Promoting sustainable use of underutilized lands for bioenergy production through a web-based Platform for Europe

D3.2

Database of attributes for sustainability assessment

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List of acronyms

BPP	Biomass Processing Plant
BPS	Biomass Processing Site
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GAEZ	Global Agro-Ecological Zones
GBEP	Global Bioenergy Partnership
GHG(s)	Greenhouse Gases
GIS	Geographic Information System
IPCC	Intergovernmental Panel on Climate Change
JR	Joanneum Research
MUC	Marginal, Underutilised and Contaminated
STEN	Sustainability Tool for Europe and Neighbouring Countries
TABL	Target Area Base Layer
UCLM	University of Castilla La Mancha

Executive Summary

This document presents a review of the data sets selected, adapted and inserted/linked to the Sustainability Tool for Europe and Neighbouring Countries (STEN) tool.

The work includes a description of the main items that compose the tool and gives a picture of the existing links between them, their language and communication, and the user's interaction with the tool's features.

The first part of the document describes the structure of the information flow with an introduction of the basic structure of the STEN tool. This section provides a map of the tool, essential to understand its "flow system".

In the second part, the tool's components are described. These components are:

- The GIS layers
- The DATABASE
- The User Input & Value Chain DATABOX
- The indicators' modules

Finally, chapter 4 draws conclusions concerning the database of attributes and its application in the STEN tool.

1 Introduction

1.1 Definitions

GIS map Layer: According to several Geographic Information System (GIS) manuals (e.g. ArcGIS, QGIS, etc.), a map layer is a GIS database containing groups of point, line, or area (polygon) features representing a particular class or type of real-world entities such as population, streets or climatic variables. A layer contains both the visual representation of each feature and a link from the feature to its database attributes. Maps in a GIS are made by combining multiple layers.

Database: A database represents a collection of information that is organized so that it can be easily accessed, managed and updated. Computer databases typically contain aggregations of data records or files, containing information about specific topics.

Standard User: The standard user is the basic form of user who is granted access to the system. This user type can search for marginal, underutilized and contaminated (MUC) land plots, view layers and MUC areas with the webGIS tool, add plots to their list of favourites to perform biomass sustainability simulations with STEN, display the available layers of the viewer and generate reports on screen with the results of the sustainability simulation.

Advanced (AD) user: The Advanced users are registered users who, in addition to the functionalities of the standard users, have the ability to edit values listed by default in the value chain DATABOX, where Standard users can only use default values for their simulations. Moreover, advanced users have the possibility to unlock the measurement of additional indicators for which Europe-wide representative data was not found in the context of BIOPLAT-EU and include those indicators provided that they can retrieve the necessary data.

1.2 General aspects

Due to its complexity, the STEN tool's database, which appears as a distributed database, takes advantage of different interconnected sources to perform its analyses. The goal of this approach, where large volumes of data are considered and accessed, is to have a platform of heterogeneous databases that in turn are harmonized by the webGIS software to work as a single database.

Users who access the platform and run a sustainability analysis through the STEN can indirectly access a series of data sources that come from different areas of the BIOPLAT-EU's webGIS Platform.

The first external data source employed in STEN consists of a series of GIS layers and maps that are linked with and controlled by the tool. This information is mainly identified as data for the characterization of the baseline conditions (without project scenario) and consist of a series of well-defined social, economic and environmental data.

The second main source of data, internal to the STEN structure, is represented by the STEN database. This is characterized by different attributes and features that provide a combination of variables that allow the system to run the sustainability analysis based on the user's inputs.

A novel approach devised for the specific context of the BIOPLAT-EU project, which this report describes in full in the following paragraphs, is the inclusion of a specific DATABOX into the STEN. This repository section of the software provides an interface between the databases and the software application. All values of the specific attributes of relevance for the sustainability assessment – both coming from the database as well as from the GIS layers/maps – land on the DATABOX section of the platform. For standard users, such information is not editable, but it is made visible so that users can follow the calculation process and learn from the changing variables how results are influenced. However, in the case of an Advanced User, this information is editable, allowing the calculations and therefore the analysis to be tailor-made specifically to the user's knowledge level with respect to the project conditions and simulation variables. For instance, if an Advanced User wants to test a different yield value for a specific crop, the structure of the STEN allows them to create their own databases as per their requirement any time they run a new analysis. These key features will enable the possibility to use the webGIS platform as a monitoring as well as a forecasting tool for bioenergy sustainability on MUC lands. Figure 1 shows the home page of the STEN tool.

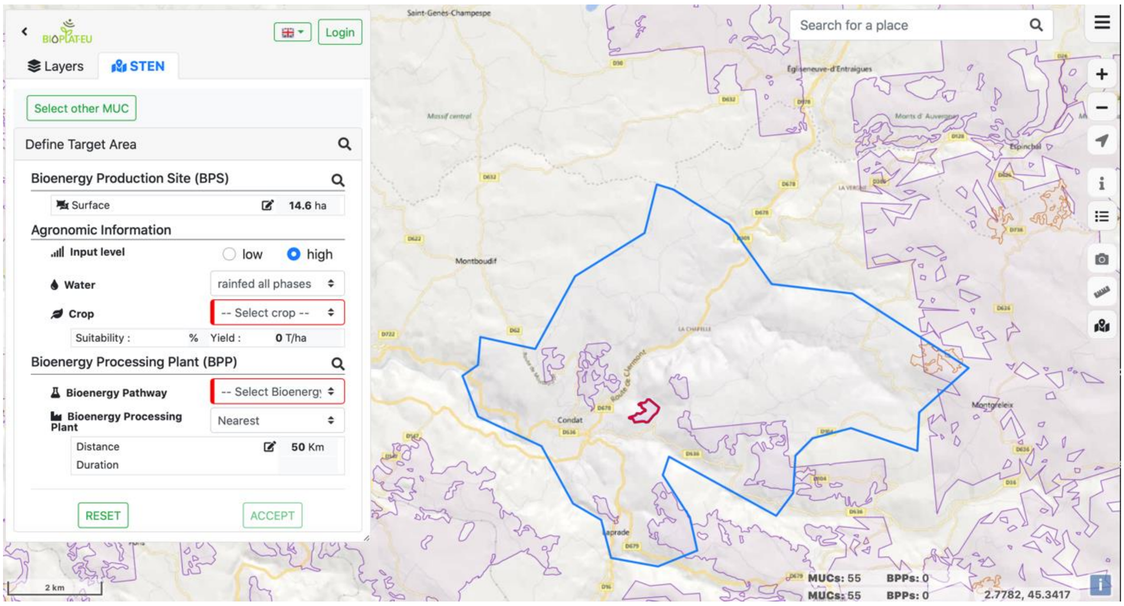

Figure 1. Home page of the STEN

2 STEN tool data requirements and information flow

The following chapter reports the STEN data flow, its components, the tool interaction with the users and the data editing.

2.1 Overview of the tool, components and information flow

2.1.1 Structure of the STEN

The STEN has been developed to assess and compare the impacts of different bioenergy production in European and Neighbouring countries from a value chain sustainability perspective. This tool allows the creation of a detailed framework for value chain analysis and the comparison of different scenarios. The specific structure of the STEN's information flow allows advanced users to modify default data from the databases to temporarily build and handle a user-tailored database that better fits the scope of a given analysis.

The development of the STEN started from previous experiences gained by FAO in developing excel-based sustainability assessment models. The knowledge of datasets, reference default values, metrics and units of a series of existing and available databases (e.g. the BioGrace tool for bioenergy GHG accounting, the IPCC reference values, etc.) developed during the implementation of previous projects constituted the roots of the STEN, which represents a step further towards an automated calculator for assessing bioenergy sustainability.

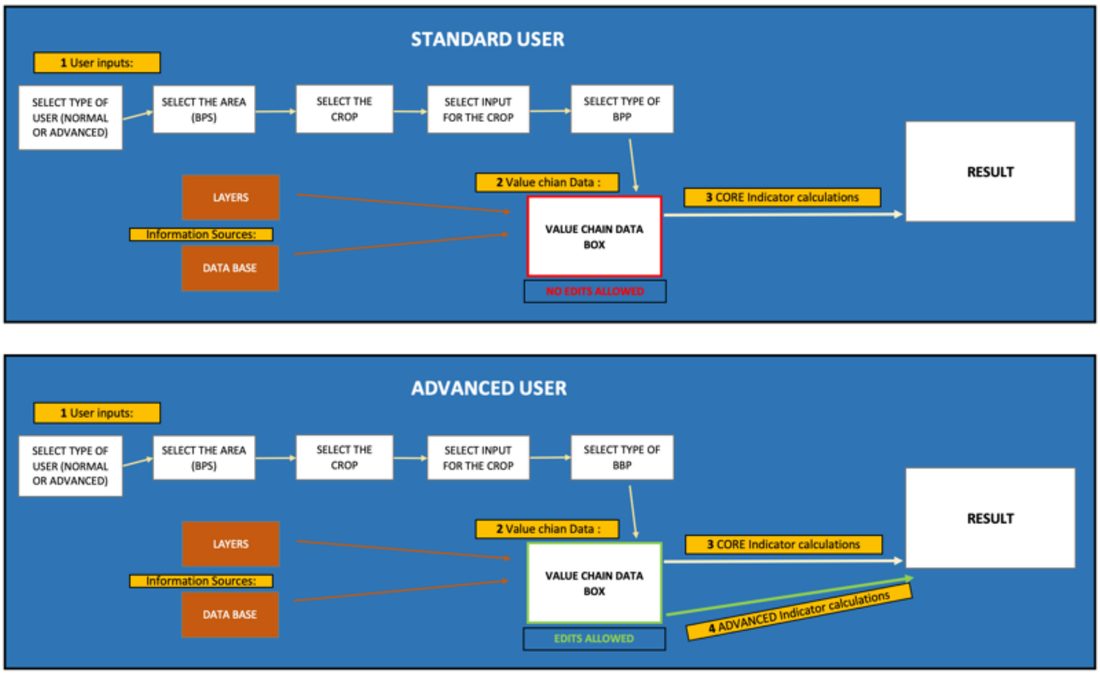

Figure 2. STEN Tool information flow

Crop suitability and productivity maps from the Global Agro-Ecological Zoning (GAEZ) produced by FAO and the International Institute for Applied Systems Analysis (IIASA), and ad-hoc layer maps developed with the same methodology have been applied to the STEN. The GAEZ methodologies utilize a land resources inventory to assess all feasible agricultural land-use options and to quantify expected production of cropping activities, for a selected number of crops, relevant in a particular agro-ecological context, for specified management conditions and three levels of inputs (high, medium and low input level).

The characterization of land resources includes all relevant components of climate, soils and landforms, which are basic for the supply of water, energy, nutrients and physical support to plants. The possibility to have the availability of the GAEZ methodology is an important added value for the BIOPLAT-EU project. It represents an impressive source of data which, coming from a single FAO tool, are ready to be used in a purpose-built processing environment, like the STEN engine.

Furthermore, the Copernicus Land Monitoring Services provided valuable data sets for the generation of a database of maps of MUC lands in Europe. From its four components (Global, Pan-European, Local, and Imagery and Reference Data), mainly the Pan-European and the Local components were considered. Particularly, images and shapefiles from the Corine Land Cover library and purpose-built time series based on Landsat and Sentinel Images have been used to define the underutilization status of the land in Europe.

National and European maps of contaminated soils have been used to create the contamination maps for the platform. In addition, EUROSTAT was used to define and incorporate demographic and social datasets. More detailed information on this is provided in the deliverable D2.1 and D2.2 of BIOPLAT-EU. Figure 2 shows the structure of STEN, its components and information flow. This simple but articulate framework is explained in detail in this report, focusing on each single component.

User Inputs:

The first step of any analysis performed through the STEN is represented by the selection by the user of 5 actions that are indispensable to identify the scope and the boundaries of the simulation. These crucial choices have to be addressed by the user, but the data selected are provided by an internal database for both standard as well as advanced users.

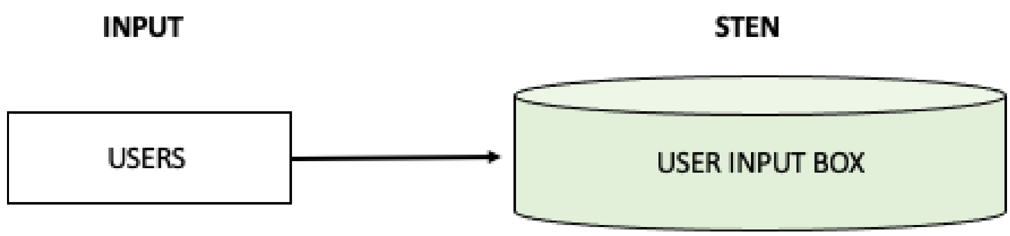

Figure 3. User Inputs BOX of STEN

The first action in the "User Inputs BOX" (Figure 3) step is the selection of the level of analysis (user type), where a user is asked to log-in to confirm the advanced user status or continue without logging-in as a standard user. Action number 2 of the User Inputs step is the definition of area where the analysis takes place. The user is asked to either select a patch of MUC lands pre-drawn by the systems or to draw one himself. The third action coincides with the selection of the bioenergy crop suitable in the given MUC patch selected previously, from a list that is updated in real time by the system based on crop suitability maps.

A fourth action required to the user is the selection of the level of agricultural input chosen for the management of the production, either a pre-compiled low input or high input regime (which differs from crop to crop). Finally, the fifth action of the User Input step of the analysis is the selection of the typology of bioenergy pathway that will characterize the value chain and the location of a real or hypothetical biomass processing plants. The following table (Table 1) shows the type of data and their origin for the five actions composing the user input section.

Input	Data typology	Origin
User type	Double choice	Database
Area BPS	Map polygon	Layer maps
Crop	List	Database+Layer maps
Input	Double choice	Database+Layer maps
Pathway BPP	List	Layer maps

Table 1. User Inputs requirements of STEN

Database and map layers:

The underlying architecture of the STEN tool is fed by two sources of information: i) the internal database, and ii) the map layers from the webGIS platform. As described above, the webGIS platform uses crop suitability and productivity maps from GAEZ and ad-hoc layer maps developed with the same methodology. In addition to the map layers, an internal database based on data from official sources of information has been developed by FAO and incorporated into the STEN's engine.

Type	Data typology	Source
DATABASE	Environmental, social and economic data, conversion factors, other variables	BioGrace, IPCC, literature review.
Layer Maps	MUC Land, Climatic data, social and economic data, crop suitability values, crop yield values, other variables	SEEMLA project, COPERNICUS, CORINE, National and European layer of contaminated soils, Open Street Map (OSM), GAEZ, etc.

Table 2. Internal and external source of data of STEN

Value chain DATA BOX:

This component of the STEN has been developed with the aim of improving the performance of the database by exploiting the expertise of the advanced users.

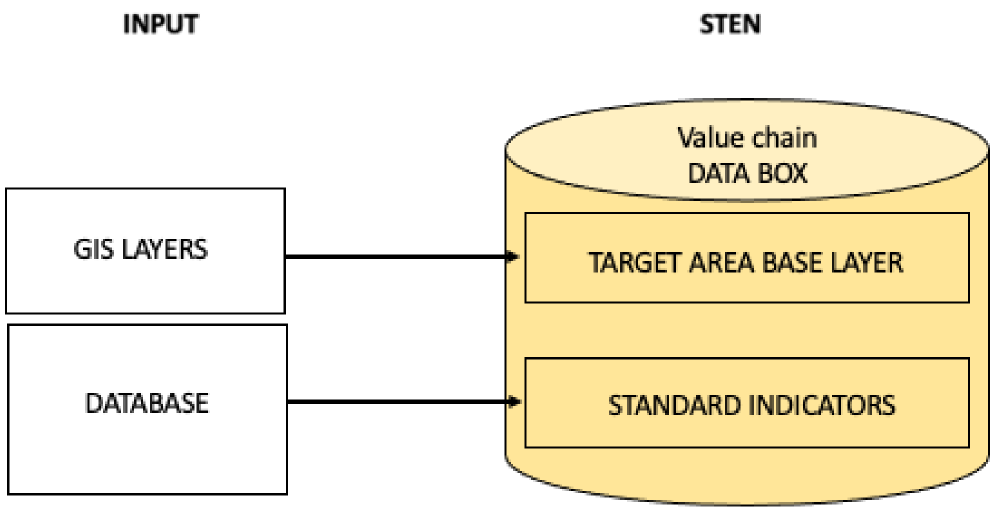

Figure 4. STEN Flow and data editability

Once arrived in the DATABOX, the information can be easily read by the users and, in the case of advanced users, eventually edited.

2.1.2 User Data editing (standard vs advanced)

The STEN provides two levels of analysis. A standard level of analysis is performed by standard users where most of the analysis runs in an automatic way. In the standard mode, although the "user inputs" variables are required to be filled out in the user input box, the information that populates the value chain DATABOX is not editable. Therefore, by inserting/selecting only five variables (i.e. actions), the system runs a semi-automatic procedure to measure the indicators and assess the sustainability of the value chain (Figure 5).

On the contrary, when the analysis is run by an advanced user, after the insertion of the five user inputs, the data that populates the value chain data box can be modified by the user (Figure 5). As already mentioned, this allows for a tailored analysis based on the detailed knowledge or requirements of the user. In any case, it is important to underline that no recording of the data is envisaged by default. The changes that the user makes to the data box information apply only to that specific analysis. After the analysis is completed, when starting a new assessment, data is restored to the default values and no signs of the user's own values remain in the database. A user, however, can download the datasets created and reupload them when running a further analysis.

Nevertheless, a possible future follow-up project for an updated version of the STEN could be considered, where the database could learn from the community (users), taking advantage of the detailed inputs that are inserted incorporating them into the software's own database. It is clear that to pursue this objective, a specific means of control of the quality and integrity of the data should be considered in order to preserve the high-quality standard of this tool and this requires a dedicated project and resources that go beyond the achievements in the context of BIOPLAT-EU.

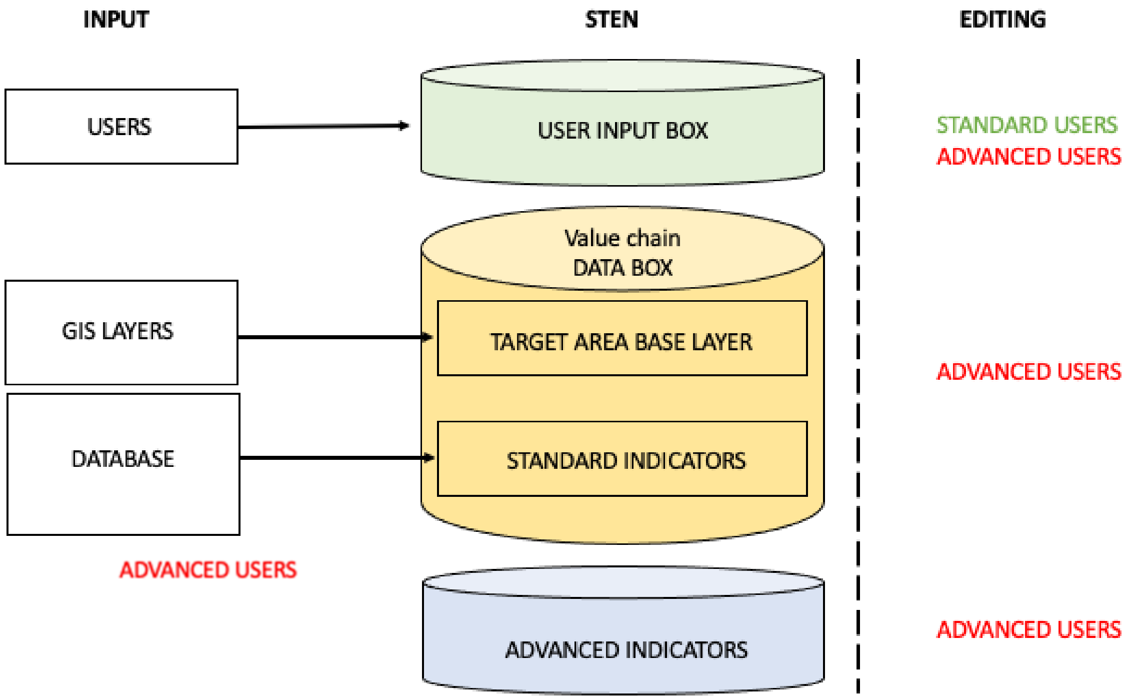

Figure 5. STEN Flow and data editability

2.1.3 Advanced indicator modules

The indicator modules of the STEN are specific sections that can be filled out only by advanced users. To understand these modules, it is important to know that there is a list of additional indicators (advanced indicators) that are not shown at the very start of the analysis, but which can be activated by the advanced user as far as he/she provides all the essential information (data) required to measure these additional indicators.

As shown in Figure 6, the data that comes into these modules does not flow in from the pre-existing databases or other repository (GIS maps, etc.) internal to the STEN, but is entirely provided by the users. The STEN, however, provides the algorithms that link the data requirements with the indicators value. The list of additional indicators includes:

- Change in Income
- Change in Land Tenure
- Change in Energy Access
- Capacity of Use of Bioenergy

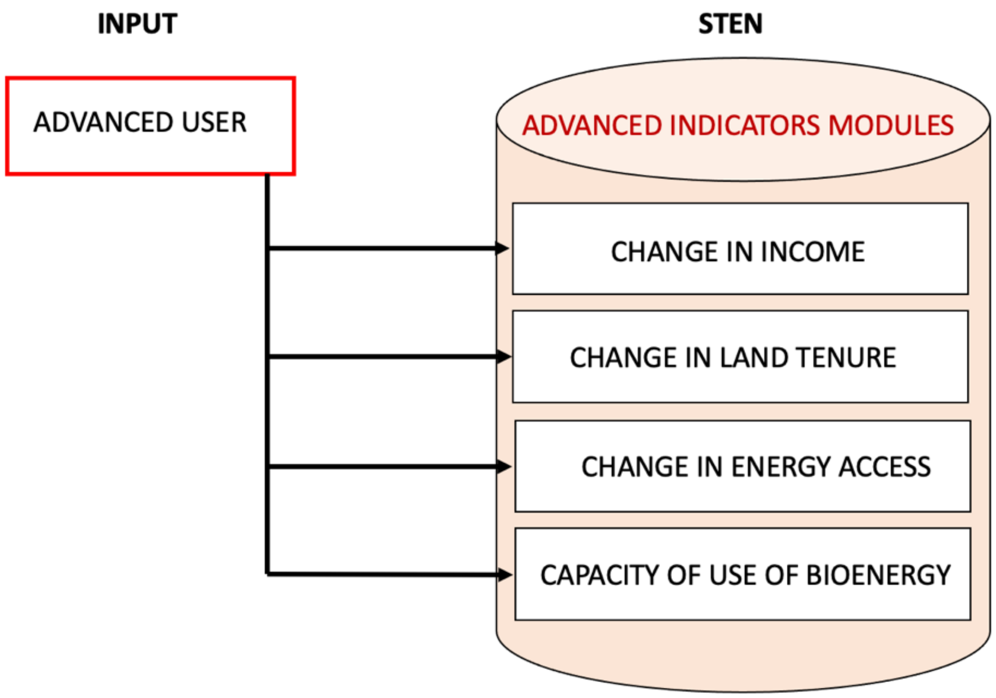

Figure 6. Structure of the Advanced Indicator Modules of STEN

3 The User Input & Value Chain DATABOX and other indicator modules

This chapter allows a deeper and more accurate understanding of the STEN components. The user input section, the value chain DATABOX and the advanced indicator modules are explained and illustrated below.

3.1 The user input BOX

The user input section is composed of the essential steps required by the system to identify the foundation of the analysis: Where is the potential production site located? What type of crop have we selected? What bioenergy product are we going to produce? In other words, these first 6 steps are indispensable to characterize the idea of investment that the user has in mind, and at the same time, to inform the system about what type of value chain has been chosen and where. Therefore, the information is read by the system, which provides all the necessary data to the value chain DATABOX, allowing the automatic measurement of the standard indicators. In this user input selection, the user is requested to specify whether the analysis is a standard or an advanced one. Figure 7 shows how the user input section is composed.

USER INPUT_ SU&AU						USER INPUT
No specific order for that						
ORIGIN	EDITORS			INFORMATION	Unit/Type	
User choice	SU	AU	1	SURFACE of BPS	Ha	18,000.00
User choice	SU	AU	2	CROP	Name	Giant reed
User choice	SU	AU	3	CROP INPUT LEVEL	LOW; HIGH	HIGH
User choice	SU	AU	4	BIOENERGY PATHWAY	Name	Cellulosic Ethanol
Layer/User chioce	SU	AU	5	BIOENERGY PROCESSING PLANT (BPP)	Position	(inserted or linked with layer)
User choice	SU	AU	6	TYPE OF USER	STANDARD/ADVANCED	ADVANCED

Figure 7. The user input BOX

3.2 The Value Chain DATABOX

All information needed to measure the standard indicators is sent and stored into the value chain DATABOX according to the information inserted into the user input BOX. This component is organized into different sub-sections based on the typology of data that come from both the internal database and the platform map layers. Only an advanced user can access the BOX and edit these data. The sections are: i) target area base layer (TABL); ii) Crop information; iii) Agronomic information and input level; iv) Bioenergy production; v) Transport of feedstock; and vi) Transport of bioenergy products. Figure 8 graphically presents the scheme of the DATABOX and its sub-components.

VALUE CHAIN DATA BOX

This is not a real baseline condition. This information will be available in specific pop-up windows when the advanced user decided to change the paramiters automatically generated by the platform. This appens in the indicator sheets.

VALUE CHAIN DATA BOX

ONLY IF USER IS AN **ADVANCED** ONE THE FOLLOWING DATA CAN BE MODIFIED

CORE INDICATORS - DATA ENTRY POP-UPs FOR STANDARD USERS (SU)

ORIGIN	Source	EDITOR		TARGET AREA BASE LAYER TABL	Unit/Type	
Layer	TABL	AU	7	Annual Crops	Ha	10,000.0
Layer	TABL	AU	8	Permanent Crops	Ha	10,000.0
Layer	TABL	AU	9	Permanent Meadows and Pastures	Ha	10,000.0
Layer	TABL	AU	10	Industrial Sites	Ha	10,000.0
Layer	TABL	AU	11	Forest	Ha	10,000.0
Layer	TABL	AU	12	Urban Areas	Ha	10,000.0
Layer	TABL	AU	13	Water & Wetlands	Ha	10,000.0
Layer	TABL	AU	14	Others	Ha	10,000.0
Layer	TABL	AU	15	Population 2016	Number	2,000,000.0
Layer	TABL	AU	16	Gross Domestic Product 2016	€	1,000,000.0
Layer	TABL	AU	17	Number of permanent jobs position	Number	70,000.0
Layer	TABL	AU	18	Number of temporary job position	Number	60,000.0
				CROP INFORMATION		
Layer	GAEZ	AU	19	Yield	Tonnes ha^{-1}	10.0
Database	Literature	AU	21	Bioenergy crop ET	mm/year	857.0
Calculated / not editable			22	Crop cycle	Type	Perennial
Database	Literature	AU	23	Market price	EUR per tonne	20.0
				AGRONOMIC INFORMATION or INPUT LEVEL		
Database	Literature	AU	24	Level of mechanization (tota Diesel consumption per hectar)	Kg/ha	83.52668213
Database	Literature	AU	25	Amount of fertilization (chemical) N	Kg/ha	150
			26	Field emission N2O kg/ha	Kg/ha	3
Database	Literature	AU	27	Amount of fertilization (chemical) P	Kg/ha	200
Database	Literature	AU	28	Amount of fertilization (chemical) K	Kg/ha	200
Database	Literature	AU	29	Amount of applied pesticides	Kg/ha	2
User	Literature	AU	30	Amount of organic fertilizers (e.g. Manure)	Kg/ha	0
Database	Literature	AU	31	Number of PERMANENT job positions per hectare	No. Per Ha	2
Database	Literature	AU	32	Number of TEMPORARY job positions per hectare	No. Per Ha	5
				BIOENERGY PRODUCTION		
Database	Literature	AU	33	MJ of Bioenergy product(s)/MJ FSTK	Rate	0.408921933
			34	MJ of co-products / MJ of bioenergy production	Rate	0.76
Calculated / not editable			35	LHV of FSTK	MJ/ton	16,140
Database	Literature	AU	36	Water consumption for feestock processing	m3/tfeedstock	4.5
Database	Literature	AU	37	MJ of energy input per unit of feedstock processed	MJ/ton	0.76
Database	Literature	AU	38	Number of PERMANENT job positions per MJ of bioenergy products	No. Per MJ	0.00002
Database	Literature	AU	39	Number of TEMPORARY job positions per MJ of bioenergy products	No. Per MJ	0.00002
Database	Literature	AU	40	EU market price of bioenergy product	€ Per MJ	7.00
Database	Literature	AU	41	Market price of co- product	€ Per MJ	5.00
Database	Literature	AU	42	Cost of raw material per MJ of bioenergy product	€ Per MJ	20.00
Database	Literature	AU	43	Cost of additional services per MJ of bioenergy product	€ Per MJ	10.00
				TRANSPORT OF FEEDSTOCK		
Layer	Open street map		44	Distance from BPS to BPP	Km	50
Database	Literature	AU	45	Number of PERMANENT job positions per ton of FSTK per Km	No. per Tonne per Km	0
Database	Literature	AU	46	Number of TEMPORARY job positions per ton of FSTK per Km	No. per Tonne per Km	0.0001
				TRANSPORT OF BIOENERGY PRODUCTS		
Layer	Open street map		47	Distance from BPP to distributor	Km	50
Database	Literature	AU	48	Number of PERMANENT job positions per MJ of bioenergy products per Km	No. per MJ per Ha	0
Database	Literature	AU	49	Number of TEMPORARY job positions per MJ of bioenergy products per Km	No. per MJ per Ha	0.0001
				CLIMATIC INFORMATION		
Layer	GAEZ	AU	50	Effective precipitation	mm/year	662
Calculated / not editable			51	Crop water consumption for processing	Km3/year	0.00000662

Figure 8. The value chain DATABOX

3.2.1 Building a baseline scenario: the target area base layer

The purpose of every baseline scenario is an estimation of what would happen up to the end of the analysis (20 years for STEN's value chains) without the development of the planned activities. This allows a realistic comparison between: i) the with-project situation; and ii) the evolution of the baseline scenario until the end of the project. What would be the status of the land use up to the end of the project without the development of the bioenergy plantation? What would be the level of emissions for an alternative fossil fuel scenario until the last drop of fuel produced? The scope of this baseline scenario characterization is to reply to these and other questions forecasting changes of the baseline variables to make the results as realistic as possible.

A specific sub-section of the value chain DATABOX, based on data that come from the GIS map layers, that characterizes the baseline scenario is the target area base layer (TABL). To understand the concept of the TABL, it is important to refer to the **target area concept**. The FORBIO project, first introduced the concept of **target area,** which is also at the heart of the delimitation of the reference system for the simulations in BIOPLAT-EU. This novel concept stepped away from the assessments performed using the GBEP Sustainability Indicators before FORBIO and towards the analysis of a single value chain at the sub-national level. The definition of the reference system in the sub-national realm was originally devised in FORBIO as the area delimited by those municipalities or watersheds touched upon the production of the biomass and its transportation to the processing plant. In terms of area then, the target area of FORBIO was the minimum surface (delimited by existing physical or political borders) that was relevant to the bioenergy value chain simulated. The same approach has been kept for the BIOPLAT-EU project, where the TABL's variables allow automatic characterization of the **target area** and its evolution during the project years (baseline scenario). Figure 9 shows the variables that compose the TABL, their origin and editability. Environmental, social and economic variables are present. All variables are based on data that comes from the GIS map layers and are editable only by an advanced user.

ORIGIN	Source	EDITOR		TARGET AREA BASE LAYER TABL
Layer	TABL	AU	7	Annual Crops
Layer	TABL	AU	8	Permanent Crops
Layer	TABL	AU	9	Permanent Meadows and Pastures
Layer	TABL	AU	10	Industrial Sites
Layer	TABL	AU	11	Forest
Layer	TABL	AU	12	Urban Areas
Layer	TABL	AU	13	Water & Wetlands
Layer	TABL	AU	14	Others
Layer	TABL	AU	15	Population 2016
Layer	TABL	AU	16	Gross Domestic Product 2016
Layer	TABL	AU	17	Number of permanent jobs position
Layer	TABL	AU	18	Number of temporary job position

Figure 9. Composition of the Target Area Base Layer (TABL) of the STEN tool

3.2.2 The With-Project variables

When it comes to the bioenergy value chains, and therefore the With-Project Scenario, a series of other variables are automatically selected as a consequence of the completion of the user input BOX entries. These variables are grouped in sub-sections and cover environmental, social and economic aspects of the planned value chain. The variables are grouped into the following sub-sections: i) Crop information; ii) Agronomic information and input level; iii) Bioenergy production; iv) Transport of feedstock; v) Transport of bioenergy product; and vi) Climatic information.

3.2.2.1 The Agronomic and energetic variables

Among the variables that compose the value chain DATABOX, many of them are indispensable to assess the impact on the environment of the potential value chains. The relative data are utilized to measure a list of environmental indicators and cover the whole value chain from the production of the feedstock to the transport of the bioenergy products to distributors.

3.2.2.2 The social and economic variables

The value chain DATABOX also foresees social and economic aspects of the proposed value chain that are indispensable for measuring the STEN's social and economic indicators. As for the environmental ones, the variables related to these aspects are grouped into sub-categories.

3.3 The advanced indicator modules

As mentioned in 2.1.3, the advanced indicator modules are data entry components directly linked to the STEN advanced indicators. Given the nature of those specific indicators, the variables that allow their measurement are fully inserted by the users.

The Figure 10, shows an example of the entry data (variables) required for the measurement of the Change in Income advanced indicator of the STEN. In this specific module, the variables that are used to measure the net margin from farm gate are provided by the advanced indicators.

ADVANCED INDICATORS - DATA ENTRY POP-UPs FOR ADVANCED USERS (AU)

			INCOME					
			Production costs		Amount			
ORIGIN	**Source**	**EDITOR**	*Operating inputs*	**Unit**	**Year 1**	**Year 2-20**	**Unit**	Marker price
AU	Entry	AU	Seeds/Plants	Kg Ha^{-1}	15.0	0.0	EUR Kg^{-1}/plant	2.0
AU	Entry	AU	Top Dress Fertilizer	Kg Ha^{-1}	0.0	0.0	EUR Kg^{-1}	1.0
AU	Entry	AU	Basal Fertilizer	Kg Ha^{-1}	150.0	0.0	EUR Kg^{-1}	1.0
AU	Entry	AU	Herbicides	Kg Ha^{-1}	0.0	0.0	EUR Kg^{-1}	2.0
AU	Entry	AU	Pesticides (Pre-harvest)	Kg Ha^{-1}	0.0	0.0	EUR Kg^{-1}	2.0
AU	Entry	AU	Pesticides (Post-harvest)	Kg Ha^{-1}	0.0	0.0	EUR Kg^{-1}	0.0
AU	Entry	AU	Manure	Kg Ha^{-1}	0.0	0.0	EUR Kg^{-1}	0.0
AU	Entry	AU	Hiring/usage tractor	Hours Ha^{-1}	10.0	10.0	EUR hr ha^{-1}	5.0
AU	Entry	AU	Transport cost	Tonnes ha^{-1}	10.0		EUR $Tonne^{-1}$	2.0
AU	Entry	AU	Irrigation	m^3/ha	0.0	0.0	EUR/m^3	0.00
			Labour:					
AU	Entry	AU	Land preparation	person day Ha	0.5	0.0	EUR person day	70.0
AU	Entry	AU	Planting	person day Ha	0.5	0.0	EUR person day	70.0
AU	Entry	AU	Weeding	person day Ha	0.5	0.0	EUR person day	70.0
AU	Entry	AU	Applying fertilizer/manure	person day Ha	0.0	0.0	EUR person day	70.0
AU	Entry	AU	Sprying pesticides	person day Ha	0.0	0.0	EUR person day	70.0
AU	Entry	AU	Harvesting (if average fill in both cells)	person day Ha	0.2	0.2	EUR person day	70.0
AU	Entry	AU	Transport	person day Ha	0.2	0.2	EUR $Tonne^{-1}$	50.0

Figure 10. Indicator module of the change in income advanced indicator of STEN

4 Conclusions and recommendations

In conclusion, the development of the STEN database structure was a delicate and comprehensive process that started from the beginning of the tool's development and involved all technical partners of the project. Particularly, the strong connection between the tool and the GIS maps developed under the WP2 required continuous interactions within FAO, UCLM and JR. Several ad-hoc technical meeting were done with the aim to define the best architecture for the STEN and its data flow. Furthermore, the development of the internal database required considerable effort and time spent in collecting the large amount of data, and to validate them conducting several internal tests.

It is expected that such a refined and comprehensive approach to database attributes will allow the project to deliver useful sustainability assessments of the studied value chains. It is also expected that the high level of accuracy reached with the harmonisation allows the project to work properly covering the large set of varied European scenarios and to prove to be effective in its sustainability analyses.