SUSTALP

Evaluation of Instruments of the European Union regarding their Contribution to Sustainable Environment and Agriculture in the Alps

Final Report

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1 Abstract

Agriculture is the branch of economy with the greatest degree of land responsibility. Because of it and because of the important role it plays in supplying the population, it is the subject of many political ordinances and interventions. The impacts of these agro-political measures are not limited to agriculture alone, but bring about considerable side effects in the ecosystem as well. These "environmental side effects" in such highly fragile areas as mountain ecosystems are of highest significance.

It is the goal of the SUSTALP Project to analyse the environmental impacts of agro-political measures and to derive from that analysis the consequences necessary to give a strategic direction to agricultural policy.

The methodological approach of the study is based on two hypotheses:

1. There are no direct impacts on the environment from agro-political measures, only indirect ones; the causal link is represented by the farm strategies used by the farm managers, whose choices can also be influenced by agricultural policy.
2. The choice of farm strategies does not depend on agricultural policy alone, but rather substantially on the regional and operational settings. The same agricultural political measures under differing regional and operational settings bring about differing environmental effects.

For the analysis of the interactions between agricultural politics and the environment, a multilevel analytical grid was used, that consists of the following components: categorising the agro-political instruments of the EU and Switzerland into more or less homogenous groups, according to their impacts; operationalisation of regional influences by the formation of agro-regional types based on natural, socio-economical, and agro-economical variables (fuzzy clustering); recording of operational settings within each agro-regional type by a sample survey of a total of 1,000 farms throughout the entire alpine arc; operationalisation of the term "farm strategy" based on the behaviour variables of the farm managers ascertained by the survey; condensation of environmentally relevant behaviour variables to environmental parameters; and linking these parameters to an impact diagram of environmental components. Except for the last step of this pathway, which is built on expert opinion and literature references, all interrelations are statistically analysed, whereby in most cases logistical regression is used

The results of the analysis can be expressed as follows:

- In the alpine region, it is possible to identify eight well distinguishable agro-regional types based on natural, socio-economical, and agro-economical indicators. Regarding the choice of variables and the statistical process this classification stands up to testing.
- Agro-policy is effective on agricultural reference values as well as on the environment. Its impact differs according to regional and operational settings.
- Five main farm strategies (optimisation of subsidies, intensification, extensification, specialisation, modernisation) are primarily responsible for the transfer of agro-political impulses to the environmental situation.

Next to a whole row of technical results, the analysis of these strategies and the way they are influenced by the regional and operational setting allow the conclusion that an environmentally appropriate European agricultural policy must be especially enduring (long-term, clearly formulated goals and instruments) and subsidiary (wide leeway for regional differentiation of the measures). Results show, furthermore, that the highest agro-political leverage on the environment exists in the disadvantaged areas. Further references for the structuring of European agricultural policy can be deduced from these strategical principles.

2 Aims and Tasks of SUSTALP

2.1 Introduction

Ulrike Tappeiner

Agriculture plays a prominent role in the European Union in many respects. If one organises the aspects of this significance according to its historical development, the following four main points can be distinguished:

- With the efficient production of foodstuffs and other basic materials, agriculture provides for the needs of the population. Until the beginning of the sixties all classes of society would undoubtedly have regarded this as the most important function of agriculture. The traumatic experiences during and after the two world wars have left their mark on generations.

  The internationalisation of agricultural markets and the almost arbitrary availability of foodstuffs and other agricultural basic materials has lead to the fact that this function is hardly the subject of agro-political debates any more. But this neglect is not justified under any circumstances. A functioning agriculture is preconditional for a certain degree of provisional security. Moreover, every realistic agricultural policy must take this aspect into account because the self-image of the farmers is shaped to a great extent by this context.
- With its perforce decentralised production, agriculture contributes to the diversity and stability of the rural area. This function was not worth considering, as long as generally more than 50% of the empoyable population worked in agriculture, and this percentage went up to 100% in the rural periphery. Under these conditions the problem was where to find employment for the rapidly growing population due to the excess of births over deaths. The various European emigration waves are characteristic of this period.

  This attitude changed when emigration was no longer "driven" by population surplus but by the better living conditions and the enormous "manpower hunger" of the fast expanding secondary sector. When migration exceeded the natural excess of births, a rise in the ratio of old in relation to young, a degradation of the social system, and a sometimes real state of neglect set in. Attempts to stop this development with monocultural settlements (e.g. artificial ski centres) failed without exception. To this day the social structure of the Alps is characterised by this development stage.

  Today it is clear that a balanced regional structure is a desideratum which can only be realised with the participation of a functioning agriculture. This attitude has been formulated by the European decision-making committees and has found expression in the various structural fund programs.

- Since the mid-seventies the population has developed a constantly increasing environmental awareness. In this connection it is clear that agriculture and forestry operations carry by far the greatest responsibility over the European landscape.

  This so-called "land responsibility" was first formulated by the environmental agencies, later by the political decision-makers and only recently by the farmers themselves. Today this topos belongs to the common property of the European population. The resulting problem is that the consequences of a perceived land responsibility – in contrast to other optimistic statements – usually conflict with the particular economic aims of the farming operations: Environmentally compatible behaviour in agriculture is connected to positive opportunity costs. This conflict will persist as long as no integrated and area covering system exists for the compensation of external effects caused by environmentally compatible agriculture.
- The reason why no such compensation system has been introduced is that, beside considerable technical problems, it would involve substantial financial transfers. Such transfers already exist on a large scale, which represents the fourth aspect of the special significance of agriculture: The payments in connection with agriculture and its production - and they are considerably higher than the payments to the farmers - make up the largest part of the budget of the European Union.

  The forthcoming expansion of the European Union (towards Eastern Europe) magnifies the fact that the unrevised expansion of agricultural aid to this new Union can hardly be financed at present.

The four aspects described here are the reason that the problems in creating an efficient, future oriented agricultural policy are so extraordinarily heterogeneous. Last but certainly not least, a serious consideration of interests will need to go into the creation of such a policy.

2.1.1 Aim of the research project

The present project deals with one aspect of this complex problem and the central question is:

How do the various instruments of the Common Agricultural Policy (CAP) influence the environmental situation in general, and more specifically, how do they influence some of the most important environmental indicators?

This approach, which was inspired by the relevant announcement of the EU, is innovative at least in two respects:

- The subject of the study is obviously an evaluation of a very important area of EU policy. It is not another classical evaluation of program aims or potential instrument suitability, as for example those used in past evaluations of structural funding programs. It is also not a classical implementation and execution monitoring mechanism. The aim of this project is, much more, to carry out a study of effects, even if the approach is of a prototypical and therefore provisional character.

- In an impact analysis, the usual approach is to compare an instrument's goals with its effects. This is not the case in this project. The subject of this study is the effect of agricultural policy on the environment. On the one hand this is an expression of the manifold task of agriculture – often described as the multifunctionality of agriculture – and on the other, it suggests that a competitive relationship between the primary and secondary aims of agricultural policy is probably inevitable.

From this basic constellation several central questions arise which shape the structure of the whole research project:

1. Is agricultural policy effective at all? This question may seem provocative, but there are recognised economic theoreticians who claim that neither medium nor long-term public interventions show any effects at all. Behind this statement stands the axiom that in the long run, the market forces will always impose themselves and that an active policy will have no other effect than to fulfil the politically motivated demand for actionism. Recently an opposite standpoint has evolved which regards long-term effects as a result of minor historical events. If this point of view is right, an effective agricultural and regional policy would definitely be possible.
2. Are the effects of the agricultural policy homogeneous and calculable? In this context 'homogeneity' refers to the question, if the effects of an instrument can be determined independently of the conditions under which it is employed; or whether for example the regional environment, farm parameters or the cultural background of the farm owner have a great influence on the effects, even to the point of a reversal of the correlation. The answer to this question is of decisive importance in the creation of a European agricultural policy; one that should be relevant to all aspects of an area that could hardly be more diverse. Spatio-invariant effects can be used transnationally in planning agricultural policy, and effects which are strongly context-dependent can only be efficiently used in the course of the subsidiarity principle.
3. Do the effects of the agricultural policy on the farmers' behaviour cause a change in the environmental situation? The main question of this project can only be answered if this second step can be empirically proven.
4. Provided that the previous questions can be answered in the affirmative, the next question to investigate is if the direction of the effects of important groups of agro-political instruments on certain significant environmental parameters can be determined. This expectation is not too high. It is limited to selected groups of instruments, to selected environmental parameters, and to the qualitative determination of the direction that the observed effects are moving in; and thus, refrains from a quantification of the effects. The project will show that it will not be simple to meet even these demands, but meeting them will definitely produce results that will well serve in the creation of an agricultural policy.

2.1.2 Selection of the Alps as a reference area

All the studies carried out within the framework of this project refer to the alpine region. Because, in many ways, the Alps are particularly characteristic for the general problem, this geographical restriction does not result in an analogous restriction on the exploitability of the insights gained in this project. These characteristics are based on the following points:

- The alpine region, with its fragile ecosystem, is one of the European regions with an especially high degree of land responsibility. Parallel to this, conditions are so difficult in many parts of this area, that production cannot have first priority. Examples for other such areas that are functionally in the same situation as the Alps are large parts of Scandinavia or the arid zones in Italy and Spain.
- Due to their topographical, morphological, and climatic diversity, the Alps offer an extremely broad spectrum of production conditions for agriculture. This spectrum ranges from the foothills of the Alps and the valley floors with very favourable production conditions to low mountain range areas and the extreme situations above 1,500 m. If agro-political instruments react to operational settings, then these different effects should be identifiable within this diversity.
- Culture and language regions are similarly diverse as the natural environment. With seven states and four main languages this diversity can hardly be surpassed. It serves as a good basis for the analysis of the role that historical developments and divergent value systems play with regard to the relationship between agricultural policy and the environment.
- Finally, the conversion of regulations into national law is not exactly homogeneous. With several EU-member-states and three non-member states (Switzerland, Liechtenstein, Slovenia), differences in aid philosophy and in aid instruments are obvious. The extensive comparison with the situation in Switzerland plays a special role. In its new orientation in agricultural aid Switzerland has already anticipated some of the central ideas of the Agenda 2000.

Apart from the qualitative diversity, this study region offers the possibility to combine and to test methods of analysis which can be further applied to the whole European region, without having to change all too much. The diversity with which these analytical methods will be confronted is hardly greater than that found in this alpine study region. From this point of view the Alps represent an ideal "laboratory" for the observation of "natural experiments". This project has taken advantage of these possibilities only to a small extent.

2.1.3 Structure of the project

The objective of the present research project is approached from three different aggregation levels: the alpine region level, the agricultural region type level, and the farm level. The following sections are structured accordingly.

In a first step a homogeneous data vector is recorded for all 5,558 communities. One can assume that it will contain essential structural characteristics which are useful for the aim of the research project (see Section 3.1.1). As usual in empirical studies, the desirable must adapt to the possible; some parameters have to be used as a proxy for a variable which cannot be obtained in either the desired nor in a comparable form. The resulting database provides a good insight into the structure of the alpine region with regard to the individual community and with regard to the individual variable.

The aim of the project is not to provide a descriptive, univariate description of the alpine region; for the aim of this project it is much more important to take into account the interaction of the variables (multivariate approach) and on this basis to search for similarities and differences between groups of communities. This is achieved in a **second step** by means of a modified procedure of cluster analysis (fuzzy clustering), the results of which are tested with regard to quality. The result is a classification of the alpine region into agricultural region types (see Sections 3.1.2-3.1.4).

This gives us the observation unit for the second aggregation level. In a **third step**, the region types are interpreted with regard to content (Section 4.1), and extended by the selection of ten representatives of the agricultural regions.

The **fourth step** examines these ten regions (Section 4.2). First they are described in order to form a connection between the abstract region types and the actually existing regions. Reference to real regions allows a more concrete portrayal. This should create a basis that allows the reader to critically appreciate the subsequently derived statistical results against a concrete regional background.

The **fifth step** is carried out in Sections 4.3, 4.4 and 4.5. The conceptual framework for the integrated analysis is formulated by systematising the agricultural instruments and the environmental aims (derived from secondary material) of the EU. As a digression, the differences and similarities between the EU and Switzerland are analysed in Section 4.5 with regard to content. This represents an attempt to create the possibility to view and relativise EU-specifics against a non-EU background .

In the **sixth step** it is determined by interviewing experts, which European agro-political instruments are of special regional consequence and which changes in behaviour they cause within the region (Section 4.6). This represents a primary basis for hypotheses on the cause and effect relationship between agricultural policy and the environment, and the regional homogeneity of these relationships.

A simple form of landscape evaluation is to show which environmental effects can be determined in this respect in the regions and to document today's starting position for the agricultural sector in these regions.

The **seventh step** involves again a change of aggregation level: from the agricultural region to the level of the individual farm operation. In this way, the data is collected that is necessary in formulating statements on the use of diverse aid sources, their influence on the chosen farm strategy, and finally on the consequences for several environmental parameters (Section 4.7). Throughout the ten test regions 1,000 farm owners were surveyed by means of a questionnaire especially geared to this topic. The results represent the raw data for the further analysis.

Finally, Sections 4.8, 4.9, and 5 present the eighth and **last step**. Section 4.8 presents a frame of reference that enables, at least rudimentarily, the integration of the three aggregation levels into one approach. At the same time individual correlations are presented which have proven to be significant. Section 4.9 is dedicated to the five farm strategies, for which statistically significant correlations were found between the agro-political instruments and the farm strategy, and between the latter and the analysed environmental parameters.

As a final point, for the hurried reader, Section 5 is an attempt at a compact summary of the most important results and conclusions.

2.2 An integrated approach to analysing the effects of agro-political instruments on the environment

Gottfried Tappeiner, Peter Eggensberger, Alex Agethle and Ulrike Tappeiner

The object of this study is to identify and, as far as possible, to quantify the environmental effects of agro-political instruments. Agro-politics do not necessarily place environmental interests as their top priority – this is the task of the environmental policy, but rather follow more global goals in the interests of agriculture. Influence on the environment is a side effect of agro-politics – albeit one of great significance. Accordingly, one cannot base the analysis of this interaction on an assumed direct influence, one must rather seek a transmission mechanism which serves to transfer the impulses of the agricultural instruments on to the environmental processes.

A second challenge is the fact that the assessment of the environmental effects of agro-political measures cannot take place in empty space, but must be based on a priority scale. This scale of priorities can only be formulated by the political decision-makers. To piece this priority scale together, a comprehensive goal analysis of political documents was carried out.

A special opportunity is presented with the fact that within the alpine region, Switzerland's agro-politics differ significantly from that of the European Union. In comparing differing political approaches, what at first glance seemed to be a "problem", is in fact the means by which the effects of each approach can be made visible, as with a contrast agent.

In the following the political scientific approach of goal analysis followed by the empirical, effect interaction approach will be introduced.

2.2.1 Goal analysis

The purpose of goal monitoring is to determine if political declarations regarding alpine agriculture and the environment have found their way, either literally or contextually, into the instruments considered in this study. This occurs by means of intersecting the declared goals of relevant political documents on one hand, and the aims of instruments on the other. The process is described in Section 4.4 and 4.5. The usefulness of goal analysis has three aspects:

- By means of a coherence analysis, deficits on the side of the political documents or instruments can be ascertained. The extent of the operationalisation of political goals through instruments, for example, can thus be examined. From this, conclusions about necessary adjustments or the reformulation of instruments can be derived.
- This analysis says nothing, though, about the actual effects of the instruments. It receives its significance in association with the efficiency analysis presented in the following. Both together form the basis for the concluding policy recommendations.
- Finally, the analysis of political goal declarations forms the basis for an assessment grid of environmentally relevant actions (see Figure 2.1).

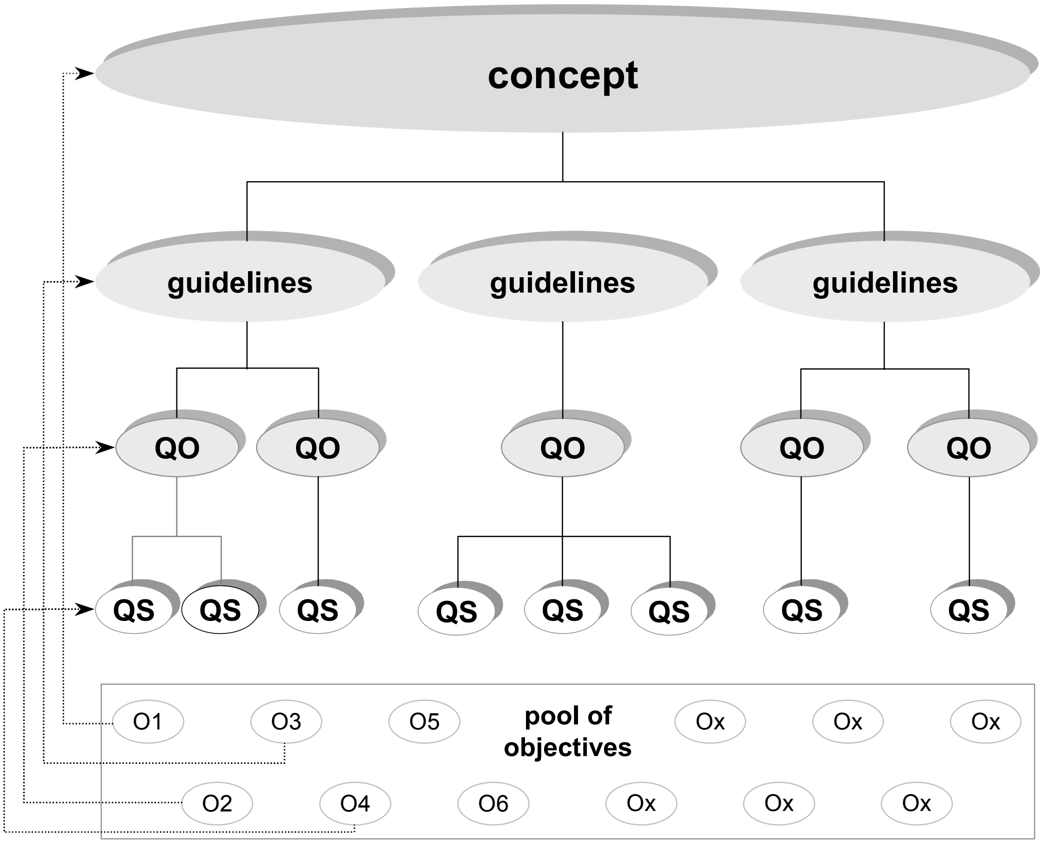

Figure 2.1: Structure of the goal analysis: Methodology of generating the system of objectives (QO = objectives of environmental/economical/social quality, QS = standards of environmental/economical/social quality, O = objectives)

2.2.2 Efficiency analysis

To serve as a theoretical basis in the implementation of an efficiency analysis of the effects of agro-politics on the environmental situation, a "transmission mechanism" is necessary that is logically and empirically capable of modelling not only the direct effects, but also indirect interactions between the two fields.

The core of this transmission mechanism consists of the actions of farm managers, which can be summarised as farm strategies. In an extremely linearised portrayal, agro-political instruments have consequences on the choice of farm strategies in the single farming operations, and these again have consequences on important environmental parameters. Therefore, a rough systematic organisation of the instruments into three main groups, which is practical for the EU as well as for Switzerland, is consequently the first step in the research plan:

- Measures which improve the income situation of farms, but have no further consequences. In this case we are referring to transfers that can be accredited to agriculturally specific socio-politics, from which, though, neither positive nor negative effects on the environment emanate.
- Measures that intend but, for different reasons (e.g. because a critical threshold value cannot be exceeded), do not succeed in a behavioural change in farming operations. In these cases we are referring to simple borrowed effects that do not differ from the first group in their impact on the environment. The not insignificant difference lies in the fact that in the first case, the limitation to the income situation is politically intended, and in the second it is not desired.
- Measures that intend and succeed in a behavioural change in farming operations. It cannot be asserted that the obtained behavioural changes are identical with those intended, and for this study it is irrelevant. All measures of this category, however, have the potential to effect the environment and are to be scrutinised under this aspect.

This third group is the focus of the present research project. It would be an inadmissible simplification, if we worked from the supposition that a certain instrument or group of instruments could affect all farm strategies under all circumstances in the same way. Differing framework conditions will decisively influence the effects that an instrument has on a choice of strategy. In the project concept we are presenting here, three groups of parameters are discerned, from which a decisive influence on the causal association between agro-political instruments and the choice of farm strategy is expected.

Regional parameters

The environmental features, as well as the socio-economical circumstances, the politico-administrative, institutional, and cultural frameworks all count as regional specific structures.

Two examples should illustrate the impact of such parameters. If, for example, a reforestation premium brings results, is dependent on which crops can be cultivated alternatively on the land in question, and this, in turn, is to a high degree dependent on the environmental features of the land. In the same way the results will differ according to the availability of non-agricultural income sources in the region. Generally, the choice of a farm strategy is determined by its opportunity costs, and these are to a high degree specific to the region.

Farm parameters

The farm operation size, the possibilities for mechanical cultivation of the fields, the condition of the farm buildings, as well as the labourer available at the farm and their level of education all count as farm parameters.

These characteristics limit the scope of freedom in farm management decision making, restricting the potential benefits of agro-political measures.

Value system of the decision makers

Finally, the choice of strategies depends on the value system of the decision makers on the farm and on group dynamical decision processes. Although being largely important for the long-term operation of alpine farming, these factors can not be monitored, and thus must be disregarded for this study approach. One can only hope that certain views of values are based on cultural differences and by means of the regional parameters are portrayed as proxy variables.

In the following, the environmental impacts of the single farm strategies will be illuminated. The transmission mechanism described below, illustrates the research concept we used in this study (see Figure 2.2).

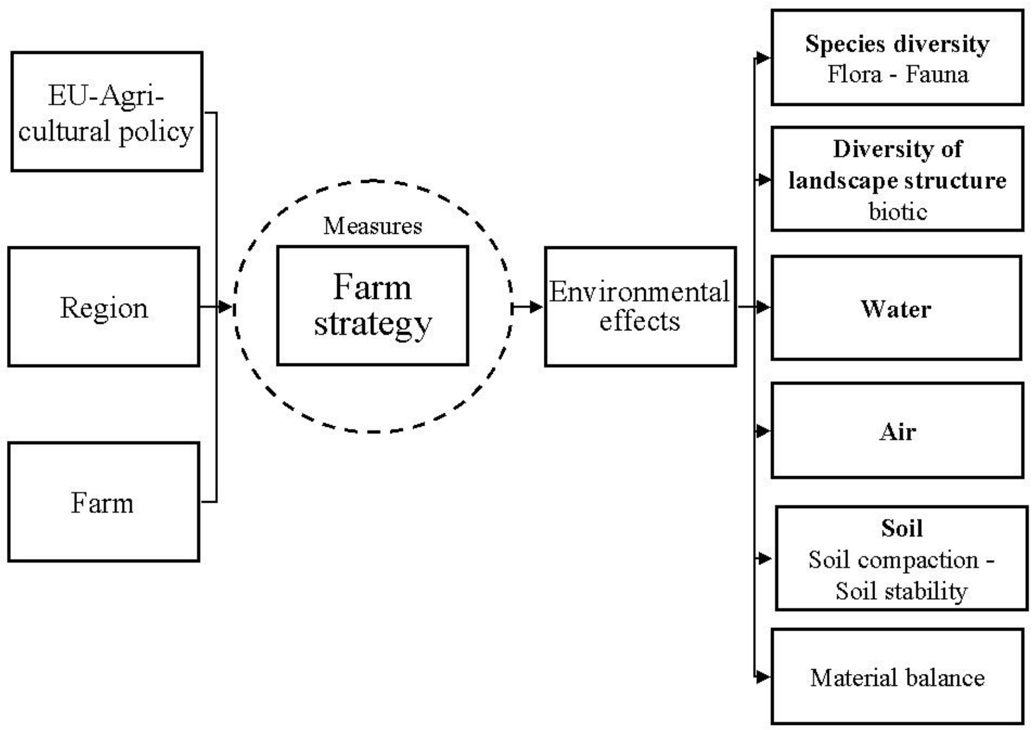

Figure 2.2: Structure of the impact analysis

In the following sections an overview is presented of the impact monitoring method used to test this ground hypothesis. A more detailed presentation follows, broken down into specific sections.

2.2.2.1 The formation of agricultural region types

The influence of regionally specific parameters on the farm strategies is methodically the most difficult to investigate. The difficulties emanate from three factors:

- There are relatively few reliable findings on which regional variables have the greatest influence on the action of an instrument. This makes the selection of the basis variables difficult; and even more so because the relevant variables should be available at least at the community level, and should be comparable in definition and substance among all alpine countries. To limit the risk that significant impacts get passed over, one must reckon with a relatively extensive database. Processing such a comprehensive database in a statistical model, means that at least as many parameters must be estimated. This is inevitably linked with a loss of degrees of freedom, and consequently compromises the reliability of the calculated results.
- Even if one finds a widely accepted variable selection, great uncertainties remain in regards to the functional realisation of its effect on the farm strategies. The method of investigating only the linear impacts, just because the instruments are available, cannot be satisfactory, because it inadmissibly simplifies reality.
- Finally, it is necessary to empirically scrutinise the influence of the regional specifics on the choice of strategy. The necessary survey expenditure limits the number of possible model regions; so that, combined with the above mentioned degrees of freedom problem, a direct determination of the impact is technically impossible.

For these reasons, an indirect process was necessary: The regional specifics should be fixed as control variables. Therefore, it was necessary to develop an appropriate method of categorising the communities into homogenous agricultural region types.

By means of a so-called cluster analysis based on an extensive database (see Section 3.1) of the 5,558 alpine communities, eight region types were established. That is, every alpine community was assigned to one of these eight types by means of a mathematical procedure, without considering geographical characteristics (distances, geographical situation). The danger of such a method is that artefacts could be generated that contain no common denominator. The validation approaches described in Section 4.1 along with the exact technical implementation show that the required approach meets the usual quality demands.

And still, a certain measure of subjectivity cannot be avoided in determining the number of such region types and the boundaries between them. The results of this classification, however, offer a useful basis that enables a regionally specific investigation of the results of agro-politics, using for the first time an approach that covers the entire alpine region.

Subsequently, one or two model regions were chosen, for practical reasons, from each region type for the empirical examination of the effects of agricultural instruments. They consisted of several communities that form a more or less continuous area, and are, as far as possible, characteristic for the respective region type. The model regions are presented in Section 4.2.

2.2.2.2 The classification of the agro-political instruments

The basis of the agro-politics of the EU and Switzerland are their political declarations and the directives and regulations derived from them. These directives and regulations do not usually apply to single instruments, but more to whole bundles of instruments. Moreover they are organised according to rather administrative criteria than according to their effect interactions. This means that many of these legal texts give rise to expectations of wide-reaching effects that can induce strongly differing environmental changes. In addition, there are considerable shades of interpretation in the realisation of the EU-ordinances in national jurisdiction as well as in the differing political implementation processes in EU and Swiss alpine agriculture.

Therefore, the research group decided on a categorisation of the agro-political instruments based on the essential regulations (also in consideration of their funding), but narrowly coupled to their probable environmental impacts. The exact process of this classification is presented in Section 4.3.

2.2.2.3 Identification of relevant farm strategies for alpine farming

A comprehensive evaluation of relevant literature was undertaken to identify the farm strategies. The results were verified and completed by means of partially structured discussions with agricultural and environmental experts who had local knowledge pertaining the model regions. The result was the set of farm strategies shown in Table 2.1, of which it is assumed that they fully describe the whole range of possible actions of a farming operation.

Table 2.1: Operational strategies of agricultural operations in the Alps

Strategy	Description
❑ no change	none of the other farm strategies were mentioned
❑ change from full-time to part-time farming	the farm strives for additional income beside that from agriculture
❑ change from part-time to full-time farming	the farm is striving for an income exclusively from agriculture
❑ combined income	the farm increases its income sources (vacation

	guests, work contracting with the community)
❑ increased co-operation with other farms	For labour economical or financial reasons the farmer seeks interoperational collaboration
❑ modernisation of the farm	the farm is increasingly mechanised and the farmer invests in its own farm buildings
❑ specialisation of the farm	the farm concentrates on one form of production (e.g. dairy farming; beef, pork, poultry production; breeding; etc.)
❑ involvement in new operational branches	the farm tests a new branch of farming
❑ abandonment of fields, letting fields lie fallow	the farm intentionally takes fields either permanently or temporarily out of the production process
❑ purchasing or leasing additional fields	the farm increases its production fields by purchasing or leasing more land
❑ leasing out fields	the farm decreases its production area
❑ termination of leases – resumed production	the farm resumes production on land recovered from tenant
❑ direct processing and marketing	the farm processes its own products and sells them directly to the consumer
❑ further intensification of the available fields	the cultivation intensity per area unit is increased (e.g. by irrigation, fertilising, more frequent hay cutting)

Table 2.1: continued

❑ extensification of the available fields	decrease in cultivation intensity per area unit (e.g. no fertilising, no chemical weed control, alternated hay cutting, decrease in LU/ha)
❑ switch to biological production	operation of the entire farm according to the criteria of ecological agriculture (Regulation 2092/91)
❑ intensification of stock feeding	to increase production, animal feed is supplemented with protein
❑ extensification of stock feeding	protein supplementation is decreased and self-produced feed is used
❑ feed sales	the farm sells feed that it produced itself
❑ increase in hay cutting on steep slopes	on slopes of at least 30% hay making is taken up or cutting frequency increased
❑ abandonment of farm	the farm is abandoned and has no legal successor

The endeavour to determine the strategies so that they describe as many different choices of action as possible, leads to the fact that they are not free of overlaps. This means that a farm can follow more than one strategy. Actually, surveys showed that each farm can be identified with an average of four strategies.

Strategies are relatively complex and abstract concepts, and it is difficult to ascertain that all surveyed participants interpret them the same way as regards content. To obtain an intersubjectively verifiable understanding of a strategy, it was operationalised based on factual questions (e.g. Was the number of cattle increased? How much of the produce is directly marketed?). This allows an additional way of scrutinising the effects of the agricultural instruments on the farm strategies.

The classification of the agricultural instruments and the definition of farm strategies form the conceptual framework for the analysis of the first part of the transmission mechanism: the effects of agro-political instruments on the farm strategy.

With "m" instrument groups and "n" farm strategies, there are theoretically n x m effect possibilities, each of which needs to be tested for its empirical relevance. This test takes place in two ways that are based on each other:

- In the course of discussions with the experts, their opinions were recorded on which agro-political instruments were of particular meaning for the respective region and what effects they had on the choice of the farm strategy.

  Because several experts for each region were surveyed, the degree to which their assessments agreed with each other is an expression of their reliability. By comparing results between the regions, hypotheses can be developed on which instruments work regionally invariant and which react sensitively to the regional context (see Section 4.6.1).

  As important as the expert opinions are, they can differ greatly from the stand point of the concerned farmers. A survey of 100 farming operations in each of the 10 model regions (see Section 4.7) offers an important possibility to re-examine the insights won from discussions with the experts.

  For this purpose it was determined which strategies each farm manager follows, and which agro-political instruments they are aware of using. The combination of both sets of answers led to a matrix, that was directly comparable to that of the survey of the experts (see Section 4.8).

2.2.2.4 The farm specific influence

From literature and within the research group, hypotheses were formulated on which farm parameters will have a decisive influence on the choice of farm strategy. On the whole, the parameters, shown in Table 2.2, were chosen as relevant.

Table 2.2: Farm parameters that have a decisive influence on the choice of the farm strategy.

Parameter at the farm level	Definition
reduced usable agricultural area	area of agricultural production fields
level of difficulty because of inclination	percentage of steep slopes within the reduced usable agricultural area
altitude	average altitude of the reduced usable agricultural area
permanent grassland	percentage of extensive permanent grassland within the total permanent grassland (without alpine pastures)

	percentage of middle intensive permanent grassland within the total permanent grassland (without alpine pastures)
permanent crops	percentage of biologically treated permanent crops within the total permanent crops percentage of the permanent crops treated with integrated production – management
arable land	percentage of biologically treated arable land within the total arable land
access	percentage of fields where access with heavy machinery is possible
available manpower potential	number of persons; including manager, spouse, and children over 16 years who are working on or off the farm or attending school
effective worktime at farm	total time spent working on farm (manager, spouse, and children over 16 years, employed workers
age	average age of the manager and spouse
farm succession	farmer's personal assessment concerning succession of the farm
training intensity	number of facilities consulted
farm buildings	state of farm buildings
income composition	percentage of income from activities outside the farm (including pension) of total time spent working
pension	receipt of pension funds
memberships	membership in a co-operative
assessment of the actual income situation	the farmers' personal assessment concerning their income situation (scale 1 – 10)
proportion leased/owned	percentage of owned reduced usable agricultural area within the total reduced usable agricultural area

A global selection of parameters, however, is insufficient for the question formulated in this study. Because a farm can follow more than one strategy, it had to be defined for every strategy, which parameters will influence this choice and at least what sign this influence will show.

This a priori determination of the influence structure is important in order to avoid giving meaning to results while "data-mining", that show only coincidental significance. Nevertheless, if effects are observed that significantly influence recommendations to the European Union regarding the development of the instruments, then deviation from these general lines is possible in certain cases. In this context, it is interesting that even highly recognised experts could not reach full agreement on the sign of an interrelation. In-depth discussions usually showed that differences can exist between the effects of instruments and those of farm strategies. As a result, the sign of an interrelation cannot be determined based exclusively on theory. Which of the several causalities is finally stronger, and therefore determines the evidence, depends, among other things, on the views of values of the decision makers (which are not directly discernible) or on the regional context. It would therefore not be surprising if a test of the hypotheses would result in differing signs for the different model regions. Provided that the "essential" characteristics were identified while defining the agricultural region types for the cluster analysis, it would be strange, though, if such "wanderings" of signs between model regions of the same type should occur.

The part of the transmission mechanism, up to the choice of farm strategy, should be operationalised and examined by the approaches described so far. Even though some strategies allow quite direct suppositions about their environmental effects, this is inadequate for our study. The two following points should more closely differentiate between the farm strategies and the environmental goals.

2.2.2.5 The relationship between the chosen operational strategies and the environmentally relevant actions

The pursuit of a farm strategy, or a combination of several, strongly influences the management of the farm, demanding short and middle-term actions that have a direct impact on environmental parameters.

It would be very interesting to directly observe and measure the effects of the farm strategy on the quality of central sustainability indicators during an extensive long-term observation of a great number of agricultural operations. Alone, the time horizon of such processes, but also the geographical frame have proven this approach impractical for this research project. Therefore, except for a limited approach to the identification of landscape structures (see Section 4.6.2), which only shows up the results of a long-lasting process, we were forced to fall back on an indirect approach. In the survey conducted on the agricultural operations, factual questions were asked on static and dynamic parameters of which one could expect that they represent proxivariables for changes in the environmental conditions on one side, and on the other, that they concern matters so familiar to the farmers, that they are capable of delivering reliable information.

The information collected for this purpose is very diversified; it starts with the development of cattle density, and goes on to fertilisation practices, the use of pesticides and fungicides, the structure element changes in the landscape (rock clearing, brush clearing), and changes in the operation’s machinery.

Similarly to the procedure with the previous effect interactions, hypotheses were formed in this area as well, about which strategy influenced which of these actions in which direction. The test can be based on the survey of the farming operations.

Here we must mention of the fact that, for practicality’s sake, the important parameters (e.g. melioration or culture type changes) are limited to the last five years. This is necessary because a longer time frame is not adequately present for the farm managers and with every increase in the survey time frame, the number of farms that have undergone a management change within that time increases. In these cases, the continuity of the information flow is given in only a limited measure.

The study results , though, suggest that, as shown in Section 4.7.4, the basic changes in landscape structure sometimes occur over extremely long periods of time, and that in some of the model regions they just do not show up because the process has already been completed.

2.2.2.6 Effect of the environmentally relevant actions on important environmental parameters

In order to consistently assess the significance of the surveyed environmentally relevant actions, a standardised grid is necessary, that implicitly refers to the priorities of environmental policy. The assessment grid was deduced from the goal declarations of political documents (see Section 4.4). But sufficiently concrete goal declarations could not be deduced, neither in regards to the source areas of environmental impacts (e.g. restriction on mineral fertiliser) nor to the corresponding effect areas (e.g. nutrient load on soils). To this end, an evaluation of reference literature had to be carried out in addition.

2.2.3 Assessment of the approach

The described approach makes it possible to apply very heterogenic information to the treatment of the question, in what way agro-politics influences the environment. To identify the instruments, it makes use of the priorities of environmental policy and, especially for the distinction of the agricultural regions, of secondary statistical sources. Conclusions from literature and expertise are consulted for the formulation of hypotheses and the effects of the operational activities on the environment. Finally, primary statistical material is consulted in modelling the operational decision processes and the actions resulting from the different farm strategies.

It is unavoidable in such a heterogeneous approach that "frictional losses" occur, especially at the interfaces between the areas. In addition, within the framework of the research process decisions are necessary that could equally well have been decided in a different variation. An example of such a decision is the determination of precisely eight agricultural region types. No-one can say for sure that seven or nine would not have been just as suitable. In order to counteract this necessary arbitrariness to a certain degree, above all, these kind of decisions are meticulously documented and justified, so that they stand open for critical scientific discussion.

A part of these decisions also had to be met the way they were, because literature on the interactions studied by our research group is rather meagre. This can be credited to the fact that our research thesis is located right at the interface between several disciplines, making single scientific approaches only conditionally applicable. The interdisciplinary approach attempted here can thus serve as the bases of further research.

3 Methods

3.1 The development of homogenous region types

Andreas Hilbert and Klaus Steininger

In the previous sections the object and the procedure of our project was described in detail. Consequently, it is clear that now the used data has to be presented. Furthermore, the used methodology for clustering the data to confirm homogenous groups of comparable communities has to be discussed. This is the aim of the current section.

To comprehend the procedure of the development of homogenous region types the Figure 3.1 is very useful. The scheme describes the process of classification in general. This process can be divided into four steps.

- First, the selection of the objects that have to be analysed and the selection of the variables which have to be used must be done.
- Second, the so-called pre-processing should be performed. This pre-processing is engaged with several problems which occur when real data have to be analysed. These are the detection of outliers, the treatment of so-called missing values and the transformation and weighting of variables to consider their different importance within the framework of cluster analysis.
- Third, the classification or cluster analysis itself must be calculated. About this, different algorithms are available which should be presented later on.
- Fourth, with regard to the well chosen and hopefully correct number of so built clusters the resulting region types have to be analysed about their validity and stability. If these analyses respectively the resulting regions are not about right the whole process has to be done once again.

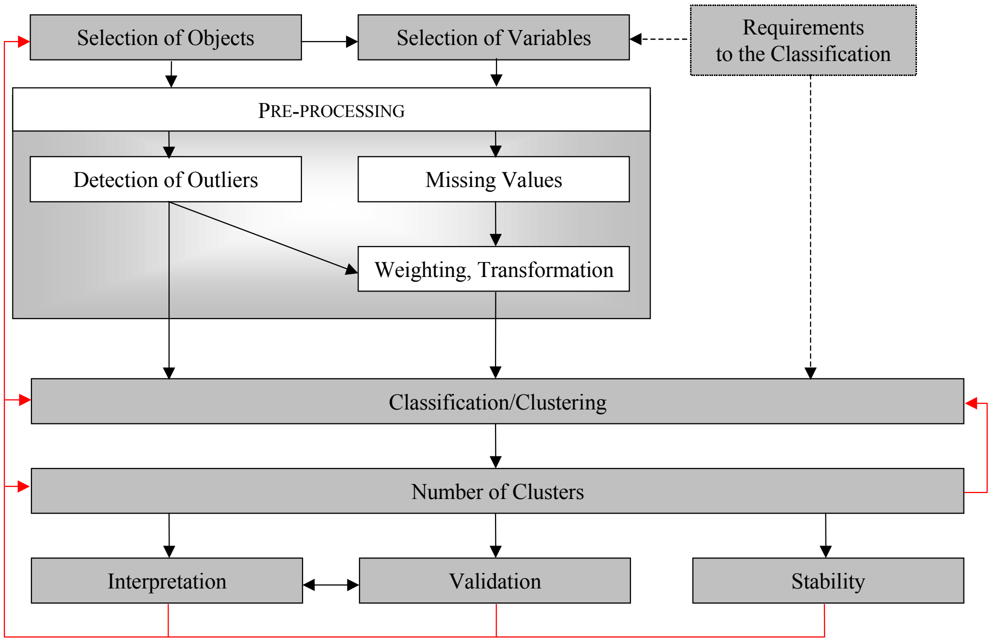

Figure 3.1: The process of classification (according to Bacher 1994)

3.1.1 The selection of an appropriate data set

3.1.1.1 The selection of objects

The task was to determine the level of investigation at which the description of the agricultural structure and other factors (natural conditions, socio-economy) seemed to be possible. In addition to that the availability of the data had to be considered. Based on the available statistics the community was chosen as level of reference for this task. With theses objects a good description of local differences within the Alps is possible on the one hand, on the other hand the subjects of interests can be analysed in a representative way.

The geographic definition of the alpine area respectively the alpine communities was based on the limitations according to the Alpine Convention. Compared to the definition of the alpine area by Bätzing (1993) here a partly wider limitation was chosen. This goes in particular for the northern limitation of the Alps. In total 5,558 communities in Germany, France, Italy, Liechtenstein, Austria, Switzerland and Slovenia were chosen for this task.

3.1.1.2 The selection of variables

Approach

For the selection and definition of data a good comparability has to be considered. Furthermore all subjects of the project (see Section 2.2) have to be covered equally. Agriculture is not to be considered as an isolated economic sector. It has on the contrary to be analysed in connection with natural conditions and the socio-economic situation.

The selected data should make possible the presentation of production conditions and of functional correlation with other sectors (trade, industry, tourism, regional planning). This is why the following thematic structure was chosen (see Figure 3.2).

Ecological and economic aspects are integrated into the database of the apine area. Factors of production are integrated in the subject *natural conditions*. Within economics the emphasis is laid on the primary sector (subject *agricultural structure*). Single data from Secondary and Tertiary sector are integrated in the subject *socio-economy* together with corresponding data from the primary sector.

Thematical structure

The economic sector agriculture is functionally connected with natural conditions and the socio-economic situation. As a consequence data for different subjects have to be considered.

- Socio-economy: Social and economic factors of influence of agriculture. Central social (e. g. place of living, population structure) and economic topics (e. g. employment structure, income possibilities, tourism) are considered. This is a pre-condition for the analysis of interactions between agriculture and other economic sectors (e. g. tourism, industry).
- Natural conditions / geography: Data characterising areas by their natural production conditions. These geo-ecological pre-conditions give a reference for agricultural production conditions without the use of additional technical facilities. The actual land-use has to adapt to these pre-conditions. Pre-conditions for agriculture can at least basically be analysed by information on altitude, inclination, geologic conditions, etc.
- Agricultural structure: Data characterising agriculture in the alpine area. This comprises the totality of conditions (types of income, land use, number and size of farms, workers, etc.) for agricultural production and the sale of agricultural products. Agriculture is considered as a branch operating on an economic base.

In the presented context the selected subjects *natural conditions*, *agricultural structure* and *socio-economy* can be expressed by the notion *agrarian ecology*. This definition corresponds to the actual literature: Bätzing (1996) sets the emphasis within the "alpine environment" on the structural change in agriculture considering economic, ecological and socio-cultural aspects.

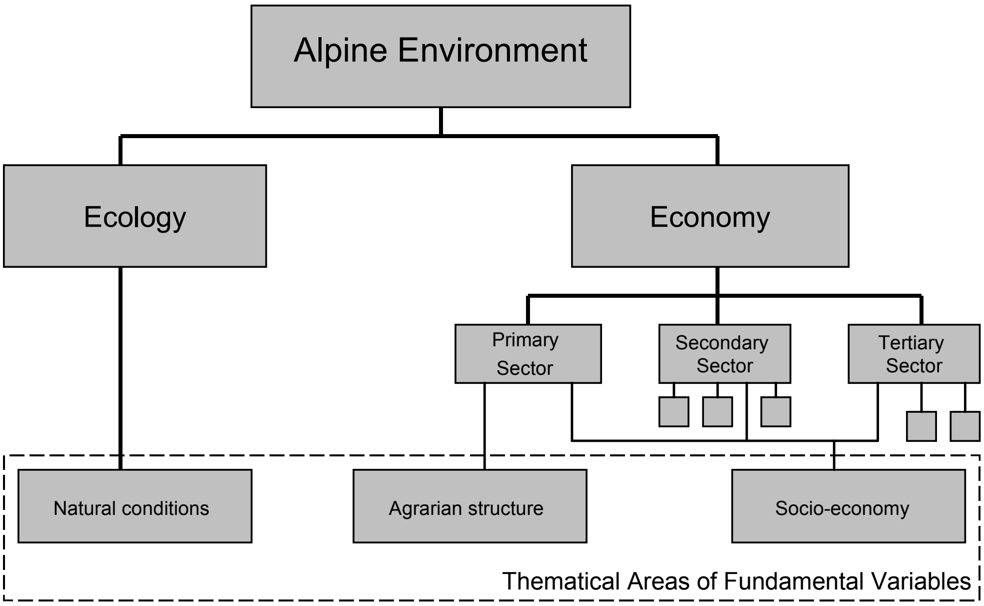

Figure 3.2: Data base corresponding to the alpine environment

Derivation of data

It seemed to be useful to differentiate the data concerning their origin and their level of aggregation. In the following a definition of the notions used in the project is given. This concerns the notions *Fundamental Variables* and *Static and Dynamical Parameters:*

- Fundamental variables: all data taken directly from national statistics. Within the project these data were the first to be surveyed.
- Static and dynamical parameters: all data which seemed to be appropriate (due to their quality and evidence) to describe the subjects relevant for the project. They were integrated into the clustering process. In general they are adapted fundamental variables. An adaptation is a connection of two or more fundamental variables. Static and dynamical parameters are thus the highest level of aggregation of fundamental variables. According to their content and to the period they can be classified into static and dynamical parameters. Static parameters describe the state for a certain moment. Dynamical parameters describe the development over a certain period of time. They are the result of at least two static parameters.

The generation of static and dynamical parameters and the requirements for their selection will be commented after the presentation of the fundamental variables.

Requirements for fundamental variables

A range of requirements for data have to be considered due to the task in general and to the following working steps:

- Availability at community level for the Alps: This means a complete availability of data at community level for the whole alpine area
- Comparability: The data have to be comparable. That means a compliance of their definitions within the different countries. Apart from the definitions and comments according to EU-regulations also all national definitions had to be considered.
- Representativeness: This is the requirement for a selection of data appropriate for the presentation of essential structural and ecological aspects of the alpine area.
- Presentation of tendencies: Selected data have to be available for two comparable dates. This concerns in particular the subject agricultural structure (especially structure of the farms, land use, livestock).
- Low number of data sources: In order to facilitate the survey and to avoid problems with the connection of data the number of data sources has to be kept as low as possible.

Only when fulfilling all the requirements the data are a satisfying basis for the following working steps. The presented requirements had to be considered carefully in relation to time and cost expenditures in the different countries (standard or special interpretation of data) and quality of their message. In the course of this working step restrictions concerning the number of appropriate data have been encountered. These will shortly be commented in the following.

At the beginning data available at community level had to be surveyed. At the same time national definitions for the data were examined. For data to be presented at two moments the comparability of data definitions had to be secured. National data were examined on their comparability with each other and with EU-definitions. A different degree of compliance could be observed for the single subjects.

There was a good compliance within the *socio-economic data*. Data taken from the census are equally defined within EU-member states, but also in the other states and are well comparable. This goes in a similar way also for data from tourism statistics. For the subject *natural conditions / geography* the situation is variable for different data types. Data on natural production conditions, which go in as statistical values, were appropriate according to the requirements. They could be presented with good compliance. However, it was necessary to use thematic maps available for the whole alpine area. In general information on the ecological state (survey of biotopes, hemerobiotic degree, etc.) were not comparable or only available for some parts of the Alps. Within the subject a*gricultural structure* comparability was partly restricted. Although in general national definitions are in compliance with EU-definitions basic differences were encountered, such as differing data units. Some of the data which seemed to be appropriate for the task concerning their contents are not available all over the Alps, for a recent time period or they are nationally defined in a different way.

Definition of data

Concerning the selection of sources the following aspects turned out. In the field of *socio-economy* nearly all data are taken from the census. Only the data concerning the migration balance were taken from migration statistics in Germany and Italy. The data concerning the capacity of accommodation were contained in tourism statistics in all countries. For the domain *natural conditions / geography* data from the census and from geographic institutions have been used (area of the communities, altitude). In addition to that thematic maps available for the whole alpine area were interpreted. Finally for the *agricultural structure* only data from agricultural statistics of the different countries have been used.

Concerning the selection of the point of time of survey of the relevant data the following objectives had to be considered:

- data describing the actual state: use of recent data;
- data for the comparison of two periods: use of data from a period of 10-15 years ago. An exact compliance of these periods is not possible due to nationally different surveys. However, it seems to be indifferent for the task which aims at showing a tendency. This tendency will mainly be used in a qualitative way during the following working steps.
- The objectives listed above lead to the selection of data sources listed in Table 3.1.

Table 3.1: Overview of selected data sources and dates of the survey

Nation	Socio-economy	Natural conditions / Geography	Agrarian structure
A	Austrian Census 1991	Thematic maps	Agrarian structure 1995, Survey of agricultural Land use 1983
CH	Swiss Census 1990	Thematic maps GEOSTAT	Survey of agricultural farm-structure 1996, 1985
D	German Census 1987	Thematic maps	Census of agriculture, Survey 1985
F	French Census 1990	Thematic maps	General Survey of agriculture 1988, 1979
FL	Census 1990	Thematic maps	Census of agriculture 1990, 1980
I	Census 1991	Thematic maps	Census of agriculture 1990, 1980
SLO	Statistical Yearbook 1996	Thematic maps	Agrarian map 1990, agricultural statistics 1980 - 1990

Selected data

Considering the requirements presented above in total 76 criteria were selected for the survey of all 5,558 communities in the Alps. The emphasis of the survey is laid on the *agricultural structure* with 57 data. The subject *socio-economy* is presented by 12 and *natural conditions / geography* with 7 data per community. The selected data for the subjects socio-economy (S), natural conditions / geography (G) and agricultural structure (A) are presented in Table 3.2. Beside the name of the selected data their acronyms and the dates of the survey are listed. The definitions used for this project are based on definitions of the European Union (Council Regulation EEC 3037/90, Council Regulation EEC 571/88). The exact definition of the national data and those used for this project are presented in a separate code-book.

Table 3.2: Overview of selected criteria

Acronym	Characterisation
S1	Resident population
S2	Resident population, male
S3	Resident population, female
S4	Resident population, number of persons over 65 years
S5	Resident population, number of persons below 15 years
S6	Total number of employed people within the resident population
S7	Employed people within the resident population in the primary sector, male
S8	Employed people within the resident population in the primary sector, female
S9	Employed people within the resident population in the secondary and tertiary sector, male
S10	Employed people within the resident population in the secondary and tertiary sector, female
S11	Migration balance
S12	Capacity of accommodation
G1	Total area of the community
G2	Altitude of the main village
G3	Highest point within the community
G4	Geological conditions
G5	Inclination of slopes
G6	Exposition
G7	Climatic type
A1	Total number of farms (full-time farms, part – time farms, farms of juristic persons); current data
A2	Total number of farms (full-time farms, part – time farms, farms of juristic persons); comparative data (10 – 15 years ago)
A3	Number of full-time farms (farms of natural persons); current data
A4	Number of part-time farms (farms of natural persons); current data
A5	Number of farms of juristic persons, current data
A6	Number of full-time farms (farms of natural persons); comparative data
A7	Number of part-time farms (farms of natural persons); comparative data
A8	Number of farms of juristic persons; comparative data
A9	Number of farms with usable agricultural area up to 2 hectares; current data
A10	Number of farms with usable agricultural area between 2 and 5 hectares;

	current data
A11	Number of farms with an usable agricultural area between 5 and 10 hectares; current data
A12	Number of farms with an usable agricultural area between 10 and 20 hectares; current data
A13	Number of farms with an usable agricultural area between 20 and 50 hectares; current data
A14	Number of farms with an usable agricultural area of more than 50 hectares; current data
A15	Total farm area; current data
A16	Usable agricultural area (LN); current data
A17	Arable land; current data
A18	Permanent grassland (intensive management); current data
A19	Pastures with low intensity (extensive management); current data
A20	Selected types of permanent crops (fruit, vine, tree nursery); current data
A21	Not used agricultural area; current data
A22	Forestry area; current data
A23	Total farm area; comparative data
A24	Agriculturally used area (LN); comparative data

Table 3.2: continued

A25	Arable land; comparative data
A26	Permanent grassland (intensive management); comparative data
A27	Pastures with low intensity (extensive management); comparative data
A28	Selected types of permanent crops (fruit, vine, tree nursery); comparative data
A29	Not used agricultural area; comparative data
A30	Forestry area; comparative data
A31	Livestock of cattle; current data
A32	Livestock of pigs; current data
A33	Livestock of sheep and goats; current data
A34	Total number of livestock; Livestock unit (L. U.); current data
A35	Livestock of cattle; comparative data
A36	Livestock of pigs; comparative data
A37	Livestock of sheep and goats; comparative data
A38	Total number of livestock; Livestock unit (L. U.); comparative data
A39	Number of farms with cattle keeping; current data
A40	Number of farms with pig keeping; current data
A41	Number of farms with sheep keeping; current data
A42	Number of farms with goat keeping; current data
A43	Number of farms with cattle keeping; comparative data
A44	Number of farms with pig keeping; comparative data
A45	Number of farms with sheep keeping; comparative data
A46	Number of farms with goat keeping; comparative data
A47	Farms specialised in crop farming
A48	Farms specialised in horticulture
A49	Farms specialised in permanent crops
A50	Farms specialised in pasture farming – dairy cattle
A51	Farms specialised in pasture farming – cattle rearing and fattening
A52	Farms specialised in intensive live stock farming
A53	Mixed farm types (plant production, livestock farming) and not classified farms
A54	Forestry farms

A55	Number of regularly employed persons at farms
A56	Number of family workers at farms
A57	Number of farmers over 45 years

Comments on difficulties and quality of the fundamental variables

Within the subject *socio-economy* no essential problems could be observed. For the subject *natural conditions/geography* problems could be avoided by the use of thematic maps available for the whole alpine area. Finally problems concentrated in particular on the subject *agricultural structure*. In spite of exact EU-definitions data units are not fully comparable in EU-member states. However, with some exceptions a satisfying result for the generation of regions could be obtained by additional research.

Within EU-member states considerable inconsistencies occurred concerning data units and the type of economic farm-orientation. Additionally problems were observed in countries outside the EU, especially in Slovenia. Due to the low number of communities these problems could be overcome by additional analogue adaptation of data. For Switzerland and Liechtenstein a good compliance with EU-definitions could be obtained without higher expenditures.

The actuality of data could be guaranteed because of surveys made in intervals of 10 years in all the alpine countries. So quite recent data could be used for the project. In the following some general remarks on the quality of statistical data are made. On the one hand possibly wrong information given by the farmers in course of the national surveys was taken over. On the other hand the so-called "cultivation principle", the basis for all agricultural statistics, had to be considered. This means that all information on a farm is attributed to the community statistics of the main site of the farm regardless whether the relevant cultivated areas are actually situated in this community or not. Further problems were data protection (especially in Austria and France) and not complete availability of data (especially in Slovenia).

Requirements for static and dynamical parameters

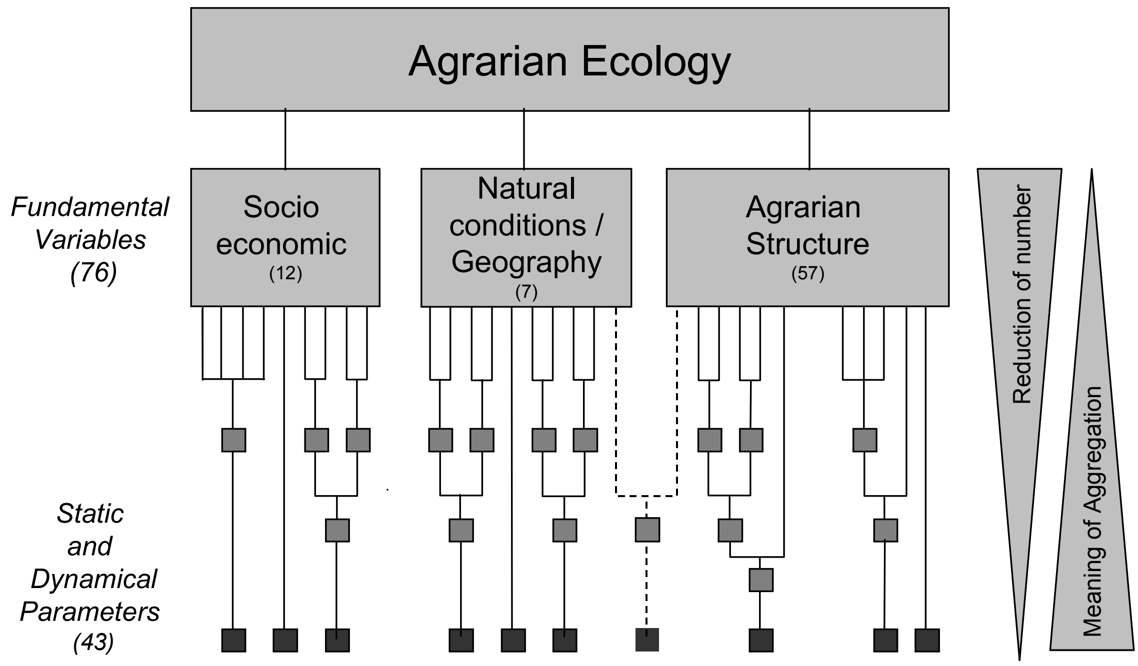

Figure 3.3: Creation of static and dynamical parameters

After the survey of data information has to be aggregated to static and dynamical parameters which seemed to be appropriate for the clustering process. During this working step the number of data has been reduced on the one hand and on the other hand a precision of their message is achieved (see Figure 3.3).

Concerning the generation and selection of these parameters their mutual dependence has to be considered in particular. Implicit correlation and redundancies can lead to considerable falsifications of the results. As a consequence the objective was the survey and the selection of independent parameters. This requirement has been secured by a statistical examination of redundancies.

Definition of static and dynamical parameters

Under consideration of the requirements mentioned above 30 static and 13 dynamic parameters have been aggregated from 76 fundamental variables. These 43 parameters integrated into the clustering process are presented in Table 3.3.

Table 3.3: Overview selected static and dynamical parameters

Acronym	*Description*	*Formula / relation to Fundamental Variables*	*Type*

	NATURAL CONDITIONS		
NR1	Altitude of the main village	G2	Static
NR2	Geology	G4	Static
NR3	Exposition	G6	Static
NR4	Climatic type (annual precipitation and temperature)	G7	Static
NR5	Inclination of slopes	G5	Static
NR6	Intensity of relief	G3 - G2	Static
	SOCIO-ECONOMY		
SOE1	Proportion of employed in the primary sector to all employed	(S7 + S8) : S6	Static
SOE2	Migration balance (geometric mean over 10 years)	S11	Dynamical
SOE3	Number of beds in accommodation businesses per inhabitant	S12 : S1	Static
SOE4	Farm abandonment factor	A1 : A2	Dynamical
SOE5	Proportion of farmers > 45 years to the number of farms of natural persons	A57 : (A3 + A4)	Static
SOE6	Proportion of farms up to 5 ha agriculturally used area to the total number of farms	(A9 +A10) : A1	Static
SOE7	Proportion of farms from 5 to 10 ha agriculturally used area to the total number of farms	A11 : A1	Static
SOE8	Proportion of persons > 65 years (rate of age)	S4 : S1	Static
SOE9	Proportion of persons < 15 years (rate of youth)	S5 : S1	Static
SOE10	Rate of employment	S6 : S1	Static
	TYPES OF INCOME		
EA1	Proportion of farms of natural persons with part-time farming	A4 : (A3 + A4)	Static
EA2	Number of employed persons + family workers at farm / agriculturally used area	(A55 + A56) : A16	Static
EA3	Change of the proportion of farms with part-time farming	A4 : (A3 + A4) / A7 : (A6 + A7)	Dynamical
	LAND USE		
BN1	Proportion of usable agricultural area / community area	A16 : G1	Static
BN2	Proportion of arable land / usable agricultural area	A17 : A16	Static
BN3	Proportion of intensive permanent grassland / usable agricultural area	A18 : A16	Static
BN4	Proportion of selected permanent crops / usable agricultural area	A20 : A16	Static
BN5	Proportion of not used agricultural area	A21 : (A16 + A21)	Static
BN6	Change in the usable agricultural area	A16 / A24	Dynamical
BN7	Change of the proportion of arable land to the usable agricultural area	A17 : A16 / A25 : A24	Dynamical
BN8	Change of the proportion of intensive permanent grassland to the usable agricultural area	A18 : A16 / A26 : A24	Dynamical
BN9	Change of the proportion of selected permanent crops to the usable agricultural area	A20 : A16 / A26 : A24	Dynamical
BN10	Change of the proportion of uncultivated usable agricultural area	A21 : (A16 + A21) to A29: (A24 + A29)	Dynamical

Table 3.3: continued

	DENSITY OF LIVESTOCK		
VD1	LU for cattle / ha usable agricultural area without permanent crops	0,80 * A31 : (A16 – A20)	Static
VD2	LU for pigs / ha usable agricultural area without permanent crops	0,35 * A32 : (A16 – A20)	Static
VD3	LU for sheep and goats / ha usable agricultural area without permanent crops	0,15 * A33 : (A16 – A20)	Static
VD4	Changes of cattle / ha usable agricultural area without permanent crops	A31 : (A16-A20) to A35 : (A24-A28)	Dynamical
VD5	Changes of pigs / ha useable agricultural area without permanent crops	A32 . (A16 – A20) to A36 : (A24 – A28)	Dynamical
VD6	Changes of sheep and goats / ha usable agricultural area without permanent crops	A33 : (A16 – A20) to A37 : (A24 – A28)	Dynamical
	LIVESTOCK KEEPER		
VH1	Change of cattle keepers	A39 / A43	Dynamical
VH2	Change of pig keepers	A40 / A44	Dynamical
VH3	Change of sheep and goat keepers	(A41 + A42) / (A45 + A46)	Dynamical
	ECONOMIC ORIENTATION OF THE FARM		
BWA1	Proportion of farms specialised in crop farming / total number of farms	A47 : A1	Static
BWA2	Proportion of farms specialised in permanent crops / total number of farms	A49 : A1	Static
BWA3	Proportion of farms specialised in pasture farming / total number of farms	(A50 + A51) : A1	Static
BWA4	Proportion of farms specialised in intensive live stock farming / total number of farms	A52 : A1	Static
BWA5	Proportion of farms specialised in horticulture / total number of farms	A48 : A1	Static

3.1.1.3 The pre-processing of the data

The detection of outliers and their consideration

The first that has to be done within the framework of pre-processing of the data is the *visual check* of the whole data matrix. Generally, three different problems are possible which have to be treated in some way:

- First, *wrong data* could exist. This kind of data is very difficult to handle if the values are in the possible or normal range of the underlying characteristic. Because of the very conscientious data collection and processing it could be assumed that no wrong data exist.

- Second, *impossible data* could exist. That means that the value of a certain characteristic for a certain object (community) is outside the possible range. This case is very easy to check out and it could be noticed that no impossible data could be observed within our data set.
- Third, *outliers* could exist. Outliers are objects (i.e. communities) which are in the possible but not in the normal range of a variable. If there is no big difference between normal and possible range, the effect of considering outliers within the data analysis is relatively modest. But if few objects have very extreme values in certain variables – and so there is a great gap between normal and possible range – the consideration of the outliers could affect the whole data analysis and biased results could appear. To avoid this, different procedures are conceivable. The best – but at the same time the most expensive – way to handle that problem is to use only such data analysis techniques which can correctly treat outliers. Because of the poor choice of these techniques this way should not be followed within our project. But another approach for the treatment of outliers, their *smoothing*, should be used. With the help of this procedure, extreme values of objects are cut and replaced by a less extreme value, for example by a corresponding quantil of the underlying distribution of the variable. The only problem that has to be solved is the determination of the quantil. But a check of the data shows that the use of the lower 1% quantil respectively the upper 1% quantil (i.e. 99% quantil) produces very pleasing results. Thus, all outliers – for us these are values which still lie above or below the corresponding quantil – are replaced by a value close to the quantil. That means that the number 100 is used even if the quantil is 99.6 or 101.4 or something like that. This freedom in selecting the "right quantil" is very useful for our project: different variables which are related and also comparable get the same new lower and upper limits. In this way the resulting variables are easier to compare and better to interpret. Biases to the results of the data analyses and/or in the interpretations should not be expected because of the minimal modifications.

So, we get a data set which now has to be checked for missing values and dependencies between the variables.

The treatment of missing-values

While data collecting by the different associate partners it could not be avoided that some individual values of different variables for single communities or even complete variables within a whole state are missing. The reasons for these so-called *missing values* (MV) are manifold and reach within our project from "data privacy" to "high costs".

Nevertheless, these variables should be taken into consideration when clustering the whole data set. To solve the MV-problem different imputation techniques exist:

- The most known representative of this group is the so-called *mean value estimator*, in which the MV are replaced by the average value of all present values of the same variable. This estimator should be taken if no further information on dependencies in the data are available.

- An imputation technique which enables to take information about (linear) dependencies in the data into consideration, is the so-called *regression estimator*. With this technique different (regression) models are analysed for the available data sets whether they describe the dependencies or not. Here, the different characteristics with the MV are the so-called regressors, i.e. the variables that should be explained, while the totally available features are the explaining variables. So, it is possible to find a proper model with that the MV could be replaced by the values resulting from the corresponding regression model.
- The most improper – but fastest – way to "remove" the MV is the *replacement* of the MV by *zero*. Even though, the structure of the data is not taken into account – in general – the procedure could even be proper in some individual cases. Nevertheless, this method should be considered with caution.

Within the framework of our pre-processing of the data the following MV are detected and treated:

- The *forest area in 1995* (A22) is missing for 25 communities in Austria. Because the correlation between the *forest area in 1995* and the *forest area in 1983* (A30) is very high (0.9292), the MV are replaced by the regression estimator

  $$A22 = 24.07 + 0.9567 * A30 \qquad (3.1)$$

  The fit of model is with regard to a determination coefficient of R^2=0.8635 very good.
- In Germany 6 variables have MV:
  a) Based upon the corresponding collection of the statistical offices the variables goat raising 1995 (A42) and goat raising 1983 (A46) are generally not available. Because, however, the holder of goats are taken into account within the characteristic sheep raising a replacement by zero does not lead to any falsification.
  b) The features abandoned agricultural area 1995 respectively 1983 (A21 respectively A29) are missing for 25 respectively 26 communities. Based upon the extreme outlier situation within these variables and the matter of fact that no meaningful correlation could be determined, an imputation does not seem to be suitable. Even the mean value imputation does not appear applicable because of the very skew distribution. Because, however, the median is five respectively ten and the 25% quantil is zero respectively one, the application of the median imputation causes no considerable distortions.
  c) The feature number of non family workers (A55) could not be collected for 29 communities. Since this feature is also very low correlated with other features and so no suggestive model could be identified, a similar strategy should be chosen as with the Abandoned agricultural area. The matter of fact, that the median is two and the 25% quantil is zero, gives reasons for the use of the application median imputation.
  d) The number of tourist beds per inhabitant (S12) could not be defined for 4 communities. Here, the reason must be sought in the data privacy since less than three companies – but at least one – accommodate guests. The zero imputation is absolutely wrong by contents; but a

consideration of the quantiles shows that the total range is scattered so far that the application of a better estimator on the base of the above described knowledge (How many beds can one or two companies offer?) could hardly bring an improvement. Because there are also no significant correlations to observe, the zero imputation is applied.

- In Italy, the variable *number of farm forestry* (A54) is completely missing based upon the incomplete collection of the corresponding statistical offices. Because no meaningful dependencies could be detected respectively these companies are taken into account in others features, a *zero imputation* is applied, too.
- The equal argumentation is also valid for the features *number of legal farms* in *1988* respectively *1979* (A5 respectively A8) in France. Thus, a *zero imputation* is applied, too.
- In Slovenia, no information was available about the *number of farmers over 45* (A57). As this feature is correlated very strongly with the *number of farms* (A1) – considering the whole data set all over the Alps – the MV are replaced with the help of the regression equation

  $$A57 = -4.495 + 0.735 * A1 \qquad (3.2)$$

  The fit of model is with regard to a determination coefficient of $R^2=0.968$ extremely good. The originally arranged mean value imputation should not be realised because of its worse fit.
- For Liechtenstein, the features *number of farms 1990* respectively *1980* (A5 respectively A8) could not be collected for all communities. Furthermore, the features *abandoned agricultural area* (A21 and A29) are missing for the whole state. Since no meaningful dependencies could be identified, a *zero imputation* is applied, too.
- For Switzerland all data are available – as far as they correspond to the convention from August/September 1998 of our project.

With the help of these imputation techniques we get a data set which is now complete and can be analysed by the clustering algorithms described later.

The problem of multicollinearity

To avoid that the same information in the data would be considered twice – which could be possible if there are high dependencies between different variables and these variables would then be used in the same data analysis – the whole data set has to be checked for dependencies between the variables, first. The literature speaks about the problem of *multicollinearity*. There are two different ways to handle it: First, one can do a so-called *factor analysis*. This method has the great advantage of reducing the enormous amount of variables down to a few but important factors, but these factors are commonly difficult to interpret.

Thus, we decided to use the second possibility: the discovery of dependencies by use of *correlation coefficients* and the *down-weighting* of the involved variables in the framework of the latter described weighting and transformation. First, we calculated all possible correlation coefficients *r* according to Bravais-Pearson and analysed all pairs of variables which have a correlation greater than 0.6 or less than –0.6. This limit was chosen because of the following consideration: If r is squared, one get – under certain assumptions – a coefficient of how far one variable describes the same thing or the same information like the other. Within the framework of statistics r^2 is called *determination coefficient* and measures the proportion of variance of one of the both variables which is described by the second. Thus, a correlation of r = 0.6 means a common variance or information of $r^2 = 0.6^2 = 0.36$. About 1/3 of the information of one of the variables is reproduced by the other feature.

In order to avoid the over proportional consideration of the information embedded in those correlated variables – e.g. in the framework of cluster analysis – different procedures are possible: first, the *radical elimination* of one of the two correlated variables which destroys more information as intended, or second, the *down-weighting* of both variables. Within our project we used the second possibility. The down-weighting means that all values of the correlated variables have to be multiplied with a number smaller than one. Thus, the range and also the variance (which is a coefficient for the embedded information) of this characteristic decreases. And this decreasing should be the higher the more two variables are correlated. For the exact calculation of the down-weighting coefficient *dwc* for two correlated variables we used the following formula:

$$dwc = 1 - 0.5 \cdot * r^2 \tag{3.3}$$

The half of the twice considered information will be subtracted for each involved variable by multiplying the original values with the down-weighting coefficient *dwc*. A detailed listing of all pairwise correlated variables and their down-weighting coefficients should not occur because of the almost technical and not very meaningful character of that procedure.

The weighting of the parameters

After the decisions about the treatment of missing values and the correlated variables, now the question about the priority of the variables has to be answered. It is valid that the higher the priority of a certain variable is, the more important is its part within the aggregation of the variables for the clustering.

Thus, it has to be analysed, first, which structure or say, characteristic, of a variable is responsible for the high importance of that variable in the framework of aggregation. Now, it is easy to understand that a variable with a large range – and so also with a high variance – is much more important for the aggregation than variables with small ranges respectively variances. Therefore, all variables have to be comparable by using a standardisation which transforms the maximum of the variable to 1 and the minimum to 0. As a result, all variables are now easy to compare and equal in priority.

In the second step, a further weighting has to be chosen to consider the different priorities of the involved variables. The more important a certain variable should be the larger its range has to be. Thus, a multiplying of the values of the looked at variable with a weight bigger than 1 leads to a higher priority of that variable, a multiplying with a value less than 1 leads to a smaller priority. As a result the question about the priority of the various characteristics leads automatically to the question about the underlying but true weighting scheme. But due to the missing knowledge about the real relationships within the data an objective selection of the needed weights is usually not possible.

Therefore, the weighting scheme is based upon thoughts of plausibility. Corresponding to the thematic structure of the fundamental variables also static and dynamical parameters can be organised in thematic groups. These are *natural conditions, socio-economy* and *agricultural structure*. The agricultural structure as central subject of interest can be divided into five groups*: Types of income, land-use, density of livestock, livestock keepers* and *economic orientation of the farm*.

In course of the generation of static and dynamical parameters a representative selection concerning the thematic groups had to be considered in addition to statistical requirements (see Section 3.1.1). This means that the number of static and dynamical parameters within the thematic groups should give a realistic impression of the agricultural structure.

A useful connection of fundamental variables leads to restrictions concerning the number of static and dynamical parameters. As a consequence the clustering processes was carried out using two different types of weighting. In addition to an equal weighting of all 43 parameters a "weighting of blocks" was carried out. From the point of view of the experts this "weighting of blocks" should be able to give a realistic impression of the agricultural structure.

- Because, such phrases as e. g. *"the protection of nature is as important as the possibility for humans to work"* (*nature contra humans*) are quite plausible and all non equal weighted phrases are difficult to comprehend we decided to select first the so-called equal weighted scheme in which all 43 involved variables are equally weighted. This means that each of the 43 (standardised) static or dynamical parameters has got the same weight respectively priority.

- "Weighting of blocks": weighting in two steps
  - a) weighting of the thematic groups: natural conditions and socio-economy: 1 each, agricultural structure: 2
  - b) weighting within the thematic group agricultural structure: land use: 1; types of income, density of livestock, livestock keepers and economic orientation of the farm: 0.5 each.

Using the "weighting of blocks" thematic groups have been set in a certain relation to each other which from the point of view of the experts was judged as efficient for the task. By this method a weighting exclusively based on the number of parameters within the thematic groups can be avoided. Because the certain block has now a certain weight and blocks themselves differ in the number of involved variables the weighting of a certain variable within a block is the less the more variables build the corresponding compilation. This is worth to note.

Even though the number of such schemes is infinite other weightings should not be discussed. So, we get three "different data sets" which are the bases for the following cluster algorithms.

3.1.2 Classification methods

When clustering a set of objects into *k* clusters the main objective is to find clusters, the objects of which show a high degree of similarity, while objects belonging to different clusters are as dissimilar as possible. Of course, many methods exist that try to achieve this aim. Thus, let us give an overview of the clustering methods used in this project, together with their most important characteristics and some hints toward typical applications.

The choice of a clustering algorithm depends both on the type of data available and on the particular purpose. Sometimes several algorithms are applicable, and a-priori arguments may not suffice to narrow down the choice to a single method. In such a situation it is probably a good idea to run more than one program and to carefully analyse and compare the resulting classifications, making use of their graphical displays. The interpretation of these results must then be based on insight into the meaning of the original data, together with some experience with the algorithms used. It is permissible to try several algorithms on the same data, because cluster analysis is mostly used as a descriptive or exploratory tool, in contrast with statistical tests which are carried out for inferential or confirmatory purposes. That is, we do not wish to prove (or disprove) a preconceived hypothesis; we just want to see what the data are trying to tell us.

Of course there exist very many clustering algorithms in the literature, and it would be infeasible to try to use and review all of them. Bock (1974) undertook the monumental task of compiling an overall survey, which accurately reflects the state of the art in the early seventies, but the field has expanded very much since that time. A newer book to that topic was written by Kaufman and Rousseeuw (1990). They select and describe (and partly construct) six clustering methods, which together are believed to cover a majority of applications. This selection (which is subjective and necessarily debatable) has been based on a combination of some theoretical considerations (such as an attempt to achieve as much logical consistency and robustness as possible) and the experience of the authors in applying clustering to a variety of disciplines. Thus, we describe first the most important methods used in our project and explain why other programs are not appropriate for us.

3.1.2.1 Partitioning methods

Generally, two kinds of clustering algorithms are considered, namely partitioning and hierarchical methods. A partitioning method constructs *k* clusters. That is, it classifies the data into *k* groups, which together satisfy the requirements of a partition:

- ❑ Each group must contain at least one object.
- ❑ Each object must belong to exactly one group.

These conditions imply that there are at most as many groups as there are objects. The second condition says that two different clusters cannot have any objects in common and that the *k* groups together add up to the full data set. It is important to note that *k* is given by the user. Indeed, the algorithm will construct a partition with as many clusters as desired. It will turn out that the choosing of the number of classes is one of the most difficult and important problems that have to be solved in our first part of the project.

Of course, not all values of *k* lead to "natural" clusterings, so it is advisable to run the algorithm several times with different values of *k* and to select that *k* for which certain characteristics or graphics look best, or to retain the clustering that appears to give rise to the most meaningful interpretation. It is also possible to have this decision made in an automatic way, that is, to let the computer try out all (or many) possible values of *k* and to choose the one which is best relative to some numerical criteria. At this point, it should be mentioned that it seemed to be reasonable to try all solutions up from seven to thirteen for the classification task in our project.

Partitioning methods are applied if one wants to classify the objects into *k* clusters, where *k* is fixed (although it may have been selected by the computer):

- You have data on 100 bacteria. Do they form groups?
- People give you subjective assessments on 12 countries. Does cluster analysis provide recognisable groups of states?
- Performance criteria have been measured for 800 companies. Can groups of companies be found that perform in a similar way?
- Different characteristics describe about 6,000 communities in the Alps. Do they form groups?

In general, the algorithm tries to find a "good" partition in the sense that objects of the same cluster should be close or related to each other, whereas objects of different clusters should be far apart or very different. The aim is usually to uncover a structure that is already present in the data, but sometimes the algorithm is used to impose a new structure.

Partitioning around medoids (PAM)

The algorithm used in the program PAM is based on the search for *k* *representative objects* among all objects of the data set. As evoked by their name, these objects should represent various aspects of the structure of the data. So, the main idea of this partitioning algorithm is the following: In order to obtain *k* clusters, the method selects *k* objects (which are called *representative objects)* in the data set. The corresponding clusters are then found by assigning each remaining object to the nearest representative object. Of course, not every selection of *k* representative objects gives rise to a "good" clustering. The clue is that the representative objects must be chosen so that they are (in a certain sense) centrally located in the clusters they define. To be exact, the average distance (or average dissimilarity) of the representative object to all the other objects of the same cluster is being minimised. For this reason, Kaufman and Rousseeuw (1987) call such an optimal representative object the *medoid* of its cluster, and the method of *partitioning around medoids* they call the *k-medoid* technique.

By construction, the k-medoid method tries to find "spherical" clusters, that is, clusters that are roughly ball-shaped. It is therefore not suited to discover drawn-out clusters. The program PAM is especially recommended if one is also interested in the representative objects themselves, which may be very useful for data reduction or characterisation purposes. The program also allows a more detailed analysis of the partition by providing clustering characteristics and a graphical display (a so-called *silhouette plot),* and an appropriate choice of *k* can be made on the basis of a validity index it computes. Unfortunately, the method is reasonable only for small data sets up to about 500 objects because of its very long calculation time. Nevertheless, PAM should be described because it is the essential part of the following clustering method.

Clustering large applications (CLARA)

The program CLARA, also introduced by Kaufman and Rousseeuw (1986), was developed for the express purpose of analysing large data sets. Its clustering objective is the same as in the program PAM: It also tries to find *k* representative objects that are centrally located in the cluster they define. But in PAM the collection of all pairwise distances between objects is needed, thereby consuming nearly n^2 memory space. This means that PAM cannot be used for large n (depends on the central memory size of the computer). Therefore, CLARA no longer stores all dissimilarities, but only the actual measurements. This is paid for by the loss of some other features.

The program CLARA proceeds as follows. By means of a random number generator, a sample of objects is drawn from the data and clustered in the same way as in PAM. Then each object of the entire data set is assigned to the nearest medoid of the sample. This whole procedure is repeated several times and the solution with the best overall objective function is retained. In this way, the computation time also remains feasible.

As we are still in the k-medoid framework, CLARA shares the robustness of PAM. Also the majority of clustering characteristics and other tools are still available, at least in approximate form. Although CLARA is intended for spherical clusters, this method should be used for our task because it is the only algorithm which can be applied to large data sets – as in our project – and needs no start classification.

The k-means and the k-median algorithm

The most commonly used partitioning method is the *k-means algorithm* from MacQueen (1967) which measures the similarity or so-called *proximity* between groups using the Euclidean distance. Thus, this methods attempts to minimize the average squared distance – just the *Euclidean distance* – yielding the so-called *centroids.* Beginning with an initial selection of *k* groups objects are reassigned until they are located in the group with the nearest centroid. As objects are reassigned the group centroids must be revised. For a given level of *k*, the optimum is reached when all objects are located in the group whose centroid is closest and no changes occur.

Even though, the k-means algorithm is very suitable for many applications it has a great disadvantage: the necessity of a start classification, i.e. a classification of the objects which should be improved by the algorithm. If such a start classification is available, the k-means algorithm could be the appropriate method to cluster a set of objects, but there is seldom such a a-priori classification – as in the project SUSTALP, too.

Another disadvantage manifests by comparing the k-means algorithm and the related algorithm PAM. It could be noticed that PAM, also called k-medoid method, is the better one because it is more robust with respect to outliers and because this method does not only deal with so-called interval-scaled measurements – explainable by only using the Euclidean distance – but also with general dissimilarity coefficients. But to follow the idea of k-means, especially the possibility to confirm the results given by another algorithm, and simultaneously to use the advantage of PAM with regard to its robustness under outliers we developed a new algorithm which we call *k-median algorithm*. This method combines the advantages of both algorithms by using the general procedure of k-means and comparing the objects not with the centroid but with the *medoid*, i.e. the imaginary object consisting of median values for all variables. In this way, the robustness of PAM can be transferred to the k-means algorithm.

The disadvantage of both methods, the k-means and the k-median algorithm, to analyse nothing but interval-scaled data count for nothing within our project because we only deal with that data. Thus, the algorithms should be used within SUSTALP for confirming the clusters resulted by the other methods: If two different methods produce almost the same results, it refers to the stability of the classification.

Fuzzy analysis

Fuzzy clustering is a generalisation of partitioning. In a partition, each object of the data set is assigned to one and only one cluster. Therefore, partitioning methods – such as the algorithms PAM, CLARA or k-means – are sometimes said to produce a hard clustering, because they make a clear-cut decision for each object. On the other hand, a fuzzy clustering method allows for some ambiguity in the data, which often occurs.

The following example which is from Kaufman and Rousseeuw (1990) should make the principle of fuzzy analysis clear.

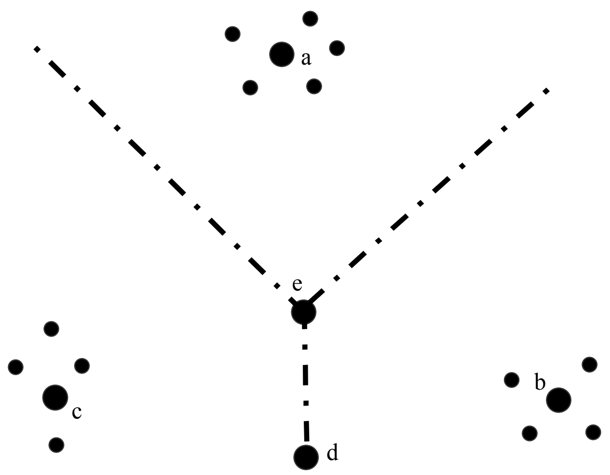

Figure 3.4: Example with intermediate point to be classified in a fuzzy way

In Figure 3.4 we see some points that can be classified with a strong degree of certainty, as well as a few intermediate objects for which it is not clear to which cluster they should be assigned. In fuzzy analysis, these different situations can be described by means of so-called *membership coefficients* as for example found in Table 3.4.

Table 3.4: Membership coefficients corresponding to Figure 3.4

	Membership coefficient		
Object	Cluster 1	Cluster 2	Cluster 3
a	0.90	0.05	0.05
b	0.05	0.90	0.05
c	0.10	0.10	0.80
d	0.10	0.45	0.45
e	0.33	0.33	0.34
⋮	⋮	⋮	⋮

They reflect that object a mostly belongs to cluster 1, that object b mostly belongs to cluster 2, and that object c belongs mostly to cluster 3. Note that the sum of the membership coefficients in each row equals 1. Object d is interesting because it is about halfway in between clusters 2 and 3, yielding a 45% membership in both. At the same time its membership coefficient in cluster 1 is only 10%, because it lies much further away from that cluster. The situation of object e is even more ambiguous, because it lies about equally far away from all three clusters, yielding membership coefficients of approximately 33%. The ability to describe such ambiguous situations is an important advantage of the fuzzy approach. Indeed, a "hard" clustering algorithm would have to assign object e to one of the clusters, leading to a distorted result. Accordingly, it could be noted that within the framework of the fuzzy clustering algorithms there is always a glimpse of doubt in assigning an object to a certain cluster.

The main advantage of fuzzy clustering over hard clustering is that it yields much more detailed information on the structure of the data. On the other hand, this could also be considered a disadvantage, because the amount of output grows very fast with the number of objects and the number of clusters, so it may become too much to digest. Another disadvantage is the absence of representative objects. But this failing could be repaired within our framework, because we do not need one representative object per group, we do need several objects which should describe the group in a "good" way. To solve that problem one can use the membership coefficients of the objects and separate the objects according to their degree of membership. Objects with a degree greater than 0.7 are called *main objects* of the underlying cluster and can be used to describe this cluster. Accordingly, all objects with a degree under 0.7 should not be used to analyse the groups.

Another disadvantage is the fact that fuzzy clustering algorithms are usually quite complicated and take considerable computation time. Nevertheless, we think that the fuzziness principle is very appealing because it allows a description of some of the uncertainties that often go with real data. And finally, there is the massive output, because fuzzy analysis provides an entire n-by-k matrix of membership coefficients, that may be very hard to interpret because of its mere size. In the end one often resorts to the corresponding "hard" clustering, obtained by assigning each object to the cluster in which it has the largest membership coefficient. For this hard partition, fuzzy analysis yields the same kind of results as other methods do, so it is possible to compare the outputs.

The following methods can be used among others to calculate a fuzzy clustering:

- The *fuzzy-k-means algorithm* proposed by Dunn (1974) and Bezdek (1974) respectively the FANNY algorithm from Kaufman and Rousseeuw (1990) which are generalisations of the above described k-means algorithm. Both methods calculate the membership coefficients in almost the same way and try to find "spherical" clusters, that is, clusters that are roughly ball-shaped. They are therefore not suited to discover drawn-out clusters. Moreover, they assume approximately equal sized clusters. The only difference between the both methods must be sought in the input data. While the *fuzzy-k-means algorithm* needs interval-scaled data with Euclidean distances, the FANNY algorithm only needs categorical data, at least. Because, however, all variables used in our project are interval-scaled the FANNY algorithm which takes much more calculation time does not have to be used.
- The *fuzzy-volume algorithm* proposed by Trauwaert et al. (1992) which is now a generalisation of the above described fuzzy-k-means algorithm. It is also suitable for interval-scaled data, however it has the big advantage of not assuming "spherical" or equal sized clusters. Moreover, the algorithm is

independent of differences in shape, size and cardinality between the different clusters. Unfortunately, the underlying mathematical algorithm for this method is so sophisticated and numerically unstable (because of the inverting of a big variance-covariance matrix) that the fuzzy-volume algorithm with all its advantages could not be used within the framework of our project.

Due to the above described reasons only the fuzzy-k-means algorithm should be used to solve our classification task. But even with this method inherent disadvantages exist. Consequently, this algorithm is only used for fuzzifying the results given by the other methods to explore which objects are the main objects of a cluster and which objects should not be used to analyse the different groups. Correspondingly, the results of this procedure will be the basis to select the representative communities within the Alps (see also Section 4.2).

3.1.2.2 Hierarchical methods

Hierarchical algorithms do not construct a single partition with k clusters, but they deal with all values of k in the same run. That is, the partition with $k = 1$ (all objects are together in the same cluster) is part of the output, and also the situation with $k = n$ (each object forms a separate cluster with only a single element). In between, all values of $k = 2, 3, \ldots, n-1$ are covered in a kind of gradual transition: The only difference between two following classifications is that one of the prior clusters split up in order to obtain one more cluster.

There are two kinds of hierarchical techniques: the agglomerative and the divisive ones. They construct their hierarchy in the opposite direction, possibly yielding quite different results. *Agglomerative methods* start when all objects are apart (that is, we have n cluster). Then in each step two clusters are merged, until only one is left. On the other hand, *divisive methods* start when all objects are together (that is, at the beginning there is one cluster) and in each following step a cluster is split up, until there are n of them. It should be mentioned that the resulting classifications are usually different.

One might think that now partitioning methods are obsolete, as we obtain all values of k in a single run. However, this is not true because a clustering formed "along the way" is not necessarily very good. Indeed, a partitioning method tries to select the *best* clustering with k groups, which is not the goal of a hierarchical method. A hierarchical method suffers from the defect that it can never repair what was done in previous steps. Indeed, once an agglomerative algorithm has joined two objects, they cannot be separated any more. Also, whatever a divisive algorithm has split up cannot be reunited. This rigidity of hierarchical methods is both the key to their success (because it leads to small computation times) and their main disadvantage (the inability to correct erroneous decisions). And thus, we decided not to use the hierarchical clustering algorithms within our protect. Another reason for that is that the structure given by the hierarchical methods resembles an evolutionary tree, and indeed these methods have been found very useful in biological applications, for the classification of animals and plants. Biologists have been most instrumental in the development of hierarchical methods, particularly in the framework of numerical taxonomy. So, one recognise that hierarchical techniques do not really compete with partitioning methods because they do not pursue the same goal, as they try to describe the data in a totally different way.

3.1.2.3 The clustering approach used in SUSTALP

Before building different region types in the Alps several tasks had to be carried out. First of all, the whole data set had to be collected, transferred in a central database and checked up on mistakes or missing values. The wrong or infeasible data were repaired, the missing values – there were several in Slovenia – were replaced by the above described suitable techniques. After that, extreme outliers were smoothed down by replacing the data by some proper chosen quantil values. The last task of the pre-processing step was the weighting of the variables to consider the different priorities of the involved characteristics. As a result, we got three standardised data sets.

Then, a short discussion about the advantages and disadvantages of the different above mentioned clustering algorithms had to be done. The most important items of this discussion about the features of the algorithms should be described, once again.

- It showed clearly that the *hard classification algorithms* – i.e. algorithms which classified a community to one and only one group – can be used in a first step to classify the approximately 6000 communities into different groups. But it is important to note that only such algorithms could be used which based on data matrices. Algorithms which are based on distances couldn't be used because of the large dimension of our data. Consequently, all hierarchical cluster methods could not be adapted.
- So, the following methods were applied: the CLARA algorithm and the classical *k-means algorithm*. Unfortunately, both algorithms showed some improper features while considering unusual, or say extreme, communities – which kept on existing, even after the treatment of the outliers. Thus, based on the k-means algorithm the new *k-medoid algorithm* was developed. It has the proper characteristic not to overweight the extreme objects in the data set and seems to be a very suitable method to classify our communities.
- After that, it was analysed whether the so-called *probabilistic methods* for classification or *the methods of fuzzy clustering* could be used within our project in a second step. Unfortunately, it showed that the *probabilistic methods* cause too many problems while estimating the different

parameters for the communities. The reason for that might be the large dimension of our data set and the missing knowledge about the common distribution of the different attributes. For these reasons we decided not to describe these methods in detail within this paper.

- But the *methods of fuzzy clustering* are extremely qualified for the classification task within this special framework. First of all, the *fuzzy-volume algorithm* of Trauwaert et al. (1992) was analysed and implemented. Unfortunately, this algorithm is not proper to classify large data sets. For small sets it has some proper characteristics, but not for large data sets. Especially, the instability of the algorithm and the property not to converge should be noted out.
- Then, the classical *fuzzy-k-means algorithm* was analysed in detail. The result is that this algorithm is proper to classify large data, especially for our data set of the communities in the Alps. Some simulation studies with a small set of the whole data set showed the suitability of this algorithm.

After that general discussion and some small simulation studies, the suitable algorithms were applied.

- To find a starting classification – which is always needed when partitioning methods are used – only the so-called *static variables* were used to classify the communities, first. As appropriate algorithm to do that we used the method CLARA, implemented in the software package S-PLUS 4 by MathSoft Data Analysis Products Division, Seattle. The program calculated the best starting classification for our data set found within 1,000 iterations of the underlying algorithm PAM. Each iteration of PAM itself was based on 500 communities. Thus, we got a starting classification which is very stable and free from random effects. Because we didn't know anything about the true number of groups within the data, we made these calculations up from 7 to 13 groups. An evaluation of the results did not yet occur.
- In a second step, these results were the base to classify the whole data set, i.e. the static and the so-called *dynamic variables* at once. To remember, the dynamic variables describe a community not at a certain point of time, but in a certain period of time. For that purpose, the above mentioned *k-means algorithm* and the new developed *k-medoid algorithm* were used. Both algorithms were implemented on a own computer system because no package on the market could treat so many objects as we had to do.

As a result we got for each weighting scheme (there are three) and for each number of groups (there are seven) two different classifications. By this, we totally got 7 * 3 * 2 = 42 partitions. A discussion with the involved experts about the quality and validity of the different results and the different algorithms followed (see also Section 3.1.1.3). The discussion showed that the new developed k-medoid algorithm, which do not overweight the "outliers" in the data set, produced the results best to interpret. In Figure 3.5, the chosen classification with 8 region types based upon the k-medoid algorithm is shown.

- In order to recognize which community belongs very strong to one group and which community has only a small membership to a special group, the existing results – produced by the hard cluster algorithms mentioned above – were *fuzzified*. Therefore, the different fuzzy algorithms were calculated, based on a partition produced by the hard algorithms. With that, it became possible to differentiate the objects of one group into representative communities and such communities which should not be chosen to describe the underlying region type.

Finally, it should be pointed out that the three-stage procedure of our classification was chosen because we wanted to learn something about the similarities and dissimilarities of the communities regarding the static variables and the dynamic variables by themselves. Thus, we decided to classify the communities only based upon the static variables, first. In a second run, we took also the dynamic variables into consideration. Furthermore, we wanted to get some information about the communities and their role within their group to represent all the other communities. Thus, we fuzzified the chosen hard classification to see what communities could be taken best as representative. Hence, we had to apply this three-stage procedure. No direct classification with only one algorithm could do that the same way.

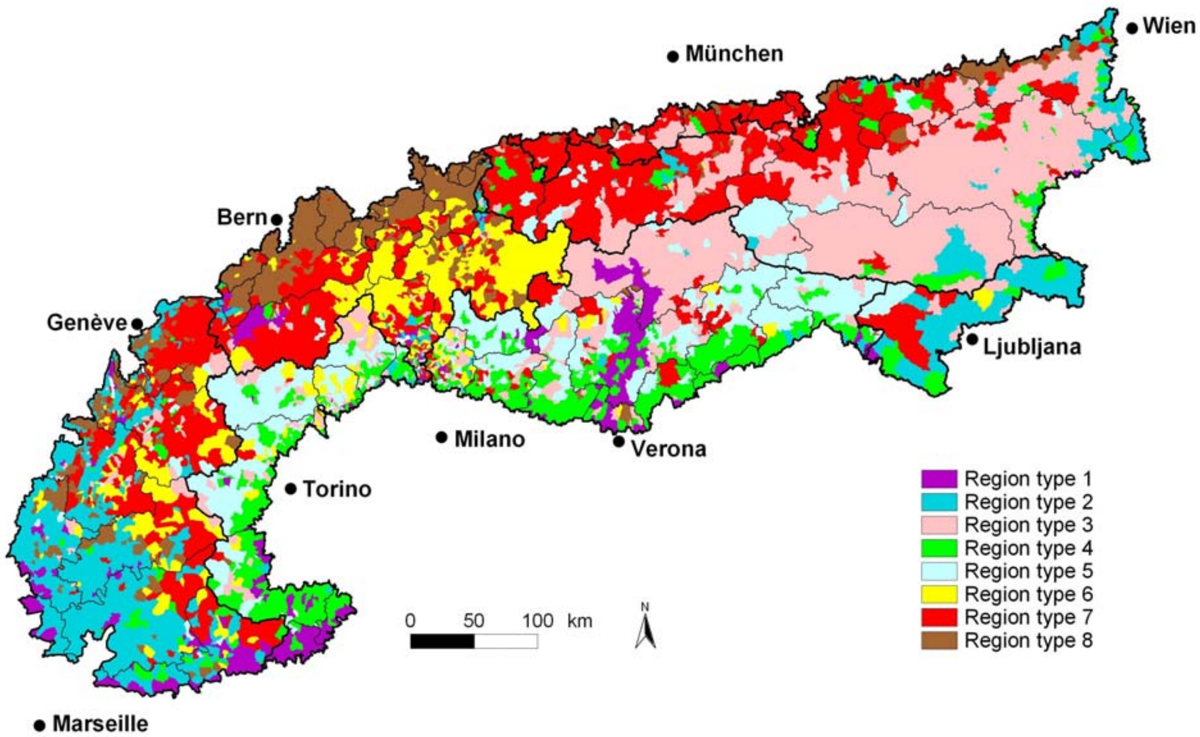

Figure 3.5: The classification of the Alps with 8 different region types

3.1.3 The quality of the classification

An inherent problem in the use of a clustering algorithm in practice is the difficulty of validating the resulting data partition. This is a particularly serious issue since virtually any clustering algorithm will produce partitions for any data set, even random noise data which contains no cluster structure. Thus, an applied researcher is often left in a quandary about the obtained clustering of a real life data set whether it actually represents significant cluster structure or an arbitrary partition of random data.

To be valid therefore, a cluster solution should not be a structure that could have occurred by chance by random sampling from a homogeneous population. The structure must be unusual to be valid. The validity of a cluster structure can now be examined in several ways.

- *External criteria* measure cluster solutions against a-priori information regarding structure. Evaluation of clustering algorithms using samples from known clusters is an example of an external evaluation of cluster methodology. Unfortunately, we do not have very much a-priori information about the clusters. Only the knowledge of the involved experts – e.g. there are several extremely different known region types within the Alps which should be detected by the cluster algorithms – could be used as a-priori information. This means that the results from the clustering process presented on maps were the base for a check of plausibility concerning the presentation of regions. The limitation of characteristic agricultural regions has been examined by the partners of this project according to criteria *land use*, *natural conditions* and *socio-economic values*.
- *Internal criteria* are used to evaluate a cluster solution relatively to the underlying sample data set and the corresponding (proximity) data. With internal criteria the issue is the goodness of fit of the cluster solution relative to the original data matrix. One index that measures this goodness of fit is the so-called *silhouette coefficient s*, introduced by Rousseeuw (1987). Expressed in easy words, this coefficient measures for each object the relation between its similarity to all objects of its own group and its similarity to all other groups. When *s* is close to 1 (its largest value) the correspondent object is well classified. The worst situation takes place when s is close to –1. The interpretation is similar. But a different situation occurs when the coefficient is about zero. Then the correct interpretation is that the object could be considered as an "intermediate" case. Based upon these object-wise values the overall *average silhouette coefficient S* for the whole classification can be calculated. With the help of this coefficient *S* each partition could now be evaluated. The closer to 1 the measurement is, the better the classification is.
- A third criterion for the evaluation of a cluster solution is *replicability* which involves the use of cross-validation procedures. Comparison of results from split-half samples would be an example of a replicability evaluation. But this methodology is only reasonable if the classification is used in an explorative sense, and not in a descriptive sense, as we would use it.
- Finally, a comparison of cluster solutions obtained from alternative clustering algorithms applied to the same data matrix, constitute what is usually

referred to as the application of *relative criteria*. In this case indices of agreement can be computed between alternative cluster solutions. But also this procedure seems not to be the suitable way to evaluate our resulting partition.

Accordingly, we used the external and the internal criteria to evaluate our solution. First, the internal criteria should be applied. Table 3.5 shows the average silhouette coefficients of all 42 calculated partitions. It could be observed that for both algorithms the weighting schemes 1 and 3 produce very bad results. Only the weighting scheme 2 is suitable for k-means and k-median. Looking at these coefficients first, it seems to be reasonable to select the 8-class solution of the k-means algorithm because of its largest average silhouette of 0.127 – which is in consideration of the large number of objects a very good result.

Table 3.5: Average silhouette coefficient of different hard partitions

	k-means algorithm						
	7	8	9	10	11	12	13
Weighting Scheme 1	0.060	0.054	0.055	0.049	0.048	0.049	0.055
Weighting Scheme 2	0.104	0.127	0.117	0.102	0.110	0.113	0.106
Weighting Scheme 3	0.078	0.074	0.072	0.062	0.063	0.061	0.062
	k-median algorithm						
	7	8	9	10	11	12	13
Weighting Scheme 1	0.049	0.052	0.045	0.049	0.045	0.044	0.045
Weighting Scheme 2	0.101	0.097	0.098	0.103	0.109	0.106	0.096
Weighting Scheme 3	0.047	0.053	0.051	0.051	0.054	0.053	0.051

But unfortunately, the application of an external evaluation by the experts shows that the 8-class solution and all the other solutions, made by the k-means algorithm, are difficult to interpret. Furthermore, there are many phenomena in these partitions which can not be explained. Also, classes arise which seem to have no similarities in reality. Thus, the solutions for the block weighting scheme 2 by means of k-median algorithm had to be analysed by experts. Because of the small difference of 1.3 between the smallest and the biggest goodness-of-fit coefficient a clear decision to one classification makes no sense. Therefore, the external evaluation had to be applied. And the experts came to a clear decision: the classification that has to be chosen is the 8-class solution of the k-median algorithm. Even though, other partitions are a little bit better, the 8-class solution shows the biggest conformance with the knowledge of the experts about the communities in the Alps.

Furthermore, it showed when applying the fuzzy algorithm that this 8-class solution is more stable and better than the 8-class solution of the k-means algorithm and even better than all the other solutions – a further clue for the appropriateness of the considered classification (see Table 3.6).

Table 3.6: Average silhouette coefficient of different fuzzy partitions

	fuzzified k-means solution						
	7	8	9	10	11	12	13
Weighting Scheme 1	0.103	0.093	0.105	0.111	0.101	0.115	0.106
Weighting Scheme 2	0.160	0.155	0.143	0.142	0.133	0.137	0.159
Weighting Scheme 3	0.121	0.101	0.111	0.089	0.092	0.101	0.102
	fuzzified k-median solution						
	7	8	9	10	11	12	13
Weighting Scheme 1	0.114	0.100	0.118	0.129	0.119	0.122	0.107
Weighting Scheme 2	0.165	0.166	0.165	0.152	0.142	0.159	0.151
Weighting Scheme 3	0.108	0.135	0.127	0.113	0.102	0.110	0.104

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4 Results and Discussion

4.1 Characteristic agricultural regions in the Alps

Gottfried Tappeiner and Andreas Hilbert

In Section 3.1 the underlying data and the methodical procedure for grouping the communities into region types were presented in detail. The results show related areas of the same type and are, with regard to the classic statistical quality codes, perfectly satisfactory.

For a classification which, as in this case, serves a precise content-related scope, the question arises whether the region types are statistical artefacts, or whether they can also be seen as units from an agro-economical point of view.

In this section the attempt will be made to answer this question applying three different methods.

4.1.1 A descriptive approach: centroids

A classic approach to the interpretation of cluster results is the comparison of the centroids of the single clusters. In the case of a high number of variables used for the classification, this approach soon becomes confusing. In this case there are 43 variables requiring a somewhat modified comparison. The following steps were carried out in preparation for the comparison:

The quartiles of the distribution over all alpine communities were determined for all variables, allowing absolute values to be positioned throughout the distribution. This simplifies the distinction between values with a characteristic divergence from the alpine mean (values below the first and above the third quartile) and those that are relatively close to the mean.

Moreover, by relating the values to the distribution quartiles, a 'standardisation' of the variables in regard to their dimension and variance is achieved.

The centroids for each of the eight region types were then determined. These centroids can be interpreted as a characterisation of each agricultural region type. It must, however, be taken into account that the communities which represent a region type may show considerable heterogeneities with regard to the employed variables.

For each regional type variable it was determined within which quartile of the entire alpine distribution the mean appears. For the content-related interpretation, those variables are used which are below the first or above the third quartile and, thus, are of characterising nature. This restriction (the two quarters at the border of the distribution) guarantees to a large degree that only those variables are used for the interpretation which are fairly homogeneous within the region. As each region consists of at least 400 communities, it is sufficiently stable concerning outliers, as it is unlikely for very heterogeneous variables that the respective mean comes within the chosen quartiles.

Table 4.1: Means of the cluster input data (CID) in the respective classes

Cluster Input Data (CID) (Means)	**Region types**								**Alps**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**1 - 8**
	purple	dark blue	pink	green	light blue	yellow	red	brown	
Altitude	421	580	750	483	784	951	814	725	687
Geology	2,0	2,0	1,0	2,0	1,0	1,0	2,0	2,0	2,0
Exposure	3,0	3,0	3,0	3,0	3,0	3,0	3,0	2,0	3,0
Climatic types	5,0	8,0	8,0	5,0	8,0	8,0	8,0	9,0	8,0
Slope angle	2,0	1,0	2,0	2,0	5,0	4,0	3,0	1,0	2,0
Local relief	924	617	1285	978	1744	1468	1342	732	1098
% of working force employed in agriculture	6,4	4,8	7,9	3,3	4,8	5,7	4,1	10,6	5,6
Population movement	3,5	6,5	0,0	2,7	0,8	3,1	5,5	6,0	3,7
Number of tourist beds per inhabitant	0,1	0,1	0,4	0,1	0,3	0,3	0,5	0,1	0,2
% of farm closures	-9,4	-22,6	-6,8	-16,3	-25,1	-47,3	-13,9	-13,2	-15,9
% of farmers over 45 years of age	74,0	68,0	62,6	78,5	78,0	65,8	61,3	59,8	70,1
% of small farms (under 5 ha UAA)	88,4	47,7	52,9	87,2	84,5	31,5	45,6	21,7	65,4
% of farms with more than 5 ha and under 10 ha of UAA	7,4	16,0	17,6	7,3	7,1	20,6	20,8	23,2	13,2
Rate of old age people (over 65)	15,9	13,9	14,3	16,0	16,9	16,6	14,0	14,3	14,9
Rate of youngsters (less than 15)	15,3	18,1	18,3	14,9	14,5	16,4	18,5	20,0	17,2
Employment rate	44,7	40,3	43,7	43,9	42,8	44,8	45,6	45,7	43,8
% of part time farming	67,3	52,1	64,8	80,7	76,2	26,2	68,1	30,8	66,1
Number of family and non family laborers per UAA	1,0	0,2	0,4	0,9	1,0	0,3	0,3	0,2	0,4
Change in part time farming in the last 10 years	0,6	-8,8	19,5	11,9	4,8	-44,9	19,2	28,5	10,1
% of UAA	17,6	21,0	12,4	16,3	4,2	4,9	9,1	28,2	13,0
% of arable land in relation to UAA	15,4	61,6	16,9	25,3	5,3	8,4	8,4	14,8	24,5
% of intensive permanent grassland in relation to UAA	20,3	31,4	81,1	63,4	89,7	90,2	90,6	83,5	67,7
% of permanent crops in relation to UAA	59,5	6,3	1,4	6,3	3,2	0,5	0,5	0,4	6,2
% of uncultivated UAA	17,1	17,6	4,5	15,2	72,2	11,3	10,3	2,7	17,7
Change in UAA	-9,2	-5,9	3,0	-15,1	-28,6	-19,1	-5,0	-2,1	-6,4
Change in the % of arable land in relation to UAA	-8,9	7,8	-37,1	5,1	-15,6	-15,4	-2,2	-1,6	-7,5
Change in the % of intens. perm. grassland in rel. to UAA	-11,8	-4,5	14,9	5,4	4,1	6,4	3,3	8,9	4,4
Change in the % of permanent crops in relation to UAA	13,3	2,3	-2,0	-5,0	41,6	15,8	-1,9	29,8	7,4
Change in the % of uncultivated UAA	22,4	21,5	66,7	63,4	86,6	-25,9	27,4	14,9	39,5
Cattle-LU per hectare UAA without permanent crops	1,6	0,7	1,3	1,1	1,1	1,5	1,3	1,6	1,2
Pig LU per hectare UAA without permanent crops	0,2	0,2	0,2	0,2	0,1	0,1	0,1	0,3	0,2
Sheep and goats LU per hectare UAA without perm. crops	0,2	0,2	0,1	0,1	0,2	0,4	0,2	0,1	0,1
Change in cattle LU per hectare UAA without perm. crops	11,2	-3,4	9,2	1,0	21,7	23,1	1,9	5,7	4,9
Change in pig LU per hectare UAA without permanent crops	14,1	2,8	-20,6	-15,5	0,6	-21,4	-30,4	-30,9	-16,5
Change in sheep and goats LU per ha UAA with. perm. crops	69,3	54,4	105,9	92,6	95,3	63,6	67,5	76,2	78,9
Changes in cattle raising	-44,1	-25,3	-17,9	-40,5	-36,9	-28,3	-21,6	-15,7	-25,7
Changes in pig raising	-57,8	-31,6	-28,2	-51,3	-49,7	-61,9	-41,6	-37,2	-37,9
Changes in sheep and goat raising	-38,5	-34,0	-6,2	-28,5	-37,0	-39,3	-18,9	-25,7	-25,5
% of farms specialised in crop farming	2,9	10,5	1,4	7,4	3,6	0,6	0,6	0,7	4,3
% of farms specialised in permanent crops	72,0	8,7	3,3	17,3	11,0	0,9	1,2	0,6	17,0
% of farms specialised in pasture farming	2,6	26,8	28,8	10,6	18,0	80,7	61,8	84,3	28,4

The results of this procedure are shown in Table 4.1. The colour of the various squares indicates the respective corresponding quartile: Blue stands for the first, green for the second, yellow for the third and orange for the fourth quartile.

The columns list the characteristic features of the agricultural regions, enabling an easy comparison between the regions. The lines list the variables that discriminate well between the various regions and those that do not. For example, it shows that the variable "Change in pig LU per hectare UAA" is on average in the third quartile for all regions and does not, therefore, discriminate at all. In contrast to this, in the case of the variable "Percentage of part-time farming" the regions can be found in each of the four quartiles. Therefore, this variable shows clear differences between the regions.

For the content-related description of the region types and to improve clarity, a combined interpretation of variables which are closely connected with each other (e.g. the percentage of the various crops) was attempted.

On this basis, the eight region types can be characterised as follows:

Type 1: High labour, intensive crop region in a favourable location with a small-scale farm structure

The natural features of this agricultural region are a low sea-level and a mild climate. Accordingly, the area is suitable for intensive crops (fruit, wine, vegetable, flowers) which involve a high labour intensity and a small average farm size.

The restriction in farm size, however, cannot be contributed to the labour intensity factor, but more probably to cultural factors (law of inheritance). The relatively high percentage of uncultivated usable agricultural area supports this assumption.

Although the low percentage of farm closures and the little change in the percentage of uncultivated usable agricultural area are not to be found in the two extreme quartiles, they are nevertheless worth mentioning. Both indicators suggest a relatively stable overall situation.

Type 2: Labour-extensive arable land region in a favourable location

The low slope angle (in combination with moderate altitude and low relief energy) identifies the region as a favourable location. With more than 61%, arable farming predominates along with other permanent crops. This class is extremely labour-extensive with only 0.2 labourers per hectare of usable agricultural area (UAA).

Outside the extreme quartiles, above-average farm sizes and a high percentage of farm closures are striking features. These indicators, together with a decline in part-time farming and the high percentage of uncultivated agricultural area, indicate that in this region a "process of structure clearance" towards specialised, labour-extensive full-time farms is underway.

Type 3: Grassland region with tourism integration and balanced population movement

The third region type is not as striking as the two preceding ones. In the two border quartiles the influence of tourism, the considerable changes concerning permanent grassland and uncultivated usable agricultural areas and the pig LU per hectare are striking features.

These indicators show a dynamic specialisation in stock farming and the economical integration of tourism.

When relating these conclusions to the remaining variables, the balanced population movement and the very low number of farm closures are striking features; therefore, the region can be considered as stable in at least two respects.

From an agropolitical point of view, however, the region is undergoing a striking change - a rapid transition from full-time to part-time farming.

Type 4: Small-scale grassland farms in favourable locations with a surplus of labourers

Technically this region is characterised by a high average age of the farm owners, an extremely high percentage of farms with less than 5 ha of usable agricultural area, a high labour intensity, as well as a fast growing percentage of uncultivated usable agricultural area.

As regards content, this region is comparable in many respects to Type 1. The natural preconditions and farm structures are basically the same. The main difference is that the percentage of permanent crops is almost 10 times higher in Type 1 than in Type 4. This results in a totally different interpretation of the high labour intensity. In Type 1 this intensity is economically sustainable because of the permanent crops and the proceeds that they bring in. In the Type 4 this high intensity is a sign of lacking alternatives. It is the result of a problematic economical situation which is expressed itself in farm closures and land abandonments, as well as in an increase of over-aged farm managers.

From an agricultural point of view the region must be classified as " in decline".

Type 5: Agricultural retraction area with remains of cultivation

This region is characterised by the highest relief energy, the greatest slope angle, and by a very small farm structure. All these characteristics are indicators of a very difficult situation for agriculture. As a matter of fact this region has the highest percentage of uncultivated usable agricultural area (more than 72%). In the last 10 years it has increased to 86%; one can say without exaggerating that agriculture is collapsing in this region.

It is evident that the attempt has been made to change to specialised or permanent crops. The morphological structures of the area, though, set natural limits to these efforts. Tourist activities are present to an extent worth mentioning.

Type 6: Structured, full-time farming region with a tendency towards intensification

The characteristics of this region type are a high number of farm closures combined with a strong reversion of uncultivated usable agricultural areas back to agriculture. Along with this development there is a focus on full-time farming - the closed-down farms are used mainly for part-time farming - which means that, in combination with a high mobility of area between farms, the agricultural land of this region is under full use.

A tendency towards intensification is indicated by the obvious increase in cattle LU per hectare, currently at 1.5 LU, and by the fact that over 80% of the farms are specialised in pasture farming.

The structure and dynamics of this region differ totally from those of the previously described regions. Already at this point the hypothesis can be suggested that this striking difference can be credited to Switzerland's agro-politics.

Type 7: Alpine 'standard region' on the way towards part-time farming

This region has the fewest characteristics in the border quartiles. Only the 0.5 tourist beds per inhabitant classify it as an intensive tourism region.

With a proportion of 4.1% of the employment force, agriculture is under-represented. The number of farm closures is moderate and the employment rate is exceptionally high (45.6%).

The percentage of part-time farmers (68%) is only slightly above average for the Alps. The increase by almost 20% in part-time farming, however, clearly demonstrates the dynamics of the present development.

Type 8: Large-scale cattle breeding in a morphologically favourable location

In this region the favourable location refers to the moderate altitude and low slope angle, combined with a low relief energy. This combination leads to a high percentage of usable agricultural area of the community area and to a percentage of almost 11% of working force employed in agriculture.

As far as farm structure is concerned, there are, for alpine conditions, relatively many so-called large farms (55% of the farms consist of more than 10 ha of usable agricultural area), and they are run by young farm managers as their main source of income.

So far, this type has much in common with the Region Type 6, except for the development aspect however, which differs greatly. Whereas in Region Type 6 part-time farming is in strong decline, in this region it is slightly growing.

Agriculture is conducted labour-extensive but materially-intensive. With more than 84% of all farms specialised in pasture farming, this region has developed the strongest specialisation of all regions.

Conclusion

It has been demonstrated that the region types clearly differ from each other. As regards content, well differing structures and developmental tendencies can be distinguished. This information makes it possible to discern different correlations between agro-political regulations and their effects on the environment.

But the content-related interpretation shows already that differences between the regions are not equally weighted: some region types, e.g. Type 6 and 8, are very similar; others, such as Types 1 and 5, could not differ more widely.

These similarity relations will be objectivised in the next section.

4.1.2 Similarities and differences between the agricultural region types

4.1.2.1 Approach 1: multidimensional scaling (MDS)

Multidimensional scaling is a statistical method which (among other things) projects the positionings of single observation units in an n-dimensional space into a lower-dimensional space, in such a way that the distances between the various observation units are shown as unchanged as possible.

In the present case the observation units are the eight region types which are illustrated by their centroids (or their medoids) in a 43-dimensional space (determined by the 43 variables used to form the cluster). By means of MDS these observations are visualized two-dimensionaly. The distances, which are to be preserved, are measured by means of the Euclidean distance coefficient.

This strong reduction in dimensionality makes the interpretation of the results considerably easier, but cannot be achieved without a loss of information. To measure information loss, either the so-called stress or the better known determination coefficient (R^2) can be used. In this case the determination coefficient is determined as square of the Pearson correlation coefficient between the distance of the observation units in the first space and the distance after projection into the two-dimensional space. The value of the determination coefficient is excellent: 0.94. That means that 94% of the distance information could be preserved or, vice versa, that the change from the 43 to the 2 dimensions involved an information loss of 6%. The value of 0.091 for stress also indicates a good result.

These results must, however, be relativised to a certain degree, as only 8 region types were based on the MDS and, therefore, the number of freedom degrees is rather low. The result can, however, certainly be used as a descriptive approach to the topic.

Figure 4.1 shows the result of the MDS emanating from the centroids of the agricultural region types.

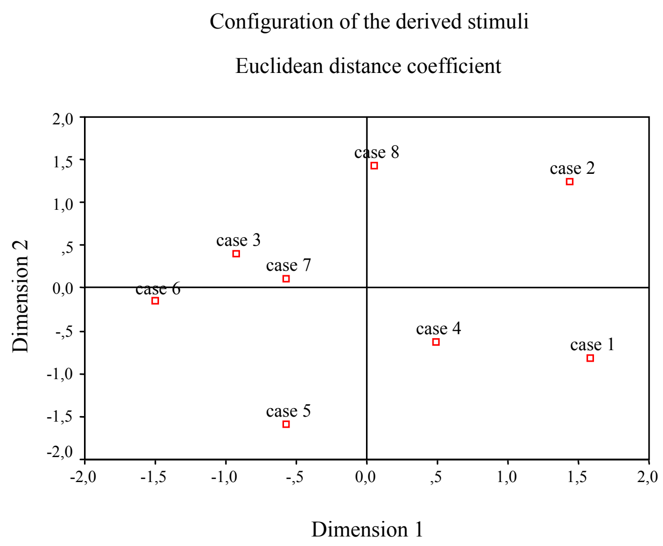

Figure 4.1: Positioning of the eight agricultural region types on the basis of the MDS

Figure 4.1 shows that the objectivisation of the similarities is definitely useful: the similarity of the two Swiss regions (6 and 8), so "obvious" in the qualitative interpretation, is clearly dissolved in both dimensions. Also the evident difference between the regions 1 and 5 is confirmed only with regard to dimension 1, whereas the regions are definitely comparable with regard to dimension 2.

These differences between the content-related and the statistical interpretations are based on implicitly different weightings in the qualitative interpretation. They can definitely be justified with regard to content. The comparison with the results of a procedure which weights all variables in the same way (and of course they were standardised), should make a critical appreciation of the proposed arguments easier.

It is further necessary to interpret the dimensions with regard to content, if the MDS results are to be used for anything more than "similarity relationships" alone. This is accomplished on the basis of a simple correlation analysis with the respective dimension values of the single region types. When using only significant coefficients, one can see that the first dimension describes the natural and social environments of the region. The altitude and the relief energy determine this factor. The consequence is specialisation in permanent grassland. The mobility balance and the employment rate, however, are dependent on the social and economic environments. On the whole, the first dimension is determined by factors which are to a large extent exogenous to agriculture.

The second dimension describes very clearly the agricultural structure: the average age of farm managers, farm size, and percentage of part-time farmers, as well as changes in this value. In close relationship to these factors are the percentages of permanent crops and uncultivated usable agricultural area, as well as changes in goat raising. Tentatively, one could interpret this as the intensification dimension.

The relatively clear differentiation between the natural factors, which can hardly be influenced, and the agricultural structure parameters, which can be agro-politically influenced with some prospect of success, emphasizes the validity of the chosen approach.

4.1.2.2 Approach 2: discriminance analysis

Like the cluster analysis, discriminance analysis is a method which assigns observation units - in the present case, communities - to a certain number of groups (agricultural region types). In contrast to cluster analysis, discriminance analysis requires a certain number of cases, for which it is presupposed to which group they belong. In order to obtain such an a-priori classification, the database of 5,558 communities is split up into two groups of the same size. With the first group the discriminance functions are determined on the basis of group membership which, in turn, was determined by cluster analysis. For the second group of communities a group assignment 'independent' of the cluster analysis is determined by means of the discriminance functions. This process should provide three pieces of information:

- Is it possible to obtain a classification which corresponds, as regards content, to the typology of cluster analysis by applying a very different statistical method? (validation attempt)

- To what percent does classification with this approach deviate from cluster analysis and is this method completely independent of cluster analysis? (discernment factor)
- Is it possible to obtain information on the similarity of the agricultural region types from the two best group membership solutions, that is compatible with the results of MDS?

The first of the three questions can be answered by means of the hit rate on the validation quantity of the communities (communities not used to determine the discriminace functions): it is 86% and very stable. This means that both methods assigned 86% of all communities identically to the eight region types.

Apart from the best class membership, the discriminance analysis provides information on the probability of a certain observation unit belonging to one of the groups. This enables the determination of not only the best solution, but also a second best. In 10% of the 14% misclassified communities, cluster analysis had recommended second best solutions. In most of these cases the probability differences between the best and the second best solutions are so small that they can be referred to as true transition communities. This result agrees with fuzzy clustering and demonstrates that there are transitions between the agricultural region types, which are, from a quantitative standpoint, not so weighty that they could invalidate the grouping process.

By forming a cross table of the two best solutions for community group assignment, the relative frequencies in this table can be used as an indicator for similarity between two agricultural region types. To obtain a comparable scale, the actual frequencies of each cell are applied to its expected frequencies, as analogous as in all chi-squared methods.

The Table 4.2 shows these relativised scales for all 64 fields; a high value of the cell (i,j) indicates a high similarity between the agricultural region types i and j.

Table 4.2: Chi square based measures of similarities between the eight region types

	Region - 1	Region - 2	Region - 3	Region - 4	Region - 5	Region - 6	Region - 7	Region - 8
Region - 1	0,000	6,782	0,037	0,964	0,480	0,023	0,056	0,000
Region - 2	2,438	0,000	1,075	1,355	0,608	0,848	0,669	1,336
Region - 3	0,035	0,998	0,000	2,466	0,594	0,402	2,149	0,086
Region - 4	1,003	1,048	2,620	0,000	4,614	0,022	0,620	0,000
Region - 5	4,570	0,076	1,001	2,283	0,000	0,319	0,317	0,000
Region - 6	0,319	0,421	0,377	0,223	0,067	0,000	1,857	4,221
Region - 7	0,015	0,399	1,763	0,717	0,490	1,684	0,000	2,359
Region - 8	0,215	0,911	0,078	0,009	0,000	3,837	2,309	0,000

Considering only the strong similarities (larger then 2), a nearly linear sequence of similarities in the order 2 – 1 – 5 – 4 – 3 – 7 – 8 – 6 can be drawn up. Only the relation between 5 and 1 is unilateral.

The ascertained sequence shows impressively the already mentioned similarity between Region Types 6 and 8. It also explains the ambivalent relation between 1 and 5 through the unilateral connection; some communities which fit to Type 1 are classified to Type 5, but there are hardly any communities of Type 1 which can be seen as "neighbouring" to Type 5. These apparently contradictory results are stemming from a different dispersion within the variables and thus show an even more realistic (in terms of details) image as the group centroids .

The plausibility of the second best classification becomes obvious when comparing the ascertained similarities with the maps of the region types (see Figure 3.5) the second best resolution is a region type which borders on the actually region type. It is thus comprehensible that the "misclassified communities" are transition types.

As basis for the present project the following results can be summarised:

- Based on a broad set of structural data of the natural space, the socio-economic surroundings and the agriculture, region types, which comprise mainly spatially connected areas and thus can be interpreted regionally, were ascertained by means of a cluster analysis.
- The ascertained region types show group centroids which can be easily interpreted in terms of structural differences.
- It is possible to depict the entire vector of variables on a two-dimensional plane by means of the multi-dimensional scaling with an only small information loss. The resulting two dimensions don't represent only an artificial construct, but are helpful for interpreting regional differences.
- An alternative procedure to the cluster analysis, the discriminance analysis, reproduces the belonging to a class with more than 85% in all examined cases. Thus, the classification shows a definite robustness of the applied method .
- Finally, the misclassified communities can be seen as actual transition phenomenon and consequently are rather a indication for the strength than for a shortcoming of the applied method.

All these points support the assumption that the chosen classification method forms a solid basis for the analysis of region-specific interrelations between the instruments of the agricultural policy and the resulting environmental effects.

4.2 Typical representatives of the eight region types

Richard Dietrich, Peter Eggensberger, Alexandra Ercolani, Martin Gasser, Roland Kals, Hans Josef Kienzl, Jens Siegloch, Rudi Staub, Klaus Steininger and Christine Vigl

The ten selected model regions are characteristic for the respective region types (see Section 4.1). They are employed to carry out case studies and extended analyses in order to enable a comparison between the single region types as well as between the various alpine countries (see Section 2.2.2.1). Figure 4.2 shows the model regions which are presented in more detail in the following sections.

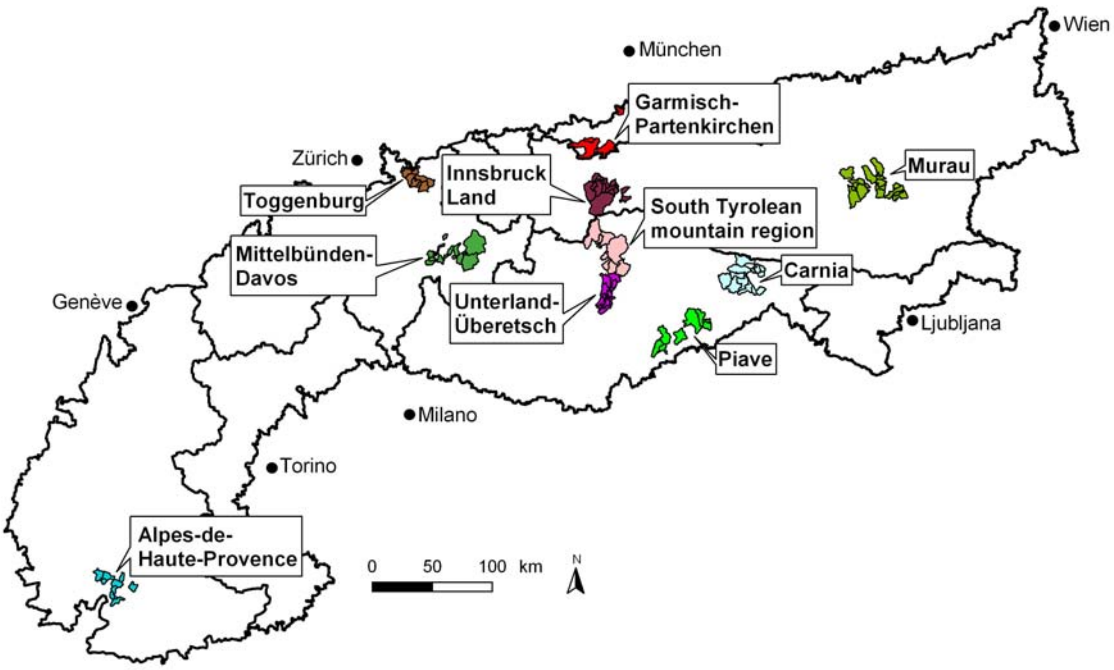

Figure 4.2: The ten model regions of SUSTALP

4.2.1 Type 1:

According to the features of the various agricultural regions (see Section 4.1) Region Type 1 is mainly characterised by a high percentage of permanent crops. Predominately it can be found along the Adige valley and at the southern border of the French Alps. The model region representing this region type comprises 13 communities in the South Tyrolean Unterland/ Überetsch.

4.2.1.1 Unterland-Überetsch:

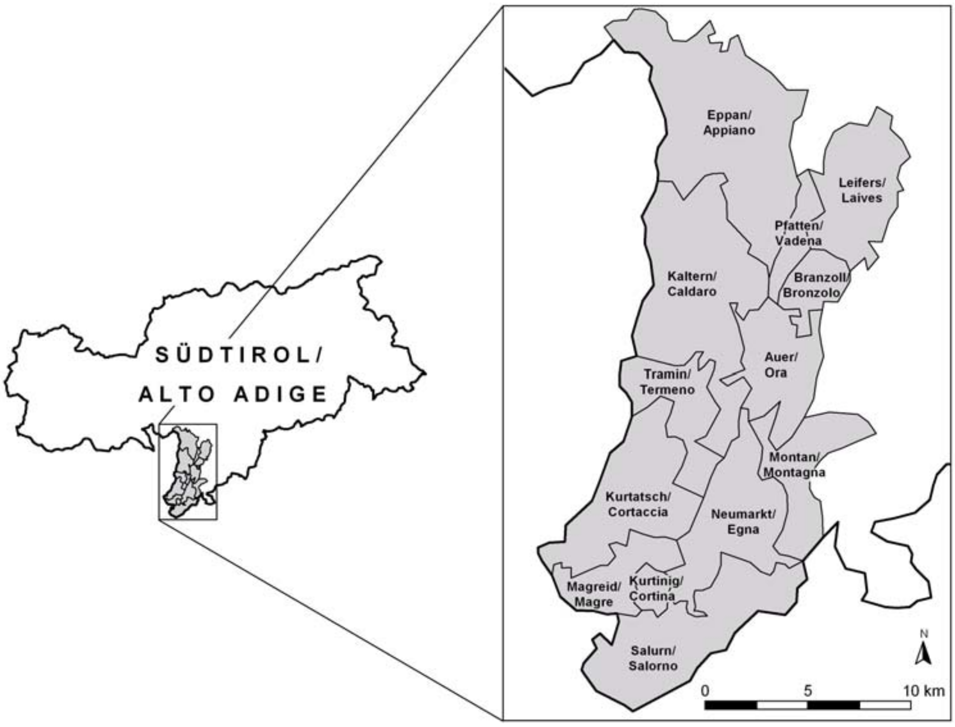

Figure 4.3: Model region Unterland-Überetsch

Unterland-Überetsch ranges from below Bolzano to the jurisdictional border at the southern end of South Tyrol as well as orographically on both the left and right banks of the Adige river. The Adige valley is a glacially formed, U-shaped valley with a wide floor in the Unterland. The valley, which received its final geomorphological shape as a result of the erosive activity of the Adige, is bordered on both sides by valley walls which at times rise up very steeply. Because of their steepness and their only occasionally existing terraces, the slopes of the valley walls offer usable agricultural areas only to a limited extent. Villages are found primarily on the gentler slopes as well as on alluvium cones or talus cones which were deposited by tributary streams that flow into the main valley. Today, areas in the valley floor have been entirely drained, levelled, and improved. In place of the original river-meadow forests and marshes, today extended, intensively farmed fruit and vineyard cultivation are found there. The foot of the slopes on the left and right side of the Adige valley including the talus cones are used primarily for viticulture. The slopes further up are dominated by deciduous and mixed deciduous-coniferous woodlands with forestry usage. Plateau areas are occasionally found. They are used for intensive fruit and wine cultivation, and, at higher elevations, primarily for grassland agriculture and intensive forestry.

The valley floor is dominated by a dense infrastructure network, such us the highway Brennero-Modena, the double-track railway Bolzano-Verona, main and secondary roads and agricultural tracks, drainage ditches as well as the natural gas pipeline along the Adige river. Beside these north-south oriented networks of routes with a considerable fragmentation effect, also different commercial areas are to be found.

The average altitude of the main villages is around 250 m. The highest point lies at about 1,300 m a.s.l. As the main-valley is open towards the south, the regional climate is strongly influenced by submediterranean climate conditions of the Lake Garda region. The mean annual temperature ranges from 8°C to 12.5°C (Hydrographical Office, Autonomous Province of Bolzano). The average annual precipitation of the last decades reaches from 700 to 1,000 mm (Hydrographical Office, Autonomous Province of Bolzano). The precipitation cycle is typically continental with a distinct summer maximum.

Table 4.3: Description of the model region Unterland-Überetsch on the basis of natural, socio-economic and agricultural criteria

Natural characteristics	Unterland-Überetsch
Climatic type	warm temperated, humid
Mean annual precipitation (mm)	713 - 962
Geology	mainly crystalline rocks, valley-floor filled with quaternary depositions
Hillslope erosion	occasionally
Field form	cleared at the valley floor, moderately structured on the slopes and slope foot sites
Structures of landscape pattern	moderately to occasionally
Socio-economic indicators	
Employment rate (%)	46.5
Percentage of employees in agriculture (%)	13.7
Population movement (changes over 10 years) (%)	4.3
Percentage of farm closures (changes over 10 years) (%)	2.4
Percentage of farmers over 45 years of age (%)	70.8
Percentage of part time farming (%)	63.2
Agricultural structure	
Percentage of small farms (under 5 ha of usable agricultural area) (%)	91.3

Large animal unit (LU) per usable agricultural area	1.8
Percentage of intensive permanent grassland in relation to usable agricultural area (%)	7.1
Percentage of arable land in relation to usable agricultural area (%)	0.6
Percentage of permanent crops in relation to usable agricultural area (%)	91.8
Percentage of farms specialised in permanent crops (%)	95.0

Reference: ISTAT (1990) Censimento agricoltura. Rom. ISTAT (1991) Censimento popolazione e abitazioni. Rom. ISTAT (1980-1990) Popolazione e movimento anagrafico dei comuni. Rom. Walter, Lieth (1960/67) Klimadiagramm Weltatlas. Jena. EROS Data Center (1995) Digital Elevation Model. Sioux Falls. Jaksch, K. (1994) Map: Gesteinszonen der Alpen. In: Die Alpen. Pinguin-Verlag, Innsbruck, p.7. Bögl, H. (1986) Map: Geologische Karte von West- und Mitteleuropa. In: Geologie in Stichworten. 4th edition. Verlag Ferdinand Hirt, Unterägeri. Europäische Akademie Bozen (1999) Landschaftstrukturanalyse

Agriculture in Unterland-Überetsch is characterised by intensive fruit and wine cultivation. The raising of cattle and the dairy farming play no role in this area, nor do the raising of sheep or goats. Fruit farmers are, for the most part, members of a fruit co-operative and sell their products through these entities. Approximately two-thirds of the grapes grown in the vineyard areas of Unterland-Überetsch are delivered to co-operatives. The remainder is mostly sold to independent wineries. In recent years the wine produced in this area has been able to establish itself at an international level. The processing of the products at the farm and direct marketing play a secondary role. Organic farming is hardly to be found in Unterland-Überetsch, but large sections of the permanent crop area are farmed using integrated production methods.

The agricultural enterprises are extremely small, with an average reduced usable agricultural area of 2.2 hectares. Many farmers must engage in a secondary occupation. Small structures, the absence of land which can be leased, and falling fruit prices represent great problems for farmers in Unterland-Überetsch.

Figure 4.4: Model region Unterland-Überetsch (I): The landscape is characterised by intensive fruit and viniculture

The Überetsch with the communities Eppan and Kaltern is strongly determined by tourism. This also results in a widely developed agritourism.

4.2.2 Type 2:

According to the characteristics of the various agricultural regions (see Section 4.1), Region Type 2 is mainly characterised by a high percentage of arable land and a low number of workers per usable agricultural area. Predominately it can be found in the French alpine region and in Slovenia. The model region representing this region type comprises 10 communities in Alpes-de-Haute-Provence.

4.2.2.1 Alpes-de-Haute-Provence

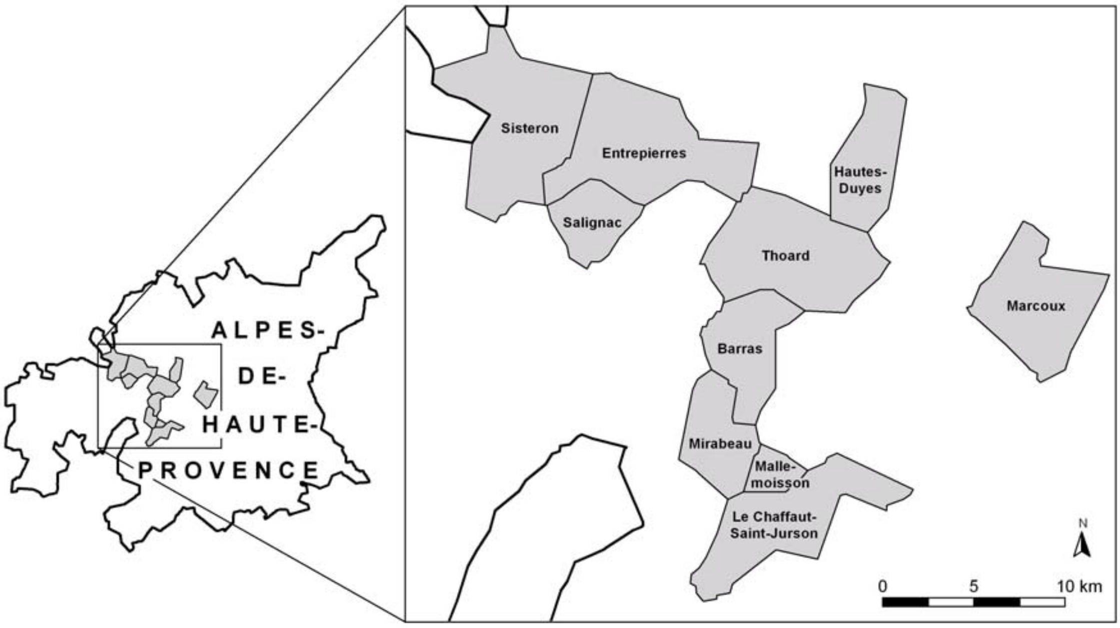

Figure 4.5: Model region Alpes-de-Haute-Provence

The French model region Alpes-de-Haute-Provence is located in the Prealps of south-eastern France, an area which stretches form the high mountain region of the Western-Alps to the more flat countryside that begins approximately with the Vallée de la Durance near Manosque and ends on the Côte-d'Azur.

From a geological point of view, the Prealps consist prevalently of limestone and are characterised by elevations which generally do not extend over 1,500 m a.s.l.. The rather smooth mountainous landscape is sporadically dispersed by steep and rocky outcrops.

A distinguishing mark of this part of the Alps is the contrast between the mainly untouched and "virgin" slopes and mountain peaks (usually covered by woods) on the one side and the rather intensive use of cultural land on the valley bottoms on the other. Intensive farming takes place also in high plateau regions (e.g. in Sisteron and Entrepierres). However, also within the agriculturally "developed" areas landscape features such as dry grass-formations or not-regulated torrents can be found.

The prevalently scattered (non agricultural) settlement structure is characterised by a low rate of recently build or modern buildings. New buildings for agricultural purposes are scarce and do not present any disturbance for the local landscape.

The fact that both, agricultural and non-agricultural land hardly suffer from any kind of erosion, might be explained by the fact that almost no slope is used for intensive farming purposes. They are usually covered by woods and bushes, frequently interrupted by extensive sheep and goat pasturage.

Table 4.4: Description of the model region Alpes-de-Haute-Provence on the basis of natural, socio-economic and agricultural criteria

Natural characteristics	Alpes-de-Haute-Provence
Climatic type	humid with Mediterranean influence
Mean annual precipitation (mm)	about 900 – 1,100
Geology	Calcareous rocks
Hillslope erosion	rarely
Structures of landscape pattern	great variety with the exception of some valley floors
Socio-economic indicators	
Employment rate (%)	38.1
Percentage of employees in agriculture (%)	5.2
Population movement (changes over 10 years) (%)	11.3
Percentage of farm closures (changes over 10 years) (%)	19.2
Percentage of farmers over 45 years of age (%)	71.1
Percentage of part time farming (%)	40.7
Agricultural structure	
Percentage of small farms (under 5 ha of usable agricultural area) (%)	27.7
Large animal unit (LU) per usable agricultural area	0.9
Percentage of intensive permanent grassland in relation to usable agricultural area (%)	16.9
Percentage of arable land in relation to usable agricultural area (%)	76.7
Percentage of permanent crops in relation to usable agricultural area (%)	4.8

Reference: Recensement agricoles, 1988; Recensement généraux de l'agriculture - Fiches comparatives, 1970-1979-1988; Recensement générale de la population, 1990; Système Informatique pour le Répertoire des Entreprises et des Etablissements (SIRENE), Evolutions démographiques, 1982 – 1990; Communoscope – Inventaire communale, 1988

The French model region is characterised by a high rate of agricultural activity and other occupations related to the primary sector. The long tradition of sheep farming determines both landscape as well as economic activities of a large part of the population (e.g. processing of sheep meat, tourism, etc.).

The only alternative to the farming sector seems to be the public service sector as well as tourism in the main "centres" Digne-les-Bains and Sisteron. The lack of specific infrastructure (hotels, restaurants, agritourism) in the smaller villages is very often a consequence of specialisation in traditional farming (no agritourism) excluding the possibility of part-time farming and thus a second income.

In the last decades a dramatic change in agriculture took place in different terms. The high rate of farm closures for the period between 1979 and 1988, as already indicated in Table 4.4, continued in the following years. In some communities, within the last 10 years 80% of the farms have been closed. Similarly, the total agricultural usable area per farm increased permanently, which lead to a low rate of small farms in comparison to the other model regions. Furthermore, several co-operation activities among the farmers have been established. Basic infrastructure for agricultural and forestry-purposes seems to be modern and well established.

In terms of production a strong tendency of specialisation in the remaining farms can be observed with the following main activities: production of sheep and goat well distributed all over the area, crops in valley floors and permanent crops especially in higher plateau regions. In higher parts of the region perfume-plants and medicinal herbs in dry and sunny areas are cultivated. Despite the specialisation on farm level, the agriculture in the model region is characterised by an enormous variety of agricultural products.

Figure 4.6: Mountain agriculture in model region Alpes-de-Haute-Provence

4.2.3 Type 3:

According to the characteristics of the various agricultural regions (see Section 4.1.1), Region Type 3 covers the typical core area of the Alps. It is mostly located in the central and eastern parts of the Alps and is represented by two model regions. One of it, namely the South Tyrolean mountain region, is to be found in the northern region of the Italian Alps and the other one, Murau, is situated in Austria, south of the main alpine ridge in the Schladminger and Sölker Tauern.

4.2.3.1 South Tyrolean mountain region:

The model region South Tyrolean mountain region stretches from the Oetztal Alps to the Dolomites in the form of vast plateaus and high-lying valleys. Apart from the valley floors it is largely made up of steep slopes and terraces, as well as of high-altitude tributary valleys and alpine pastures. The average altitude of the main villages is around 1,000 m a.s.l.

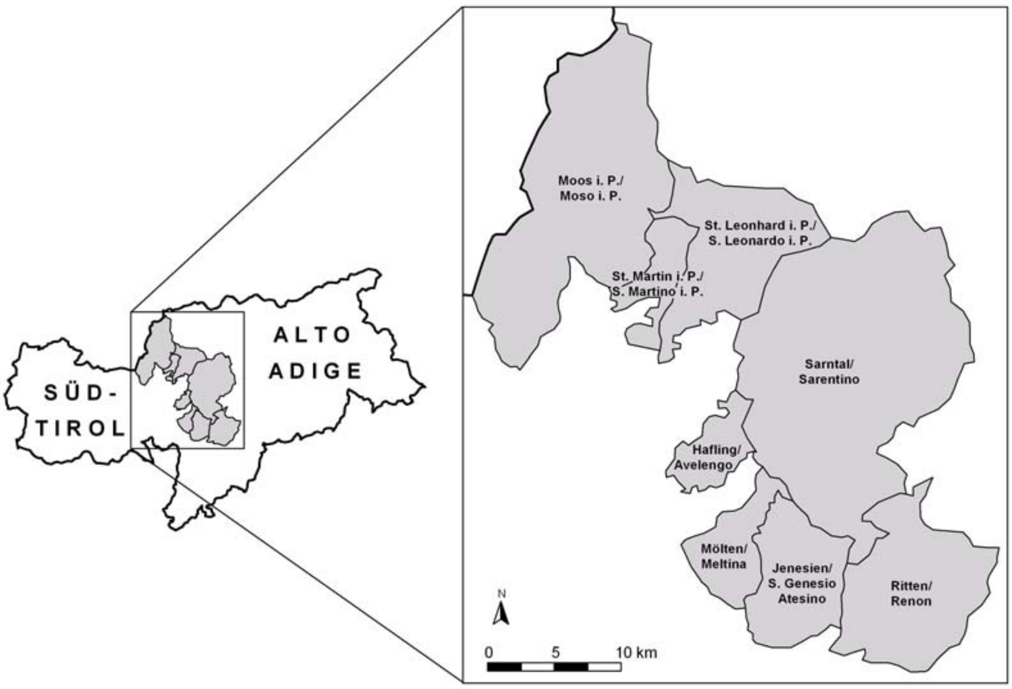

Figure 4.7: Model region South Tyrolean mountain region

Along the terraces, the slope foots and the valley floor fertile meadows caused by intensive agricultural use of the land can be found almost exclusively. Intensive land use resulted also in large landscape clearances and land levelling activities in many places. It is remarkable, that in the side valleys and at the high-lying areas nearly all cultivated land is still being used today to its full extent. Yet, a great number of this area (e.g. mountain meadows and alpine pastures) belongs to marginal land. Depending on the respective steepness of land, a more or less wide stretch of forest which is frequently used extends between the alpine pastures and the valley meadows.

The model region South Tyrolean mountain region is characterised by a large variability in altitude. It stretches from the colline-montane altitudinal zone in the main valley to the nival altitudinale zone of the glaciated region. Consequently, the climatic conditions vary correspondingly. The average annual temperature of the intensively used areas reaches from 7°C to 10°C in the main valley and is around 2°C in the high-altitude valleys (Hydrographical Office, Autonomous Province of Bolzano). Large parts of the intensively used land can be described as being moderately humid. The average annual precipitation of recent decades ranges from 773 to 1,043 mm (Hydrographical Office, Autonomous Province of Bolzano). Depending on altitude, however, it increases to about 1,500 mm in the upper region. Principally, precipitation is considered to be safe and shows a typically continental distribution with the rainfall maximum occuring in summer.

Table 4.5: Description of the model region South Tyrolean mountain region on the basis of natural, socio-economic and agricultural criteria

Natural characteristics	**South Tyrolean mountain region**
Climatic type	humid with cold season, mountain region
Mean annual precipitation (mm)	773 – 1,043
Geology	crystalline rocks
Hillslope erosion	occassionally
Field form	moderately cleared
Structures of landscape pattern	moderately to occassionally
Socio-economic indicators	
Employment rate (%)	45.7
Percentage of employees in agriculture (%)	20.7
Population movement (changes over 10 years) (%)	- 0.8
Percentage of farm closures (changes over 10 years) (%)	- 10.5
Percentage of farmers over 45 years of age (%)	61.3
Percentage of part time farming (%)	46.8
Agricultural structure	

Percentage of small farms (under 5 ha of usable agricultural area) (%)	51.7
Large animal unit (LU) per usable agricultural area	2.0
Percentage of intensive permanent grassland in relation to usable agricultural area (%)	95.2
Percentage of arable land in relation to usable agricultural area (%)	2.4
Percentage of permanent crops in relation to usable agricultural area (%)	2.2
Percentage of farms specialised in pasture farming (%)	49.2
Percentage of farms specialised in arable crops (%)	0.3
Percentage of farms specialised in permanent crops (%)	3.8

Reference: ISTAT (1990) Censimento agricoltura. Rom. ISTAT (1991) Censimento popolazione e abitazioni. Rom. ISTAT (1980-1990) Popolazione e movimento anagrafico dei comuni. Rom. Walter, Lieth (1960/67) Klimadiagramm Weltatlas. Jena. EROS Data Center (1995) Digital Elevation Model. Sioux Falls. Jaksch, K. (1994) Map: Gesteinszonen der Alpen. In: Die Alpen. Pinguin-Verlag, Innsbruck, p.7. Bögl, H. (1986) Map: Geologische Karte von West- und Mitteleuropa. In: Geologie in Stichworten. 4th edition. Verlag Ferdinand Hirt, Unterägeri. Europäische Akademie Bozen (1999) Landschaftstrukturanalyse

With an average reduced usable agricultural area of 9.7 ha, the farms operating in the South Tyrolean mountain region are relatively small when compared with the rest of the alpine area (18.4 ha). This, and the climatically determined short vegetation period reduce production possibilities significantly. Consequently, intensive grassland farming with specialised dairy farms is predominant in the valleys, on the terraces and at the lower sloping sites. The stocking density of 1.6 LU/ha UAA lies above the alpine average of 1.1 LU/ha UAA. Cattle fattening, vegetables and timber only play a minor role. Cultivation forms, such as fruit, wine and berries however are of little importance, except in a few areas of lower altitude.

The areas belonging to the agricultural farms are frequently fragmented. However, the farms and the individual areas are well developed and accessible by larger farm vehicles. Most of the farms are modernised i.e. the farm buildings and living areas are in good condition. Most of the farms have also an intact stock of machinery.

Around half of the agricultural farms in the South Tyrolean mountain region are run as a second occupation. Natural conditions, falling prices for agricultural products, as well as a lack of possibilities to convert to alternative products with a higher yield force several farmers to run the farm in this manner, as an existence and an adequate income from the farm can no longer be guaranteed. Some farmers go into agritourism in order to secure an income at the farm. Moreover, attempts at the direct marketing of products can also be seen in the South Tyrolean mountain region.

Figure 4.8: Farms operating in the South Tyrolean mountain region (I) are relatively small, therefore intensive grassland farming with specialised dairy farms is predominating

4.2.3.2 Murau

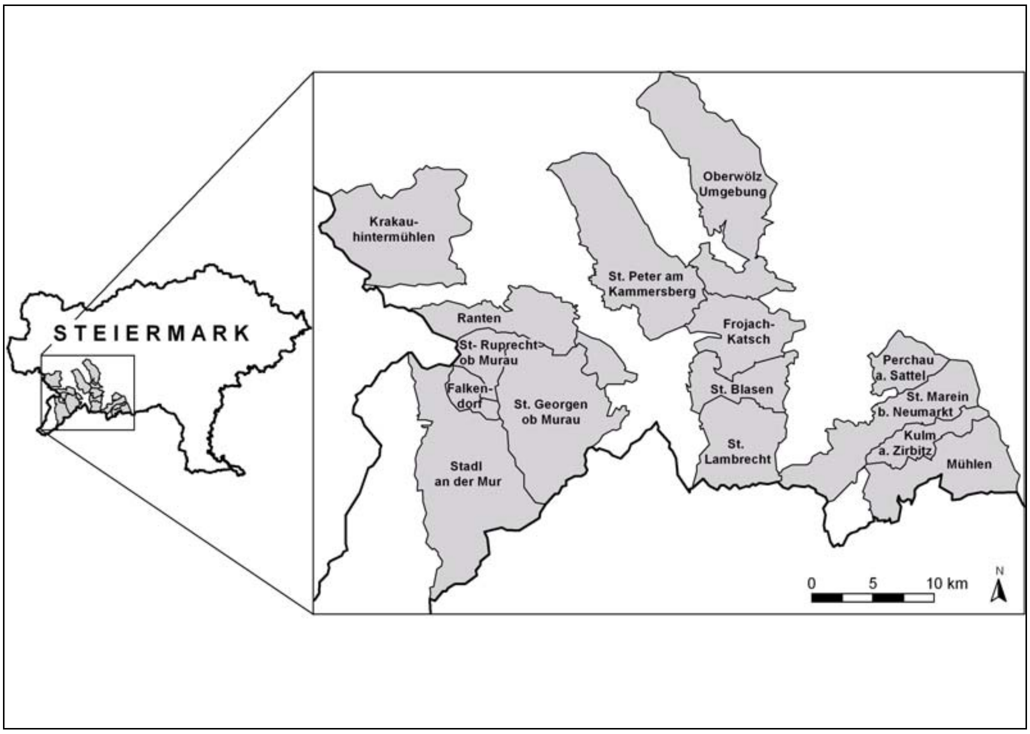

Figure 4.9: Model region Murau

General

The region of Murau is situated in the Austrian province of Styria south of the main alpine ridge with rocky summits up to 2,700 m a.s.l. To the south and east natural borders are built by mountain ranges which are generally lower (max. 2,400 m a.s.l. in the far south-west, for the rest 1,800 m to 2,150 m a.s.l.) with typically smoothed shapes. Good pastures are found high up while the mountain slopes are almost completely forested . Potential vegetation consists of mountainous and sub-alpine woods with spruces and larches, at higher altitudes turning into dwarf-pines and dwarf-shrub-heather.

The geological structure is dominated by silicate metamorphic rock (mostly gneiss and mica schist). In the centre of the region a range of carbonate rock crosses the Mur valley. The hard, withstanding material forms an eye-catching cliff bearing a huge cave entrance called "Puxer Loch".

Smoother landforms in the south-eastern part of the region show the occurrence of phyllite sediments (green schist and graywacke schist).

Climatic conditions based on a temperate continentality are specific for alpine basins. Moderate average annual temperatures (5 - 6 ^{o}C) contrast with a rather low average in January (-4 till –5 ^{o}C). Annual precipitation varies with altitude from about 700 – 770 mm/y up to 900 – 1,000 mm/y.

Agrarian settlement, economy, infrastructure

Generally agricultural dwellings are situated on slopes, in most cases exposed towards south and west reaching up to 1,350 m a.s.l. Farm houses typically are situated near the centre of the arable property which is surrounded by forest.

Near the bottom of valleys villages and hamlets are to be found frequently, commonly combined with block-cultivation. Historic settlements usually occupy fans or terraces in avoidance of the formerly marshy valley ground. Settlements, shape and material of buildings, meadows, pastures and woodland together still build up a very specific and harmonic scenery.

Valley floors in common are cultivated as mowed grassland and – occasionally – as arable land. Forests on the slopes reach up to 1,700 m a.s.l., in the north and south-west of the region even up to 1,900 m a.s.l.

Organic farming at which the spectrum of products is almost the same as in conventional farms, is widely spread. As a result of low production intensity rich structures within the landscape pattern like hedgerows, traditional fences or tiny waters can still be found widely. Recently uncommon views arise with the introduction of modern farming techniques (e. g. bail silage).

The spectrum of marketable agricultural products has become very poor. Dairy-farming and cattle-breeding dominates by far, production and marketing of "alternative" goods are limited by climatic conditions and lacking market proximity. Forestry holds an eminent place, whether combined with agriculture or as pure forestry enterprises of considerable size.

Figure 4.10: Rural settlement (1,150 m a.s.l.) at the foot of Zirbitzkogel: In regional comparison excellent farming conditions: reasonable size of the economic unit, good configuration of fields, minor unfavourable areas.

An important initiative with close connection to native farming and craft is the "wooden road" ("Steirische Holzstraße"), a permanent exhibition distributed over 23 locations in the whole region. It shows historical and modern possibilities of using wood (bridges, buildings, heating techniques, tools, furniture, music-instruments, etc). In the south-east of the region the "Naturpark Grebenzen" (an "area of outstanding natural beauty") offers "gentle" tourism with emphasis on experience of nature and holidays on the farm.

Table 4.6: Description of the model region Murau on the basis of natural, socio-economic and agricultural criteria

Natural characteristics	Murau
Climatic type	Alpine valley and basin climate, mountain climate
Mean annual precipitation (mm)	700 – 1,000
Geology	metamorphic rock, sporadic carbonate rock
Hillslope erosion	insignificant
Field form	"Einödflur", "Blockflur"
Structures of landscape pattern	reasonable
Socio-economic indicators	
Employment rate (%)	43.1

Percentage of employees in agriculture (%)	16.5
Population movement (changes over 10 years) (%)	-6.1
Percentage of farm closures (changes over 10 years) (%)	-1.7
Percentage of farmers over 45 years of age (%)	58.9
Percentage of part time farming (%)	57.2
Agricultural structure	
Percentage of small farms (under 5 ha of usable agricultural area) (%)	34.4
Large animal unit (LU) per usable agricultural area	1.5
Percentage of intensive permanent grassland in relation to usable agricultural area (%)	85.8
Percentage of arable land in relation to usable agricultural area (%)	14.0
Percentage of permanent crops in relation to usable agricultural area (%)	0.0
Percentage of farms specialised in pasture farming (%)	23.3

Reference: OeSTAT (1997) Agrarstrukturerhebung 1995, special analyses 1998. Wien; proprietary inquiry (Landschaftstrukturanalyse 1999)

4.2.4 Type 4:

The Region Type 4 (characterisation see Section 4.1.1) is to be found almost exclusively at the southern border of the Italian alpine arch. The model region which represents this region type is located in the Italian province of Belluno, between and around the communities of Feltre and Belluno.

4.2.4.1 Piave

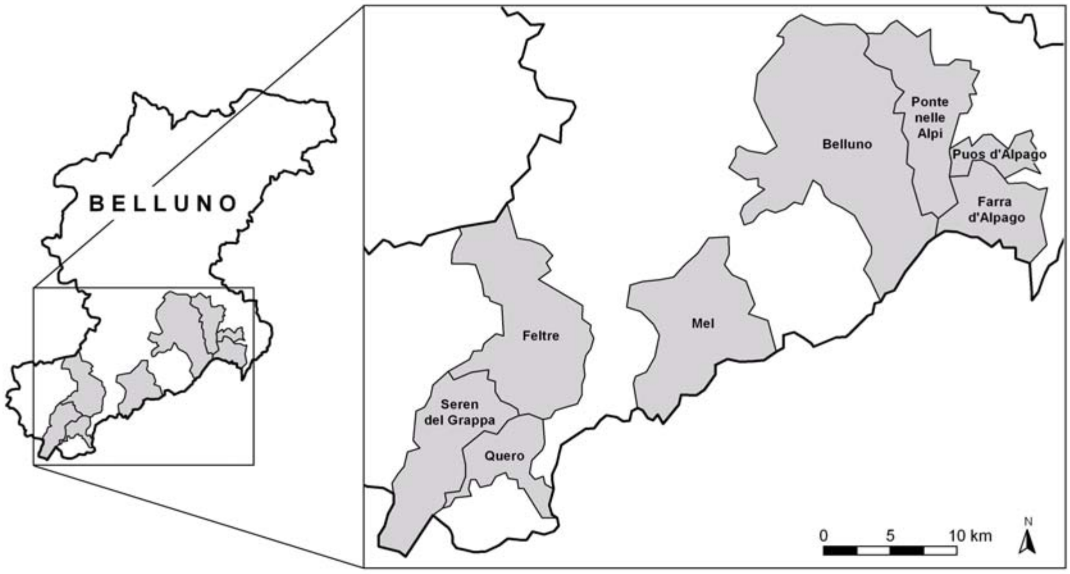

Figure 4.11: Model region Piave

Between Belluno and Feltre the model region Piave extends from the fluvial-glacial valley floor of the Piave, over slope foot areas, terraces and low mountain range areas to the Dolomites of Belluno. The valley floor is generally quite broad (approximately 0.5 - 1.5 km). The entire valley floor is strongly spoiled by settlement, and in the areas immediately surrounding Feltre and Belluno the settlement structure already has an urban character. In the whole valley floor there are many road settlements, exclusive residential areas and dormitory towns. Agriculture has been harmed by expansive building policies in the last decades. Good infrastructural connections to the near conurbations Treviso and Vicenza have increased the settlement of industrial companies, shopping centres and other large concerns. The whole valley floor is heavily fragmented by a dense road network. The majority of the remaining agricultural areas in the valley are used intensively. Intensively used areas are also to be found at the slope foot and on the terraces. At higher elevations, in the lateral valleys and in remote villages, however, agriculture has come to an almost complete standstill. Large parts of the model region are covered with mixed deciduous woods and at higher elevations with coniferous and deciduous woods. In the alpine area the typical grass and rock vegetation is to be found.

Regarding temperature, the model region Piave extends from the colline altitudinal zone in the valley floor (average annual temperature 10°C) to the alpine altitudinal zone (average annual temperature -5°C). However, most parts of the agricultural used area belongs to the colline-montane altitudinal zone (7°C - 10°C). The whole area can be classified as moderately humid (annual precipitation 1,200 – 1,500 mm) to very humid (annual precipitation over 1,500 mm). Precipitation varies considerably from year to year. It shows a mediterranean distribution with rainfall maxima occuring in spring and in autumn.

Table 4.7: Description of the model region Piave on the basis of natural, socio-economic and agricultural criteria

Natural characteristics	Piave
Climatic type	warm temperated, humid
Mean annual precipitation (mm)	1,200 – 1,500
Geology	sedimentary rocks, mainly limestone and dolomite
Hillslope erosion	none
Field form	moderately to richly structured
Structures of landscape pattern	moderately to richly
Socio-economic indicators	
Employment rate (%)	43.5
Percentage of employees in agriculture (%)	3.1
Population movement (changes over 10 years) (%)	0.8
Percentage of farm closures (changes over 10 years) (%)	22.6
Percentage of farmers over 45 years of age (%)	82.5
Percentage of part time farming (%)	80.8
Agricultural structure	
Percentage of small farms (under 5 ha of usable agricultural area) (%)	88.5
Large animal unit (LU) per usable agricultural area	0.8
Percentage of intensive permanent grassland in relation to usable agricultural area (%)	82.3
Percentage of arable land in relation to usable agricultural area (%)	16.4
Percentage of permanent crops in relation to usable agricultural area (%)	0.7
Percentage of farms specialised in pasture farming (%)	14.3
Percentage of farms specialised in arable crops (%)	6.0
Percentage of farms specialised in permanent crops (%)	0.6

Reference: ISTAT (1990) Censimento agricoltura. Rom. ISTAT (1991) Censimento popolazione e abitazioni. Rom. ISTAT (1980-1990) Popolazione e movimento anagrafico dei comuni. Rom. Walter, Lieth (1960/67) Klimadiagramm Weltatlas. Jena. EROS Data Center (1995) Digital Elevation Model. Sioux Falls. Jaksch, K. (1994) Map: Gesteinszonen der Alpen. In: Die Alpen. Pinguin-Verlag, Innsbruck, p.7. Bögl, H. (1986) Map: Geologische Karte von West- und Mitteleuropa. In: Geologie in Stichworten. 4th edition. Verlag Ferdinand Hirt, Unterägeri. Europäische Akademie Bozen (1999) Landschaftstrukturanalyse

In 1980 the average size of farms was under 3 ha UAA per farm (ISTAT 1980). Due to the small size of farms, many farmers had to go about a non-agricultural occupation in order to survive. The steadily growing industrialisation in this area represented an attractive possibility and opportunity for the farmers both to carry on a non-agricultural activity and to run the farm. For others these attractive workplaces were a reason for giving up farming altogether, so that areas became available for leasehold. Unfavourable areas, especially on higher slope exposures, were abandoned, while areas on the valley floor and in the slope areas were leased and used by the remaining farmers. The farms are characterised by a high share of leased areas as well as by a strong fragmentation of the various areas.

Most of the farms are to be found in the area of Feltre and its surroundings as well as Mel, whereas agriculture in Belluno and its surroundings is of little importance. The agricultural production is characterised by grassland farming and arable cropping, especially maize. The farms in Feltre and its surroundings primarily specialise in dairy farming, whereas the farms in Mel primarily conduct forage sales. Permanent crops are of no importance. Only occasionally fruit orchards and vineyards can be found. According to experts, in the last years also horticulture enterprises have, mainly in Feltre, established themselves as an attractive possibility of gainful employment.

Figure 4.12: The model region Piave (I) is characterised by a high share of leased areas on the valley floor and on less inclined slopes, a strong fragmentation of the fields, and by a great number of abandoned areas on higher-lying and steeper slopes

4.2.5 Type 5:

In accordance with the characterisation of the various agricultural regions (see Section 4.1.1), the Region Type 5 reflects those areas with very small agricultural concerns and a high rate of farm closures. It can be found predominantly in Italy and occasionally in Austria and is represented by the model region of Carnia in the north-western section of the Italian province Friuli - Venezia Giulia.

4.2.5.1 Carnia

The model region of Carnia is found in the north-western section of the Italian province Friuli - Venezia Giulia. It is bordered on the north by the Republic of Austria and on the west by the Italian province of Veneto. Carnia is subdivided into five valley areas which spread out in a half-moon shape toward Tolmezzo. Tolmezzo is the main town of the entire district and has a central significance for Carnia, especially with regards to administrative and public order structures.

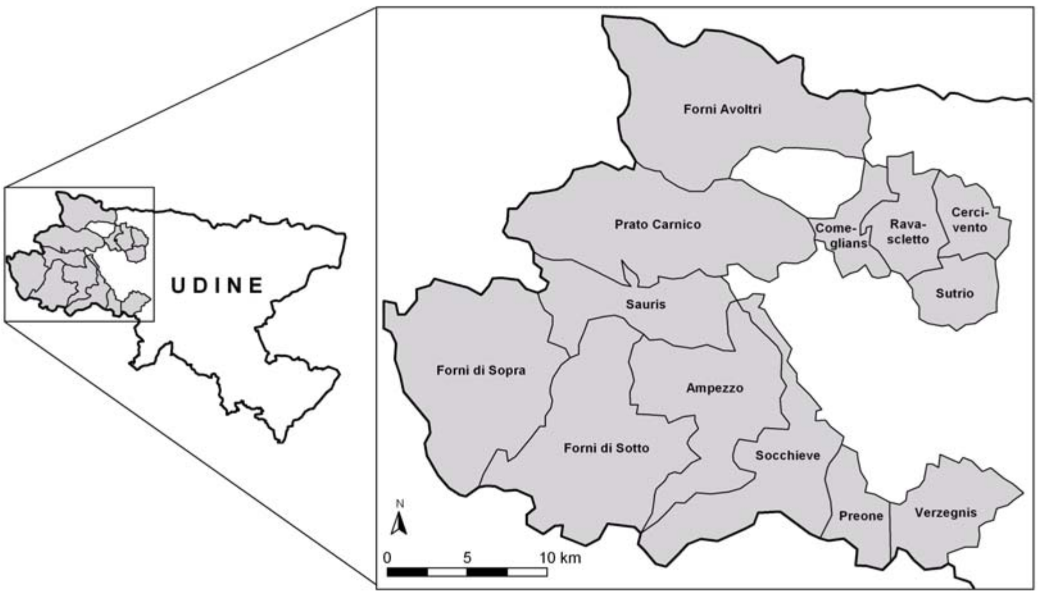

Figure 4.13: Model region Carnia

The valleys of the area are for the most part narrow, broader only where villages are found and at areas of valley confluence. The hilly slopes of the valley walls have a steep incline in their lower areas, and outside of the towns they are, for the most part, covered by thick forest. Distinct terrace areas at middle altitudes are found only occasionally.

From the geomorphological perspective, Carnia resembles an amphitheatre which surrounds the Tolmezzo valley basin. The glacial influence over the entire area is clearly recognisable. Consequently numerous moraine cones are found.

The area is climactically characterised by a very wet and cool winter and by a hot and rather dry summer. Temperature zones in the model region of Carnia range from the colline altitudinal zone at the valley floors (average yearly temperature of 10°C) to the alpine altitudinal zone (average yearly temperature of -5°C). The average annual temperature of the most important parts of the agriculturally used area ranges from 6°C to 8°C (Forni di Sopra, Sauris; Centro servizi agrometeorologici per il Friuli Venezia Guilia, Centro meteorologico regionale del Friuli Venezia Giulia). The entire area can be characterised as humid to very humid. The average annual precipitation for the last thirty years ranges from 1,400 to 1,700 mm (Centro servizi agrometeorologici per il Friuli-Venezia Guilia, Centro meteorologico regionale del Friuli-Venezia Giulia).

Table 4.8: Description of the model region Carnia on the basis of natural, socio-economic and agricultural criteria

Natural characteristics	Carnia
Climatic type	humid with cold season
Mean annual precipitation (mm)	1,400 – 1,700
Geology	sedimentary rocks, mainly limestone and dolomite
Hillslope erosion	occassionally to frequently
Field form	richly structured
Structures of landscape pattern	richly to moderately
Socio-economic indicators	
Employment rate (%)	39.2
Percentage of employees in agriculture (%)	5.5
Population movement (changes over 10 years) (%)	-1.4
Percentage of farm closures (changes over 10 years) (%)	14.9
Percentage of farmers over 45 years of age (%)	82.0
Percentage of part time farming (%)	90.8
Agricultural structure	
Percentage of small farms (under 5 ha of usable agricultural area) (%)	94.3
Large animal unit (LU) per usable agricultural area	0.5
Percentage of intensive permanent grassland in relation to usable agricultural area (%)	93.3
Percentage of arable land in relation to usable agricultural area (%)	4.9
Percentage of permanent crops in relation to usable agricultural area (%)	0.6
Percentage of farms specialised in pasture farming (%)	9.5

Percentage of farms specialised in arable crops (%)	15.5
Percentage of farms specialised in permanent crops (%)	1.6

Reference: ISTAT (1990) Censimento agricoltura. Rom. ISTAT (1991) Censimento popolazione e abitazioni. Rom. ISTAT (1980-1990) Popolazione e movimento anagrafico dei comuni. Rom. Walter, Lieth (1960/67) Klimadiagramm Weltatlas. Jena. EROS Data Center (1995) Digital Elevation Model. Sioux Falls. Jaksch, K. (1994) Map: Gesteinszonen der Alpen. In: Die Alpen. Pinguin-Verlag, Innsbruck, p.7. Bögl, H. (1986) Map: Geologische Karte von West- und Mitteleuropa. In: Geologie in Stichworten. 4th edition. Verlag Ferdinand Hirt, Unterägeri. Europäische Akademie Bozen (1999) Landschaftstrukturanalyse

The communities of Carnia offer only modest opportunities for income to their inhabitants. Because of the great distances to population centres, tourism and industry can establish themselves only with difficulty. Employees commute for the most part either to the neighbouring region of Belluno or else to Udine. Thus, the living quarters in Carnia are used primarily only as sleeping quarters or as weekend residences. The shortage of employment possibilities in the last few years has brought with it an equivalently high level of depopulation as people leave the area.

Agricultural usage is dominated by grassland agriculture, which, on the whole, however, is structured on a very small scale, is greatly divided up, and is mostly conducted in areas close to settlements. In general, a large drop in the number of agricultural operations has taken place. Today only very few farmers are found in each community (5 - 10 farms per community on average). Smaller farms and those in unfavourable areas have been primarily abandoned. Areas in favourable zones are, on the other hand, continuing to be cultivated. The cultivated areas on the whole still demonstrate an abundance of structures that are characterised by various structural elements (river-meadow copses, rows of shrubs, border strips, hillock meadows) and above all by a pattern of cultivation made up of small areas. Thus, intensively used meadows are found in close succession with extensively exploited meadow areas (once a year or once every two years), small corn fields, vegetable gardens, and single rows of grape vines (wire-frame vine trellises).

Figure 4.14: Agricultural usage in the model region Carnia (I) is dominated by very small structured grassland farming. Large areas are frequently abandoned. Only areas in favourable zones are still being cultivated.

4.2.6 Type 6:

The Region Type 6 includes the characteristics of Swiss agriculture in the inner-alpine area. The selected model region comprises 17 communities of the Domleschg, Schons and Albulatal as well as the landscape of Davos in the canton of Graubünden. In total the communities with 17,500 inhabitants cover 643 km².

4.2.6.1 Mittelbünden-Davos

Natural conditions

Natural conditions in the region are diverse. The model region covers surfaces on the bottom of the valleys (600-700 metres above sea level), terraces (1,000-1,400 m) and alpine valleys situated above 1,500 m.

The model region belongs to the dry inner-alpine zone (annual precipitation from 665 mm in Thusis to 1,020 mm in Davos) with a maximum of precipitation in summer. The vegetation belts comprise the mountain belt with pine- and spruce-fir-forests, forests dominated by spruce and the sub-alpine belt with larch-cembra pine-forests. alpine and nival zone cover wide parts of the model region and are partly used as alpine pastures. On the agricultural surfaces at the bottom of the valleys and slightly inclined slopes there takes place grassland-management and partly cultivation on arable land. The landscape structure is also characterised by extensive grassland and woods along rivers and terraces. In some parts of the region there are minor formations of moor land. This leads to a particular responsibility of the model region for the protection of rare species in extensive grassland and in the alpine zone. Alpine areas are used as pastures. In areas with climatically favourable conditions more intensively used, less structured parts of the landscape can be found.

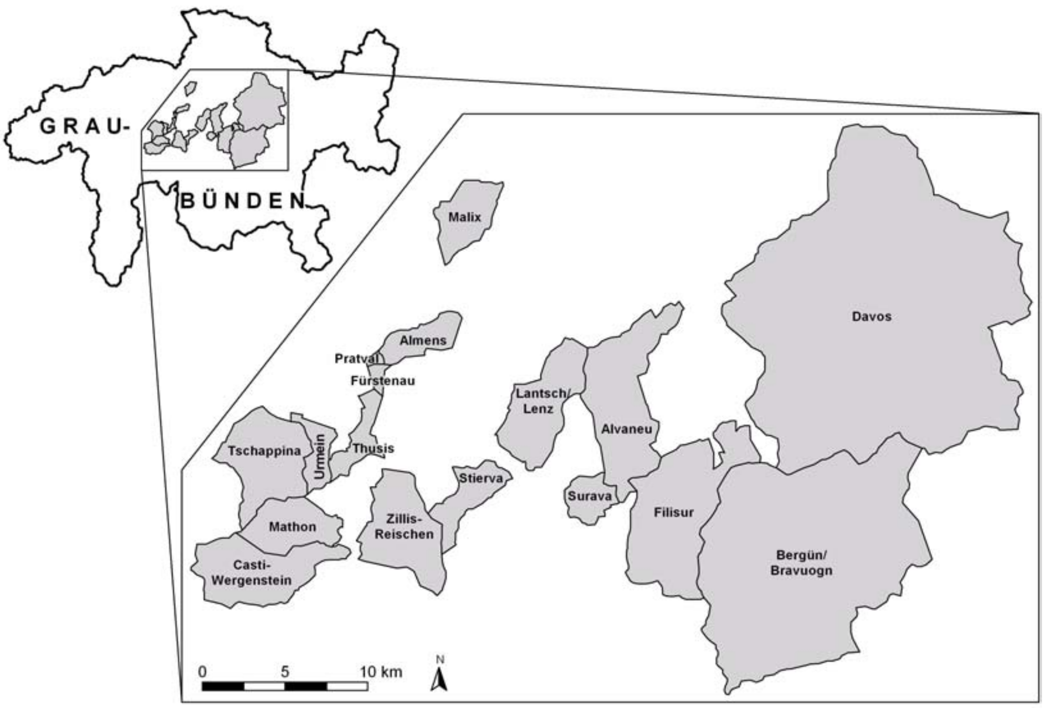

Figure 4.15: Model region Mittelbünden-Davos

Economic conditions

The model region is characterised by a relatively low agricultural rate due to the urban centres of Thusis and Davos. However, outside these centres agriculture is an important economic branch also for the employment in the region. The area of Davos dominates economically because of winter and congress tourism. Thusis is an important junction due to its situation along the transalpine road over the San Bernadino.

Demography is characterised by dynamic development with a high increase of the population and on the average a young population. Even in remote communities there is hardly any tendency for moving away, yet there is a rise in the ratio of old people to total population. Structures of settlement are various and range from disperse settlements in the area of Davos – as a consequence of the settlement of the Walser – to concentrated villages in Mittelbünden.

Agriculture in the region

The model region covers the mountain zones I-IV, that means areas with moderate to very high handicaps, partly with extremely steep slopes. Agriculture is dominated nearly exclusively by specialised milk farms, over 81% with full-time farming. The average reduced usable agricultural area per farm is higher than in the model region of Toggenburg. The intensity of grassland cultivation varies from more intensive cultivation under climatically favourable conditions to pastures and more extensive grassland on steep slopes. This is also the reason why the average density of livestock is lower than in the pre-Alps.

Table 4.9: Description of the model region Mittelbünden-Davos on the basis of natural, socio-economic and agricultural criteria

Natural characteristics	Mittelbünden-Davos
Climatic type	Semi-humid with cold season, mountain region
Mean annual precipitation (mm)	665 – 1,020
Geology	lime-silicate
Hillslope erosion	no-single
Field form	moderately – rich structured
Structures of landscape pattern	rich-moderate
Socio-economic indicators	
Employment rate (%)	52.5
Percentage of employees in agriculture (%)	4.9
Population movement (changes over 10 years) (%)	3.7
Percentage of farm closures (changes over 10 years) (%)	23.3
Percentage of farmers over 45 years of age (%)	57.1
Percentage of part time farming (%)	13.4
Agricultural structure	
Percentage of small farms (under 5 ha of usable agricultural area) (%)	11.1
Large animal unit (LU) per usable agricultural area	2.4
Percentage of intensive permanent grassland in relation to usable agricultural area (%)	92.4
Percentage of arable land in relation to usable agricultural area (%)	6.9
Percentage of permanent crops in relation to usable agricultural area (%)	0.0
Percentage of farms specialised in pasture farming (%)	96.6

Reference: Bundesamt für Statistik (BFS; 1980): Eidgenössische Volkszählung 1980, Bern; Bundesamt für Statistik (BFS; 1980): Eidgenössische Volkszählung 1990, Bern; Bundesamt für Statistik (BFS, 1985): Eidgenössische Betriebszählung 1985 – Landwirtschaft und Gartenbau, Bern; Bundesamt für Statistik (BFS, 1985): Eidgenössische Betriebszählung 1996 - Landwirtschaft und Gartenbau, Bern; und 1996; Bundesamt für Landestopographie, Bern; survey by RENAT 1999

During the last decade an important change in agricultural structures took place. About a quarter of the farms have been abandoned, the agricultural area has been reduced by 20%. However the average size of the farms has only increased by 2 ha per farm. Possibilities for enforced use of machinery are restricted by natural conditions.

In some parts of the region the landscape is well structured by woods and hedges. In addition to that structured wood edges, extensive grassland and alpine pastures contribute to the richness of the landscape. Agriculture has therefore a high importance for the maintenance of cultural landscape, also as a base for tourism. Ecological compensation areas (extensive grassland, hedges) cover a high part of the area and organic farms are an important factor within the agricultural structure; they represents a quarter of the total number of farms.

Figure 4.16: Model region Mittelbünden-Davos: On the slopes in Schons above the road over San Bernadino still a lot of small landscape structures have been maintained. Clear distinctions can be made between mown grassland and pastures.

During the last decades important investments have been made for the improvement of agricultural structures. The infrastructure of the farms including machinery is in a good state. Good perspectives for the future lie in direct marketing, specialisation and in some cases in additional non-agricultural income. Possibilities for direct-marketing and additional income can result from co-operations with tourism and gastronomy (e.g. label "Eco-market Graubünden").

Important agricultural products are milk, cheese and slaughter cattle. The mountain area is traditional supplier of breeding cattle for farms in the pre-Alps and valleys. In this context the cultivation of alpine pastures is of central importance for the feed balance of the farms which depends on feed reserves due to the short vegetation period.

Problems for the model region occur as a consequence of the single specialisation on grassland cultivation and milk and cheese production. Presently the restricted range of products and the missing of urban centres still complicate direct-marketing. In addition to that greater distances to extra-alpine economic centres raise the prices of mountain products. The decrease of prices of milk and abolition of the purchase guarantee by the federal government bring on serious problems for the farmers. They fear especially competition with climatically favoured farms at the border of the Alps.

4.2.7 Type 7:

According to the characteristics of the various agricultural regions (see Section 4.1.1), Region Type 7 is mainly characterised by a high percentage of part time farming as well as a high number of tourist beds per inhabitant. It is mostly located in the northern part of the Alps and is represented by two model regions. One of it, Garmisch-Partenkirchen, is to be found in the German Alps south of Munich and the other one, Innsbruck Land, is situated in Austria, between Brennerpaß and Innsbruck.

4.2.7.1 Garmisch-Partenkirchen

Figure 4.17: Model region Garmisch-Partenkirchen

The model region Garmisch-Partenkirchen is part of the Bavarian Pre-Alps as well as of the Northern High Limestone Alps. The area is part of the "Wettersteingebirge", "Estergebirge", "Karwendelgebirge" and "Kocheler Berge".

The surroundings of Garmisch-Partenkirchen and Mittenwald are characterised by flat and mainly very wide valley bottoms, framed by more or less steep slopes covered with well-stocked mixed, spruce and pine forests. They merge into the alpine zone characterised by steep and vegetational poor rock formations.

The cultivated area of the valley zones is dominated by grassland partly dispersed by some patches of marsh land. In the montane belt between 800 and 1,300 m a.s.l. especially between Mittenwald and Garmisch-Partenkirchen hump meadows mowed once a year reach great spatial extension. Due to the concentration of these vegetation-formations in this part of the German Alps they are of great ecological and cultural interest.

In the upper montane and sub-alpine belt (between 1,400 and 1,900 m a.s.l.) pastures are very frequent although many of these have been recolonised by forest due to a high rate of abandonment.

The main settlements of the four communities located in the model region are situated on an average altitude of 750 m a.s.l. (ranging from 670 to 910 m). The climate is humid with cool and wet summers and heavy winter snow falls. The mean annual precipitation (maximum in summer) rises from 1,400 mm in the valley floor up to 2,000 mm and more in the sub-alpine and alpine belt. The annual temperature mean is about 7 °C on the valley floor.

Table 4.10: Description of the model region Garmisch-Partenkirchen on the basis of natural, socio-economic and agricultural criteria

Natural characteristics	Garmisch-Partenkirchen
Climatic type	Humid with cool summer
Mean annual precipitation (mm)	1,350 – 1,500
Geology	calcareous rocks
Hillslope erosion	rare
Structures of landscape pattern	on valley floor fairly uniform, on slopes great variety
Socio-economic indicators	
Employment rate (%)	47.1
Percentage of employees in agriculture (%)	1.6
Population movement (changes over 10 years) (%)	9.2
Percentage of farm closures (changes over 10 years) (%)	5.1
Percentage of farmers over 45 years of age (%)	66.5
Percentage of part time farming (%)	82.6
Agricultural structure	
Percentage of small farms (under 5 ha of usable agricultural area) (%)	56.2
Large animal unit (LU) per usable agricultural area	0.9
Percentage of intensive permanent grassland in relation to usable agricultural area (%)	89.7
Percentage of arable land in relation to usable agricultural area (%)	0.6
Percentage of permanent crops in relation to usable agricultural area (%)	0.0

Reference: Hydrographisches Zentralbüro im Bundesministerium für Land- und Forstwirtschaft in Wien, 1973; Bayerisches Landesamt für Statistik und Datenverarbeitung: Volkszählung, 1987; Betriebsgrößenstruktur, Landwirtschafts-zählung/Agrarberichterstattung, Bodennutzungshaupterhebung, each 1983 and 1995; Bevölkerungsstatistik, 1987-1996

The majority of farms in the model region Garmisch-Partenkirchen has a spatial extent of usable agricultural area smaller than 10 ha (75% of the farms). Possibilities for a further expansion of farming are not only limited by the scarcity of usable agricultural area but also by the high amount of rainfall and the short vegetation period. About 94% of the area under cultivation is grassland. Livestock consists mainly of cattle and sheep.

Besides dairy farming also sheep rearing and cattle fattening contribute to the agricultural income. Afforestation of farmland especially in valley floors takes place to a very small extent.

Figure 4.18: Mountain farming in the model region Garmisch-Partenkirchen

Except of few pastures all cultivated land is accessible with machines. Farm buildings are mostly in good condition. Only farms without successor show less investments in the maintenance of buildings and machinery.

In the meanwhile rural tourism became very important for the farmers income. However, other management strategies such as direct marketing, specialisation, processing or organic farming are still not wide-spread.

Part-time farming is the main form of management (more than 80% of the farms). On the other hand, local people fear that the trend towards part-time farming during the last decades will lead to an increasing rate of abandonment in the following years. Decline of prices, natural disadvantages for production and thus increasing production costs, change of social values and finally out-migration of the young generation can, from the point of view of local people, threaten the existence of agriculture in the region.

4.2.7.2 Innsbruck Land

This model region is situated in the Central Alps in the political district of Innsbruck Land.

It comprises 15 communities spread over three valleys:

- ❑ the valley of Sellrain to the south-west of Innsbruck,
- ❑ the Wipptal towards the south and
- ❑ the Stubaital as a tributary valley of the Wipptal towards the south-west.

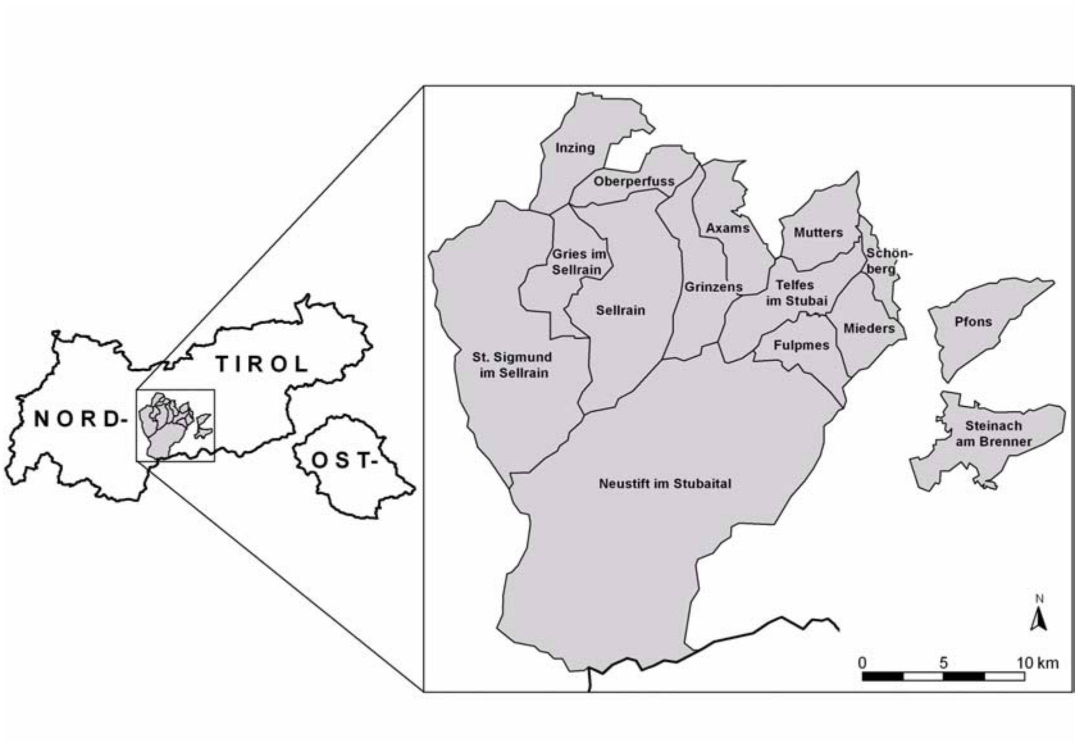

Figure 4.19: Model region Innsbruck Land

Altitude ranges from 900 m to 3,000 m with settlements mainly around 1,000 m a.s.l..

Geological structure is quite heterogenic, consisting of gneisses in the Sellrain and the Stubai Alps, with some additional metamorphic sediments and in the Wipptal with all sorts of rocks from gneisses to more or less metamorphic sediments and mica schists in the lower part towards Innsbruck.

The climate reaches from the montane altitudinal zone on the valley floors to the nival altitudinal zone where some glaciers can be found. Medium annual temperature are around 2° C to –5° C. Average annual precipitation varies from about 700 to 1,500 mm/y.

Transport infrastructure is very well developed. One major European transit road over the Brennerpaß to Italy is running through the Wipptal, causing a considerable negative environmental impact on the people in the area.

Landscape structures in the valley floors are limited due to clearings in the course of the last decades. Rivers in the proximity of communities are mostly remodelled to safeguard settlements from floods.

The region is dominated by intensive grassland farming in the valley floors, coniferous forests at the slopes and expansive mountain meadows and alpine pastures at higher altitudes. Due to special premiums land abandonment is rare.

People working in agriculture are only 3% of the working population. Farms are still very small structured. 72% of the farms have a size less than 10 ha. Farm abandonment was no major strategy so far due to a high traditional connection with the holdings. As a result and to improve family income, part time farming is above Austrian average and is still further increasing. There are enough non-agricultural income sources available in the well established tourism sector, with the highest intensity of all model regions (0.7 beds per inhabitant). Also the provincial capital of Innsbruck is rather near, offering additional jobs and allowing people to return to their farms on a daily basis.

Table 4.11: Description of the model region Innsbruck Land on the basis of natural, socio-economic and agricultural criteria

Natural characteristics	Innsbruck – Land
Climatic type	Alpine valley and mountain climate
Mean annual precipitation (mm)	700 – 1,500
Geology	mostly gneisses with some metamorphic rocks
Hillslope erosion	rare
Field form	moderately cleared
Structures of landscape pattern	low
Socio-economic indicators	
Employment rate (%)	46.7
Percentage of employees in agriculture (%)	3.0
Population movement (changes over 10 years) (%)	8.2
Percentage of farm closures (changes over 10 years) (%)	-1.8
Percentage of farmers over 45 years of age (%)	61.5
Percentage of part time farming (%)	73.6

Agricultural structure	
Percentage of small farms (under 5 ha of usable agricultural area) (%)	46.0
Percentage of small farms (under 10 ha of usable agricultural area) (%)	72.4
Large animal unit (LU) per usable agricultural area	1.9
Percentage of intensive permanent grassland in relation to usable agricultural area (%)	82.0
Percentage of arable land in relation to usable agricultural area (%)	17.7
Percentage of permanent crops in relation to usable agricultural area (%)	0.1
Percentage of farms specialised in pasture farming (%)	75.6

Reference: OeSTAT (1997): Agrarstrukturerhebung 1995 – Gesamtergebnisse für die Land- und Forstwirtschaft. Wien. Leidlmair, A. (eds.) (1999): Tirol-Atlas. Wagner Verlag. Innsbruck.

Farm buildings are mostly in a good condition and machinery equipment is generally on a high level. The income situation is considerably improved in the model region through direct payments also to compensate falling product prices. Especially mountainous regions are gaining from the application of Regulation 2078/92 (e.g. special premium for hand mowing of mountain meadows) and compensatory allowances for mountain farming, depending on steepness and altitude. With high losses of the product income in the last years these payments are of major importance for the upkeeping of agriculture in the region. Nevertheless the work load for the families is extremely high.

Dairy farming and cattle rearing are the main farm types. Whereas cattle and pig numbers were decreasing, sheep and goat rearing, although still on a relatively low level, was becoming more prominent in the last decade with a growth rate of 63%. Arable land only exists on a low level around settlements.

Figure 4.20: Innsbruck Land: Steeper slopes are partly abandoned due to lacking labour forces

4.2.8 Type 8:

The Region Type 8 includes the characteristics of Swiss agriculture at the borders of the Alps in transition to the agriculturally favourable areas of the Mittelland (see Section 4.1.1). The selected model region Toggenburg is situated in a valley at the north-eastern border of the Alps in the canton of St. Gallen and comprises 12 communities with 324 km^2 and 24,000 inhabitants.

4.2.8.1 Toggenburg

Natural conditions

The bottom of the valley rises up in south-eastern direction from 600 to 1,100 metres a.s.l. It is surrounded by mountains rising up steeply to 2,000 m. The vegetation belts in the region range from the mountain belt dominated by beech, sub-alpine forests with spruce up to the alpine belt. The climate is humid (annual precipitation of 1,900 mm in Ebnat-Kappel) with a maximum of precipitation in summer.

On agricultural surfaces on the bottom of the valley created by clear-cutting and slightly inclined slopes intensive grassland is cultivated. The landscape is structured by woods along rivers and terraces and especially by a high number of moors. This leads to a particular responsibility for the protection of rare species of moor land and hedges. Alpine areas are used as pastures. In areas with climatically favourable conditions more intensively used, less structured parts of the landscape can be found.

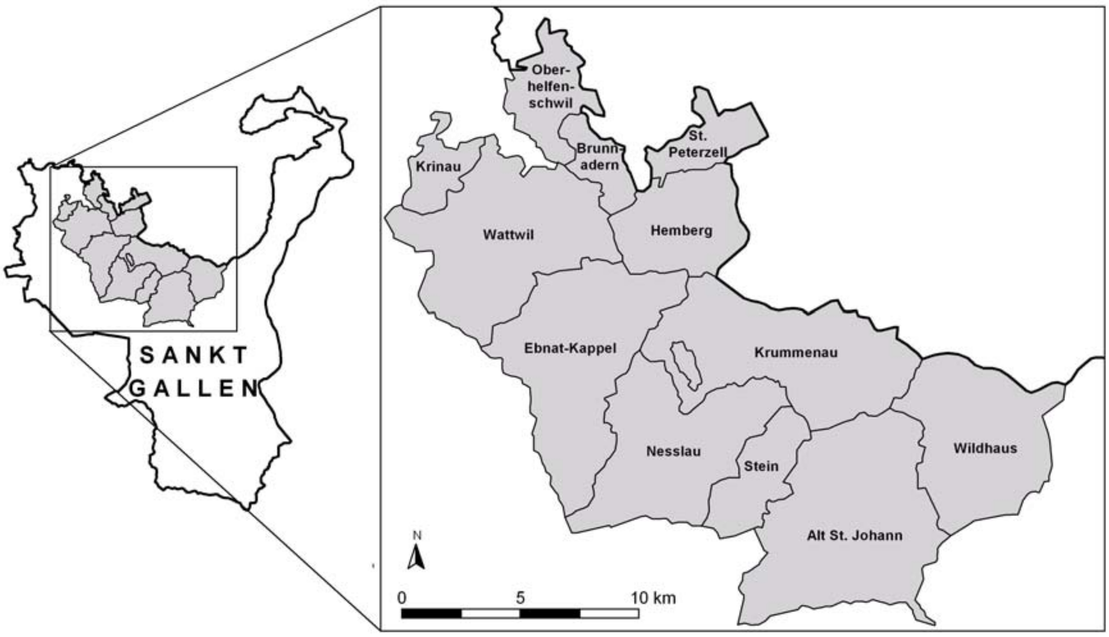

Figure 4.21: Model region Toggenburg

Economic conditions

In particular the bottom of the valley is used more intensively. The economic centres of the region Wattwil and Ebnat-Kappel are situated in this part of the region. In the communities higher up (Wildhaus, Alt. St. Johann) tourism is of great economic importance. Especially skiing tourism is an essential source of income. Due to the short distance to urban centres of the Swiss Mittelland and good traffic facilities day tourism is important. In summer Toggenburg is a popular hiking area.

The traditional structure of the villages on the bottom of the valley has been essentially maintained. Numerous farms are dispersed over the margins of the valley. Outside the urban centres of Wattwil and Ebnat-Kapel agriculture offers 20% of the working places. In these communities agriculture plays a central economic role in connection with processing and supplying enterprises. Presently there is no tendency for a decrease of population.

Agriculture in the region

The model region covers surfaces with moderate to high handicaps (mountain zones I-III). Agriculture in Toggenburg is dominated nearly exclusively by specialised milk farms, over 80% with full-time farming. The average size of the farms is relatively small (13.6 ha of agricultural area). This leads to a rather intensive cultivation of grassland (3-4 cuts) in areas with favourable conditions and a high average density of livestock (about 1.7 L. U. per ha).

Table 4.12: Description of the model region Toggenburg on the basis of natural, socio-economic and agricultural criteria

Natural characteristics	Toggenburg
Climatic type	humid with cold season, mountain region
Mean annual precipitation (mm)	1,900
Geology	metamorphic rocks
Hillslope erosion	No-single
Field form	moderately
Structures of landscape pattern	rich-moderate
Socio-economic indicators	
Employment rate (%)	46.2
Percentage of employees in agriculture (%)	13.8
Population movement (changes over 10 years) (%)	3.9
Percentage of farm closures (changes over 10 years) (%)	9.5
Percentage of farmers over 45 years of age (%)	56.3
Percentage of part time farming (%)	19.3
Agricultural structure	
Percentage of small farms (under 5 ha of usable agricultural area) (%)	15.5
Large animal unit (LU) per usable agricultural area	2.1
Percentage of intensive permanent grassland in relation to usable agricultural area (%)	90.1
Percentage of arable land in relation to usable agricultural area (%)	0.1
Percentage of permanent crops in relation to usable agricultural area (%)	0.0
Percentage of farms specialised in pasture farming (%)	98.0

Reference: Bundesamt für Statistik (BFS, 1980): Eidgenössische Volkszählung 1980, Bern; Bundesamt für Statistik (BFS, 1990): Eidgenössische Volkszählung 1980, Bern; Bundesamt für Statistik (BFS, 1985): Eidgenössische Betriebszählung 1985 – Landwirtschaft und Gartenbau, Bern; Bundesamt für Statistik (BFS, 1996): Eidgenössische Betriebszählung 1996 -Landwirtschaft und Gartenbau, Bern; Bundesamt für Landestopographie, Bern; survey by RENAT 1999

Between intensively cultivated surfaces numerous biotopes and landscape structures can be identified. Agriculture has therefore a high importance for the cultural landscape, also as a base for tourism. In this context the high share of moist meadows cultivated extensively and less intensively cultivated meadows is a central factor. For some farms direct payments for landscape management measures can be essential sources of income. In addition to that there is a tendency towards a more environmentally appropriate orientation of cultivation with an above-average share of organic farms, especially in Obertoggenburg.

The infrastructure of the farms is in a good state as a consequence of major investments during the last 15 years. In spite of the abandonment of farms during the last years – lower than in the other parts of Switzerland – the agricultural surface has increased. Possible additional income can result from tourism and forestry. Further possibilities are niche production, regional marketing activities and starting of additional branches of farming (diversification). There already exist co-operations with tourism and gastronomy and direct-marketing. In addition to that there are efforts for the creation of a biosphere reserve and in this context for an own regional label.

Figure 4.22: In Toggenburg grassland is cultivated intensively. Nevertheless in parts of the region landscape is still well structured, as for example in the area above Unterwasser.

The main agricultural product is milk. About a half of the quantity is processed to famous types of Swiss cheese (Appenzeller, Tilsiter, Emmentaler). Meat and breeding-cattle are further products in the model region. The cultivation of alpine pastures (private and in co-operation) is of importance especially in Obertoggenburg. About 20% of the total feed production results from the cultivation of alpine pastures. In this domain there still exist major deficiencies in the infrastructure.

Problems for the model region occur as a consequence of the specialisation on grassland cultivation and milk and cheese production. In some cases a high concentration of fertiliser due to the increase of the number of livestock in smaller farms or financial problems due to investments for modernisation can be observed. Presently the restricted range of products and the distance to urban centres still complicate direct-marketing. The decrease of prices of milk and abolition of the purchase guarantee by the federal government bring on serious problems for the farmers in the region. As a consequence further structural changes can be expected for the next years.

4.3 Typology of agricultural EU-instruments

Hans Josef Kienzl and Christine Vigl

4.3.1 Selection of EU-instruments

In order to analyse the effects of EU-regulations and directives, it must first be determined which EU-instruments are important for the agriculture and the environment in the Alps. Not only instruments which have an immediate effect on agriculture (agricultural and structural policy), but also instruments of environmental policy which have an indirect effect on agriculture shall be analysed.

Based on expert knowledge the following list of EU-regulations and directives has been compiled (Table 4.13) and their effects have been evaluated:

Table 4.13: List of EU-regulations and directives and their effects on the environment which have been evaluated in the present research project

Number of document	Title of the document
R 2078/92	Council Regulation (EEC) No 2078/92 of 30 June 1992 on agricultural production methods compatible with the requirements of the protection

	of the environment and the maintenance of the countryside
R 746/96	Commission Regulation (EC) No 746/96 of 24 April 1996 laying down detailed rules for the application of Council Regulation (EEC) No 2078/92 on agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the countryside
R 2080/92	Council Regulation (EEC) No 2080/92 of 30 June 1992 instituting a Community aid scheme for forestry measures in agriculture
R 619/93	Commission Regulation (EEC) No 619/93 of 17 March 1993 on improving the quality of milk in the Community
R 2067/92	Council Regulation (EEC) No 2067/92 of 30 June 1992 on measures to promote and market quality beef and veal

Table 4.13: continued

R 2066/92	Council Regulation (EEC) **No 2066/92** of 30 June 1992 amending Regulation (EEC) No 805/68 on the common organisation of the market in beef and veal and repealing Regulation (EEC) No 468/87 laying down general rules applying to the special premium for beef producers and Regulation (EEC) No 1357/80 introducing a system of premiums for maintaining suckler cows
R 3013/89	Council Regulation (EEC) **No 3013/89** of 25 September 1989 on the common organisation of the market in sheepmeat and goatmeat
R 804/68	Regulation (EEC) **No 804/68** of the Council of 27 June 1968 on the common organisation of the market in milk and milk products
R 805/68	Regulation (EEC) **No 805/68** of the Council of 27 June 1968 on the common organisation of the market in beef and veal
R 3611/93	Council Regulation (EC) **No 3611/93** of 22 December 1993 amending Regulation (EEC) No 805/68 on the common organisation of the market in beef and veal
D 92/46	Council Directive **92/46/EEC** of 16 June 1992 laying down the health rules for the production and placing on the market of raw milk, heat-treated milk and milk-based products
R 2092/91	Council Regulation (EEC) **No 2092/91** of 24 June 1991 on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs
R 2081/92	Council Regulation (EEC) **No 2081/92** of 14 July 1992 on the protection of geographical indications and designations of origin for agricultural products and foodstuffs
R 2082/92	Council Regulation (EEC) **No 2082/92** of 14 July 1992 on certificates of specific character for agricultural products and foodstuffs
R 2515/94	Commission Regulation (EC) **No 2515/94** of 9 September 1994 amending Regulation (EEC) No 1848/93 laying down detailed rules for the application of Council Regulation (EEC) No 2082/92 on certificates of specific character for agricultural products and foodstuffs
R 950/97	Council Regulation (EC) **No 950/97** of 20 May 1997 on improving the efficiency of agricultural structures
R 951/97	Council Regulation (EC) **No 951/97** of 20 May 1997 on improving the processing and marketing conditions for agricultural products
R 952/97	Council Regulation (EC) **No 952/97** of 20 May 1997 on producer groups and associations thereof
D 91/676	Council Directive **91/676/EEC** of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources
D 79/409	Council Directive **79/409/EEC** of 2 April 1979 on the conservation of wild birds
D 92/43	Council Directive **92/43/EEC** of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
D 97/62	Council Directive **97/62/EC** of 27 October 1997 adapting to technical and scientific progress Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora
"INTERREG II" 94/C180/13	Common initiatives on the development of border regions, cross-border collaboration and selected energy networks **("INTERREG II") 94/C180/13**
"LEADER II" 94/C180/12	Community initiatives on actions for rural development **("LEADER II") 94/C180/12**
R 2052/88	Council Regulation (EEC) **No 2052/88** of 24 June 1988 on the tasks of

	the Structural Funds and their effectiveness and on co-ordination of their activities between themselves and with the operations of the European Investment Bank and the other existing financial instruments
R 2081/93	Council Regulation (EEC) No 2081/93 of 20 July 1993 amending Regulation (EEC) No 2052/88 on the tasks of the Structural Funds and their effectiveness and on co-ordination of their activities between themselves and with the operations of the European Investment Bank and the other existing financial instruments

Table 4.13: continued

R 4254/88	Council Regulation (EEC) No 4254/88 of 19 December 1988, laying down provisions for implementing Regulation (EEC) No 2052/88 as regards the European Regional Development Fund
R 4255/88	Council Regulation (EEC) No 4255/88 of 19 December 1988, laying down provisions for implementing Regulation (EEC) No 2052/88 as regards the European Social Fund
R 4256/88	Council Regulation (EEC) No 4256/88 of 19 December 1988, laying down provisions for implementing Regulation (EEC) No 2052/88 as regards the EAGGF Guidance Section
R 2085/93	Council Regulation (EEC) No 2085/93 of 20 July 1993 amending Regulation (EEC) No 4256/88 laying down provisions for implementing Regulation (EEC) No 2052/88 as regards the European Agricultural Guidance and Guarantee Fund (EAGGF) Guidance Section
R 2200/96	Council Regulation (EC) No 2200/96 of 28 October 1996 on the common organisation of the market in fruit and vegetables
D 79/117	Council Directive 79/117/EEC of 21 December 1978 prohibiting the placing on the market and use of plant protection products containing certain active substances
D 91/414	Council Directive 91/414/EEC of 15 July 1991 concerning the placing of plant protection products on the market
D 86/363	Council Directive 86/363/EEC of 24 July 1986 on the fixing of maximum levels for pesticide residues in and on foodstuffs of animal origin
D 76/895	Council Directive 76/895/EEC of 23 November 1976 relating to the fixing of maximum levels for pesticide residues in and on fruit and vegetables
D 90/642	Council Directive 90/642/EEC of 27 November 1990 on the fixing of maximum levels for pesticide residues in and on certain products of plant origin, including fruit and vegetables
D 74/63	Council Directive 74/63/EEC of 17 December 1973 on the fixing of maximum permitted levels for undesirable substances and products in feedingstuffs
D 80/68	Council Directive 80/68/EEC of 17 December 1979 on the protection of groundwater against pollution caused by certain dangerous substances
D 80/778	Council Directive 80/778/EEC of 15 July 1980 relating to the quality of water intended for human consumption
D 96/61	Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control
R 1765/92	Council Regulation (EEC) No 1765/92 of 30 June 1992 establishing a support system for producers of certain arable crops
R 822/87	Council Regulation (EEC) No 822/87 of 16 March 1987 on the common organisation of the market in wine
R 823/97	Council Regulation (EEC) No 823/87 of 16 March 1987 laying down special provisions relating to quality wines produced in specified regions
R 2392/89	Council Regulation (EEC) No 2392/89 of 24 July 1989 laying down general rules for the description and presentation of wines and grape musts
R 3201/90	Commission Regulation (EEC) No 3201/90 of 16 October 1990 laying down detailed rules for the description and presentation of wines and grape musts

From this list one can see that only a few of the mentioned instruments are clearly and directly orientated to the integration of the requests of the environment into agriculture. Most of them have indirect effects, which are not apparent beforehand, but they often have considerable positive or negative effects on the environment, too.

4.3.2 Synthesis of EU-instruments

The agricultural and environmental policy of the EU pursues a high number of objectives and undertakes a wide range of measures. Because of the large amount of measures and objectives, it was necessary to synthesise and typologise the EU-regulations and directives. The aim of the typology, which will be described in the following, has been to show the priorities of the EU-instruments, which have been dealt with in this project, and to preserve a clear structure of them. The various regulations and directives with different measures and promotion aims were assigned to three types: price guarantee, accompanying measures or structure strengthening. These types form the basis for the further proceeding in this research project.

The first step for the synthesis and the typology of the selected agricultural and environmental instruments of the EU has been a detailed analysis of all 45 regulations and directives. In order to evaluate the effects of EU-instruments, the sphere of influence and effect of all EU-instruments must be analysed and the essential objectives and measures must be recorded.

The analysis of the EU-instruments has been carried out according to the following scheme:

1. Determination of the essential objectives of the regulations and directives
2. Determination of the essential measures intended for the achievement of the objectives
3. Classification of the regulations and directives according to the sphere and length of effect. The instrument may primarily have effects in the economical, in the ecological or in both areas. As far as the length of effect is concerned, an effect of up to five years has been classified as short-term and an effect of more than five years as long-term.

With the example of the Council Regulation (EEC) No 2078/92 of 30 June 1992 on agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the countryside, the analysis of the EU-instruments will be shown:

a) Determination of the essential objectives of the Council Regulation (EEC) No 2078/92

- ❑ Reduction or maintaining the reduction in the use of fertilisers and/or plant protection products, or adoption or continuation with organic farming production methods
- ❑ An environmentally favourable extensification of crop farming
- ❑ An environmentally favourable extensification of sheep and cattle farming

- The conversion of arable land into extensive grassland
- Ways of using agricultural land which are compatible with the protection and improvement of the environment, the countryside, the landscape, natural resources, the soil and genetic diversity
- The upkeep of abandoned farmland and woodlands
- Long-term set-aside of agricultural land for reasons connected with the environment
- Land management for public access and leisure activities
- Education and training for farmers in types of farming compatible with the requirements of environmental protection and upkeep of the countryside

b) Determination of the essential measures of the Council Regulation (EEC) No 2078/92, which are intended for the achievement of the objectives

The Council Regulation (EEC) No 2078/92 is a general framework, within which flexibility of action is allowed in accordance with the principle of subsidiarity. The scheme itself had to be implemented by zonal programmes at Member State level, in order to reflect the diversity of the environment and meet Member States' particular needs for nature conservation and the sustainable use of natural resources. Programmes may include granting a premium to farmers who on a voluntary and contractual basis undertake measures to achieve the above mentioned objectives. In addition, the scheme can include training farmers in farming or forestry practices compatible with the environment, and demonstration projects (Segrè 1999).

c) Classification of the Council Regulation (EEC) No 2078/92 according to the sphere and length of effect

The Council Regulation (EEC) No 2078/92 has effects in the ecological and in the economical area, that is a short-term effect on the production method and a long-term effect on human resources. The measures included in the Council Regulation (EEC) No 2078/92 require a conversion of cultivation on the part of the farmers. Organic farming, the set-aside of arable land and the reduction in the use of plant protection products require the farmers to adopt an environmentally friendly behaviour. This results in a change of production methods which is rewarded with direct payments. In the long term this environmentally friendly land use has a positive effect on the protection of the environment and consequently on the human resources.

4.3.2.1 Priorities of EU-instruments

From the example of the Council Regulation (EEC) No 2078/92 one can conclude the large host of information that has been gained in the analysis of the EU-instruments. Nonetheless or especially because of that the information had to be arranged in a clear form. In the course of the synthesis three priorities of the considered EU-instruments could be determined: price guarantee, accompanying measures and structure strengthening (Figure 4.23). The typology of the EU-instruments according to the three priorities should not be regarded as a generally valid model for the agricultural and environmental policy, but as a synthesis model which is orientated to the objectives of this project.

As with all aggregations, also in this case detailed information get lost; the essential measures of the EU-instruments, however, remain in a clear form and are, therefore, still usable for this project.

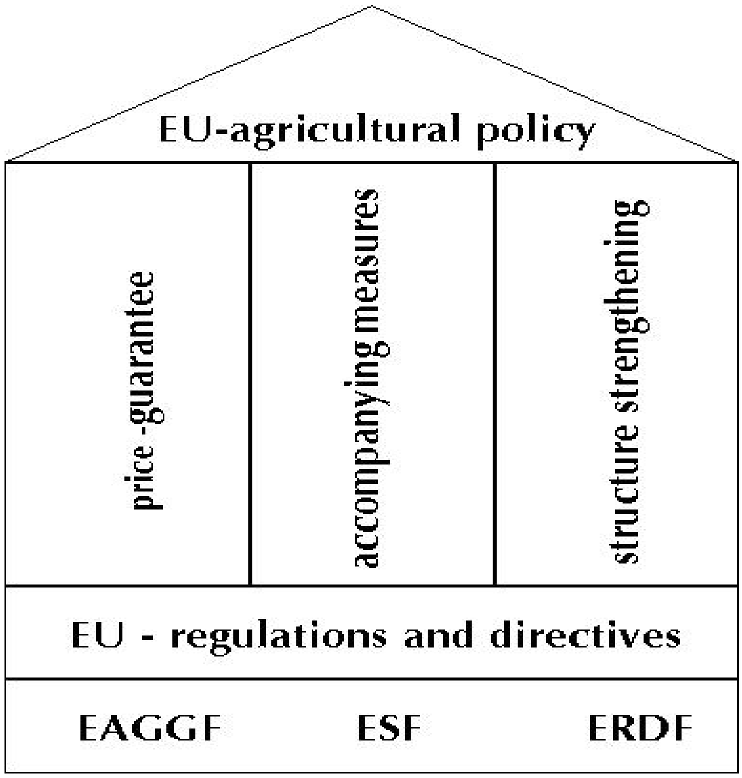

Figure 4.23: The three types of the EU-regulations and directives – price guarantee, accompanying measures and structure strengthening – reflect the main emphasis of the agricultural policy of the EU. Agricultural policy is financed primarily by the European Agricultural Guidance and Guarantee Fund (EAGGF). The EAGGF comprises two parts. The Guarantee Section finances Community expenditure under the policy on prices and markets, including CAP reform compensatory payments and the accompanying measures. By far the greater part of expenditure goes on the Guarantee Section. The Guidance Section contains the Community resources allocated to the structural policy, such as aids for the modernisation of holdings, the installation of young farmers, aids for processing and marketing, diversification and so on. It is also to be noted that, together with the European Regional Development Fund (ERDF) and the European Social Fund (ESF), it also finances rural development actions (Segrè 1999).

Type 1 (price guarantee) comprises measures, which guarantee the farmers a minimum price for their products. This is done by imposing quota regimes or by fixing intervention prices for certain products.

Type 2 (accompanying measures) includes direct payments with and without environmental requirements. First and foremost they are measures accompanying the price guarantee. This type also includes environmental protection measures such as measures to reduce the nitrate in the groundwater, measures to fix the maximum levels for pesticide residues in various products or measures for the conservation of wild fauna and flora.

Type 3 (structure strengthening) comprises measures to strengthen the position of the producers. They include investment aids for producer groups and associations thereof as well as setting-up aids for young farmers or promotion of regional development programmes.

In a further step the EU-regulations and directives have been assigned to the three types (price guarantee, accompanying measures, structure strengthening). The assignment has not been carried out by looking directly at the regulations and directives, as in that case the distinguishing would not always have been clear. Rather the concrete measures of the single instruments have been assigned to the three types (Figure 4.24). The result has been an overview of the essential measures of the EU-instruments as well as their assignment to the content-related priorities of the agricultural policy of the EU.

Priorities of the EU - agricultural policy									
price-guarantee			accompanying measures			structure strengthening			
			direct payments		environmental measures				
quantity control	price support	quality requirements	direct payments with environmental requirements	direct payments without environmental requirements	protection of the environment	marketing	production	vocational training measures	regional development
quota regime import license	intervention price aid for private storage export refund levy on imports of products	standard of quality of products and production	aid for extensification for various products substantial reductions in the use of fertilisers and plant-protection products additional amount aid for afforestation	suckler cow premium deseasonalisation premium processing premium premiums for producers of sheepmeat and goatmeat compensatory allowances in less-favoured agricultural areas	reducing water pollution caused or induced by nitrates maximum levels for pesticide residues in various products conservation of wild fauna and flora	investment aid to producer groups and associations thereof protection of designations of origin and of geographical indications of agricultural products and foodstuffs	modernisation diversification aid to comply requirements setting-up aid to young farmers	training for farmers	regional development programmes measures for improving infrastructures
EAGGF			ESF			ERDF			

Figure 4.24: Priorities of the EU-agricultural policy

In the following the various priorities of the EU-instruments will be explained in more detail by looking at the major corresponding objectives and measures.

Price guarantee

The price guarantee, which is of major importance for the farmers in the Alps, can be subdivided into 3 parts:

1. quantity control
2. price support
3. quality requirements.

All three measures are aimed at guaranteeing the farmers a certain price and sales for their products.

Quantity control

By means of the quantity control the EU fixes production ceilings for various products (e.g. milk). Moreover, it regulates the output in the Community by allocating import licenses. Both measures – quota regime and allocation of import licenses – influence the market price formation in the Community.

Price support

The EU has introduced measures which should make the adjustment of the supply to the requirements of the market in order to stabilise the markets and to guarantee the farmers an appropriate income (Rieder et al. 1999). An example for these measures are intervention measures which are reflected in purchases by intervention authorities or in aids for private storage. Along with the intervention system, a levy on imports of products and a refund system for exports fundamentally contribute to a stabilisation of the Community market. This prevents fluctuations of the world market prices from infecting the prices within the Community. The application of special import prices makes it possible to prevent disturbances of the common market (Council Regulations No 804/68; No 805/68).

The measures for the price support guarantee a certain minimum price for agricultural products which have been produced in the EU. The intervention price basically represents a guaranteed price for a product with certain quality standards. If a certain product, such as meat, butter or skimmed milk powder, falls below the EU-determined price, this product will be purchased by an intervention authority for the intervention price and thus the sales of the product are guaranteed. The product must, however, meet imposed quality standards.

Quality requirements

Quantity control and price support are accompanied by quality requirements. The latter are quality and marketing standards which are valid both for products produced in the Community as well as for those imported in the Community. They prevent the disadvantaging of the Community products. Without imposed quality standards the EU-product cannot enjoy the price support.

The measures for the price guarantee do not involve any direct payments for farmers. This is why most of the times the farmers do not know about these regulations protecting agricultural products by guaranteeing a minimum price for the products. The regulations of the second and third type of the EU agricultural policy are better known because they include primarily direct payments to the farmers.

Accompanying measures

The "accompanying measures" contain regulations which function along with the other two types (price guarantee, structure strengthening).

This type is characterised by three large classes:

1. Direct payments with environmental requirements
2. Direct payments without environmental requirements
3. Directives for the protection of the environment

Direct payments with environmental requirements

Only those farmers who are prepared to carry out the imposed environmental requirements on the farm are granted direct payments with environmental requirements. Especially the Council Regulations (EEC) No 2066/92, No 2078/92 and No 2080/92 include recommendations of extensification to protect the environment with a simultaneous compensation by means of direct payments. For example the Council Regulation (EEC) No 2078/92 provides for compensation premiums for various measures to reduce cultivation. They reach from the reduction in the use of fertilisers and/or plant production products to the set-aside of farmland for at least 20 years. The agro-environmental measures (Council Regulation (EEC) No 2078/92) seek to achieve a dual objective, firstly, by helping to limit production through the encouragement of extensive farming practices and, secondly, by recognising the public interest role exercised by farmers in terms of land management and the protection of natural resources. Aid for afforestation under Council Regulation (EEC) No 2080/92 is intended to provide an alternative use for agricultural land and to encourage the development of farm forestry.

If the farmer is prepared to undertake extensification measures to protect the environment, he will be granted direct payments. For example they are granted for:

1. Reduction in cultivation
   a) Reduction of the use of fertilisers
   b) Maintaining of the reductions already made or introduction or continuation with organic farming methods
   c) Conversion of arable land into extensive grassland
   d) Upkeep of abandoned farmland or woodlands
   e) Set aside farmland for at least 20 years
2. Reduction in the use of plant protection products
3. Afforestation of usable agricultural area
4. LU stocking of cattle per hectare lower than 1.4

Direct payments without environmental requirements

The direct payments without environmental requirements are the opposite of the direct payments with environmental requirements. The great difference is that the farmer is granted direct payments without having to meet environmental requirements. They are first and foremost measures which are intended to reduce the production of surplus products, such as milk and beef (Council Regulations No 2066/92; No 3013/89; No 950/97).

The primary objectives are:

1. Reduction of milk production by granting the suckler cow premium
2. Avoidance of excessive slaughterings within a year by granting the deseasonalisation premium
3. Reduction of meat production by granting the processing premium
4. Weakening of the decreased intervention price by granting the sheep and goat premium
5. Conservation of agriculture in less-favoured agricultural areas by granting compensatory allowances

In order to achieve these aims, various premiums are granted. For example farmers who deliver neither milk nor milk products are granted the suckler cow premium. The premium can nevertheless be granted if the milk or the milk products are sold directly at the farm to the consumer. The suckler cow premium is also granted to producers whose single reference quantity (milk quota) is at the most 60,000 kg.

Directives for the protection of the environment

The accompanying measures include, along with direct payments, environmental measures. These are not really agricultural instruments but they nevertheless exert a strong influence on agriculture and cannot be ignored in this study (Council directives 91/676/EEC; 79/409/EEC; 92/43/EEC; 97/62/EC; 79/117/EEC; 91/414/EEC; 86/363/EEC; 76/895/EEC; 90/642/EEC; 74/63/EEC; 80/68/EEC; 80/778/EEC; 96/61/EC).

The priorities of this group are:

1. Reduction of nitrates in the groundwater
2. Fixing of the maximum levels for pesticide residues in various products
3. Protection of wild fauna
4. Protection of flora

The reduction of water pollution caused by nitrates from agricultural sources serves the protection of human health, living resources and water-ecosystems. In order to reduce the nitrates in the groundwater, the EU-directive fixes the amount of fertilisers that may be used on the areas of a farm per year and per hectare (Council directive 91/676/EEC). This case shows very clearly that the directive has a direct effect on the farmers. Moreover, in the long term it has a positive effect on the human being, on society and on the environment.

Structure strengthening

The third type comprises all measures which contribute to the structure strengthening of farms. The four dominating classes are:

1. Measures supporting the marketing
2. Measures supporting the production
3. Vocational training measures
4. Regional development programmes

Measures supporting the marketing

They are aimed at the improvement of the processing and marketing of agricultural products. Moreover, they represent a recommendation and assistance in the adaptation of producer groups to new market situations. To this end the EU grants investment aids for producer groups and associations thereof. The investments have to contribute to the improvement of the situation in the respective lines of production of agricultural commodities.

The EU also supports the marketing of agricultural products and foodstuffs by introducing trademarks. For this the EU has elaborated common basic conditions for the protection of geographical indications and of designations of origin. The result is that consumers have more trust in products with a trademark. Especially in less-favoured or remote areas this regulation can be very advantageous to the rural development. By increasing the farmers' incomes the migration of the rural population from these areas can be slowed down (Council Regulations No 951/97; No 952/97; No 2092/91; No 2081/92; No 2082/92; No 2515/94).

Measures supporting the production

These measures are intended for the support of the modernisation and the diversification and also for setting-up aids to young farmers and aids to comply requirements (Council Regulation No 950/97). They should contribute to the improvement of the agricultural incomes and of the living, working and production conditions on the farms. Aids are granted for investments which

1. contribute to the qualitative improvement and conversion of production according to the requirements of the market and to the adjustment to common quality standards
2. contribute to the diversification of activities on the farm (especially tourist and trade activities)
3. contribute to the improvement of the living and working conditions
4. contribute to the improvement of hygiene conditions in livestock raising and to the keeping to the Community norms regarding the protection of animals
5. contribute to the protection and the improvement of the environment

Vocational training measures

This class comprises vocational training measures for the improvement of the agricultural professional qualifications (Council Regulation No 950/97). It comprises courses or practical trainings for the professional education and continuation of education of farm owners, family workers and agricultural hired labour.

Regional development programmes

This class comprises regional development programmes and farm internal or external infrastructural measures. Because these measures are not limited to just one sector, they are not considered to be typical agricultural instruments. The regional development programmes are autonomous, on-the-spot developed, in many cases innovative programmes for the rural development (Community initiatives ("LEADER II") 94/C180/12). They should give all fields of activity in the rural area an impetus for innovative measures. Common initiatives for the development of cross-border collaboration (Common initiatives ("INTERREG II") 94/C180/13) also belong to the regional development programmes.

The regional development programmes are important instruments of the European structural policy. However, they could not be analysed in detail in this research project. The regional development programmes have a spatial-specific orientation and thus they have local effects. For this reason no generalising statements can be made for the Alps, as the objective and the task of this research project would have been. Moreover, the development programmes are aimed at a comprehensive regional promotion. Apart from agricultural measures they include many other promotion measures, which lead to a strong intertwining of the primary, secondary and tertiary sector. Because of that environmental effects which result purely from the agricultural sector cannot be deduced in a general way.

This survey of the priorities of the EU agricultural policy represents the central building block for the research project. The typology of the EU-instruments constitutes the basis for the expert interview which has been carried out within the framework of this project (see Section 4.6).

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4.4 Coherence of political objectives and EU regulations and directives

Alex Agethle and Peter Eggensberger

Political objectives form a fundamental basis for the development of legal norms. They express furthermore certain values of the society. Therefore it is of high interest to analyse the political objectives in regard to the topics agriculture and environment in order to show possible deficits or differences within the alpine region. Additionally it is studied to which extend these objectives are covered by European legal norms and in a next step whether deficits of implementation can be identified. For the EU regulations and directives concerned in this study of course mainly European objectives are of relevance (Swiss instruments see Section 4.5). But as often stated on the European level, the consideration of also regional objectives is of great importance especially in the very heterogeneous area of the alpine region. In order to guarantee a comprehensive and consensus-based implementation on the regional level it would be advisable to consider also these regional objectives in the scope of the European legislation.

This section focuses on a comparison (by wording or by sense) of political objectives and corresponding aims of instruments directly or indirectly related to mountain farming and alpine environment both on national and international level. However, chronological relations of political statements and aims of instruments are not taken into account. The real effect of these instruments is discussed in the following sections.

The analysis of effects together with the analysis of objectives, as described in the following, form the basis for recommendations (see Section 5) for the future programming of agricultural and environmental policies in the EU. Thereby a stepwise approach was performed as described in the following:

- At the beginning political documents were identified and relevant objectives concerning agriculture, environment and alpine topics in general as well as additional document characteristics such as year of decision and administrative range of validity were extracted.
- In a next step identified objectives were put into a consistent system including a thematic structure on the one hand and a ranking of objectives on the other hand.
- This system was analysed in regard to different qualitative perspectives such as thematic emphasis, chronological succession or differences between countries.
- Most effort was put into the analysis of coherence showing the degree of conformity of considered European regulations and directives due to the corresponding political formulations of objectives.
- Finally principle conclusions were drawn for the future programming of agricultural and environmental policies in the EU.

4.4.1 Identification of political documents

Relevant documents were selected according to the following criteria:

a) Chronological selection

Mainly documents since the late 70ies were considered when environmental policy became an important and independent political topic. This period of interest can be divided into three phases which also served as a time reference for other analysis.

- The late 70ies are characterised by an active period of legislation which finds its expression in a variety of different regulations concerning the protection of environment.
- In the 80ies these regulations became more and more a common practise in the field of administration. At the end of this decade the principle of provision gained in significance.
- At the beginning of the 90ies the phase of "sustainable development" started. In this decade important political documents were launched such as the Agenda 21, the 5th Environmental Action Programme of the EU, the Alpine Convention and the new orientation of the European agricultural policy.

b) Selection by administrative units

- International documents (global, European, transnational concerning European/alpine regions) decided by political bodies with institutional collaboration of the EU. This category includes documents such as the 5th Environmental Action Programme of the EU, the European Charta of Mountainous Regions, the Alpine Convention and others.
- International documents decided by political bodies without institutional collaboration of the EU. This category comprises bi- (tri-, etc.) lateral agreements between alpine countries concerning a so called "Alpine Policy" such as the ARGE ALP concept.
- National documents concerning the alpine region launched in alpine partner countries. In this context documents such as the Austrian Memorandum on Mountain Farming and the Italian Memorandum on Agriculture and Forestry in Mountainous Regions had to be considered. Objectives from Slovenia and Liechtenstein could not be analysed due to the more difficult access of documents.

On the basis of an international agreement the concerned political bodies had to operate on the NUTS 2 level (NUTS = Nomenclature of Territorial Units for Statistics). This spatial reference means for the alpine countries (Table 4.14):

Table 4.14: Spatial reference for the selection of political documents (Switzerland: see separate classification)

NUTS 0	NUTS 1	NUTS 2
Austria	Groups of "Bundesländer"	"Bundesländer"
France	"ZEAT" and "DOM" (Departement d´outremer)"	"Régions" and "DOM"
Germany	"Bundesländer"	"Regierungsbezirke"
Italy	NUTS 2 groupings	"Regioni"
Switzerland	Switzerland	"Großregionen"

c) Selection by type of document

Mainly documents without direct legislative effect on natural persons are considered. Of course they express a political intention but need further legislative instruments in order to have an effect on individual persons. Referring to Anreiter (1997) these documents can be divided into the following groups (Table 4.15):

Table 4.15: Type of documents referring to the classification of Anreiter (1997)

Type of document	Examples
Contracts: Conventions, (implementation-) Protocols, Pacts	- Alpine Convention and its various protocols - New orientation of the European agricultural policy 1992

Declarations, Resolutions, Memorandums, ...	❑ Declaration of Cork concerning the policy for rural areas ❑ ARGE ALP-concept ❑ Charta of Mountainous Regions ❑ Austrian Memorandum on Mountain Farmers

Documents with direct legislative effect on natural persons such as specific laws are only by way of exception included in this study since they are actually a part of policy implementation. Thus they have an intermediate position between political documents and corresponding instruments. Only selected skeleton laws in Switzerland were considered due to their high political relevance.

In Table 4.16 the most important documents are listed.

Table 4.16: List of documents taken into consideration for the extraction of political objectives

Name of Document	country
Agenda 21	Int
Alpine Convention of 7th November1991	Int
Declaration of Cork (GD VI)	Int
Environmental policy Agenda 21, Documents of the "Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit"	Int
European Environment (The Dobris Assessment)	Int
European Perspective for Spatial Development, first official draft	Int
Recommendation 14 (1995) on the European Charter of Mountain Regions	Int
Alpine Convention protocol "Mountain Agriculture"	Int
Draft report of the European Charter of Mountain Regions, Doc. 7319	Int
ARGE ALP concept	Int
5th Environmental Action Programme	Int
Concept "Ökoland Österreich"	A
"Nationaler Umweltplan (NUP)"	A
"Österreichisches Bergbauernmemorandum"	A
Elements of an action plan for sustainable development - a basis for implementation	CH
Federal law on the environmental planing (Raumplanungsgesetz, RPG) SR 700	CH
Federal law on the conservation of nature and cultural heritage (NHG) SR 451	CH
Federal law on water conservation (BBl 1987 II, 1061)	CH
Report on the agreement on the protection of the Alps (Alpine convention) and on various additional protocols	CH
Report on the characteristics of the environmental planing in Switzerland (96.038)	CH
Report on the modification of the federal law on agriculture (92.010)	CH
Report on the modification of the federal law on environmental protection (USG) (93.053)	CH
Report on the reform of the politics on farming: second step (Agrarpolitik 2002)	CH
Sustainable development - action plan for Switzerland	CH

Sustainable land use in Switzerland - elements concerning concept and content for its assessment, implementation and evaluation	CH
Charte nationale pour l'installation des jeunes en agriculture	F
Memorandum L'espace rural entre protection et contraintes	F
Memorandum interprétatif de la directive « habitats »	F
Memorandum pour l'agriculture et la forêt de montagne	F
Une politique européenne pour la montagne	F
Bodenschutzprogramm Bayern	G
Gemeinsame Erklärung über den Pakt für naturnahe Almwirtschaft (Almpakt)	G
Inaugural speech of the "Bayerischer Staatsminister für Ernährung, Landwirtschaft und Forstwirtschaft" on 29th November 1995 in the Bavarian "Landtag" concerning the new orientation of the agrarian policy of the EU	G
Landesentwicklungsprogramm Bayern	G
Plan für die Entwicklung des ländlichen Raumes	G
Memorandum "Agriculture in the Mountain Areas"	I

4.4.1.1 Extraction of objectives

The decision whether objectives were extracted from documents or not was made on the basis of the following criteria:

- ❑ First of all those objectives were of special interest which are dealing with the complex network of interaction between environment and agriculture (e.g. conservation of biodiversity, conservation of land traditionally cultivated by man). Both compartments of the man-environment system can not be seen independently from other fields of interaction. The degree of consideration of environmental concerns in agriculture is determined by a range of other factors such as economic (operational and political economics) and social acceptance of specific environmental measures. This means that also aspects with only functional impacts on the field of interaction between environment and agriculture have to be considered. Thus not only ecological but also economic, social and cross-section objectives were extracted.
- ❑ Furthermore only those objectives were extracted which are as a whole of high importance. Objectives such as supporting the extensive sheep farming in the Austrian-Italian border space are therefore not included in this study.

A specific objective is related to a concrete sentence or a part of sentence included in a document and was expressed as a specified term. This procedure is demonstrated by means of article 10 of the mountain farming protocol of the Alpine Convention (concrete objectives are underlined, additional information is marked by dotted lines):

"The contracting parties agree that site-adapted and land bound livestock farming as a source of income as well as a forming element of countryside and cultural heritage is a major component of mountain agriculture. Therefore <u>a site-adapted, land bound and ecologically</u>

consistent livestock farming considering also various traditional races as well as their typical products has to be conserved".

The extracted objective is: "Maintenance of site-adapted, land bound and ecologically consistent livestock farming".

In order to obtain a database for further analyses also the following document characteristics were written down:

- Year of decision
- NUTS-level (Int., 0, 1, 2)
- Document information according to country of origin respectively EU-participation

4.4.2 Development of a structured system of objectives

By means of the procedure described above the extracted objectives were put into a structured system. This was done by a stepwise approach as demonstrated in the following:

1. First of all objectives were related to three parts of the so called "sustainable development" approach: ecology, economy and social aspects. Separate categories had to be introduced for very general as well as for not directly objective related topics.
2. In a next step objectives were related to specific levels of precision. This was done by the method of concept orientated development of environmental indicators referring to the "Deutscher Sachverständigenrat für Umweltfragen" (1994). The applied systematic introduces a ranking of different levels of precision by means of concept like objectives. This systematic can be also applied for social and economic aspects.
3. In a further step still not classified objectives were arranged by means of a bottom-up approach. This procedure is characterised by a system that is generated by the content of these elaborated objectives. Each concrete objective was assigned to a higher ranked one with a lower level of precision, and so on. In the case of no higher ranked objectives so called frame objectives were introduced covering those of lower ranking (5 cases). Figure 4.25 illustrates this specific procedure.
4. Classified objectives were arranged in a specific table showing different levels of ranking and additional document characteristics in separate columns.

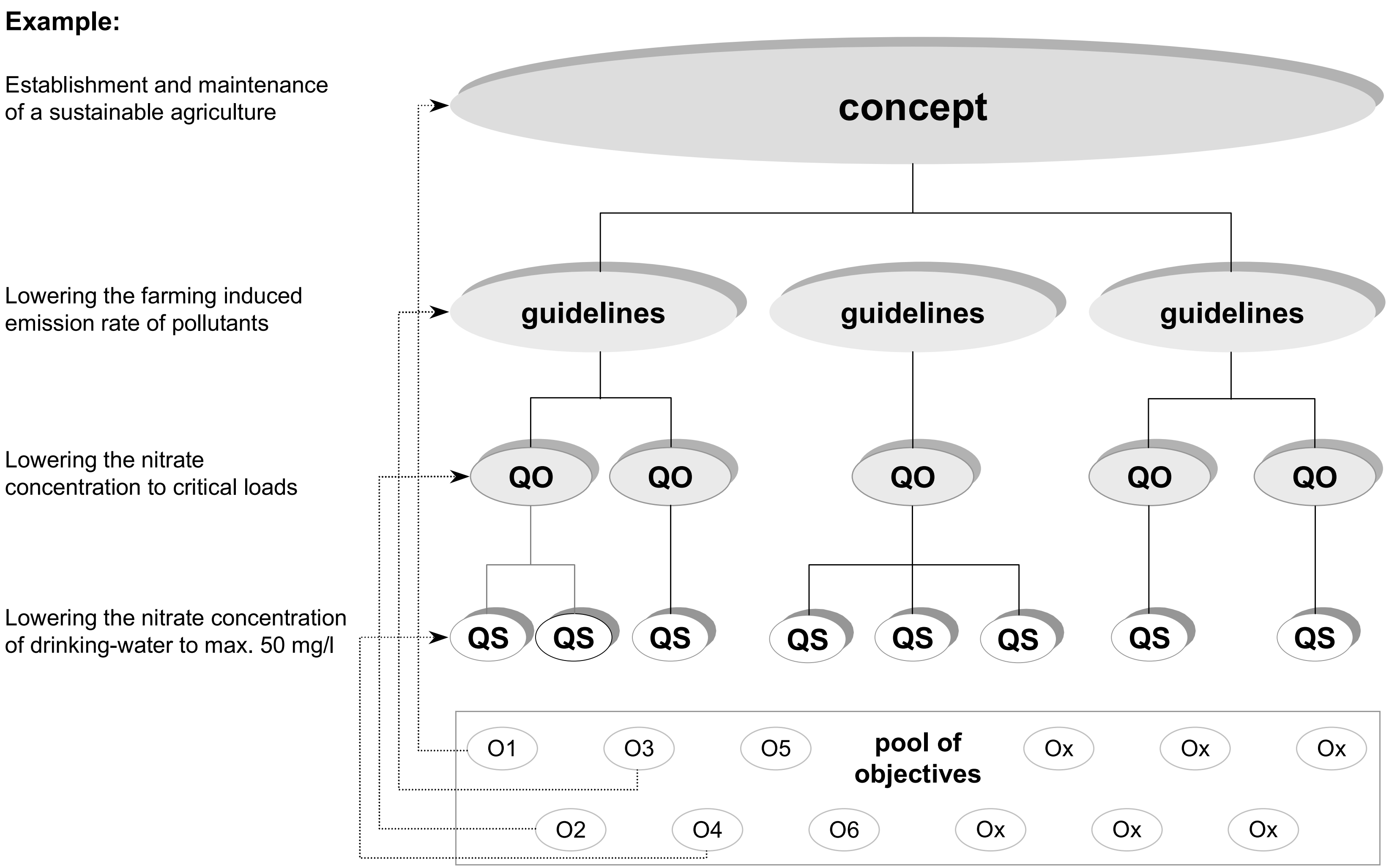

Figure 4.25: Methodology of generating the system of objectives (QO = objectives of environmental / economical / social quality, QS = standards of environmental / economical / social quality, O = objectives)

4.4.3 Qualitative analysis of objectives

4.4.3.1 Methodology

The system of objectives consists of 511 objectives together with the characteristics of the corresponding documents structured by thematic fields and ranked according to their degree of precision. Except of the 5 self-defined objectives they were taken from the documents already identified in Section 4.4.1. The step as detailed below aimed an analysis of this system with regard to both content and document characteristics.

The evaluation of the system of objectives was effected by descriptive analysis and is based on two pillars:

- Assessment of objectives only by content (is there thematic emphasis?)
- Statistical analysis of document characteristics, partly in combination with contents

Interpretation was based on accumulations in abscissa and ordinate as well as the corresponding maxima and minima.

4.4.3.2 Results of the analysis of content

Although the three dimensions of sustainability were equally considered in the choice of documents and the formulation of objectives one can clearly observe an emphasis on the fields of ecology and economy. While German and Swiss documents are rather of ecological content (they confirm the general assessment of ecology playing an important role in the political discussion in these countries), Austrian and Italian documents focus on economic issues.

In general, the small number of social objectives was striking. Out of German documents not even one social objective could be extracted. This raises the question about the reasons for this lack of social issues which cannot be settled here. It's especially debatable whether the observed result is only due to the already as difficult known implementation of social issues or if, additionally, the decisive factor could be found in the low importance of social questions within the public discussion. In any case it has to be emphasised that social aspects have not yet been seen as integrative part of a sustainable development of mountain agriculture.

4.4.3.3 Results of analysis of document characteristics

a) Evaluation by country of origin and EU-participation

Besides the 35% international documents constituting the main emphasis among the 506 analysed objectives, Switzerland mentioned the most political expressions of will followed by Germany and Italy and as last group France and Austria. A correlation to the number of documents could not be observed. In all cases it is interesting that also the spatial portion of alpine countries to the total alpine area is of no significant influence to the number of political formulations of objectives concerning interactions between agriculture and environment. It is obvious that also intercultural differences in terms of social and political values are of certain relevance.

Regarding the degree of precision of objectives it is stated that Austria, followed by Switzerland and Germany mostly remain on the level of concepts. Correspondingly, rather few quality objectives can be found in Austrian documents, whereas Italian documents stand out by their high number of these very concrete formulations.

In documents with participation of the EU there are relatively more objectives formulated on the level of visions and quality objectives than in documents of single countries whereas the EU doesn’t participate too often in the formulation of guidelines.

b) Evaluation by level of NUTS

72.3% of all non-international documents are based on NUTS 0, that is the level of nations. Objectives on NUTS level 1 (e.g. "Bundesländer" in Germany, "Kantone" in Switzerland) cover 20% of all objective formulations. The rest, almost 8%, is related to NUTS 2 (e.g. in Germany the Bavarian "Regierungsbezirke", in Italy the "regioni"). Furthermore, it is remarkable that ecological objectives were mentioned equally on all NUTS levels, whereas economic ones were stressed on NUTS level 2. This result confirms the high national importance of agricultural policy in alpine regions.

It is stated that the released documents on NUTS level 2 contain clearly more visions than, for example, those on NUTS 0. On NUTS level 1 mostly guidelines were formulated.

c) Evaluation by year of decision

According to the development of environmental policy already described in Section 4.4.1, the documents respectively objectives were assigned to three periods: 1966-1979, 1980-1991, 1992-1998. As expected, ecological objectives dominate the first period, while the high proportion of social objectives seems astonishing. In the second period only ecological objectives play an important role; in this decade environmental policy reaches its culminating point. Corresponding to a more integrative approach in the last period, political objectives shift to the field of economy while a slight decrease of ecological issues can be observed. It seems especially astonishing that, in spite of all manifestations of an integrative way of looking at ecological, economic and social issues as a result of the UNCED conference in Rio de Janeiro 1992, this change of paradigm hasn't taken place so far in political reality.

4.4.4 Analysis of coherence

4.4.4.1 Methodology

In this step it was analysed whether and how far the considered European regulations and directives correspond with the political formulations of objectives. Additionally, a connection with general document characteristics was examined. The importance of this step is evident due to the fact that it allows to show strong and week points concerning the realisation of political formulations of objectives within legal norms. On this basis first information can be obtained due to possible deficits of implementation.

The political objectives as well as document characteristics are determined by the system of objectives, the aims of European regulations are taken from the systematic analysis of agricultural and environmental instruments described in Section 4.3.

The analysis of coherence consists of two steps:

a) General analysis: Correspondence of aims of instruments (abscissa) with political objectives (ordinate)

For this, the statements in the system of objectives were cross-tabled with the aims of agricultural instruments of the EU. Each formulation of objective was compared with all aims of every examined instrument and analysed in regard to agreements of sense and wording. Each correspondence was then marked in the matrix Table 4.17 schematically shows the described proceeding.

Table 4.17: Schematic proceeding of analysis of correspondence of political objectives with aims of instruments

	EU space (same for Switzerland)			
	obj. 1, 2, 3, n of instrument 1	obj. 1, 2, 3, n of instrument 2	obj. 1, 2, 3, n of instrument 3	obj. 1, 2, 3, n of instrument 4
political objective 1	x	x	x	
political objective 2		x		x

political objective 3	x	x	x
political objective n			x

b) Detailed analysis: Correspondence of aims of instruments (abscissa) with political objectives (ordinate) on different levels of precision

For closer examination by different levels of precision the system of objectives was restructured in a new hierarchy. Each subordinate objective (e.g. guideline, objective of quality) was assigned to its related objective on higher level (e.g. a concept) which then was characterised in its total by the number of correspondences with the aims of instruments. This was done as well on the level of concepts as on the level of guidelines and objectives of quality. On the basis of this assignment dependencies between the number of references in instruments and document characteristics were analysed.

4.4.4.2 Results of general analysis

a) Evaluation of documents by country of origin and EU-participation

It is evident that 31.5% of all objectives are not covered by any considered agricultural instrument of the EU.

A comparative analysis of countries has shown that French and German formulations of objectives are covered by instruments above average. On the other side stands Italy where 60% of ecological criteria do not correspond with instruments neither by sense nor by wording although the number of ecological objectives is already small. Also only about 50% of Italian objectives concerning economic issues are considered by EU instruments. It has to be questioned whether this result can be seen as a reflection of political priorities or of lobbying activities of the considered European countries.

Among 180 formulations of objectives originating from international political documents 151 are developed under EU-participation. However, about one third of those are not covered by the considered EU-instruments. Concerning ecological aspects (mostly objectives originating from the Agenda 21) this not covered part rises up to more than 50%. The most important not covered formulations of objectives concerning ecological and economic aspects are listed in Table 4.18 but without showing thematic emphasis.

Table 4.18: Not covered formulation of objectives

Not covered ecological formulations of objectives
Planning and carrying out of breeding programs for indigenous races in order to

preserve their population and to avoid replacing by cross-breeding and substitution crossing
Registration of soil resources. Development of an adapted planning for land use concerning arable cultivation also in drainage basins due to hydrological aspects (erosion of soil), the increase of biomass production and the maintenance of ecological balance until 2000
Consideration of environmental friendly mountain agriculture as far as limits of production are concerned
Assessment of the agricultural potential of marginal land in comparison to alternatives of land use and the development of systems enabling a sustainable increase of productivity
Collection of information in order to establish a database and information-systems for an easier and faster assessment of potential risk in mountain regions
Lowering the production of food, feed and resources by improving the nutrient content of crops, animals and micro-organisms and reduction of the harvesting losses

Not covered economic formulations of objectives
Installation and enlargement of a communication system and of a clearing institution for organisations dealing with specific questions of mountain regions
Liberalisation of the quota system due to the absence of alternatives for production in mountain regions
Maintenance of the quota system concerning milk production
Better use of synergies between local, private and public measures of financing
Fragmentation of holdings to property consortiums and associations for the maintenance of farm land
Individual maximum for the direct payments as far as income is concerned

b) Evaluation by level of NUTS

As shown in Section 4.4.3.3 the majority of political objectives originate from documents elaborated on NUTS 0 level. The portion of not covered objectives mainly concerning ecological and economic aspects is also highest on this level of decision making. However, the degree of correspondence increases on NUTS 1 level and is even higher on NUTS 2. At least for these different portions the absolute number of existing objectives is without any doubt of high importance.

c) Evaluation by year of decision

In the first period (1966 to 1979) a high rate (84%) of ecological and social objectives were covered by instruments. In this context the time factor plays an important role regarding political implementation.

In the second period (1980 to 1991) a decrease of covered political objectives can be observed. Especially on the field of economy this low rate has to be stressed given that the already small number of formulated economic objectives would rather give rise to the supposition of a higher share of correspondences with political instruments. No explanation could be found for this effect.

The third period (1992 to 1998) is characterised by not covered objectives concerning all three dimensions of sustainability. Due to the time consuming procedure of political implementation this result cannot surprise.

d) Evaluation by selected EU instruments

First of all it has to be mentioned that mainly the instruments of the European structural funds cover a wide range of political objectives. On the level of concepts these objectives are for instance:

- Taking into account special conditions in the Alps
- Comprehensive development of mountain areas
- Development of a common system for the identification of disadvantaged areas
- Ensuring of living standard, in particular environmentally sound settlement and economic development
- Improvement of quality of life
- Promotion of economic and social progress and a high level of employment
- Easier access to community and national subsidies for all mountain farmers
- Creation of a common market and of an economic and monetary union by working out common policies and measures following articles 3 and 3a promoting a balanced and sustainable development of economy, a high level of employment and a high level of social security, equal status for man and woman, a constant non-inflationary growth, high level of competitiveness and convergence in terms of economy, a high level of environmental protection and improvement of environmental quality, the improvement of quality of life, and the economic and social solidarity of the member states
- Maintenance of the Alps for residence and economic activities.

Although many of these objectives concern as expected economic issues, the existence of also ecological and social objectives prove the integrative approach of the instruments of the European structural funds.

On the other hand several instruments show also a very specific covering of political objectives such as EU regulations for the conservation of wild birds, conservation of natural habitats and of wild flora and fauna. They focus for instance on the following political objectives:

- Conservation of nature in its dynamic diversity
- Protecting, restoring, and developing the natural resources and environment
- Maintenance of nature's capacity for regeneration and sustained productivity and preservation of the variety, uniqueness and beauty of nature and countryside.

The regulation for the application of pesticides and for controls of residues, the regulation for determining the limits for harmful substances and products in feed as well as the regulation for the protection of groundwater cover the following political formulations of objectives:

- ❑ Conservation of nature in its whole diversity,
- ❑ Prudent use of soil,
- ❑ Maintenance of the natural basis of living,
- ❑ Non-polluting methods of production.

Finally it can be concluded that the EU-instruments mentioned above have at least in regard to the content taken up the corresponding political objectives. However, this result does not show any information concerning the actual effects but let expect a high probability of implementation.

4.4.4.3 Results of detailed analysis

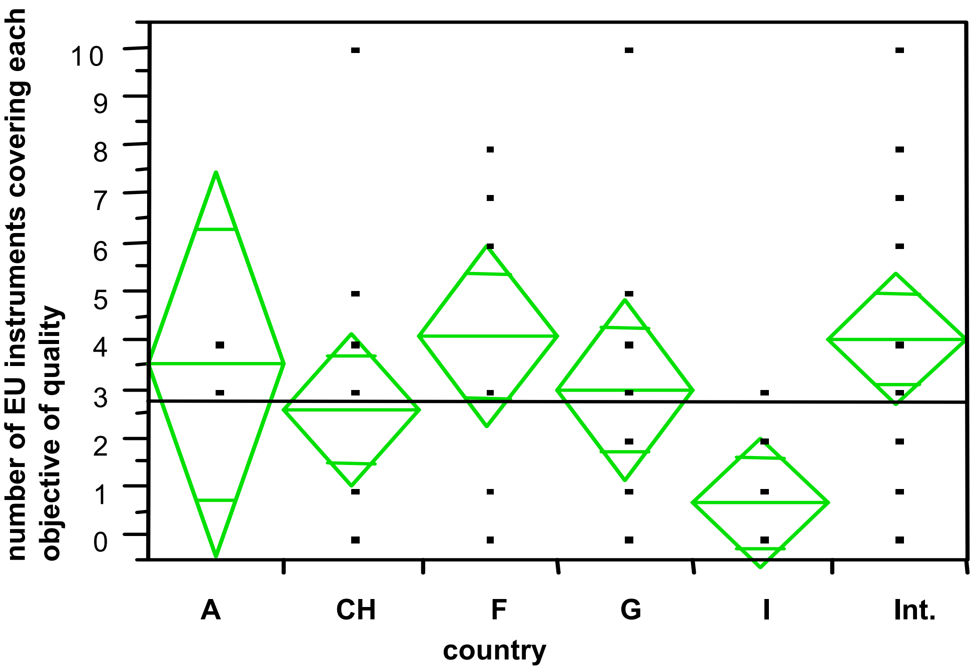

Figure 4.26: Degree of correspondance of formulations of objectives originating from EU-instruments with political aims of quality shown for different countries. The centre of the rhomboid corresponds with the mean in each country, whereas the upper and lower line stands for maximum and minimum. The top of the rhomboid represents the quartiles and the continuous line expresses the overall alpine average (The grammalogues stand for: A= Austria, CH= Switzerland, F= France, G= Germany, I= Italy, Int = International)

Detailed analysis was only done on the levels of concepts, guidelines and objectives of quality given that only here an adequate number of objectives for further analysis could be identified. Surprisingly, no correlation could be observed on the level of concepts and guidelines.

However, objectives of quality show dependencies concerning document characteristics as country of origin and year of decision. As seen in Figure 4.26, Italian objectives show a number of references below average and therefore are only covered marginally by EU-instruments. Objectives of quality arising from French and International documents, however, are covered above average.

It is also interesting to consider the distribution of covered objectives of quality to years of decision. Those objectives of quality with most references in instruments date from the year 1993. Also objectives of quality dating from 1991 and 1995 are represented above average. However, objectives dating form 1992, 1996 and 1997 are covered below average. Especially for the more recent objectives once more the time factor is to be considered concerning political implementation.

4.4.5 Conclusions

This task was challenging from the beginning. First of all, from the large number of existing political documents those had to be chosen that contain essential statements on agriculture and environment. Similarly, EU instruments relevant for the alpine region were selected. In a next step correspondences of comprised objectives were analysed without considering any causal connection (i.e. which political objective caused which instrument) or estimating actual effects. In this context, the comparison of Swiss political objectives with EU instruments represents an extreme. This might appear formally incorrect, but seems justified when looking at an integrative development of the alpine region according to the Alpine Convention. Additionally, further methodical questions had to be solved concerning, for example, the extraction of objectives, their distinguishing from measures and the way of comparing objectives and instruments itself.

In simplified terms, the conclusions listed below and shown in Table 4.19 were obtained by comparison of a selective cross-section of objectives with a just as selective cross-section of instruments. Even though alternative methodical approaches would have led to a result slightly different in some parts, following statements can be regarded as quite stable due to the broad cross-sectioned way of looking. Their importance even increases when considering also the results of the controlling of effects described in the following sections.

- In principle, the needs for comprehensive formulations of objectives seem to be met both on international and national level.

- Surprising is the high share of objectives deriving from international or national documents whereas objectives from regional documents are rather small in number and mostly of economic background. Especially the differences as regards content indicate an inadequate co-ordination between the bodies of different NUTS levels in terms of objectives. Above all, it is within the responsibility of each alpine country as well as the European Union to examine its own policy with regard to these aspects. Furthermore, this result could be used as opportunity to motivate regions to intensified formulation of their specific objectives, for example through regional Agenda 21 processes.
- As in political objectives social issues are considered only marginally respectively were rather considered in the past, the opportunity should be used by all bodies of different NUTS levels to emphasise these aspects in future political expressions of will. Not only because of the integrative approach of sustainability, also for the reason of actual social developments (especially in the field of participation) the continued segregation in agricultural and environmental documents doesn't seem to be up-to-date any longer.
- The fact that almost one third of identified objectives was neither by wording nor by sense taken up in instruments suggests a deficit of implementation. Of course, one has to admit that some objectives were implemented without directly been mentioned in the specific instruments. Furthermore, it is not the actual task of the EU to cover completely all ideas of objectives developed by the alpine countries down to NUTS 2 level.
- Two conclusions can be drawn on the basis of the different degree of correspondence of political objectives of the alpine countries with EU instruments. On the one hand the disadvantaged alpine countries can take the political initiative, on the other hand the EU itself could promote a balanced development.
- In spite of an institutional participation of the EU on the agreements of the Agenda 21, a range of objectives (mainly environmental) mentioned in this set of agreements are not covered by instruments. However, one has to admit that the Agenda 2000 can be considered as an instrument increasingly taking into account environmental aspects.
- It is also remarkable that ideas of objectives concerning regional policy (NUTS 1 and 2) are covered better by EU- than by national political documents. Thus, one cannot say by principle that the EU does not consider regional ideas of objectives.

Table 4.19: Need for action on the different political levels

Need for action	EU	NUTS 0	NUTS 1	NUTS 2
On the side of political objectives				
Increased integration of social objectives	x	x	x	x
Increased integration of ecological objectives				x
Better co-ordination of contents of political objectives on the different levels of competency	x	x	(x)	(x)
Formulation of regional objectives				x
On the side of establishing instruments				

Better implementation of own objectives, especially in the field of ecology	x		
Equal consideration of objectives of all alpine nations on international level	x	x	(x)

References:

Anreiter, W.G. (1997) The Effectiveness of International Environmental Agreements and the Implications for the Alps Convention. Oxford Brookes University, Working-Paper No. 172.

Deutscher Sachverständigenrat für Umweltfragen (1994) Umweltgutachten 1994. Bonn.