

## Comparison of Geographic Information Systems (GIS) software

As of January 2018, WHO has reached an agreement with ESRI (an international supplier of GIS software) for an unlimited use of ArcGIS Desktop program. However, this agreement only applies to the usage of ArcGIS Desktop within WHO (headquarters, regional and country offices). To date, this agreement is not available for other external partners including the Ministries of Health, NGOs and agencies. The purpose of this document is to provide an overall summary of different open-source (free to use) and ESRI GIS programs in terms of their capabilities and functionalities.

### 1. Open-source GIS

There are several open-source GIS programs and analytical tools with GIS mapping capabilities available on market. These programs include, but not limited to:

Stand-alone GIS application	Analytical tool with GIS/mapping capabilities
<ul style="list-style-type: none"><li>• <a href="#">QGIS* (Quantum GIS)</a></li><li>• <a href="#">GRASS (Geographic Resources Analysis Support System)</a></li></ul>	<ul style="list-style-type: none"><li>• <a href="#">R</a></li><li>• <a href="#">GeoDa</a></li><li>• <a href="#">EpiInfo</a></li><li>• <a href="#">HealthMapper</a></li></ul>

Among various open-source GIS programs, **QGIS** can be the best suitable option which can be used across partners for reasons outlined below.

*\*Please note the criteria and descriptions outlined in this document are based on available resources and research at the time of this comparison and are subject to change according to any further updates to the tools.*

	QGIS	GRASS	R	GeoDa	EpilInfo	HealthMapper	ArcGIS*
Supported by all common operating system	●	●	●	●	●	●	●
User-friendly GUI	●	●	●	●	●	●	●
Cartographical operations	●	●	●	●	●	●	●
Supports common data formats	●	●	●	●	●	●	●
Data manipulation and analysis	Spatial analysis	●	●	●	●	●	●
		●	●	●	●	●	●
		●	●	●	●	●	●
		●	●	●	●	●	●
Integration with other open-source GIS platform	●	●	●	●	●	●	●
Basemaps	●	●	●	●	●	●	●
Scripting functionality	●	●	●	●	●	●	●
Training sources and technical support	●	●	●	●	●	●	●

● fully supported      ● partially supported      ● not available

\* A paid license is required.

**Figure 1. Open-GIS tool comparison**

- **Supported operating systems**

QGIS is available for multiple operating systems including Windows, MacOS X, Linux and Android.

- **User friendly GUI (graphic user interface)**

QGIS offers an easy-to-navigate GUI for importing data, running analyses, editing data, modifying the map layout.

- **Supported data format**

QGIS supports various incoming and output data formats for both tabular and spatial data, including but not limited to:

Tabular data

CSV, Excel, database connection with MSSQL Spatial databases and PostgreSQL

Spatial data

QGIS uses the OGR library to read and write both vector and raster files. Hence, most of the common spatial data formats are supported. These include ESRI Shapefile, MapInfo and MicroStation file formats, AutoCAD DXF, PostGIS, Spatialite, Oracle Spatial and MSSQL Spatial databases, ArcInfo Binary Grid, ArcInfo ASCII Grid, GeoTIFF, ERDAS IMAGINE, and many more.

A complete list of supported data formats in QGIS can be found in the links below.

- OGR vector formats  
[http://www.gdal.org/ogr\\_formats.html](http://www.gdal.org/ogr_formats.html)
- OGR raster formats  
[http://www.gdal.org/formats\\_list.html](http://www.gdal.org/formats_list.html)

- **Cartographical operations**

QGIS supports easy-to-navigate cartography and mapping functionalities. Users will be able to easily pan and zoom the map extension and customize necessary map components such as scale bar, map legend, north arrow, inset maps etc.

- **Data manipulations and analyses**

With the vector drawing and editing functionalities, vector data (i.e. ESRI Shapefile) can easily be edited in QGIS. This will allow users to create and edit their own GIS data as needed. For example, users will be able to manually plot the locations of hospitals, operation centres, offices and also draw their own boundaries such as camp site zones and so on.

There are also many plugins to run advanced spatial analysis methods such as joining multiple datasets based on their spatial relationships (intersect, overlap, falling within a certain buffer distance), data interpolation, distance calculation, raster calculation, zonal statistics, hot spot analyses etc.

- **Integration with other open-source GIS platform**

QGIS is included as part of the OpenGeo Suite (<http://workshops.boundlessgeo.com/suiteintro/>) which enables the integrations with other applications such as PostGIS, GeoServer, OpenLayers and many others. By linking with other applications, users will be able to build their own web map applications and online maps more easily.

- **Basemaps**

Using 3rd-party plugins, QGIS includes a continuously updated list of basemaps including but not limited to ArcGIS Online, Google Maps and OpenStreetMap.

- **Scripting functionality**

QGIS also supports querying and programming functionalities using SQL and Python programming languages, with which users can script and automate repetitive workflows.

- **Training sources and technical support**

QGIS is one of the most commonly used open-source GIS programs. Therefore, there are many user guides, videos, tutorials and documentations available online. There is

also a big QGIS user community who is consistently helping other QGIS users through StackExchange and online platform.

## 2. QGIS vs. ArcGIS

- **Complete ESRI ArcGIS application suite**

ArcGIS offers its own complete GIS application suite, including ArcSDE for storing spatial database, ArcGIS Desktop for static mapping and extensive spatial analyses, mobile GIS applications for field data collection, ArcGIS Online for interactive web map applications, and ArcGIS Server for web-based spatial information sharing. Since these platforms are well linked, in general an entire work flow can be achieved using the ESRI products. For example, users can collect field geographic data with the ArcGIS mobile application (Survey123), then rapidly share information through ArcGIS Server and Online. Any extensive mapping and analyses can be done using ArcGIS Desktop. Since QGIS has been mostly developed as a desktop GIS application, in some cases users may have to rely on other tools and software to achieve the same type of work flow mentioned above. Sometimes the linkage across platforms is not as straightforward due to the difference in supported data formats and licensing issues.

- **Documentation, customer support for troubleshooting**

ArcGIS often offers extensive documentation, online training materials, sample datasets, customer support through ESRI offices which are based in over 80 countries.

- **Cartographic operations**

There are more native cartographic output options with ArcGIS. Different data frames can be added and linked. ArcGIS also has lot of advanced mapping functionalities. In QGIS, different data frames can not be linked. QGIS does not have advanced mapping functionalities as compared to ArcGIS. ArcGIS also in general supports more sophisticated labelling rules and options.

- **Built-in functions and tools**

ArcGIS offers a well-structured set of tools for geoprocessing and spatial analyses. These tools are well documented and their methods are also well explained in scientific papers or online resources. QGIS plugins are usually developed and published by their core-developers as well as user communities and volunteers. Although there is a review process on these plugins, the documentation might not be sufficient. There are also several similar QGIS plugins to achieve the same task. This can be confusing for users to know what plugins to use for achieving certain tasks.

- **Compatibility between QGIS and ArcGIS**

Although both ArcGIS and QGIS share a lot of similarities including the data formats they can take, map files produced in ArcGIS (.mxd) are not always easily accessible from QGIS and vice-versa (QGIS .qgs map files not fully compatible with ArcGIS). This means that some of the mapping components produced in ArcGIS such as labelling, symbology etc will have to be recreated in QGIS if users have to switch in between the two applications.