Case Study of Data Collection & Data Sharing for Rural Water Supply Management in Rwanda

20th November 2019

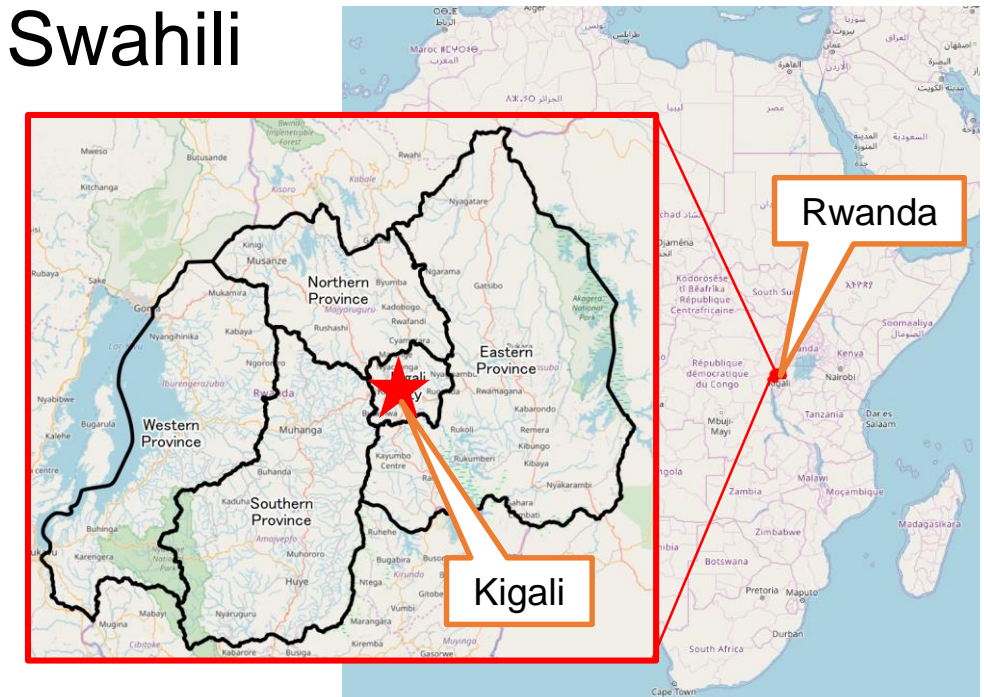Ms. Larissa DUSABE (RWSS department, WASAC Ltd, Rwanda)
Mr. Jin IGARASHI (JICA Expert, Kokusai Kogyo Co., Ltd, Japan)
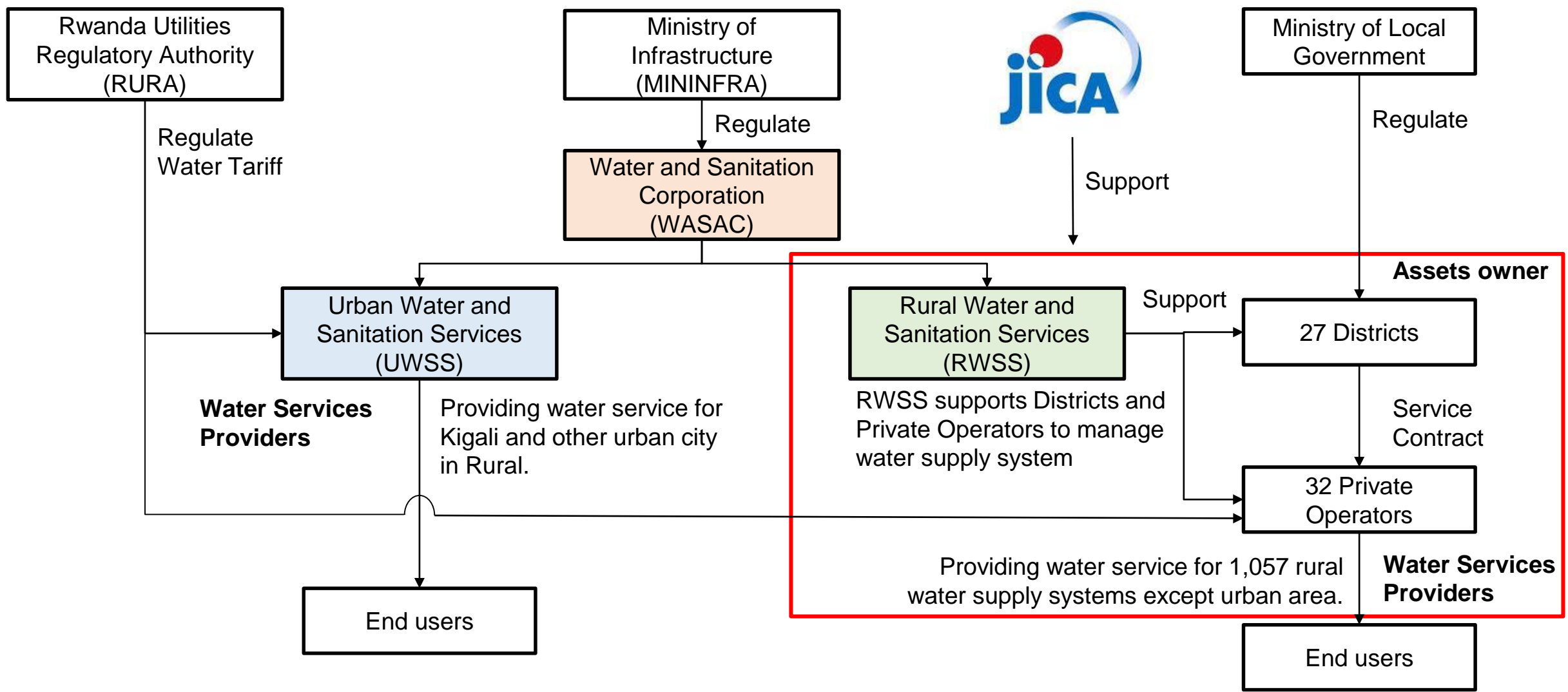
General information about Rwanda

- Area: 26,340km2

- Population: 11.9 million (2016)

- Capital city: Kigali

- Language: Kinyarwanda, English, French, Swahili

- Religion: Christianity, Islam

- GDP: USD 81.65 billon (2016)

- GNI per capita: USD 700 (2016)

- Economic Growth Rate: 5.9% (2016)
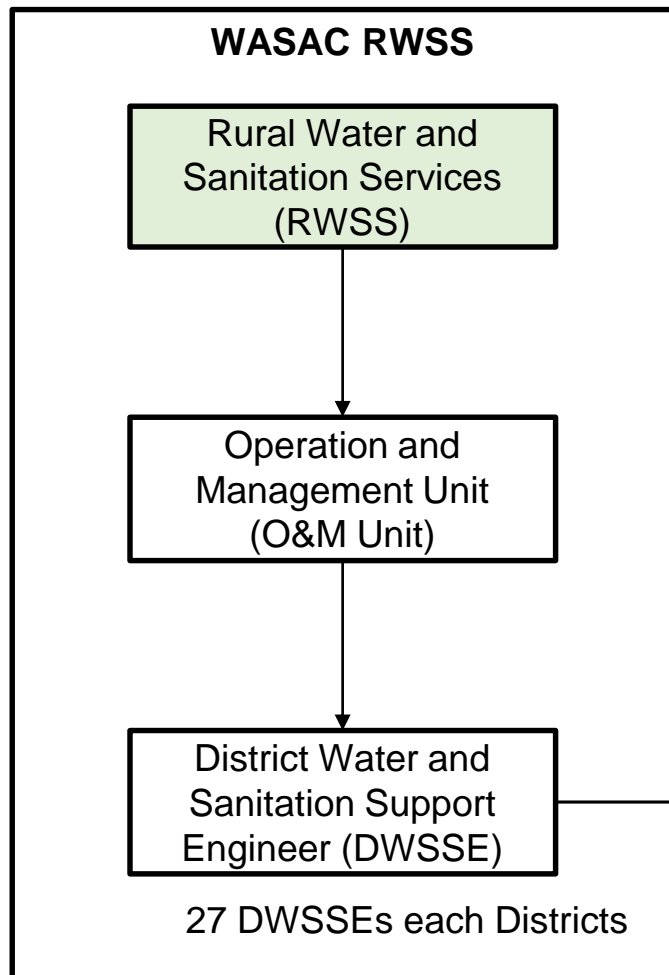
- the most **safe** and **clean** country in Africa

Organization Structure of WASAC

```
Rwanda Utilities                Ministry of                              Ministry of Local
Regulatory Authority            Infrastructure          JICA             Government
(RURA)                          (MININFRA)
```

Regulate   │ Regulate   │ Regulate
Water Tariff   ▼   │
                          Water and Sanitation   │ Support   │
                          Corporation   ▼   │
                          (WASAC)   │

```
                                          ┌──────────────────────────────────────────────┐
                                          │                              Assets owner     │
  Urban Water and                  Rural Water and          Support                        │
  Sanitation Services              Sanitation Services  ─────────────►   27 Districts      │
  (UWSS)                           (RWSS)                                                   │
                                                                                           │
Water Services          Providing water service for     RWSS supports Districts and        │
Providers               Kigali and other urban city     Private Operators to manage   Service │
                        in Rural.                        water supply system          Contract │
                                                                                      ▼        │
                                                                                  32 Private   │
                                                                                  Operators    │
                                                                                               │
                                          Providing water service for 1,057 rural   Water Services │
                                          water supply systems except urban area.   Providers  │
                                          └──────────────────────────────────────────────┘
        ▼
     End users                                                                    End users
```

What does RWSS do in RWANDA?

WASAC RWSS

Rural Water and Sanitation Services (RWSS)

↓

Operation and Management Unit (O&M Unit)

↓

District Water and Sanitation Support Engineer (DWSSE)

27 DWSSEs each Districts

RWSS is Supporting Districts…

- Development of Guidelines
- Development of O&M manual for each system
- Management of Monthly Reports
- Mapping for a better management of water supply systems
- RWSS projects(NFRWSS,Public toilets, Water supply to ECD)
- …etc.

District

↓

Private Operators

↓

End users

- 27 Districts,
- 31 Private Operators,
- 1,058 Water Supply Systems
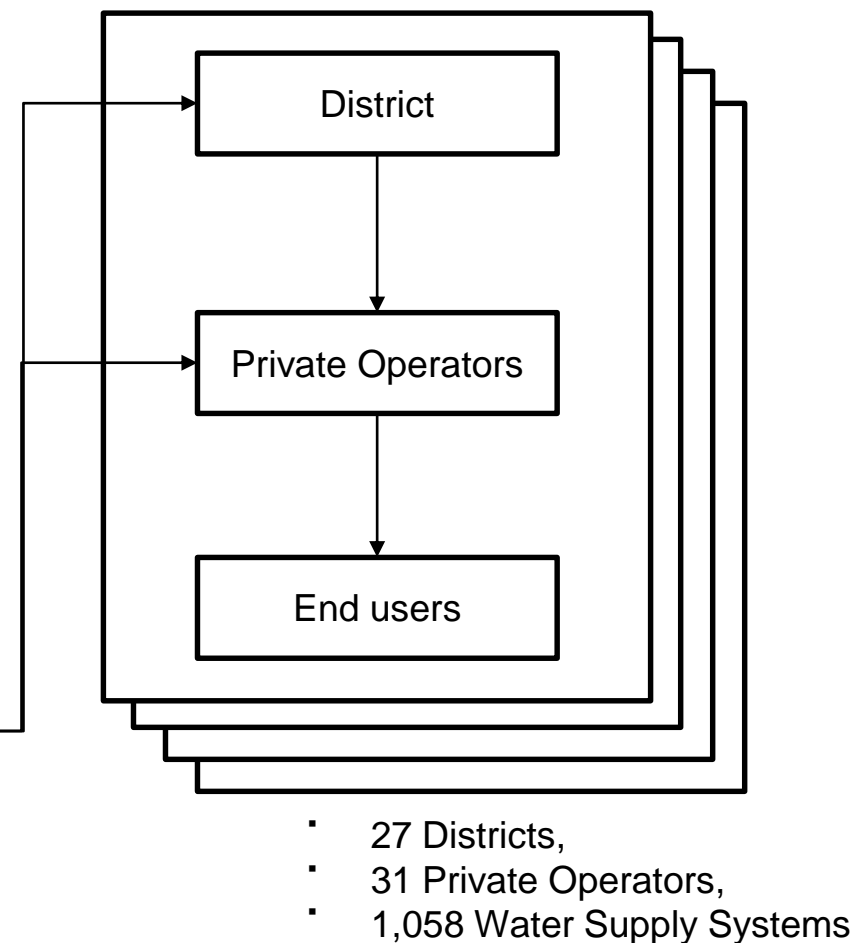
Why do we need the water supply system inventory?

Planning for 100% coverage of water access

2030

100% coverage of water access

- The Government of Rwanda targets to reach 100% of water access by 2020;
- SDGs targets to reach 100% of water access by 2030;
- It is very important to know the current assets and location of existing water facilities
  To support:
  (i) **Monitoring and Evaluation** of the progress towards the achievement of that golden goal in the sub sector;
  (ii) **Informed Decision Making**;
  (iii) Proper **planning**;
  (iv) and improving **Operation & maintenance** activities.

Why using FOSS4G for Rural Water Management in Africa?

Limited Budget

Wide area to be covered

Easier and free to learn
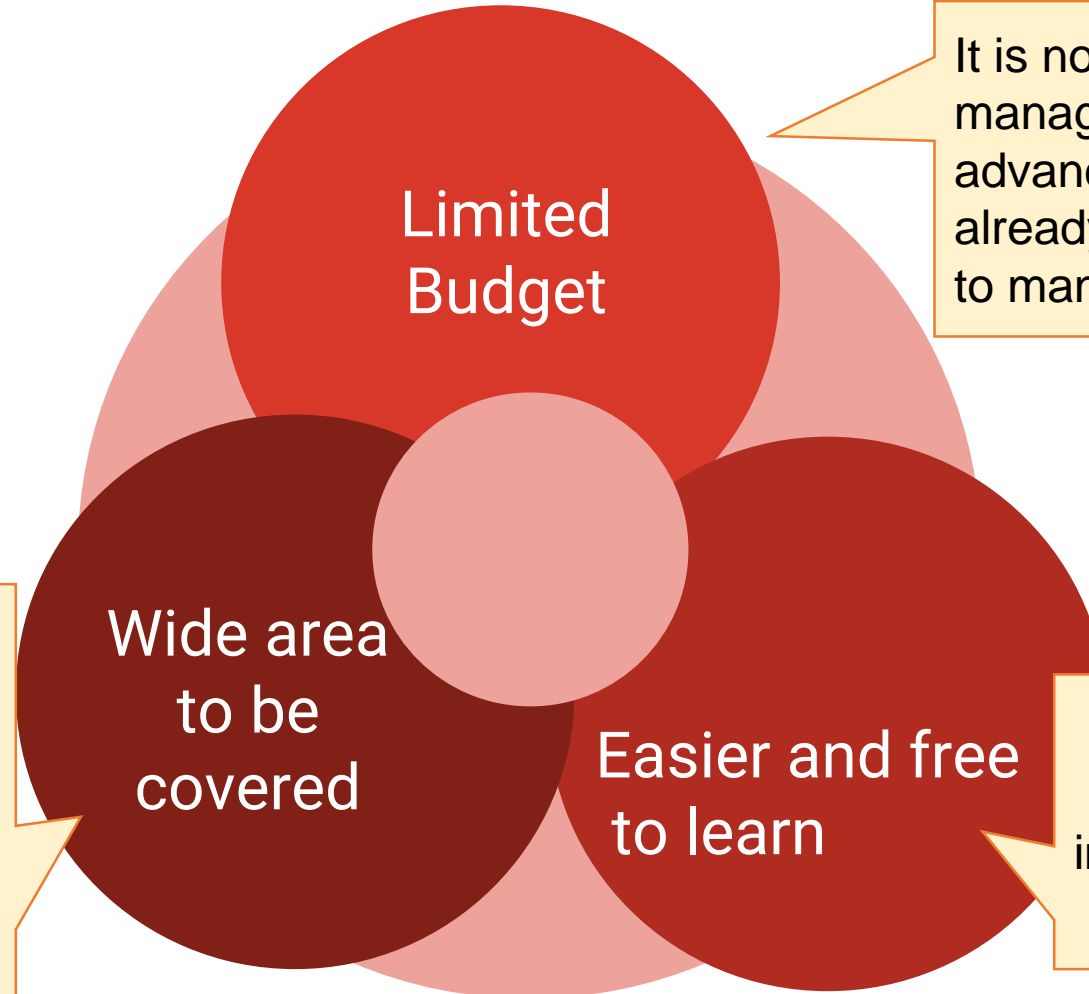
It is not necessary for water management to have high advanced function of GIS. FOSS4G already has enough functions for us to manage water supply systems.

In the field of urban water, targeted areas are small, but rural water needs to cover very wide area normally. In such a case, FOSS4G is easier to expand to the entire country.

FOSS4G has a lot of information in the Internet.

Mapping Result in Rural area of Rwanda as of May 2019

Water Supply System (WSS)	No.	**1,058**
Pipeline	Km	**1,388**
Household	No.	**42,992**
Public Tap	No.	**14,129**
Water Kiosk	No.	655
Industrial	No.	44
Air release chamber	No.	2,117
Valve chamber	No.	5,667
PRV chamber	No.	26
Break pressure chamber	No.	981
Washout chamber	No.	3,344
Starting chamber	No.	1,170
Collection chamber	No.	689
Pumping station	No.	228
Reservoir	No.	5,805
Water source	No.	2545
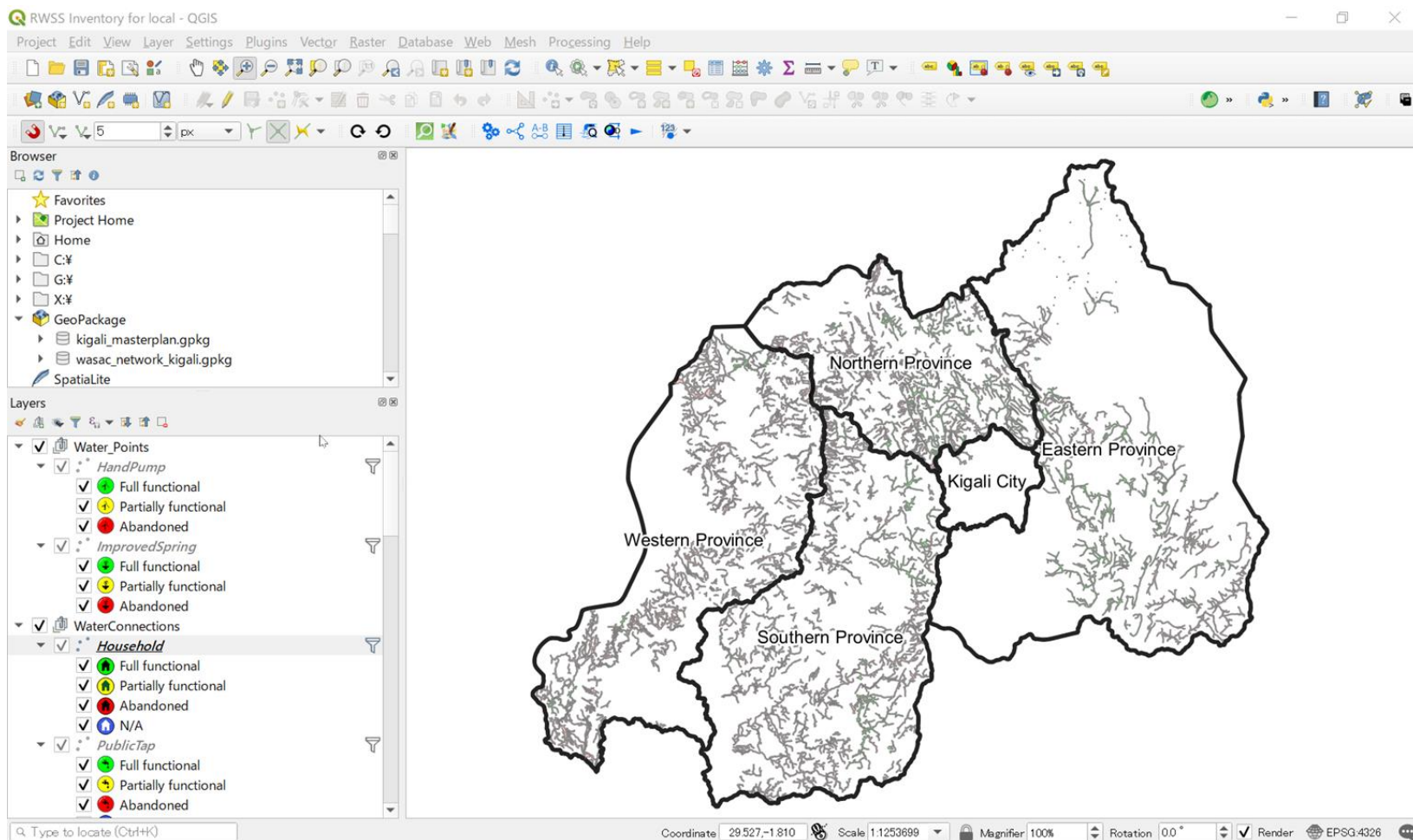
It took **9 months** to map **1,058 WSS (1,388km length)** by **21 engineers** in the entire country.

RWSS mapping activities roadmap

July 2018   Feb 2019   Apr 2019   May 2019   Aug 2019
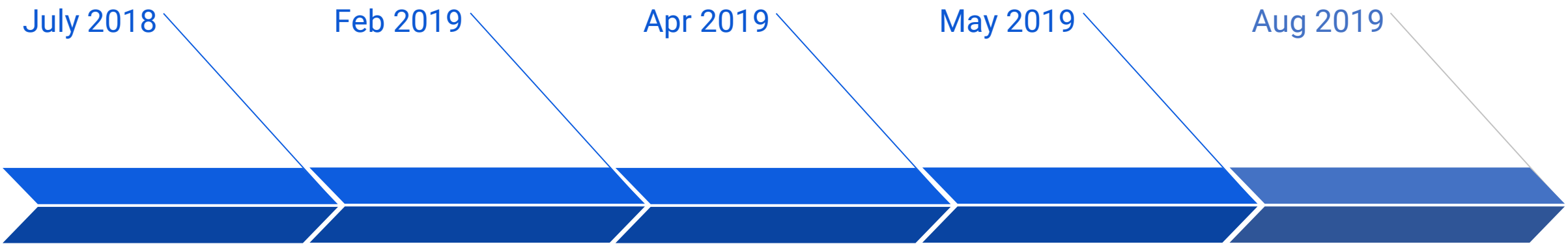
Data Collection

We trained on data collection to DWSSEs on July 2018, then we started data collection.
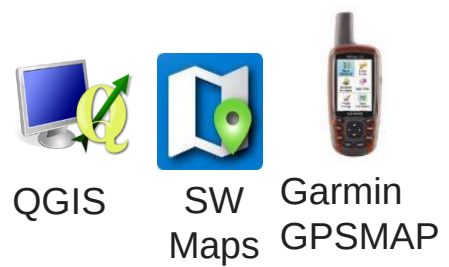
QGIS   SW Maps   Garmin GPSMAP

Offline access & data updating

We trained on offline data access and updating by QField from some districts which completed data collection from February 2019.

Qfield Android device

Data cleaning

We completed data collection in the entire country by April 2019. Then, MIS Specialist and JICA Expert conducted data cleaning.

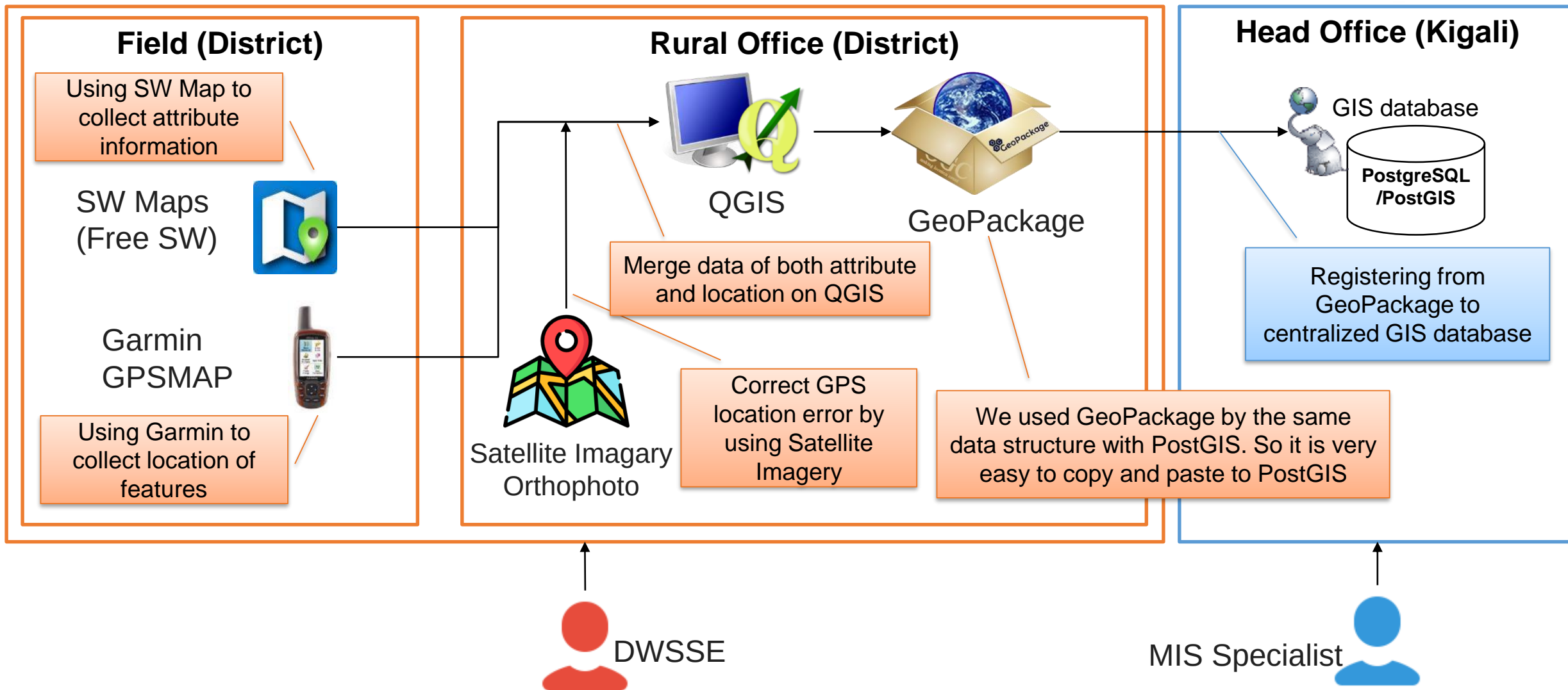## Data updating & Analysing

Now, we are doing data updating by offline and doing some data analysis for decision making.

Data Collection in Field

Field (District)

Using SW Map to collect attribute information

SW Maps (Free SW)

Garmin GPSMAP

Using Garmin to collect location of features

Rural Office (District)

QGIS

GeoPackage

Satellite Imagary Orthophoto

Merge data of both attribute and location on QGIS

Correct GPS location error by using Satellite Imagery

We used GeoPackage by the same data structure with PostGIS. So it is very easy to copy and paste to PostGIS

Head Office (Kigali)

GIS database

PostgreSQL /PostGIS

Registering from GeoPackage to centralized GIS database

DWSSE

MIS Specialist

Challenge encountered during data collection

- We chose SW Map for data collection, because it is easier to input attribute.

- About snapping and topology editing, we must rely on QGIS during data collection phase.

- due to the hilly relief ,the SW Map to collect data attribute information was also not working properly.
- inaccessibility of water supply systems located in remote areas.

Data Structure on PostGIS

All of assets tables are linked to WSS table.

WSS table is linked to District table.
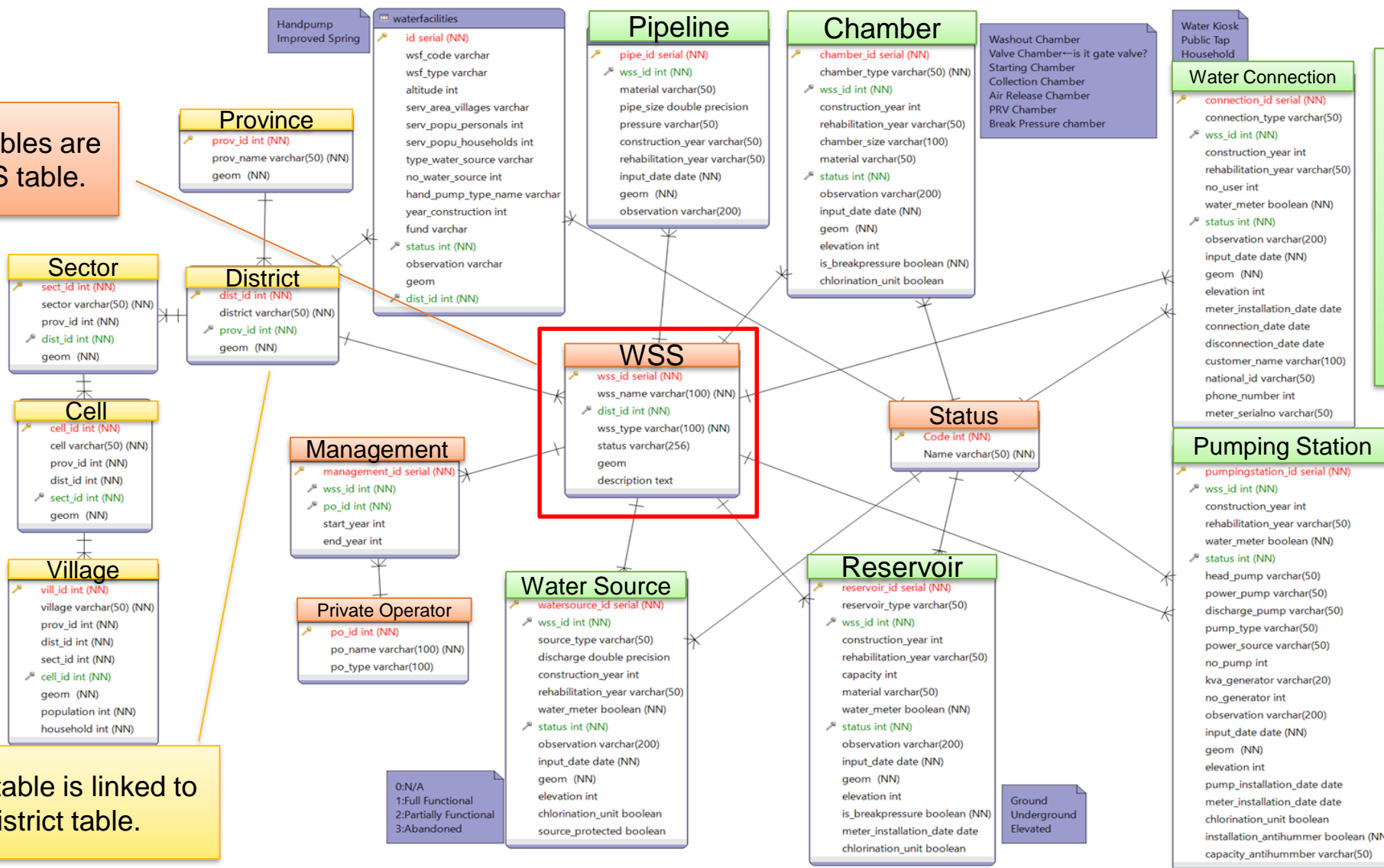
We have following tables for water supply system.
- Pipeline
- Chamber
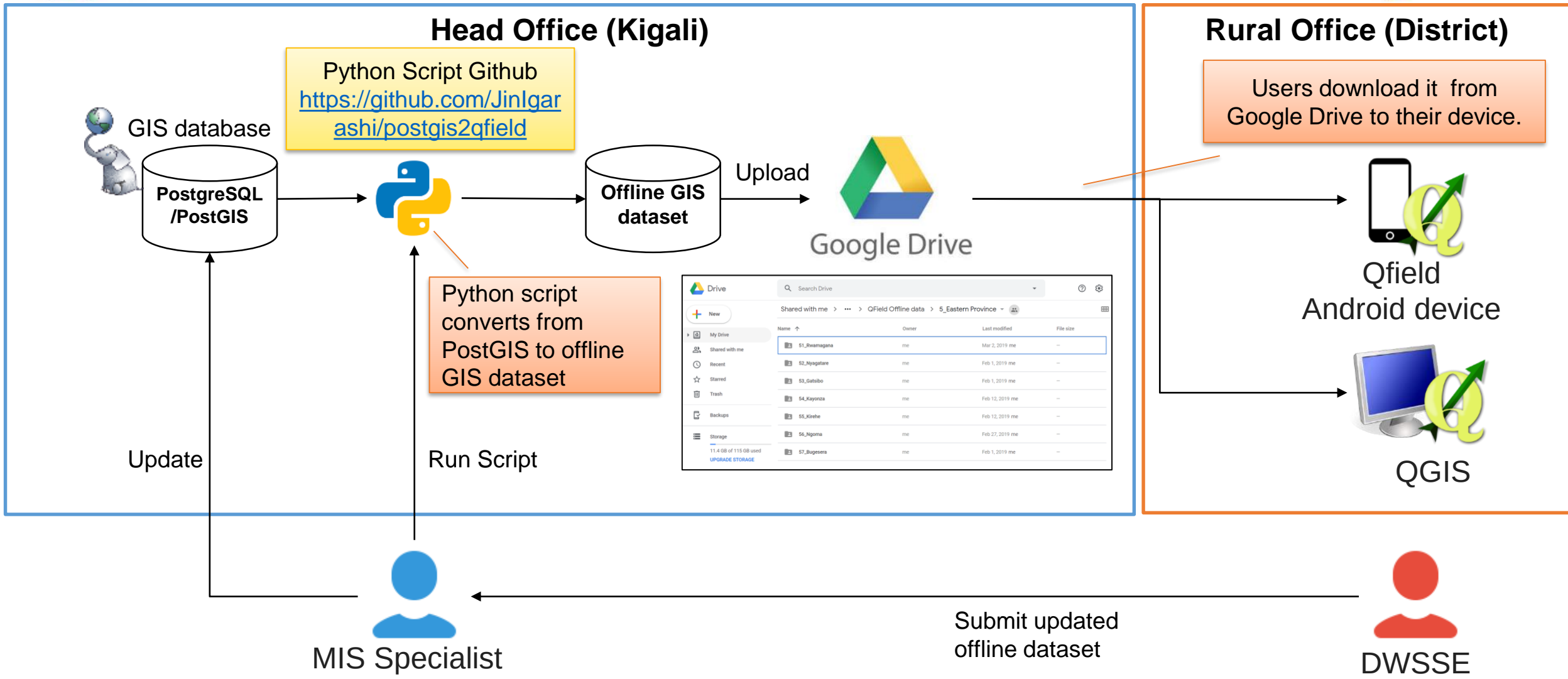- Water Connection
- Reservoir
- Pumping Station
- Water Source

Offline Data Access and Updating

Head Office (Kigali)

Rural Office (District)

Python Script Github
https://github.com/JinIgar
ashi/postgis2qfield

Users download it from
Google Drive to their device.

GIS database

PostgreSQL
/PostGIS

Offline GIS
dataset

Upload

Google Drive

Qfield
Android device

Python script
converts from
PostGIS to offline
GIS dataset

QGIS

Update

Run Script

MIS Specialist

Submit updated
offline dataset

DWSSE

Creation of Inventory Report each Districts

Head Office (Kigali)

GIS database

PostgreSQL /PostGIS

Python Script Github
https://github.com/JinIgarashi/postgis2inventoryreport

Python script creates inventory report each district from PostGIS

Inventory Report

Run Script

MIS Specialist

Upload

Google Drive

Rural Office (District)

Download

Finalizing

Upload

PDF

Printing

District   DWSSE   Private Operator
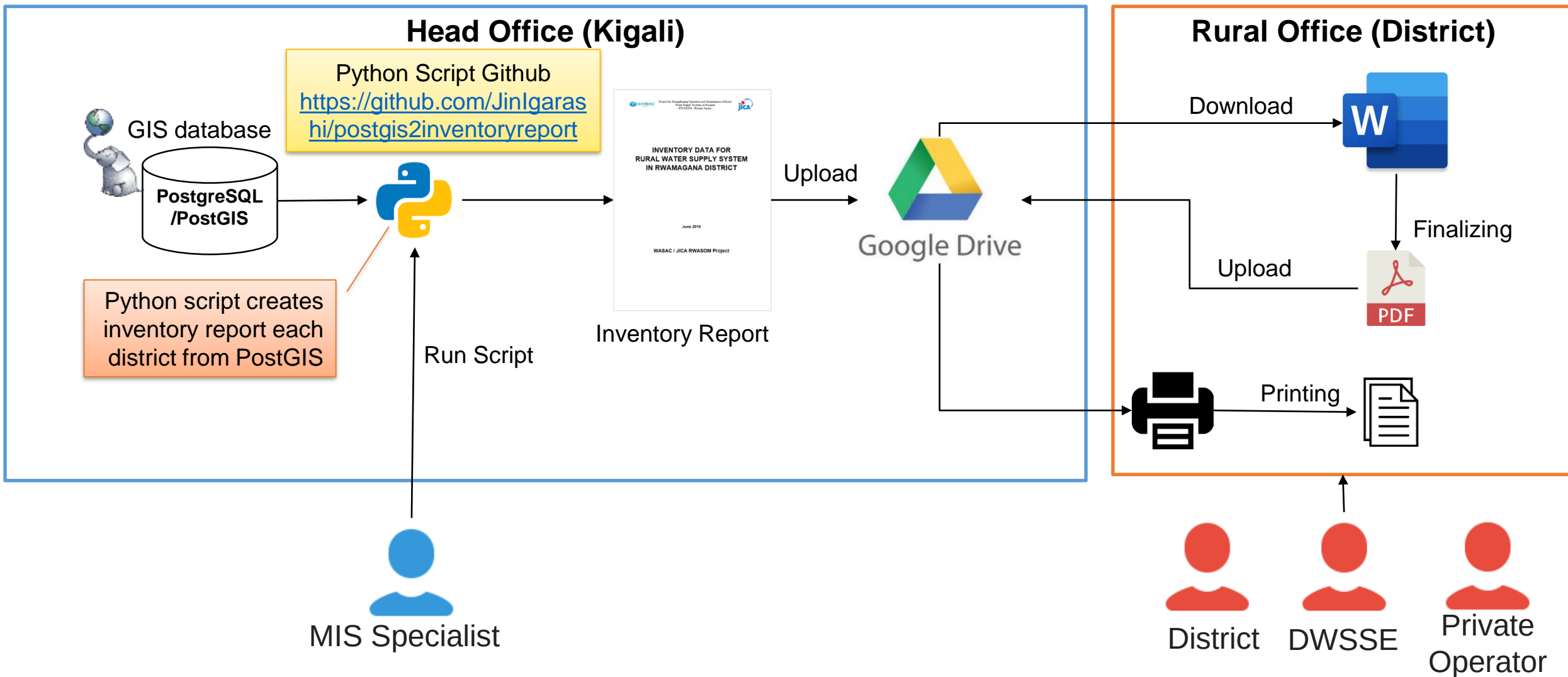
Modeling Water Distribution System from PostGIS (1)

EPANET

Qwater Plugin on QGIS
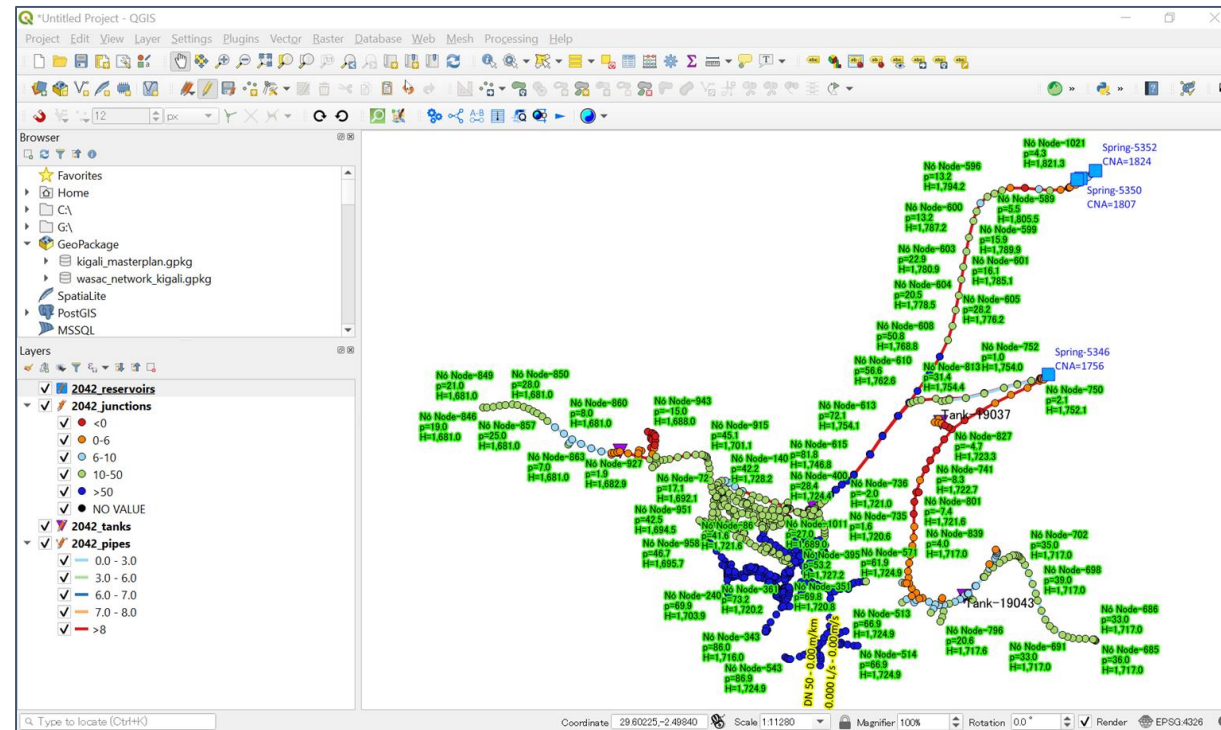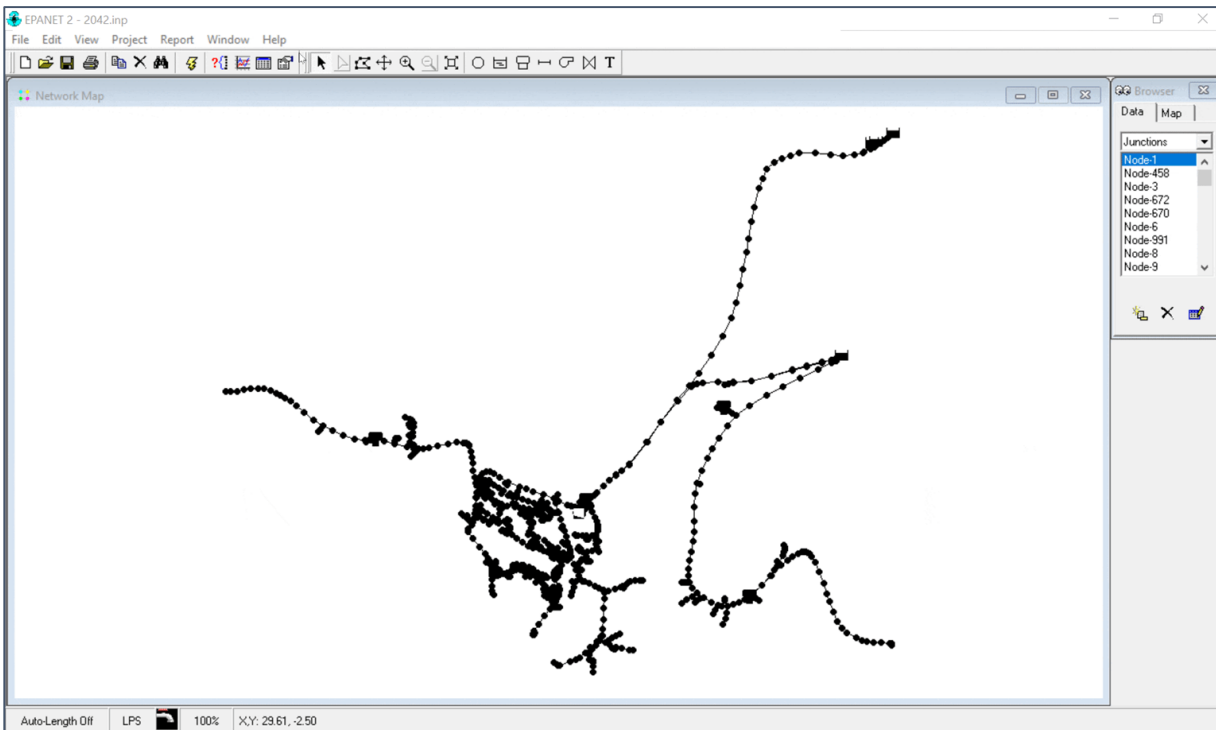
- EPANET is the most famous software to model and simulate water distribution system. It helps water company to do better planning, operation and maintenance.
- But it is not easy to create data for EPANET application and QGIS Plugin (QWater)…

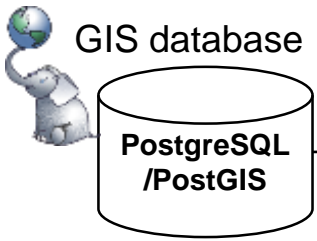# Modeling Water Distribution System from PostGIS (2)

Python Script GitHub
https://github.com/JinIgarashi/postgis2epanet

We can directly import INP file to EPANET. Operation of EPANET is quite difficult, but it helps water company's work efficiently.

GIS database

PostgreSQL /PostGIS

Convert → Python → **Upload** → Google Drive → **Download** → INP File → EPANET

ESRI Shapefile → QGIS

Our Python script can link the data from PostGIS to both EPANET and QGIS Plugin.

QGIS has "QWater" Plugin, it is more user friendly to simulate water network, although it has only limited functions.

QWater Plugin
https://github.com/jorgealmerio/QWater

GIS activities for future planning

August, 2019   Late 2019   2020

Offline access & data updating

We already completed data collection and started to use the data offline. We will focus to use offline data in case Internet condition is not good.

Qfield

Online access & data updating

We are planning to make our Web-GIS server be available online. After that, it will be much easier to update the data real time.
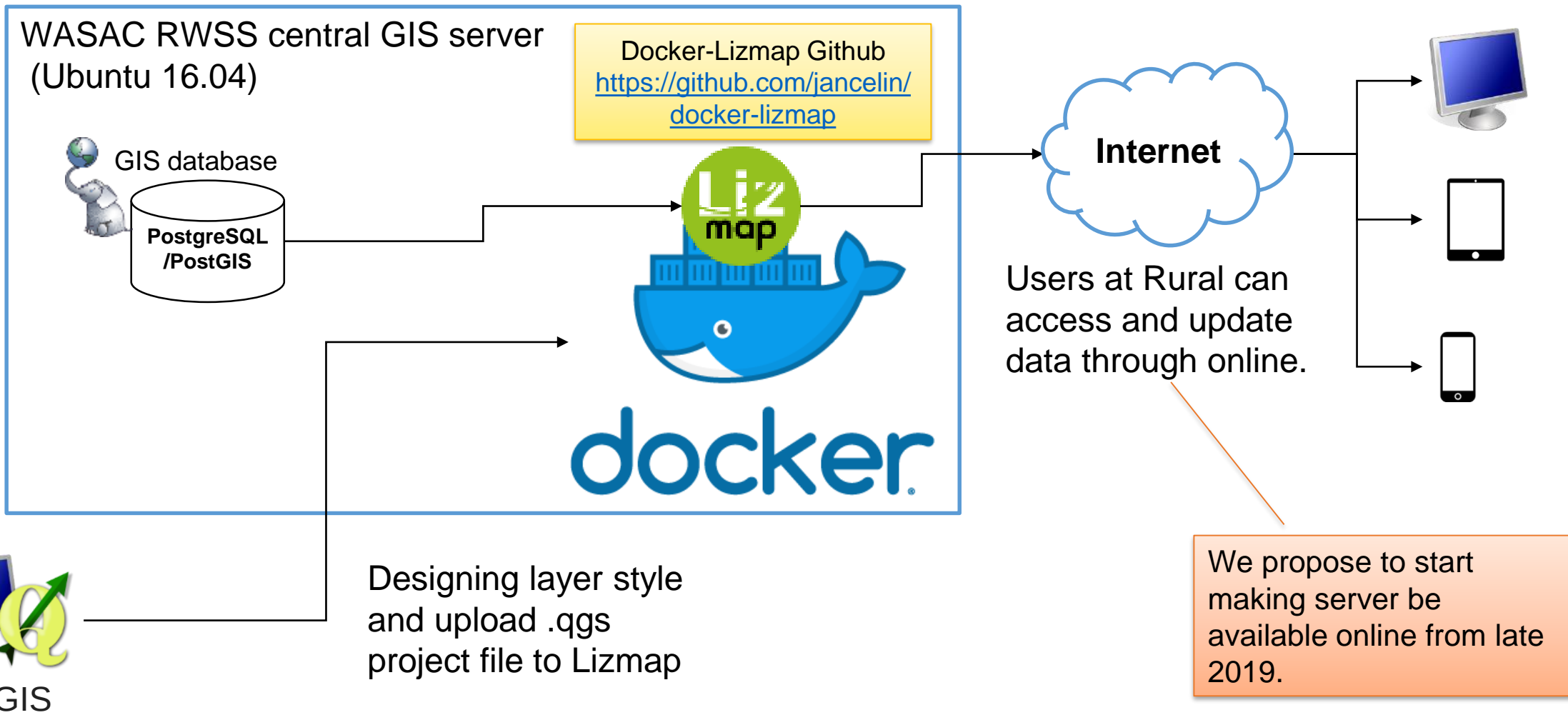
Online reporting tool

We also think about to install online reporting tool in 2020. Currently, we propose to use Jasper Server.

Online Data Access and Updating(1)

WASAC RWSS central GIS server
(Ubuntu 16.04)

Docker-Lizmap Github
https://github.com/jancelin/
docker-lizmap

GIS database

PostgreSQL
/PostGIS

Internet

Users at Rural can access and update data through online.

Designing layer style and upload .qgs project file to Lizmap

QGIS

We propose to start making server be available online from late 2019.

Online Data Access and Updating(2)

Functions of Lizmap
- Easy to design layer style by QGIS
- User access control
- Zooming by layers
- Viewing attributes
- Switching layers
- Measuring distance and area
- Editing feature and attributes
- etc...

Murakoze cyane!! Thank you for your attention!!