Working Paper: Georeferencing Strategy and procedures for the CS-FOR

Author: Jacopo Monzini

Abbreviations, Acronyms

- **ADB** – Asian Development Bank
- **AE** – Accredited Entity
- **ArcGIS** – GIS Software for Desktop provided under license by ESRI
- **AWPB** – Annual Working Plan and Budget
- **CPM** – Country Program Manager
- **CS-FOR** - Carbon Sequestration through Climate Investment in Forests and Rangelands
- **CSV –** Comma Separated Value
- **ESRI** - Environmental Systems Research Institute
- **GCF** – Green Climate Fund
- **GDP** – Gross Domestic Product
- **GE** - Google Earth
- **GEF** – Global Environmental Facility
- **GIS** - Geographical Information System
- **GIZ** - Gesellschaft für Internationale Zusammenarbeit (German Society for Int. Cooperation)
- **GPS** - Global Positioning System
- **GPX** – GPS Exchange Format
- **HTML** - Hypertext Markup Language
- **IFAD** - International Fund for Agriculture Development
- **INEMCRP** – Integrated Natural Resource Management and Community Resilience Plan
- **IT** – Information Technology
- **KM** - Knowledge Management
- **KML** - Keyhole Markup Language
- **KMZ** - Keyhole Markup Language Zipped
- **M&E** – Monitoring and Evaluation
- **MAFL** - Ministry of agriculture, food industry and land reclamation
- **MOU** – Memorandum of Understanding
- **NDA** – National Designated Authority for the Green Climate Fund
- **NDVI** – Normalized Difference Vegetation Index
- **NSDI MOU** – Kyrgyzstan National Spatial Infrastructure Memorandum of Understanding
- **NGO** – Non Governmental Organization
- **N.O.** – No Objection
- **NRM** – Natural Resource Management
- **PCM –** Project Cycle Management
- **PIU** – Project Implementation Unit
- **PUA** – Pastures Users Association
- **QGIS** - Quantum GIS Software for Desktop provided for free under open source license
- **RS** – Remote Sensing
- **SWOT** - Strengths, Weaknesses, Opportunities, Threats
- **U.S. –** United States of America
- **WB** – World Bank

Table of Contents

Currency Equivalent

The only currency used in the present document is USD.

Weights and Measurements

The present document reports weights and measurement according to the metric system international standards.

Definitions and Glossary

Decimal Degree: measure unit of a location on the Earth by latitude (Lat.) and longitude (Long.). Example: Lat. 48,55° N ; Long. 35,6° E

Georeferencing: Aligning geographic data to a known coordinate system so it can be viewed, queried, and analyzed with other geographic data. Georeferencing may involve shifting, rotating, scaling, skewing, and in some cases warping, rubber sheeting, or orthorectifying the data (ESRI 2017).

Geospatial data: data that has a geographic component to it. This means that the records in a dataset have locational information tied to them such as geographic data in the form of coordinates, address, city, or ZIP code (GISLOUNGE 2017)

Geographical Information System: is an association between actors and informatics facilities (computer, software, etc.) used to collect, create, store, manage, analyze and display all geo-referenced* information in order to understand relationships, trends and patterns, and to communicate them.

Geospatial Browser: interactive application that allows user to visualize geographical data and interact with them. The best example is probably Google Earth Pro that is freely available on line.

Global Positioning System: A system of radio-emitting and -receiving satellites used for determining positions on the earth. The orbiting satellites transmit signals that allow a GPS receiver anywhere on earth to calculate its own location through trilateration. GPS was created by U.S. Department of Defense but there is also GLONASS for the Russian Federation and Galileo GNSS for the European Union.

Ground Truthing: in the context of this document ground truthing means "the process of sending technicians to gather data in the field that either complements or disputes remote sensing data.

HTML: (Hypertext Markup Language): A markup language used to create Web pages for publication on Internet. HTML is a system of tags that define the function of text, graphics, sound, and video within a document, and is now an Internet standard maintained by the World Wide Web Consortium.

Kml/kmz file: KML, or 'Keyhole Markup Language', is a file format for modeling and storing geographic features such as points, lines, images, polygons, and models for display in Google Earth, Google Maps and other applications. The KML format is used to share places and information with other users of these applications. A KMZ file is a compressed version of KML file. Google Earth can open KML and KMZ files if these files have the proper file name extension (.kml or .kmz).

Map Projection: A map projection is used to portray all or part of the round Earth on a flat surface. This cannot be done without some distortion. Every projection has its own set of advantages and disadvantages. There is no "best" projection. The mapmaker must select the one best suited to the needs, reducing distortion of the most important features. Mapmakers and mathematicians have devised almost limitless ways to project the image of the globe onto paper.

Metadata: Information that describes the content, quality, condition, origin, and other characteristics of data or other pieces of information. Metadata for spatial data may describe and document its subject matter; how, when, where, and by whom the data was collected; availability and distribution information; its projection, scale, resolution, and accuracy; and its reliability with regard to some standard. Metadata consists of properties and documentation. Properties are derived from the data source (for example, the coordinate system and projection of the data), while documentation is entered by a person (for example, keywords used to describe the data) (ESRI 2017).

NDVI: Normalized Difference Vegetation Index. NDVI describes photosynthetic activity. It is calculated from the visible red and near-infrared light reflected by vegetation. Healthy vegetation absorbs most of the visible light that hits it, and reflects a large portion of the near-infrared light. Unhealthy or sparse vegetation reflects more visible light and less near-infrared light. When applied to a given area, this index establishes a value for how green the area is, the quantity of vegetation present and its state of health or vigor of growth. The NDVI values range from –1 to +1. Areas of barren rock, sand, or snow usually show very low NDVI values (for example, 0.1 or less). Sparse vegetation such as shrubs and grasslands or senescing crops may result in moderate NDVI values (approximately 0.2 to 0.5). High NDVI values (approximately 0.6 to 0.9) correspond to dense vegetation such as that found in temperate and tropical forests or crops at their peak growth stage

Remote sensing: Collecting and interpreting information about the environment and the surface of the earth from a distance, primarily by sensing radiation that is naturally emitted or reflected by the earth's surface or from the atmosphere, or by sensing signals transmitted from a device and reflected back to it. Examples of remote sensing methods include aerial photography, radar, and satellite imaging.

Shapefile: A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class (points, lines, polygons, etc.)

Spatial Analysis: The process of examining the locations, attributes, and relationships of features in spatial data through overlay and other analytical techniques in order to address a question or gain useful knowledge. Spatial analysis extracts or creates new information from spatial data.

Time series analyses: There are two main goals of time series analysis: (a) identifying the nature of the phenomenon represented by a sequence of observations, and (b) forecasting (predicting future values of the time series variable). Both of these goals require that the pattern of observed time series data is identified and formally described. Once the pattern is established, data can be interpreted and integrated. Regardless of the depth of the understanding and the validity of the interpretation (theory) of the phenomenon, the identified pattern can be extrapolated to predict future events.

Web GIS: is a type of distributed information system, comprising at least a server and a client, where the server is a GIS server and the client is a web browser, desktop application, or mobile application. The server has a URL so that clients can find it on the web (ESRI 2017).

Executive Summary

1. Georeferencing is the process of attributing geographical coordinates to specific sets of data and or activities. The process *per se* is not new to Kyrgyzstan that has sporadically applied it in very specific contexts yet the same is still too scattered and dependent from internationally funded projects such as those funded by IFAD, the WB and GIZ.

2. In Kyrgyzstan, the use of georeferencing as well as geospatial analysis is still not fully exploited and not always accessible to the large public or shared with other institutions. Nonetheless, in the past decade, the Country has considerably advanced and several institutions recently started a process of standardization, digitalization and sharing of their databases. In this regards 10 key public institutions, including the Ministry of Agriculture, the Ministry of Emergency and the State Agency for Environment and Forests, signed in 2016 an MOU[1]. By signing the MOU, involved institutions confirm such positive direction as well as the intent of securing transparency and data sharing among different institutions and the large public.

3. The project is therefore a relevant opportunity to capitalize on such institutional momentum and a great occasion to scale up and mainstream georeferencing and geospatial analysis via GIS among public institutions and the public. Georeferencing is in fact an opportunity to ensure efficient and effective data management reducing costs and time for project executors as from identification to evaluation, project/program cycles generate large amount of information, data and analysis often reducing potential and reliability of the M&E and KM processes. In order to ensure accuracy of reporting, precision of monitoring and accountability of results, the project will apply enhance its M&E and KM process applying Georeferencing and geospatial analysis processes.

4. From concept note to impact evaluation the simple action of attributing GPS coordinates to project's activities will allow for evidence based management and reporting increasing the efficacy of the project and ensuring accountability of effectiveness of investments.

5. Georeferencing will allow the project to profit from the vast geospatial data set available for the Country and will support involved institutions in sharing and mainstreaming geospatial data as aimed by the 2016 NSDI MOU. Consequently, the integration of 'geo-spatial' elements will allow stakeholders to overlay different classes of data such as climate trends, hydrography, erosion, flood risks, land cover, land use, distribution of population and livelihoods that are a non-negligible part of an evidence based and informed decision making process. Finally, the process will contribute in enhancing national and regional data collection activities that will support the understanding of Climate Change impacts at local level.

6. The combination of data derived from the project with available geospatial data will therefore allow involved institutions to improve the overall management and coordination of activities and to secure important requirements and targets such as:

- Investments are executed in target areas in areas of relevance.
- Investments are trackable during the year avoiding supervision surprises and attribution is clear.
- Investments are clearly quantified and mapped allowing for precise carbon accounting.

[1] Cooperation between state bodies that produce spatial data, in order to systematically exchange and improve the quality of spatial data, as well as to implement Sustainable Development Goals

- Investments are shared with stakeholders enhancing project's transparency, accountability and coordination potential.
- Cost of management, M&E and supervision are optimized increasing project and AE effectiveness.
- Results are replicated according to objectively verifiable evidence based on data and will allow the NDA to enhance its coordination capacities.
- Real time sharing of acquired knowledge as well as state of art of the project.

7. The use of such approach will not require special technologies, equipment or advanced IT skills. Basic software are available under license (i.e. ArcGis/ESRI) or in open source (i.e QGIS) and most of the currently available smart phones/tables, regardless of their operative systems, can execute most of the processes required to ensure georeferencing and data management. Therefore, the project will use locally available technology and expertise to support this process and to ensure its scalability at the national level as aimed by the 2016 MOU.

Introduction

8. Georeferencing will ensure a unique relation between project's activities and unique sets of geographical coordinates collected according to a specific procedure (Ref: Georeferencing Procedures). This will allow the project and the Country to ensure clear identification of activities and beneficiaries in the precise context identified during project identification and design.

9. Investments, trainings and activities with communities and institutions will therefore be identified with a precise set of coordinates that allowing the project to generate tailored maps and clearly showing what had been done, where, targeting which community and/or administration and finally allowing understanding of results' evolution in the given context and against the identified baseline of variables. Proposed indicators will therefore have a third relevant "dimension". If quality and quantity are standard reading keys of projects' indicators, FAO is adding to its project the geographical dimension. This will allow us to better execute and fine-tune investments and stakeholders to understand results within a clear and objective context. In other word, by georeferencing our work we are allowing stakeholders to have a close to real time eye on what we are doing and on how we are working.

10. The process will not generate additional datasets or databases but will enrich mandatory M&E databases with additional information related just to the precise geographical position (table 1) allowing the PIU to map activities and impacts in an easy and friendly way.

Simplified Example of an M&E database

Additional Columns

#	Activity	Baseline	Indicator	Contribution to outcome's indicators	Latitude (x)	Longitude (Y)	Area Map

Latitude and Longitude can be collected via smartphone or GPS devises. They identify one point

In case of lines (i.e. roads, windbreakers, walls, others) or polygons (i.e. areas) the operator will insert a link to a shapefile including all needed coordinates.

Table 1: Georeferencing database add-ins sample.

11. The set of georeferenced data, once transposed into a geo-browser such as Google Earth (GE), will allow the PIU or any stakeholder to visualize project's activities in the framework of the most advanced satellite/aerial photos available as showed in figure 1.

Figure 1: Visual representation of Georeferencing and its potential to support monitoring and evaluation.

12. In addition to the visual analysis presented in Figure 1, PIU and AE will be in the position to process collected data via remote sensing (RS) analysis. For this purpose, FAO has developed a unique tool (Earth

Map – figure 2) that allows interpretation of large datasets in real time.. Earth Map is an innovative tool that facilitates and empowers users in performing historical and current climate-environmental analysis for a given area through a graphical interface that has been developed ad hoc by FAO to ensure solid and objective climate scenarios. Users will be able to visualize project's areas from the M&E georeferenced database and run tailored analysis such as changes in NDVI, land cover, land use and others. Outcomes of the analysis will be exportable as picture, pdf or KMZ files to be uploaded in Google Earth Pro or other similar geobrowsers. Uploading of data on selected geobrowsers (i.e. Google Earth) will allow also for time series analysis that will show how georeferenced activities evolved in the given timeframe. Figure 2 shows how changes in land use/cover can be analysed via Earth Map and followed via Google Earth.

Figure 2: Earth Map Demo and time series (2003-2011-2017) analysis via Google Earth of land use changes in agriculture.

13. FAO has started this process since the early stages of the national engagement process developing an atlas of climate vulnerability, exposure to natural disasters and others key information such as climatic variables, land cover and land use. By mapping the different analyzed variables, stakeholders selected the 4 most vulnerable districts as core target areas and started collecting additional data, which are available and shared so to understand clearly targets but also to ensure precision and accountability of the proposed intervention. Project's target areas are therefore the resultant of this process. With this objective in mind, the project georeferenced the entire baseline that is now visible on Google Earth and as a printable project atlas file.

Country Context

14. **The national Dimension:** Georeferencing and GIS in general are tools and processes partially new to Kyrgyzstan. Recently, the Country has started an ambitious process of harmonization and standardization of GIS related data and has initiated a vast process of georeferencing that has started with the pasture user associations and their attributed lands and is now in use at the cadaster and, in some cases, household survey level. The missing part of this process was - and still partially is - accessibility of collected data and produced analysis/maps.

15. To overcome this bottleneck 10 key Kyrgyz institutions[2] have recently signed an MOU that aim at: (a) creation of a national spatial data infrastructure and (b) create the bases for standardization and

2 (1) Department of cadaster and registration of real estate rights, (2) Department of water resources and land reclamation of the MAFL, (3) Department of pasture, livestock and fisheries, (4) MAFL, Water department, (5) State Agency for architecture, construction and housing and communal services, (6) National Statistical Committee, (7) The crisis management Center, (8) State

sharing of spatial data among state institutions and the public. The NSDI MOU, although an important step in ensuring efficiency, effectiveness and transparency in the field of spatial data management, is just the beginning of a long process. The NSDI MOU is in fact only a declaration on intents and it does not bind any of the signatories to support the achievement of presented objectives. De facto, the effectiveness of the NSDI is as strong as the willingness to share of its signatories. Nonetheless, the momentum is tangible the political willingness to shift to more transparent data management processes is there.

16. In terms of capacities, the Country disposes of the required human and technical capacities. Although limited to Bishkek, GIS and RS service providers are amply available in the market and most of the public and private universities offers since many years specific courses and degrees. Additionally, international actors such as FAO, IFAD, GIZ, the WB and ADB supported the State with dedicated training and provisions of technical equipment such as computers, GPSs and others. Representatives of the civil society are also familiar and in many cases advanced with GIS and RS environments with some acting as service providers for the State and rural communities. Nonetheless, mainstreaming of georeferencing and spatial analysis is a rarity in projects and programs. This often curbs down projects and institutions' investments in GIS and RS analysis as the main element (coordinates) is missing.

17. **The local dimension:** If at national level, institutions started the political and technical processes of standardization and sharing of spatial data and metadata this does not happens at local level. GIS, georeferencing and spatial analysis are still lagging behind and mostly unknown among communal and regional administrations. If we exclude a few pasture unions, assisted by specialized NGOs, georeferencing and GIS are still new to the largest part of local administrations and rural communities.

Sector Performances

18. Potential, technologies and human capacities are well rooted and available in the country. Public and private universities have GIS and remote sensing among their classes and courses, while the growing permeability of internet in urban and rural areas allows for advanced uses of GIS and geospatial based approaches - including georeferencing – via mobile or tablets in most of the Country. In general, there is no evident technological nor human capacity bottleneck in the Country preventing or jeopardizing the use of GIS and geospatial processes such as georeferencing.

19. Over 20 different companies offer GIS based services and assistance to both public and private sectors. The large public (38% of households) have access to reasonably good internet connection and mobile technologies are accessible to the entire population[3] of which about 24% via 3G and 4G band[4]. Finally, public central institutions as well as civil society organizations are often reasonably equipped with human and technical resources to secure GIS processes and basic geospatial analysis.

20. In terms of data, there is a vast satellite database available to secure key information on natural resources, climate, demography and others (available data have been included in the Earth Map

Agency for Environment Protection and Forestry, (9)MALF, State Institute of land management industry and land reclamation, (10) State maps and geodetic service of the State Committee of industry, energy and mining .

3 Numbers will reduce drastically since the introduction of the nominal line policy that attribute numbers to physical persons or companies only.

4 Source: National Statistics

database). These are available online from peer-reviewed publications as well as from international databases.

21. Although the ground for GIS and geospatial processes is available, the sector is still performing well below its real potential. Lack of data standardization, poor clarity of metadata as well as diffuse unwillingness to share and open databases are reducing the potential geospatial analysis and applications.

22. Addressing these bottlenecks will surely contribute in improving monitoring and efficiency of public and private organization and will increase participation of local administration and communities in the overall governance of the Country and, in the precise context of this project, of its natural resources and climate driven risks.

SWOT Analysis

STRENGTHS	WEAKNESSES
National Capacities: The Country disposes of the appropriate set of human ad technical capacities to ensure efficient and effective georeferencing as well as advanced GIS and RS analysis. **Simplicity of the georeferencing process:** georeferencing does not require advanced technologies or skills. It is a step based process where each step is autonomous and self-standing allowing users to adapt the process accordingly with financial and human capacities. **Economic and Financial Viability:** applying georeferencing as one of the key steps to ensure evidence based management and decision support will not increment the overall budget of users. On the contrary it will optimize planning and use of resources reducing costs and allowing for new investments.	**Lack of inclusion of local administration and community representation bodies in the process.** This has reduced the momentum of the process of data digitalization and limited the impact of such a key innovation in public goods' management. Even in the case of pasture users' association understanding and uses of the digitalized maps of pastures is limited and unevenly ensured. **Lack of technical and human capacity at local and community level:** although both knowledge and technologies are available in the main urban centers and central administrations the same does not seems applicable at the local administration and community levels. This is causing the exclusion of final users from the process and de facto limiting the effectiveness of the process. **Resistance to abide to the new National Spatial Data Infrastructures Strategy:** there is still a well-pronounced resistance of few institutions in abiding to the principles set with the NSDI MOU and relative national policy framework to ensure standardization of data, transparency and accessibility of data. **Weak Land Tenure Governance:** lack of proper governance and appropriate hierarchy of responsibilities on issues concerning land, land tenure and administrative boundaries in the field of natural resources (Forests/Pastures).

OPPORTUNITIES	THREATS
Momentum: as demonstrated by the national effort to georeference and map the cadaster, pastures and others and as confirmed by the recent NSDI MOU, the overall conditions to enhance georeferencing of projects and programs as well as the use of collected coordinates for evidence based monitoring and decision making is a strength. The signature of the NSDI MOU on standardization and sharing of national spatial data as well as the interest of major international players such as the WB, GIZ, IFAD and FAO constitute a unique occasion to promote further georeferencing among development actors and Country's institutions. **Experience of key institutions:** each of the involved partners from both institutions and civil society organizations have already tested georeferencing and connected analyses. **Need:** georeferencing and spatial analysis are among the priorities of the Country to manage their statistical information as well as to ensure monitoring of natural resources such as pastures and forests.	**Obstructionism:** Data sharing may still be perceived, by some institutions, as an issue. The NSDI MOU should mitigate such perception but resistances might persist at the technical and local management levels. Also, data sharing is not a requirement of the NSDI MOU but a recommendation that might not be sufficient. This resistance is slowing down the process and causing friction among institutions as well as donors that still struggle with unreasonable requests of payment for data that should be public or sharable for free. **Uncertainty of Standards:** although the NSDI MOU addresses standards and sharing methodologies, substantial work is still needed to ensure coherence of collected data, clarity of metadata and harmonization of standards.

Table 2: Georeferencing Process SWOT Analysis

Past and ongoing development project programs

23. As previously reported, GIS and georeferencing are mostly promoted by projects that work in different sectors such as cadaster modernization (WB), ecosystem management (GIZ and GEF/FAO), livestock and pasture management (IFAD, WB), water management (Finnish Aid and Swiss International Cooperation) and forest management (WB). The project will ensure cooperation with each active projects and will learn from those that are now completed. Data, when relevant and functional, will be absorbed within the project atlas.

Recommendations

24. **Project Level:** in order to ensure a smooth and effective georeferencing process it is important to ensure that in the PIU there will be one person responsible for the process and that this person (possibly with GIS expertise) is located in the M&E unit. FAO should ensure that adequate resources (ref: budget) are allocated for training of PIU's staff at start up with a refresh session at midterm. FAO should ensure data quality review to secure efficiency of the process and intervene to fix issues and problems that may arise in the execution of the process.

25. **National Level (Scale-Up):** The PIU will have to engage stakeholders in the georeferencing process and should ensure restitution sessions were findings are presented with clear geographical indication. Involved institutions need first to understand relevance and effectiveness of georeferencing so to be fully engaged into tailored trainings that will be organized by the PIU and that will aim at mainstreaming

georeferencing among stakeholders. Given the current momentum on spatial data (georeferenced information), the PIU should plan georeferencing mainstreaming in the framework of the NSDI MOU and according to its recommendations and objectives.

Rationale

26. Georeferencing and use of GIS and RS analysis is a key step forward to ensure evidence based management and mostly evidence based decision making process. Georeferencing is not adding additional information but is adding context to information. Georeferencing is a very simple and inexpensive step that opens almost infinite management and planning opportunities as it allows to contextualize and it allows precision follow up thanks to RS technologies and geospatial analysis. Without it is nowadays difficult to ensure quality and objectivity of interventions.

27. As described in the previous sections, georeferencing will require minimum investments and will yield highly relevant results for administrations and citizens. Knowing what is happening is important, knowing where it is happening allows decision makers to take informed decisions.

Detailed description of interventions

28. Before getting into the details of georeferencing, it is important to look at required skills and technology so to ensure efficiency, effectiveness and accuracy of the process. As reported in the introductory parts of this document georeferencing requires minimum technological inputs and basic IT skills.

Minimum IT Skills

29. Georeferencing requires knowledge of the followings:
    a) Use of smartphone applications or GPS,
    b) Basic use of Excel,
    c) Basic use of Google Earth Pro.

30. To ensure georeferencing nothing more is required. Staff will collect coordinates and transfer them into the M&E database or in the georeferencing database according to PIU preferences in data management. There is no specific skill required.

Minimum Technology

31. Georeferencing requires availability of the following hardware:

    a) Smartphone / Tablet or GPS,
    b) Desktop/Laptop,
    c) Internet connection (for uploading on Google Earth Only).

32. Current cellular-enabled smartphones and tablets include an integrated GPS chip-set . Operating systems (iOS/Android) are already set to georeference user's activities. Unless manually disabled

by users each smartphone/tablet automatically collects GPS coordinates. Pictures are always automatically georeferenced. Each devise is equipped with a compass application that provides GPS coordinates. If only few points are to be collected this application is more than enough to achieve georeferencing. If smartphones are not available, any basic GPS device is enough for the purpose. There is no need to acquire advanced or expensive dedicated devices.

33. In regards of desktop or laptop, there is no specific requirement as far as the machine has enough computing capacity to run Office environment and to access the internet. If users intend to acquire new equipment a standard unit will suffice for the purpose. It goes without saying that in case of use of advanced GIS and RS software, users will need more powerful machines.

34. In terms of software and/or applications, basic georeferencing requires the followings:

a) Geo-tracker application,
b) QGIS / ESRI ArcGIS / Other commercial or open source software,
c) Google Earth Pro / Other Geo-browser,
d) Microsoft Excel or equivalent.

35. Basic georeferencing does not require any specific application or software. Nonetheless, to facilitate the process and to add value to georeferencing with basic analysis a few software might come at hand. While some are already installed by default (Excel) the others are available either for free (GE, QGIS) or under license (ArcGIS, Geo-tracking applications).

36. Geo-tracking applications are remarkable tools to support the process. They can track points, lines and provide users with plenty of additional information such as speed, altitude, main weather parameters and others. As far as the application allows for data saving and sharing, there is no other specific requirement. Users are free to select the application they feel more comfortable with. In case of GPS's use, these applications are not needed. Geo-tracking applications are necessary to georeference lines (i.e. roads, canals, windbreakers). Geo-trackers are the best option to upload - without further processing data – into GE (figure XX). When selecting your geo-tracking application, ensure that it works offline and that it allows automatic conversion in GPX, CSV and KML/KMZ format.

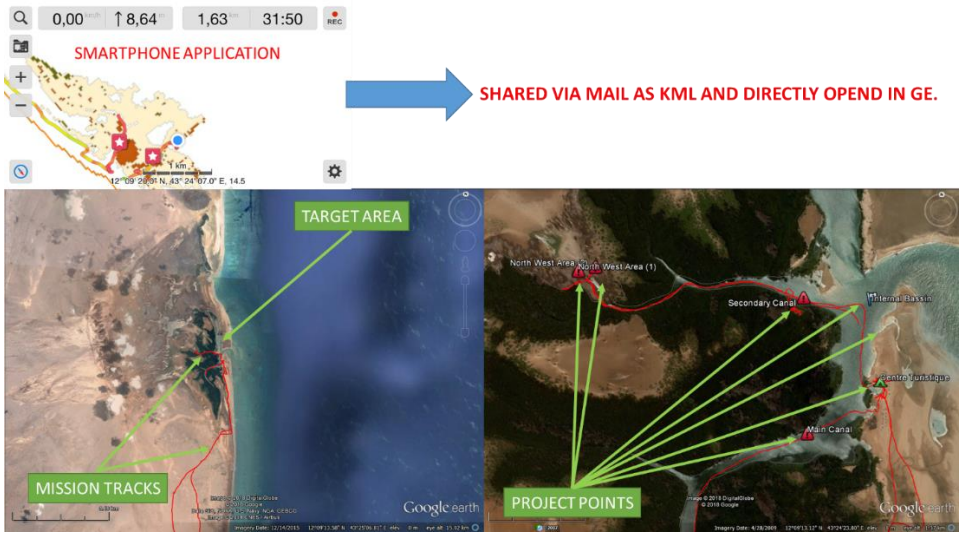


Figure 3: Example of georeferentiation of tracks and points from the geo-tracking application to GE (Djibouti case Study).

37. GIS software are paramount if users want to analyze collected data. As georeferencing is only the process related to coordinates' collection, these software are required only in case of advanced use. Given the needs of most projects and programs, open source software such as QGIS will answer the needs of basic and advanced users. Knowledge of such software is not required for georeferencing but it is for RS and advances GIS analysis such as the one reported in figure 4.

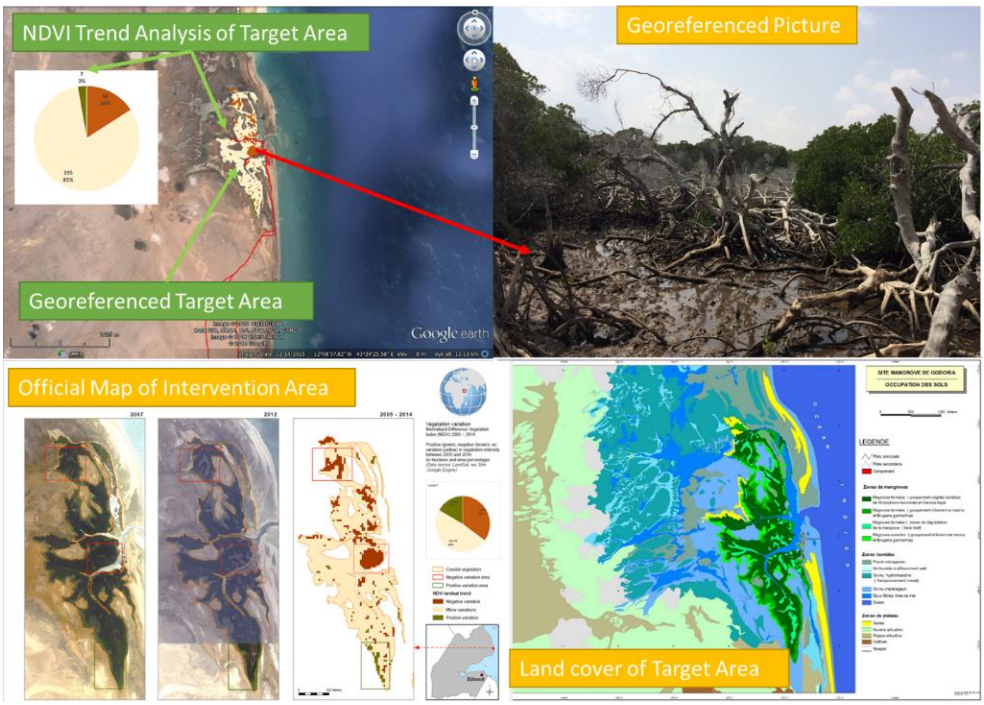


Figure 4: Example of advanced use of georeferencing via GIS and RS analysis

38. Google Earth Pro is a freeware application by Google that allows browsing of current or historical available satellite and aerial photographs at high resolution. The software is available on the Web

(browser), as desktop or laptop application, and on mobile devices. It works with iOs, Windows, Android and Linux platforms; but as today, it performs better on Windows systems. Google Earth Pro is available for free download in each platform store (i.e. Apple Store, Google Play and others) at www.google.com/earth/; however, conditions apply for commercial uses.

Georeferencing Process

39. As reported in several paragraphs of this document, once set with the selected hardware and software, users can start georeferencing with no further delay. Nonetheless, it is good practice to plan what to georeference, when and how.

40. As general rule, the person in charge of georeferencing will follow the regular planning of the project/program as reported in the PIM and illustrated in this document. Therefore, georeferencing is articulated in the 6 steps. Of these 2 have already been completed (1,2) during preparation of the concept note and of the full funding proposal and constitute a substantial part of the baseline while the third one (3) will be executed at start up. Each step is reported below with a table specifying timeframe, desired outputs, formats, responsibility, distribution and required technology.

Generation of the Context Atlas:

#	Step	Timeframe	Output	Format	Responsibility	Distribution	Used Technology
1	Generation of the Context Atlas	Concept Note and Full Funding Proposal	Target Areas Atlas	PDF + KMZ + Web based GIS	FAO/NDA/PIU	Open	Earth map / GIS Software / Google Earth Pro

41. As vulnerability to climate change - associated with mitigation potential - is one of the major drivers of target areas selection, FAO collected a large number of data sets at national and sub-national scale and using the described Earth Map tool, performed a series of vulnerability analysis to identify project's core target areas. Target areas have been selected mainly according to the following criteria:

a. Exposure of ecosystems and communities to natural hazards triggered by climate change,
b. Vulnerability of ecosystems and communities to climate change,
c. Mitigation potential in terms of forest and pasture rehabilitation,
d. High dependency of communities from natural resource exploitation,
e. Socio-economic vulnerability of communities,
f. Availability of public land to ensure effectiveness of investments in terms of mitigation and DRR.

42. Data and analysis that allowed the identification of the proposed target areas were organized in form of an atlas that presents the rationale behind areas' selection and that form the main part of the baseline in terms of distribution, density, status and vulnerability of target ecosystems (forests and pastures) and communities. The atlas presents key information such as climate variables, including trends, demography, agriculture productivity, infrastructures' distribution, pasture user associations grazing areas, forest fund lands and others. The ensemble of presented data constitutes the context generating the assessed needs as well as the context into which the validity of the paradigm shift will be objectively

demonstrated. The atlas will include also available historical data so to create, in GE, time series analysis as well as interactive videos similar to the one presented with figure 2.

Figure 5: Use of time series and historical data to explain impacts and visualize changes in land use (Haiti case study)

43. The Atlas (soon available in annex) is a living document that will be updated by the PIU with georeferenced data and that will form the foundation of the KM process of the project. The atlas will be available both as pdf, ppt and KMZ and will be prepared according to the standards set by the NSDI MOU. The atlas will be distributed along with the full funding proposal. FAO will be responsible for preparation and presentation of the atlas during the initial phases of the project and will pass under the responsibility of the PIU during project's execution and of the NDA after project completion.

Identification of Key investment areas:

#	Step	Timeframe	Output	Format	Responsibility	Distribution	Used Technology
2	Identification of Key investments' areas	Full Funding Proposal	Georeferenced LFM	PDF + KMZ +	FAO/NDA	Open	GIS software/Google Earth/Earth map

44. The second step of the process constitute in identifying, with national and local stakeholders, key investment areas in the 4 identified districts (core area) as well as other vulnerable areas where the project will be scaled up thanks to cofinancing and mainstreaming among Kyrgyz institutions. Areas will be selected according to the following criteria:

a. Potential, when restored, to reduce exposure of communities,
b. Relevance of ecosystem services such as those provided by pastures and forests (i.e. protection, livelihood, water) benefitting communities,
c. Potential sustainable use of products and resources for local communities,
d. Availability of public land of at least 1 000 hectares,
e. Agreement of Communities in reducing pressure on identified areas.

45. FAO, with the support of the NDA and through local consultation with administrations and communities, will ensure georeferencing and mapping of each of the priority areas (key hotspot) in target district so to be able to analyze in a more objective and holistic way possible risks – including those

deriving form communities - as well as potential impacts in terms of mitigation and disaster risk reduction for local communities. The areas will be included in the atlas and collected data will contribute to the baseline. The areas will be also included in Earth Map so to understand changes and impacts derived from project investments. As reported in the next subsections, georeferenced activities will be followed to ensure effective (i.e. activity is done) and efficient (i.e. survival rate is optimal and cost effective) execution of activities.

46. As per the previous step, this part will be under the responsibility of FAO. To ensure ownership and sustainability of the action, FAO will organize and implement both training and on the job capacity development activities so to ensure engagement of stakeholders and transfer of information to the concerned public.

Georeferencing Training

#	Step	Timeframe	Output	Format	Responsibility	Distribution	Required Technology
3	Start-Up Training	Design/Start-up/Mid Term	Training Manual	PDF	FAO	Open	None

47. Although georeferencing is a basic process that does not requires any specific skills, FAO has already started and will further sustain a long-lasting training program for the PIU and for the other involved stakeholders as part of its strategy to secure evidence based results as well as to scale up and mainstream the proposed process.

48. Training, as well as sharing of similar experiences, will have the primary objective of securing understanding of the process and mainstreaming among stakeholders to ensure that georeferencing become the foundation of planning and decision making in the fields of climate change, natural resource management and rural development. FAO has already developed a full curriculum of trainings that will involve the PIU as well as the NDA and other involved stakeholders. Table 3 below reports the planned timeframe for training. Proposed training will ensure full ownership of the process and technical capacity at the national level to use georeferencing and proposed special analysis in NRM planning and monitoring.

Georeferencing Training Timeframe				
#	Topic	Targets	Trainer	Timeframe
1	Principles of Georeferencing and geospatial data management	PIU/NDA/Stakeholders	FAO	Start-up
2	FAO Earth Map Tool: principles and use of basic remote sensing analysis	PIU/NDA/Stakeholders	FAO	Start-up
3	Google Earth Pro: upload and basic analysis of georeferenced data	PIU/NDA/Stakeholders	FAO	Start-up
4	Enhanced project / sectorial coordination via georeferencing	PIU/NDA/Stakeholders	FAO	Year 1
5	Enhanced project / sectorial external communication via georeferencing	PIU/NDA/Stakeholders	FAO	Year 1
6	Georeferencing - Refresh	PIU/NDA/Stakeholders	FAO	Supervision missions (# 7)
7	Preparing Georeferenced M&E reports	PIU/NDA/Stakeholders	FAO	Mid Term Review
8	Preparing Georeferenced Impact Reports	PIU/NDA/Stakeholders	FAO	Terminal Evaluation

Table 3: Georeferencing timeframe and topics

Key Georeferencing Pillars

#	Step	Timeframe	Output	Format	Responsibility	Distribution	Required Technology
4	Georeferencing AWPB	Yearly	Georeferenced AWPB	PDF + KMZ + Web based GIS	PIU	Internal	None

49. Now that staff and stakeholders are trained and are proficient users of georeferencing, it is time to start adding some coordinate to project's activities. Given that a key element of project management is the annual working plan and budget (AWPB), the PIU prepares and submits the AWPB to the AE at the beginning of each fiscal year. The AWPB will contain the budget, the rational and the list of activities that the PIU will execute in that precise timeframe. The AWPB is one of the pillars of georeferencing. At this stage the PIU will present the AE with all the coordinates where project activities are planned to be executed. This step will therefore allow to link annual activities, timeframe and budget to a precise set of coordinates. Such set of coordinates will transpose the AWPB into a layer that will allow the PIU, the Steering Committee, and the AE to understand the extent of the AWPB against the context already declined in the Atlas.

50. Coordinates will be presented as set of points, lines or polygons depending on type of activities. A pasture rehabilitation or an afforestation investment will appear as a polygon. A road, canal or windbreaker will appear as a line. A well or a training will appear as a point. The PIU will ensure that each activity is related to the appropriate set of coordinates and will include, as annex to the rational, maps reporting the precise areas/lines/points identifying investments. Coordinates will also be available in excel.

51. The AE will receive the georeferenced AWPB and will approve it also based on the findings of coordinates' analysis. Associating planned activities with coordinates will allow the AE to evaluate if the proposed investment is in selected priority areas, to understand physical risks related to the investments and to weight those related to proximity with communities. In other words, georeferencing the AWPB will allow the project and the AE to contextualize investments and understand connected risks and opportunities. Finally, georeferenced AWPB will also allow to forecast impacts and provide stakeholders and evaluator with evidence based data and reporting.

Georeferenced No Objection Process

#	Step	Timeframe	Output	Format	Responsibility	Distribution	Required Technology
5	No Objection Process (N.O.)	Ad hoc	Georeferenced N.O.	PDF + KMZ	PIU	Internal	None

52. Activities implemented in the framework of approved AWPBs will require in most of the cases the formal no objection from the Country Program Manager (CPM). Such approval will require the presence, among the others, of specific and unique geographical coordinates. This set of coordinates will allow the CPM to identify the exact location of the proposed activity and approve / deny payments based on coherence with the identified target areas and communities, feasibility of the intervention against the given context and finally ensure accountability of the investment. The project will present the CPM with clear set of coordinates according to the specification defined in the project implementation manual and

below reported (Implementation Arrangements). Coordinates will be recorded, together with budget, in the M&E database and automatically transposed into the atlas.

Georeferencing for M&E, KM and Reporting/communication

#	Step	Timeframe	Output	Format	Responsibility	Distribution	Required Technology
6	M&E and Reporting	Constant	Georeferenced AR	PDF + KMZ	PIU	Internal	If needed updated satellite pictures

53. Once coordinates will start populating the M&E database, activities will be visible in project's maps and will be monitorable (if needed) via consolidated remote sensing practices. This aspect of the process is paramount to ensure knowledge building within the PIU and among stakeholders. This particular step of the process is also determinant in mainstreaming the process at national level. Showing activities in their exact location visualizing relations with the context will allow a more objective impact's and will provide decision makers with an objective, transparent and evidence based support to strategies.

54. Monitoring of coordinates will be under the responsibility of the PIU as part of the regular M&E, KM and reporting/communication processes. Additionally, collected coordinates will be part of the documentation that will form the baseline for the mid-term and terminal evaluation of the project. Figure 6 shows the relevance of georeferencing in support to M&E. Areas in the target areas are becoming more productive thanks to the investment on tertiary canals. The investment, already two year after completion, generated both increase of productivity (green areas) and changes in land use as farmers, thanks to the newly acquired water availability shifted from cereals to vineyards and orchards.

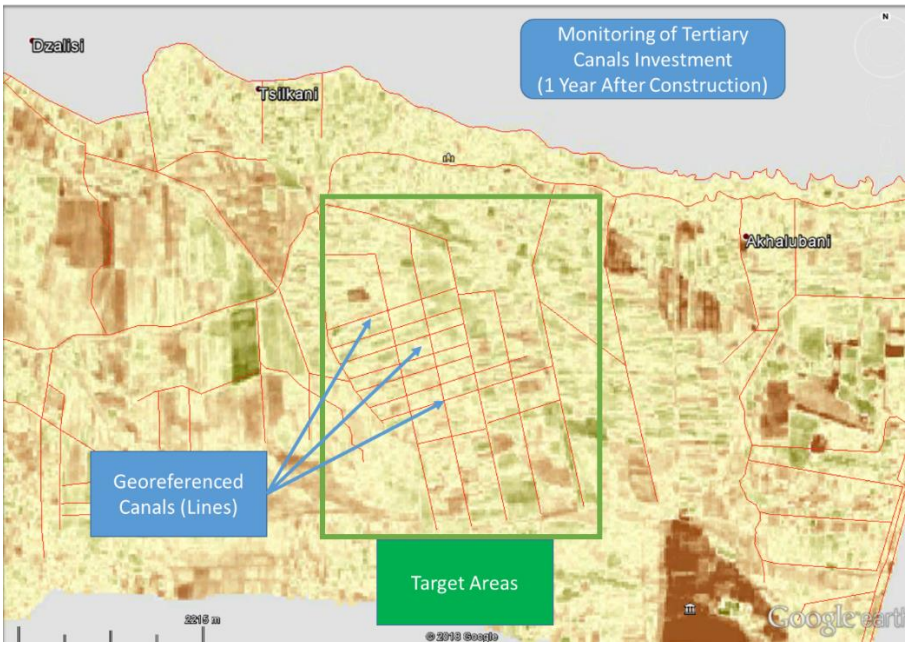


Figure 6: Monitoring and impact evaluation of project's investments (NDVI analysis and ground truthing). Georgia case Study.

55. Having georeferenced investments as well as soft activities (i.e. trainings, capacity development, policy support) will allow the project to answer indicators with objective elements of evaluation. In the specific case of this project the PMU as well as all the other stakeholders including the GCF will be able to understand if activities have been executed, if these have been successful and finally if there is a specific impact that could be objectively linked to project's theory of change. As the project foresees investments

in forestry and pasture rehabilitation, georeferencing will allow to follow investments over time and to evaluate if these had an impact as described in figure 1 and 6.

56. Activities identified in the INEMCRPs and related coordinates will form the core of the annual reporting process as well as ensuring evidence based communication to the public. Project's reports will present yearly achievements starting from the acquired sets of coordinates that will be dully mapped and analyzed according to the funding criteria of the proposal. This activity will be under the responsibility of the M&E unit that will prepare the annual report according to the indication provided in the PIM.

57. Impact assessment will be one of the core responsibilities of FAO and of the NDA that will apply a set of consolidated remote sensing analysis to evaluate the impacts of project's investments. Remote analysis will follow the same protocol established for the construction of the baseline and project's atlas. FAO will deploy the appropriate resources to secure the analysis and will delegate to the NDA ground truthing and dissemination among stakeholders and communities.

58. Finally having a well georeferenced M&E and KM process, will allow the PIU to ensure respect and disclosure of the environmental and social safeguards according to GCF guidelines.

Scaling Up Georeferencing

#	Step	Timeframe	Output	Format	Responsibility	Distribution	Required Technology
9	Process scale up	Entire Project Cycle	Training Manual	PDF	FAO	Open	GIS Software/Google Earth/Earth map

59. Although presented as a step of the process, scaling up is included in each part of the process. Stakeholders, with specific emphasis on the NDA, will participate each step of the process in order to ensure understanding of the process as well as its relevance in management. FAO has started this process long before the conceptualization of the present proposal assisting, with IFAD, the ministry of Agriculture in georeferencing and mapping pastures and forests in other areas of the Country. Examples of such activities have already been shared with stakeholders during the various national engagement workshops and amply explained to the NDA who will be as well trained within project's activities. Results of such work are promising as they can guide the Ministry of Agriculture in monitoring pasture concession all over the Country with minimum investments. Figure 7 shows how the process can be instrumental in supporting management and decision-making processes. Having georeferenced public pastures allows to use a different set of tools to analyze the state of the area and its suitability for further concession to local communities. In the specific case of figure 7, given the positive trend also during drought years (2014), concession to local PUA is renewable.

MOD13Q1.006 Mean Vegetation Indices 16-Day, 250m
km² = 18.96
Annual means inside area:

2012	0.1214
2013	0.1102
2014	0.0820
2015	0.1223
2016	0.1566
2017	0.1553

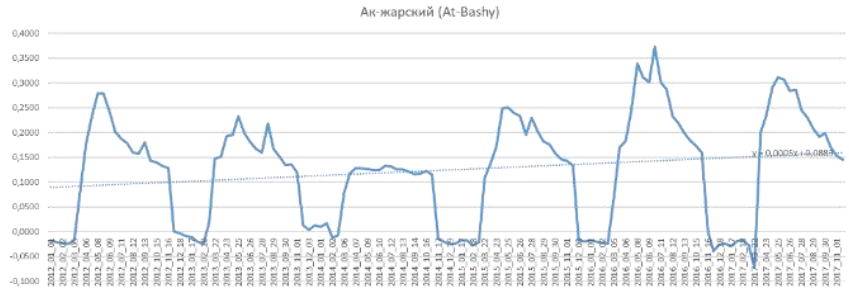


Figure 7: NDVI Analysis (Positive Trend) of a Georeferenced Public Pasture under community management (PUA)

60. As reported in literature, the ability to monitor and map pasture resources is paramount for making timely livestock management decisions (i.e. stocking rates, rotation intervals, daily pasture allocation, pasture closure and supplementary feeding) and increasing the efficiency of pasture grazing systems (Shaefer, 2016). Likewise, monitoring of forestry investments via georeferencing interventions and remote sensing monitoring will increase efficiency of actions as well as effectiveness of investment and can support the Country's measurement, reporting and verification systems both in terms of ordinary management of natural resource and to access REDD+ support (Mitchell, 2017).

61. Georeferencing and more in general geospatial analysis will also be instrumental in mapping and monitoring areas with higher exposure to natural disasters and climatic hazards such as in target areas. The video reported below shows a brief sample of how areas at risk can be monitored once georeferencing and remote sensing are in place. Therefore, mainstreaming and scale up georeferencing and spatial analysis will be one of the priorities of the project as the approach and related tools are key in securing the outcomes of Component 1.

Figure 8: Video on DRM via Georeferencing and RS analysis

62. In summary, the project will support the Country in mainstreaming georeferencing in forestry and rural development so to ensure a richer portfolio of available data and analysis. Mainstreaming will include communities and local administrations so to stimulate and support evidence based planning of natural resources and climate change preparedness. As reported in the previous sections of the document mainstreaming activities are considered and budgeted as part of the overall georeferencing program of the project. The PIU will involve identified stakeholders during the whole project via tailored trainings and on the job practices.

Institutional Aspects and Implementation Arrangements

63. The process as well as its scaling up at the national level will be under the responsibility of the M&E unit of the PIU that will execute georeferencing activities according to the following set of procedures:

a) The project will ensure that each Annual Working Plan and Budget reports as well the coordinates of each planned intervention ensuring when possible cadaster maps of selected areas. Clear and precise maps will present coordinates in the framework of the project atlas. Maps will constitute one of the annexes to the AWPB and related rationale.

b) Within the set of activities planned in the AWPB and approved by the AE, the PIU will ensure that each no objection requests related to project's expenditures contains clear maps reporting investments' coordinates as well as georeferenced cadaster maps describing the areas of intervention. Absence of coordinates and maps will negatively affect the process denying automatically the authorization to proceed with expenditures.

c) Project's data and information will be georeferenced and provided in in ArcGIS compatible formats, shapefile if vector format and GeoTIFF if raster. Each dataset and information, including maps attached to the no objection process, will be also reported as KMZ file for uploading and sharing via Google Earth Pro.

d) All coordinates will be taken in a unique and known reference system, which by preference should be the geographic coordinate system (datum WGS84 and unit in decimal degrees). The full set of coordinates and KMZ files will represent the geographical location and distribution of the interventions in the project areas and will be included in the "Project's Atlas". Produced maps will be provided in digital format (ArcGIS or equivalent) with all the metadata and sources of information. Maps shall be reported as well as in KML/KMZ format.

64. Involved institution and stakeholders (including the Steering Committee) will be involved both directly and indirectly via dedicated communication and training processes. PIU/M&E unit will ensure communication via the annual reporting processes, national ownership workshops and via the project atlas. Communication documents will be constantly updated at the disposal of stakeholders, AE as well as donors. FAO will provide stakeholders with at least 9 training session to secure full mastering and ownership of the promoted process.

65. The process is in line with the objective of the NSDI MOU on Spatial Data Sharing. The project will share data and apply standards according to Kyrgyz Republic strategies and will provide technical assistance and data in order to facilitate such objectives and to ensure mainstreaming of georeferencing

among national institutions and other actors relevant in the field of Climate Change and Natural Resource Management.

66. Finally, the project will ensure coordination and complementarity with past and current projects/programs supporting the Country in the field of GIS, remote sensing and mapping funded by donors such as GIZ, the WB, IFAD and ADB.

Expected Benefits

67. Georeferencing will enhance PIU and FAO monitoring and evaluation potential and will allow stakeholders to monitor closely the development of funded activities and assess their impact and contribution to approved targets at midterm and completion. Additionally, it will enhance the capacity of the program to provide technical assistance to beneficiaries and monitor advancements and impacts. Georeferenced activities and resulting project intervention areas will be analyzed via remote sensing and photointerpretation techniques so to ensure Evidence Based M&E and support Result Based Management of the project. Results of the different analysis will be presented annually via a dedicated “Project’s Implementation Atlas”. Data, supervision reports and conclusions obtained by the above-mentioned process will be presented annually to the Green Climate Fund as well as to the other stakeholders.

Monitoring and Evaluation

68. Georeferencing will be one of the pillars of the evidence based M&E and KM processes of the project each acquired coordinate will form, among the others, the archive of the project and will complement the M&E database by adding two columns dedicated to coordinates.

69. The database will be managed by the M&E unit and it will be made available to the PIU, the Steering Committee and FAO at any given moment. Project’s logical framework as well as its indicators are georeferenced and forms the architecture of the intervention part of the project atlas. Figure 8 below report a clear example of how georeferencing is already part of the project cycle and therefore in its M&E and KM processes.

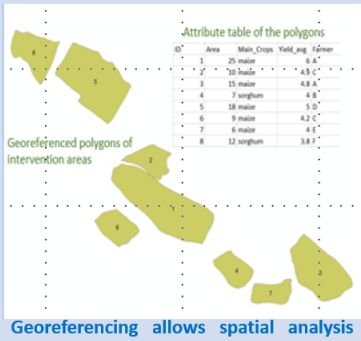
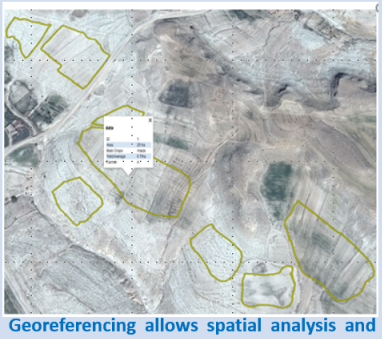
Descriptive LFM (Traditional Approach)	Descriptive + GPS in GIS environment (Intermediate Approach)	Descriptive + GPS in GIS and Google Earth (Project Approach)
The project will improve management of at least 530, 0000 ha of lands and forest areas in the oblast of Osh, Naryn and Jalalabad contributing to emission reduction of about 64 MtCO2e.	The project will improve management of at least 530, 0000 ha of lands and forest areas in the oblast of Osh, Naryn and Jalalabad contributing to emission reduction of about 64 MtCO2e.	The project will improve management of at least 530, 0000 ha of lands and forest areas in the oblast of Osh, Naryn and Jalalabad contributing to emission reduction of about 64 MtCO2e.
		
Without georeferencing it is impossible to know the exact location of investments and their relations with the context. Indicators will be mostly quantitative with complicate procedures to ensure the quality dimension and to guarantee project's accountability.	**Georeferencing allows spatial analysis and production of information layers in GIS environment ensuring clear identification (accountability) of investments. Indicators will be both quantitative and qualitative and can immediately secure accountability of the project as well as laying the ground for a fast and precise impact evaluation**	**Georeferencing allows spatial analysis and production of information layers in GIS environment and their representation on Google earth. Such representation allows to understand activities in the real context and, eventually, forecast risks and impacts more efficiently and effectively. Indicators will be both quantitative and qualitative and will immediately secure accountability of the project as well as laying the ground for a fast and precise impact evaluation. Additionally, thanks to Google Earth imagery activities and their impacts will be immediately contextualised and available for sharing with stakeholders.**

Figure 9: Georeferencing contribution to M&E and KM Processes

Risks and Mitigation

70. Although the process is not new in the Country and is a consolidated practice for the AE the same is not devoid of risks. As reported in the introductory chapters of this working paper, both the technology and the human resources are widely available in Kyrgyzstan and FAO as already identified a set of reliable partners and experts to support the project with the process. Accordingly, table 4 describes the main risks potentially associated with the process as well as recommended mitigation actions.

Risk	Probability	Potential Impact	Mitigation Measure
Resistance to change	M	M	FAO will provide training and constant support the PIU and will establish a dedicated supervision schedule to ensure all needed mitigation measures.
Sharing of data: Scaling up the process at the national level will require the use of standards as well as enhanced sharing of data and information among involved stakeholders.	M	M	FAO will follow the guidelines set by the XXXXX MOU and will work with the NDA and the government to ensure that each signatory of the MOU (representing concerned institutional stakeholders) will abide to agreed actions and will support the process. Additionally the AE will act as facilitator and involve as

			well other key actors such as the WB, GIZ, IFAD and others.
Availability of local data: The large majority of needed data will be generated by the project and will not require additional inputs from stakeholders and or AE. Nonetheless, the project might need to acquire additional satellite pictures.	L	L	The project might require additional satellite pictures that will be acquired by the project with a dedicated budget from the M&E and KM voice.
Privacy: Although the project will only use da available to the large public. Nonetheless, institutions might consider project produced data as sensitive.	L	L	The project will abide by national rules and regulations. It will work in the framework of the signed NSDI MOU and will share with stakeholders the metadata if and before making them public.

Table 4: Georeferencing Process risks and Mitigation Measures

Sustainability

Georeferencing is a process that is designed to add sustainability to projects and programs and that allows understanding of activities. There is no expected problem with sustainability of the process. Investments costs are well below 1% of the total amount of the project budget and both technological and human requirements are fairly available in Kyrgyzstan.

Budget

71. Given the recorded availability of expertise and technology at local level, budget requirements to ensure an optimal execution of the process will affect the overall cost of the process by about USD 120 000 (0.05% of the total budget). Of such amount, USD 62 000 (58%) have already been absorbed by FAO in the framework of its commitment to develop the concept note and full funding proposal. During execution of the project the PIU will require about USD 50 000 to secure the process and produce the aimed M&E and KM outputs. Table 5 briefly present expenditures per stage and type of investment.

#	Stages of the Georeferencing Process	Total Required Budget	Responsibility	Investment Type
1	Generation of the Context Atlas	$ 45,000.00	FAO	Study
2	Identification of Key investments' areas	$ 7,000.00	FAO	Study/Training
3	Training and Sharing	$ 15,000.00	FAO	Training/Communication
4	Georeferencing of Activities	$ 10,000.00	PIU	Equipment
5	Monitoring of Acquired Coordinates and Reporting	$ 25,000.00	PIU	Equipment

6	Process scale up	$ 10,000.00	PIU	Training/Communicatio n
7	Impact Assessment Preliminary Analysis	$ 8,000.00	PIU	Study/Communication
A	Total Cost of the Process	**$ 112,000.00**	FAO/PIU	
B	Project Cost	**$ 50,000.00**	PIU	
C	Absorbed by the AE	**$ 62,000.00**	FAO	
D	Total Project Cost as % of the total investment	**0.05%**	FAO/PIU	
E	Percentage to be charged to the Project	**45%**	PIU	
F	Percentage already absorbed by AE	**55%**	FAO	

Table 5: Georeferencing Budget

72. As reported in the previous chapters, georeferencing will not require major additional investments for the project. As part of the start-up process, a dedicated training will be provided to PIU's staff so to ensure since the early beginning of activities full knowledge of the process and its requirements. Ideally, the project should count among its staff a GIS expert but this is not a precondition to apply the georeferencing strategy.

73. Being Georeferencing a process there is no major investment to foresee. The following tools will be needed:

- Computer
- Smart Phone or GPS
- GIS software (no need to buy licenses, any open source software will be sufficient)
- Google Earth Pro
- FAO Earth MAP.

74. Standard last generation PC will be sufficient for the purposes of georeferencing. The indicated software are free open source tools that can be downloaded or that are provided by FAO. Therefore, the only investment to be done is on a set of GPS or Smart Phones. In these regards it is highly recommended to acquire smart phones as these already have a GPS built in and will allow staff to take pictures and video that will be automatically georeferenced.

Conclusions

75. Although not new in Kyrgyzstan, georeferencing of project and program activities will have a positive impact on both execution of activities and on scaling up of results. Georeferencing provides users, at almost no cost, access to a larger set of information that ultimately allows for better planning, execution and monitoring of projects and programs.

76. Georeferencing and therefore the use of spatial data and analyses will help (1) to improve local knowledge of targeted areas, (2) to follow the evolution of activities by collecting information at every step of the project cycle, (3) to enhance negotiations and (4) to communicate easily with donors and the public.

77. In the Project Cycle Management (PCM) context, the integration of ‘spatial’ elements allow you to overlay different kind of data like meteorological patterns, hydrography, erosion, flood risks, etc. It will also improve your communication skills by offering a visualization of the on the ground reality.

78. In the precise framework of the project, georeferencing will also allow for enhanced ownership of the process for communities and administrations. Available software and smartphones have de facto eliminated the need of extensive IT competences and made complex analysis of vast data sets available to every citizen and of course administrator.

79. The process will also allow for more precise and tailored technical assistance to the Country. Knowing the detailed context and having the possibility to analyze climatic and environmental trends ahead of missions will allow relevant resource savings as well as precise calibration of technical assistance and or financial support.

80. The project will be visible in its entirety and most relevant it will be understandable in the precise context where target beneficiaries’ lives. Therefore, every citizen will be available not only to understand its territory - including dependency from variables external to its direct experience - but will also be capable of understanding directly how its actions or no actions are impacting the territory and affecting the ecosystem services he/she largely depends from.