

JOINT COOPERATION PROGRAMME BANGLADESH – THE NETHERLANDS

Technical Report 9

Information for Impact – The development of the BDP2100 Knowledge App

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Knowledge development for a prosperous delta

JCP Technical Report 9

Information for Impact – The development of the BDP2100 Knowledge App

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SUMMARY

Information is critical for decision making in deltas. Maps and tables can easily show where polders are located, salinity intrusion happens, and crops are grown. Complexity and uncertainty increase in deltas, due to climate change and development, and there for the demand for easily accessible information increases. In the Joint Cooperation Program (JCP), a 4-year knowledge cooperation between applied research institutes in Bangladesh and the Netherlands, practical solutions are being developed to support the implementation of the Bangladesh Delta Plan 2100 (BDP2100). One of the projects within JCP is the Project 'Information for Impact'. The objective of this project is to develop an easily accessible app for smartphones that will make available information on the BDP2100. The project Information for Impact is led by the Center for Environment and Geographical Information Services (CEGIS) together with Wageningen University and Research (WUR). This report covers describes the user demand assessment, technical details of the app, the app development process, the (future) business model and training & workshops.

The app development was initiated through stakeholder engagement followed by a series of workshops, group and informal discussions with the stakeholders. The app development team shared the initial concepts, purpose and scope of the app through a mockup design to get feedback and comments from stakeholders on the functionalities and flow of the application and further develop the design of the application for the development team.

The app-based information service has been in this study. The app makes information on BDP2100 available through a smart phone by connecting to an 'in between' database at a server while leaving the original data in its original database. In this way, the knowledge app makes the BDP2100 and related information accessible to a wide range of users. Based on a user assessment, seven functional modules were developed, such as Delta Plan 2100, Water Resources, Agriculture, Environment & Disaster, Socio Economic, Spatial Planning & Land use and Climate. It generates tables, graphs, charts and maps to providing information to users and the user gets easily accessible location-specific critical decision-making information by using their smartphone. A PostgreSQL database is being used as the backend database for the App. Java language is being used for front-end design and analysis. It is a dynamic tool to have facilities to update information in future which would be useful to users, stakeholders and planners.

In an interactive process with the stakeholders, the BDP2100 App was tested with various groups of stakeholders, and based on the feedback the functionality was improved. The team explored the (future) business model, finding that in this initial stage, a user agreement is the best way to introduce and further develop the app. At the current level, the app provides location specific information about BDP investment projects, BDP 2100 hotspots, water availability, rainfall, flood risk, BDP scenarios, crops production, agricultural practices, and also spatial planning and climate risk and vulnerability-related information. With this, the app provides excellent information services and thus facilitates the BDP implementation.

TABLE OF CONTENTS

SUMMARY	II
LIST OF TABLES	IV
LIST OF FIGURES.....	IV
ACRONYMS AND ABBREVIATIONS.....	V
I INTRODUCTION	I
1.1 Introduction	1
1.2 Background of the Study	1
1.3 Objectives of the Study	2
1.4 Literature Review.....	2
1.5 Methodology of the Study	2
2 DESIGN AND DEVELOPMENT OF THE MOBILE APP APPLICATION	4
2.1 User Demand Assessment and Planning Strategy	4
2.2 Development of Content and Facility: Architecture of the App and Mock-up Design.....	5
2.2.1 Mockup Design.....	5
2.2.2 Architecture of the App	7
2.3 Functional Design and Development.....	8
2.3.1 Functional Design	8
2.3.2 ER Diagram.....	9
2.3.3 System Configuration	10
2.3.4 Training and Workshops for App Developers.....	11
3 CONSULTATION AND TESTING OF THE APP.....	13
3.1 Consultation and Testing during First Year: User Demand	13
3.2 Consultation and Testing during Second Year: Feedback on Beta Version.....	13
3.3 Consultation and Testing during Third Year: App Demonstration	13
3.3.1 Demonstrations of the App.....	13
3.3.2 Feedback from App Demonstrations.....	14
4 BUSINESS MODEL.....	16
4.1 Developing the Business Model	16
4.2 Key Partners	16
4.3 Key Activities.....	16
4.4 Customer Relationships	16
4.5 Customer Segments	16
4.6 Channels	16
4.7 Cost Structure	16
4.8 Revenue Streams	17
5 DISCUSSION.....	18
6 CONCLUSION.....	19
REFERENCES	20
LIST OF THEMATIC LAYERS.....	21

LIST OF TABLES

Table 2.1: System Configuration	10
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LIST OF FIGURES

Figure 1.1: Development Process of App	3
Figure 2.1: Process of the User Demand Assessment.....	4
Figure 2.2: Delta Forum Consultation Meeting.....	5
Figure 2.3: Mock-up Design of App.....	5
Figure 2.4: Design of App.....	6
Figure 2.5: System Architecture of App.....	7
Figure 2.6: Activities of App	9
Figure 2.7: Entity–Relationship Model	10
Figure 5.1: Time Series of App Download in All Countries	18

ACRONYMS AND ABBREVIATIONS

BDP2100	Bangladesh Delta Plan 2100
BGP	Blue Gold Programme
CEGIS	Center for Environment and Geographical Information Systems
EKN	Embassy of the Kingdom of the Netherlands
ER	Entry-relationship
GED	General Economics Division (of the Planning Commission)
GOB	Government of Bangladesh
JCP	Joint Cooperation Programme Bangladesh - the Netherlands
OMT	Operational Management Team
ORDBMS	Object Oriented Relational Database Management System
SDLC	System Development Life -Cycle
SIBDP	Support to the Implementation of the Bangladesh Delta Plan
UI	User Interface
WUR	Wageningen University and Research

I INTRODUCTION

1.1 Introduction

Bangladesh is a rapidly growing country and is expected to achieve the middle-income status by 2021. In the pursuit of development, the Government of Bangladesh took a pro-active approach to address major challenges related to adaptive delta management and sustainable development. The government has approved the Bangladesh Delta Plan 2100 intending to ensure water and food security, as well as economic progress [1]. The plan is expected to boost the country's GDP growth by another 1.5 percent by 2030.

The Knowledge and Information Portal of BDP2100 was developed during the preparation of the plan, to provide information services to support planners and decision-makers in participatory and interactive planning and decision-making processes. It contains a number of data layers on water resources, disaster management, spatial planning and land use, environmental management, food security, economics, finance, climate change and other basic data [2]. The Portal will be regularly updated with recent data and information [3].

It is foreseen that after the completion of SIBDP project, GED can update the portal with the assistance of CEGIS. A user agreement will be prepared for this purpose [4]. Gathering spatial and temporal data layers, policy documents and other technical reports will thus be a continuous process. Besides information, the portal includes a number of knowledge-based tools such as the Climate Atlas, and the Bangladesh Metamodel to support planning, decision making and the implementation process for Sustainable Delta Management. In addition to the work on knowledge portal development, a (location) based information service is being developed through this project to support the implementation of the BDP-2100, as an easy to use and easy accessible information service. Shortly this is called the BDP2100-app.

Nowadays, most of the people of the country own have smartphones and other internet-usable devices. The number of mobile phone users, ICT facilities and internet connections are rapidly expanding in Bangladesh. The use of mobiles as information service tools is also gaining popularity. Using mobile applications, shortly called apps, as a means for providing continuously up-to-date information services, the knowledge portal can become an innovative solution, and through smart data analysis, we can eventually provide information to a wide range of planners, decision-makers, plan implementers, specialists, researchers, teachers, students, media and the other people. The app allows easy access to continuously up-to-date information and engage the users in participatory and interactive planning process, ensuring quick and efficient sharing of information and decision-making.

The BDP200-app has been developed on the basis of data layers in the Knowledge and Information Portal of Bangladesh Delta Plan 2100 and the Bangladesh Delta Plan 2100 report [5]. The BDP2100-app delivers location-specific information about water availability, temperature, flood risk, soil parameters, crops, agricultural practices, and also spatial planning and climate risk and vulnerability-related information. The app can further demonstrate the potential of using the information services which will strengthen or facilitate assessment and implementation processes.

1.2 Background of the Study

The Bangladesh Delta Plan 2100 has been approved by the government with a view to secure water and food security as well as economic progress (boosting GDP growth by another 1.5% within 2030). A knowledge and information portal consisting of several data layers including water resources, disaster management, spatial planning and land use, environmental management, food security, economics, finance and basic data was developed during the formulation of the BDP2100. Many people however, are unaware about the knowledge portal. At the same time, there is a wide array of information available, from which it is difficult to choose the right information to support planning and decision-making. Moreover, the users are not well conversant with the information they might get from the knowledge portal.

Mobile phone with smart applications is now available everywhere in Bangladesh which helps access all sorts of information. Therefore, as a start, this project aims to design and develop an app (mobile app) based information platform to provide location-based information service that support planning and decision-making in line with

the activities of Adaptive Delta Management.

1.3 Objectives of the Study

The main objective of the study is to design and develop a mobile app to provide location-based information services. More specifically,

- To support planning and decision-making in line with the activities of Adaptive Delta Management.
- To facilitate information and knowledge services using smartphone;
- To demonstrate and disseminate information for the public users and stakeholders using a mobile app;

Therefore, the research questions that this study focusses on are

- What literature is available on app development and information services to guide the app development
- How can the app be developed
- Once a test version is developed, how can it be tested with user involvement
- What could be the business model for continuation of the app

1.4 Literature Review

Mobile app is modern and advanced technology. It has come up for the new generation in the form of a digital platform with advisory services for the general public. Some national apps like Fosholi [6], Pesticide Prescriber, Agriculture Information Service [7], Bangladesh Rice Knowledge Bank (BRKB) [8], Fish Advice [9], Agro Knowledge Bank (AKB) [10] are intended to educate the people about the agriculture and agro based facts and information. The objective of the application is to aware and deliver proven scientific evidence on agriculture. This is an icon and menu based app for the Bangladeshi Agriculturists. Also reviewed some international apps like globe climate [11], ClimaticWatch [12], UN Climate Change [13], MyFloodRisk [14], Climate Change Awareness are social media platforms to bring people together and raise awareness about climate change and how it impacts our environment and ecology. All these apps provide comprehensive facts causes and effects of climate change. These are also the icons and menu-based mobile apps for the international community. Using these apps one can get detailed information on how to plan for future. Furthermore, one can also know about the implementation, management and maintenance of the climate resilient. After reviewing all these it is understood that apps the Knowledge App needs to combine with the following features:

- Interactive information presentation;
- Icon and menu based mobile app;
- User friendly information navigation;
- Popular Android-oriented design interface for better performance of knowledge app;

1.5 Methodology of the Study

The methodology of this work has been designed in such a way that app development activities can be carried out in an organized way, and the workflow has been set according to the steps to be followed throughout the process. The overall methodology consists of three major components which are user demand assessment, application development (mock up version and further development) and business model development.

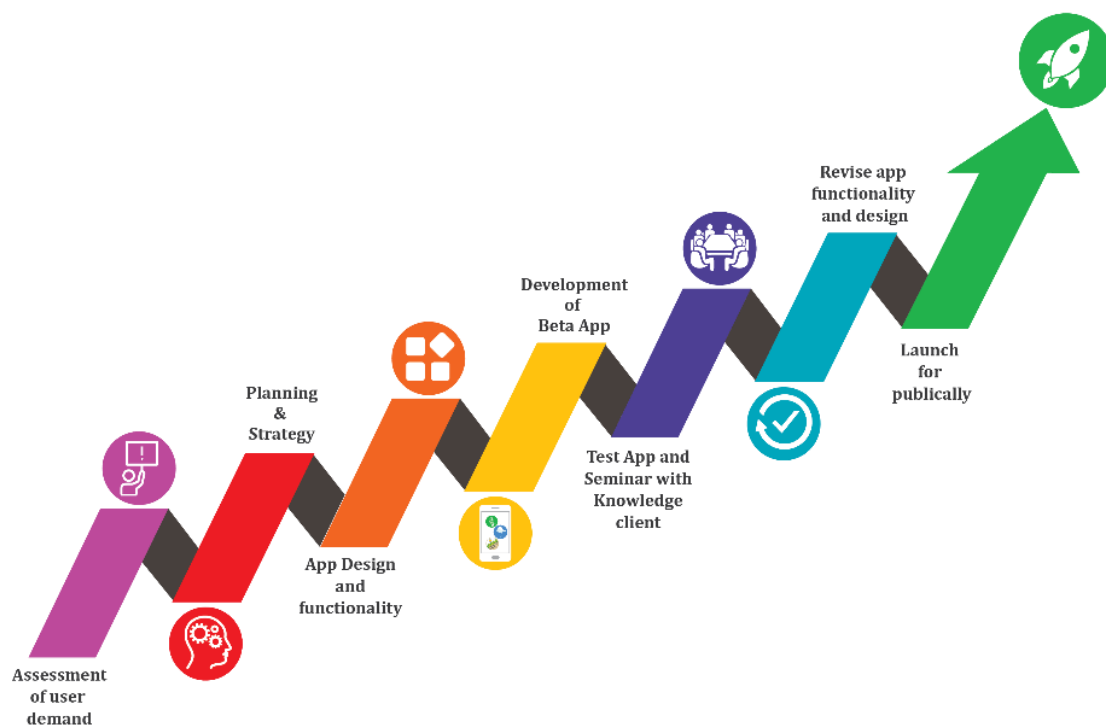


Figure I.1: Development Process of App

2 DESIGN AND DEVELOPMENT OF THE MOBILE APP APPLICATION

The main focus of this study is to develop an effective and efficient app that can provide information services to support the implementation of Bangladesh Delta Plan 2100. Presently, the App development has been completed. The user gets location specific critical decision-making information in their pockets. The mobile app generates table, graph, chart and map for providing information to the stakeholders. PostgreSQL database is being used as backend database for the App. Java language is being used for front-end design and analysis. The main interface has been developed, that helps to access each module of the app. The app comprises seven functional modules such as Delta Plan 2100, Water Resources, Agriculture, Environment & Disaster, Socio Economic, Spatial Planning & Landuse and Climate. It uses information from Bangladesh Delta Plan knowledge portal and delta plan reports.

We'll report on the design and development the mobile app application in 3 steps, i.e. user demand assessment and planning strategy, the development of the content and facility in the mock-up design and thirdly, the software development, i.e. from the mock-up design to the functional design.

2.1 User Demand Assessment and Planning Strategy

The app development has begun with stakeholder engagement followed by a series of workshops, group and informal discussions with the stakeholders of GED, BWDB, WARPO, LGED, SIBDP, BUET and BADC. The app development team shared the initial concepts, purpose and scope of the app to get feedback and comments from participants on the functionalities and flow of the application. They presented mock up design and proposed primary functions of the app in three different workshop such as JCP inception workshop, Delta Forum sharing workshop at General Economic Division (GED), Planning Commission, dated 17 June 2019 and Dhaka Water Knowledge Days, Dhaka, 27-31 October 2019. In the workshops, participants frequently asked open and obvious questions and were requested to share their needs, and reflection on the design of the app, the development of the platform and the information technology.

The app development team conducted one-on-one user feedback sessions with the professionals of GED, SIBDP and CEGIS. The team asked participants to give their information requirements, design and expected functionalities. Moreover, the team also discussed with other Programmers and IT experts in CEGIS regarding database structure, system architecture and the development platform of the app. Many brainstorming sessions among the app development team were held to finalize the features of the app. Storyboard was created to illustrate the interaction between user interfaces and components.

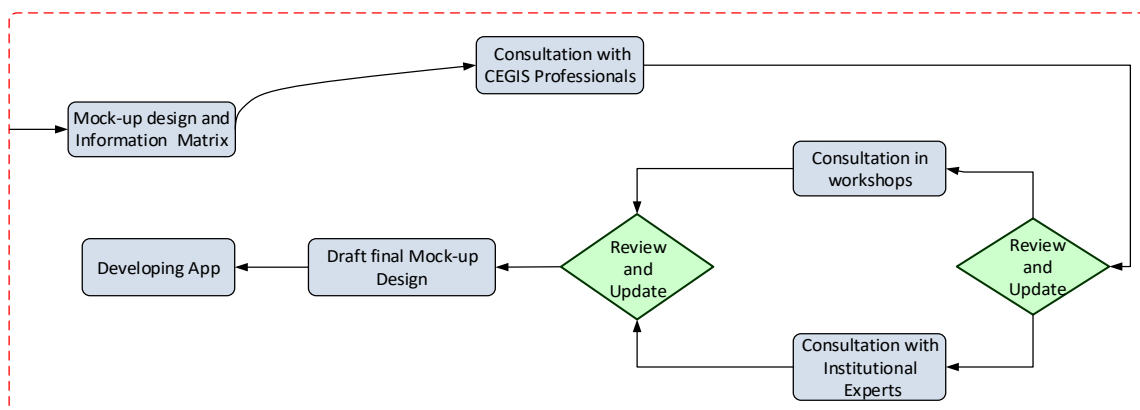


Figure 2.1: Process of the User Demand Assessment



Figure 2.2: Delta Forum Consultation Meeting

2.2 Development of Content and Facility: Architecture of the App and Mock-up Design

2.2.1 Mockup Design

A mockup design of the app has been developed using PowerPoint to visualize the app user interface of the information services to implement Bangladesh Delta Plan 2100. Mockup answered stakeholder questions and supported the development team to finalize design. It was developed for sharing information among stakeholders. Stakeholders can see, interact and communicate with mockup more easily and effectively. Thus, they could involve to discuss in various improvements in user interface (UI) design, logo, icons, color scheme, outlook and feel of the app. The mockup includes buttons, menus, sub-menus and features, which illustrate the connections between the different screens and the navigation path through the app. The mockup presents information in map, chart, graph, table and text format. A number of spatial and non-spatial data layers have been used for developing mockup. It describes general usability and allows users to involve in the designing process.

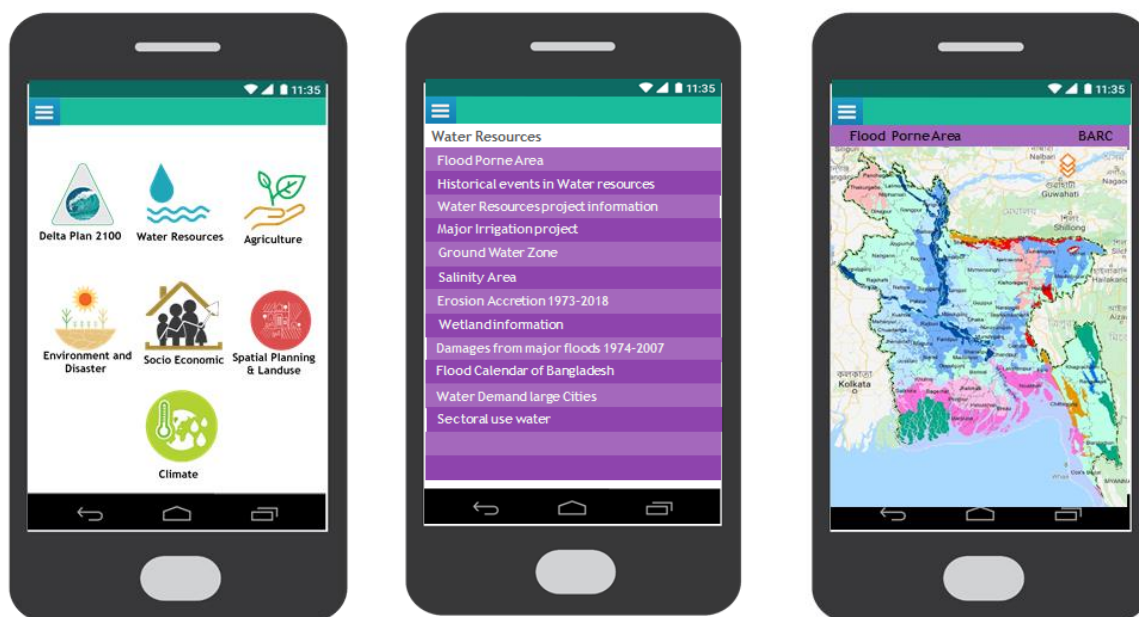


Figure 2.3: Mock-up Design of App

A mockup design of the app has been developed using literature and PowerPoint to visualize the app user interface of the information services to implement Bangladesh Delta Plan 2100. The mockup helped to answer stakeholder questions and supported the development team to finalize the design. It was developed for sharing information among stakeholders. Stakeholders can see, interact and communicate with the mockup more easily and effectively, and further specify their needs based on the mockup design. Thus, they can involve discussing in various improvements in user interface (UI) design, logo, icons, color scheme, outlook and feel of the app. The mockup includes buttons, menus, sub-menus, features and maps, which illustrate the connections between the different screens and the navigation path through the app. The mockup presents information in map, chart, table and text format. A number of spatial and non-spatial data layers have been used for developing mockup. It describes general usability and allows users to involve in the design process.

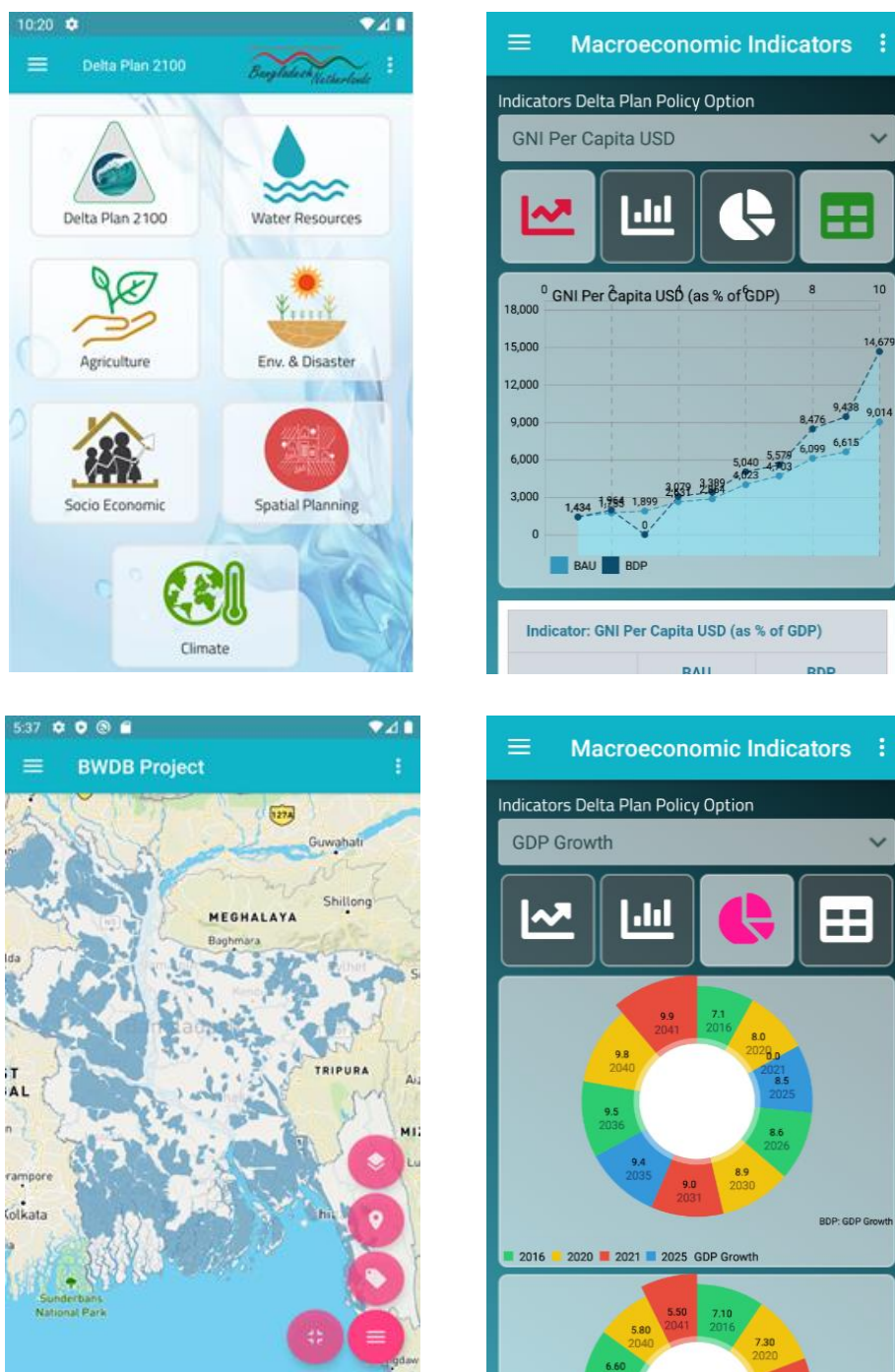


Figure 2.4: Design of App

2.2.2 Architecture of the App

The app works based on information from the BDP Knowledge Portal. It is not foreseen that the app uses the information directly, as this has disadvantages, e.g. it makes the app slow, as the data needs to be retrieved from a large database. Therefore, the app uses its database, which is regularly updated with the data in the Knowledge Portal. The application's database is set up and placed on a data server. It contains spatial and no-spatial data, views, triggers and stored procedures. Geographical data services via the internet require proper management of spatial and non-spatial data. Geographic Information System helps in the effective analysis and management of spatial data. Spatial data attributes can be efficiently managed using an open source-based Object-Oriented Relational Database Management System (ORDBMS).

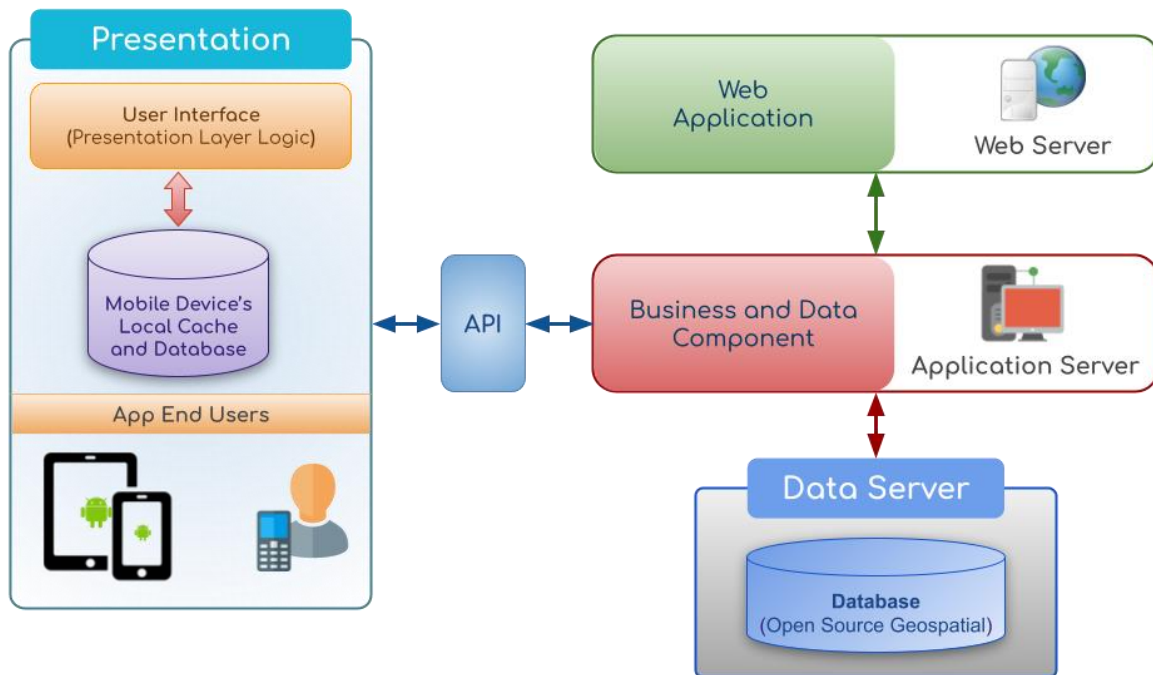


Figure 2.5: System Architecture of App

Depending on the requirements identified and functionalities determined in the need assessment, a logical model or framework of the overall system has been developed (Figure 2.3). The system consists of four layers as Presentation (user-interface), Web Server, Application Server and Data Server. It consists of the following layers:

- Presentation (user-interface)
- Web Server
- Application Server
- Data Server

Presentation (user-interface)

The presentation layer is a user-interface that a user uses to interact with the application. This layer contains an interface of seven thematic areas. This layer is being developed using Java and in support of Android Studies.

Web server

The main component of a web-enabled application is the web server. It is a program that manages, delivers and allows users to communicate with the server for data service through the internet. The web server is being configured using Internet Information Services (IIS).

Application Server

The application layer is one of the main development area which will consist of business and data components. The business component is used to impose different business logic. The data component is responsible for retrieving data from the server through API. ASP.Net (Core 3.1) and the Representational State Transfer (REST) web service protocol have been used to develop the application layer. RESTful APIs are more lightweight, manageable and scalable.

Data Server

The data server contains data, views, triggers, stored procedures and spatial data. It executes SQL statements, views, triggers, and stored procedures for data manipulation and presentation. An open-source relational database PostgreSQL [15] has been used to store and organize data.

The Database, API and Web Server layers are not visible to the user, as the Presentation layer is the main part that the users see of the app.

2.3 Functional Design and Development

At this stage, the app developer was translating mockup design into software. The application developer was developing the first version of app on the android platform that can meet end-user requirements from the workshops and consultations. First version of app had demonstrated to the stakeholder's focusing on its applicability, available information and functionality. Through discussion, stakeholder feedback had received for the revised design and information services of app. According to feedback from stakeholders, the app developer revised app functionality and improved information services. Applicability had checked by launching the app by the stakeholders using an end-user-defined case study.

2.3.1 Functional Design

The main focus of this study was to develop an effective and efficient app that can provide information services to support the implementation of Bangladesh Delta Plan 2100. Presently, the App is developed and the data has been updated. The user gets location-specific critical decision-making information in their pockets. The mobile app generates tables, charts and maps for providing information to the stakeholders. A PostgreSQL database has been used as a backend database for the App. Java language has been used for the front-end design and analysis. The main interface is developed, which helps to access each information package (module) of the app. The app comprises seven functional modules such as Delta Plan 2100, Water Resources, Agriculture, Environment & Disaster, Socio Economic, Spatial Planning & Landuse and Climate (Figure 2.4). It uses information from the Bangladesh Delta Plan knowledge portal.

Each module contains a distinct user interface that interacts with a number of data layers including tabular and spatial data. The mobile (android) app is publicly available in the Google Play Store. Brief descriptions of the modules are narrated below:

Delta Plan 2100: This module includes Bangladesh Delta Plan-related information. The user can obtain information on key facts of Delta Plan 2100, delta management strategies, delta opportunities, delta challenges, delta scenarios, BDP2100 investment projects, etc. which helps them in support of their activities related to long-term integrated and holistic plan in delta plan implementation.

Water Resources: This module contains information regarding water resources and river system management, which are essential components for water resources planning, implementation and operation & maintenance issues. It includes historical events in water resources, water resources development projects, major irrigation projects, flood-prone areas, groundwater zones, salinity areas, major flood damage, erosion and accretion, water demand, etc.

Agriculture: This module includes information on crops, food security, agricultural technology and critical information such as crop area, crop suitability, food production and demand, drought information, irrigation coverage, food availability, fish production, crop calendar, boro and aman coverage, fertilizer use, land type, etc.

Environment and Disaster: This module contains environmental and disaster information such as natural hazards, arsenic contamination, cyclone-affected areas, drought, river erosion and accretion, natural hazards, flood extent, salinity intrusion, damages resulting from major floods, protected areas, etc.

Socio Economic: This module provides socio-economic information including population distribution and density of rural and urban populations, household income, poverty, availability of safe drinking water, sectoral employment, literacy rate, settlement locations, household information, and population projections for planners and decision-makers.

Spatial Planning & Landuse: This module incorporates information related to general landuse, land type, physiographic units, forest land, agro-ecological zones, ecosystem, char land, urban land use data etc.

Climate: This module incorporates information related to Climate and Climate Change related data to describe and interpret the present and future status of climate.

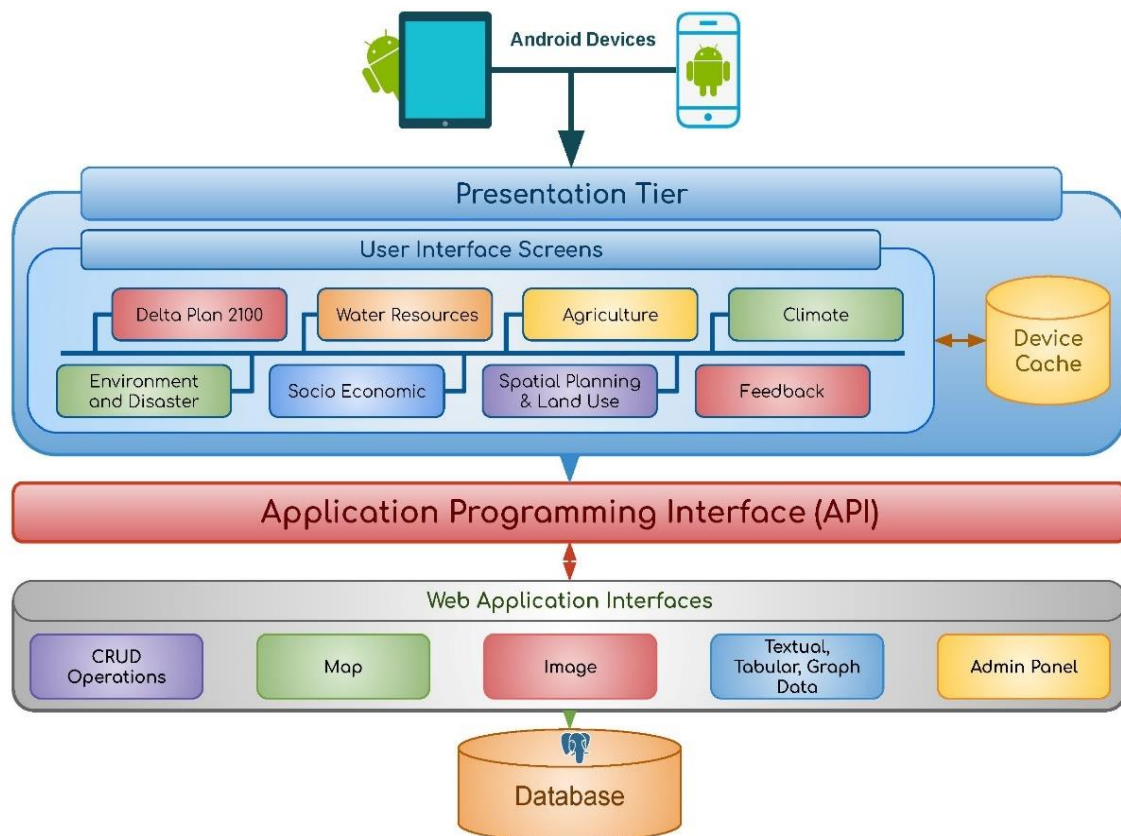


Figure 2.6: Activities of App

2.3.2 ER Diagram

An entity–relationship model (or ER model) describes interrelated issues of interest in a specific domain of knowledge. A basic ER model is composed of entity types (which classify the things of interest) and specifies relationships that can exist between entities (instances of those entity types). In the case of App, an ER model is commonly formed to represent the business needs required to perform business processes. Consequently, the ER model becomes an abstract data model that defines a data or information structure that can be implemented in a database, typically a relational database.

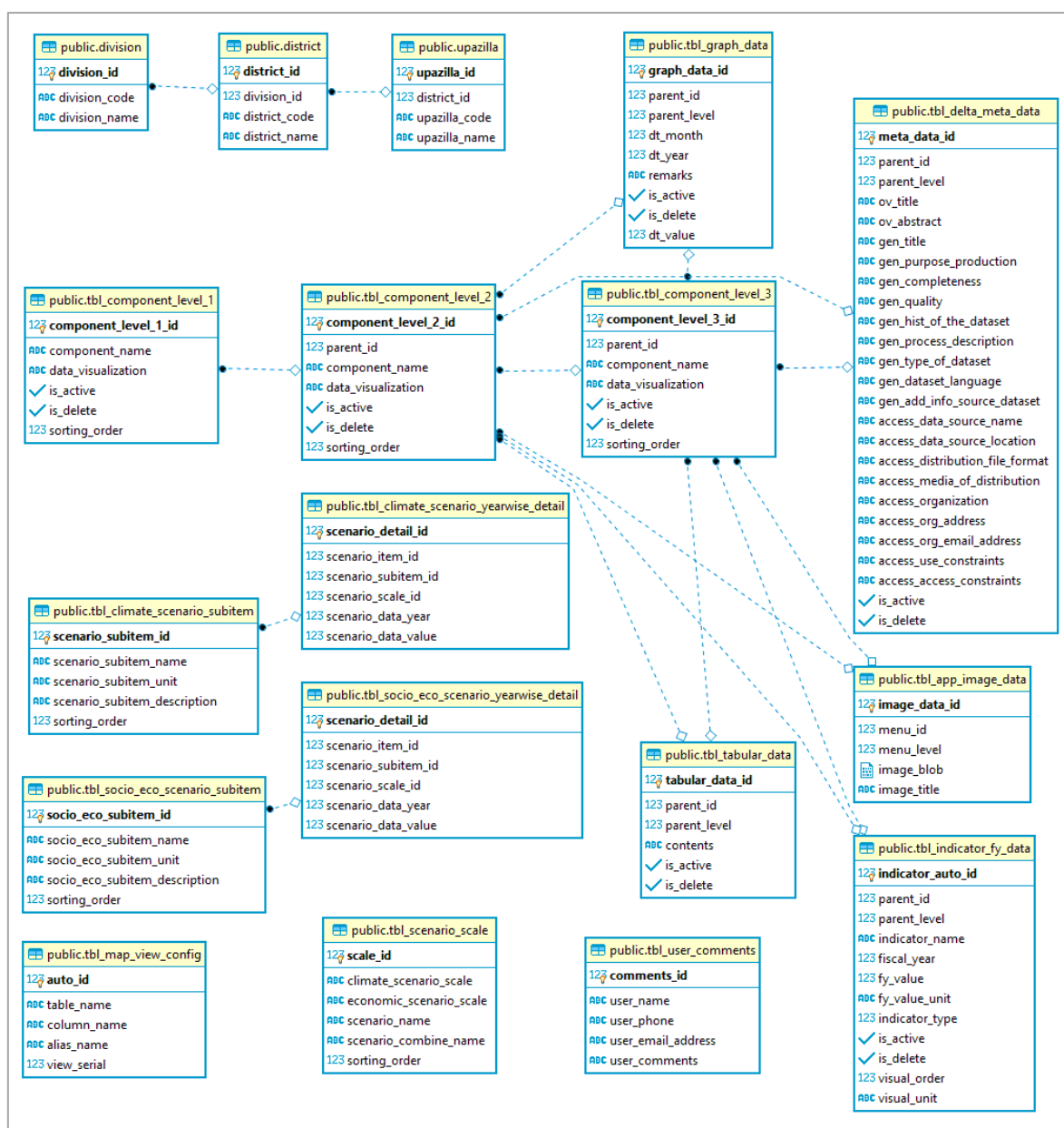


Figure 2.7: Entity–Relationship Model

2.3.3 System Configuration

The system Configuration of the APP and technology used is given in the table below.

Table 2.1: System Configuration

Development Language	Java
Front-end Design	XML (Extensible Markup Language 1.0)
Development Tools	Android Studio 3.5.1
GIS Tools for map rendering	MapBox (SDK 8.6.0)
SDK Version	Minimum 15 (Ice Cream Sandwich) to up to date
Gradle Version	3.5.3
App storage	Google Play Store

Google Play Version	≥17.0.0
Web Server	Internet Information Services (≥7.0)
Database	PostgreSQL (≥11.7)
Spatial Database	PostgreSQL 11 (≥11.7)

2.3.4 Training and Workshops for App Developers

The app project was also taken up, as part of capacity development for staff: for knowledge to have impact, you have to provide other types of products. In order to be able to work with an app, and make the app useful and further strengthen the professional's capacity with respect to app development. A training course on Python programming language as a part of the capacity building of national institutes under the Joint Cooperation Program (JCP) was organized. The Project team organized a training on “Introduction to Python and App development” on 7, 9, 12 and 14 December 2021 where CEGIS, IWM and WUR professionals participated. IBCS-PRIMAX Software (Bangladesh) Limited a reputed professional training institute together with CEGIS was engaged to provide training covering:

Basic App Development

Beginner's Python programming fundamentals covered concepts such as: data types, variables assignments, loops, and conditional statements, functions, and Files operations. In addition, this section covered key Python libraries for data science such as Numpy and Pandas. Furthermore, this section covers data visualization tools such as Matplotlib, Seaborn, Plotly, and Bokeh. This section also covered how to write GIS applications using Python tools and applications for ArcGIS.

Python Programming Fundamentals

This section covers practical projects on AI/ML applications in Finance. The training covered the application of Deep Neural Networks such as Long Short Term Memory (LSTM) networks to perform stock price predictions. In addition, we will cover unsupervised machine learning strategies such as K-Means Clustering and Principal Components Analysis to perform Banking Customer Segmentation or Clustering. Furthermore, we will cover the basics of Natural Language Processing (NLP) and apply them to perform stock sentiment analysis.

Data Science & Machine Learning in Python

This section covers Android SDK and Platform specification, various SDK versions, Android Studio – the most powerful and smartest IDE, Android projects are structured, Design and Logic parts are separated to build a scalable and extendable project, Manifest and other Resource files, Android projects are built with a powerful build tool – Gradle etc.

The Knowledge App that we are developing to bring BDP2100 ‘in your pocket’ to a wide range of people, is an app service that needs a sustainable business model. This means that, in order to provide the service on a longer-term basis, we need a number of costs to be covered. Data comes from the government and other sources. Agreement with the partners that supply data is, that we do not share their data. However, we agree with our partners that we can share maps representing the data, as this is for the wider interest of all. In order to make the app most useful and further strengthen the professionals for building a business model for the app. Training for building a business model as a part of the capacity building of the project involved institutes under the Joint Cooperation Program (JCP). The Project team organized training on the “Basic Capacity Building workshop of a Business model for the app.” on dated 19th Jan and 9th Feb 2021 where CEGIS, IWM and WUR professionals participated. The business model covered the fundamentals of business analysis, business clients, a focus group of business administrators, and the concept of the knowledge-based product.

The stakeholders expressed their keen interest in the mobile app in the workshops. Numbers of Seminar and workshop was arranged and got positive expression and comments about the App such as International Conference on Sustainable Development 4 organized by United International University (UIU), Coastal River Conference 2022 at Kuakata and River Championship program at Dhaka etc. They gather knowledge from the

app and sharing with all the participants to interrelate this constructive information with their practical information.

3 CONSULTATION AND TESTING OF THE APP

3.1 Consultation and Testing during First Year: User Demand

In the first year, the app testing was mainly focused on user demand. The app development team identified internal and external stakeholders. Internal stakeholders were from CEGIS who have expertise in their subjects such as Water Resources, Spatial planners, Agriculture, Fisheries, Climate change, Ecology and IT. The External Stakeholders were from GED, BWDB, BMD, IWM, BIWTA, WARPO, DU, BUET, SIBDP interested in exchanging knowledge and information.

Majority of the stakeholders expressed their keen interest in mobile app to interact with the information. Stakeholders expected a sophisticated mobile app that has usable features as well as an elegant design. They preferred the Android-based app as it is the most common and popular device among the users. Moreover, they recommended the menu and icon-based most user-friendly and interactive information navigation facilities in the app including all standard functionalities such as zooming, panning, and different map views. Users expressed the number of information thematic areas such as Delta Plan 2100, Water Resources, Agriculture, Environment & Disaster, Socio-Economic, Spatial Planning & Landuse and Climate. Most of the participants have shown interest in having some content available also offline. Mockup design was updated with the feedback and ideas given by the stakeholders and applied in the development stage.

3.2 Consultation and Testing during Second Year: Feedback on Beta Version

In the second year, the focus for consultation and testing was on the beta-version of the app. We started as soon as possible with a beta version. The beta version of app was demonstrated to the stakeholder's focusing on its applicability, available information and functionality. Through discussion stakeholder feedback was received for the revised design and information services of the app.

- App demonstration in user groups.
- Test Version deployed in Google Play Store.
- Development of First Version.

3.3 Consultation and Testing during Third Year: App Demonstration

In the third year, we focused on the demonstration of the app and incorporating feedback in the functionality of the app.

- Improve design and functionality-dashboard icon, JCP name, logo position, sub-menu name re-order, add image and table data.
- Incorporate available data and information of Delta plan2100 report.
- Incorporate scenario information both climate change and socio-economic.
- Update backend database and configure in new server and deployment of update version in server.
- Capacity building training on sustainable business model, App development technique and Python Programming.
- Attended Coastal River Conference 2022 to share knowledge app for information service.

3.3.1 Demonstrations of the App

Coastal River Conference 2022

The Coastal River Conference was held 28-29th January 2022, in Kuakata, Patuakhali, [16], jointly organized by 9 organizations including Bangladesh River Foundation. JCP gave input, sharing the BDP2100 app.

Young River championship 2022

Bangladesh River Foundation, River and Delta Research Center, JCP and other 12 organization arrange a Young River Championship, 2022. It was aim to create awareness among young people about river. From JCP we are participating to help youth with easy access to information though the BDP knowledge app. Young River Championship will be held in three stages.

Delta Knowledge Day 2022

Delta Knowledge Days, 17th and 18th September, 2022 was held on Joint Cooperation Programme Bangladesh – the Netherlands. JCP is a four year applied research programme, contributing to new knowledge supporting adaptive water management in Bangladesh and supports the implementation of the Bangladesh Delta Plan 2100. In the knowledge day BDP2100 app was shared.

3.3.2 Feedback from App Demonstrations

- User friendly navigation
- User feedback form
- Frequently data updating process
- MoU with relevant organizations

Several Comments in App User Section:

- Md. Saifur Rahman - September 19, 2022

I really appreciate CEGIS to take the initiatives to make app like this. Congratulations GED Team and CEGIS Team for an excellent effort.

- Anonymous user - February 19, 2020

Very useful app for whom are interested to research in water sector in Bangladesh. Very informative and knowledgeable app. I'd like to thank the developer for this app.

- Anonymous user - February 19, 2020

Thankful to the entire team for good services.

- Anonymous user - February 19, 2020

Want to use the app without internet connection

- Anonymous user - February 13, 2020

Very informative app for all

- Anonymous user - February 18, 2020

Very nice and interesting app

- Comments from Delta Knowledge Day 2022

Technical Feedbacks

- Most of the participants were getting bug reports for the app.
- The App stopped working in most cases.
- Even using the 4G network in mobile data, the app was crashing.

General Feedbacks/Concerns

- App is useful for researchers, but not for farmers. The facilities can be extended to the farmers.
- The language is in English, not in Bengali.

- Question raised about data updating while it was informed that the app will be hosted by GED server.
- The World Bank is interested in increasing the existing 82 data layers into 182 data layers.
- Agricultural portals can be linked with this app and thus, the information will be updated.
- WARPO data could be connected with the App.
- A demonstration or explanation on the adaptive management and knowledge agenda should be considered in the knowledge portal.
- The efficiency of the app can be improved offline which can be accessed by clicking a browser link.
- Monitoring data from the Ministry of Food and other food related data from National Food Council can be included in the app for updating information in the food section.
- An MOU between CEGIS and GED will be signed soon for the continuation of updating data.
- Legal obligations should be initiated to share information with WARPO and then to incorporate them in the app.

The feedback was incorporated in the design of the app.

4 BUSINESS MODEL

4.1 Developing the Business Model

The Knowledge App that we are developing to bring BDP2100 ‘in your pocket’ to a wide range of people, is an app service that needs a sustainable business model. This means that, in order to provide the service on a longer term basis, we need a number of costs to be covered.

This note is to explore, how we can systematically develop such a business model.

The elements of the model are Key Partners, Key Activities, Key Resources, Value Proposition, Customer Relationships, Customer Segments, Channels, Cost Structure, and Revenue Streams.

We will now discuss each of these elements, with particular reference to the BDP Knowledge App.

4.2 Key Partners

Data comes from government and other sources. Agreement with the partners that supply data is, that we do not share their data. However, we agree with our partners that we can share maps representing the data, as this is for a wider interest for all.

CEGIS and WUR are the partners with IWM, Deltares, in JCP.

Further, there is the SIBDP project, where currently a TA team is working together with the BD government, to enhance and facilitate implementation of BDP2100. At this stage GED wants to make a user agreement MoU with CEGIS and WUR for sustainable progress of the app.

4.3 Key Activities

We provide a database, distilled from the Knowledge Portal Database, from where the data for the App comes. We provide an app, where the customers can see the BDP2100 and related information, we provide the infrastructure between the Knowledge Portal, the database, and the app.

4.4 Customer Relationships

- Inform the updates and latest features of the app
- Provide a window for users to get reward points and use them for payments.
- Offer Different subscription methods.

4.5 Customer Segments

- User Guide/Manual
- Common Q/A section
- Comment Section in Knowledge App.
- Rating and comment section for users on Google Play Store.

4.6 Channels

- Through Internet
- Some data will be in cache memory.
- Mobile Application (Google Play store)

4.7 Cost Structure

We are working in an area, where there are many government services. This means that some costs are hidden

costs, provided by government services. We are assuming that we need to quantify some costs, as we need to ensure recovery of the costs, in order to keep the service to the customer active and up to date.

For the use of the Knowledge Portal, we will like to contribute an amount, which will be going to CEGIS, and for which CEGIS will keep the Knowledge Portal up to date, plus the link between the Knowledge Portal and the Knowledge App database. Further CEGIS needs to keep the KA database up to date. The third cost, is the regular maintenance and update of the app itself.

4.8 Revenue Streams

Freemium: Providing a limited version of the app to the user for free and encourage them to become customers by offering a full-featured version of the app for a price.

Virtual Goods with In-App Purchases: Display the low resolution map to the general user and sell the high resolution with payment.

Advertising and Sponsorship: Earn revenue with large base of users who interact with the app frequently and tap the ads by the different sites and sponsors.

In-app affiliate marketing and Lead Generation.

5 DISCUSSION

Presently BDP2100 is under implementation and GED provides information related to BDP2100 to the wider user to strengthen the use of information and knowledge services, a knowledge app that is available to provide delta plan-related information. GED and other agencies involved in the implementation of the BDP2100, such as ministries, BWDB, BIWTA, LGED, DAE, DoE, are the potential knowledge clients for information services regarding BDP2100.

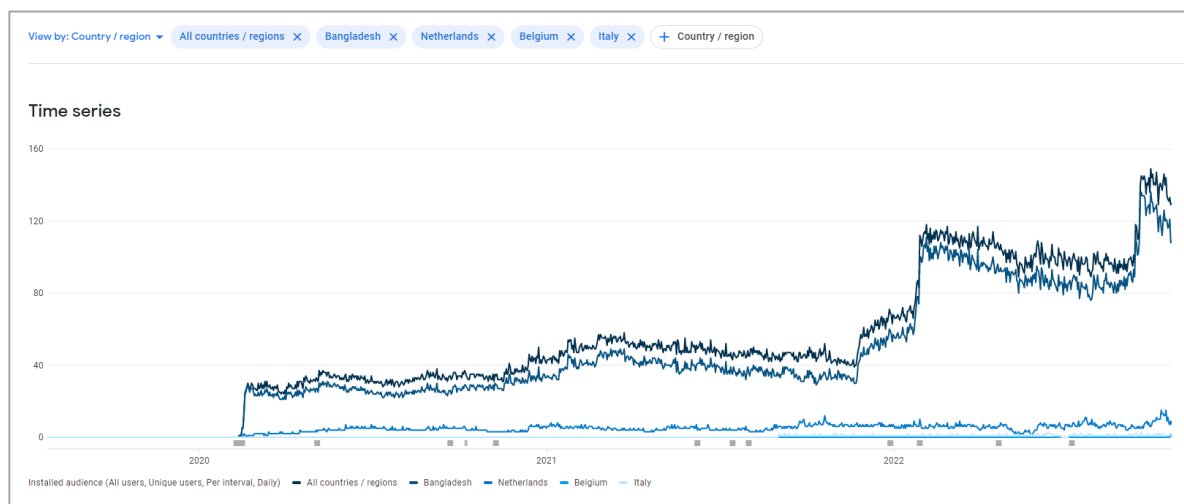


Figure 5.1: Time Series of App Download in All Countries

Presently, the App has been developed including all standard functionalities such as zooming, panning, different map, chart and table views. The user gets location-specific decision-making information using their smartphone and it is easy to get information. The mobile app comprises of seven functional modules which can generate table, chart and map for providing information to the stakeholders that help to access and visualize multi-sectoral spatial and tabular information. This app facilitates by providing BDP2100 information including scenario information on both climate change and socio-economic in their hands. It has also incorporated information on BDP investment projects, different socio-economic indicators such as macroeconomic, employment and poverty, GDP per capita, population dynamics, labor force dynamics, migration dynamics, etc. It provides information on crop, food security, agricultural technology and critical information and visualizes environmental and disaster information to the users. Easy access to BDP2100 information would encourage the user to use the information for further planning. It makes it simple for the user to obtain information. It improves how information and knowledge services are used for planning and decision-making. Additionally, it supports users', planners', researchers', and decision-makers capacity building.

6 CONCLUSION

A knowledge app to make the BDP2100 information accessible to a wide range of users such as planners, decision-makers, and researchers to provide information that given the potential support to the implementation of BDP2100. This study focused on developing a mobile application helping users by improving their information use skills. The process of app development involved a co-creation process with stakeholders, developing the app structure and the content of the app and a business model was developed to ensure longer-term sustainable use and update of the app for providing information services. It reduces the expense and time required to obtain information and also eliminates the information gap, and increases understanding of the advantages of adaptation and adaptive delta management techniques.

In the future, the next step in the study is to elaborate the business model, and extend the involvement of broader communities by providing benefits of information services through the app. Based on feedback from the App user, improvement of the application by expanding the information covered will be considered. Future climate risk and vulnerability and metamodel information will be incorporated into the app for spatial planning. The app will be updated and up scaled in a multi-platform interface allowing users to use this app on any smart mobile phone. The app will be customized based on different institutional and cultural requirements.

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LIST OF THEMATIC LAYERS

Data List of Knowledge App

THEMATIC GROUP	THEMATIC TYPE	THEMATIC LAYERS	VISUALIZATION FORMAT
DELTA PLAN 2100	Intro of BDP2100	Intro of BDP2100	Text
DELTA PLAN 2100	Key Facts of Delta Plan 2100	Key Facts of Delta Plan 2100	Text/ HTML
DELTA PLAN 2100	Delta Challenges	Delta Challenges	Text/ HTML
DELTA PLAN 2100	Delta Opportunities	Delta Opportunities	Text/ HTML
DELTA PLAN 2100	Delta Management Strategies	Delta Management Strategies	Table
DELTA PLAN 2100	Delta Scenario	Macroeconomic Indicators	Graph/Chart
DELTA PLAN 2100	Delta Scenario	Employment and Poverty	Graph/Chart
DELTA PLAN 2100	Delta Scenario	GDP per Capita	Graph/Chart
DELTA PLAN 2100	Delta Scenario	Population Dynamics	Graph/Chart
DELTA PLAN 2100	Delta Scenario	Labor Force Dynamics	Graph/Chart
DELTA PLAN 2100	Delta Scenario	Migration Dynamics	Graph/Chart
DELTA PLAN 2100	Delta Scenario	Climate Change Scenario	Graph/Chart
DELTA PLAN 2100	Delta Scenario	Socio-economic Scenario	Graph/Chart
DELTA PLAN 2100	Investment projects	Investment projects	Map
DELTA PLAN 2100	BDP 2100 Hotspots	BDP 2100 Hotspots	Image
DELTA PLAN 2100	Delta Investment Requirements	Delta Investment Requirements	Table
DELTA PLAN 2100	Sources of BDP 2100 Investments	Sources of BDP 2100 Investments	Image
DELTA PLAN 2100	Sources of Public Sector Financing	Sources of Public Sector Financing	Table
DELTA PLAN 2100	Indicative Composition of Public Investment	Indicative Composition of Public Investment	Table
WATER RESOURCES	Average Maximum Salinity	Average Maximum Salinity	Image
WATER RESOURCES	Damages Resulting from Major Floods	Damages Resulting from Major Floods	Table
WATER RESOURCES	Digital Elevation Model	Digital Elevation Model	Image
WATER RESOURCES	Erosion Accretion 1973-2017	Erosion Accretion 1973-2017	Image
WATER RESOURCES	Flood Calendar of Bangladesh	Flood Calendar of Bangladesh	Image
WATER RESOURCES	Flood Prone Area	Flood Prone Area	Image

WATER RESOURCES	Ground Water	Ground Water Zone	Map
WATER RESOURCES	Ground Water	Ground Area Wise Comparison Table	Table
WATER RESOURCES	Hydro-logical Regions of Bangladesh	Hydro-logical Regions of Bangladesh	Image
WATER RESOURCES	List of Major Water Related Policies, Acts	List of Major Water Related Policies, Acts	Table
WATER RESOURCES	Navigation Route	Navigation Route	Image
WATER RESOURCES	Salinity Area	Salinity Area	Image
WATER RESOURCES	Sources of Drinking Water (% of Households)	Sources of Drinking Water (% of Households)	Table
WATER RESOURCES	Surface Water Recession of Bangladesh	Surface Water Recession of Bangladesh	Image
WATER RESOURCES	Wastewater Management	Wastewater Management in Dhaka	Table
WATER RESOURCES	Wastewater Management	Volume of Industrial Wastewater in Dhaka	Table
WATER RESOURCES	Wastewater Management	Waste Generation Rate of Six City Corporations	Table
WATER RESOURCES	Wastewater Management	Waste Collection Efficiency of City Corporations	Table
WATER RESOURCES	Water Bodies in Bangladesh	Water Bodies in Bangladesh	Table
WATER RESOURCES	Water Demand Projections for Large Cities	Water Demand Projections for Large Cities	Table
WATER RESOURCES	Water Quality Indicators of Selected Rivers	Water Quality Indicators of Selected Rivers	Table
WATER RESOURCES	Water Resources Development Projects	BWDB Project	Map
WATER RESOURCES	Water Resources Development Projects	LGED Project	Map
WATER RESOURCES	Water Resources Development Projects	O&M Funding Gap of BWDB	Image
WATER RESOURCES	Water Supply	Coverage in Urban Areas	Table
WATER RESOURCES	Water Supply	Water Supply Status in Dhaka City	Table
WATER RESOURCES	Water Supply	Piped Water Supply Status in Paurashava	Table
WATER RESOURCES	Water Supply	Cost and Revenue	Table
WATER RESOURCES	Waterway Route	Inland Waterway Route Classification	Table
WATER RESOURCES	Waterway Route	Classified IWT Routes (I & II)	Table
WATER RESOURCES	Waterway Route	Core Waterways Network	Table
WATER RESOURCES	Waterway Route	Passenger Services Routes	Table
WATER RESOURCES	Waterway Route	Major IWT Cargo Services Routes	Table
WATER RESOURCES	Waterway Route	Ferry Service Routes	Table
WATER RESOURCES	Waterway Route	Average Turnaround Time in Handling	Table
WATER RESOURCES	Waterway Route	Waterway Accidents and Fatalities	Table
WATER RESOURCES	Waterway Route	Key Routes of India-Bangladesh	Table

AGRICULTURE	Consumption of Different Food Items	Consumption of Different Food Items	Table
AGRICULTURE	Crop and Hazard Calendar	Crop and Hazard Calendar	Image
AGRICULTURE	Identified Groups of Plants	Identified Groups of Plants	Table
AGRICULTURE	Production	Rice Production	Table
AGRICULTURE	Production	Rice Production	Table
AGRICULTURE	Rice Demand, Production, Surpluses	Rice Demand, Production, Surpluses	Image
AGRICULTURE	Technology Generation and Innovations	Technology Generation and Innovations	Table
ENVIRONMENT AND DISASTER	Arsenic Contaminated Wells	Arsenic Contaminated Wells	Image
ENVIRONMENT AND DISASTER	Assumptions: Environmental Risk Parameters	Assumptions: Environmental Risk Parameters	Table
ENVIRONMENT AND DISASTER	Bank Erosion and Accretion	Jamuna River 1973-2018	Table
ENVIRONMENT AND DISASTER	Bank Erosion and Accretion	Ganges River 1973-2018	Table
ENVIRONMENT AND DISASTER	Bank Erosion and Accretion	Padma River 1973-2018	Table
ENVIRONMENT AND DISASTER	Bank Erosion and Accretion	Lower Meghna River 1973-2018	Table
ENVIRONMENT AND DISASTER	Cyclone Affected Area	Cyclone Affected Area	Image
ENVIRONMENT AND DISASTER	Damages Resulting from Major Floods	Damages Resulting from Major Floods	Table
ENVIRONMENT AND DISASTER	Inland and Resident Vertebrates	Inland and Resident Vertebrates	Table
ENVIRONMENT AND DISASTER	Multi Hazard	Multi Hazard	Image
ENVIRONMENT AND DISASTER	Natural Hazards	Natural Hazards	Image
ENVIRONMENT AND DISASTER	Protected Areas of Bangladesh	Protected Areas of Bangladesh	Image
ENVIRONMENT AND DISASTER	River Erosion and Accretion	River Erosion and Accretion	Image
ENVIRONMENT AND DISASTER	Water Quality Indicators of Selected Rivers	Water Quality Indicators of Selected Rivers	Table
SOCIO ECONOMIC	Distribution of Employed Persons	Distribution of Employed Persons	Table
SOCIO ECONOMIC	Electricity, Internet and Mobile Phone Connections	Electricity, Internet and Mobile Phone Connections	Table
SOCIO ECONOMIC	Employment and Unemployment Rate	Employment and Unemployment Rate	Table
SOCIO ECONOMIC	Food Demand	Scenario I	Table
SOCIO ECONOMIC	Food Demand	Scenario I	Table
SOCIO ECONOMIC	Frequency of Household Food Shortages	Frequency of Household Food Shortages	Table
SOCIO ECONOMIC	Household Income	Household Income	Table
SOCIO ECONOMIC	Housing Structure - Roof Materials	Housing Structure - Roof Materials	Table
SOCIO ECONOMIC	Labour Force Participation Rate	Labour Force Participation Rate	Table
SOCIO ECONOMIC	Literacy Rate	Literacy Rate	Table

SOCIO ECONOMIC	Per Capita	Income Pattern	Table
SOCIO ECONOMIC	Per Capita	Availability of Major Food Items	Table
SOCIO ECONOMIC	Population Distribution and Density	Population Distribution and Density	Table
SOCIO ECONOMIC	Population Growth by Hotspot	Population Growth by Hotspot	Image
SOCIO ECONOMIC	Population Projection	Population Projection	Table
SOCIO ECONOMIC	Poverty	Poverty	Table
SOCIO ECONOMIC	Poverty and Inequality	Poverty and Inequality	Table
SOCIO ECONOMIC	Public Expenditure Composition	Public Expenditure Composition	Image
SOCIO ECONOMIC	Rural and Urban Population	Rural and Urban Population	Image
SOCIO ECONOMIC	Sanitation Facilities	Sanitation Facilities	Table
SOCIO ECONOMIC	Structure of Main Occupation	Structure of Main Occupation	Table
SOCIO ECONOMIC	Urbanization Overview	Urbanization Overview	Table
SPATIAL PLANNING & LANDUSE	Annual Net Land Loss and Gain	Annual Net Land Loss and Gain	Image
SPATIAL PLANNING & LANDUSE	Average Annual Change in Land Use	Average Annual Change in Land Use	Table
SPATIAL PLANNING & LANDUSE	Bio-Ecological Zone	Bio-Ecological Zone	Image
SPATIAL PLANNING & LANDUSE	Land Types of Bangladesh	Land Types of Bangladesh	Image
SPATIAL PLANNING & LANDUSE	Land Utilization/ Land Cover of Bangladesh	Land Utilization/ Land Cover of Bangladesh	Table
SPATIAL PLANNING & LANDUSE	Legal Framework for Environmental Management	Legal Framework for Environmental Management	Table
SPATIAL PLANNING & LANDUSE	Physiographic	Physiographic	Map
CLIMATE	Average Annual Rainfall	Average Annual Rainfall	Image

