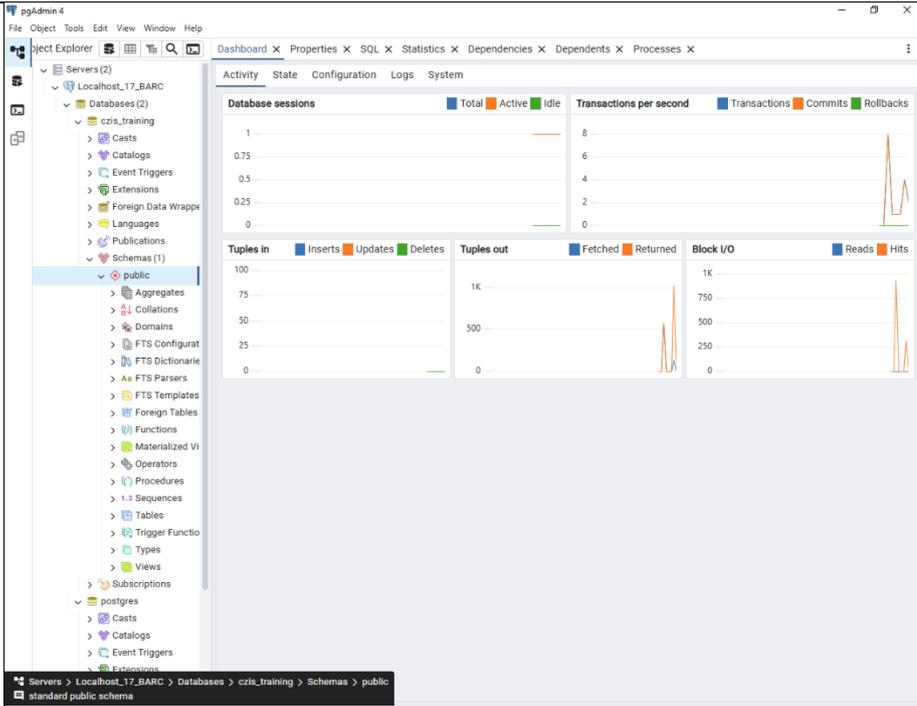
Database need to be added

Step 8:



Select databases> Click on the right button of mouse and select create and then add database

Step 9:



Database is added

Step 10:

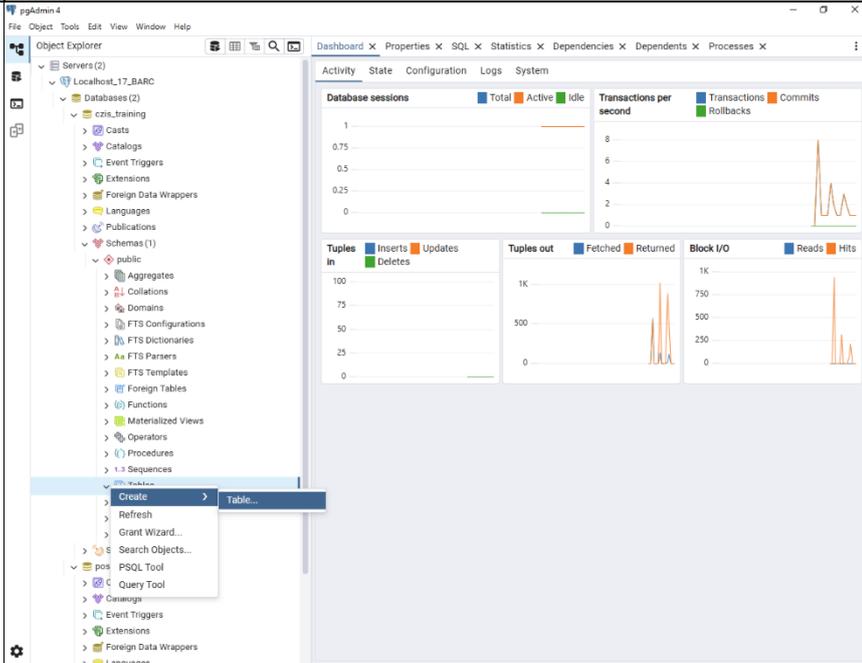
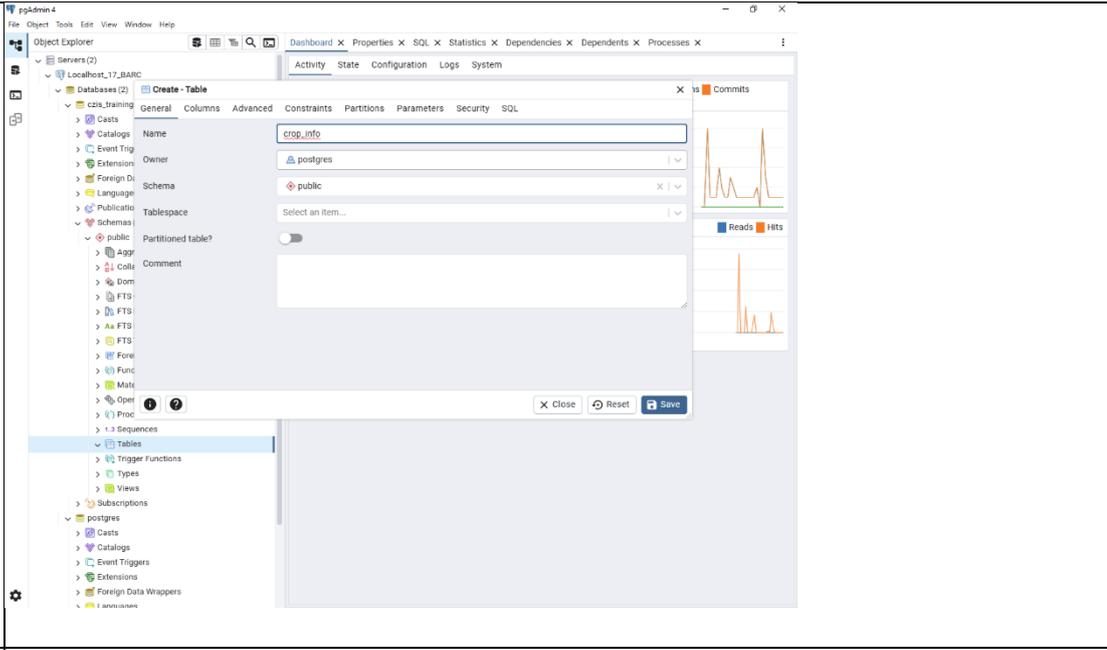


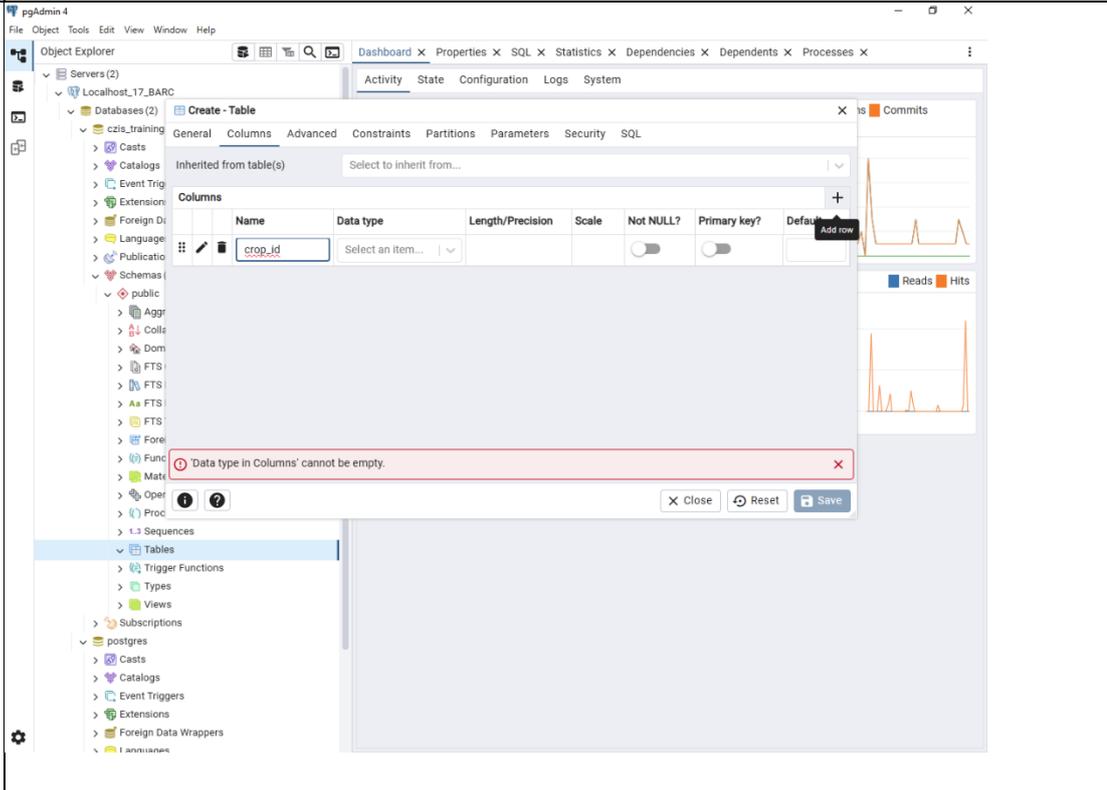
Table of information need to be added

Step 11:

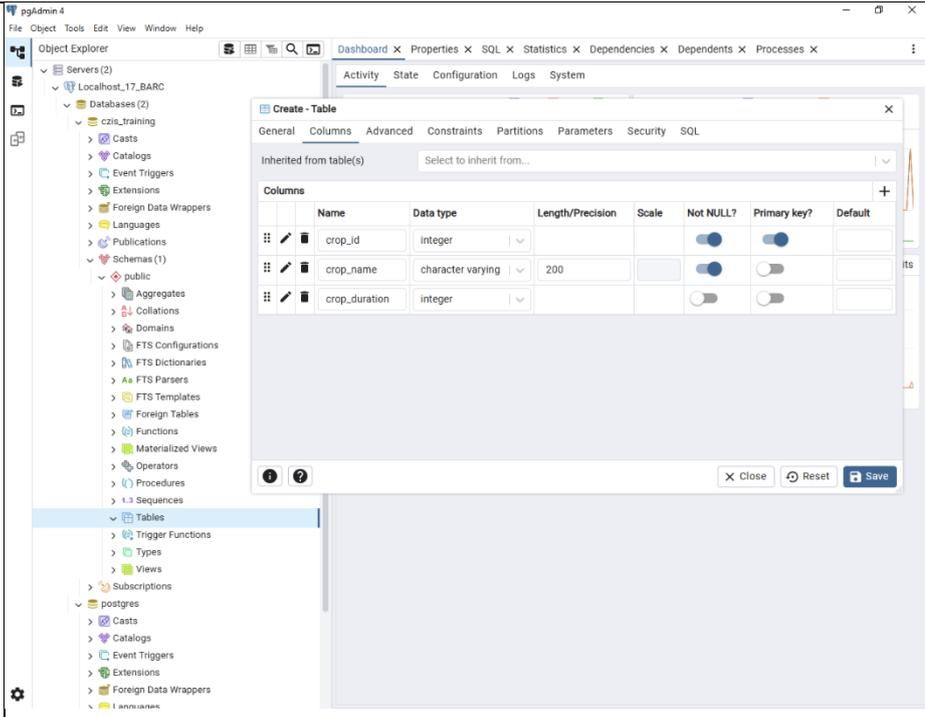


Step 12: Name should be lowercase and underscore is used if needed break.
Database all info will be in lowercase.

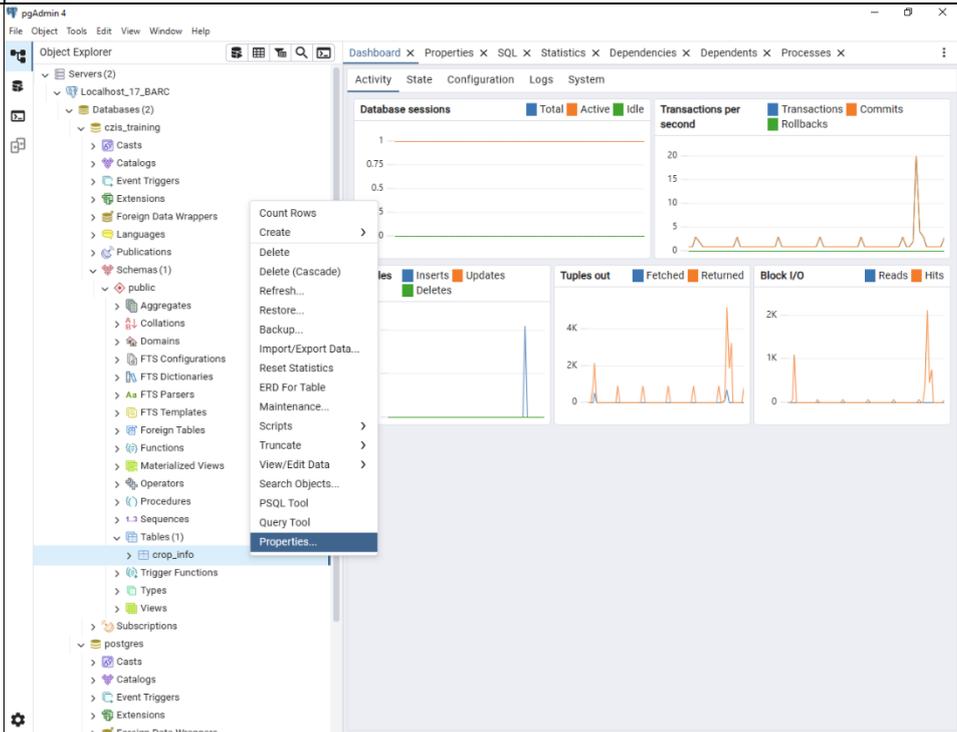
Step 13:



Step 14:

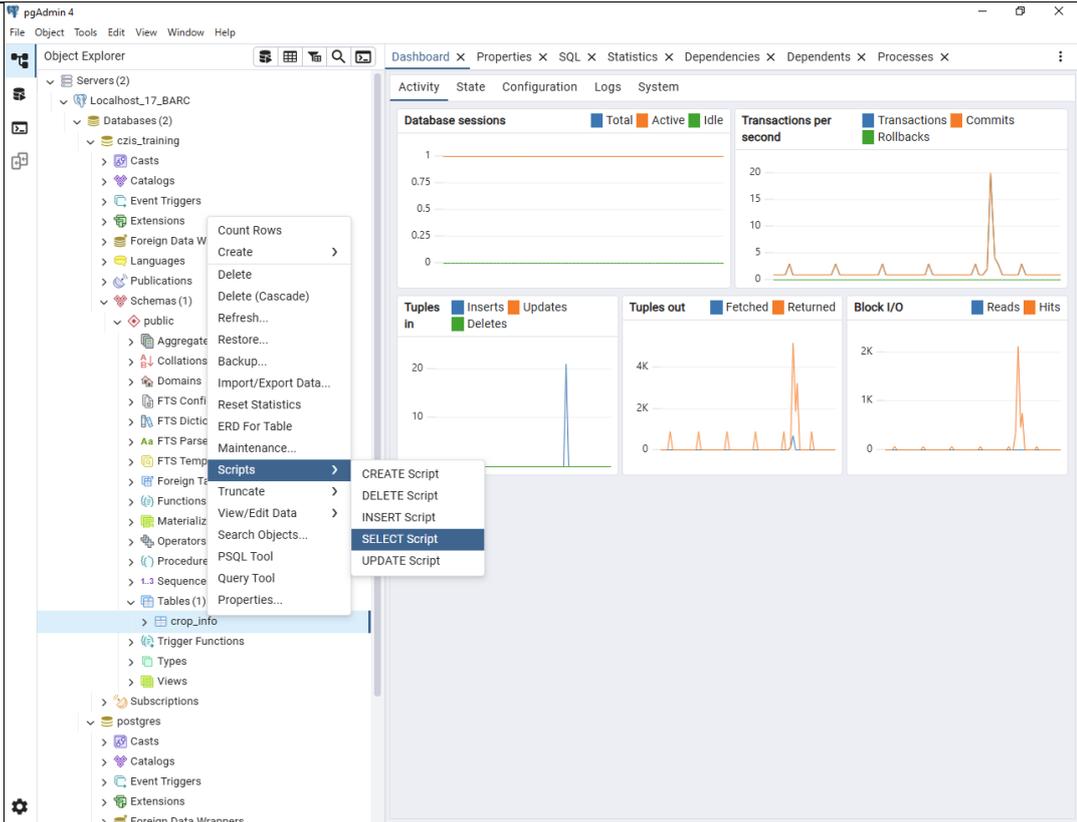


Step 15:



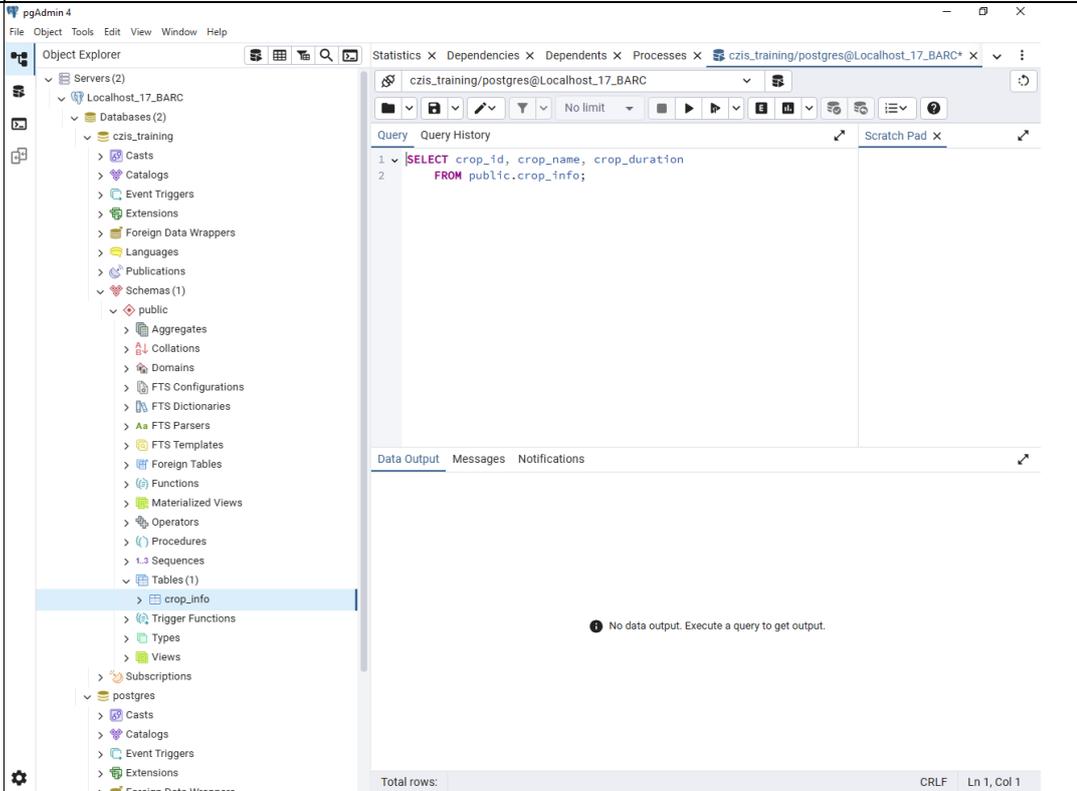
To see table properties click on the right button of mouse and select properties

Step 16:



To add info in table, click on the right button of mouse and select script and then select script

Step 17:



Script is displayed

Step 18:

The screenshot shows the pgAdmin 4 interface. The Object Explorer on the left shows the database structure for 'Localhost_17_BARC' > 'Databases (2)' > 'czis_training' > 'Schemas (1)' > 'public' > 'Tables (1)' > 'crop_info'. The main query editor contains the following SQL query:

```
1 SELECT crop_id, crop_name, crop_duration
2 FROM public.crop_info;
```

The 'Execute script' button is highlighted. Below the query editor, the 'Data Output' tab is active, showing the table structure for 'crop_info':

crop_id	crop_name	crop_duration
[PK] integer	character varying (200)	integer

The status bar at the bottom indicates 'Total rows: 0' and 'Query complete 00:00:00.214'.

Step 19:

The screenshot shows the pgAdmin 4 interface. The Object Explorer on the left shows the database structure for 'Localhost_17_BARC' > 'Databases (2)' > 'czis_training' > 'Schemas (1)' > 'public' > 'Tables (2)' > 'crop_variety'. A context menu is open over the 'crop_variety' table, with 'Query Tool' selected. The main query editor contains the following SQL query:

```
1 SELECT variety_id, variety_name, variety_character, crop_id
2 FROM public.crop_variety;
```

The 'Data Output' tab is active, showing the table structure for 'crop_variety':

variety_id	variety_name	variety_character	crop_id
[PK] integer	character varying (100)	character varying (500)	integer

The status bar at the bottom indicates 'Total rows: 0', 'Query complete 00:00:00.207', and 'Changes staged: Added: 4'.

Execute query tool to data output

6. GeoServer Overview

What is GeoServer

- GeoServer is an **open-source server** for sharing geospatial data.
- Developed in Java and maintained by the Open Source Geospatial Foundation (OSGeo).
- Enables **interoperability** by publishing data using **open standards**.

Supported Data Formats

- **Vector:**
 - Shapefile
 - GeoJSON
 - GML
 - PostGIS
 - Oracle Spatial
- **Raster:**
 - GeoTIFF
 - JPEG, PNG
 - ImageMosaic

OGC Standards

- **WMS** (Web Map Service): Render maps as images.
- **WFS** (Web Feature Service): Access vector features.
- **WCS** (Web Coverage Service): Serve raster data.
- **WMTS** (Web Map Tile Service): Pre-rendered tiles for fast access.

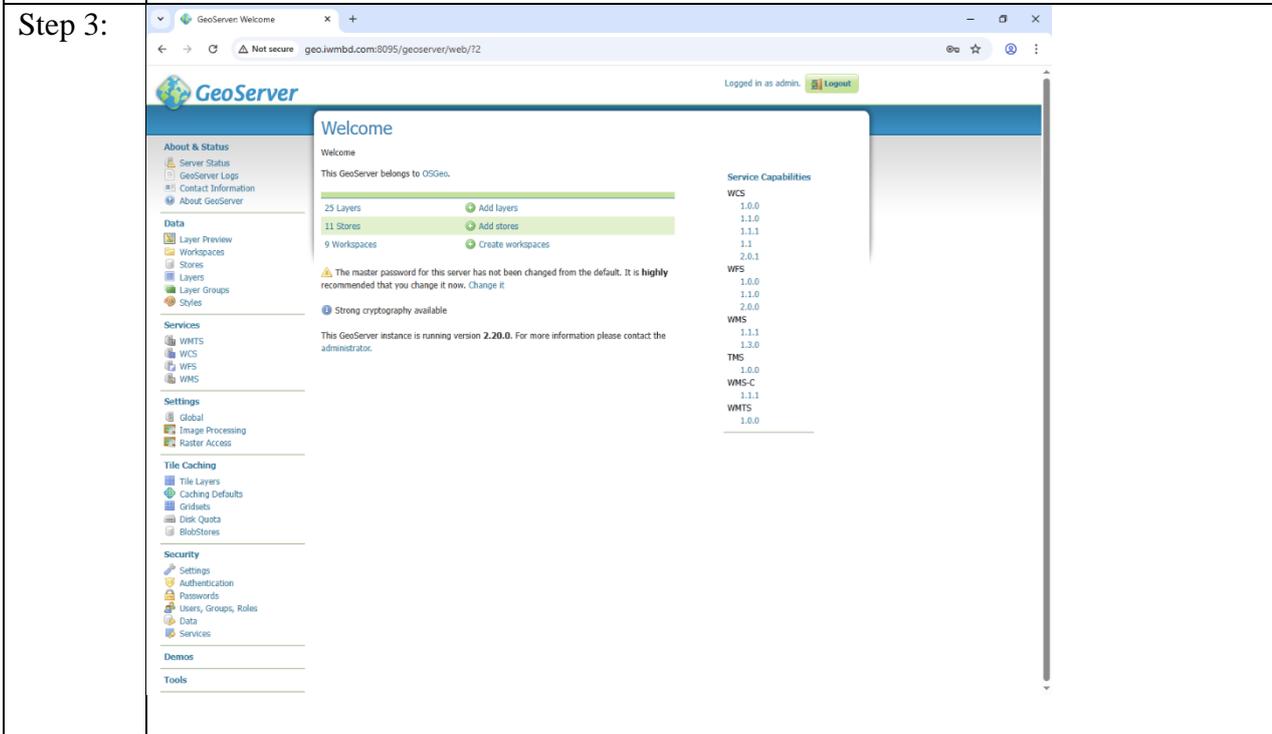
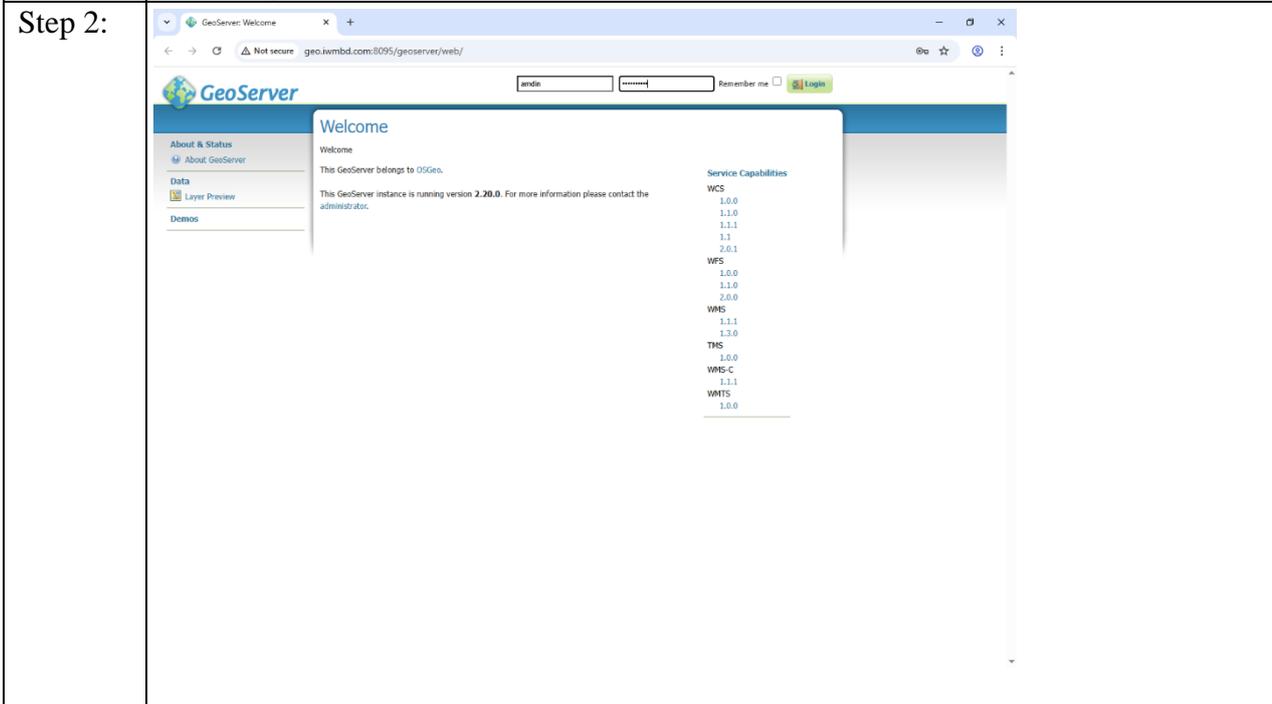
Key Features

- Supports **OGC standards**: WMS, WFS, WCS, WMTS.
- Provides **web-based administration interface**.
- **Connects to spatial databases**: PostGIS, Oracle Spatial, etc.
- Supports **vector and raster data formats** (Shapefile, GeoTIFF, etc.)

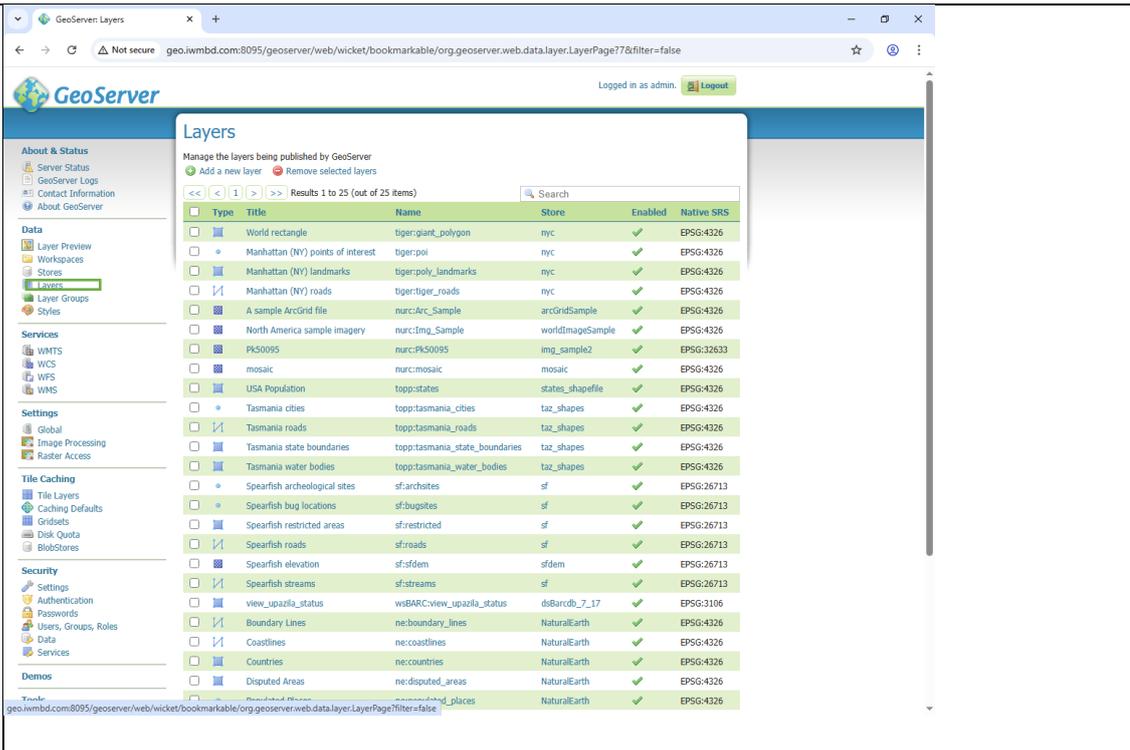
OGC Standards

- **WMS** (Web Map Service): Render maps as images.
- **WFS** (Web Feature Service): Access vector features.
- **WCS** (Web Coverage Service): Serve raster data.
- **WMTS** (Web Map Tile Service): Pre-rendered tiles for fast access.

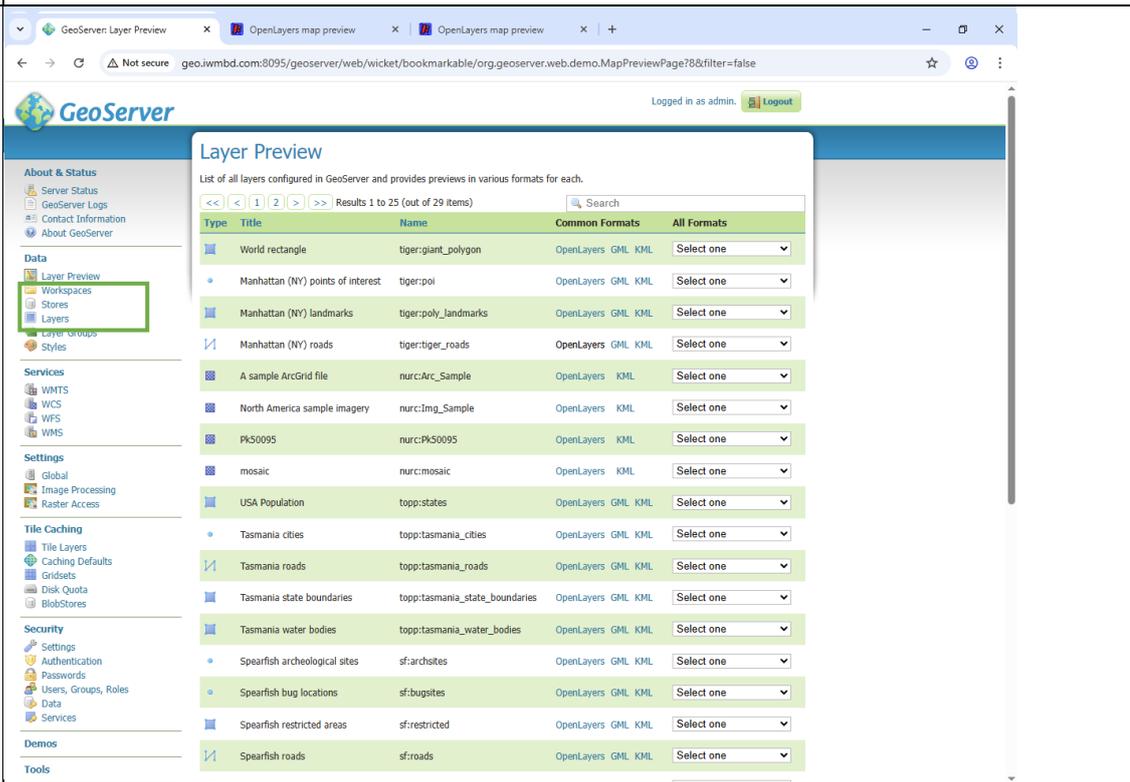
Step 1: geoserver admin panel:
<http://geo.iwmbd.com:8095/geoserver/web/>
 Username: as provided
 Pass: as provided



Step 4:

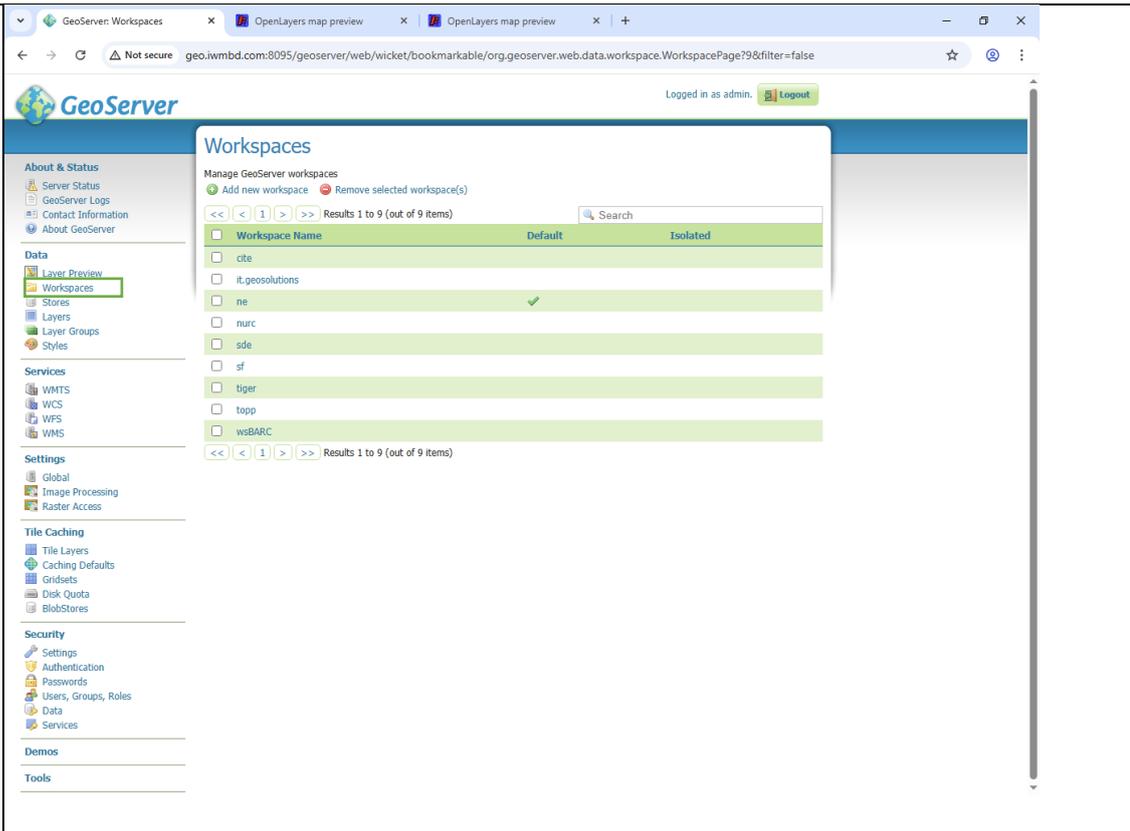


Step 5:

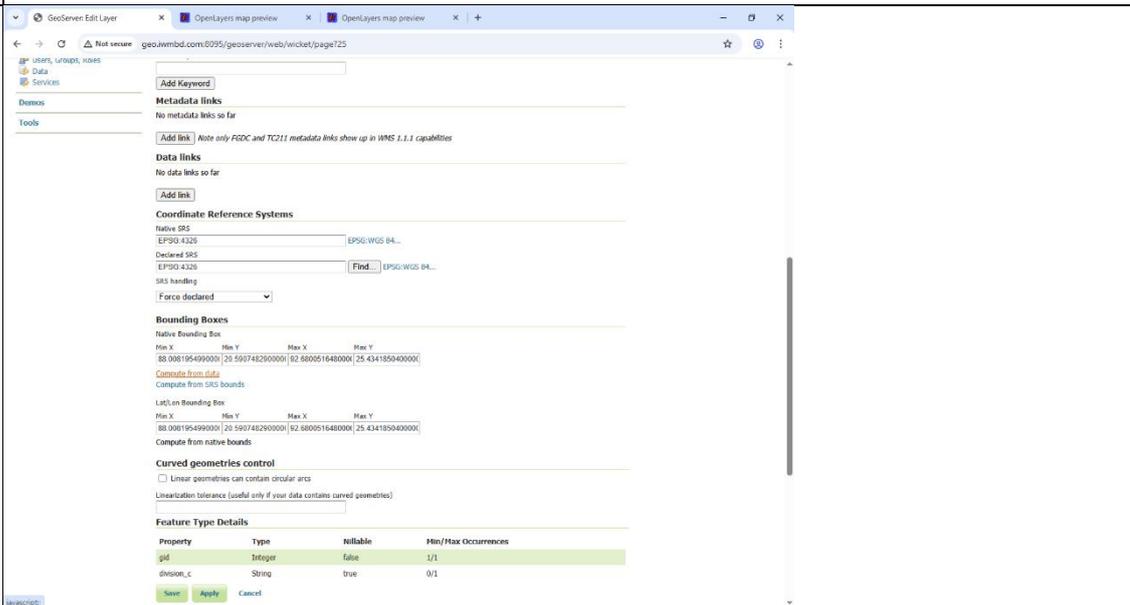


To publish new layer workspace, store and layers

Step 6:



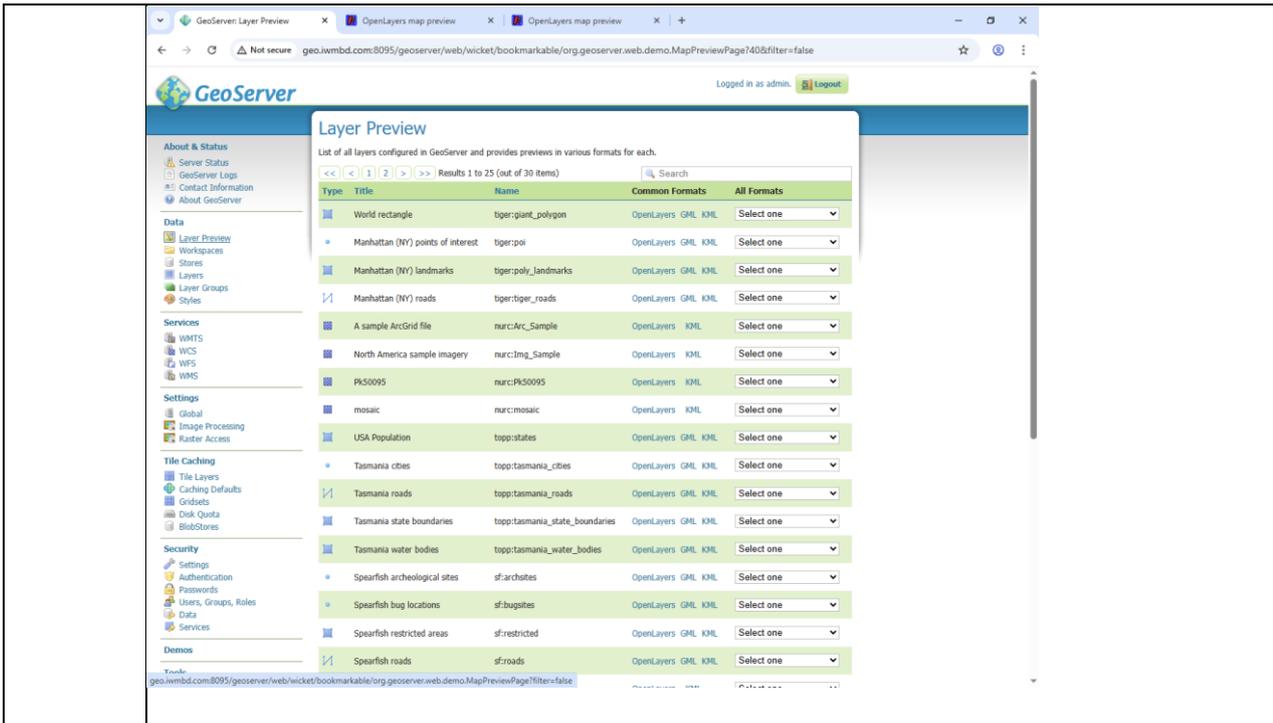
Step 7:



Need to select Compute from data and Compute from native bounds

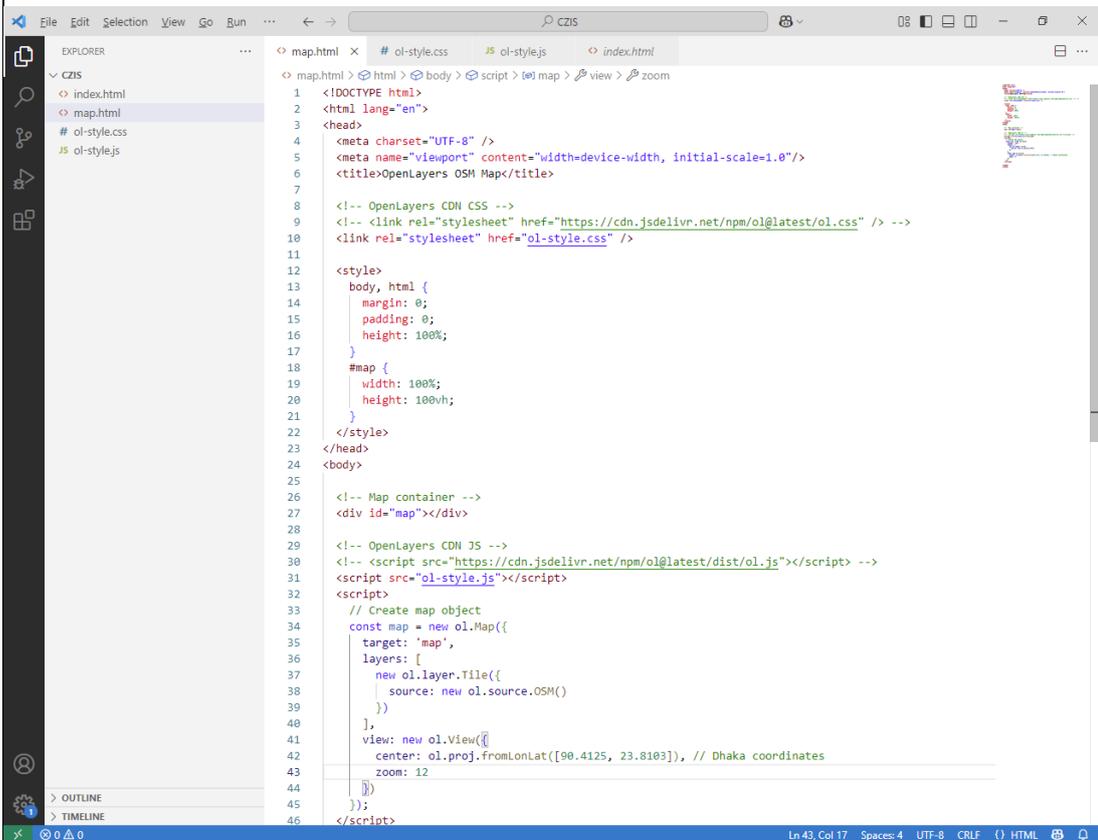
Step 8:

To display Layer, we need to go through layer preview



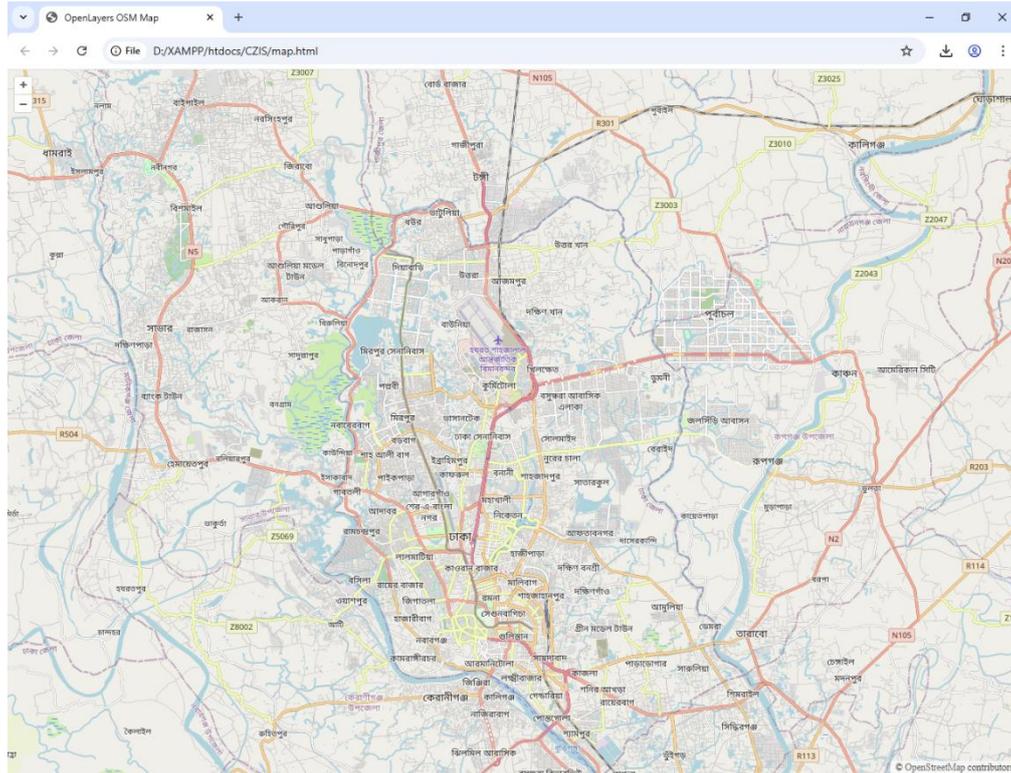
Step 9:

To see a map layer:
 Prepare a map.html file in a folder and open with visual studio code
 Open the map.html file with Chrome browser

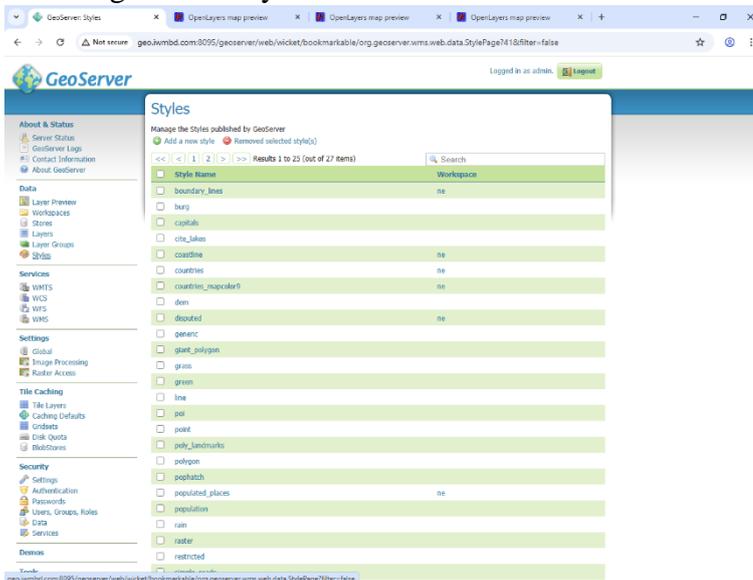


In visual studio code file place the coding and show output in the local host

Step 10:



Step 11: To change color / style



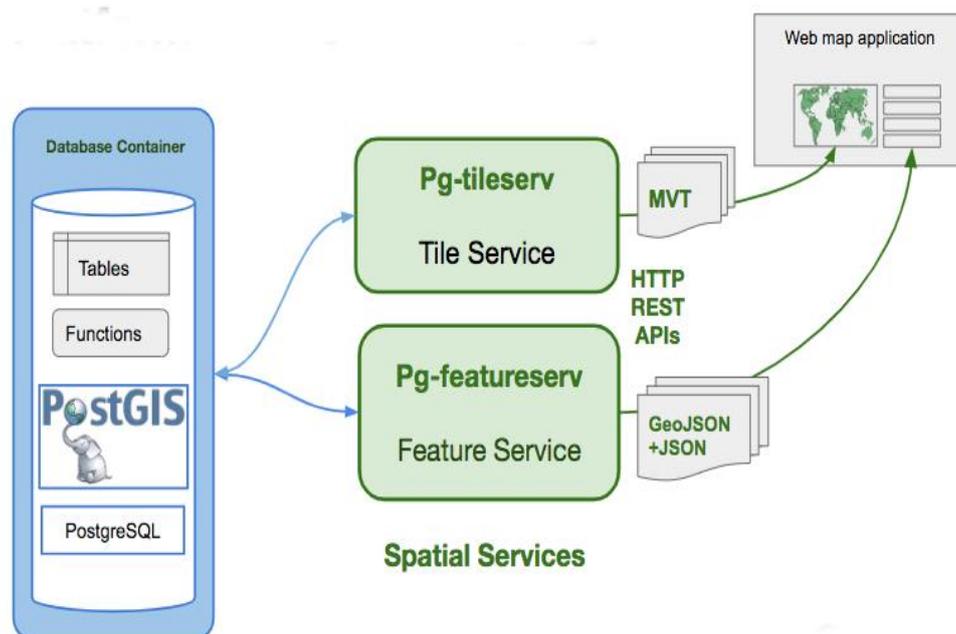
7. Overview of Spatial Extensions in PostgreSQL (PostGIS)

What is PostGIS?

- ✓ PostGIS is a spatial database extender for PostgreSQL that allows geographic objects to be stored and queried.
- ✓ It transforms PostgreSQL into a powerful spatial database that supports location queries and spatial data analytics.

Why Use PostGIS?

- ✓ Enables storage, manipulation, and analysis of geographic data directly within PostgreSQL.
- ✓ Supports a wide range of spatial data operations, essential for applications in GIS (Geographic Information Systems), mapping, urban planning, and more.



Key Features of PostGIS

- ✓ **Support for Geometric and Geographic Data:** Allows handling of both planar (2D) and spherical (3D) geometries.
- ✓ **Spatial Functions:** Hundreds of functions to perform complex spatial analyses, such as distance, area calculation, and spatial joins.
- ✓ **Spatial Indexing:** Optimized for querying large datasets using R-tree-based GiST indexing.
- ✓ **Compatibility:** Works with many GIS applications and standards (e.g., GeoJSON, GeoServer, QGIS).

PostGIS Data Types

Geometry and Geography Data Types

- ✓ **Geometry:** Represents planar geometries, useful for Cartesian calculations (e.g., distances in meters).
- ✓ **Geography:** Represents spherical data, better suited for large-scale geographic calculations (e.g., distances in kilometers).

Common Spatial Data Types

- ✓ **Point:** Represents a single location (e.g., a city).
- ✓ **Line:** Represents a sequence of points (e.g., a river or road).
- ✓ **Polygon:** Represents an area (e.g., a lake or city boundary).
- ✓ **MultiPoint, Multi-Line, Multi-Polygon:** Collections of points, lines, or polygons.

Spatial Reference Systems (SRS) and Coordinate Systems

Spatial Reference System (SRS)

- ✓ Defines how spatial data aligns with real-world coordinates.
- ✓ Common SRS examples include WGS 84 (EPSG:4326), used for latitude/longitude.

Coordinate Transformation

- ✓ PostGIS supports transforming geometries between different coordinate systems.

sql

```
SELECT ST_Transform(geom, 3857) FROM my_table; -- Transforms to Web Mercator
```

Working with Spatial Data in PostGIS

- ✓ CREATE EXTENSION postgis;
- ✓ CREATE TABLE cities (
id SERIAL PRIMARY KEY,
name VARCHAR(100),
location GEOGRAPHY(Point, 4326)
);
- ✓ INSERT INTO cities (name, location) VALUES
('New York', ST_SetSRID(ST_MakePoint(-74.006, 40.7128), 4326));
- ✓ SELECT name FROM cities
WHERE ST_DWithin(location, ST_MakePoint(-74.006,
40.7128)::geography, 10000); -- within 10 km

Indexing Spatial Data

GiST Indexing

- ✓ Spatial Index: Use GiST (Generalized Search Tree) indexing to optimize spatial queries.

sql

```
CREATE INDEX cities_location_idx ON cities USING GIST(location);
```

- ✓ Effect: Drastically improves performance for queries involving spatial functions like ST_Intersects and ST_DWithin.

Hands-On Examples

Example 1: Distance Calculation

- ✓ Calculate the distance between two cities.

sql

```
SELECT ST_Distance(  
  ST_MakePoint(-74.006, 40.7128)::geography,  
  ST_MakePoint(-118.2437, 34.0522)::geography  
) AS distance_km;
```

Example 2: Finding Intersecting Polygons

- ✓ Identify polygons representing land use that intersect with a specific area.

✓

sql

```
SELECT land_use.id, land_use.type  
FROM land_use, protected_areas  
WHERE ST_Intersects(land_use.geom, protected_areas.geom);
```

Overview of Geospatial Functions and Operators in PostgreSQL (PostGIS)

Introduction to Geospatial Functions in PostGIS

PostGIS is an extension of PostgreSQL that supports geographic objects, allowing users to store and query geospatial data directly in the database. Geospatial functions in PostGIS cover a wide array of operations, from basic geometry creation to complex spatial analytics, useful in GIS (Geographic Information Systems), mapping, and location-based services.

Benefits of Using PostGIS Geospatial Functions

- ✓ Perform complex spatial queries and analyses within PostgreSQL.
- ✓ Efficiently manage and manipulate geospatial data.
- ✓ Build applications requiring location-based analysis, proximity queries, or mapping capabilities.

Spatial Data Types in PostGIS

Core Data Types

- ✓ Geometry: Represents planar geometries (2D).
- ✓ Geography: For data on a spherical model, supporting large distances (e.g., global datasets).

Common Geometry Types

- ✓ Point: A single location (latitude/longitude).
- ✓ Line: A sequence of points (e.g., a road).
- ✓ Polygon: An enclosed area (e.g., a park boundary).
- ✓ MultiPoint, MultiLine, MultiPolygon: Collections of points, lines, or polygons.

Basic Geospatial Functions

Geometry Creation

- ✓ ST_MakePoint(x, y): Creates a point geometry.

sql

```
SELECT ST_MakePoint(-71.060316, 48.432044);
```

- ✓ ST_MakeLine(array of points): Creates a line geometry.
- ✓ ST_MakePolygon(line): Creates a polygon geometry from a closed line.

Setting and Transforming Spatial Reference Systems (SRS)

- ✓ ST_SetSRID(geometry, srid): Assigns an SRS to a geometry.

sql

```
SELECT ST_SetSRID(ST_MakePoint(-71.060316, 48.432044), 4326);
```

- ✓ ST_Transform(geometry, srid): Converts a geometry from one SRS to another.

Spatial Relationship Functions

Spatial relationships help identify the relative positions of spatial objects.

- ✓ ST_Intersects(geomA, geomB): Checks if two geometries intersect.
- ✓ ST_Contains(geomA, geomB): Returns true if geomA fully contains geomB.
- ✓ ST_Within(geomA, geomB): Checks if geomA is within geomB.
- ✓ ST_Touches(geomA, geomB): Returns true if the geometries have at least one point in common, but their interiors do not intersect.

Example

sql

```
SELECT name FROM parks
```

```
WHERE ST_Contains(parks.geom, ST_MakePoint(-71.060316, 48.432044));
```

Geometry Processing and Analysis Functions

PostGIS includes functions to analyze and modify geometries, such as:

- ✓ **ST_Buffer(geometry, distance):** Creates a buffer around a geometry.

sql

```
SELECT ST_Buffer(ST_MakePoint(-71.060316, 48.432044)::geography, 1000);
```

- ✓ **ST_Intersection(geomA, geomB):** Returns the intersection of two geometries.
- ✓ **ST_Difference(geomA, geomB):** Returns the parts of geomA that do not overlap with geomB.

Example

sql

```
SELECT ST_Intersection(a.geom, b.geom)
FROM table_a a, table_b b
WHERE ST_Intersects(a.geom, b.geom);
```

Spatial Aggregation and Measurements

Distance and Measurement Functions

- ✓ **ST_Distance(geomA, geomB):** Calculates the minimum distance between two geometries.
- ✓ **ST_Length(geometry):** Calculates the length of a Line.
- ✓ **ST_Area(geometry):** Calculates the area of a Polygon.

Example

sql

```
SELECT ST_Distance(
  ST_MakePoint(-71.060316, 48.432044)::geography,
  ST_MakePoint(-73.935242, 40.730610)::geography
) AS distance_in_meters;
```

Aggregating Spatial Data

- ✓ **ST_Union(geometry set):** Merges multiple geometries into one.

sql

```
SELECT ST_Union(geom) FROM rivers;
```

Practical Examples and Use Cases

Example 1: Finding Nearby Points

- ✓ Query to find locations within a 5-kilometer radius of a point.

sql

```
SELECT name
FROM cities
WHERE ST_DWithin(
  geom,
  ST_SetSRID(ST_MakePoint(-71.060316, 48.432044), 4326),
  5000
);
```

Example 2: Calculate the Area of a Polygon

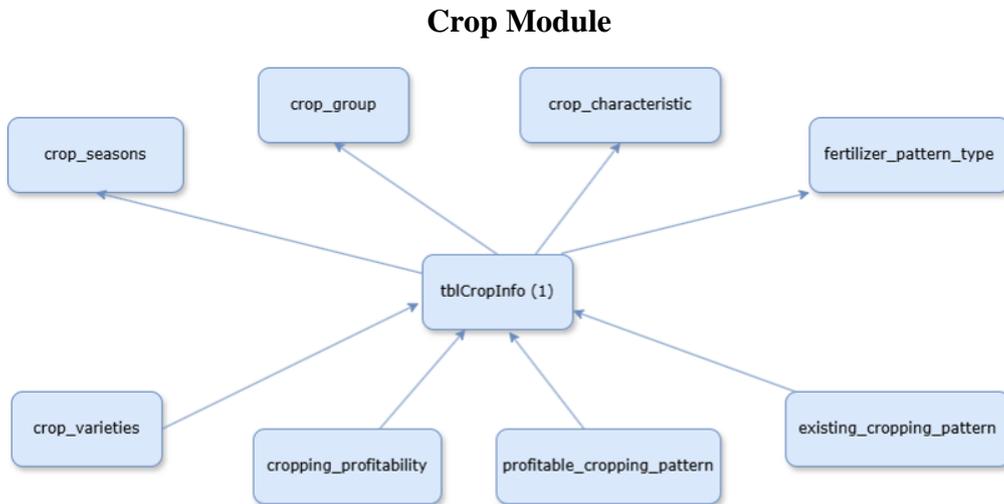
✓ Useful in applications like calculating the area of a land parcel.

sql

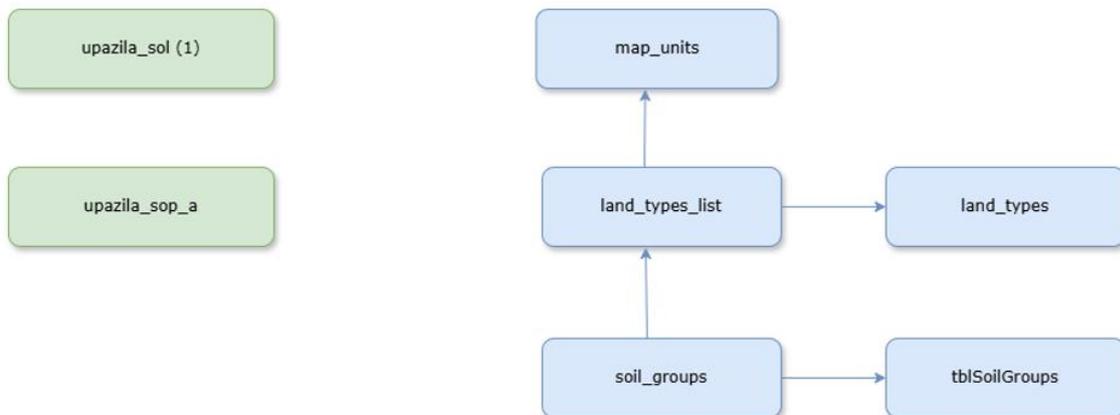
```
SELECT name, ST_Area(geom) AS area_sq_meters
```

```
FROM parcels;
```

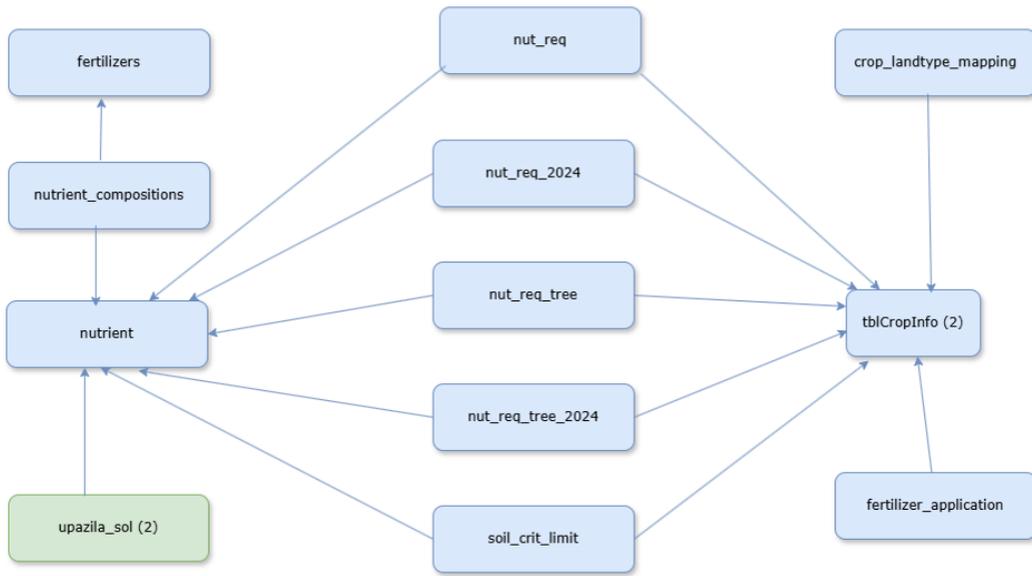
ER Diagram of major modules



Core Entry Module of Upazila Data



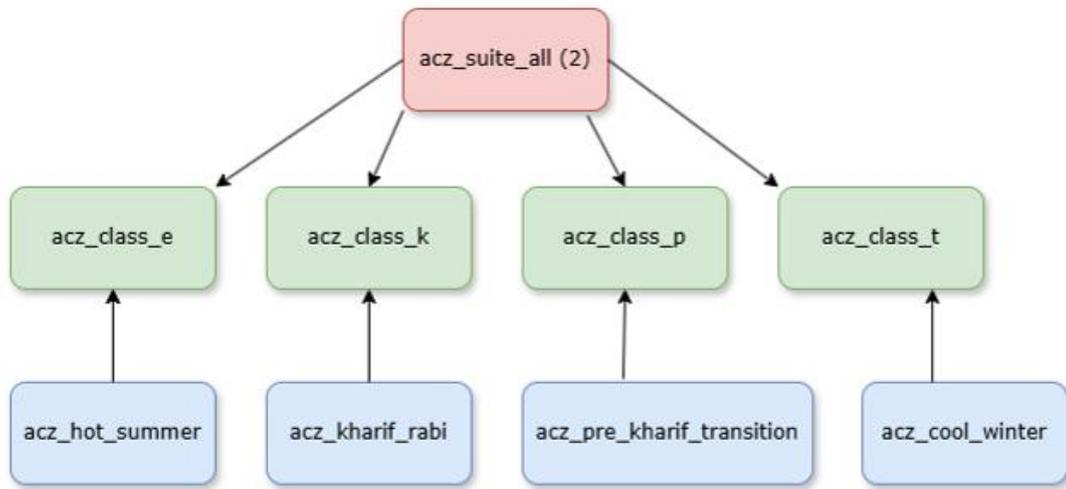
Fertilizer Module



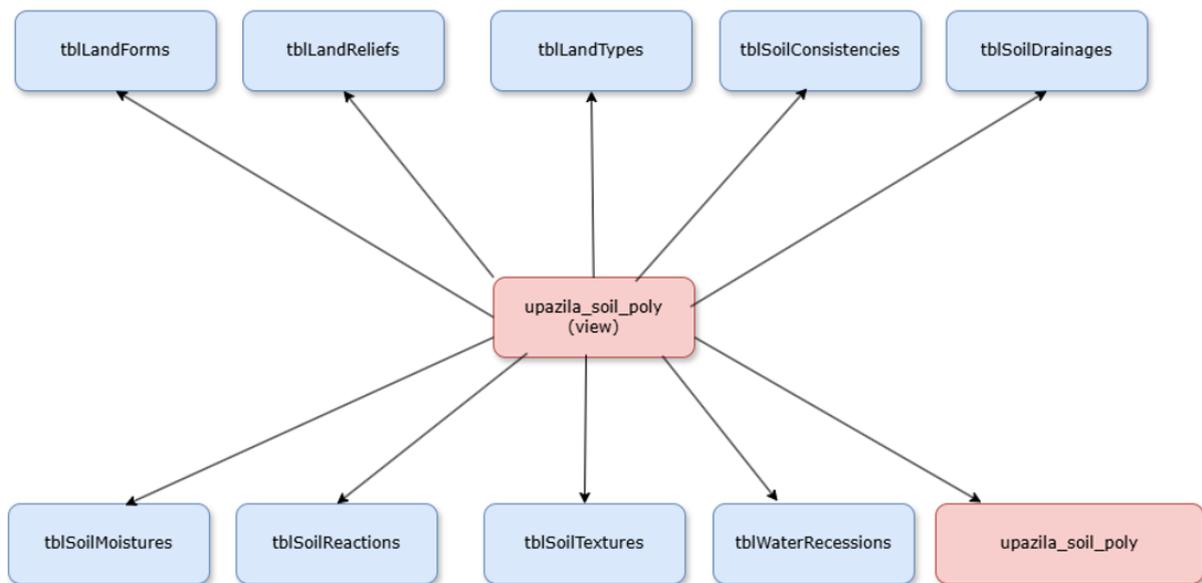
Crop Suitability Module



Agro Climatic Module

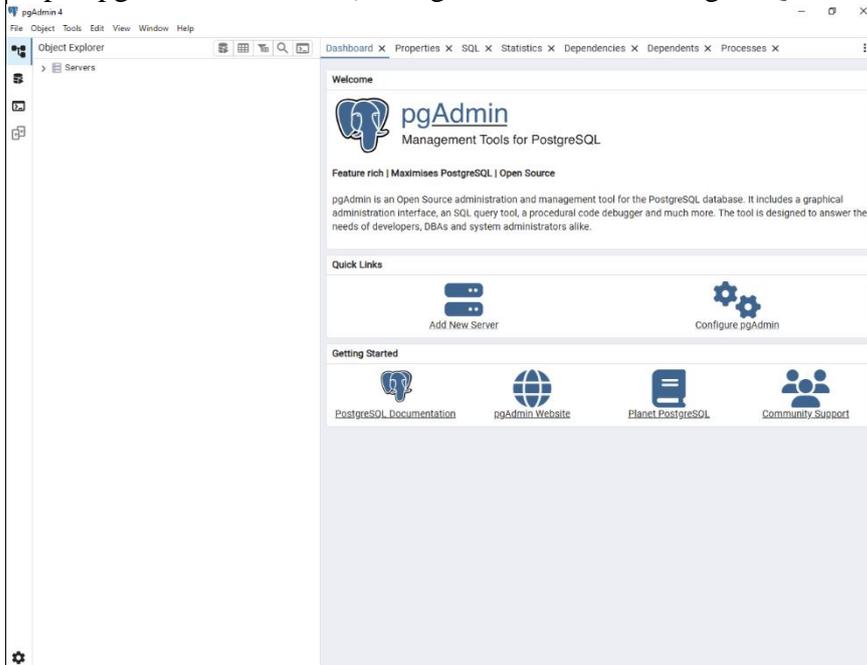


Fertilizer Module

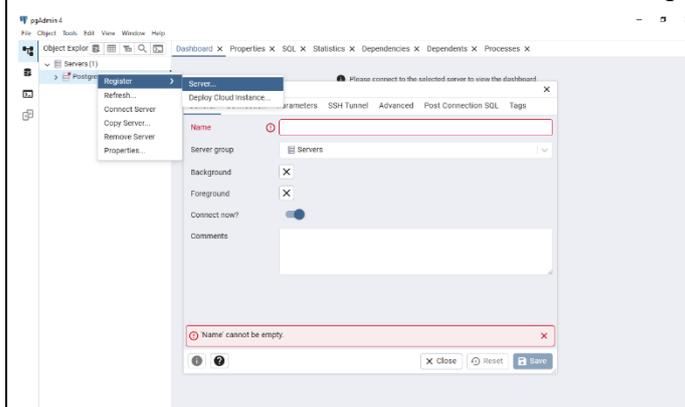


pgAdmin and Postgresql Activity

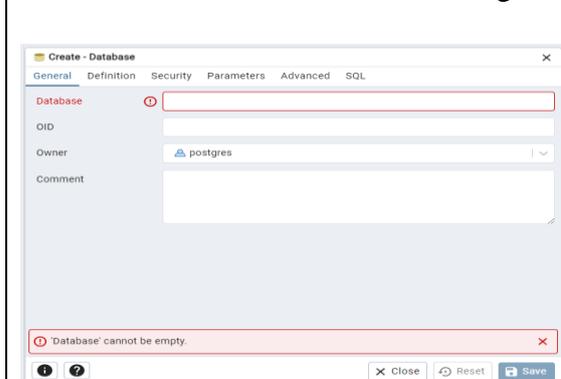
Step 1: Open pgAdmin software (Management tools for PostgreSQL)



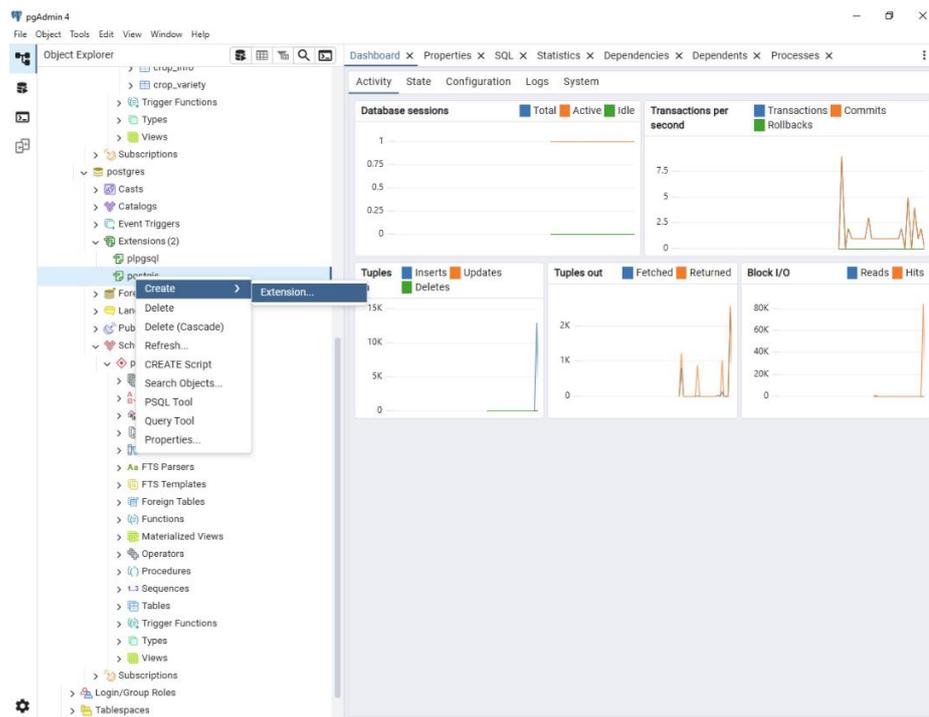
Step 2: Click on 'Servers' and add server to connect with postGIS



Step 3: Create New Database from this dialog box:



Step 4: add extension like postgis from Extension option



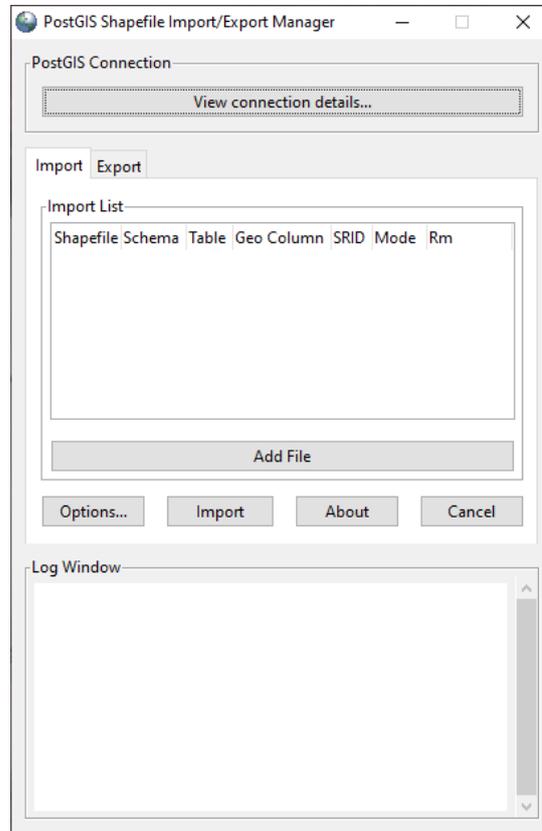
Step 5:

PostGIS Shapefile Export/ Import Manager

Open shp2pgsql-gui.exe file

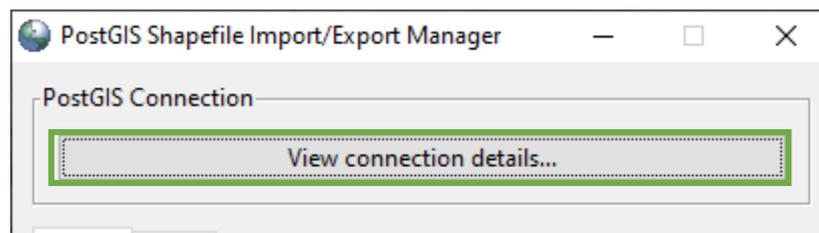
Normally this file is located at :

{postgresql_setup_directory}\{version_number}\bin\postgisgui\



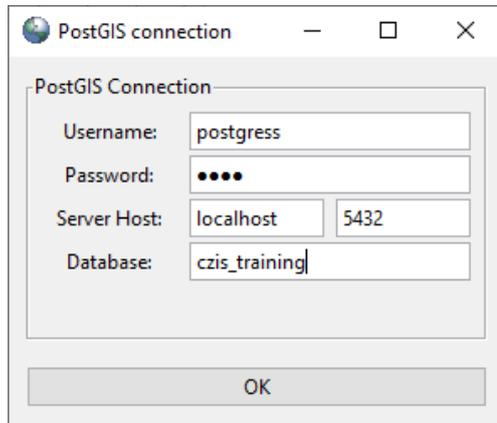
Step 6:

Click on the View connection details

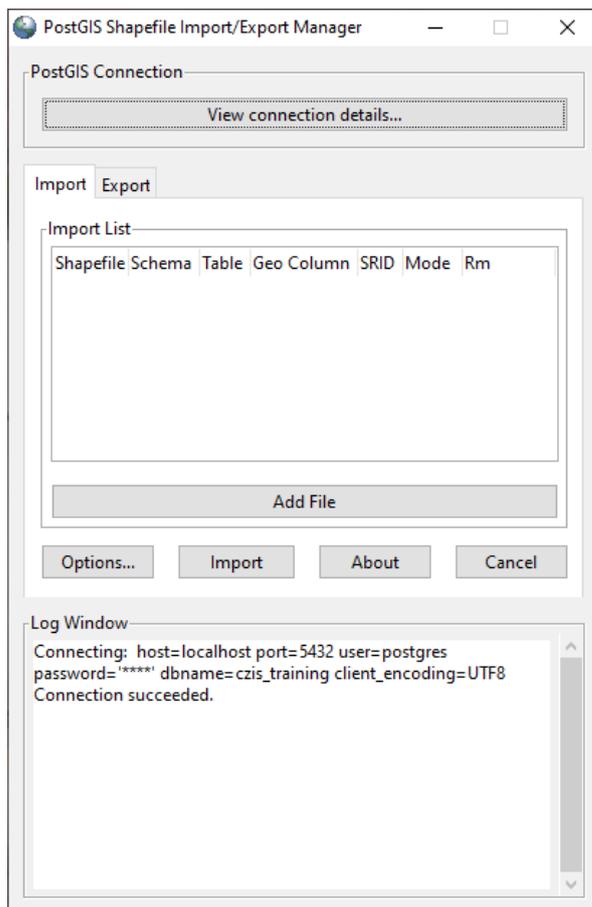


Step 7:

Fill the table content, username is the server name added in the server in pgAdmin, password was saved during preparing the database in pgAdmin
Click Ok to connect to the server.

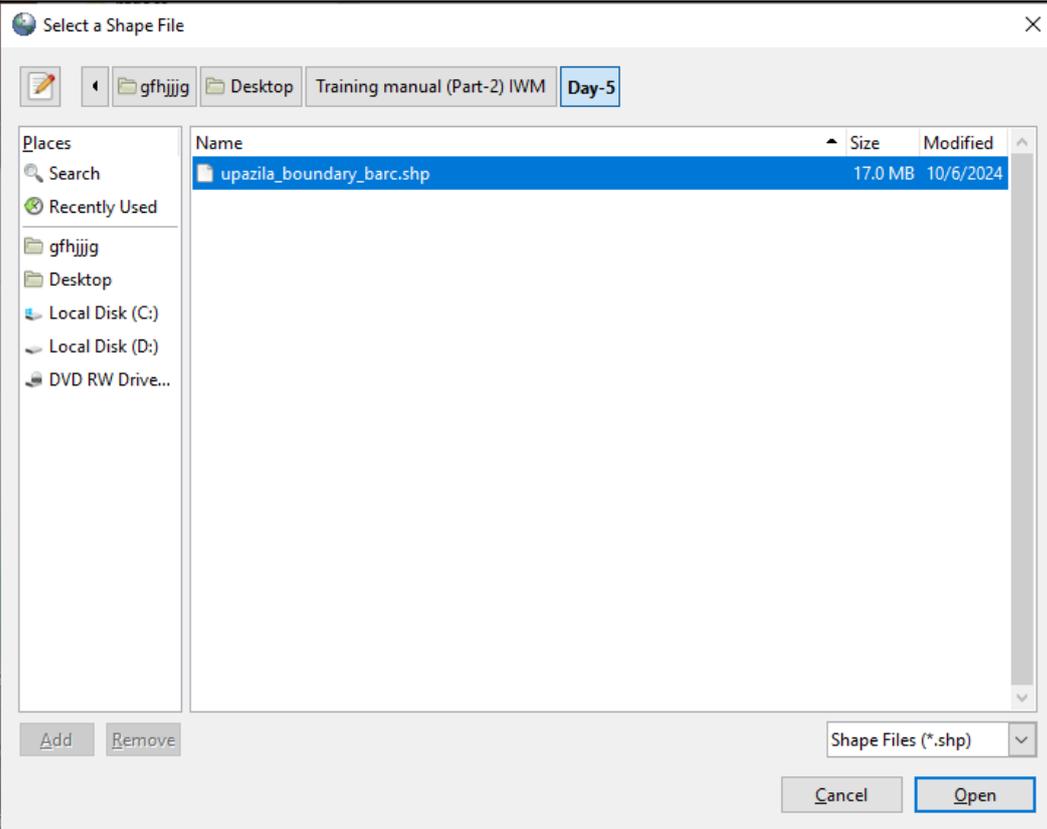


Connection succeeded.



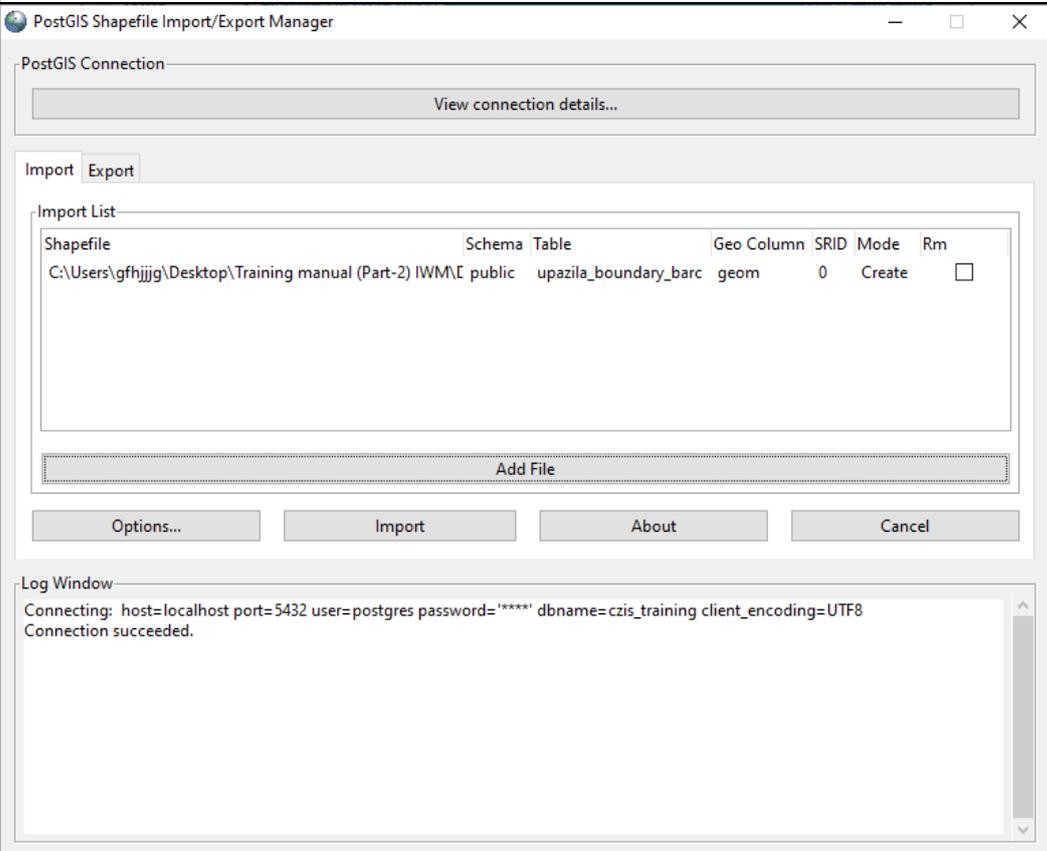
Step 6: Click on Add File

Step 7:



Select shape file and open

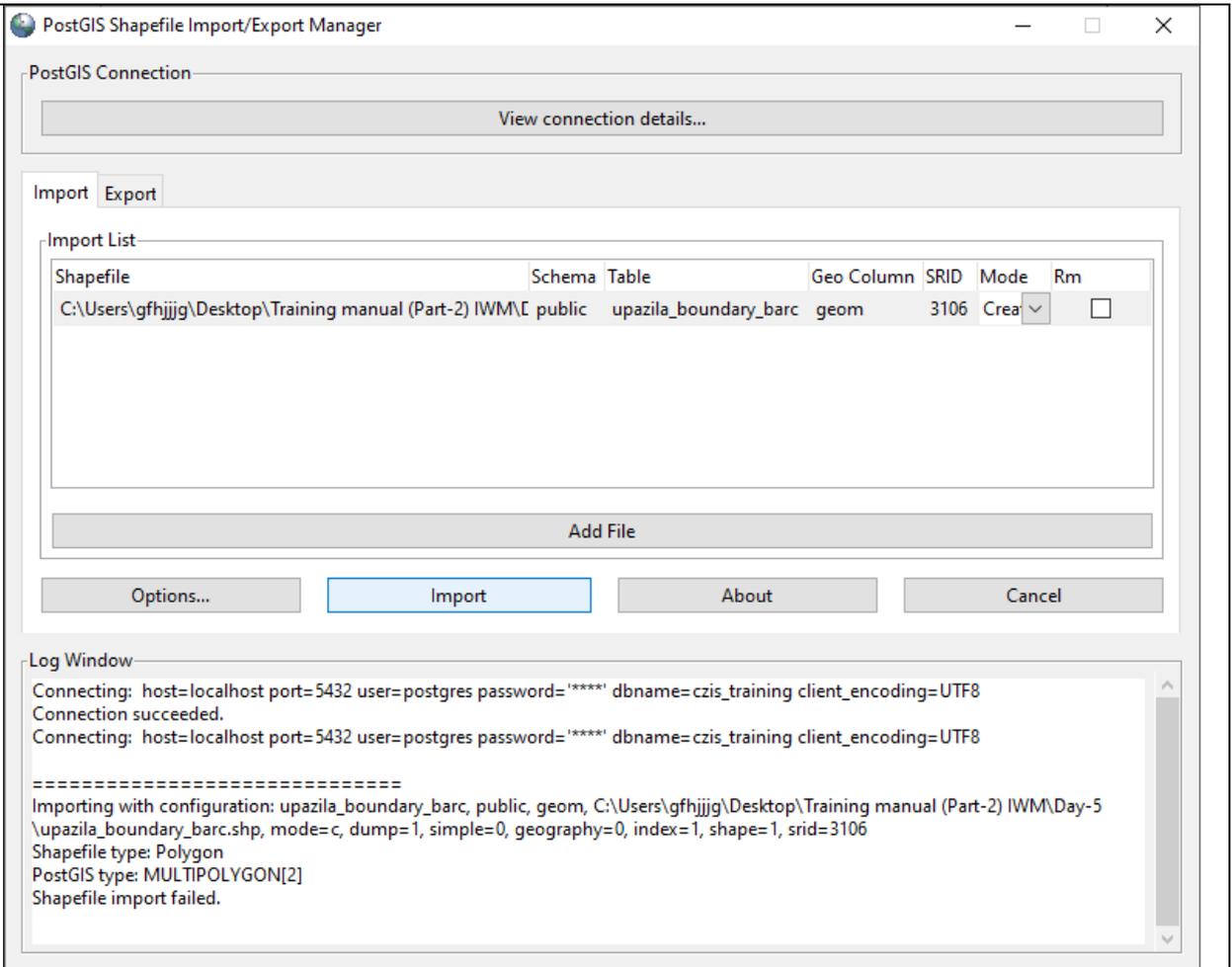
Step 8:



Connection succeeded

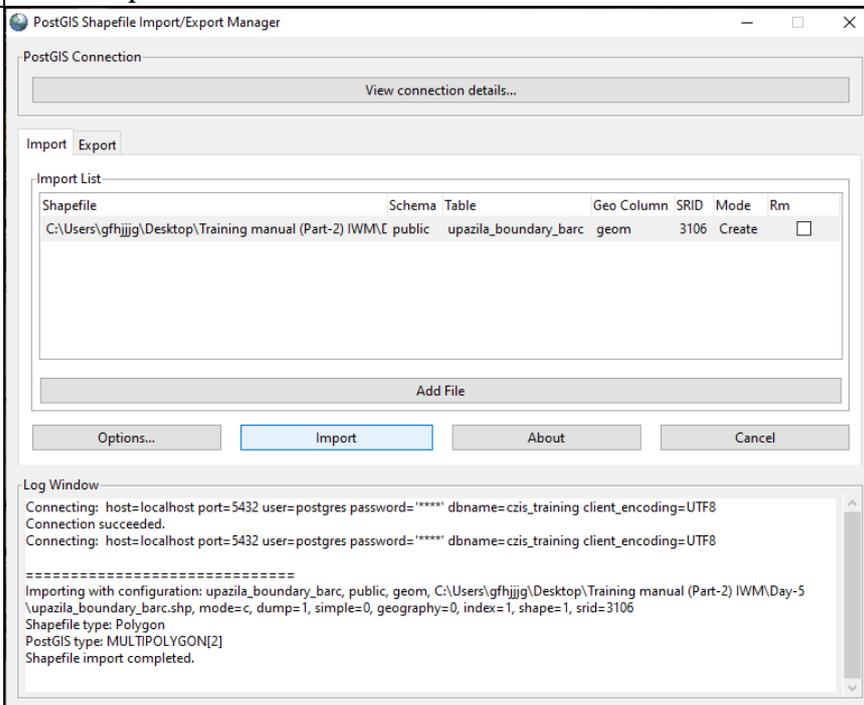
Step 9: Fill the SRID 3106 and other options as you need

Step 11:



Then Import

Step 12:

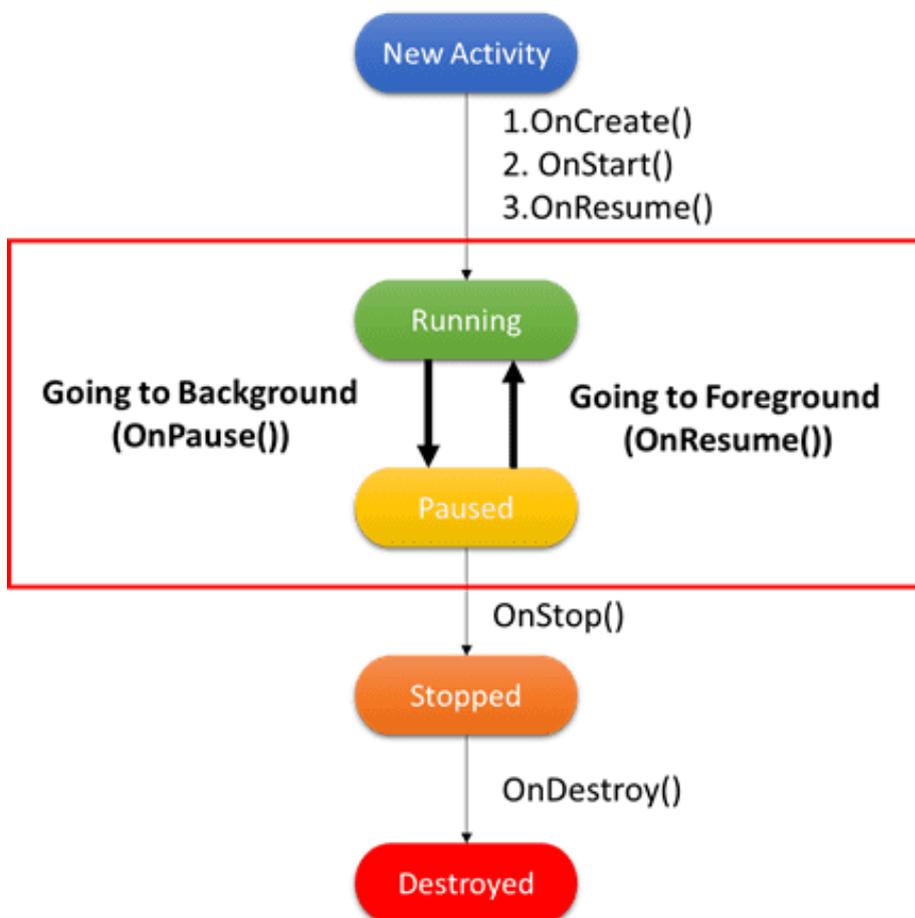


Shapefile import completed

8. Khamari Mobile App Overview

Android Application Lifecycle

- Definition: The Android application lifecycle describes the sequence of states an app goes through, from launch to shutdown, driven by user interactions and system events.
- Importance: Managing lifecycle states is crucial for optimal memory usage, smooth user experience, and app performance.



Lifecycle Phases

- ✓ Launch (Activity Creation):
 - ✓ onCreate(): Initialization of essential components.
 - ✓ onStart(): Preparing the app to become visible.
- ✓ Active (Running State):
 - ✓ onResume(): App becomes interactive; UI is fully visible.

Android Activities

Definition: An Activity represents a single screen in an Android app, serving as the entry point for user interactions with an app.

Purpose: Activities are essential for managing the app's user interface and handling user inputs.

Lifecycle Management: Each Activity goes through a lifecycle of states (created, started, resumed, paused, stopped, destroyed) which affects its visibility and interaction capability.

These are the activity lifecycle callbacks we'll be taking a look at:

1. onCreate
2. onStart
3. onResume
4. onSaveInstanceState
5. onPause
6. onStop
7. onDestroy
8. onRestoreInstanceState

Android Fragments

- **Definition:** A Fragment is a reusable, modular section of an Activity that has its own lifecycle, UI, and can be added or removed dynamically.
- **Purpose:** Fragments enable flexible UI designs that adapt to different screen sizes, especially on tablets and multi-pane layouts.

Key Benefits:

- **Modularity:** Enables code reuse across multiple activities.
- **Dynamic UI:** Add, replace, or remove fragments at runtime to provide a responsive user experience.

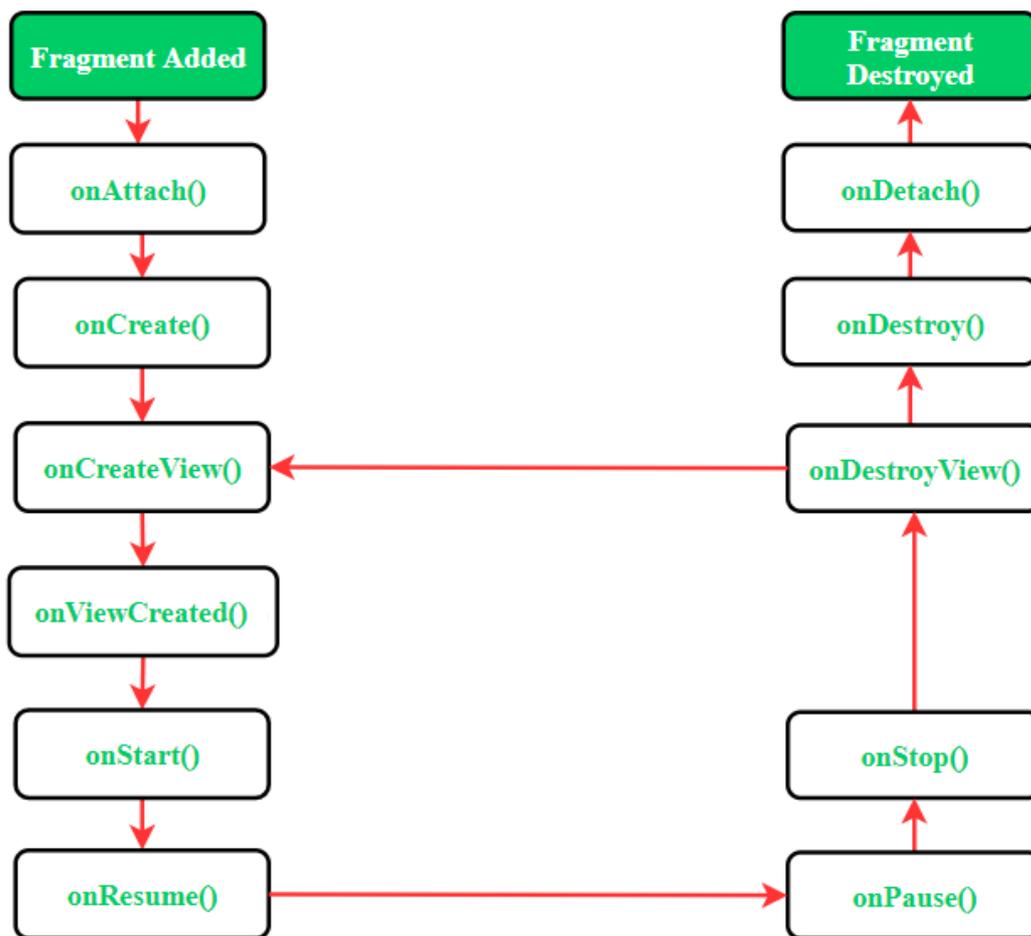
Example Use Case:

- **Master-Detail Layout:** On tablets, show a list on one fragment and details on another.

Types of Android Fragments

1. **Single Fragment:** Display only one single view on the device screen. This type of fragment in android is mostly used for mobile phones.
2. **List Fragment:** This Fragment is used to display a list-view from which the user can select the desired sub-activity. The menu drawer of apps like Gmail is the best example of this kind of android fragment.
3. **Fragment Transaction:** This kind of fragments in android supports the transition from one fragment in android to another at run time. Users can switch between multiple fragments like switching tabs.

Fragment Lifecycle and Management



Android Intents

- **Definition:** An Intent is a messaging object used to request an action from another app component, allowing communication within and between apps.
- **Types of Intents:**
- **Explicit Intent:** Directly specifies the target component (e.g., start another activity within the same app).
- **Implicit Intent:** Declares an action and lets the system determine which app can handle it (e.g., sharing a file or opening a URL).

Common Use Cases:

- **Activity Navigation:** Start a new screen in the same app.
- **Data Sharing:** Send data to other apps, such as a photo or text.

9. BCC Cloud Console Overview

About BCC Cloud

- ✓ Hosted at: <https://ndc.bcc.gov.bd>
- ✓ National Data Center by Bangladesh Government
- ✓ Provides Elastic Compute Service (ECS) and other cloud solutions
- ✓ Secure, scalable, and locally hosted infrastructure

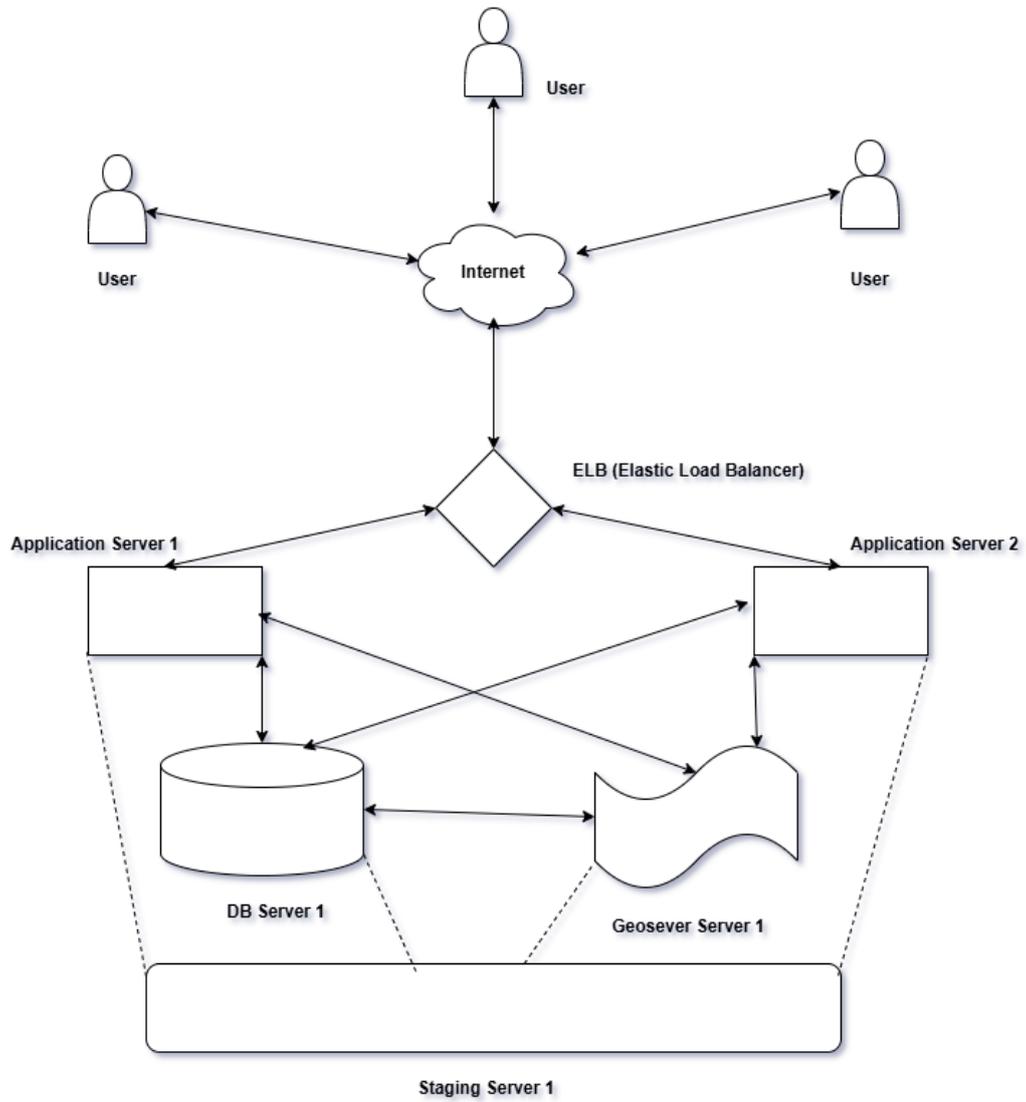
Deployment Summary

- ✓ 5 ECS instances across different roles
- ✓ Application servers behind load balancer
- ✓ Dedicated PostgreSQL DB
- ✓ High-memory GeoServer setup
- ✓ Staging ECS with developer tools

Application Server Overview

- ✓ Hosted at: <https://ndc.bcc.gov.bd>
- ✓ National Data Center by Bangladesh Government
- ✓ Provides Elastic Compute Service (ECS) and other cloud solutions
- ✓ Secure, scalable, and locally hosted infrastructure

Server System Architecture Diagram



Load Balancing Strategy

- ✓ Elastic Load Balancer distributes traffic
- ✓ Ensures high availability & fault tolerance
- ✓ Health checks monitor instance status
- ✓ Horizontal scaling-ready

Database Server (PostgreSQL)

- ✓ 1 ECS: 16 Cores, 32 GB RAM, Ubuntu
- ✓ PostgreSQL configured for high performance
- ✓ Weekly backups
- ✓ Only accessible from App servers (firewalled)

GeoServer Architecture

- ✓ 1 ECS: 16 Cores, 64 GB RAM, Ubuntu
- ✓ Running 3 GeoServer instances
- ✓ Uses PostgreSQL/PostGIS for spatial data
- ✓ Serves WMS/WFS/Geo

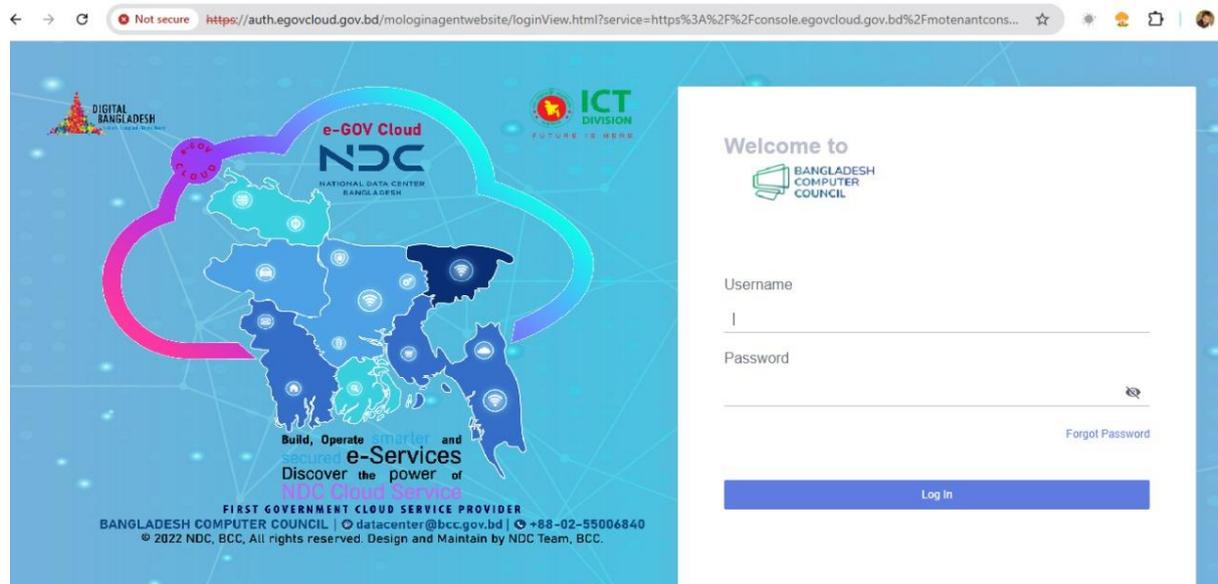
Staging Server Configuration

- ✓ 1 ECS: 4 Cores, 8 GB RAM, Windows OS
- ✓ Tools Installed:
- ✓ pgAdmin for DB management
- ✓ MobaXterm for SSH/terminal
- ✓ FTP server for file transfers
- ✓ Isolated for UAT & internal testing

BCC Cloud Console Panel Access Process

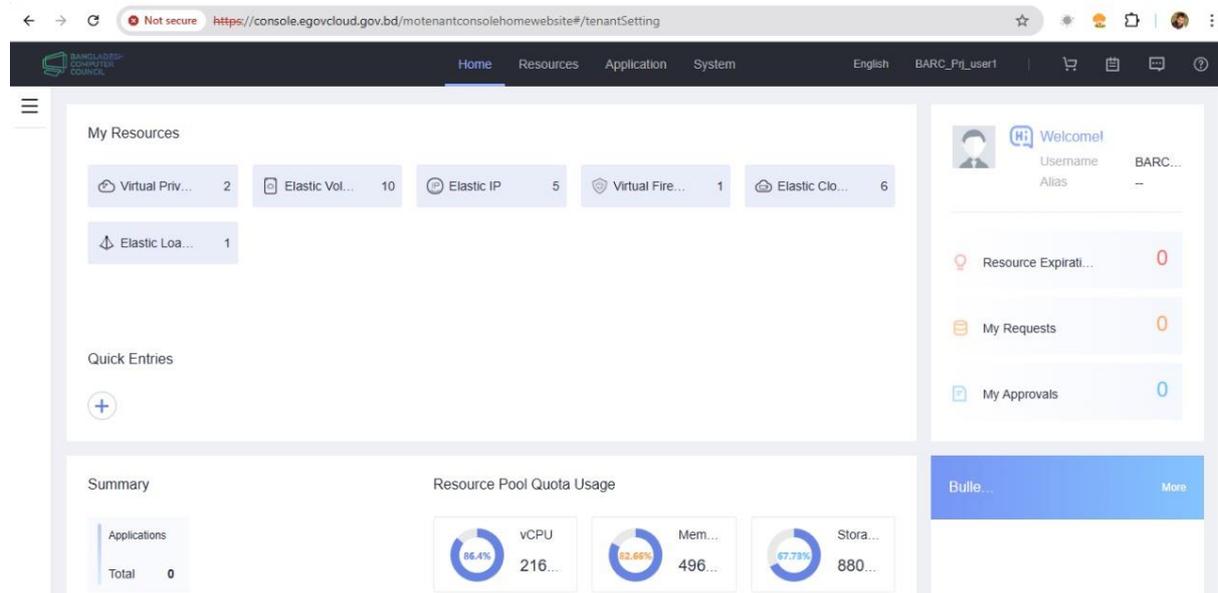
Step 1: Setup BCC provided VPN client SecoClient as instructed by their manual.

Step 2: Brows the URL - <https://console.egovcloud.gov.bd>



Step 3: Login to the panel with User Id and Password.

Logged in Dashboard of BCC Console Panel



Current ECS list

The screenshot shows the Cloud Server Console interface. The left sidebar contains navigation options: Dashboard, Elastic Cloud Server (selected), Elastic Volume Service, Image Management Service, Auto Scaling, Key Pair, and ECS Group. The top navigation bar includes the Bangladesh Computer Council logo, location (Dhaka-01), and user profile. The main content area displays a list of ECS instances with the following columns: Name, Status, Flavor, Image (Version), IP, EIP, AZ, C..., E..., C..., M..., and Ope... (Operations). The table lists seven instances, all with a status of 'Running'.

Name	Status	Flavor	Image (Version)	IP...	EIP	AZ	C...	E...	C...	M...	Ope...
cropzone_application_s2	Running	8 vCPUs 16 GB	Ubuntu 24.04 LT...	1...	--	D...	X86	N...	B...	fa...	Rem
cropzone_db_s1	Running	16 vCPUs 32 GB	Ubuntu22-04 LT...	1...	--	D...	X86	N...	B...	fa...	Rem
cropcone_application_s1	Running	8 vCPUs 16 GB	Ubuntu 24.04 LT...	1...	--	D...	X86	N...	B...	fa...	Rem
cropzone_staging_s1	Running	4 vCPUs 8 GB	Window 10 Pro ...	1...	1...	D...	X86	N...	B...	fa...	Rem
cropzone_geoserver_s1	Running	32 vCPUs 64 GB	Ubuntu Server 2...	1...	--	D...	X86	N...	B...	fa...	Rem
barcapps	Running	4 vCPUs 8 GB	Centos 8.4 2105...	1...	4...	D...	X86	N...	B...	fa...	Rem

Single ECS Details

The screenshot shows the details page for the ECS instance 'cropcone_application_s1'. The page includes a navigation sidebar, a top navigation bar, and a main content area with a detailed view of the instance's configuration and associated resources.

ECS Details:

- Name: cropcone_application_s1
- Status: Running
- ID: b3733929-e484-4a69-a8d6-edebbf2e47fd
- Disks: 2
- AZ: Dhaka-01
- CPU Architecture: X86
- Created: Nov 20, 2024 13:06:07
- Creator: BARC_Pri_user1
- Description:
- VPC: [Shared] MOA_BARC_SHARED_VPC
- Flavor: Medium | 8 vCPUs | 16 GB
- Image: Ubuntu 24.04 LTS Noble Numbat Minimal
- NICs: 1
- Configure agency:
- Expires: Never
- Same Storage: Yes
- CD-ROM Drive: Available
- Static Injection Drive: None

Attached Disks:

- cropcone_application_s1-volume-0000 | System Disk | 100GB
- cropzone_application_s1_volume-0001 | Data Disk | 50GB

D. Concluding Remarks

Training on crop zoning system will help to continue, update and maintain crop zoning activity after the completion of project. Application of crop zoning system in agriculture will not only promote sustainable agriculture but also ensure food and nutrition security maintaining good soil health. This training manual will serve as a guideline of crop zoning system development.