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Livestock

*More meat, milk and eggs by and for the poor*

2021

# Geoinformatics Options by Contexts for Sustainable Livestock Management (GeOC4SLiM) - An User Manual with Focus on Interfaces and Operational Functions

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# Geoinformatics Options by Contexts for Sustainable Livestock Management (GeOC4SLiM) - An User Manual with Focus on Interfaces and Operational Functions

## 1 Introduction

Sustainable Livestock Management (SLiM) are required to interrelated UN Sustainable Development Goals (SDGs) on poverty alleviation, achieved food security, improved nutrition, promoted sustainable agriculture and land degradation neutrality (Godfray *et al.*, 2010; Eisler *et al.*, 2014). SLiM options are fitted to the social, economic and ecological contexts (Eisler *et al.*, 2014). The high contextual diversity of drylands in particular prevents the design and application of “uniform blanket” policies to promote SLiM over large scales where significant impacts are expected. The Geoinformatics Options by Context for promoting Sustainable Livestock Management options (GeOC4SLiM) has designed to provide stakeholders/projects and programmes with standardized description of SLiM options, and plausible extrapolation domains for supporting outscaling of SLiM options (Le and Rischkowsky, 2018). In specific, the tool is expected to improve targeting of SLiM-related projects/programs in coping with given limited resources and inherent diversity of socio-ecological context, such as:

- (1) Targeting options in context: given a defined socio-ecological context, tool users can know about *what* promising SLiM options from current large shares of SLiM data or knowledge, or,
- (2) Targeting context given option, i.e. relevant extrapolation/recommendation domain: given a set of promising SLiM options identified in a limited number of project sites, tool users can know *where* efforts should be focused by managing or coping with *what potential drivers*. The visualization of relevant extrapolation/recommendation domain would support the outscaling of site-specific successful SLiM options.

This use manual focuses on user interfaces and operational functions of the GeOC4SLiM tool.

## 2 GeOC4SLiM basics

### 2.1 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.

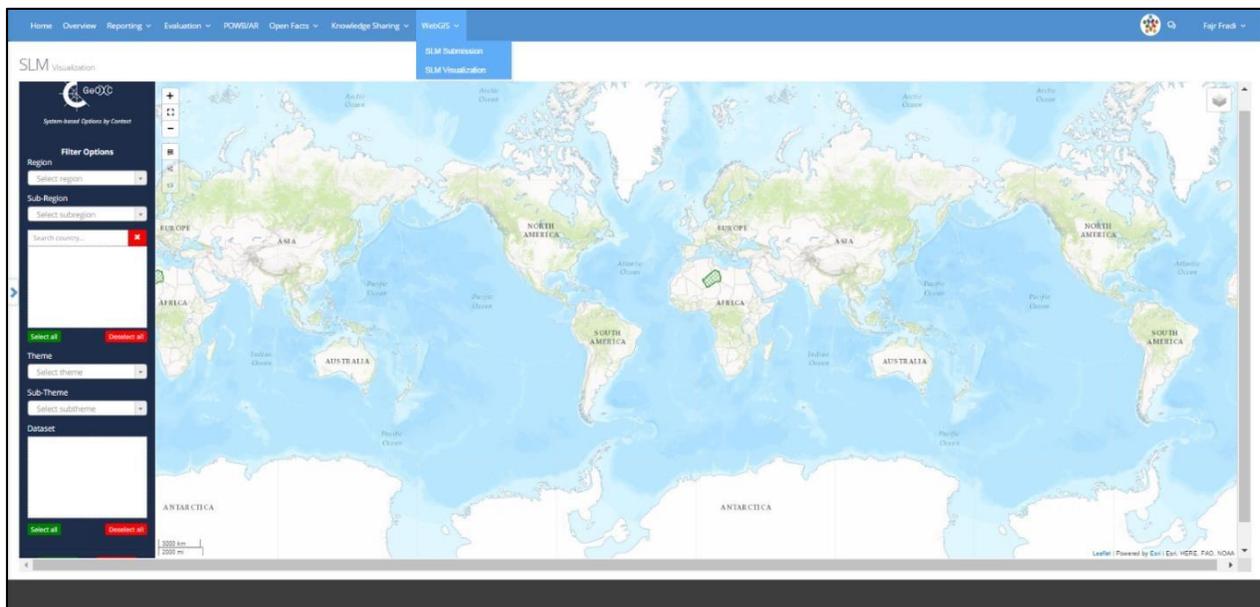
Enter in the address bar of the browser “[cgmel.org/slm/index](http://cgmel.org/slm/index)” and confirm to reach the GeOC

page.

## 2.2 Access

Two types of accounts are defined for the tool:

- *The user account*: it gives full usage of all SLiM 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 SLiM datasets, approving new suitable ones and ensuring the good functioning of the tool.

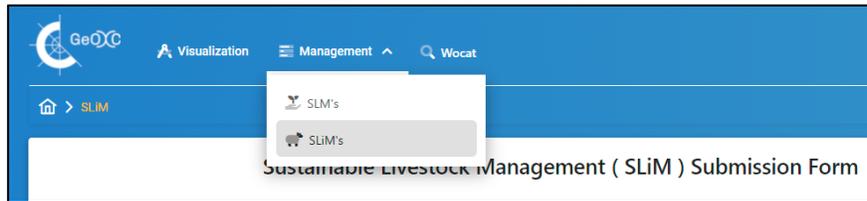


## 3 Online SLiM template and SLiM data submission

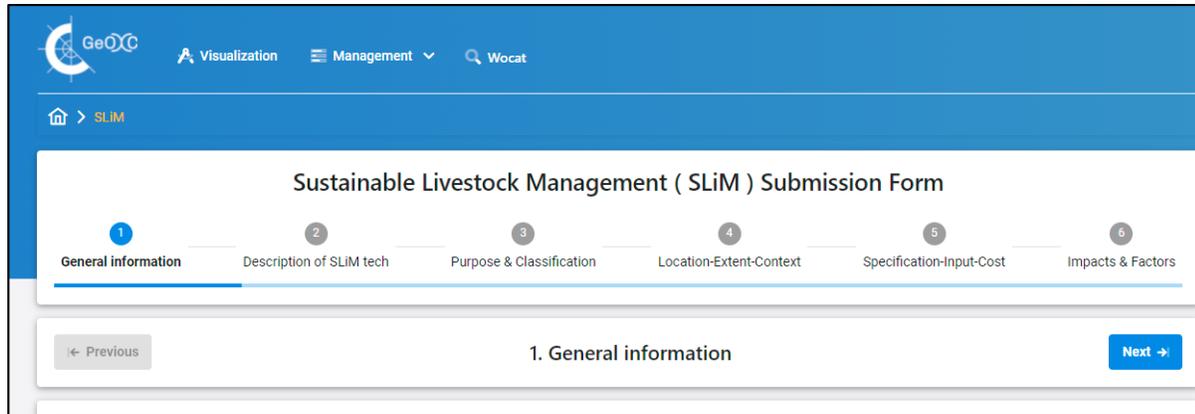
Online Template for Sustainable Livestock Management Option-by-Context (SLiM OxC) (<https://mel.cgiar.org/geoc/slim2>). The online template is consistent with an off-line template version in Excel (Le and Rischkowsky, 2019). In the tool interface, please go to “Management” tab, then click on “SLiMs”:

<sup>1</sup> When this link is not working it means that the domain is being under maintenance/improvement, and the temporary alternative link is <http://geoc.dev.scio.services/#/SLiM>

<sup>2</sup> When this link is not working it means that the domain is being under maintenance/improvement, and the temporary alternative link is <http://geoc.dev.scio.services/#/SLiM>



The online SLiM template has six parts:



- (1) General information: Name of the SLiM technology, data documentor(s), resource person(s) (optional) and information sources
- (2) Description of the SLiM technology
- (3) Purpose and classification
- (4) Location, extent and context
- (5) Technical specification, inputs and costs
- (6) Impact and influencing factors

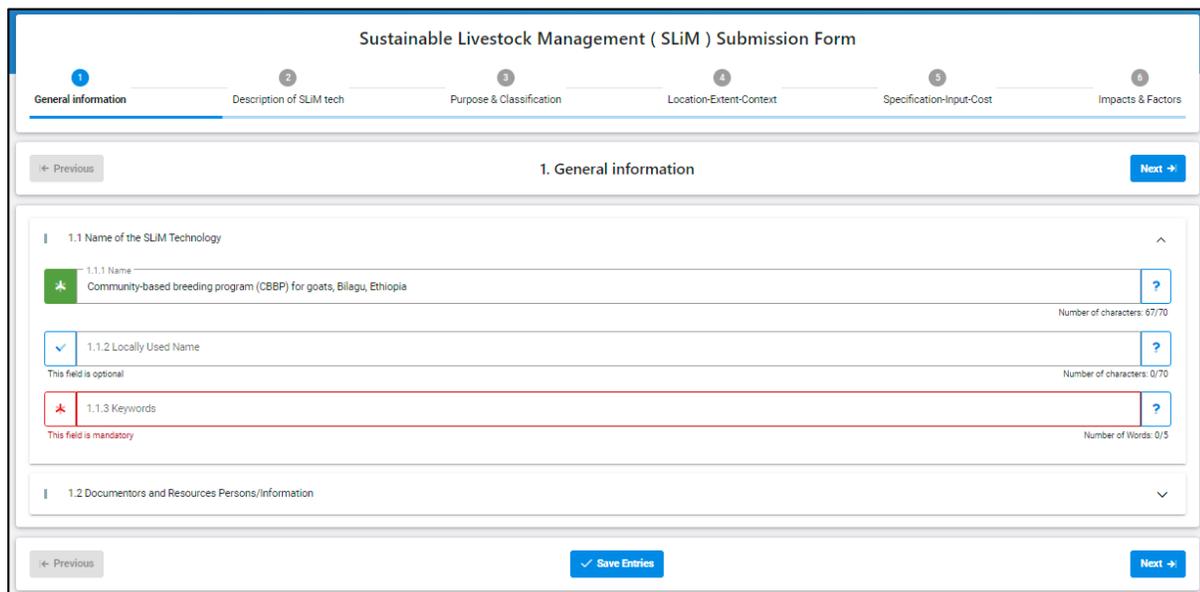
Every part can be filled and saved separately. Please, ensure to provide all the mandatory information that is begun with a red asterisk symbol:



The filling of information fields are based on either the provided answer choices (drop-down menus provided), or texts with structured instruction. Besides optional information fields, there are compulsory fields that form a minimal description of the SLiM data. Because the SLiM data are compiled using different available information sources that are very much varying in reported categories and variables, spatial clarities and times, the data are presented by version-to-version over time. The version-to-version approach offers chances to improve data quality and comprehensiveness upon new reference sources considered and additional peer-reviews offered, meanwhile encourage usages of the current version with informed limitations.

### 3.1 Part 1: General information

Please insert the name of the SLiM technology. The name should include the name of the technology itself, e.g. “Community-based breeding program (CBBP) for goats”, and the name of location where the technology implemented, e.g. “Bilagu, Ethiopia”. Please note that each information box has requirements about maximal length indicated on the right side of the box. Once the filled information is in due with the format requirement, the square box on the left side becomes green (see Figure 2a). For information sources, they can be literature (a standardized reference syntax, or Internet link) or originally created by a person or a group of persons (syntax: <list of authors><year>. Expert knowledge. Location) (see Figure 2b)



The screenshot shows the 'Sustainable Livestock Management (SLiM) Submission Form' with a progress bar at the top indicating six steps: 1. General information, 2. Description of SLiM tech, 3. Purpose & Classification, 4. Location-Extent-Context, 5. Specification-Input-Cost, and 6. Impacts & Factors. The current step is '1. General information'. Below the progress bar, there are navigation buttons for 'Previous' and 'Next'. The form contains three input fields: '1.1.1 Name' with a green checkmark and a character count of 67/70; '1.1.2 Locally Used Name' with a blue checkmark, a note 'This field is optional', and a character count of 0/70; and '1.1.3 Keywords' with a red asterisk, a note 'This field is mandatory', and a word count of 0/5. A 'Save Entries' button is located at the bottom of the form.

Figure 1a. Part 1 – General information: name of SLiM technology



Are you the main documentor?  Yes  No

1.2.1 Select Documentor  ?  
This field is mandatory

Do you have a co-documentor?  Yes  No

1.2.3 Date Of Filling This Form  ?  
This field is mandatory

1.2.4 Place of filling this form  ?  
This field is mandatory

Is there any Resource Person (if different from the Documentor(s))?  Yes  No

?

Information Sources

Citation  Location

No Information Sources Found.

« < > »

Figure 1b. Part 1 – General information: Documentor(s), resource person(s) and information source (s) (citation(s))

### 3.2 Part 2 - Description of SLiM technology

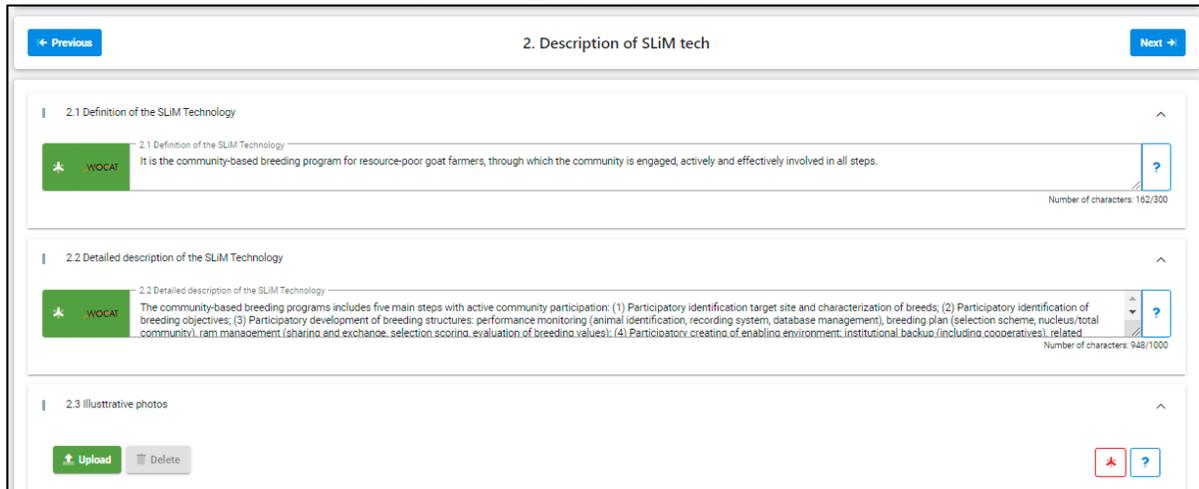
This section requires more detailed information on the SLM technology proposed. The section has 8 sub-sections (see Figure 2a). Users can see the details of a sub-section or hide them by click the down arrow on the right side (see Figure 2b).

Please upload maximal three typical graphics (e.g. photographs, charts or diagrams) demonstrate key aspects of the technology. All uploaded graphics must be with captions and sources (see Figure 2c).

2. Description of SLiM tech

- 2.1 Definition of the SLiM Technology
- 2.2 Detailed description of the SLiM Technology
- 2.3 Illustrative photos
- 2.4 Size of the site
- 2.5 Years of implementation
- 2.6 Year of evaluation/documentation
- 2.7 Mode of introduction of the SLiM Technology
- 2.8 Additional Mode of introduction of the SLiM Technology

Figure 2a. Part 2 – Description of SLiM technology: Overview



2. Description of SLiM tech

2.1 Definition of the SLiM Technology

2.1 Definition of the SLiM Technology  
It is the community-based breeding program for resource-poor goat farmers, through which the community is engaged, actively and effectively involved in all steps.  
Number of characters: 162/300

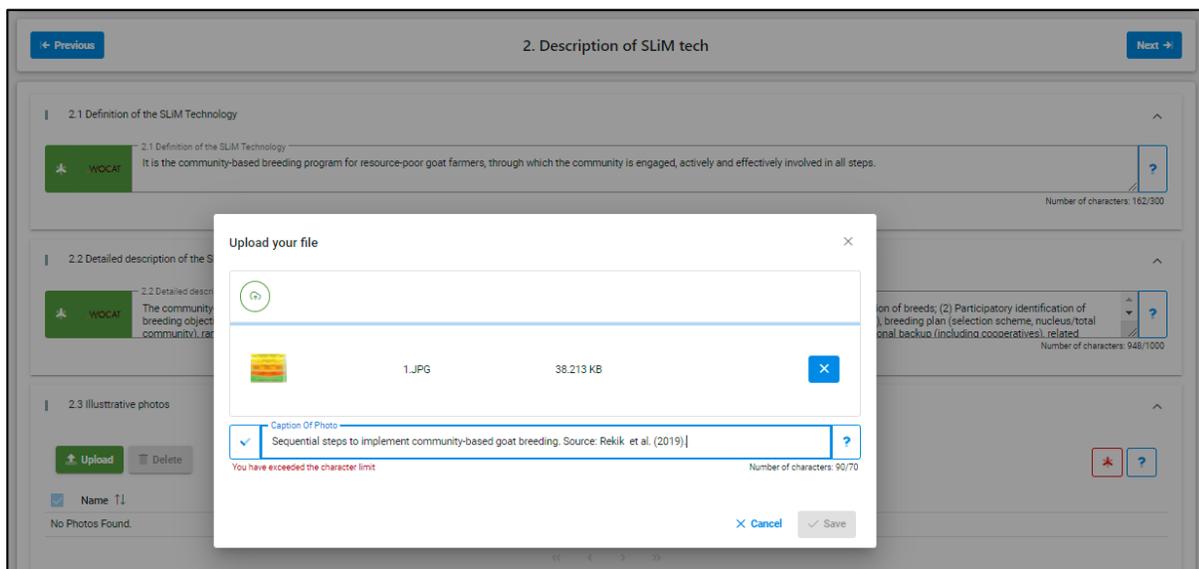
2.2 Detailed description of the SLiM Technology

2.2 Detailed description of the SLiM Technology  
The community-based breeding programs includes five main steps with active community participation: (1) Participatory identification target site and characterization of breeds; (2) Participatory identification of breeding objectives; (3) Participatory development of breeding structures: performance monitoring (animal identification, recording system, database management), breeding plan (selection scheme, nucleus/total community), ram management (sharing and exchange, selection scoring, evaluation of breeding values); (4) Participatory creation of enabling environment, institutional backup (including cooperatives), related.  
Number of characters: 948/1000

2.3 Illustrative photos

Upload Delete

Figure 2b. Part 2 – Description of SLiM technology



2. Description of SLiM tech

2.1 Definition of the SLiM Technology

2.1 Definition of the SLiM Technology  
It is the community-based breeding program for resource-poor goat farmers, through which the community is engaged, actively and effectively involved in all steps.  
Number of characters: 162/300

2.2 Detailed description of the S

2.2 Detailed descri  
The community  
breeding object  
community, ram

2.3 Illustrative photos

Upload Delete

Name 11  
No Photos Found.

Upload your file

1.JPG 38.213 KB

Caption Of Photo  
Sequential steps to implement community-based goat breeding. Source: Reikik et al. (2019)  
Number of characters: 90/70  
You have exceeded the character limit

Cancel Save

Figure 2c. Part 2 – Description of SLiM technology: Upload photos/charts/diagrams with captions and sources.

### 3.3 Part 3 - Purpose and classification

This part requires information on in the purpose (multiple are possible), the targeted livestock production system (LPS) and the measures comprising the SLiM option (Figure 3a). For all data fields, users fill information by selecting choices from standardized drop-down lists (Figure 3b).



Figure 3a. Part 3 – Purpose and Classification: Overview

Figure 3b. Part 3 – Purpose and Classification: Select purposes from drop-down standardized list

The target Livestock Production System (LPS) is described by: main class of LPS, main livestock group, main livestock (animal), main crop group, main crop, and an automatic description of LPS comprising all above information (see Figure 3c, data not yet filled for showing names the data field).

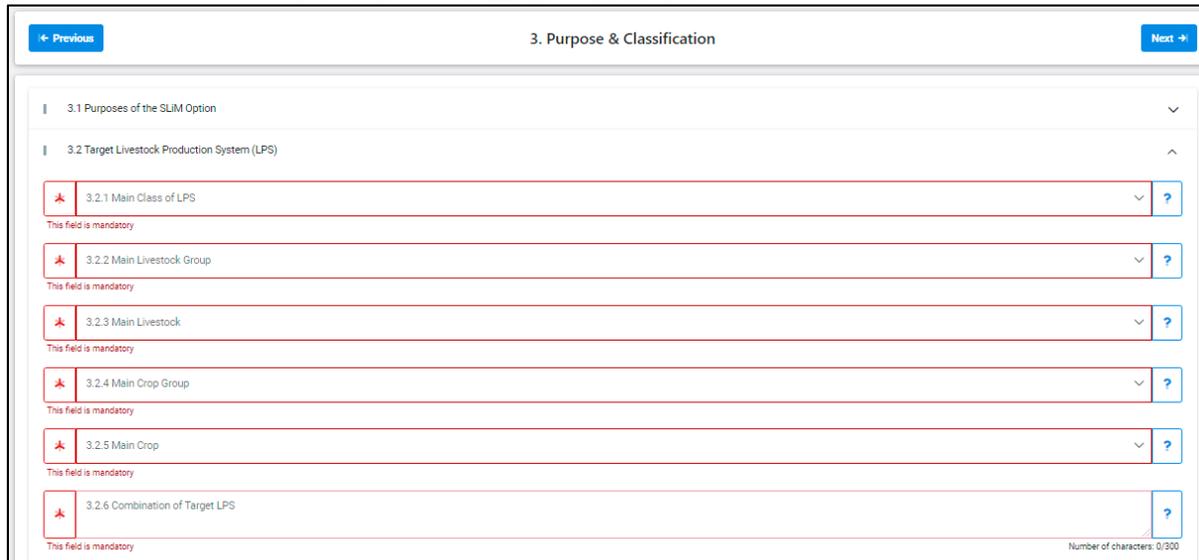
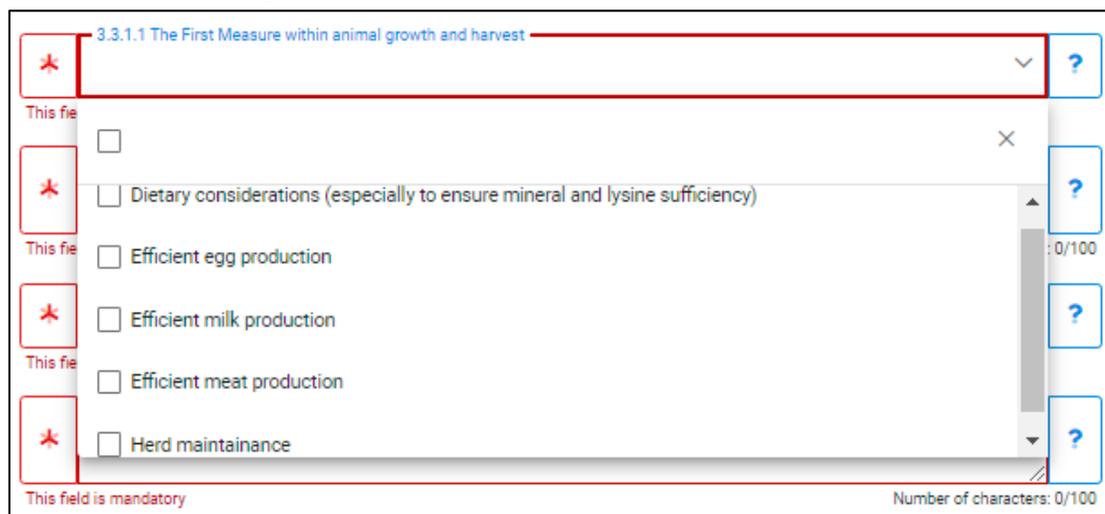


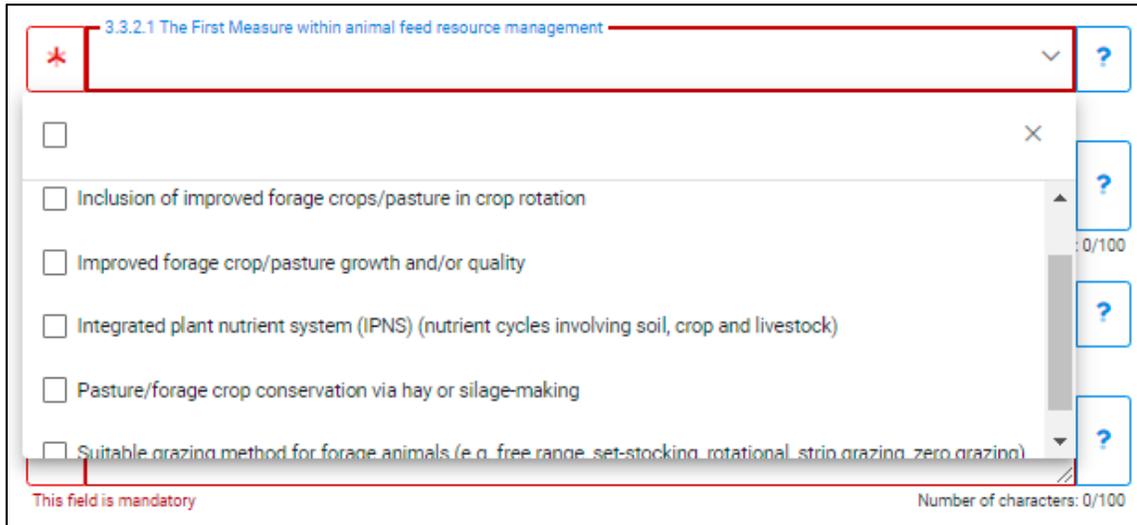
Figure 3c. Part 3 – Purpose and Classification: standardized data fields describing the target Livestock Production System (LPS).

Livestock management measures comprising the SLiM option are selected from the standardized list of five management measure groups:

- Measures for “Animal growth and harvest”:



- Measures for “Animal feed resource and management”:



3.3.2.1 The First Measure within animal feed resource management

Inclusion of improved forage crops/pasture in crop rotation

Improved forage crop/pasture growth and/or quality

Integrated plant nutrient system (IPNS) (nutrient cycles involving soil, crop and livestock)

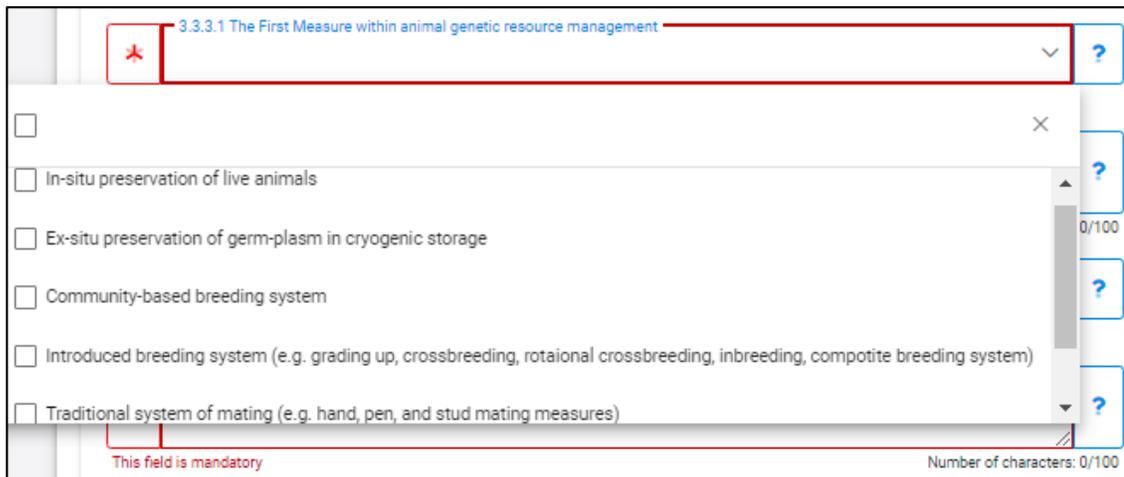
Pasture/forage crop conservation via hay or silage-making

Suitable grazing method for forage animals (e.g. free range, set-stocking, rotational, strip grazing, zero grazing)

This field is mandatory

Number of characters: 0/100

- Measures for “Animal genetic resource management”:



3.3.3.1 The First Measure within animal genetic resource management

In-situ preservation of live animals

Ex-situ preservation of germ-plasm in cryogenic storage

Community-based breeding system

Introduced breeding system (e.g. grading up, crossbreeding, rotational crossbreeding, inbreeding, composite breeding system)

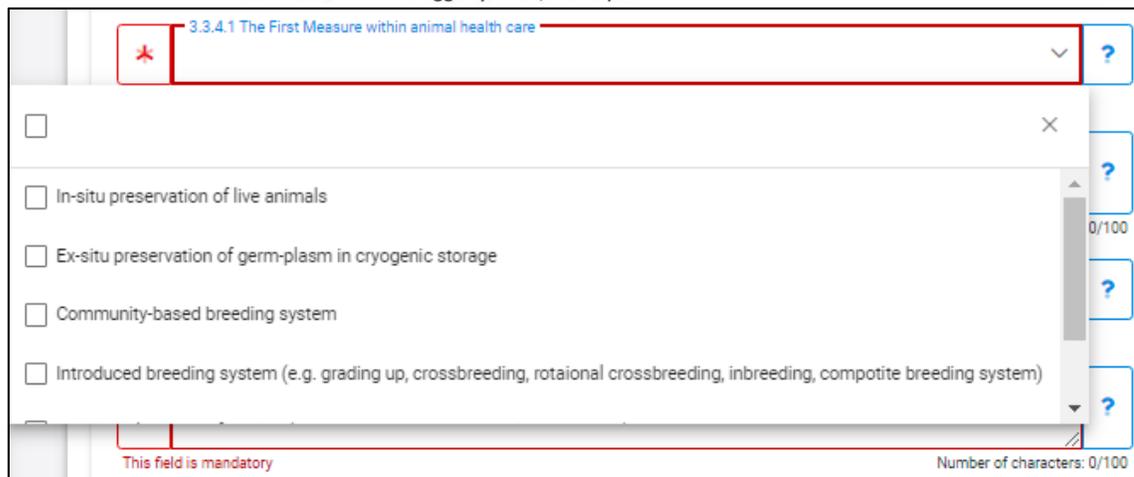
Traditional system of mating (e.g. hand, pen, and stud mating measures)

This field is mandatory

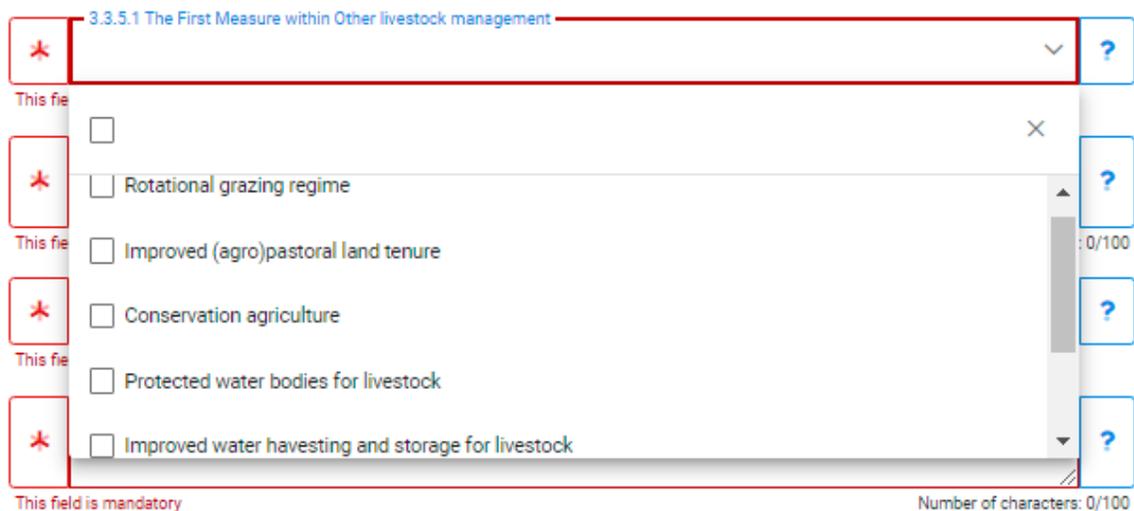
Number of characters: 0/100

- Measures for “Animal health care”:

More meat, milk and eggs by and for the poor



- Management measures for “Other livestock management”:



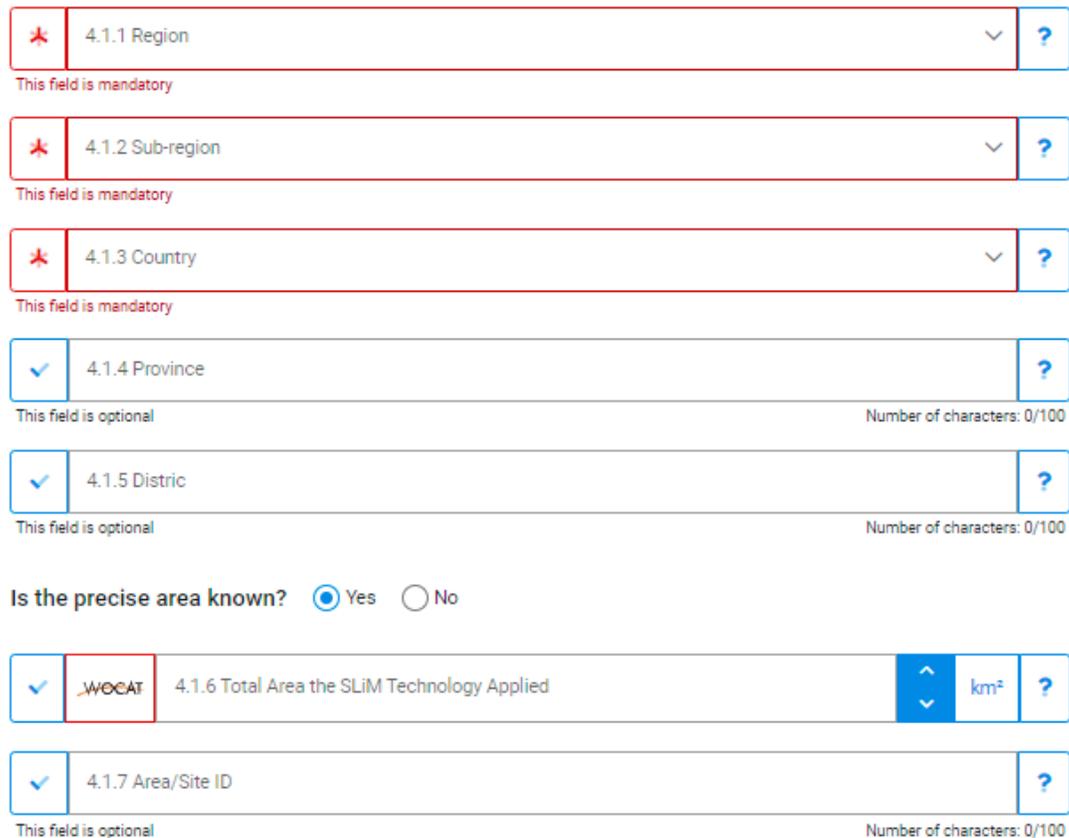
- At the end of the part, the tool automatically combines the above management measures into an data field 3.3.6:



### 3.4 Part 4 Geographic location, extent and context

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

- Sub-part 4.1- Regions/locations in term of administration units where the SLM technology has been applied and the total area the SLiM technology applied (if the precise area is known):



4.1.1 Region  This field is mandatory

4.1.2 Sub-region  This field is mandatory

4.1.3 Country  This field is mandatory

4.1.4 Province  This field is optional Number of characters: 0/100

4.1.5 Distric  This field is optional Number of characters: 0/100

Is the precise area known?  Yes  No

4.1.6 Total Area the SLiM Technology Applied  km<sup>2</sup>

4.1.7 Area/Site ID  Number of characters: 0/100

Figure 4. Part 4 – Location, extent and context: Data fields for administration locations and total implementation area of the SLiM

The sub-part has functions that allow users to define the geographic boundary of the SLiM implementation site by different ways: (1) clicking on WebGIS button to jump to a mapping window to draw the shape of SLiM site on the base map, or (2) clicking on Upload File button to upload own vector file of the SLiM site (KML or ESRI shape file), or (3) use URL button to load the shape file from an Internet site.



- Sub-part 4.2 includes socio-ecological contextual data fields that are automatically retrieved from GIS raster layers stored in the WebGIS component of the GeOC4SLiM tool.
- Sub-part 4.3 comprises of data field for impacts indicators that are automatically retrieved from GIS raster layers stored in the WebGIS component of the GeOC4SLiM tool.

Data fields in sub-parts 4.2 and 4.3 are described in Tables 1 and 2, respectively.

**Table 1.** List of contextual variables, their definitions and data sources that are included in sub-part 4.2 of the SLiM template.

<i>Variable</i>	<i>Definition</i>	<i>Data sources</i>
PREC-MEAN	Mean annual precipitation over 1982-2006 (mm/year)	Calculated from CRU TS 3.1 dataset (Harris <i>et al.</i> , 2014; Le <i>et al.</i> , 2016)
HUMIDITY	CGIAR-CSI's aridity index	Trabucco and Zomer (2009)
ELEVATION	Above sea level elevation (m)	Global 30 Arc-second Elevation (GTOPO30) (USGS, 1998)
SLOPE-DEG	Surface slope (degree)	Calculated from GTOPO30 data (USGS, 1998)
SQC-NUAV	Constraint in soil nutrient availability <sup>b</sup>	Harmonized World Soil Database (HWSD) supplementary data (Fischer <i>et al.</i> , 2008)
SQC-NURET	Constraint in soil nutrient retention capacity <sup>b</sup>	HWSD supplementary data (Fischer <i>et al.</i> , 2008)
SQC-ROOTCD	Constraint in soil root condition <sup>b</sup>	HWSD supplementary data (Fischer <i>et al.</i> , 2008)
SQC-OXYGEN	Constraint in soil nutrient availability <sup>b</sup>	HWSD supplementary data (Fischer <i>et al.</i> , 2008)
SQC-SALT	Constraint in soil oxygen condition <sup>b</sup>	HWSD supplementary data (Fischer <i>et al.</i> , 2008)
SQC-TOXIC	Constraint in soil toxicity <sup>b</sup>	HWSD supplementary data (Fischer <i>et al.</i> , 2008)
SQC-WORK	Constraint in work capacity of the soil <sup>b</sup>	HWSD supplementary data (Fischer <i>et al.</i> , 2008)
TREE-DEN	Tree density (% coverage)	
COVER-BROAD	Broad land use/cover zones	Re-classed from ESA-LC-CCI dataset 2015
SHEEP-DEN	Sheep density (head/km <sup>2</sup> )	Gridded Livestock of the World (GLW) (Robinson <i>et al.</i> , 2014)
GOAT-DEN	Sheep density (head/km <sup>2</sup> )	Gridded Livestock of the World (GLW) (Robinson <i>et al.</i> , 2014)
CATTLE-DEN	Cattle density (head/km <sup>2</sup> )	Gridded Livestock of the World (GLW) (Robinson <i>et al.</i> , 2014)
DIST-ROAD	Distance to the nearest road (km)	ICARDA (2016)
DIST-TOWN	Distance to the nearest town (km)	ICARDA (2016)
POP-DEN	Population density in 2015 (person/km <sup>2</sup> )	Extracted from Gridded Population of the World, Version

		3 (GPWv3) (CIESIN and CIAT, 2005)
POP-CHANGE	Change in population density in over 2000 - 2015 (person/km <sup>2</sup> )	Calculated from Gridded Population of the World, Version 3 (GPWv3) (CIESIN and CIAT, 2005)
GDP-PERS	Gross Domestic Production (GDP) per capita per 15 x 15 minutes in 2008	Global 15 x 15 Minute Grids of the Downscaled GDP Based on the SRES B2 Scenario, averaged for 1990-2025 (Gaffin <i>et al.</i> , 2004)
GDP-GRW	Growth of GDP per capita over 1990 – 2025 (% of baseline value in 1990)	Calculated using gridded downscaled GDP (SRES B2 Scenario) (Gaffin <i>et al.</i> , 2004)

**Table 2.** List of impact indicators, their definitions and data sources that are included in sub-part 4.3 of the SLiM template.

<i>Variable</i>	<i>Definition</i>	<i>Indicating aspect</i>	<i>Data sources</i>
NPP-TREND	Annual change in Net Primary Productivity (NPP) over 2000-2014 (unit: annual change in gC/m <sup>2</sup> )	Periodictrend of biomass productivity of the land, a proxy for soil productivity.	Extracted from (Le, 2016)
NPP-TRENDP	Relative annual change in Net Primary Productivity (NPP) over 2000-2014 (unit: annual change in % of NPP in the base year, i.e. 2000)	Periodictrend of biomass productivity of the land, a proxy for soil productivity. Relative measuring scale eases comparison among heterogeneous sites.	Extracted from (Le, 2016)
NPP-GAP	Gap between actual and potential Net Primary Production (NPP) (unit: % of potential NPP)	Extended concept of crop yield gap to biomass yield gap. Lower value indicates higher potential for intensification.	Krausmann <i>et al.</i> (2013), Haberl <i>et al.</i> (2002)
HANPP	Human appropriation of natural NPP (unit: % of natural NPP)	Human pressure on land resources. Very high value, e.g. > 70%, indicates not much remaining fraction of	Krausmann <i>et al.</i> (2013), Haberl <i>et al.</i> (2002)



*More meat, milk and eggs by and for the poor*

		natural biomass for ensure regulating/protecting ecosystem services	
--	--	--	--

- Sub-parts 4.4 and 4.5 include data fields of environmental and socio-economic conditions at the SLiM sites that comes from either documental sources or field observations (not retrieved from WebGIS).

### 3.5 Part 5 - Technical specification, inputs and costs

Part 5 contains three sub-parts:

- Sub-part 5.1 is the textual description of the SLiM technology in details.

5.1 Technical Specification ^

5.1.1 Technical specification

✓ | 🌐 ?

This field is optional Number of characters: 0/3500

- Sub-part 5.2 is the space users fill information for the costs of inputs needed for the establishment of the SLiM:

5.2 Costs Of Inputs Needed For The Establishment Of The SLiM

WOCAT ?

Further specifications	Quantity	Cost/unit (in USD)	Cost/input	% of cost borne by land users
> CONSTRUCTION MATERIALS				
> EQUIPMENT				
> FERTILIZERS AND BIOCIDES				
> LABOR				
> OTHER INPUTS				
> PLANT MATERIALS				

Total Cost: 0\$

\* 5.2.8 Additional Remarks Regarding Establishment Costs ?

This field is mandatory Number of characters: 0/3500

Figure 5a. Part 5 – Technology specification, inputs and cost: Overview input categories for SLiM establishment.

For each cost category, there is accounting line in which users give data on input quantity, cost/input unit, cost/input and % cost borne by land users:

Further specifications	Quantity	Cost/unit (in USD)	Cost/input	% of cost borne by land users		
∨ CONSTRUCTION MATERIALS						
Specifications	0	0	0	0%		
Total construction materials Cost:			0\$			

Figure 5b. Part 5 – Technology specification, inputs and cost: Cost parameters.

- Sub-part 5.3 is the space users fill information for the annual costs of inputs and current activities needed for the maintenance of the SLiM needed for the establishment of the SLiM. The structure of data fields is similar to sub-part 5.2.

### 3.6 Part 6 – Impacts and Influencing factors

Part 6 includes 8 sub-parts for measuring the SLiM's impacts (on-site and off-site), exposure and sensitivity to climate change, cost-benefit, adoption, adaptation, strengths / advantages / opportunities and weakness / disadvantages (see Figure 6a) using an expert-based approach with semi-quantitative measuring scale (7 levels) (see Figure 6b).

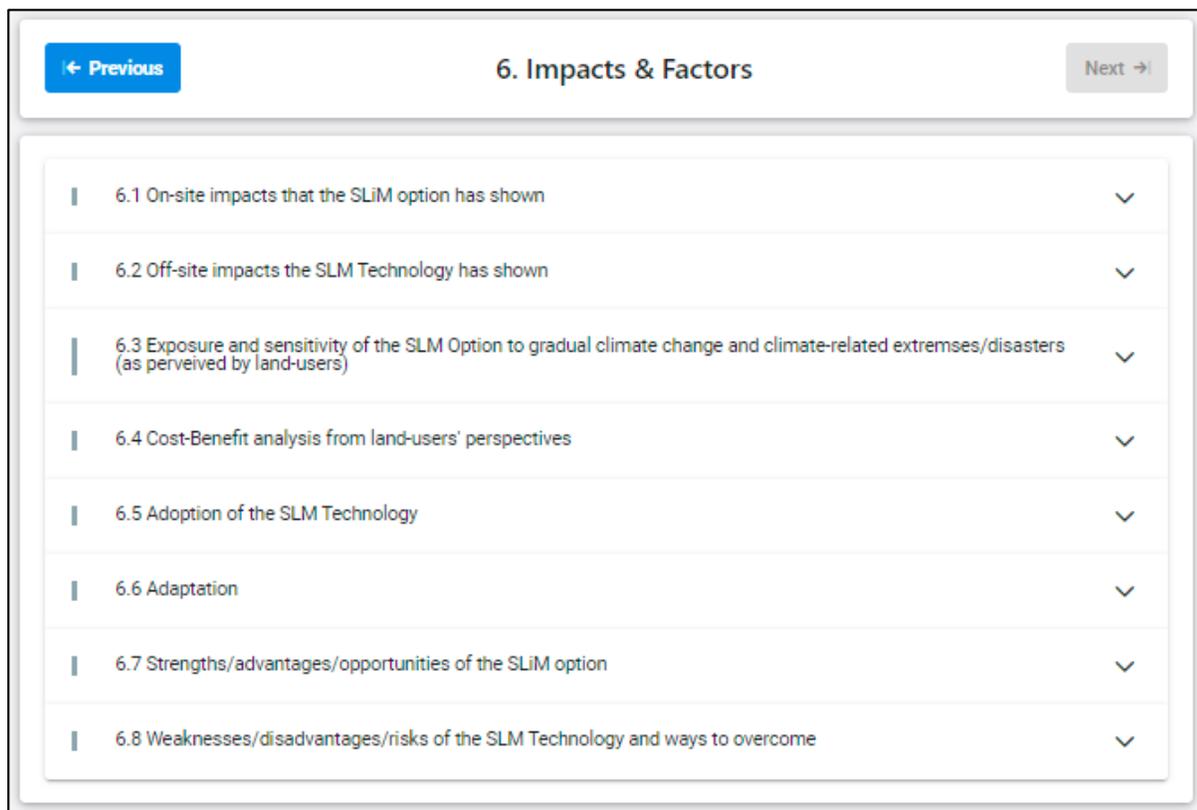


Figure 6a. Part 6 – Impacts and influencing factors: Overview.

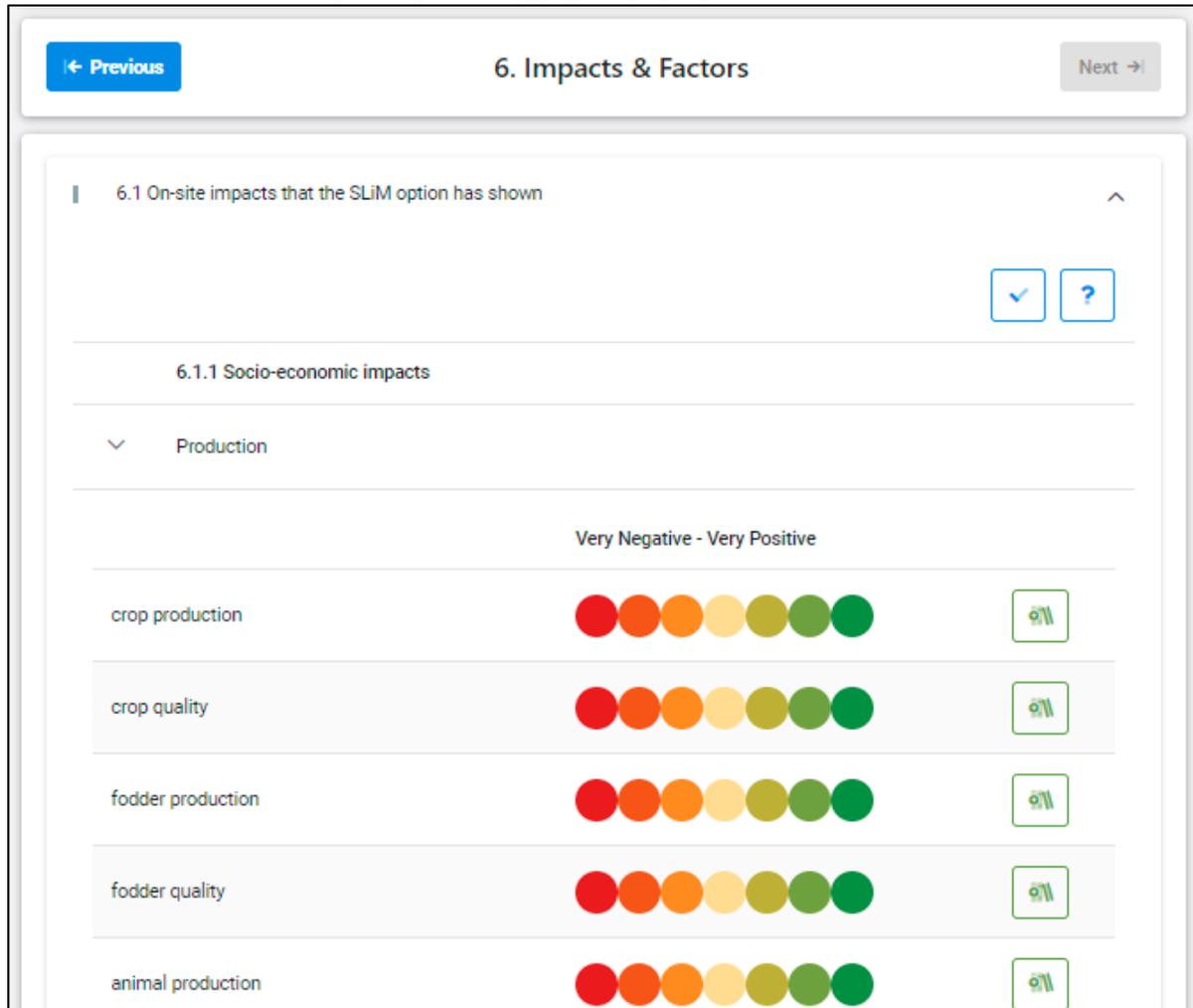


Figure 6b. Part 6 – Impacts and influencing factors: 7-level scale for impact indicators.

## 4. Visualization (WebGIS)

### 4.1 Overview of the WebGIS window

By selecting "Visualization" in the GeOC menu, the tool will load, prompt and ready for use (see Figure 7)

More meat, milk and eggs by and for the poor



Figure 7: Overview of the getting into WebGIS window

This WebGIS interface has two elements: (1) the **map window with mapping tool** for basic GIS functions (zooming, drawing, etc.) and contextual similarity mapping (i.e. mapping the area of socio-ecological context similar to the SLiM implementation site), and (2) the **GIS data pane** on the left that provides users with lists of GIS data allow selecting contextual variables, and/or impact indicators for SLiM options by context analysis (see Figure 8).

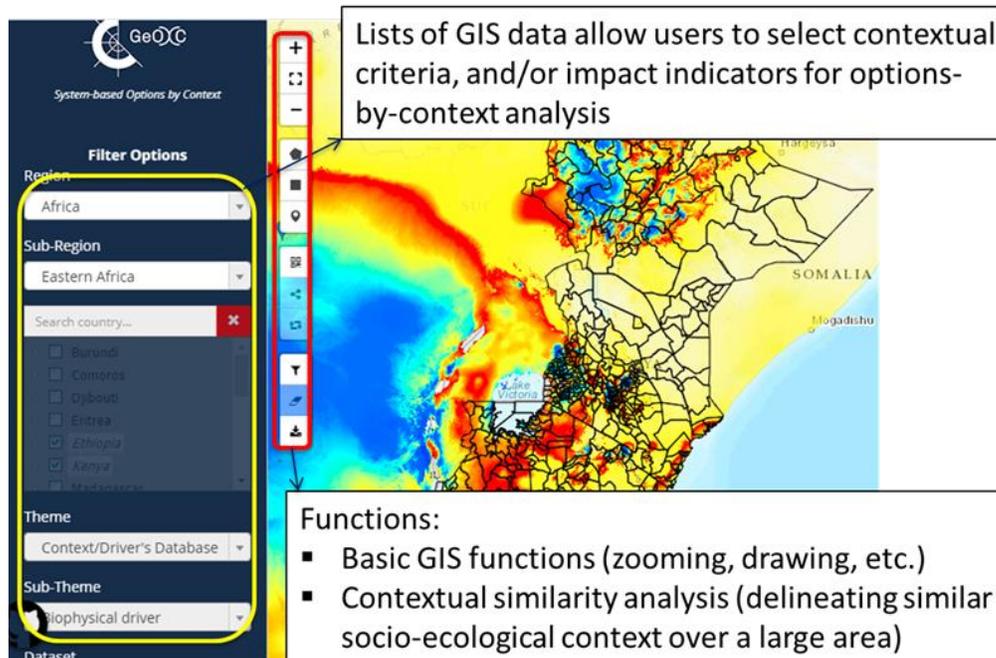


Figure 8: Mapping window with mapping tools and GIS data pane of the WebGIS interface

### 4.1.1 Map window with mapping tool

The functions of mapping tool in the map window are briefly explained in the text boxes in Figure 9.

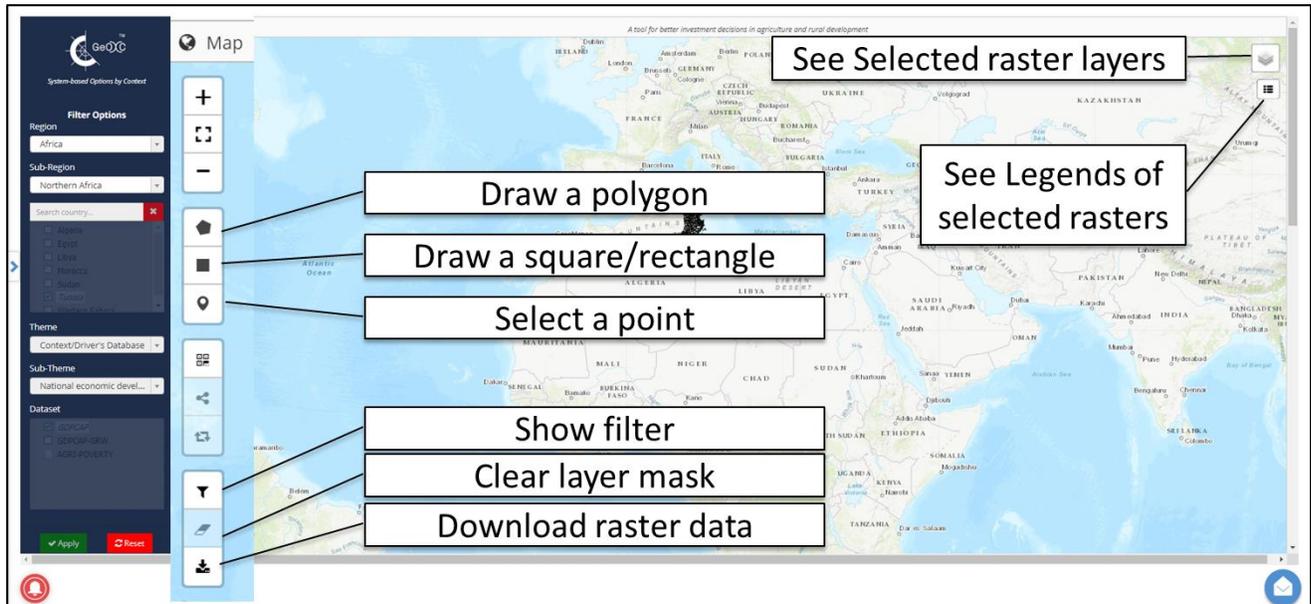


Figure 9: Mapping window with mapping tools and functions (explained in the text boxes)

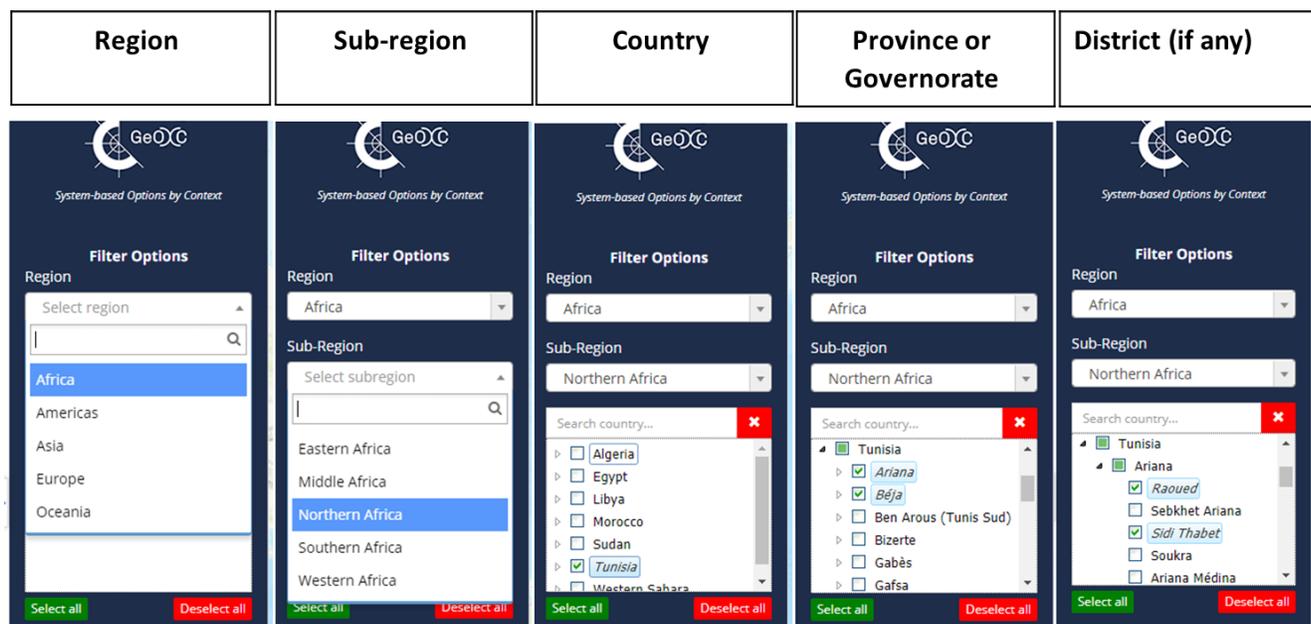


Figure 10: Administrative Region part in the GIS data pane help users select administrative region of interest at the level preferred.

#### 4.1.2 GIS data pane

##### Administrative region

In the GIS data pane, from top is the sub-pane for users select their administrative region of interest, from large to small administration units: region (e.g. Africa) → sub region (e.g. Eastern Africa) → country (e.g. Ethiopia) → lower units (if any) (see Figure 10). This help users select administrative region of interest at the level preferred.

##### GIS data hierarchy: Theme → Sub-theme → Variables

In the GIS data pane, below the part administrative region there are three parts (from top to down): Data theme → Data sub-theme → Data variables. First, in the Theme box users select a theme, next in the Sub-theme box select a sub-theme, and lastly select one or more GIS variables under those theme and sub-theme. To continue to select GIS variables of other themes and sub-themes while hold the current selection, users can repeat other sequential selections theme → sub-theme → variables (see Figure 11).

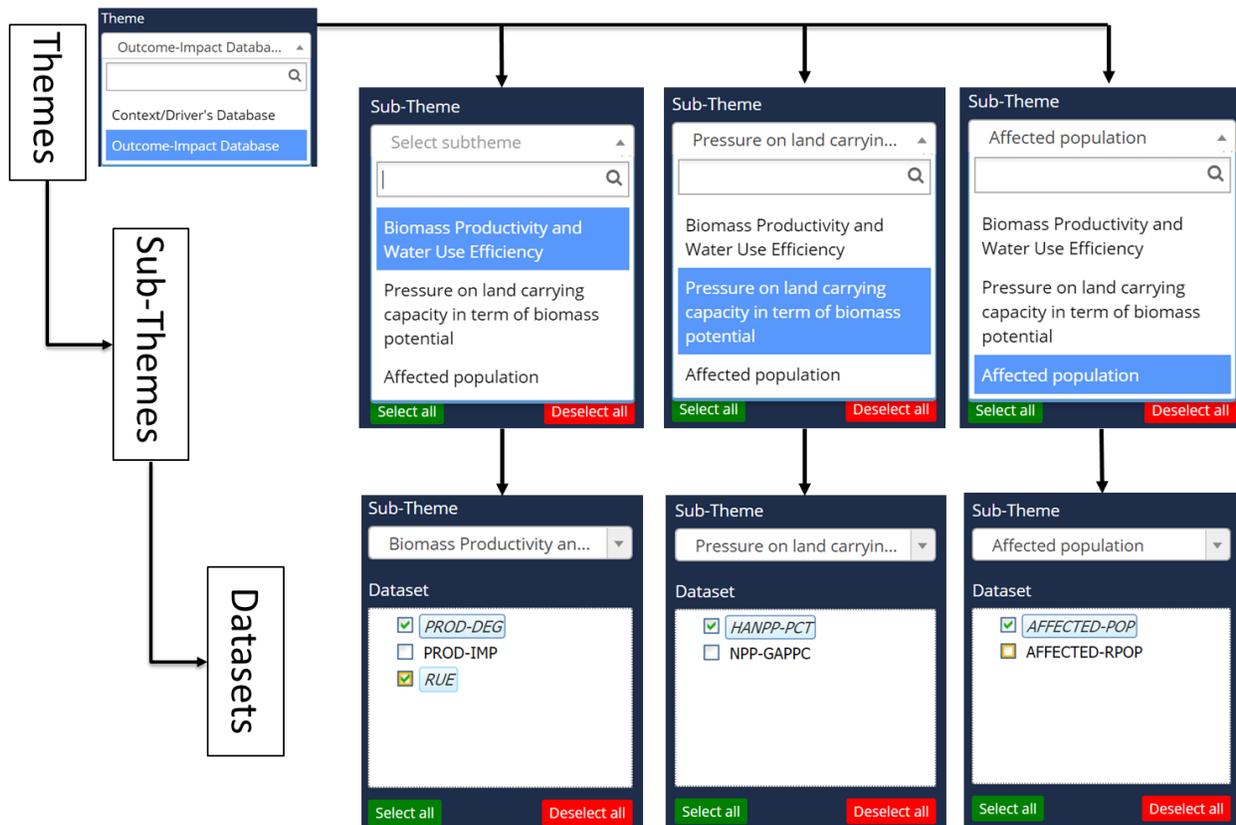


Figure 11: Hierarchy in the GIS data pane that allows users select GIS variables under different data themes and sub-themes to visualize in the map window.

Users can view a short definition of any GIS variable in the GIS data pane by hovering the mouse on the variable name in the variable list (see Figure 12).

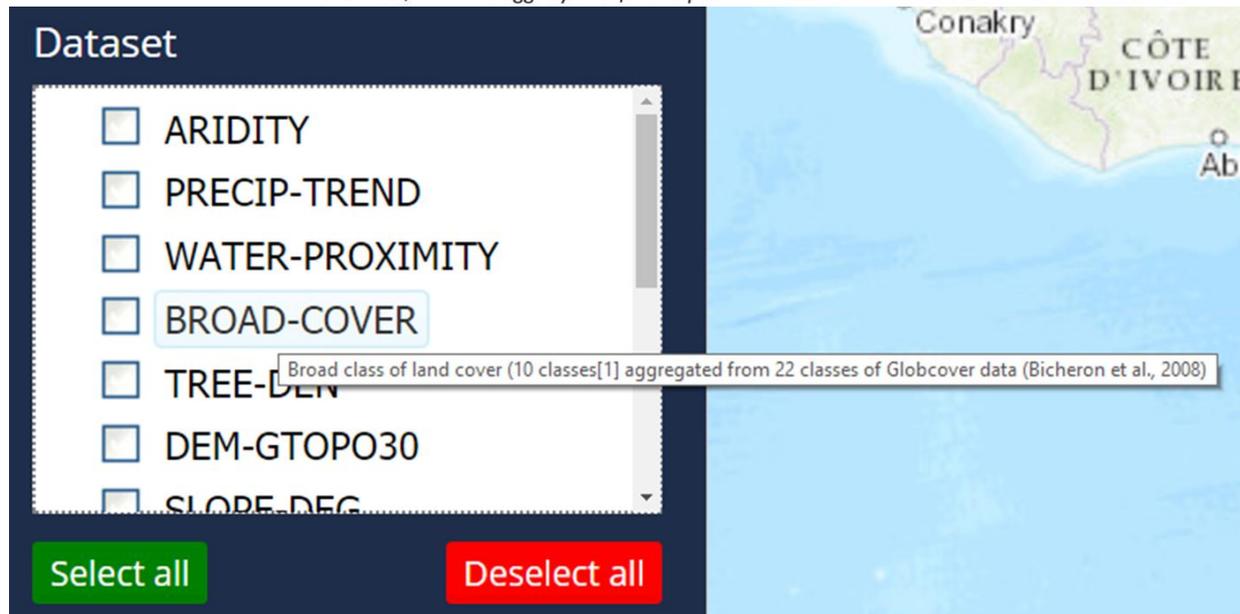


Figure 12: Hovering the mouse on the variable name in the variable list for viewing short definition of the variable

#### 4.1.3 Useful video clip demonstrating WebGIS and key functions

YouTube Clip:

<https://www.youtube.com/watch?v=MWR-LiY3128&list=PLRIsJ0x4IVjn1NUkaWPcIVswWv5jKtEVH&index=2>

## 4.2 Define a region of interest (RoI) using WebGIS

There are two ways to define a region/area of interest (RoI):

### 4.2.1 By selecting an administrative unit at preferred level

Using the Administrative region box in the GIS data pane and filter button in map window as show in steps in Figure 13.

More meat, milk and eggs by and for the poor



Figure 13: Steps define a region of interest using administrative unit(s).

#### 4.2.2 By drawing polygon(s) using mapping tool in the map window

Users can also draw an area of interest as showed in Figure 14. This is especially appropriate when the preferred area is smaller than administrative unit or has specific boundaries, such as the implementation sites of SLiM/SLM.

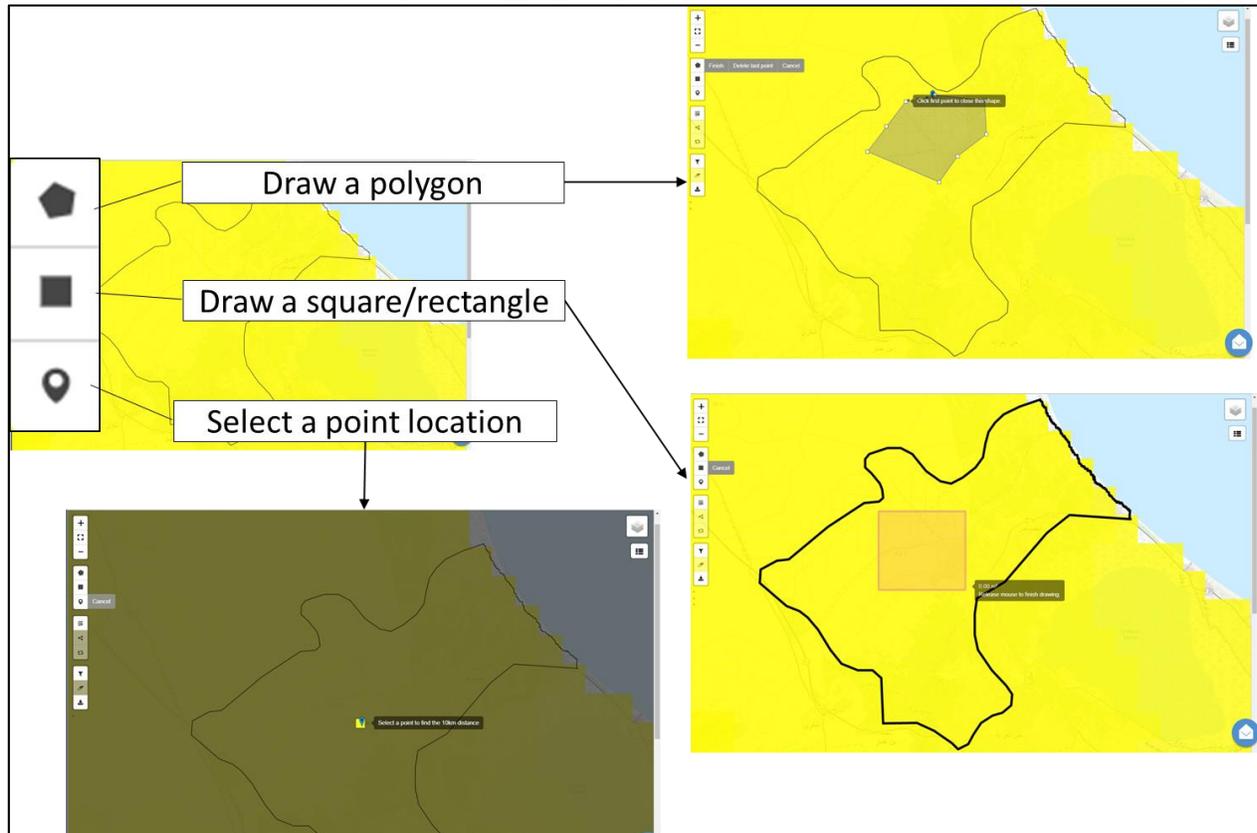


Figure 14: Using drawing tools on the map window for defining area of interest.

## 5 Demonstrations of operational use cases

### 5.1. Definition and visualization of the socio-ecological context at a SLiM/SLM site

YouTube video clip:

<https://www.youtube.com/watch?v=iPzQLiYyIC8&list=PLRIsJ0x4IVjn1NUkaWPcIVswWv5jKtEVH&index=3>

### 5.2. Mapping areas with socio-ecological context similar to the context in the considered SLiM/SLM site

YouTube video clip:

<https://www.youtube.com/watch?v=hGS-4xnQONc&list=PLRIsJ0x4IVjn1NUkaWPcIVswWv5jKtEVH&index=4>

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