

2,415 m by 2050 for the Schladming Tauern region. If no significant management measures are undertaken, we will lose almost the entire open grassland region above the current forest line. This can be permanently and naturally realised through the regular, monitored grazing by larger flocks of sheep and herds of goats.

For the area of the Kleinsölk Valley, this planning process has been started: For manually selected pasture zones the potential, the possible number of sheep has already been calculated: The region requires 2,300 sheep annually for grazing. But in a rotation process over several years, a herd of 700-800 animals can suffice to meet the need. Thus with sustainable methods, humans can counteract the climatic change in pasture regions, insofar qualitatively suitable forage is available and the supply of water is ensured for grazing with sheep and goats. The basis for planning for realisation was created within this project, the management methods must be developed locally.

## 4. ENEALP 1.0 Beta Planning software for the grazing of alpine regions

### 4.1 Introduction

Implementation of the discussed models is complex and work intensive. Differing parameter settings, moreover, leads to results that cannot be compared. The focus of the INTERREG IIIB ALPINET Gheep project is drawing up of practical approaches that can be used in the entire region of the Alps. These factors led to the decision to depict the entire working model in a cohesive software package. ENEALP deals with the analysis of flows of energetic material on alpine pastures (ENE = energy, ALP = alpine). The aim is to provide information on additionally useable capacities in existing pasture regions. As a planning tool, for example, ENEALP calculates the number of animals that can be driven up to the pasture in addition to already existing

farming. Enormous additional potentials are very often calculated that can hardly be covered in current practice. But in connection with rising forest lines, grazing offers the only effective protection of the biodiversity of these pastures. ENEALP is available free of charge as a Beta version with a reduced level of data resolution (minimum pixel size: 50 metres; maximum number of pixels: 10,000). No liability is assumed for all and whatever forms of demands of and for the program, as well as the local correctness of the calculations. Some calculations require some investment of time, but patient users will be successful.

### 4.2 Technical prerequisites

ENEALP was implemented in C# based on the .NET framework, which has to be installed on your computer in version 2.0. If this is not already the case, it can be downloaded free of charge from the Internet and installed. In its GIS analyses, ENEALP is based on the classes of the Arc Objects tool package from ESRI. The functionality of the grid analysis and the overlay techniques are taken from there. Therefore, ENEALP is not able to work without the GIS-Suite ArcMap. Moreover, in combination with the installation of ArcMap it is recommended to install the ESRI .NET classes. ArcMap version 9.1 is currently supported.

- Sources: ArcMap: [www.esri.com](http://www.esri.com)
- .NET: [www.microsoft.com/download](http://www.microsoft.com/download)  
(Select the Redistributable Package (x86))

### 4.3 Installation

The latest version of ENEALP can be acquired from the HBLFA Raumberg-Gumpenstein ([www.raumberg-gumpenstein.at](http://www.raumberg-gumpenstein.at)) service webpage. A zip file of about 3 MB can be downloaded via the Service - Download - Software menu sequence. After decompressing with the standard WinZip program, you receive the two folders „Software“ and „TestData“. The „Software“ folder contains the setup.msi and setup.exe files. You can

start the installation with both. There is a series of files in the “TestData” folder that have been used for illustrations found in this book. The ENEALP functionality can be directly tried with the test data. To run the application, please start the file ENEALP.exe from the folder you have created during the installation.

#### 4.4 Necessary datasets

ENEALP uses a series of standardised input data and reads the necessary values for analysis. For this data formats, structures and types are accessed that cannot be given without selection. Moreover, the user must take the highest care in structuring the data. The following basic rules are mandatory.

All geo-datasets must be defined in the same geographical system of coordinates.

The spatial extent of the grid data (digital elevation model, land-cover class, precipitation) must be identical. At the same time the entire vector data range (alpine pastures, outer limits, rivers and lakes) is to be covered. All grid data must be in the same pixel resolution.

The name of the standard data field of the grid data are read as value. The datasets of the terrain model and the precipitation per year, or during the vegetation period, are available as floating point grids, the land-cover classes as a signed integer. The terrain model and the land-cover data must be created individually and locally by the user. The precveg and precyear precipitation datasets were taken from the freely available data in the ALP-IMP project (<http://www.zamg.ac.at/ALP-IMP/>). The basic data for local interpolation can be taken from the Time Services Gallery section.

The vector dataset is available as a point object and can also incorporate springs or other non-linear waters. Alpine lakes are generally small enough to be depicted by a representative point. Rivers are linear waters, a topological network is not necessary.

Pasture borders are given as a polygonal dataset that depicts the legal borders of the

alpine pastures. The following fields (data types) must be available.

- FID (Object ID) allocated
- Shape (Polygonal)
- ID (Long)
- Type (Short) : 1 = core pastures, 2 = total pastures
- Shape\_Area (Double): area
- Name (String)

FID and ID can contain the same data

Regional borders are given as a polygonal dataset of the large alpine areas (valleys...). The following fields (data types) must be available.

- FID (Object ID) allocated.
  - Shape (Polygonal)
  - GRIDCODE (Long)
- FID and GRIDCODE can contain the same data

#### 4.5 Resulting data

All results of the GIS analysis are filed in the gisdata subdirectory of the installation directory. This data is given preferentially in the ESRI grid format and can be used directly for further analysis. All numerical calculations related to the pastures and vicinity objects are in the MS-Access database/databases/BasicParameter.mdb in the installation directory.

*Description of selected grid datasets  
(see table 42)*

The structure of the Pastures and Outside tables contains a series of data fields, which describe the data input as well as the numerical results. Some fields are described in the table 43.

#### 4.6 Program description

##### 4.6.1 System settings

1. Program interface: The basic element of the program is a row of tabs that should be gradually worked through from left to

Table 42: Results of the grid datasets

Name	Description
yieldres	Result of the estimation of dry matter yield (dt/ha)
enenet	Result of the energy estimation (MJ ME/kg DM)
energypixel	Energy yield/pixels (MJ ME)
quality	Quality assessment (Notes 1-5)
outintensi	Additional possible capacities (grazing animals/year) in the high quality share in the regional analysis
outextensi	Additional possible capacities (grazing animals/year) in the medium quality share in the regional analysis
outused	Percentage of the currently used grazing potential (%) of the region
pasintensi	Additional possible capacities (grazing animals/year) in the intensive quality share on individual pastures
pasextensi	Additional possible capacities (grazing animals/year) in the extensive quality share on individual pastures
pasused	Percentage of the currently used grazing potential (%) of an individual pasture

Table 43: Results in the database

Fieldname	Description
TotalEnergy	Total energy requirement/day
TotalEnergyYear	Total energy requirement/grazing period
EnergyYieldSumYearIntensiv	Energy yield of the pasture in the intensive quality class (MJ)
EnergyYieldSumYearExtensiv	Energy yield of the pasture in the extensive quality class (MJ)
EnergyPotentialIntensiv	Free energy volumes in the intensive quality class (MJ)
EnergyPotentialExtensiv	Free energy volumes in the extensive quality class (MJ)
EnergyPastUnitIntensiv	Additional possible capacities (grazing animals/year) in the intensive quality sphere
EnergyPastUnitExtensiv	Additional possible capacities (grazing animals/year) in the extensive quality sphere
PotentialUsed	Percentage of the currently used grazing potential (%)

right. The beginning is in the „Start“ tab, followed by „Data Source“, and so on, until the last „Maps“ tab. Program errors are to be expected if individual tabs are skipped.

2. Software key: A software key for the program has been calculated to document the distribution of the software. This key is necessary to use the software. This key is calculated from a computer key. You can acquire the software key from thomas.guggenberger@raumberg-gumpenstein.at by stating your name, address, planned field of analysis and your computer key. Enter the returned key (e.g.: 7024) and store it with the „Save“ key.

3. Resetting the system: The entire system can be reset via „Reset Project“. This means the loss of all data, and therefore the old volume of data must definitely be first stored.

#### 4.6.2 Data sources

1. Grid data sources: The dataset in question can be loaded via the respective buttons. The selection for grid datasets end with the grid dataset folder (e.g.: C:\TestData\dhm50). Vector data can be loaded via your file (e.g.: C:\TestData\River.shp).
2. Two MS Access databases are required for implementing the software. These are found in the /database directory after

installation. The name of the system file is BasicParameter.mdb. The name of the GI objects is Feature.mdb.

3. Land-cover classes: All of the land-cover analysis inputs can be loaded into the system with the „Load Land-cover Classes“ button. Be sure to enter the name of the ID field (this is normally called „value“).
4. With the „Test and save all data connections“ button, the content of all paths are stored and all structure data read in. The progress diagram bar always shows the extent of already completed work (5).
5. Progress bar and description of the activity
6. After storing the path, the surface distance to the water must be calculated. This task can take some time.
5. Estimation of the maximum possible energy content: selection of the individual land-cover classes takes place via a mouse click on the cell in the „LandCoverClass“ column. The following additional attributes must be subsequently given.
6. Name: name of the class (e.g.: rich pastures)
7. Quality type: an entry can be selected from the dropdown list. Some entries are executed in a way that all fields (quality types a, b1 and b2) are independently filled in.

Execute with the „Save“ button

8. Selection sphere of the data
9. Formulas to be allocated
10. Decision concerning the calculation behaviour of the system

Close with the „Basic GI Calculation I“ button!

#### 4.6.3 Comparative estimations

1. Estimation of the length of the vegetation period: The length of the vegetation period is defined via the local altitude. A quadratic function is generally used here. A broad variation of regional formulas is offered for Austria to achieve a local adaptation. A separate comparative estimation must be created for areas not to be covered. A region can be selected from the list - activating the check box selects its formula. Conclusion is executed with the „Save“ button.
2. Estimation of the maximum possible forage yield: Selection of the individual land-cover classes takes place via a mouse click on the cell in the LandCoverClass column. The following additional attributes must be given subsequently.
3. Name: name of the class (e.g.: rich pastures)
4. Yield type: an entry can be taken from the dropdown list. Some entries are so executed that all filed types (yield types a, b1 and b2) are independently filled in.

Execute with the „Save“ button.

#### 4.6.4 Management data

1. The selection of individual pastures enables input of the currently grazing animals. These are to be entered in the given fields according to category. Of great importance is indication of the grazing type. There are several possibilities here. A fixed category can be allocated through the selection of a standard type as defined in Point 2. The only variable category reads „Depending on livestock“. With this category, a linear function is activated that calculates the quality reduction of forage dependent on animal stock.
2. Standard types of grazing
3. After all information has been entered, the „Estimation from animal list“ calculates the current animal stock and the energy reduction.

Close with the „Basic GI Calculation II“ button!

#### 4.6.5 Quality assessments

1. Quality levels of slope inclination (in degrees): As for all quality parameters,

the individual assessment classes and a quadratic formulation of the same can be given here. Through the input of a value, its „from“ and „to“ allocation is subsequently stored by pressing the „Save“ button. Through the selection of an ID value, the value can be reactivated and further processed. Formation of the regression must be carried out in an external statistics program. The individual weight of the slope-inclination classes can be defined above the data grid. One also ensures (if necessary) defining a class with 0 points, which is defined from the last possible value to the maximum value (0 points = 2,000 to 3,000 metres). Thus unsuitable sectors can be excluded.

2. Quality levels of water supply (given in metres): as for 1.
3. Energy concentration (given in MJ realisable energy ME): as for 1.
4. Entry sphere of the assessment classes
5. Entry sphere of the formulas

#### 4.6.7 Result maps

1. Selection of the theme areas and individual maps (drop-down list)
2. Map: Serves only for the control of the existence and forming of results (rough analysis)

Close with the „Basic GI Calculation III“ button!

#### 4.6.6 Quantitative calculations

1. Regional information: Individual alpine pastures are categorised in regions. These can be used to derive recommendations. The structure of the alpine pastures in the datasets of the pasture borders must therefore be undertaken as fully as possible. The following limit values and consumption volumes must be given for the planned assessment of potential.
2. Limit value for unsuitable qualities: these regions should not be considered. Here, for example, classic hunting practices should take place (e.g.: < 3.5).
3. Extensive use: the upper-limit value for use by sheep and goats (e.g.: 3.5-4.5).
4. Maximum value: the highest possible class value
5. Total number of animals

Close with the „Basic GI Calculation IV“ button!

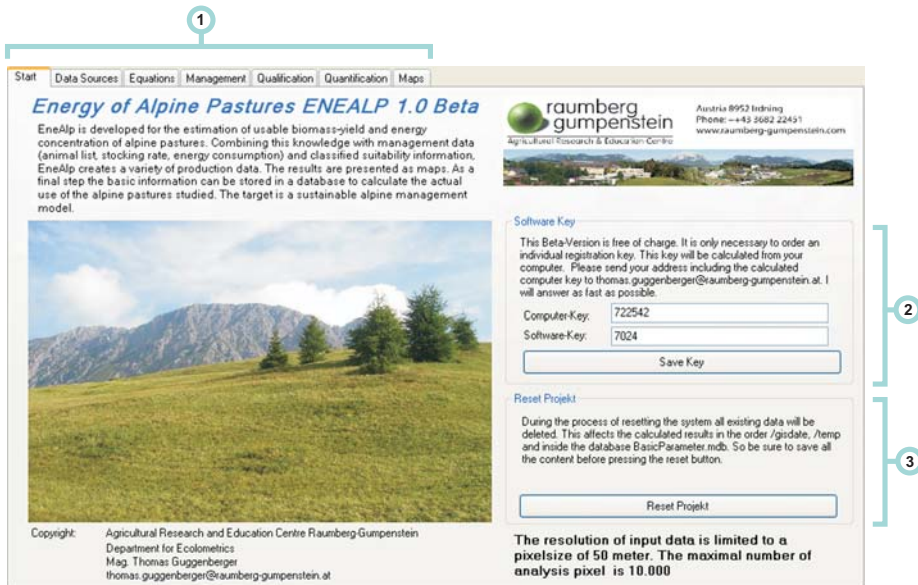


Figure 33: System release and reset



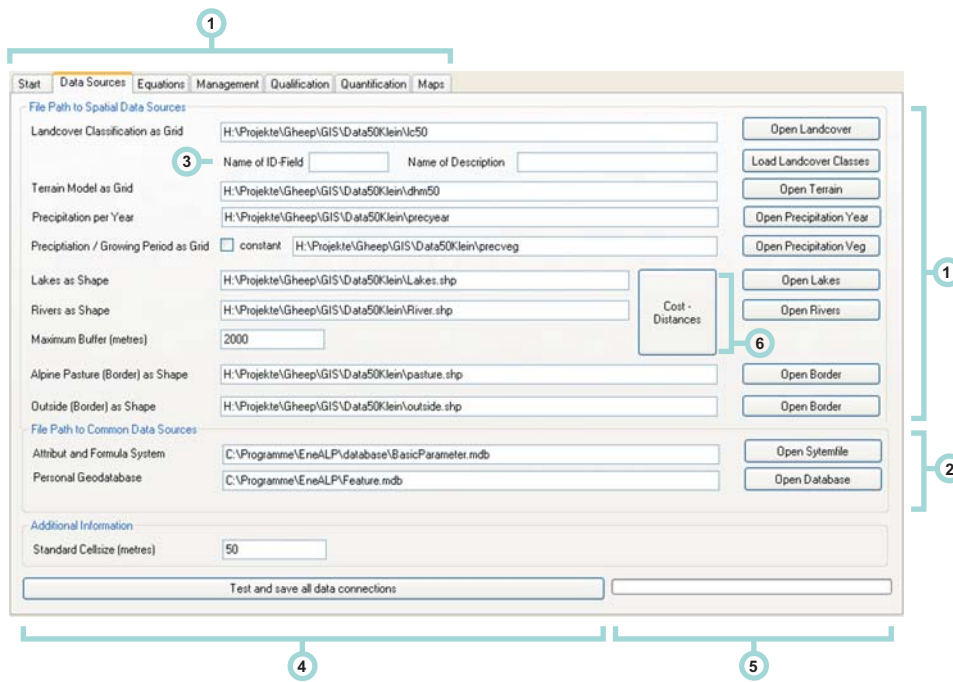


Figure 34: Setting the data paths

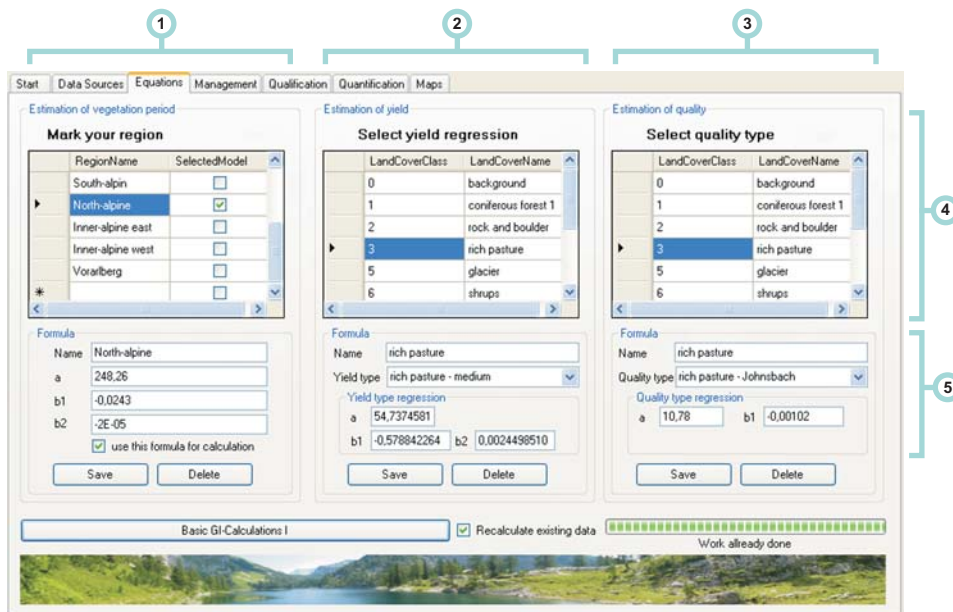


Figure 35: Comparative estimations and examination region

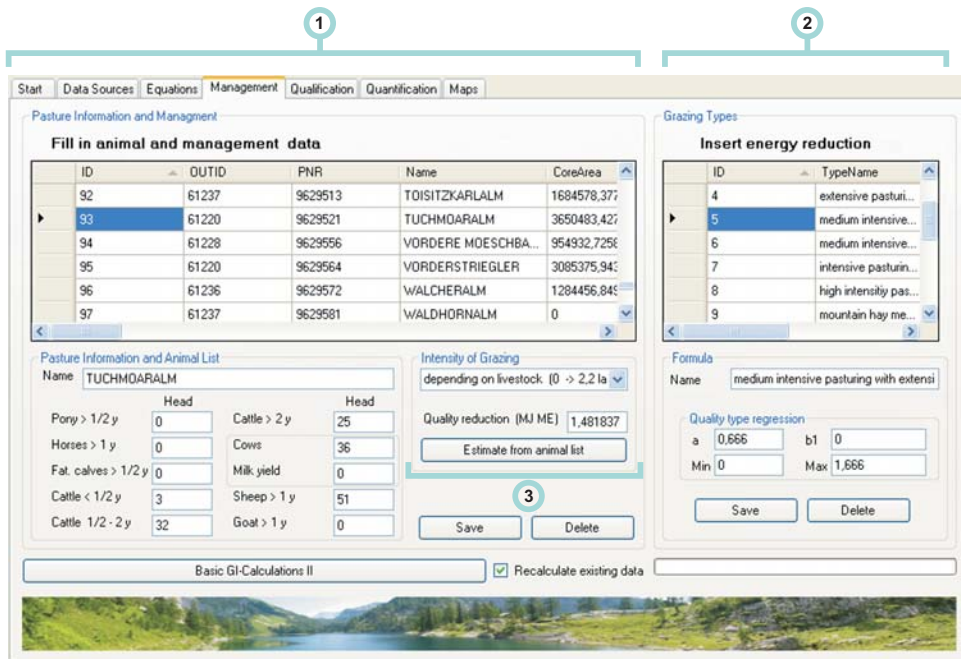


Figure 36: Management data

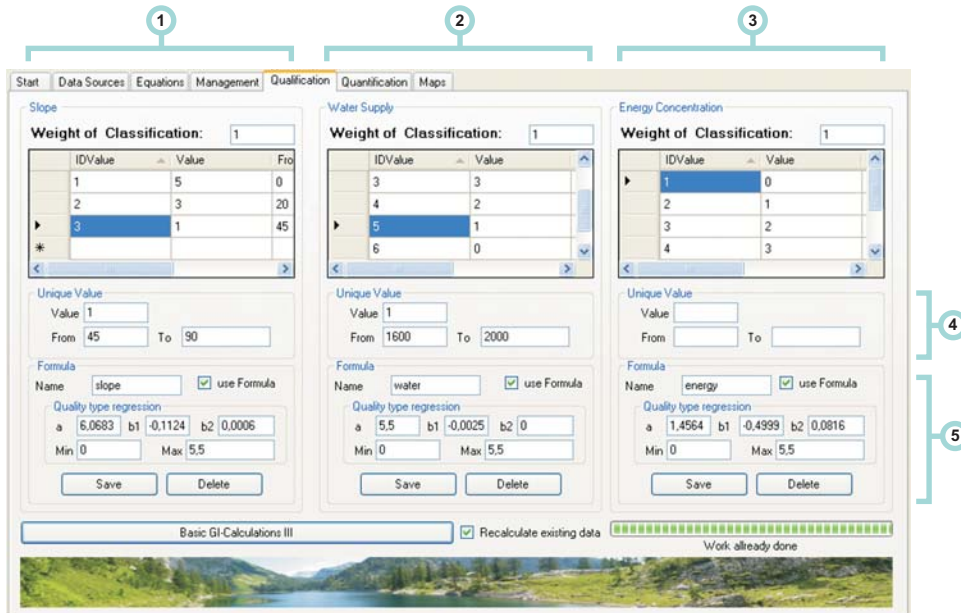


Figure 37: Quality levels

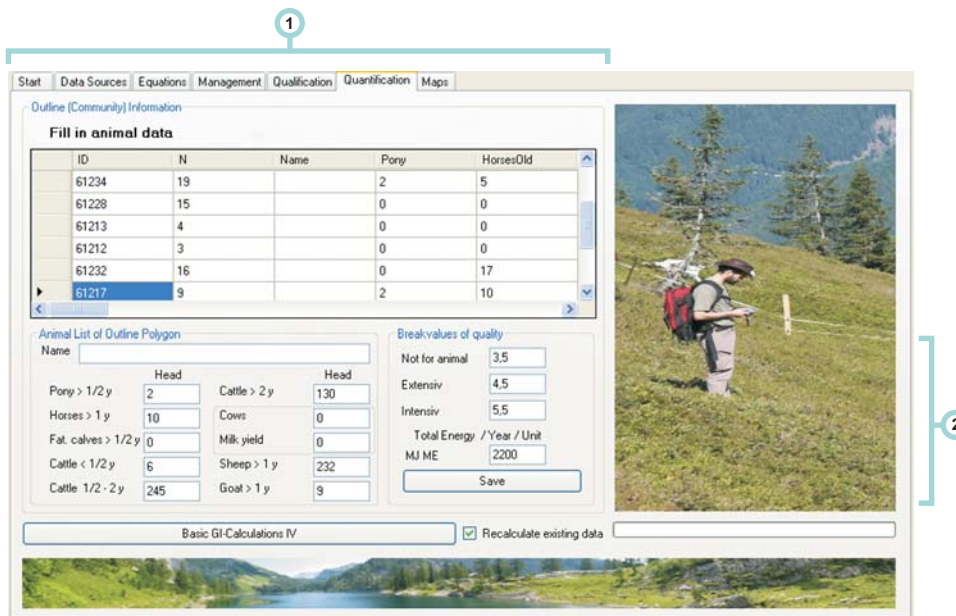


Figure 38: Quantity calculation and usage classes

## 5. Conclusions

The methods presented in this manual can be useful, starting from basic information about a mountain area and its exploitation, to rank the suitability and to measure the potential for sheep and goat grazing.

This work is based on the application of information technologies, both in the field of Geographical Information Systems (GIS) and remote sensing, which allow studying a territory in a global way. The availability and the development of these technologies which occurred in the last decade allows integrating the experimental data based on field assessments, the management experience of experts and instrumental data obtained from cartography and satellite images.

The methods used, as well as the software ENEALP contained in a specific CD ROM, are potentially applicable in the whole Alpine Space Area. As shown by the results obtained in the study areas in Friuli Venezia Giulia (I), province of Trento (I), province of Belluno (I) and Schladming Tauern (A), the model can give objective indications on the type of

animal most suitable for a certain pasture and on its optimal animal stocking rate. These indications can be an operational decision support both for territorial planning and alpine pastures management. Public administrators, who were identified as the main target of this work, are able to have better knowledge about the best way of pasture utilisation in order to contrast area abandonment as well as environment and landscape degradation. On the other hand, pasture managing bodies and breeders can also benefit from this information for a sustainable management of their animals.

Yet the computing approach, although pragmatic, is incomplete if the knowledge and the local culture of the breeders are not considered. The sharing of information among breeders, administrators and technicians operating in the alpine space regions is a prerequisite for model qualifying and implementation. Furthermore, the model can not substitute the training of breeders and the extension services proposed to the pasture management and its importance on cultural, naturalistic and socio-economical point of views.