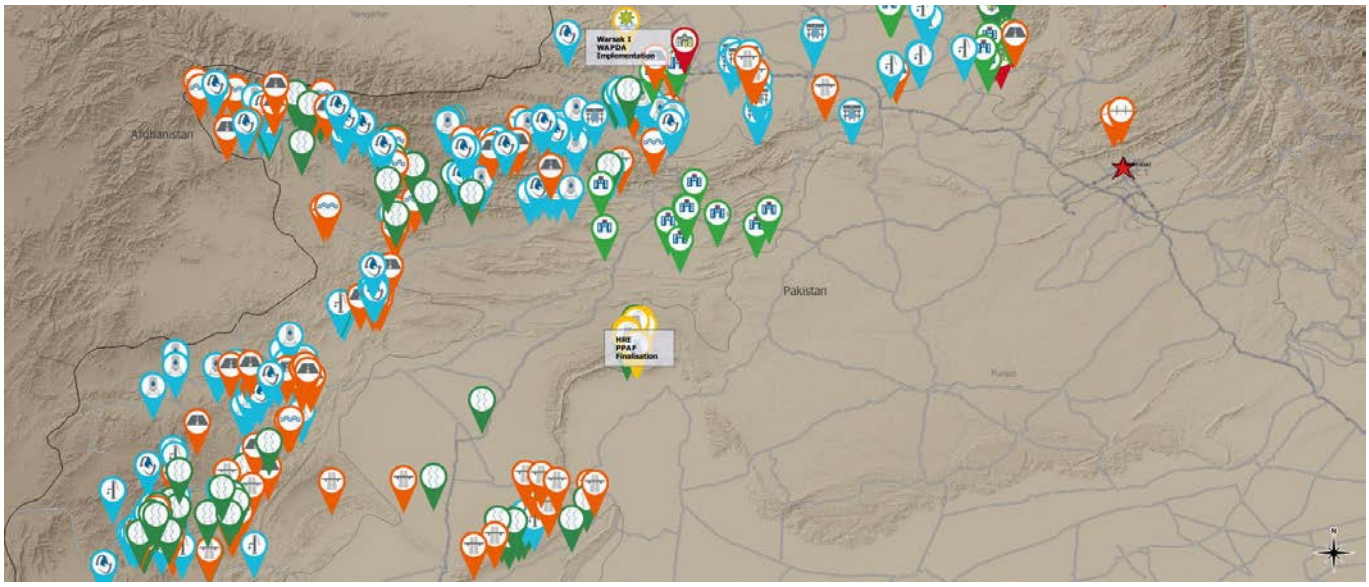
Geospatial Tools / GIS



Source: www.qgis.org (Pakistan)

An overview of Financial Cooperation project locations in Pakistan

Relevance of this Tool Type within the Project Cycle

Geospatial tools facilitate the mapping of potential and actual project locations; the monitoring of implementation, usage, operation, and maintenance across all project sites; and the risks and impacts of natural or manmade occurrences. They are also useful for comparing internally collected project site information with external (open) geodata on a map.

Definition

For this fact sheet, geospatial tools encompass geographic information systems (GIS) as desktop and web-based (webmapping) software. GIS software is a specialized tool designed to collect, integrate, aggregate, store, edit, manipulate, analyze, manage, share, and present different types of geospatial data in layers of maps. Webmapping is the process of visualising and sharing maps on the internet. The delimitation between web maps and GIS is blurry: maps are often a presentation means in GIS but are increasingly gaining analytical capabilities.

Geospatial tools are particularly relevant for projects with a wide geographic radius because of scattered infrastructure investments in communities—either because of decentralization processes or for projects needing multilayered visualization and handling of specific location-based services.

Step 1: Check the Digital Principles

Before designing / selecting any geospatial tool or GIS, the *nine Principles for Digital Development* should be considered: https://digitalprinciples.org/

Step 2: What Types of Data Should I Consider?

GIS software can process any data that contains geocoordinates. These can be represented by two main types of geospatial data: vector (map) data or raster (image) data. This data can be visualized in a map and be referenced to images, sensor data, features, 3D models, and socio-economic and environmental data. Maps have shifted from manually made, one-off, static, paper-printed, and scanned images (in PNG, JPEG, TIFF, SVG, PDF, and SWF formats) towards web maps as more interactive and digital savvy alternatives of visualizing and manipulating data on the web. For example, dynamic and distributed maps are generated upon upload thanks to database sources distributed through different servers containing different map layers. Animated maps show changes over time (graphical or temporal variables) using multimedia formats and technologies such as: SVG, Java, Quicktime, etc.). Near real-time maps display a live phenomenon, using sensors. Customizable web maps (such as Open Layer Framework, Yahoo! Maps, or Google Maps) offer embedding in third-party webpages and/or map-based services (route planner, location marking, etc.)

Step 3: What Information Do I Need?

Geospatial tools process georeferenced geospatial data on sites, locations, attributes, and cross-sectoral information within a given geographical area through multidimensional layers that can be combined with project data or isolated according to analysis requirements, for example:

- **Assessment of risks**/vulnerability of populations to disasters, conflicts, or diseases
- **Planning of infrastructure** projects, for example, electricity grids, road construction layered with secluded homes, and hard-to-reach schools
- **Visualization** of wildlife, biodiversity, climate, and environmental issues, for example, deforestation and temperature changes
- **Forecasting analysis**, for example, crop exposition to flood-prone areas

For information visualization needs and monitoring purposes, geospatial tools make use of recent technological and webmapping developments and offer enhanced functionalities, such as animation; real-time feed; personalization via filtering, symbolization, and styling; and collaboration and can be combined with web-based cloud processing and analysis of geospatial data.

Step 4: What Should I Consider When Acquiring Geospatial Data and Software Tools?

Due to the variety and increasing importance of applications for geospatial data, a multitude of open, freely downloadable, geospatial data sources exists online that can be used for project-level analysis > Fact Sheet Data sources (incl. Open Data and Big Data).

Should data be collected first-hand to meet specific information needs, geospatial data collection can be incorporated into project monitoring via several tools presented in other > Fact Sheets (see below).

For the **processing and managing** of georeferenced geospatial data, several software solutions exist:

- open-source geospatial tools are available on the market, such as QGIS, GRASS GIS, ESA-SNAP, ILWIS, and gVSIG.
- Proprietary GIS tools are also available but require careful elabo-ration of licensing costs during and after project implementation (e.g., ESRI ARCGIS, ERDAS, and Ecognition).

For **collaboration, visualization, and presentation** purposes, geo-spatial tools such as OpenStreetMap, WikiMapia, and Google Earth may be of use.

The following **challenges** should be considered when using geo-spatial data for project planning, implementation, and monitoring or verification:

a) the availability of (updated) data
b) adequate data storage, hardware, and IT infrastructure
c) inter-institutional cooperation in terms of data exchange
d) access to the internet
e) adequate training of project implementers/monitors in the target regions to increase sustainability
f) access to appropriate software

Interoperability Requirements

The following standards/requirements should be considered as part of the setup of any geospatial tool:

- File formats for handling vector and raster data are manifold. Industry standards are recommended for georeferenced data exchange, such as KML, GeoTIFF, GeoJSON, SHP, GPX, GPKG, GIF, IMG, and JPEG.
- KfW will require the export of geo-referenced project data (in KML or XLS) according to a new template as part of its regular reporting. This template also ensures compatibility of the reporting with the International Aid Transparency Initiative (IATI) Standard and the Open Geospatial Consortium (OGC) for feature classes > RMMV Guidebook Annex 3.
- Additional standards / definitions / requirements from established international initiatives, such as the Open Geospatial Consortium (OGC); feature classification of the Multinational Geospatial Co-production Program (MGCP); land cover classification and mapping of the Land Cover Classification System (LCCS) from the UN Food and Agriculture Organization (FAO), and Copernicus EAGLE. For forests: Reducing Emissions from Deforestation and Forest Degradation (REDD) can be used to further disaggregate georeferenced data types.

Legal Aspects

Human rights risks: In countries with human rights issues or in conflict settings, project location data containing exact GPS coordinates could be used against the population or vulnerable parts thereof, such as minorities. This information could be misused for targeting them via discriminatory policies, (state) terror attacks, and so on. The funding of a specific infrastructure or location by an international donor could increase such a risk. Careful attention to data protection and data security (below) is required so as not to risk harming individuals or groups.

Intellectual property rights for using the GIS information must be secured, thereby avoiding liability for infringement on such rights, whether intended or not. Such infringements could include failure to control access to geo-data or tools, resulting in the illegal use of the data or tools by others. Users must familiarize themselves with the terms of use of the respective GIS tool.

If commercial services, such as **Google Maps and Google Earth**, for example, are employed, any use has to comply with their general Terms of Services and their Additional Terms of Services for Maps and/or Satellite Services. Those terms prohibit certain conduct, including copying the content or "mass downloading" content (even content from projects that was mass-uploaded before).

Data Protection: Combining descriptive data with precise location data is the cornerstone of many types of spatial analyses. But when locations are easily linked to identities of individuals, households or farms, there is potential for violating personal privacy. Avoid the inadvertent collection of personal data. Only strictly relevant personal data should be collected and processed in line with the recommendations in the > Fact Sheet Earth Observation via Satellites. If initial data minimization is impossible, personal data must be anonymized (e.g., by redaction or pixilation).

Data security requirements can also arise from applicable data protection regulations (local and/or GDPR) or the above-mentioned human rights risks, which stipulate basic security requirements for storing and processing of exact GPS coordi-

nates. Entities may be required under those rules and/or conditions to ensure the ongoing confidentiality, integrity, availability, and resilience of storing and processing systems and services (technical and organizational measures).
More information on legal aspects can be found here:
> RMMV Guidebook Section 2.3.

Project Examples/Use Cases

- In the crop production project PABSO (PN: 27495) in Burkina Faso, geospatial analysis was used to analyze vegetation and road networks.
- In the water and sanitation program RANC-EE (PN: 30343) in Central America, a GIS was used to map networks and conditions to reduce water loss.
- In "REDD Early Mover" project (PN: 29763) in Ecuador, a GIS, Satellite Imagery and Third-Party Monitoring are used to enable the Ministry of Environment to monitor forest degradation and carbon emissions.

Links to Further Sources

- KfW Terms of Reference for project geo data collection:
  > RMMV Guidebook Annex 3
- GIS Encyclopedia in Wikipedia:
  http://wiki.gis.com/wiki/index.php/Main_Page
- Geospatial is not GIS (GIS vs geospatial definitions):
  https://www.forbes.com/sites/forbestechcouncil/2019/03/21/geospatial-is-not-gis/
- List of Limitations or Challenges of GIS:
  https://grindgis.com/remote-sensing/limitations-or-challenges-of-gis
- List of open-source GIS applications
  https://www.gislounge.com/open-source-gis-applications/

Linkages to other tool types

Further information on how to use this tool type in an RMMV context can be found here: