Global Geo-Informatics Options by Contexts (GeOC)

User Guide

with Focus on Online Interfaces and Functions

The Global Geo-informatics Context and Options (GeCO) is a new web-based GIS tool that enables its users to define, monitor, assess and co-create knowledge and learning on relevant Sustainable Land Management (SLM) options that match the social-ecological context at global, regional and national scales. The GeOC tool aims to support the implementation of SLM practices by the local international communities by providing them with context-specific information that is required to make sound investment decisions for agricultural and rural development. The GeOC is designed to provide land users, development projects or programs, and policy decision-makers with plausible, robust extrapolation domains for guiding decisions on the selection and use of SLM options, and an open platform for docking different disciplinary projects into integrative/holistic and converging actions for promoting SLM at scale.

GeOC is the result of the synergic efforts by CGIAR Research Program on Dryland Systems (CRP-DS), the German Federal Ministry for Economic Cooperation and Development (BMZ), the International Center for Agricultural Research in the Dry Areas (ICARDA), ICARDA Geoinformatics Unit (GU), the CGIAR Research Program on Water, Land and Ecosystems (CRP-WLE) and is powered by iMMAP, Codeobia, D-Space and Amazon Web Services.

For more information, please visit:
Main website: https://mel.cgiar.org/slm/index
Guide: https://cgiarmel.atlassian.net/wiki/display/MEL/GeOC+User+Guide+-+Global+Geo informatics+Options+by+Contexts

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DISCLAIMER

[1] The International Center for Agricultural Research in Dry Areas (ICARDA)

Revision History

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1.0	28-Mar-2017	Fajr Fradi	Enrico Bonaiuti, Quang Bao Le, Megi Cullhaj, Federico Lettieri	structure, content
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Acronyms

CIP	International Potato Center
CRP	CGIAR Research Program
CRP-DC	CGIAR Research Program on Dryland Cereals
CRP-DS	CGIAR Research Program on Dryland Systems
CRP-GL	CGIAR Research Program on Grain Legumes
CRP-RTB	CGIAR Research Program on Roots, Tubers and Bananas
GU	ICARDA Geoinformatics Unit
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRAF	World Agroforestry Center
IDO	Intermediate Development Outcome
IFS	Interdependent Filters System
MEL	Monitoring, Evaluation and Learning
SDG	Sustainable Development Goals
SLO	Strategic Level Outcome
UN	United Nations

Welcome to GeOC

The Global Geo-Informatics Options by Context (GeOC) tool is designed to support the implementation of sustainable land management (SLM) practices by the international community. GeOC is designed to provide research for development projects and programs, stakeholders and private sector third parties with reliable extrapolation domains to inform decision-making. The platform aggregates many data layers, from many disciplinary projects, allowing multi-disciplinary, holistic approaches to SLM planning and interventions.
The Global Geo-Informatics Options by Context (GeOC) is a new online GIS tool that allows to define, monitor, assess, co-create knowledge and learn from relevant SLM options that match the social-ecological context at global, regional and national scale. The main unique features of GeOC are:

- It is based on a systems framework scientifically sound and able to cope with the high level of contextual diversity;
- It improves linkages among different scales and kinds of data that are essential for SLM implementation, evaluation and upscaling;
- It provides multiple entry points for diverse needs and preferences of users;
- It offers user-friendly functions in multiple languages;
- It offers online multi-system interoperability;
- It is developed to allow for continuous improvements and customization.

GeOC Basics

Requirements

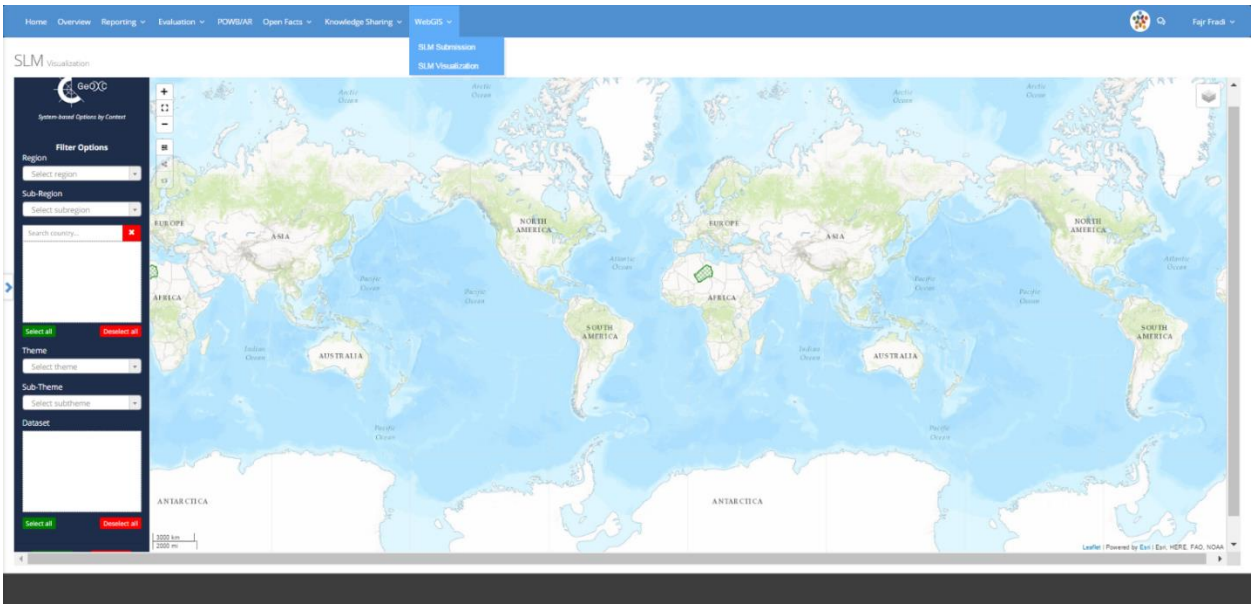
The tool is accessible to all MEL users. All that is needed is access to a browser, such as Google Chrome, and internet connection.

Enter in the address bar of the browser "cgmel.org/slm/index" and confirm to reach the GeOC page.

Access

Two types of accounts are defined for the tool:

- The **user account**: it gives full usage of all SLM datasets approved by an admin, and also allows to enrich the tool with new datasets submitted by the users.



- The **admin account**: the admin manages all SLM datasets, approving new suitable ones and ensuring the good functioning of the tool.

SLM Submission

New SLM datasets can be submitted by the users on Monitoring, Evaluation & Learning (MEL).

The template is composed by six parts:

- Name of the SLM Technology
- Description of the SLM Technology
- SLM Purpose and Classification
- Geographic Locations, Extents and Socio-Ecological context/Environment
- Technical Specifications, Inputs and Costs
- Impacts, Influencing Factors

Every part can be filled and saved separately. Please, ensure to provide all the mandatory information.

Name of SLM Technology

Please insert the name and location of implementation. then provide the required references on the author and the technology. If the references are clear and accurate enough, the technology might be approved by the admins. This information is mandatory.

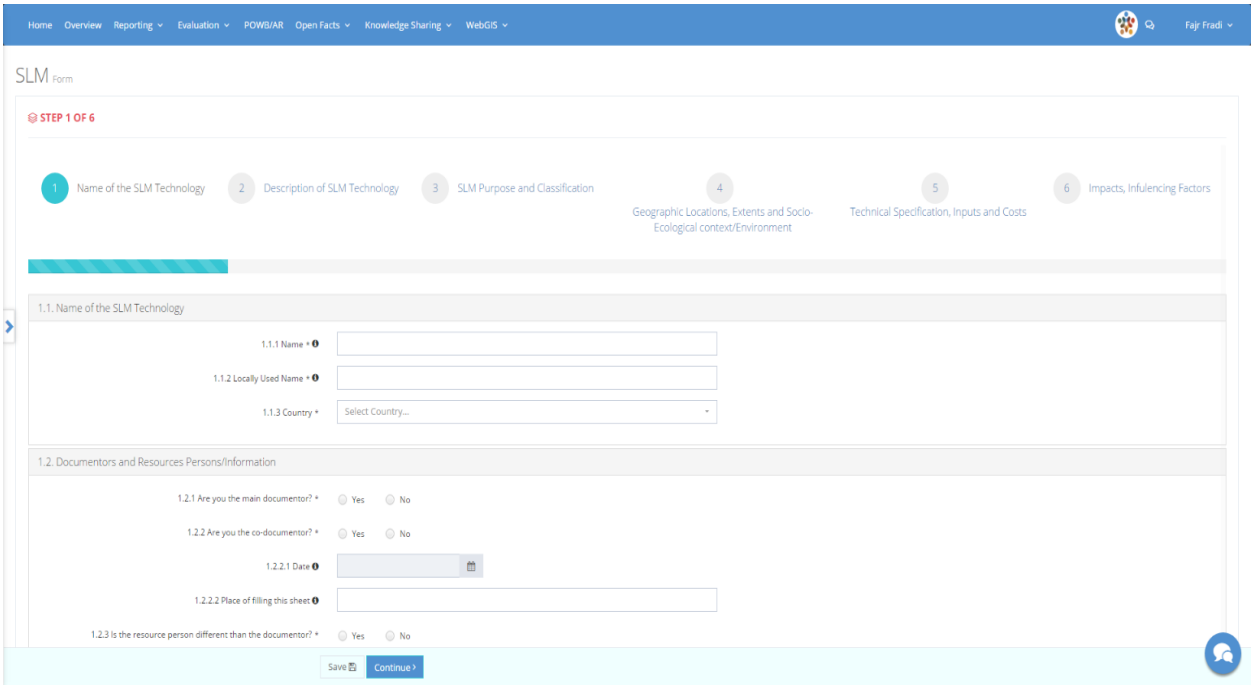


Figure 1: Overview of Section 1

Description of SLM technology

This section requires more detailed information on the SLM technology proposed. Describe the technology and provide as many details as possible. Photos of the technology and related references are not mandatory but highly recommended.

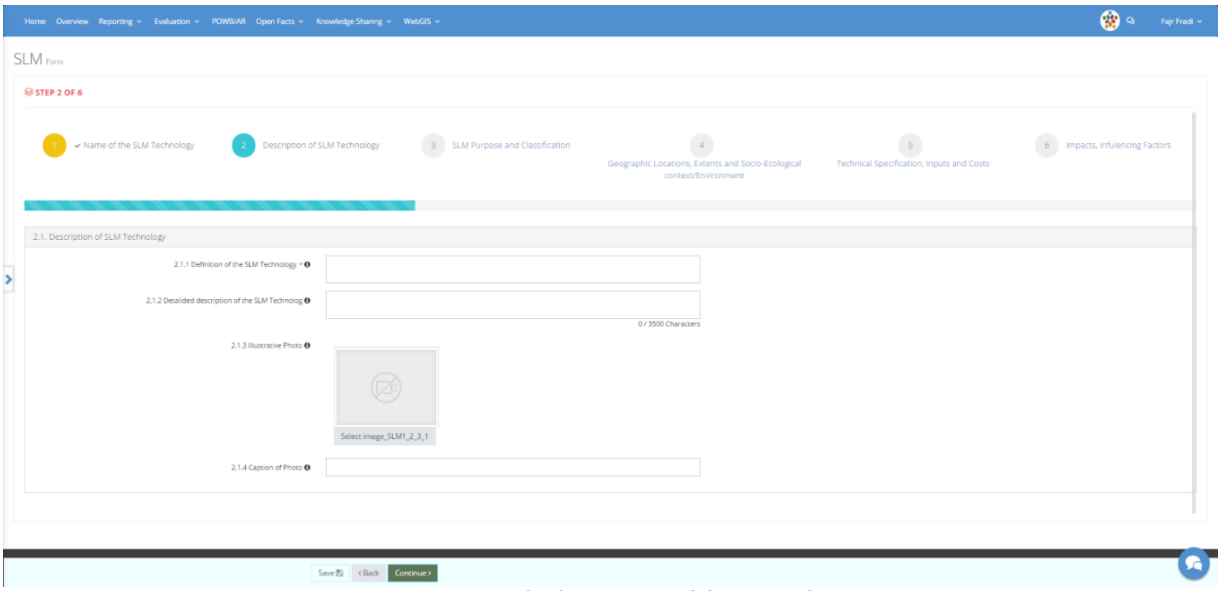


Figure 2: Overview of Section 2

SLM Purpose and Classification

This section requires information on in the purpose, type and measures of the SLM technology proposed. All the points are mandatory.

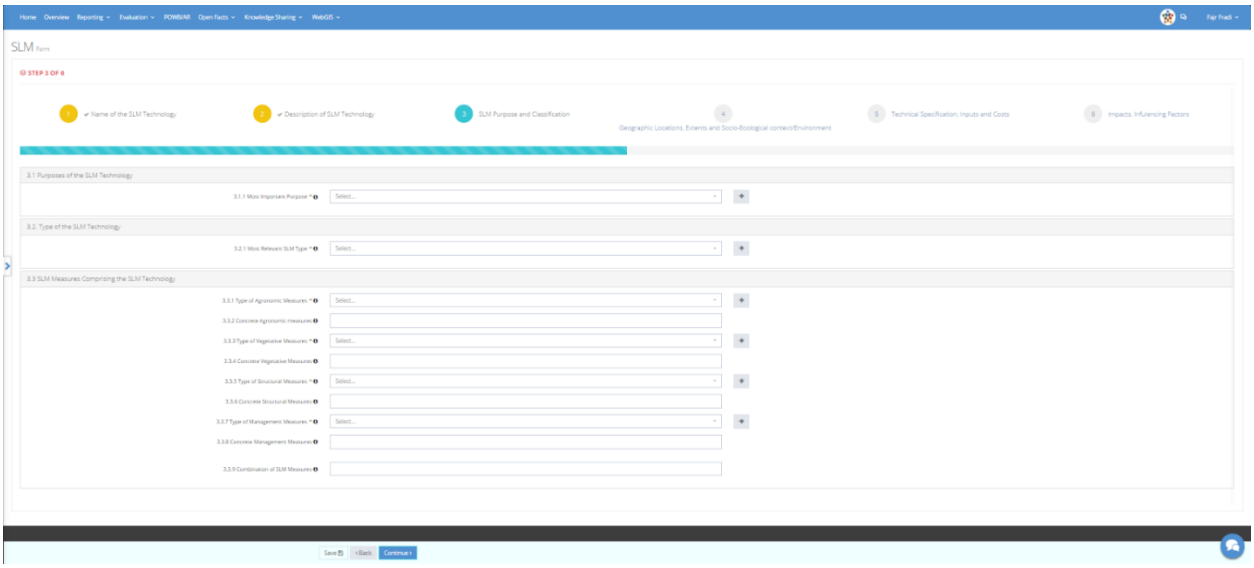


Figure 3: Overview of Section 3

Geographic Locations, Extents and Socio-Ecological context/Environment

This section requires defining the context and the extent of the SLM technology, in seven aspects:

- **4.1:** Regions/locations where the SLM technology has been applied.
- **4.2:** Total area where the SLM technology has been applied.
- **4.3:** Geographic boundary of the area where the SLM technology was documented.
- **4.4:** Socio ecological context/environment variables automatically extracted from the GIS performance/ impact Database.

- **4.5:** Environment variables.
- **4.6:** Socio-economic conditions.

Points 4.4 and 4.5 are filled in automatically upon completion of the previous points. Find more information on these datasets in Annex 1.

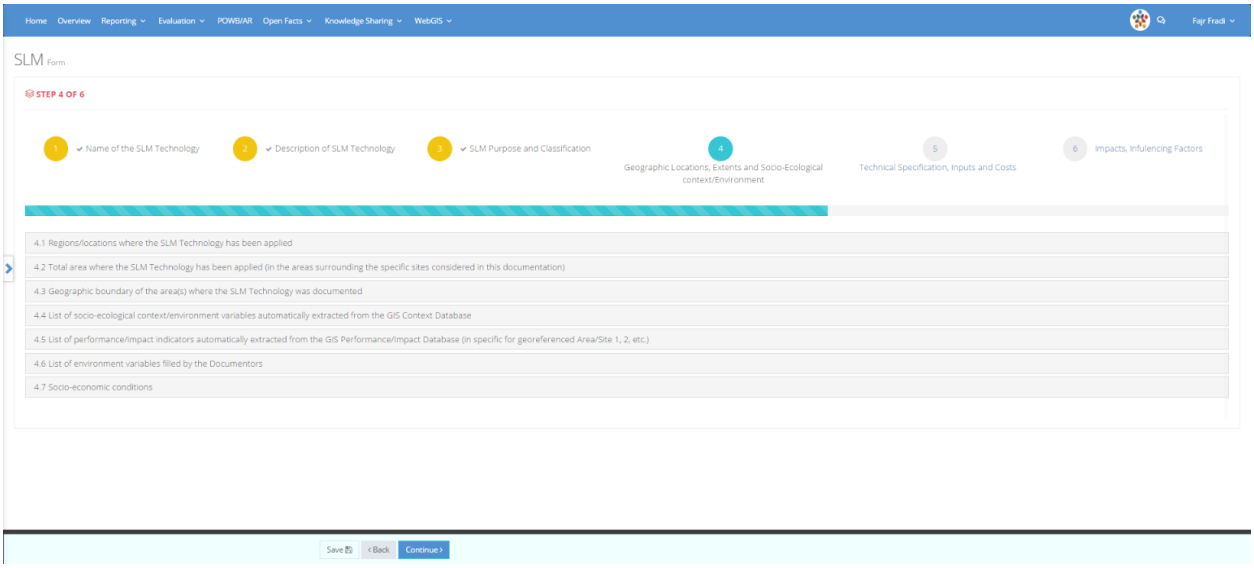


Figure 4: Overview of Section 4

Technical Specifications, Inputs and Costs

This section requires defining the technical needs and costs of the SLM technology proposed, in particular:

- **Technical specifications**
- **Costs of inputs needed for the establishment and upkeep of the SLM**

Which are sub-divided into:

- **Labor:** How many workers are required to establish and upkeep the SLM technology? What is the cost per worker? This information can be provided per "labor categories" instead of "workers".
- **Equipment:** Which tools are needed to establish and upkeep the SLM technology? What is the cost per tool? This information can be provided per "equipment categories" instead of "tools".
- **Plant materials:** Which plants are needed to establish and upkeep the SLM technology? What is the cost per plant? This information can be provided per "plants categories" instead of "plants".
- **Fertilizers and biocides:** Which fertilizers and biocides are needed to establish and upkeep the SLM technology? What is the cost per fertilizer or biocide? This information can be provided per "fertilizers/biocides categories" instead of "fertilizers/biocides".
- **Construction materials:** Which construction materials are needed to establish and upkeep the SLM technology? What is the cost per material? This information can be provided per "materials categories" instead of "materials".
- **Other inputs:** Any other need can be registered in this sub-section.
- **Costs:** The total cost will be automatically calculated in this sub-section.

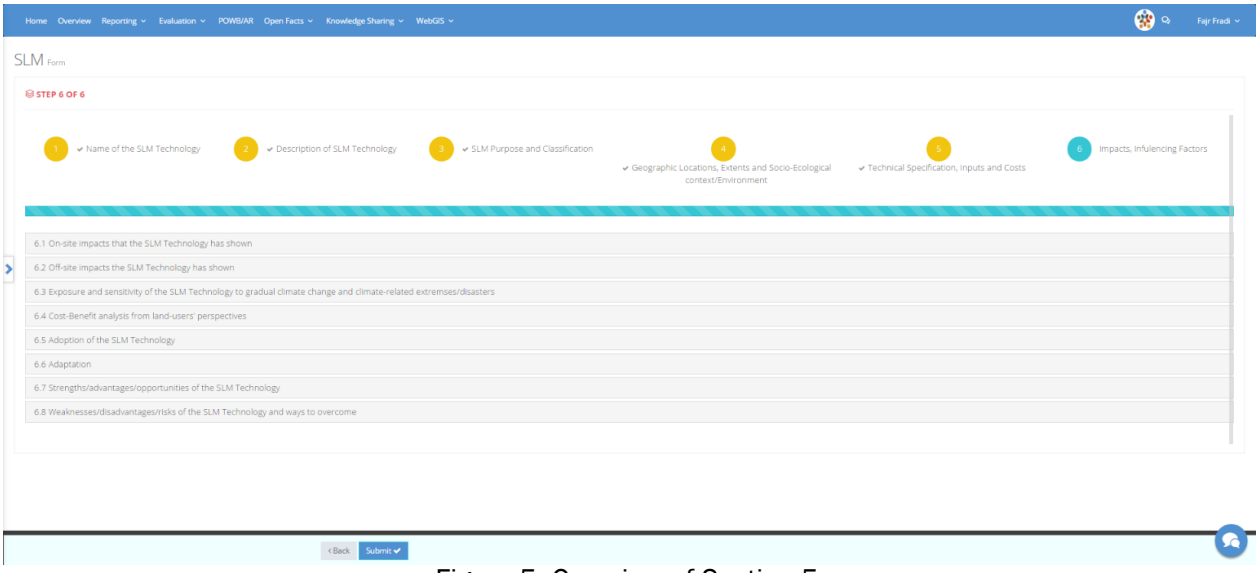


Figure 5: Overview of Section 5

Impacts, Influencing Factors

This section requires highlighting the expected impact of the SLM technology proposed, from several perspectives:

- **On-site impact**: divided into three categories 1) socio-economic, 2) socio-cultural, 3) ecological impacts.
- **Off-site impact**: in particular, risk reduction in the neighbor fields and areas.
- **Exposure and sensitivity of the SLM technology to gradual climate change and climate-related extremes and disasters**: How does the SLM technology cope with 1) gradual climate changes and 2) extremes disasters (e.g. meteorological, climatological, hydrological, biological)?
- **Cost-Benefit analysis from land-users perspectives**: in particular, are costs of establishment and upkeep balanced by the benefits for the land users?
- **Adoption of the SLM technology**: The section is about how much this SLM technology, where and how?
- **Adaptation of the SLM technology**: How does the SLM technology cope with generic potential changes?
- **Strengths, advantages and opportunities of using SLM technology**: these are discussed from the perspective of 1) land users, 2) SLM experts, 3) documenters and other observes, 4) policy-makers and third parties.
- **Weaknesses, disadvantages of the SLM Technology and ways to overcome them**: these are discussed from the perspective of 1) land users, 2) SLM experts, 3) documenters and other observes, 4) policy-makers and third parties.

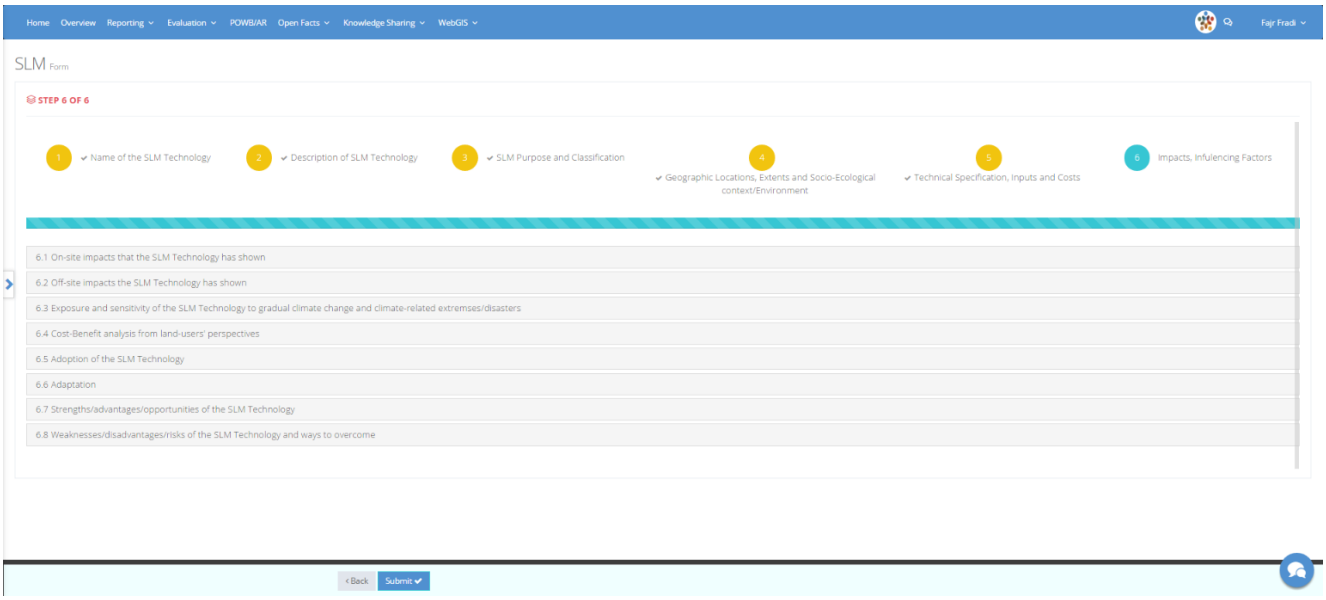


Figure 6: Overview of Section 6

SLM Visualization

Overview of the input window

By selecting "Visualization" in the GeOC menu, the tool will load, prompt and ready for use.

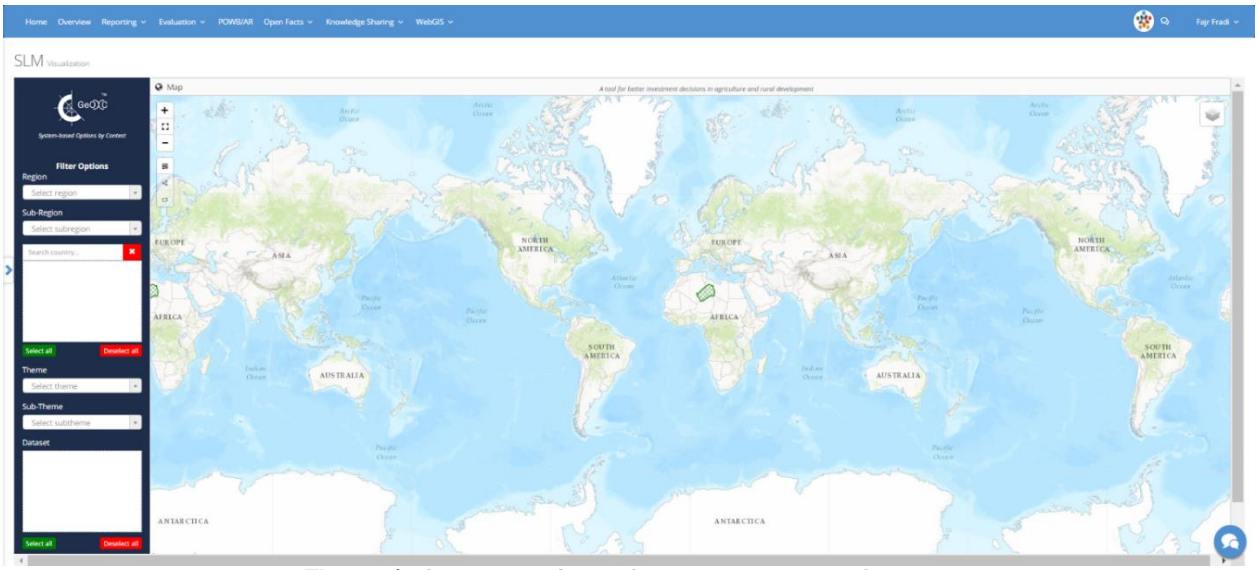


Figure 1: Overview of the "SLM visualization" Section

This interface is composed by two sections:

The Map: a navigable world atlas by UN Regions.

Figure 2: Map tool bar

Zoom In	Zoom Extent	Zoom Out	Show/Hide SLM	Layers	Share	Cycle
+	⛶	−	▦	◈	⤴	↻

The Query: Users can gauge and view SLM technologies satisfying a particular contextual setting.. In the the query, normally users can define the contextual criteria in a step-by-step process, once the details is selected, all the other sub-details will be prompted. A common procedure is a 6-step process:

Region → Sub-region → Country → Theme → Sub-Theme → Dataset(s)

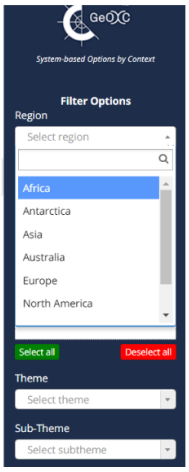
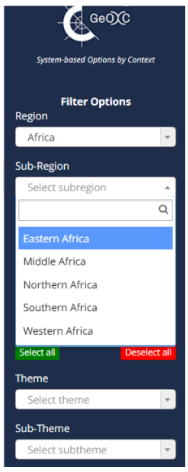
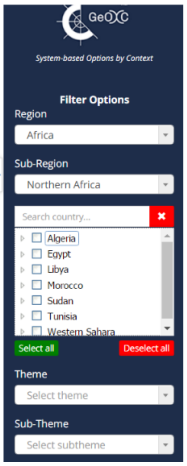
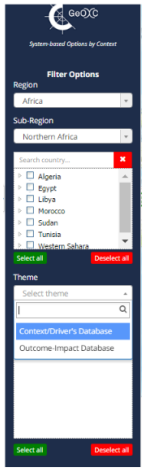
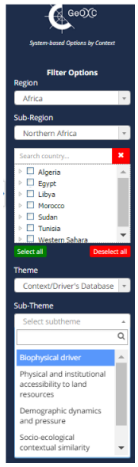
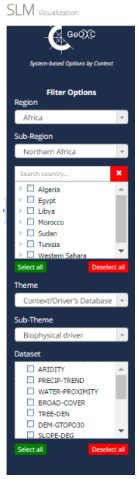
1- Region	2- Sub-region	3- Country	4- Theme	5- Sub-theme	6- Datasets
					

Table 1: The process of selection of criteria in a query analysis

Another procedure is that users follow the procedure in Table 1, but after the step 3 they can select provinces, or draw an area of interest, within the selected country/ies, then continue steps 4-5-6.

1, 2, 3) Select a region, then the sub-region and the countries of interest.

4, 5) Define the theme/topic of interest of that particular location. There are two themes to choose from:

- **context/driver database** allows querying SLM techniques with similar criteria of geographical, biophysical and socioeconomic context;
- **outcome-impact database** allows querying SLM techniques a particular state of land degradation or improvement.

Depending on the option selected, a variety of related sub-themes will be available for selection.

6) The last step is the datasets selection. Can be checked as many datasets as needed, please note that more datasets will require more loading time.

Once all the details have been defined, the "Apply" button will show the results in the output section.

Overview of the output Window

The Map: once the query process is over, the layers of the chosen datasets will be shown as by example figure.

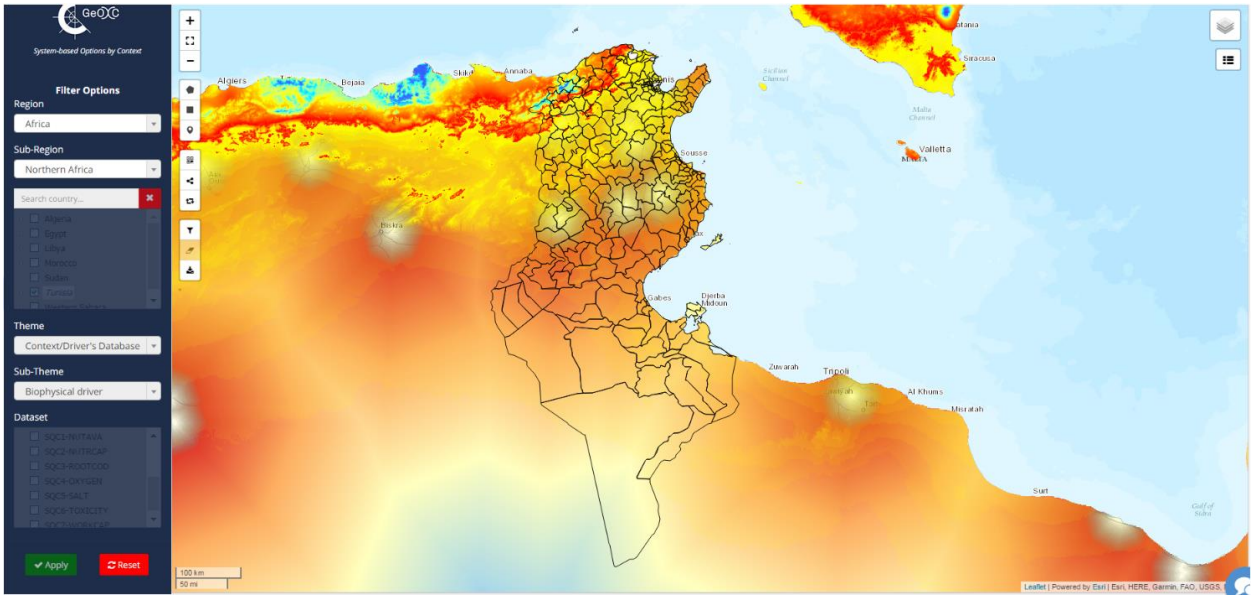


Figure 3: Overview of the output of the SLM query

Selection

Polygonal Selection	Box Selection	Point Selection
Draw a polygon around the regions of interest (ROI), this will select all related rasters, provide statistics about them and allow their download.	Inscribe the regions of interest (ROI) in a pre-defined 10x10 km box, this will select all related rasters, provide statistics about them and allow their download.	Define a point within a region of interest (ROI), this will select all related rasters, provide statistics about them and allow their download.
⬟	■	📍

Legend ☰

The legend and related information can be toggled on and off.

Filter ⏷

The filter allows to toggle on and off specific rasters.

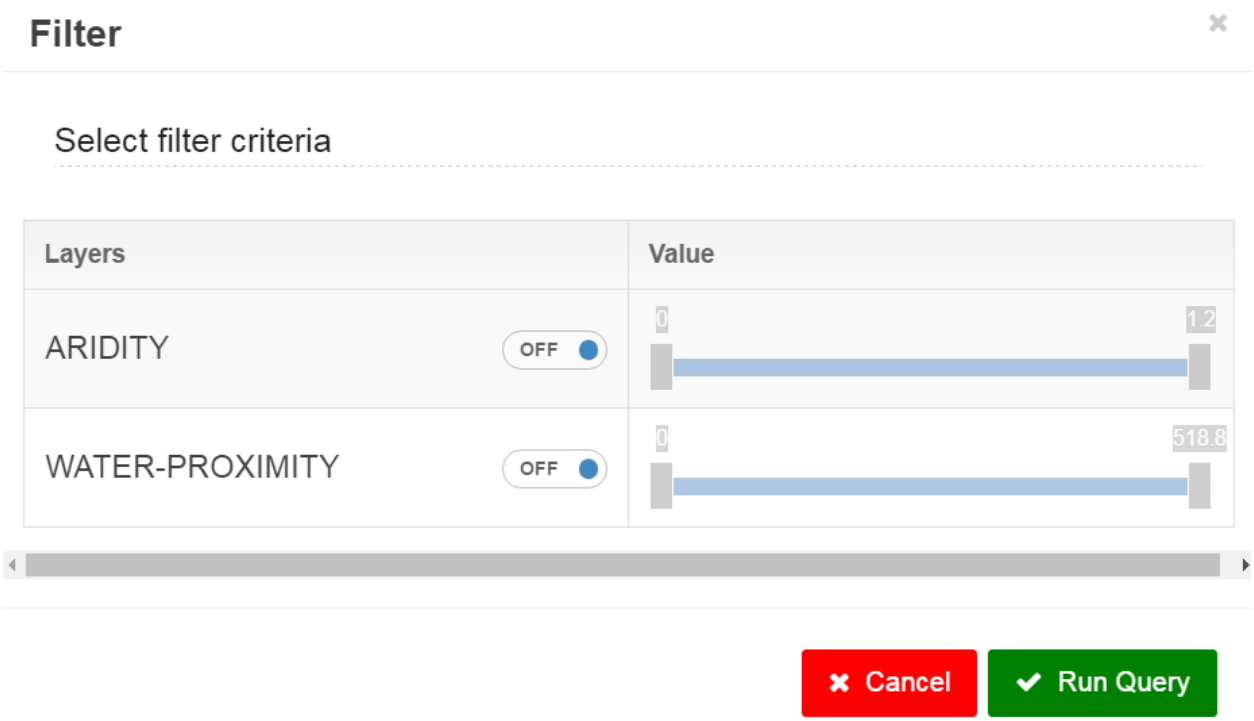


Figure 4: Overview of the filter window

Clear Layer Mask

This This tool allows to clear a custom area from undesired layers.

Download Section

The results of the analysis can be downloaded as .zip archive by clicking the specific icon.

Value by Location

This table indicates the values measured for the active rasters in a pinpointed location.

Summary Statistics

This table indicates the values measured for the active rasters in the whole country of a pinpointed location.

Options by context

This table indicates the most applied SLM practice, as a result of the tool's calculation of the values measured in the area of interest.

Value by Location

Layer	Value	Display Unit
ARIDITY	1.0	Index
WATER-PROXIMITY	0.0	Meter

Summary Statistics

Layer	Min	Max	Mean	Stdv	Range	Display Unit
ARIDITY	0.0	1.2	0.3	0.2	1.2	Index
WATER-PROXIMITY	0.0	518.8	217.2	129.5	518.8	Meter

Options by Context - Rainfed crop areas

SLM Practices	Rank
0	1
Improve production (crop, fodder, wood/ fibre, water, energy)	2
Preven land degradation (soil, water, vegetation)	3
Reduce land degradation (soil, water, vegetation)	4

Figure 5: The output results section

SLM Approval

This section is only available to GeOC admins, for them to add, review and approve or reject the SLM datasets submitted by the users.

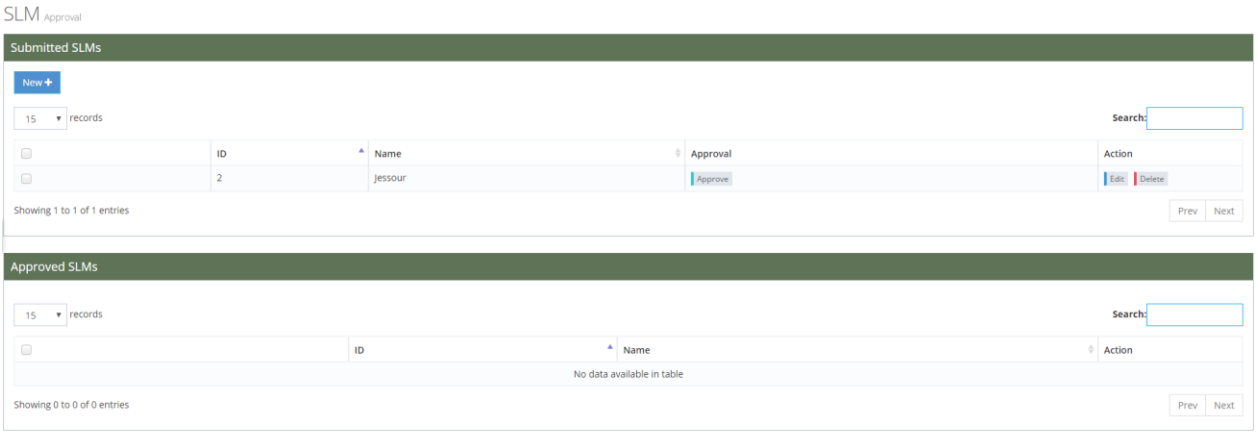


Figure 1: Overview of the "SLM Approval" section

Annex 1 - Key Contextual Variables in the "Context/Drivers" Database (Le et al., 2017)

Note: Source of original data is in another document. Each variable when displayed and exported (see queries) should report the source and the year both visually and embedded.

Variable	Definition (measuring unit) (sources)	Spatial coverage	GIS type, resolution
Biophysical driver			
ARIDITY	Aridity index (Trabucco and Zomer, 2009)	Global	Raster, 1-km pixel size
PRECIP-TREND	Long-term trend of annual precipitation (floating trend coefficient) (Le et al., 2016)	Global	Raster, 1-km pixel size
WATER-PROXIMITY	Proximity to water body (m) (Bidarar/ICARDA, 2015)	Global	Raster, 1-km pixel size
BROAD-COVER	Broad class of land cover (10 classes[2] aggregated from 22 classes of Globcover data (Bicheron et al., 2008)	Global	Raster, 1-km pixel size
TREE-DEN	Tree density (trees/km2) (Glick et al., 2016)	Global	Raster, 1-km pixel size
DEM-GTOP030	Altitude above sea level (m) (USGS, 1998)	Global	Raster, 1-km pixel size
SLOPE-DEG	Surface slope (degree) (calculated from GTOP030 data (Le, 2016)	Global	Raster, 1-km pixel size
SQC1-NUTAVA	Soil quality constraint regarding nutrient availability (4 ordinary classes from HWSD supplementary data3) (Fischer et al., 2008)	Global	Raster, 1-km pixel size
SQC2-NUTRCAP	Soil quality constraint regarding nutrient retention capacity (4 ordinary classes from HWSD supplementary data2) (Fischer et al., 2008)	Global	Raster, 1-km pixel size
SQC3-ROOTCOD	Soil quality constraint regarding rooting condition (4 ordinary classes from HWSD supplementary data 2) (Fischer et al., 2008)	Global	Raster, 1-km pixel size
SQC4-OXYGEN	Soil quality constraint regarding soil oxygen (4 ordinary classes from HWSD supplementary data2) (Fischer et al., 2008)	Global	Raster, 1-km pixel size
SQC5-SALT	Soil quality constraint regarding salinity (4 ordinary classes2) (Fischer et al., 2008)	Global	Raster, 1-km pixel size
SQC6-TOXICITY	Soil quality constraint regarding toxicity (4 ordinary classes2) (Fischer et al., 2008)	Global	Raster, 1-km pixel size
SQC7-WORKCAP	Soil quality constraint regarding work capacity (4 ordinary classes) (Fischer et al., 2008)	Global	Raster, 1-km pixel size

[2] Ten aggregated land cover classes: 1- irrigated crop areas, 2- rain-fed crop areas, 3- mosaic crop-vegetation, 4- forested areas, 5- mosaic forest-shrub-grassland, 6- shrubland, 7- grassland, 8- sparse vegetation areas, 9- wetland, 10- bare soil areas

[3] Four ordinary classes of soil quality constraint: 1- no/slight constraint, 2- moderate constraint, severe constraint, 4- very severe constraint

Physical and institutional accessibility to land resources			
DIST-ROAD	Distance to main road (km) (Biradar/ICARDA, 2015)	Global	Raster, 1-km pixel size
DIST-TOWN	Distance to district capital (km) (Biradar/ICARDA, 2015)	Global	Raster, 1-km pixel size
PROTECT-AREA	Protected area (1= protected, 0= otherwise) (IUCN world database of protected areas – WDPA) (UNEP-WCMC, 2016; https://protectedplanet.net/)	Global	Raster, 1-km pixel size
TENURE-SEC	USAID's tenure security level (Mirzabaev et al., 2016)	Global	Raster, 1-km pixel size
Demographic dynamics and pressure			
POP-DEN2015	Average population density 2015 (persons/km2) from GPW data (CIESIN-CIAT, 2005 and 2016)	Global	Raster, 1-km pixel size
POP-DEN-RURAL	Rural population density 2000 (person/km2) (downscaled from FGGD database (FAO, 2007))	Global	Raster, 1-km pixel size
POP-CHANGE	Change in population density over the period 1990-2015 (persons/km2) (calculated from GPW data) (Le, 2016)	Global	Raster, 1-km pixel size
National economic development			
GDPCAP	Average GDP per capita per 15 x 15 minutes in 2008 ($US/person/yr) (Global 15 x 15 Minute Grids of the Downscaled GDP Based on the SRES B2 Scenario, averaged for 1990-2025 (Gaffin et al., 2004))	Global	Raster, 1-km pixel size
GDPCAP-GRW	Mean growth rate of annual GDP during 1990-2025 (% of baseline value in 1990) (Calculated using gridded downscaled GDP (SRES B2 Scenario) (Gaffin et al., 2004))	Global	Raster, 1-km pixel size
AGRI-POVERTY	ICARDA's index of agricultural resource poverty	Global	Raster, 1-km pixel size
Socio-ecological contextual similarity			
SES-TYPE	CRP-DS's socio-ecological context type (numeric codes of different contextual types) (Le et al., in prep.)	Global	Raster, 1-km pixel size

Annex 2 - Key Outcomes and/or Impact Variables in the "Impact-Outcome" Database (Le et al., 2017)

Variable	Definition (measuring unit) (sources)	Spatial coverage	GIS type, resolution
Biomass Productivity and Water Use Efficiency			
PROD-DEG	Biomass productivity-based land degradation, approximated by inter-annual trend of NDVI with statistical test, correction of confounding effects of rainfall variation, atmospheric and artificial fertilization (Le et al., 2016)	Global	Raster, 1-km pixel size
PROD-IMP	Biomass productivity-based land improvement, approximated by inter-annual trend of NDVI with statistical test, correction of confounding effects of rainfall variation, atmospheric and artificial fertilization (Le et al., 2016)	Global	Raster, 1-km pixel size
RUE	Rain use efficiency = mean of annual sum NDVI / annual rainfall (Le, 2016)	Global	Raster, 1-km pixel size
Pressure on land carrying capacity in term of biomass potential			
HANPP-PCT	Human appropriation of natural NPP (% of natural NPP) in 2000 (Haberl et al., 2004; Krausmann et al., 2008)	Global	Raster, 1-km pixel size
NPP-GAPPC	Gap between actual and potential Net Primary Production (NPP) in 2000 (% of potential NPP) (Haberl et al., 2004; Krausmann et al., 2008)	Global	Raster, 1-km pixel size
Affected population			
AFFECTED-POP	Approximately population affected by land degradation (affected persons/km2) (Le, 2016)	Global	Raster, 1-km pixel size
AFFECTED-RPOP	Approximately rural population benefited by land improvement (affected person/km2) (Le, 2016)	Global	Raster, 1-km pixel size