

GNSS Supported Survey and Open Source Web GIS for Forest Inventory and Its Management

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 - GEOSERVER
 - Apache HTTP Server

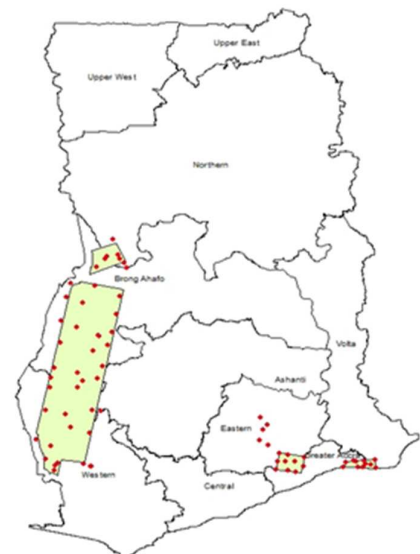
Component 1

Use of GNSS to establish GCP and Mapping plots location

GNSS Survey to Establish GCP

GCP Network Design

- 59 GCPs (9 existing + 50 new)
 - at least one GCP fall within 20km from each forest inventory sampling plots
- GCP were navigated using
 - 1:50,000 scale topographic map and
 - handheld GPS
- GCP observation: Static method
- New GCP monumentation: concrete 24cmx24cmx54cm
- GCP numbering: Regional system



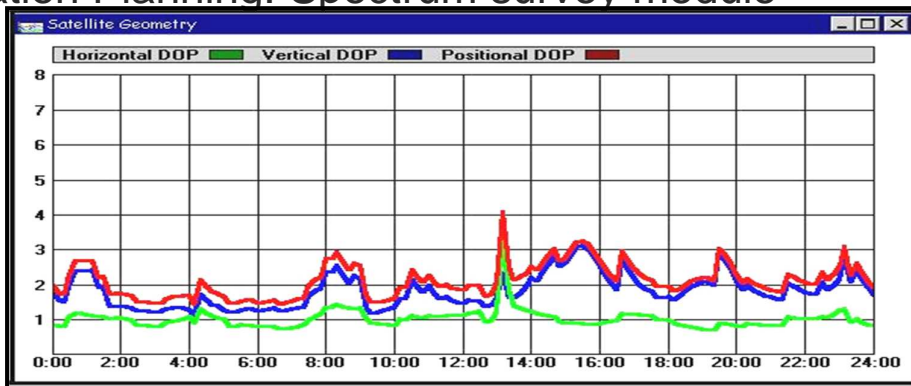
Location of GCPs in Study Area

Accuracy, HW/SW & Observation Planning

- Accuracy Requirements of Control Points
 - Third Order (FGDC, 1998) was enough, but Second Order Class II taken
- Hardware and Software used
 - South S86-S GNSS receiver ($\pm 2.5\text{mm} + 1\text{ppm}$ in XY & $\pm 5\text{mm} + 1\text{ppm}$ in Z accuracy)
 - Spectrum Survey Version 4.20

GCPs Data Observations

- Observation Planning: Spectrum survey module



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Observation Parameter

- Geometric Dilution of Precision (GDOP) : < 4
- Observation time at a station : > 1.5 hr.
- Elevation mask set for observation : +15°
- Minimum log satellites for recording of epochs : 4
- Troposphere correction model : Hopfield
- Ionosphere correction : On
- Ambiguity resolution : Search
- Rejection criteria : 3 x rms.
- Epoch period : Begin/End

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Data Processing

- Spectrum Survey (ver. 4.20): post-processing
- Differential processing
- Automatically generated baseline
- Known coordinates used to calculate the new GCP

Sample results

Point	WGS84 UTM - ZONE 30N			Geographical Coordinates		Accuracy	
	Northing	Easting	Height Ellipsoidal	Latitude	Longitude	RMS	SD
Description	Meter	Meter	Meter	Deg Min Sec (N)	Deg Min Sec (W)		
SGB A582.11.FPP01	880225.521	538680.958	390.507	7° 57' 46.85408"	2° 38' 56.48719"	0.015	0.007
SGB A582.11.FPP02	876261.352	567688.548	256.495	7° 55' 36.66988"	2° 23' 09.17585"	0.013	0.009
SGB A582.11.FPP03	862734.597	599017.003	324.600	7° 48' 14.37951"	2° 06' 06.95472"	0.013	0.007
SGB A582.11.FPP04	862257.970	533050.261	349.931	7° 48' 01.90788"	2° 42' 00.83301"	0.016	0.008
SGB A582.11.FPP05	854214.368	553067.574	319.366	7° 43' 39.37937"	2° 31' 07.53254"	0.015	0.007

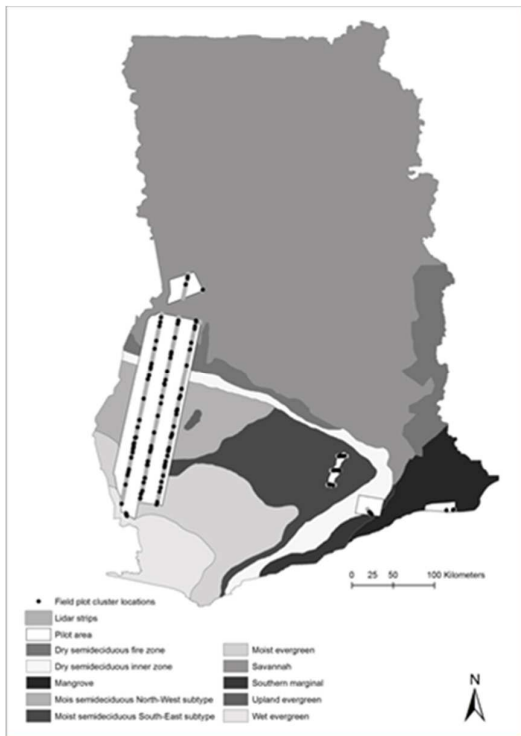
Component 2

Use of GNSS for Mapping plots location

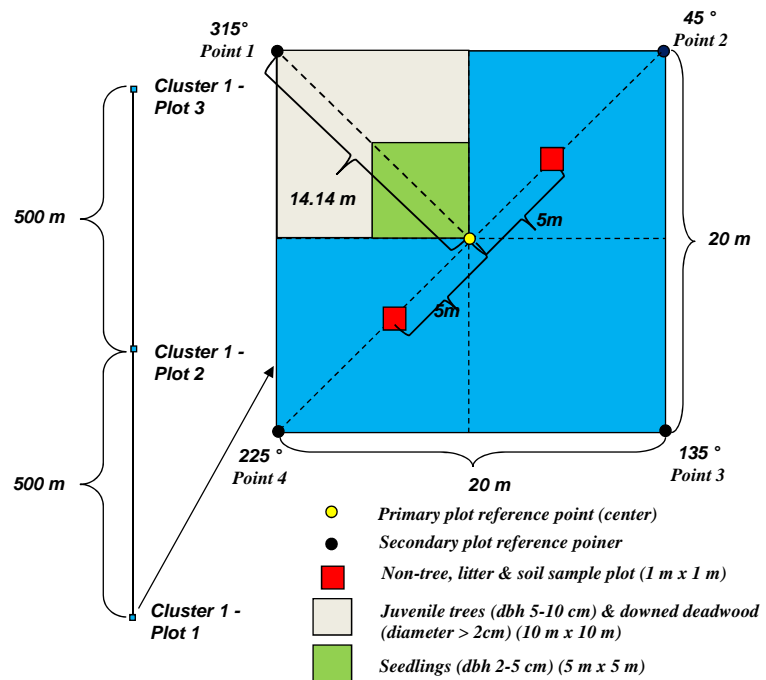
Forest Inventory Sampling Plot Location Survey

- Requirement of accurate plot location measurements for
 - spatial overlay and data extraction,
 - LIDAR (Light Detection and Ranging) point cloud processing
 - modeling for deriving carbon look-up tables
- Sampling Plot Design (271 plots)
 - 1) Savannah and Dry semi-deciduous fire & inner zones: total 90 plots
 - 2) Moist semi-deciduous N-W zone: total 120 plots
 - 3) Moist semi-deciduous S-E, Moist & Wet evergreen: total 90 plots
 - 4) Upland evergreen: total 39 plots
 - 5) Southern Margin: total 12 plots
 - 6) Mangroves: total 10 plots

Distribution & Design of Sample Plots



Distribution of sample plots in Climatic Zones



A sample cluster with sub-plots

GNSS Measurement of sample Plots

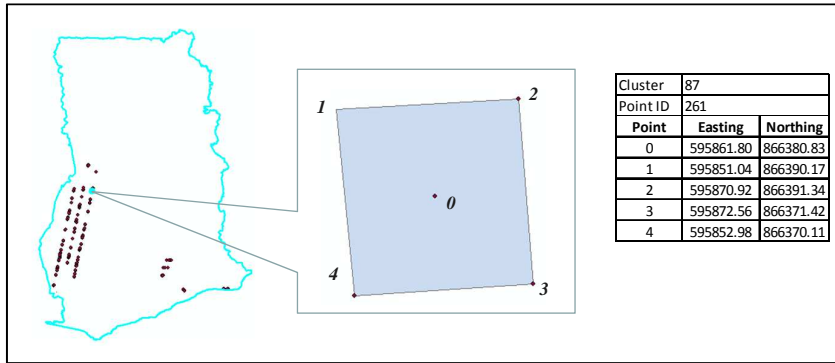
Observation specification:

- Equipment used : **Trimble GNSS**
- Observation points : **5 (center & four corners)**
- Observation time : **10 minutes**
- Observation method : **fast static**
- Software used : **Trimble TBC for post processing**

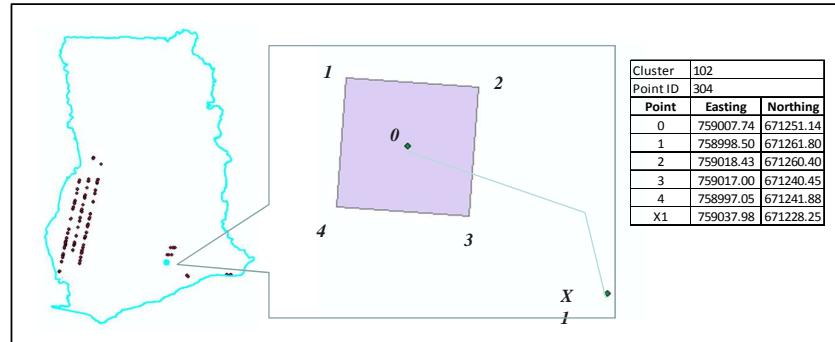
Being a forested area, 3 CASES encountered on satellite signals

- CASE 1: All five points observed
- CASE 2: At least one point observed
- CASE 3: No any point inside plot observed (traversed from nearby)

Calculation of missing points to create plot



- CASE 2: Satellite reception was difficult in one or few coordinates of a plot.



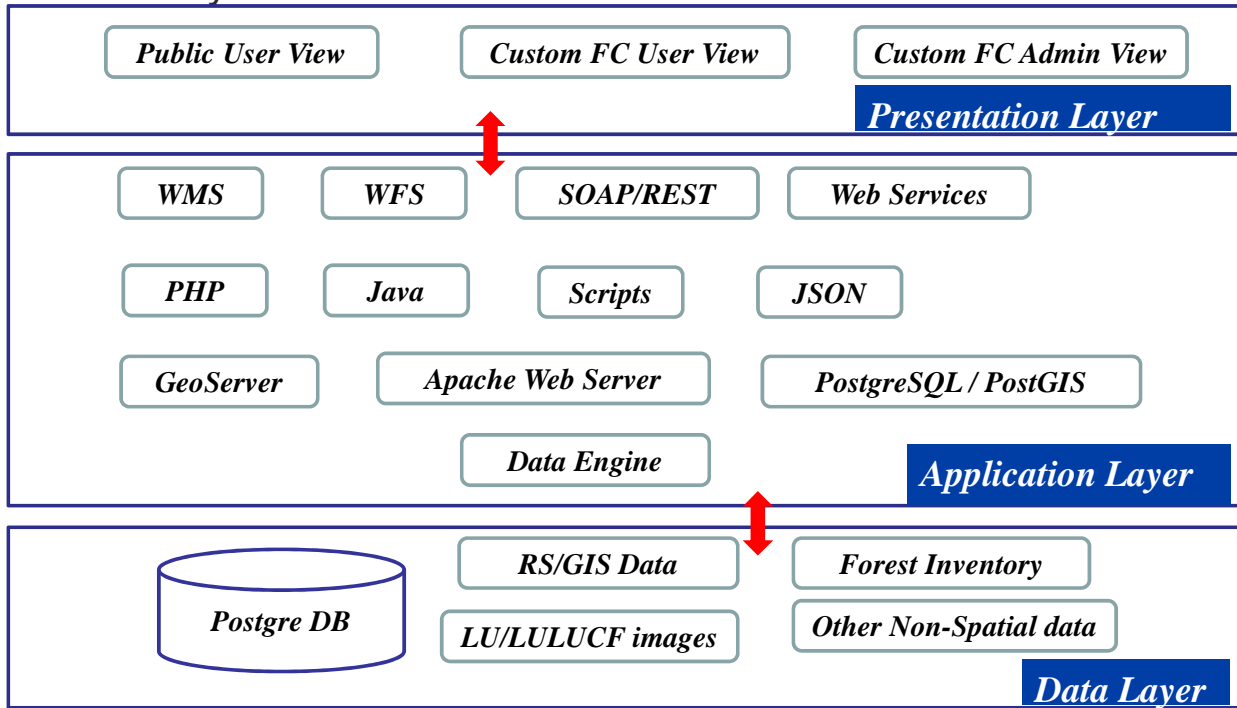
- CASE 3: Satellite reception was very difficult in all coordinates of a plot

Component 3

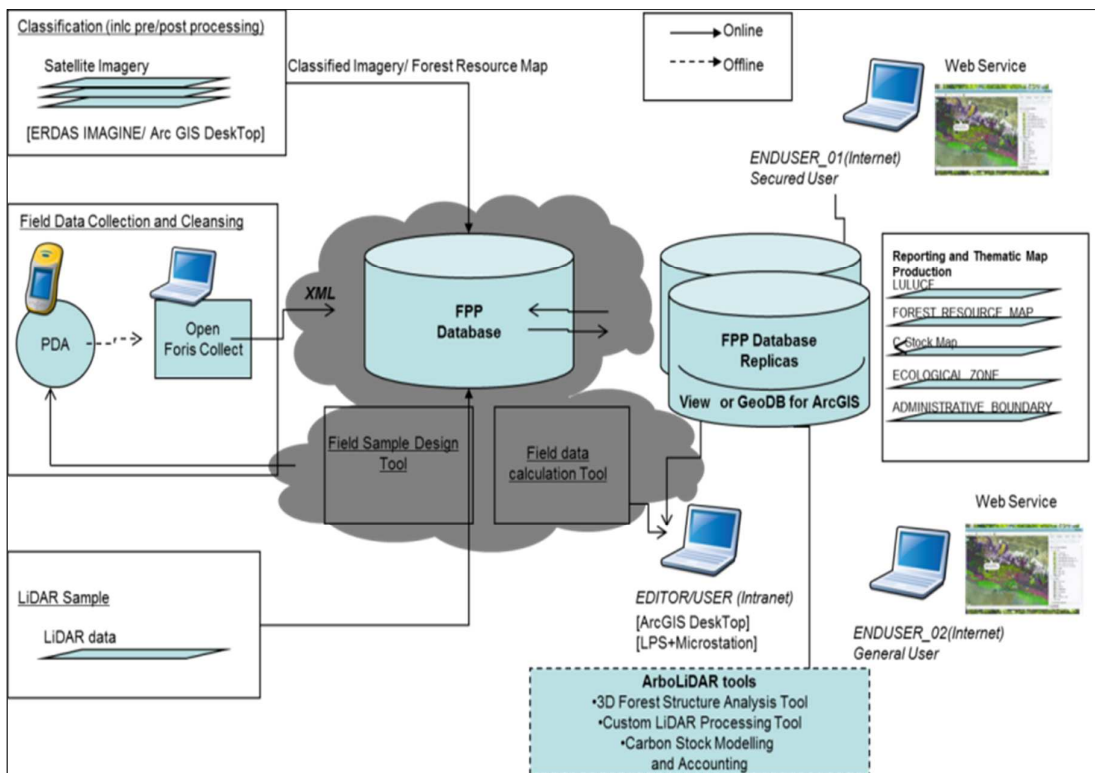
**Web-GIS portal
for
Forest Inventory & Its Management**

Architect of Web-GIS Portal

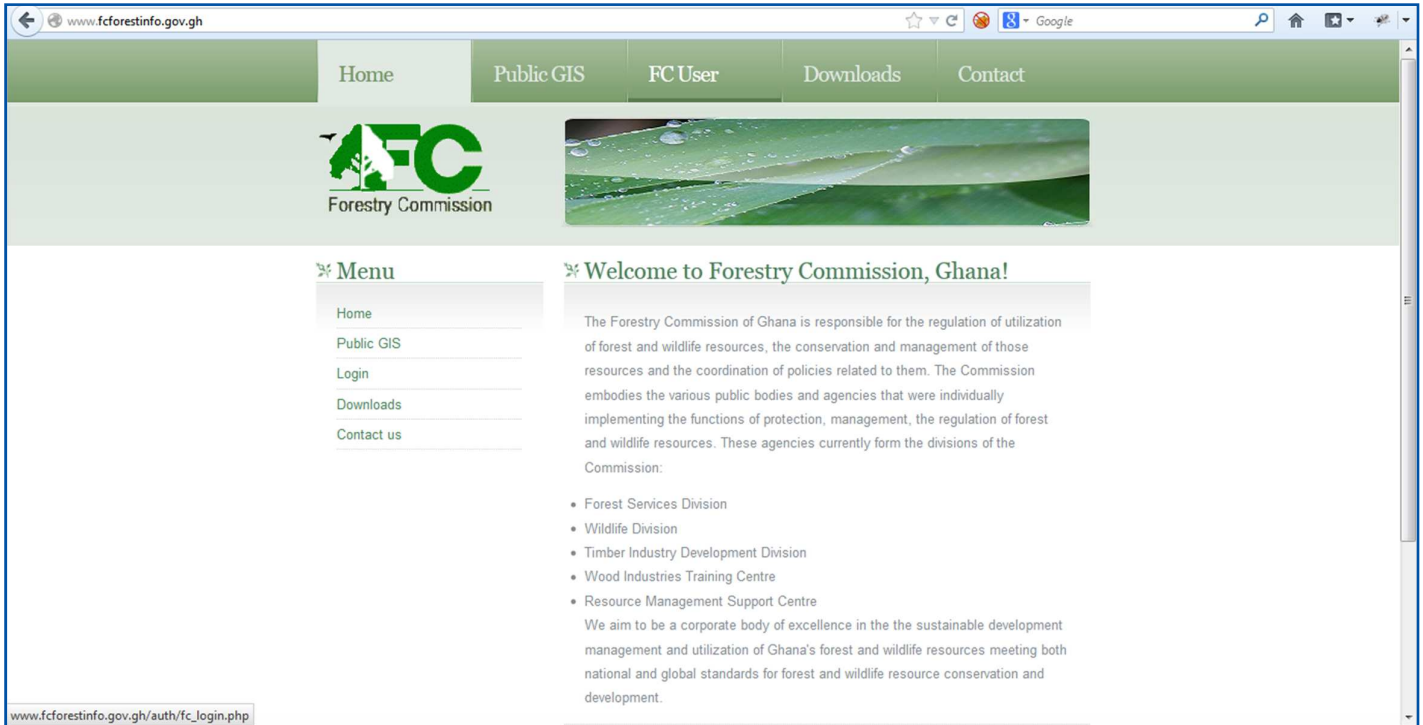
- Three Layer Architect of Web GIS Portal



Application of Web GIS in FC Ghana (1)



WebGIS Portal - Homepage

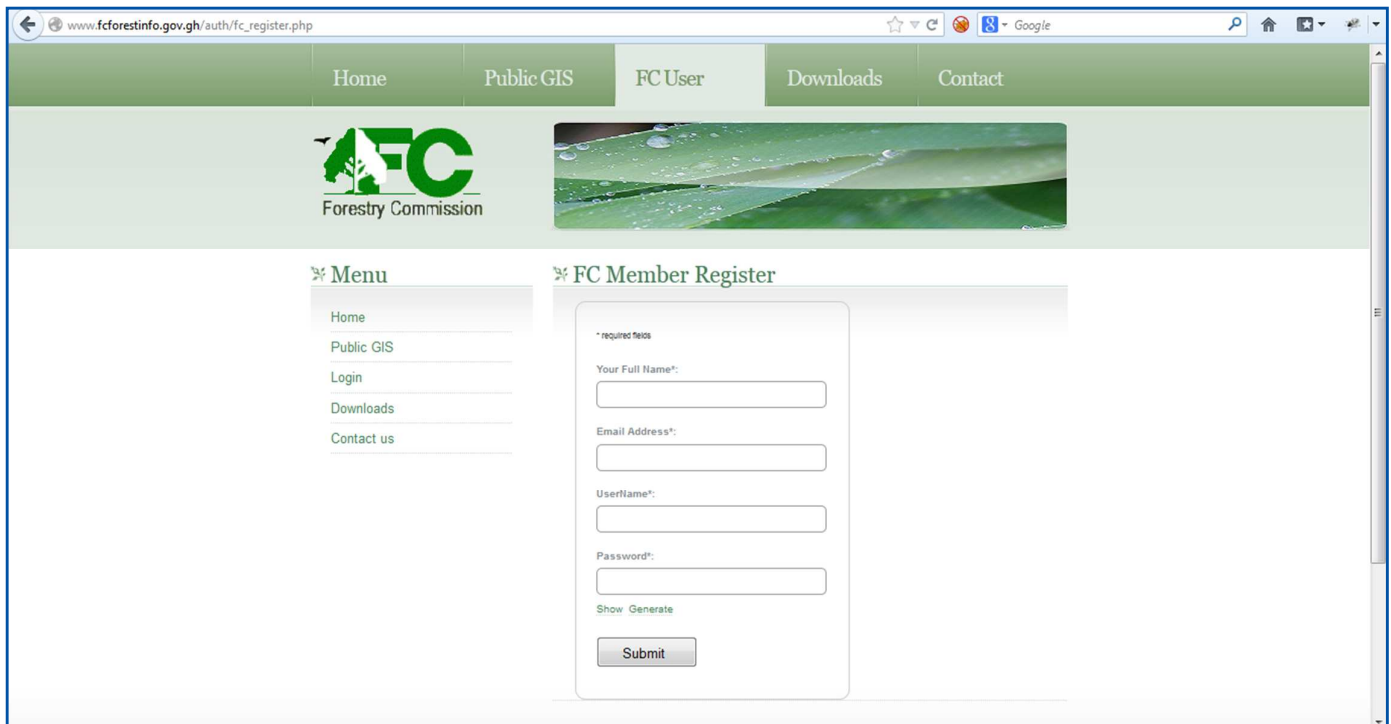


The screenshot shows the homepage of the Forestry Commission of Ghana's WebGIS Portal. The browser address bar displays `www.fcforestinfo.gov.gh`. The navigation menu includes [Home](#), [Public GIS](#), [FC User](#), [Downloads](#), and [Contact](#). The main content area features the Forestry Commission logo and a banner image of a green landscape. A **Menu** sidebar lists: Home, Public GIS, Login, Downloads, and Contact us. The main heading is **Welcome to Forestry Commission, Ghana!**, followed by a paragraph describing the commission's role in regulating forest and wildlife resources. A list of divisions is provided:

- Forest Services Division
- Wildlife Division
- Timber Industry Development Division
- Wood Industries Training Centre
- Resource Management Support Centre

The footer of the page includes the URL `www.fcforestinfo.gov.gh/auth/fc_login.php` and the PASCO Corporation logo.

: WebGIS Portal - Register User

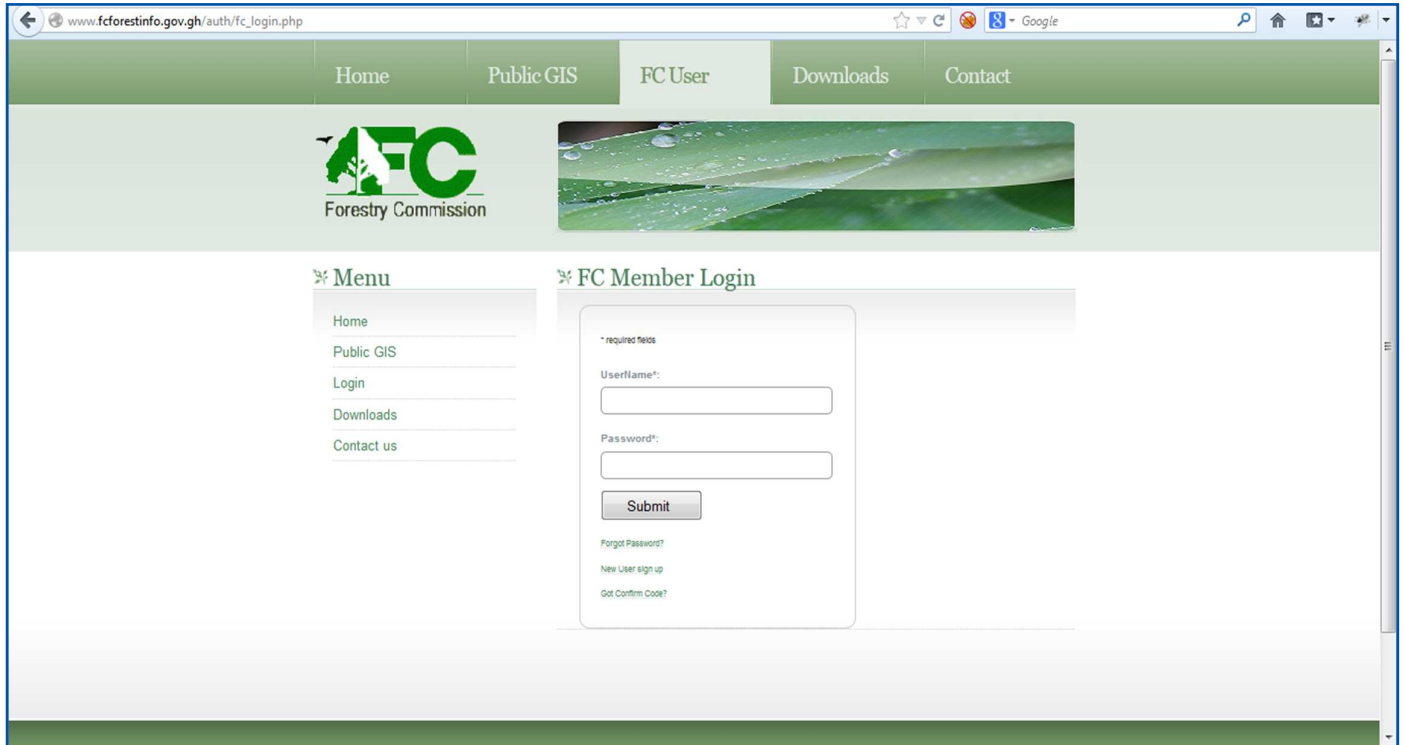


The screenshot shows the 'FC Member Register' page of the WebGIS Portal. The browser address bar displays `www.fcforestinfo.gov.gh/auth/fc_register.php`. The navigation menu is identical to the homepage. The main content area features the Forestry Commission logo and a banner image. A **Menu** sidebar is present. The main heading is **FC Member Register**. Below the heading is a registration form with the following fields:

- Your Full Name* (required field)
- Email Address*
- Username*
- Password*

There are 'Show' and 'Generate' links for the password field, and a 'Submit' button at the bottom of the form. The footer of the page includes the URL `www.fcforestinfo.gov.gh/auth/fc_register.php` and the PASCO Corporation logo.

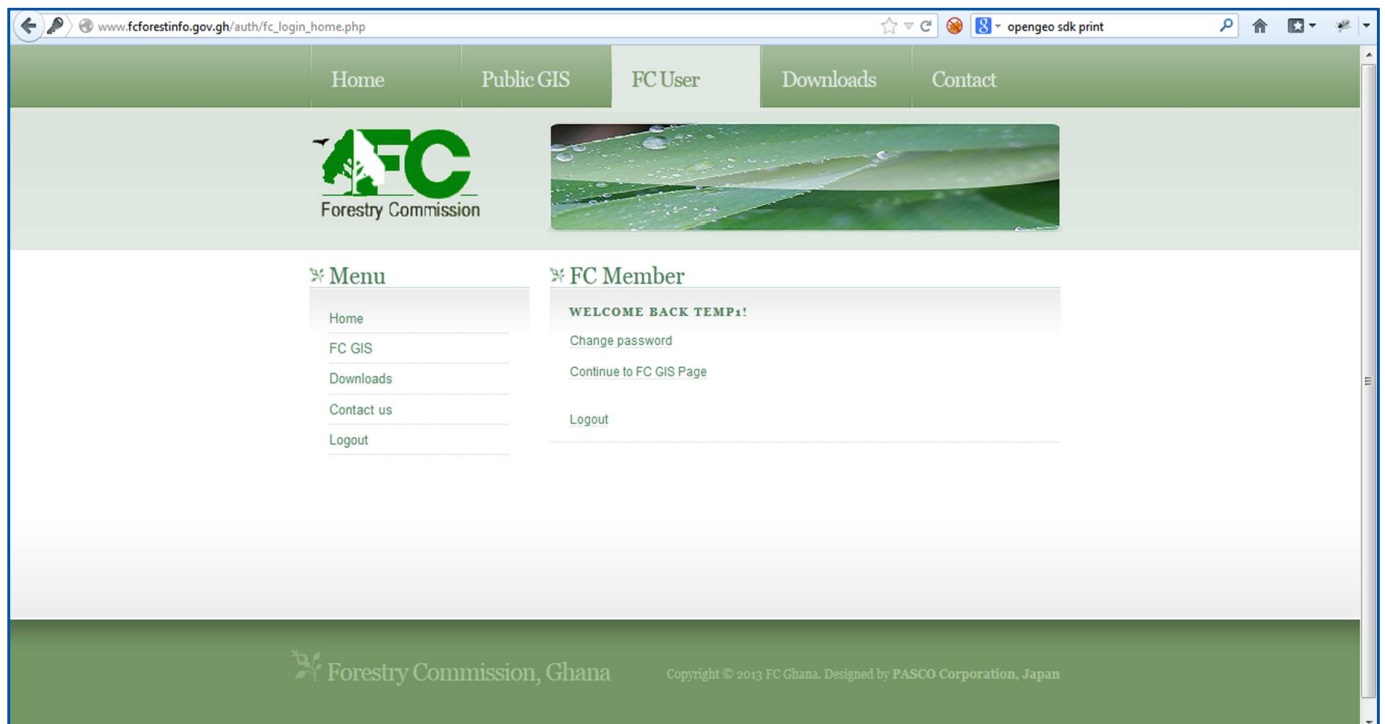
: WebGIS Portal – Login Page



The screenshot shows the login page of the WebGIS Portal. The browser address bar displays www.forestinfo.gov.gh/auth/fc_login.php. The navigation menu includes Home, Public GIS, FCUser, Downloads, and Contact. The page features the Forestry Commission logo and a banner image of green leaves. A menu on the left lists Home, Public GIS, Login, Downloads, and Contact us. The main content area is titled "FC Member Login" and contains a login form with the following fields and options:

- * required fields
- Username*:
- Password*:
-
- [Forgot Password?](#)
- [New User sign up](#)
- [Get Confirm Code?](#)

WebGIS Portal – FC User Page

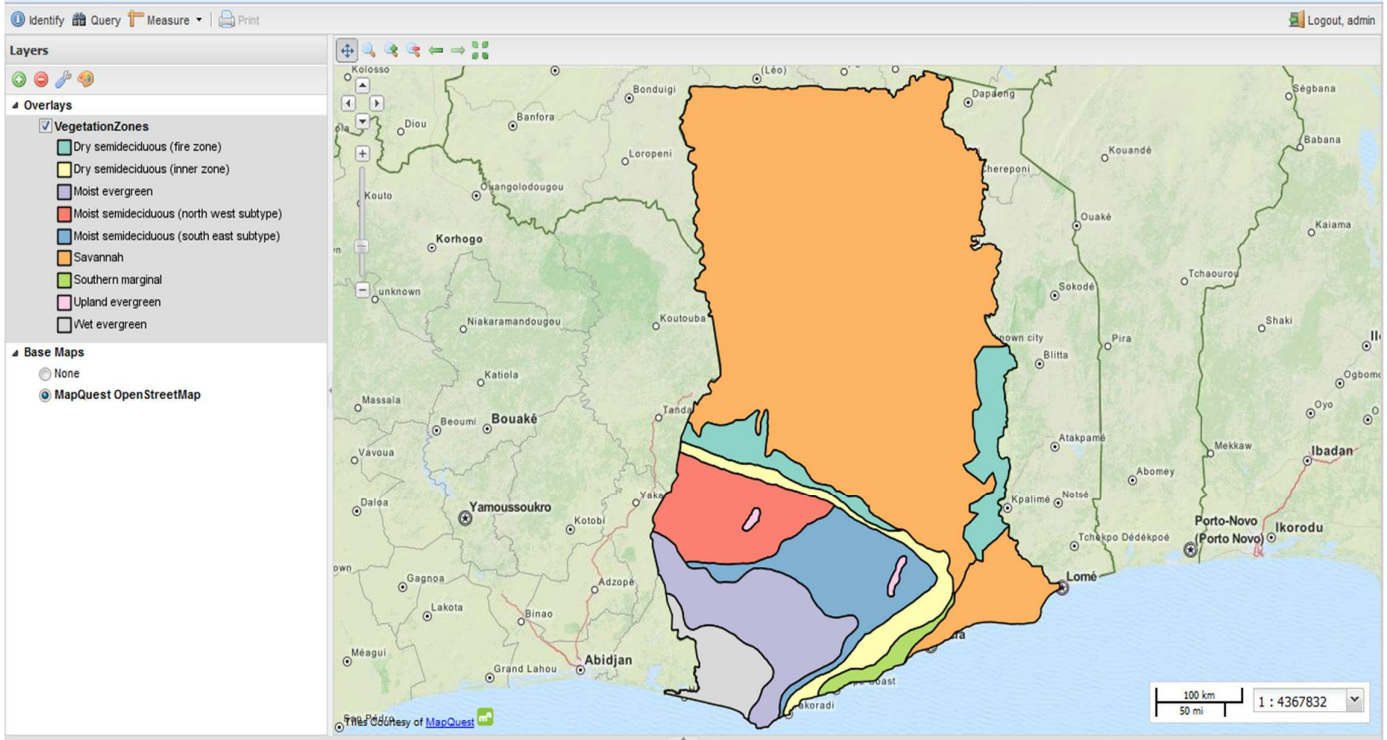


The screenshot shows the FC User Page of the WebGIS Portal. The browser address bar displays www.forestinfo.gov.gh/auth/fc_login_home.php. The navigation menu includes Home, Public GIS, FCUser, Downloads, and Contact. The page features the Forestry Commission logo and a banner image of green leaves. A menu on the left lists Home, FC GIS, Downloads, Contact us, and Logout. The main content area is titled "FC Member" and displays a welcome message and navigation options:

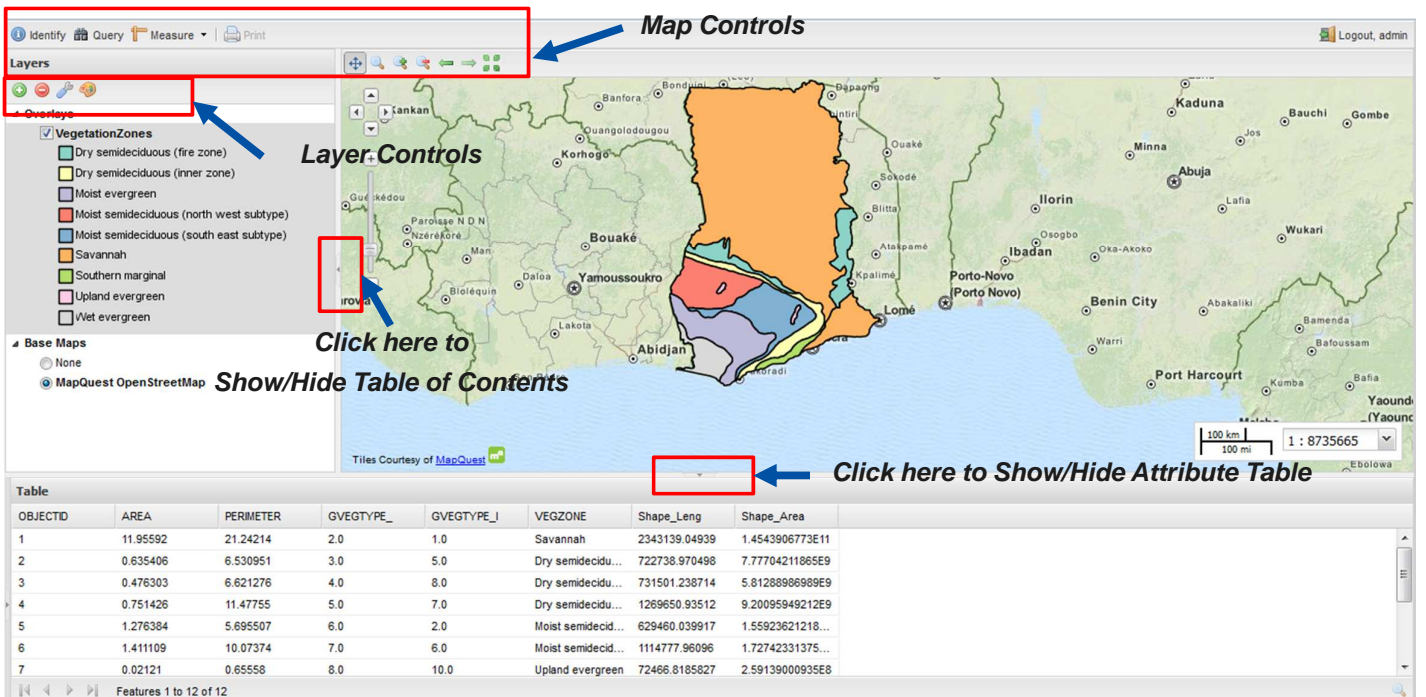
- WELCOME BACK TEMP1!**
- [Change password](#)
- [Continue to FC GIS Page](#)
- [Logout](#)

The footer contains the text: Forestry Commission, Ghana. Copyright © 2013 FC Ghana. Designed by PASCO Corporation, Japan.

WebGIS Portal – Map Page

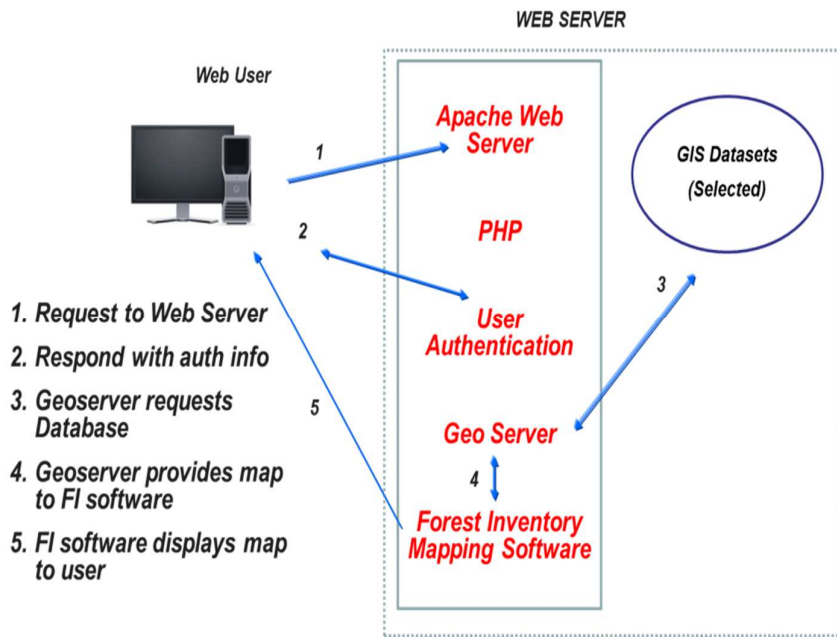


WebGIS Portal – Map Page - Layout



OBJECTID	AREA	PERIMETER	GVEGTYPE_	GVEGTYPE_I	VEGZONE	Shape_Leng	Shape_Area
1	11.95592	21.24214	2.0	1.0	Savannah	2343139.04939	1.4543906773E11
2	0.635406	6.530951	3.0	5.0	Dry semidecidu...	722738.970498	7.77704211865E9
3	0.476303	6.621276	4.0	8.0	Dry semidecidu...	731501.238714	5.81288986898E9
4	0.751426	11.47755	5.0	7.0	Dry semidecidu...	1269650.93512	9.20095949212E9
5	1.276384	5.695507	6.0	2.0	Moist semidecid...	629460.039917	1.55923621218...
6	1.411109	10.07374	7.0	6.0	Moist semidecid...	1114777.96096	1.72742331375...
7	0.02121	0.65558	8.0	10.0	Upland evergreen	72466.8185827	2.59139000935E8

Application of Web GIS in FC Ghana (2)



Conclusion

- GNSS
 - DGNSS is accurate and less time and resource consuming method of establishment of GCP
 - GNSS was successfully used for accurately locating the forest inventory sampling plots in different climatic zones with various forest canopy types
- GIS Web Portal
 - Web-GIS portal with 3 tier architecture.
 - GeoServer has been used as Web GIS Server,
 - Customised Web-GIS portal was developed using open source software
 - Well structured Web-GIS portal to server different level of users
 - General Public: viewing and query
 - FC Ghana staff (general user): download/upload data
 - FC Ghana staff (Analyst/Admin): editing, analysis/ admin control

Acknowledgement

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ありがとうございます
Arigatou-gozaimasu

TERIMA KASIH !!

Thank you very much for your attention