SOME NEW ASPECTS OF LAND USE IN SLOVENIA

NEKAJ NOVIH VIDIKOV RABE TAL V SLOVENIJI

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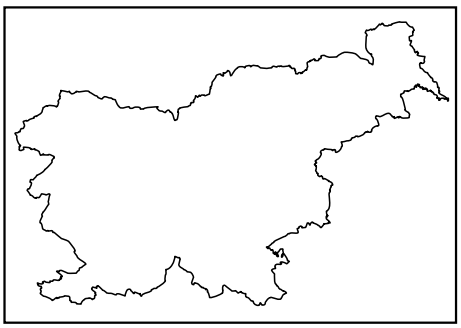
Carst field Lučki dol with the church sv. Ožbolt (photography Igor Maher).
Kraško polje Lučki dol s cerkvico sv. Ožbolta (fotografija Igor Maher).



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Some New Aspects of Land Use in Slovenia

KEY WORDS: land use, rural geography, tipology, Slovenia

Because of its exceptional role in determining the appearance of the landscape, land use has long been a recognized subject of research in geography as much abroad as in Slovenia. This article first gives a brief survey of the notable achievements of Slovene geographers. The continuation presents the results of analyses of the reciprocal correlation between land use and several important landscape elements (lithological structure, climate types, and altitude) carried out with the help of the Geographical Information System and the IDRISI computer program. Attention is drawn to new aspects of presenting the occurrence of individual land categories based on uniform large deviations from the average occurrence of certain categories in the country as a whole. Also presented are a test survey of predominant land use on the basis of arability equivalents and an improved survey of the typology of the change in land use, this time undertaken for the period between 1961 and 1994.

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Nekaj novih vidikov rabe tal v Sloveniji

KLJUČNE BESEDE: raba tal, agrarna geografija, tipologija, Slovenija

Raba tal je zaradi svoje izjemne vloge pri opredeljevanju pokrajinskega videza že dolgo hvaležna tema preučevanja geografije tako v svetu kot v Sloveniji. V prispevku je najprej podan kratek pregled vidnejših dosežkov slovenskih geografov. V nadaljevanju so prikazani rezultati analiz medsebojne soodvisnosti rabe tal in nekaterih pomembnih pokrajinskih prvin (litološke sestave, podnebnih tipov in nadmorske višine), izvedenih s pomočjo Geografskih informacijskih sistemov in računalniškega programa Idrisi. Opozoriti velja tudi na nove vidike prikaza zastopanosti posameznih zemljiških kategorij, ki temeljijo na enakomerno velikih odklonih od povprečne zastopanosti določene kategorije v državi kot celoti. Predstavljen je tudi poizkus prikaza prevladujoče rabe tal na osnovi ornih ekvivalentov, izpopolnjen pa je tudi prikaz tipologije spreminjanja rabe tal, tokrat izveden za obdobje med letoma 1961 in 1994.

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1. Introduction

Land use reflects a complex correlation between natural, historical, and socioeconomic factors. Among the first to single out is the relief of the surface area reflected in altitude, slope, and exposure of the slopes to the sun. The lithological structure influences both the relief and the land use itself. Among historical factors, land use is largely defined by the characteristics of settling, the economic conditions in the past, and the land ownership situation so closely related to them that it almost extends into the area of socioeconomic conditions.

Land use also constantly changes, which is seen in the changing of land categories or their relative proportions. Registering the changes is a demanding and expensive task, and therefore a universal methodology has not yet been advanced. In spite of the most modern aids such as satellites and computers, establishing current land use is still bound to field work that can either confirm or contradict suppositions created by lab work. In nature, it is frequently difficult to distinguish specific land categories since in the process of changing they fall between individual typical forms.

In spite of the many problems, the study of land use in geography, and a little less in other spatial planning fields, is relatively well represented. However, interest in this field is apparently declining, a fact reflected in the smaller number of contributions of general character and the smaller number of authors. At the same time, a deeper approach is evident that ensures more systematic and more effective work specialization. It is possible to compare results and seek answers to possible discrepancies. Also, for some procedures in the current contribution, older starting points for the better evaluation of processes are ensured, while some aspects represent innovations that were, at least to some extent, only made possible by the use of modern computer technology.

Slovenia belongs among European countries with the smallest proportion of agricultural and cultivable land and the largest proportion of forest. However, in areas with limiting factors for agriculture that is, in areas with poor natural conditions (hilly-mountainous, mountainous-high-altitude, karst, etc.), there is as much as 72% of total agricultural land while only 28% of it stretches in flatland (*Slovene Agriculture in Numbers, 1994*). According to the area of agricultural land per inhabitant (0.44 hectare), Slovenia is at the European average, largely due to the significant percentage of meadows and pastures. However, there are only 0.12 hectares of cultivated fields per capita, which represents a critical limit to ensuring self-sufficient food production (Gabrovec, Kladnik, Material for the *Geographical Atlas of Slovenia*). On the other hand, there is more than a half hectare of forest per capita, which considerably more than the norm (0.35 hectare) for satisfactory self-sufficiency in wood. According to estimates, forests cover well over half of the country's surface area, and according to data from the agro-map made in the early 1990's, almost 142,440 hectares or 16.4% of all the available agricultural land is in one phase or another of afforestation (Golob, Hrustel-Majcen, Cunder, 1994). Simultaneously, many tens of thousands of hectares are estimated to be uncultivated or poorly cultivated (Kocjančič, 1983). After World War II, an average of 1700 hectares of agricultural land were permanently lost every year (Leonardi, 1990).

In the endeavours to mitigate negative consequences of these losses, extensive land amelioration projects were started in the 1970's, among which ecologically controversial drainage projects were in the forefront (Belec, 1982; Kert, 1979; Kladnik, Marjeta Natek, 1989, Matičič, 1983; Marjeta Natek, 1990). The positive side of carrying out amelioration projects was the simultaneous carrying out of land consolidation projects, whose significance was and still is largely disregarded. Such projects (Avbelj, 1986; Slavič, 1983), at least in some places, improved the economy of production that due to the excessive partition of land was on a rather low average level (Kladnik, 1990 a). To prevent the constant reduction of agricultural land, an intervention law was passed in the 1980's. With this law, 427,500 hectares were ranked as first category agricultural land permanently devoted to agricultural use, while another 354,700 hectares were ranked in the second category with less strict protection regime. The law was also based on the results of a study on the categorization of agricultural land (Stritar et al., 1974).

2. Previous Studies in Slovene Geography

Because of its visual component which reflects complex cause and effect relationships between natural and social elements, land use has been at the center of interest of Slovene geography for a long time. Because of their considerable influence on the development of geographical science, the achievements of several authors from related fields are mentioned (Stritar, Marušič).

It is noticeable that in the recent past land use has been given more attention than in the present due to the expansion of subjects for study in the field of geography. Studies in agrarian geography and geography in general were established by Medved (1972). In 1969, Maribor hosted the third conference of the Subcommittee for Land Use in Central and Eastern European Countries, the results of which were published in English and French in *Geographica Slovenica 4*. Land use is frequently defined in the role of establishing agricultural systems.

Work methods changed or improved gradually, and therefore it is possible to see a transition from the once predominant detailed studies of smaller areas to more general studies on the level of Slovenia as a whole in which the spectrum of studied parameters has expanded considerably. To test established theses, detailed field studies were still necessary. With specialization, the number of researchers of land use decreased considerably, but since numerous elements were studied on a wider level and due as well to ever better databases and more capable aids for their faster processing, knowledge regarding this important landscape element has improved greatly. Vrišer's textbook (1995) points to the current specific weight given land use within agrarian geography and by stating land categories in the first place shows the differences between individual continents. In the chapter on regionalization methods, he also shows the possibilities originating in its detailed studies. Here he points out its importance in defining agricultural (rural or agrarian) systems.

Agricultural land on different types of surface in time developed characteristic parcelization; on the basis of field studies, Svetozar Ilešič (1950) divided it into systems (types) of field partitions.

At first, the study of land use on the level of cadastral municipalities strongly prevailed. The majority of such studies were made between 1955 and 1975. The geography students at the Ljubljana Faculty of Arts, under the guidance of Svetozar Ilešič and his successors, alone did 42 diploma theses and 71 seminar projects on this subject. Among the students, only Dolores Lavrenčič (1948) tackled land use on the level of Slovenia as a whole in her seminar work. Simultaneously, deeper studies were carried out in some typical cadastral municipalities around Slovenia (Jeršič, Lojk, Olas, Vojvoda, 1962; Klemenčič V., 1962). Their intention was to throw some light on the characteristics of agricultural systems, as much on natural as in socioeconomic conditions. Much attention was paid to the evaluation of the quantity of various agricultural products, and therefore the studies have considerable methodological value for agrarian geography. In this context, the contribution by Milan Natek (1977) may also be included since it primarily illustrates sociogeographic influences on changes in land use.

Considerable attention was paid to intensive cultures, reflected in the vineyard, orchard, and hop field land categories. The leading researcher in this field is Belec (1973, 1975, 1978, and 1981). His main focus is the transition of the landscape under the influences of particular cultures.

Among the more comprehensive studies of socioeconomic influences on land use on the level of Slovenia as a whole, the articles by Medved (1974) and Kladnik (1983) are worth mention.

As a culmination of the classical technique of cartographic overlay in studying the intertwining of landscape elements and searching for new reciprocal connections, we can point to *Pokrajinska ekologija* (Landscape Ecology) by Gams (1976) in which land use plays the role of synthetic indicator. Quite similar in methodology are the works by Stritar (1971, 1983, 1990), except that the latter puts the soil, or rather its characteristic sequences called *pedosequences*, in first place among natural factors.

These are presented mostly through differences in land use where much attention is paid to differences in growth. In his search for the optimal use of space, Stritar also suggests suitable forms for man's adaptation in individual landscape units. As an important element of landscape transformation, land use in the Dravska dolina (the Drava River Valley) (Zgonik, 1970) and in many other landscape units of our diverse country was studied.

In Slovenia, the beginnings of the utilization of a cell network in studying land use reach back to the early 1970's when a theoretical foundation was added to the applications (Orožen-Adamič, 1972, 1973, and 1974). In the 1980's, more modern methods started to prevail, which greatly enriched the spectrum of studies. The first more important research results from landscape architects (for example, Marušič, 1983) then started to appear and were almost without exception based on the cell network.

Using the cell network, attempts were made to evaluate the influence of natural and social factors on the intensity of land use and to find new answers in the detailed partition and later reciprocal connection of individual elements (Perko, 1989; Topole, 1990). Due to the need to adapt the parcel network through which socioeconomic aspects were determined to the basic network system, a group of authors (Kladnik, Marjeta Natek, Bat, 1988) established a system of 25 × 25-meter squares. The greatest problem with this type of methodology is the extremely time-consuming creation of the necessary database. It is therefore no wonder that the authors were only able to process 723 hectares of the Dolenja vas cadastral municipality in the Selška dolina (the Selška Sora River Valley). Still, light was thrown on a whole set of connections that only indirectly touch upon land use. The major findings have been presented in geographical publications (Kladnik, 1989 and 1990 b; Marjeta Natek, 1989).

The first comprehensive geographical study of land use in which the phase of data processing was completely accomplished using computer technology was done by Kladnik (1985 a). Land use was studied for all of Slovenia according to natural geographic units, the administrative municipalities of the time, planning regions, and demographic areas, and the calculations were done in particular for less developed regions. The main results were later published (Kladnik, 1985 and 1988).

With the widening use of computer technology and improvements to its ability for use with personal computers, ever more diverse applications appeared that took advantage of the geographical information system (GIS), particularly the digital relief model (Banovec, Hočevar, Kunaver, Petkovšek, 1972; Bat, Gabrovec, 1987; Banovec, 1994). In concrete cases, studies of the countryside presented possibilities for the use of computers (Ogrinc, 1990). Cartographic displays of Slovene territory on the basis of the digital relief model (DRM) also appeared (Perko, 1991 a; Perko, Orožen-Adamič, 1995) along with instructions for its use (Perko, 1991 b) and a synopsis of its other useful aspects (Perko, 1991 c). In the last decade, geographical information systems (GIS) have flourished. Geography did not just stand on the sidelines, and its achievements can be set beside those of geodesy and other spatial planning fields. Perko (1994) also presented one of the most important implementations of GIS's in geography.

The use of the rastered GIS and DRM also enabled a series of more detailed studies that were able to illuminate the reciprocal connections between landscape factors and land use more profoundly. These studies mainly tried to establish differences between land use according to the Franciscan cadaster (Milan Natek wrote of its importance for agrarian-geographic studies in 1979), land use according to cadastral data, and land use determined by field work or the analysis of aerial photography. Due to the detailed collection of data and its exceptional volume, the studies were limited to characteristic, carefully selected probe areas that could include entire cadastral municipalities or their individual component parts (Bat, 1990 c; Gabrovec, 1990 and 1995 a; Kladnik, 1990 b).

In some studies, the importance of the formation of the relief was put forward (Karel Natek, 1984 and 1993; Gabrovec, 1990 and 1993). This does not mean that other landscape-forming elements were not considered among the influences on land use. Particular articles and studies were even narrower, searching for the correlation between land use and the slope of the surface (Bat, 1990 b) or focusing mostly on dolomite surfaces (Gabrovec, 1994, 1995 a, 1995 b).

Along with computer technology, aerial photogrammetry increased in importance in the studies of land use (Marjeta Natek, 1996) as did satellite surveillance (Pavlin, 1996 a, 1996 b) mostly intended to establish actual land use. For various reasons, the cadastral service does not register every change in land use immediately but with a considerable time lag. Therefore, in some places, the actual situation differs from the officially registered situation by up to one third (Kladnik, 1985). While the usefulness of satellite surveillance is still in the testing phase, another method has a relatively long period of applications. Among them, the first to point out is the drawing of agro-maps, the technical basis for the preparation of planning and other important documents for agriculture (Grmek et al., 1987). Unfortunately, different land categories appear in the tables and on the 1 : 5000 scale maps than those used in the cadaster, which diminishes their value. Their contribution in recording the land in the process of being overgrown is important, but on the other hand, they do not show the spreading of the forest. Several important geographical studies were carried out by analyzing periodic aerial photography sessions, for example, on land amelioration in the Vipavska dolina (the Vipava Valley) (Marjeta Natek, 1990) and in the border regions of western Slovenia (Pavlin, 1991).

To conclude our survey, let us mention the study of land use with special regard to the impact on the environment of artificial fertilizers and sprays (Rejec-Brancelj, 1994): Problem studies of this type have become quite popular and are currently running in many test areas across Slovenia.

2.1. A Survey of the Most Important Articles and Studies

Under this special subheading, only those contributions are included that illustrate subjects covering the entire territory of Slovenia and to a certain extent enable reciprocal comparison and supplementation of the results.

The first to present the characteristics of land use was Ilešič (1935). These were presented through the analysis of the proportion of cultivated surface areas from the entire surface area of individual cadastral municipalities in Slovenia and in the immediate vicinity inhabited by Slovenes. He relied on cadastral data from the year 1900.

Ilešič's work was continued by Leban (1947). The difference between the two is mostly in the fact that Leban calculated and graphically illustrated the proportions of agricultural land, adding pastures to Ilešič's cultivated land (cultivated fields, gardens, vineyards, and meadows). He too used data mostly from 1900 when orchards had not yet been distinguished as a separate land category. For Prekmurje, he took data from 1937. Leban's map reaches far into the surroundings of today's Slovenia. In it, the proportions are united into nine categories, and in this process he searched for ratios between the occurrence of arable land in which he ranked cultivated fields, gardens, and vineyards and the possible secondary dominance of meadows and pastures. In essence, he carried out a simple typification.

The first in the line of later more comprehensive studies was performed by Ingolič (1966). Although he relied on statistical data available only for a good sixty of the former administrative municipalities, he presented the basic ratios of land use in Slovenia, establishing them largely through the differences in natural conditions and the methods of husbandry by comparing the proportions of agricultural land, forest, and infertile land. He also roughly analyzed the changing of land categories between 1900 and 1960. He was the first to study the differences between the private and social sectors. Another innovation was the division of intensive land categories into extractive, intensive, structure-forming, permanent, and other cultures. The first culture is composed mostly of cereals, the second of corn and potato, the third of alfalfa and clover, the fourth of vineyards and orchards, and the remainder of industrial plants and garden vegetables.

The work by Medved (1970) is an extremely important step in the study of land use. Although his article still deals with the property and socioeconomic structure of households, he designed a typology on the basis of calculating changes between 1954 and 1967 to the surfaces of land categories in

individual cadastral municipalities that despite criticism is still often used. He relied on cadastral data; unfortunately, in the very period that he treated, changes occurred in the assessment of the land categories of »poor meadows« (*senožeti* or *košenice*) and orchards. He called the trends in the change of land use »afforestation«, »grassing over« (*ozelenjevanje*), »urbanization«, and »intensification«. His terminology has also taken root outside the field of geography. According to the markedness of the dominant determined trend, he divided these main trends into distinct, strong, and weak subtypes. His methodology enables graphical and tabular comparison between different time periods. In the period Medved selected, for example, grassing over still prevailed; later, afforestation dominated. In the continuation of his article, he presented cartographically according to administrative municipalities the changes to the surface areas of forest and cultivated land that he separated in his description into arable land and meadow. In his tables, he presented the changes to surface areas from 1939 to 1954. In the conclusion of the article, he systematically cites the wide spectrum of natural, property, social, and economic aspects as factors in the changing of land use.

Kladnik (1985) used Medved's methodology to study the typology of changes in land use for the periods 1953–1979 and 1971–1979. He relied on cadastral data for individual cadastral municipalities for the years 1953, 1961, 1971, and 1979 provided by the regional geodetic offices. For each of these years, the situation was analyzed according to individual land categories and graphically presented on the level of municipalities together with their proportions. On the basis of the then current legislation, the trends for expected changes in land use were calculated to 1985 and to 2000.

Vrišer (1987) rejected Medved's methodology due to certain deficiencies. However, he still used Medved's terminology, but more in the sense of defining the process than in denoting a specific typology. His graphical survey was based on administrative municipalities. He illustrated the changes to the surface areas of the primary land use categories in the twelve main Slovene regions between 1900 and 1981 in the tabular form as well as the trends for 1929 and 1953 for Slovenia as a whole. Vrišer too relied on cadastral data. The main value of his contribution is the extremely systematic survey of the changes in the definition of individual land categories based on cited laws and other relevant sources. The degree of accuracy of the main data sources is evaluated, and the reasons for the considerable differences among them are stated. Also presented are some calculation simplifications that almost all later authors of studies of this kind use due to various changes in the data sources.

Let us mention three more presentations of agricultural systems in Slovenia (Vrišer, 1967 and 1988; Medved, 1973). It is interesting that the methodologies employed by the two authors appear identical, but Vrišer's typology is based on the intertwining of surface area occurrences while Medved's is based on the monetary value of the harvest classified into cereals, root crops (both authors include here vegetables and industrial plants), fodder plants (meadows, pastures, and, according to the new classification, silage corn), and special cultures (vineyards, orchards, hop fields). It is interesting that Medved speaks somewhat awkwardly about types of land use although he relies on value ratios in the crops and not on the surface occurrence of individual categories. The types presented are relatively similar in both authors: fodder, cereal, root crops, and special types and various combinations. Vrišer's study for the private sector is based on data from statistical evaluations in 290 agricultural areas for 1965 and 1984, while Medved's study is based on statistical data from administrative municipalities for 1969 and is therefore more general. In Vrišer, the data for the former social sector pertains to individual companies. The findings can be compared, and it is especially convenient that both Vrišer's studies are methodologically completely harmonized.

3. Work Methods

3.1. Sources

The basic source in undertaking the study is the data from the land cadaster maintained by the Surveying and Mapping Authority of the Republic of Slovenia (*Land Cadaster, 1994*). The data is assembled

on the basis of cadastral records showing current situation in all the cadastral municipalities; however, the data is not up-to-date due to the failure to record changes promptly and indeed lags permanently behind the actual situation. Still, because the data is available in digital form, its importance for the execution of cartographic illustrations is exceptional.

To follow ongoing changes in land use, data from the central statistics office is available (*Statistics Annual*). Data on the private sector is based on evaluations of approximately 300 evaluation regions covering five to ten cadastral municipalities. On the basis of detailed knowledge of the field situation, this data is gathered by statisticians, and actual discrepancies with the situation in the land cadaster are taken into consideration. This data is also presented for former municipalities and current administration units (Krznar, 1995). A weak point of agricultural statistics lies in ensuring data for the former social sector on the basis of reports from labour organizations; the gathering of information with different methodologies can also create problems (Vrišer, 1987).

For older periods, we used the database from Kladnik's study (1985), using the data for 1961 as a starting point to ensure the comparability of findings with the usual time lines applied in other fields such as demography. Most of the problems in matching two time lines are caused by the continual changes to the borders of cadastral municipalities. On one hand, new municipalities are established, and on the other, the borders between municipalities were changed so that some cadastral municipalities had already been reduced to the smallest common denominator of surface area in the mentioned study.

For the year 1900, data from Vrišer's article (1987) and citations from *Gospodarska in družbena zgodovina Slovencev* (Economic and Social History of the Slovenes) (1970) were used, and in some cases other immediately cited sources were used.

3.2. Land Categories

Land use is reflected in the occurrence and distribution of land categories. We decided on the graphical illustration of the proportions of the six basic land categories (cultivated fields, vineyards, orchards, meadows, pastures, and forests) that are the basis of the activity of the primary sector, that is, the various branches of agriculture and forestry. Along with these, the distribution of otherwise diverse infertile land is shown. Among the basic land categories there are several transitional forms whose ratios have changed numerous times in the course of history (Vrišer, 1987).

The Emperor Francis' cadaster (1818–1827) distinguished the following types of land: cultivated field, meadow, pasture, forest, and vineyard. It also included land with mixed cultures, for example cultivated fields, meadows, or vineyards containing fruit trees, as well as several special categories: vegetable gardens, ornamental gardens, hop or tobacco fields, olive groves, swamps, quarries, building sites, rivers, streams, etc. As a rule, the culture that occupied the greater part of the parcel was stated.

With data from the revised cadaster for 1896, the land was divided into cultivated fields, gardens, vineyards, meadows, pastures, and forest, and the collected data was calculated for communal surfaces and the surface area of fertile land.

In Yugoslavia between the two World Wars, agricultural statistics again introduced independent land categories for orchards, swamps and marshes, fishponds, and infertile land. Following World War II until 1955, the independent land category of »poor meadows« (*senožeti* or *košenice*) extracted mainly from pastures was introduced. Because of the difficulties in distinguishing between them, cultivated fields and gardens were combined.

Major changes in the definition of land categories were made in 1974 with the law on land cadaster (*Official Gazette of the SRS*, No. 16, 1974) that envisaged a new book of regulations for the cadastral

classification of land which appeared in 1979 (*Official Gazette of the SRS*, No. 28, 1979). This law introduced some new land categories, and others were more clearly defined. The law defines:

- *cultivated fields* as land where field crops, berries, clover, and various plants are grown,
- *gardens* as land where vegetables and flowers are grown using regular irrigation,
- *hop fields* as land planted with hop,
- *vineyards* as land planted with noble or autochthonous grapevines,
- *plantation orchards* as land with more than 1000 m^2 planted with fruit trees that are intensively cultivated using agricultural mechanization,
- *extensive orchards* as land planted with fruit trees that do not fulfill the criteria for inclusion in the previous group,
- *meadows* as land overgrown with grass that can be economically mown at least once a year,
- swamp meadows as land on organic or mineral-organic soil overgrown with grass or horsetail,
- *pastures* as land that due to poor growth, steep slope, rocks, or inaccessibility cannot be economically mown or can only be used for grazing livestock; they may be partly overgrown with bushes, juniper, or bramble,
- *marshes* as land covered with reeds or other swamp vegetation that can be economically exploited,
- *forest plantations* as land planted with rapidly growing deciduous trees intended for the production of wood,
- *forests* as land overgrown with serried forest trees and various clearings.

All these land categories are ranked among the so-called cadastral cultures (*Bilance površin* ..., 1992). The land category »infertile« includes very diverse occurring forms: building sites (houses, commercial, and other buildings), courtyards, rocks, waters (rivers, streams, canals, artificial channels, lakes), transportation right-of-ways (roads, paths, railways, airports, etc.), and other unexploited land. Because their distribution is to a large extent the consequence of variations in development, they are not treated quite equally with the basic land categories.

In the study, gardens and hop fields are ranked with cultivated fields, while plantation and extensive orchards are combined, as are meadows and swamp meadows and forest plantations and forests.

Some categories deserve their own definition more for their appearance than for their role, which in fact they do not actually perform. Pastures are a typical example of this kind, since cattle actually graze only on a small part of their registered surface areas and village orchards in the immediate vicinity of farm houses are also intended for grazing although they are ranked among meadows, pastures, or orchards. Methodologically, the distinction between forests and pastures is still not established; within these categories there is extensive land with varied contents in the process of being overgrown (Klemenčič, 1975; Žonta, 1981).

Let us mention that agricultural statistics use a slightly different definition criteria for the majority of categories (Vrišer, 1987). They do not distinguish between the two types of orchards and forests, and they separate fishponds and land intended for the natural or artificial breeding of fish.

3.3. Spatial Units

The smallest surface area unit on which land use is officially recorded is a parcel (there are more than 5.5 million parcels in Slovenia). Due to this great partitioning, individual land categories are mixed, and is necessary to integrate their occurrence recorded according to parcels into spatial units of a higher level. Individual land categories thus appear in certain areas to a larger or smaller extent that can be expressed in proportions.

The cadastral municipality was selected as the basic unit and in comparison with other spatial units is a relatively stable territorial unit on the level of which the land category structure has been regu-

larly recorded for almost two centuries, since the introduction of the Emperor Francis' cadaster. In Slovenia, there are just under 2700 cadastral municipalities, enough for the essential characteristics of land use in Slovenia to be reflected in the ratios between land categories.

The calculated proportions of individual land categories show only mean values. A cadastral municipality occupies the territory of one or more neighbouring settlements with the adjoining land; as a rule, villages have been built at the juncture of several different natural units in order to suitably enable the livelihood of the owners of the land. Simultaneously, with the adaptation of cadastral measurements to changing administrative and political units, cadastral municipalities were constantly divided and their individual parts renamed. Barely had the network of cadastral municipalities been harmonized with the borders of the administrative municipalities from the 1960–1994 period after two decades of work when a new division of Slovenia into new, smaller municipalities took place; the process was far from concluded in the period when this article was written. We can only hope that additional adjustments of cadastral borders will not be required that will place new obstacles in the path of research into land use.

A cadastral municipality is normally demarcated according to natural features (ridges, tops of ridges, rivers, streams) or transportation right-of-ways (roads, field paths) and includes all the natural units in a particular village's territory that with their diversity dictate a diverse land structure. Therefore, apparent absurdities appear on individual maps, for example, that cultivated fields or orchards reach far above the altitude of their actual spread (Gams, 1960), all the way to the borders of the cadastral municipalities, particularly in the alpine region and on high karst plateaus. The same applies to vineyards that in some places such as Gorjanci seemingly reach to the top of the mountains. This means that the land categories are actually even more compact on suitable land, for example, cultivated fields on the bottoms of valleys and vineyards on sunny slopes up to 500 meters in some places where their actual proportion is much larger.

Cadastral municipalities belong among the basic spatial units that homogeneously cover the entire territory of Slovenia. They are an obligatory component part of the *Register prostorskih enot* (Register of Spatial Units) and have a reciprocal hierarchical connection with other basic units (Ažman, 1996): census and statistical units, settlements, municipalities, administrative units, and the state. Until 1995, the *Register prostorskih enot* (Register of Spatial Units) was called the *Register teritorialnih enot* (Register of Territorial Units) (Mauri, 1994), while the system based on centroids is called the *Register območnih teritorialnih enot in Enotna evidenca hišnih številk* (Register of Regional Territorial Units and Uniform Record of House Numbers) (Banovec, 1994). For the needs of cartographic illustration, we obtained the border lines of cadastral municipalities in digital form from the the Surveying and Mapping Authority of the Republic of Slovenia.

Comparative calculations for the tabular and graphical illustration of natural geographic units were made on the basis of partition, adjusted to the investigation of land use in Kladnik's study (1985). Along with the alpine, pre-alpine, mediterranean (of Primorska), dinaric (of Dolenjska and Notranjska), and (hilly) subpannonian regions, the intensively cultivated and built-up basin and flatland regions of northeastern and eastern Slovenia are singled out. According to their type of surface, lithological structure, and climate conditions, individual cadastral municipalities are ranked in one of the seven stated natural geographic units, although classifying the indistinct transition areas between them into one or the other adjacent unit can be quite problematic.

For the latest natural geographical regionalization (*Land Use*..., 1994; Kladnik, 1996), land use was calculated on the basis of the classification of cadastral municipalities according to mesoregions; however, their borders do not agree with the borders of the cadastral municipalities. Each cadastral municipality is classified in the mesoregion where its largest part is situated.

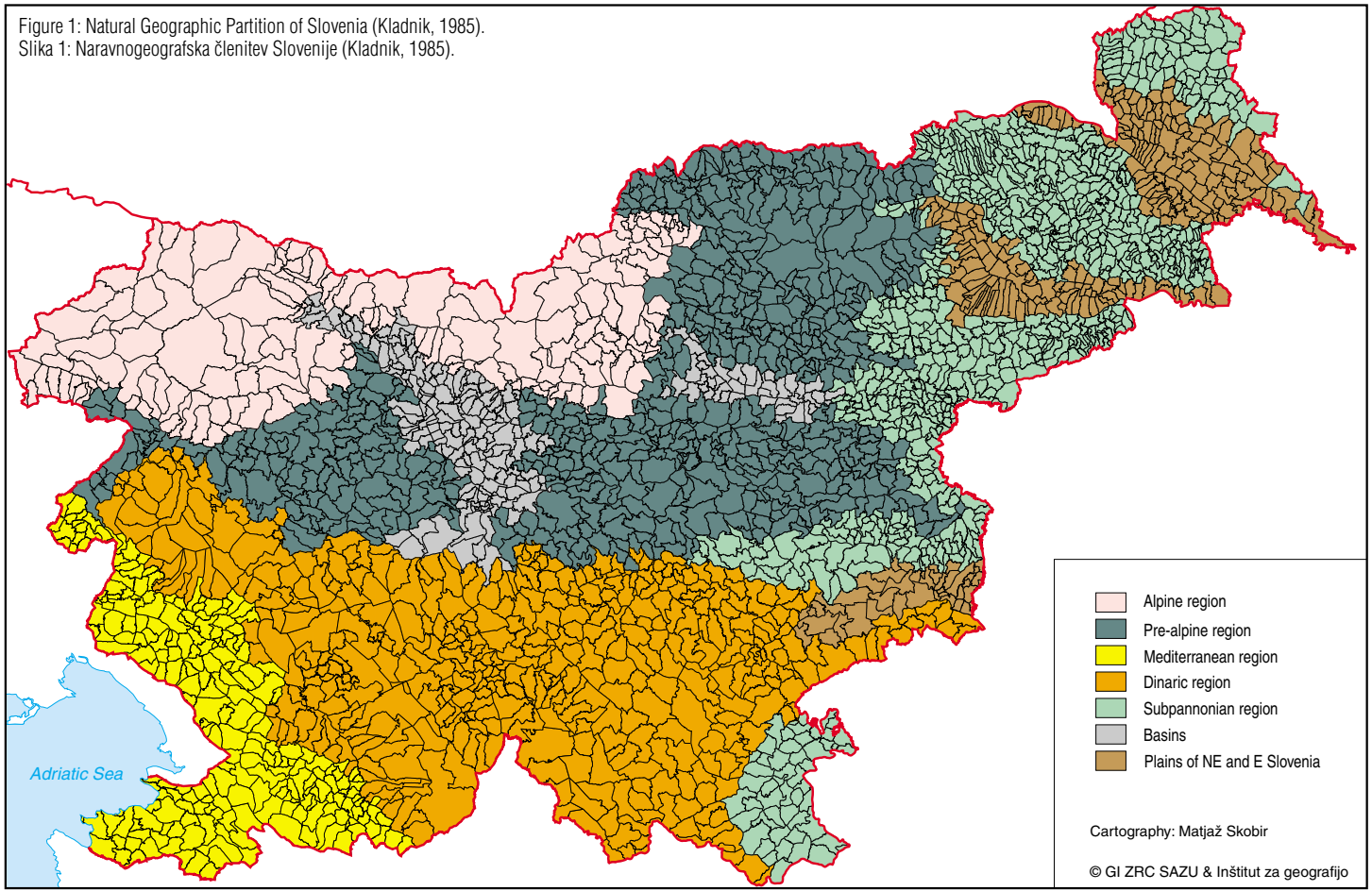


Figure 1: Natural Geographic Partition of Slovenia (Kladnik, 1985).
Slika 1: Naravnogeografska členitev Slovenije (Kladnik, 1985).

3.4. Calculations and Graphical Processing

It is almost impossible to achieve absolute accuracy, and simplified calculations are necessary (Vrišer, 1987). Over longer time periods, mutual comparisons become ever more problematic, especially on the level of the regions of flatland, although less so for Slovenia as a whole. Fortunately, despite all the shortcomings, it is possible to see the fundamental features of the situation and the changes in land use, and methodologically, a certain degree of inaccuracy is allowed in the geographical information system (Ivačič, 1994).

The basic programming tools for the data processing were IDRISI (Eastman, 1992 and 1995) and EXCEL. IDRISI is a rastered geographical information system. For all the analyses, the cell size was 100×100 meters. Lithological (Verbič, GAS) and climate (Ogrin, 1996) maps were first digitized and then converted into raster form. In the same way, we rastered the vector descriptions of cadastral municipality borders. In this way, we obtained data for every hectare cell in Slovenia showing in which cadastral municipality it lies and to which lithological unit and climate type it belongs. This data was easily inserted into the digital relief model. In calculating mutual links between land use and lithological structure, only those cadastral municipalities were considered of which at least two thirds of the surface area fall into a particular lithological unit. To ensure a smaller number of classes and thus greater clarity, we combined certain similar rock types. Also in studying links with climate characteristics, we combined several of Ogrin's types because of their small areas into common units so that his presentation is somewhat simplified. Thus, we have only one type of submediterranean climate, and his three subtypes of montane climate are combined into one common montane type.

Because various land categories appear in individual territories, we tried to evaluate the prevailing or so-called primary use on the basis of their occurrence. The simplest possibility for a survey of this kind is offered by establishing the absolute surface prevalence of a specific land category in individual cadastral municipalities. Because of the prevailing presence of forest, the powerful dominating significance of forests is evident in the use of this method; cultivated fields, meadows, pastures, and infertile land are much less noticeable, and vineyards and orchards even less so.

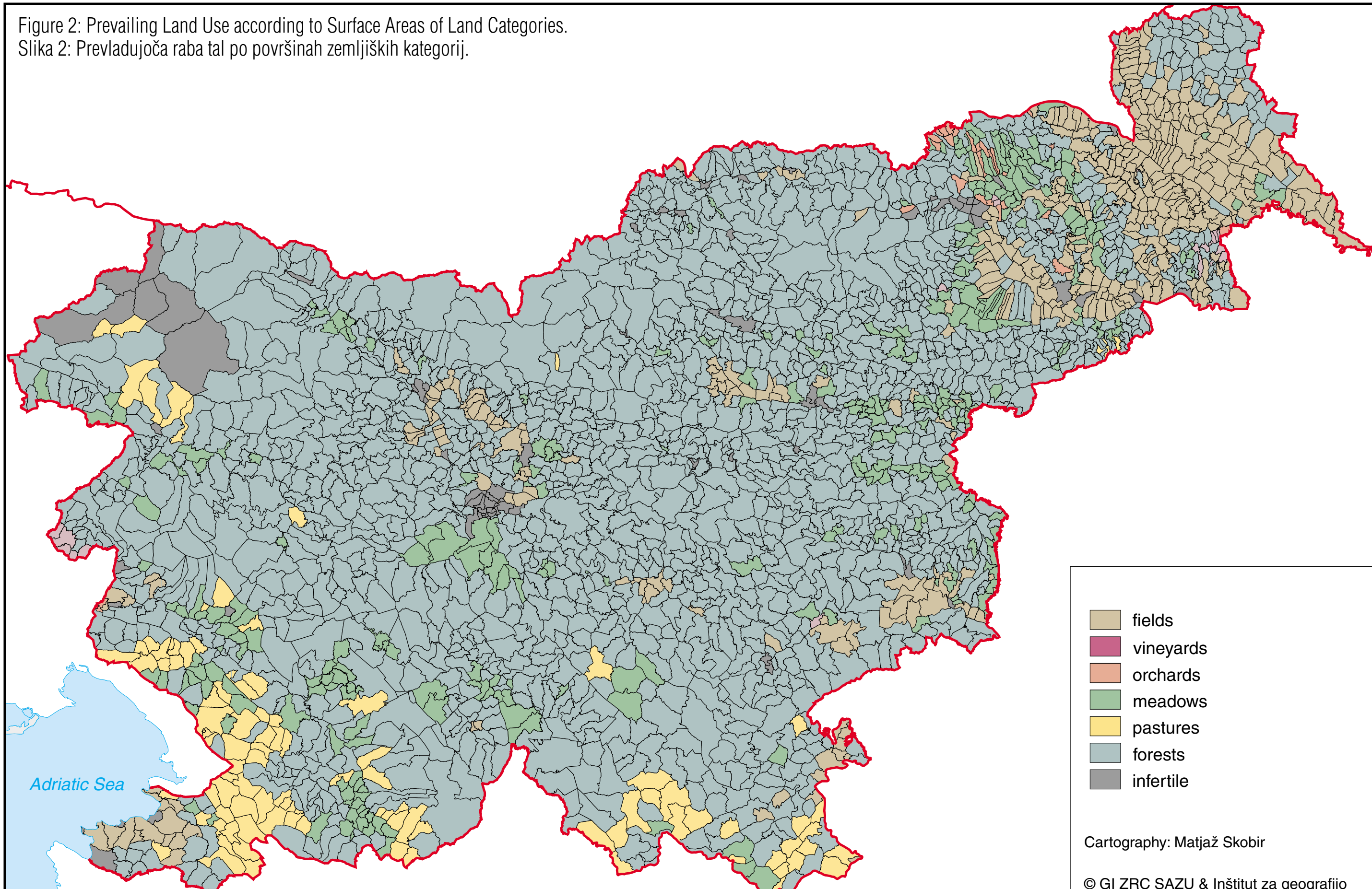
We get a more realistic picture of prevailing land use by using arability equivalents, coefficients that in comparison with the starting-point value of 1.0 for a cultivated field show the productivity and the necessary work intensity to master individual land categories. In our conditions, the corresponding value for meadows is 4.0, for vineyards 2.5, for orchards 1.2, for pastures 0.1, and for forests 0.15 (Gosar, 1976). The prevailing land category for individual cadastral municipalities was calculated by multiplying surface area and the coefficients. To achieve better results, unproductive land at altitudes above 1800 meters was eliminated (using the DRM), while those cadastral municipalities where more than the half of surface area is built up are presented separately.

The differences between the two methods are shown in Figure 3. The most distinctive difference is in the occurrence of forests and cultivated fields. Using the method of arability equivalents, the occurrence of forests decreases considerably due to cultivated fields. There are also more meadows and proportionally more vineyards and orchards in particular. On the other hand, the occurrence of pastures and infertile areas drops due to their small role in farm life.

To study the typology of the change of land use, we relied on Medved's methodology (1970). It is based on determining the changes to the surface areas of individual land categories since these change constantly, some growing while others decline. The calculations are based on the changes between 1961 and 1994; the time period was selected to reveal clearly the main consequences of rapid economic development and the consequential pronounced social restratification of the population.

To carry out the typology, all the changes had to be systematically evaluated by means of generalization and arranged on the basis of the surface prevalence of individual kinds of change. In cases where most of the various land categories are being prevailingly overgrown with forest, we speak of

Figure 2: Prevailing Land Use according to Surface Areas of Land Categories.
Slika 2: Prevladujoča raba tal po površinah zemljiških kategorij.



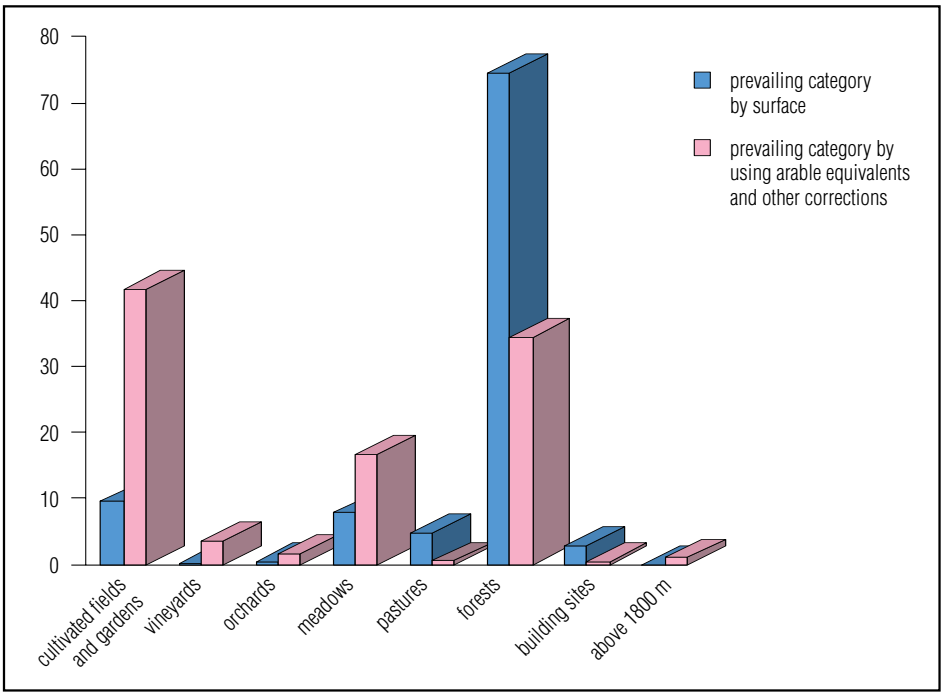


Figure 3: Distribution of Surface Area Proportions of Prevailing Land Use according to Two Different Approaches.
Slika 3: Razporeditev površinskih deležev prevladujoče rabe tal za dva različna prikaza.

»afforestation«. If the more intensive categories (cultivated fields, vineyards, orchards) are prevailingly changing into meadows, the process is called »grassing over«. If the less intensive land categories prevailingly change into more intensive categories (for example, forests into pastures, pastures into meadows, meadows into cultivated fields, orchards, or vineyards), the prevailing process is called »intensification«. If fertile land prevailingly becomes infertile due to building activity and the construction of infrastructure, the process is called »urbanization«.

To establish the extent of the changes, all the established main types of change were evaluated relative to their proportions of occurrence within the entire surface of recorded changes and divided into subtypes. In cases where the proportion of change in a specific type exceeds three quarters of all the established changes, the individual main type is classified in the subtype of *distinct* change; if it reaches a half to three quarters of all the changes, the subtype is *strong* change; however, if only the absolute prevalence of a certain main type is recorded, the subtype is *weak* change (in Medved, *mitigated*). Here, according to Medved, it is not the absolute size of the changes that is significant but merely their appearance and recording in the cadastral data. This fact was the main objection voiced by the critics of this kind of methodology.

To avoid this apparent shortcoming, in the process of graphic illustration all those cadastral municipalities were classified into special classes where the proportion of the changes did not reach one percent of their entire surface area; hatching was used to show cadastral municipalities with highest intensity of the changes (the proportion of the surface area of the main type relative to the entire surface area of the cadastral municipality), and at the same time, infertile land above the tree line was eliminated from the illustration of the spread of individual types. It is understandable that the structure of the land use in a specific environment also influences the typology of changes, and it is

therefore necessary to attach the presented typology of changes to the occurrence of the spread of individual land categories. Despite some execution problems (generalization in the framework of diverse events within individual cadastral municipalities, inconsistent recording of changes, changes to borders and surface areas of cadastral municipalities, etc.), the established findings are extremely interesting, especially when compared to older illustrations of this type.

3.5. Survey of the Distribution of the Main Land Categories

Because the proportions of individual land categories vary on the level of the entire state, we chose to illustrate them on the basis of equally large deviations from the average occurrence of specific categories, which were secured by means of indexation. The average proportion of a category has an index of 100, and relative to the deviations from the average, the indexes are ranked into seven classes; as in the eighth class cadastral municipalities where certain land categories do not exist are presented. The advantage of the methodology used lies primarily in the uniform spans of classes for all land categories allowing comparison of the illustrations. With them, mostly land areas with above-average and below-average occurrences of a specific land category are emphasized, indicating their smaller or larger role in a specific agricultural branch or in forestry. Of course, the absolute limit values of the proportions for defining the limits of the classes of individual land categories vary. They are stated in Table 1.

TABLE 1: BORDER VALUES OF THE PROPORTIONS OF MAIN LAND CATEGORIES FOR DEMARCATING CLASSES ON MAPS (RELATIVE TO THE UNIFORM INDEXATION OF CLASSES).
PREGLEDNICA 1: MEJNE VREDNOSTI DELEŽEV GLAVNIH ZEMLJIŠKIH KATEGORIJ ZA RAZMEJEVANJE RAZREDOV NA ZEMLJEVIDIH (GLEDE NA ENOTNO INDEKSACIJO RAZREDOV).

%	Fields	Vineyards	Orchards	Meadows	Pastures	Forests	Infertile
up to 50	up to 6,30	up to 0,53	up to 0,98	up to 9,05	up to 5,12	up to 24,44	up to 3,56
50,1 to 75	6,31 to 9,44	0,54 to 0,80	0,99 to 1,47	9,06 to 13,57	5,13 to 7,67	24,45 to 36,65	3,57 to 5,34
75,1 to 100	9,45 to 12,59	0,81 to 1,06	1,48 to 1,96	13,58 to 18,09	7,68 to 10,23	36,66 to 48,87	5,35 to 7,12
100,1 to 125	12,60 to 15,74	1,07 to 1,33	1,97 to 2,46	18,10 to 22,62	10,24 to 12,79	48,88 to 61,09	7,13 to 8,90
125,1 to 150	15,75 to 18,89	1,34 to 1,59	2,47 to 2,95	22,63 to 27,14	12,80 to 15,35	61,10 to 73,30	8,91 to 10,68
150,1 to 200	18,90 to 25,18	1,60 to 2,12	2,96 to 3,93	27,15 to 36,19	15,36 to 20,46	73,31 to 97,74	10,69 to 14,24
201 and more	25,19 and more	2,13 and more	3,94 and more	36,20 and more	20,47 and more	97,75 and more	14,24 and more
Average	12,59	1,06	1,96	18,09	10,23	48,87	7,12

To illustrate the values of the presented method (used for maps 22–28), comparative cartographic analyses were performed. Certain typical land categories were selected (cultivated fields, vineyards, and forests) for which cartographic illustrations were executed in two ways:

- with an *adjusted scale* in each category with equal spans between the classes (5% for cultivated fields, 2% for vineyards, and 10% for the forests), through which we tried to show the main lines of distribution of individual categories;
- with a *uniform scale* with various spans between the classes, through which we tried to ensure better comparison between individual categories.

The differences between the methods used are immediately evident in the graphical illustration of the selected categories.

The comparison of the results of all three methods for all three categories is also graphically illustrated. It is based upon surface occurrence of the proportions of all the classes in the various presentations. The course of the curve in the graphs indicates the distribution of individual classes on the maps.

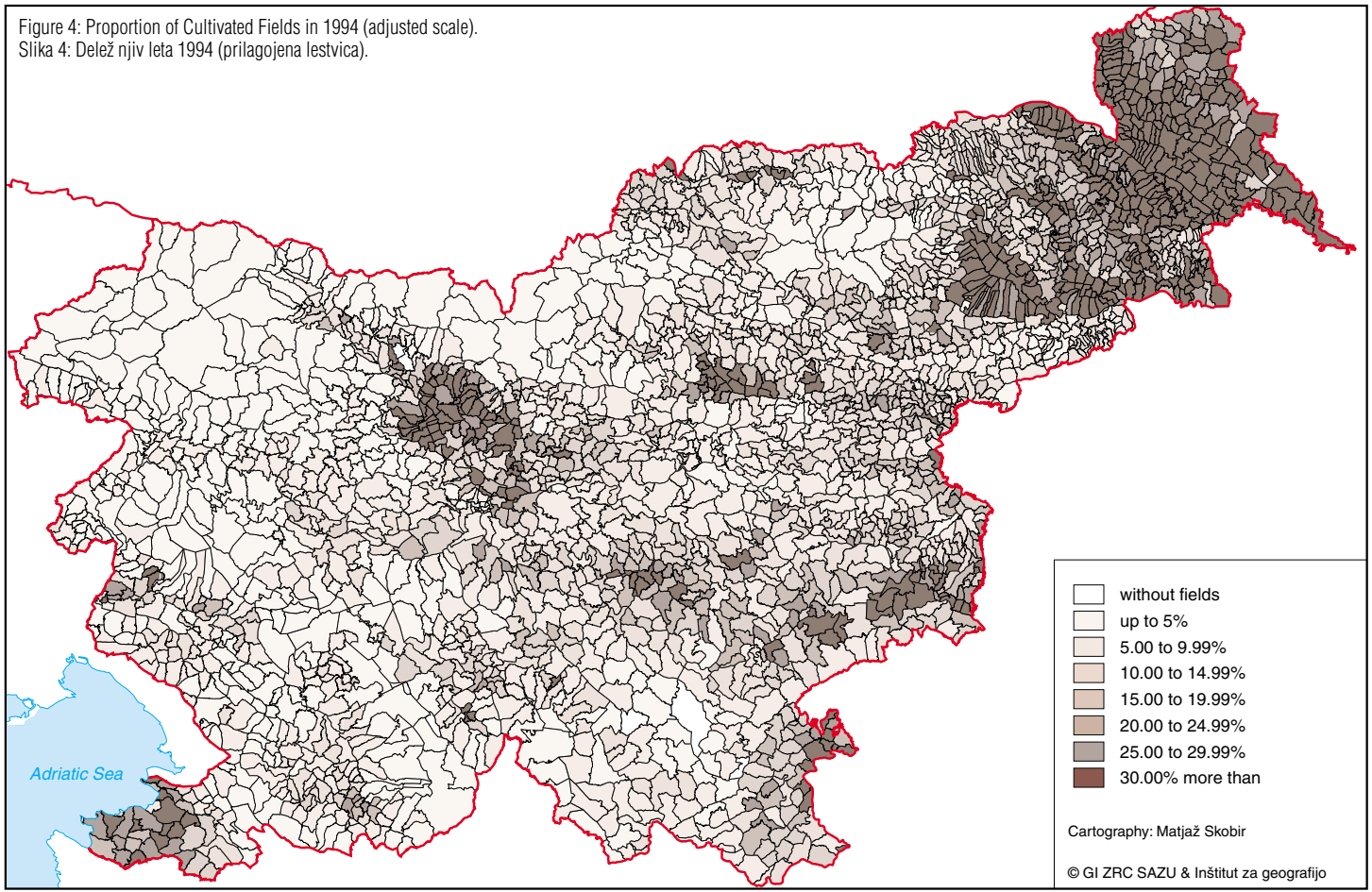


Figure 4: Proportion of Cultivated Fields in 1994 (adjusted scale).
Slika 4: Delež njiv leta 1994 (prilagojena lestvica).

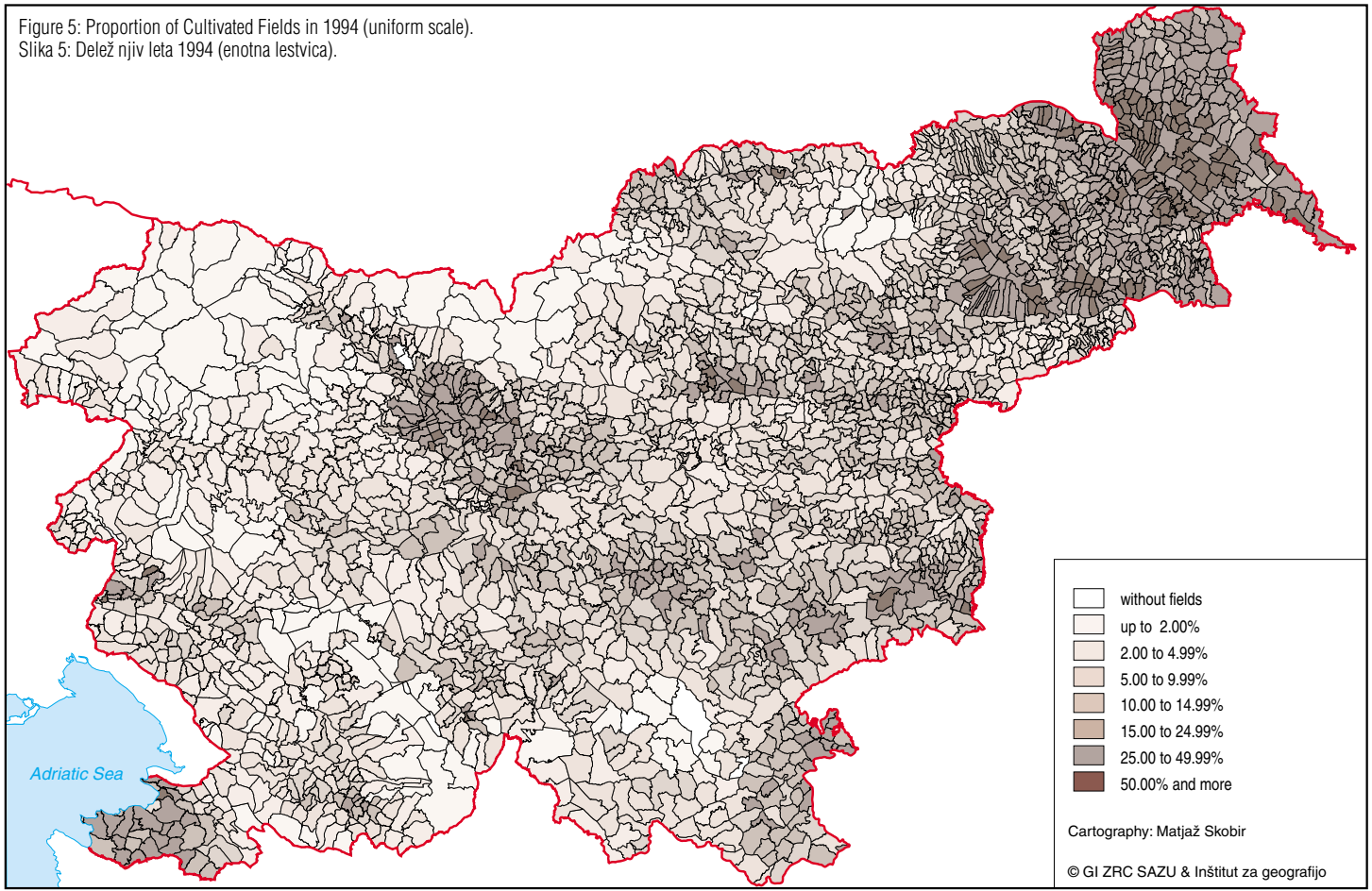
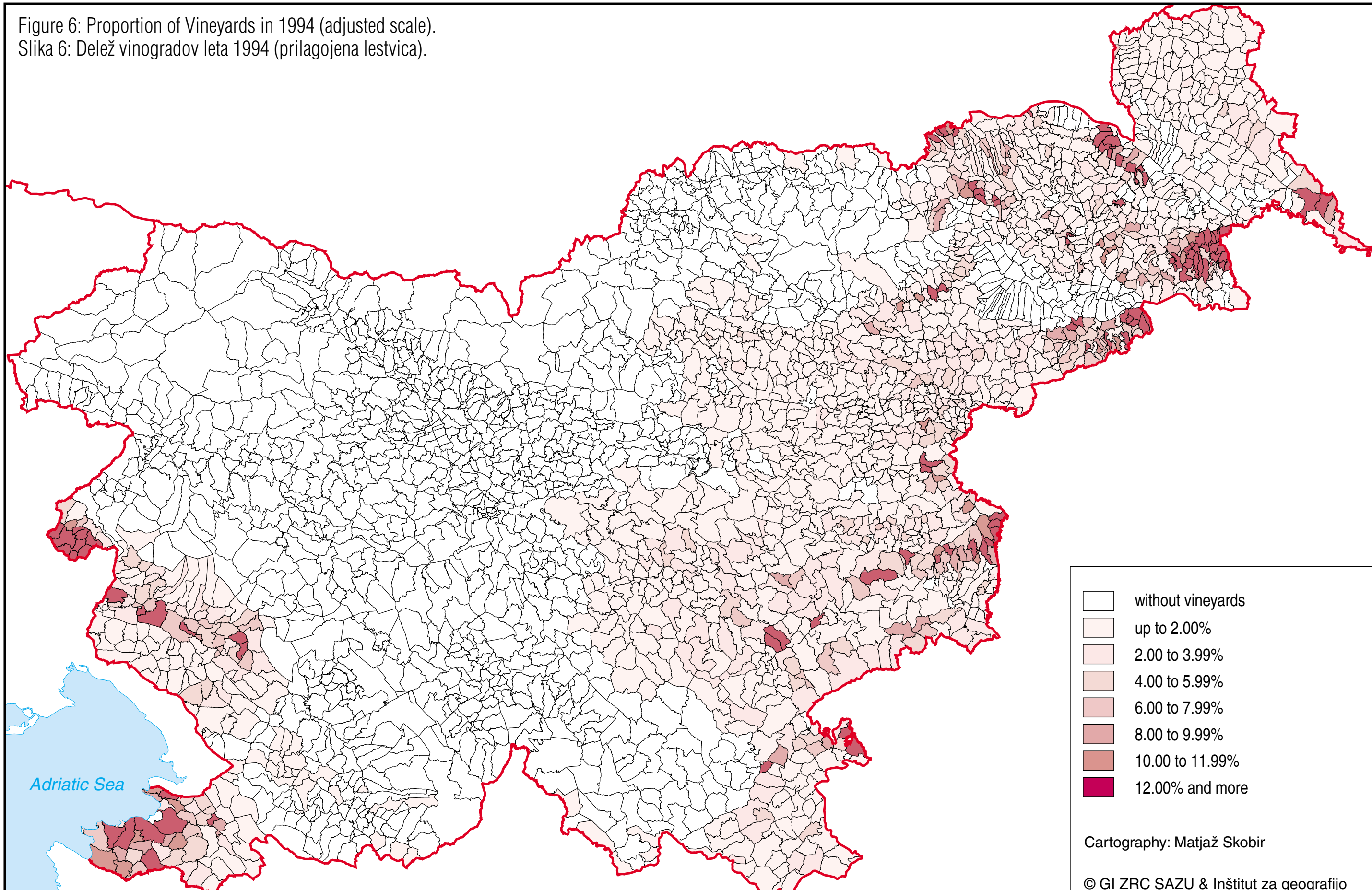


Figure 5: Proportion of Cultivated Fields in 1994 (uniform scale).
Slika 5: Delež njiv leta 1994 (enotna lestvica).

Figure 6: Proportion of Vineyards in 1994 (adjusted scale).
Slika 6: Delež vinogradov leta 1994 (prilagojena lestvica).



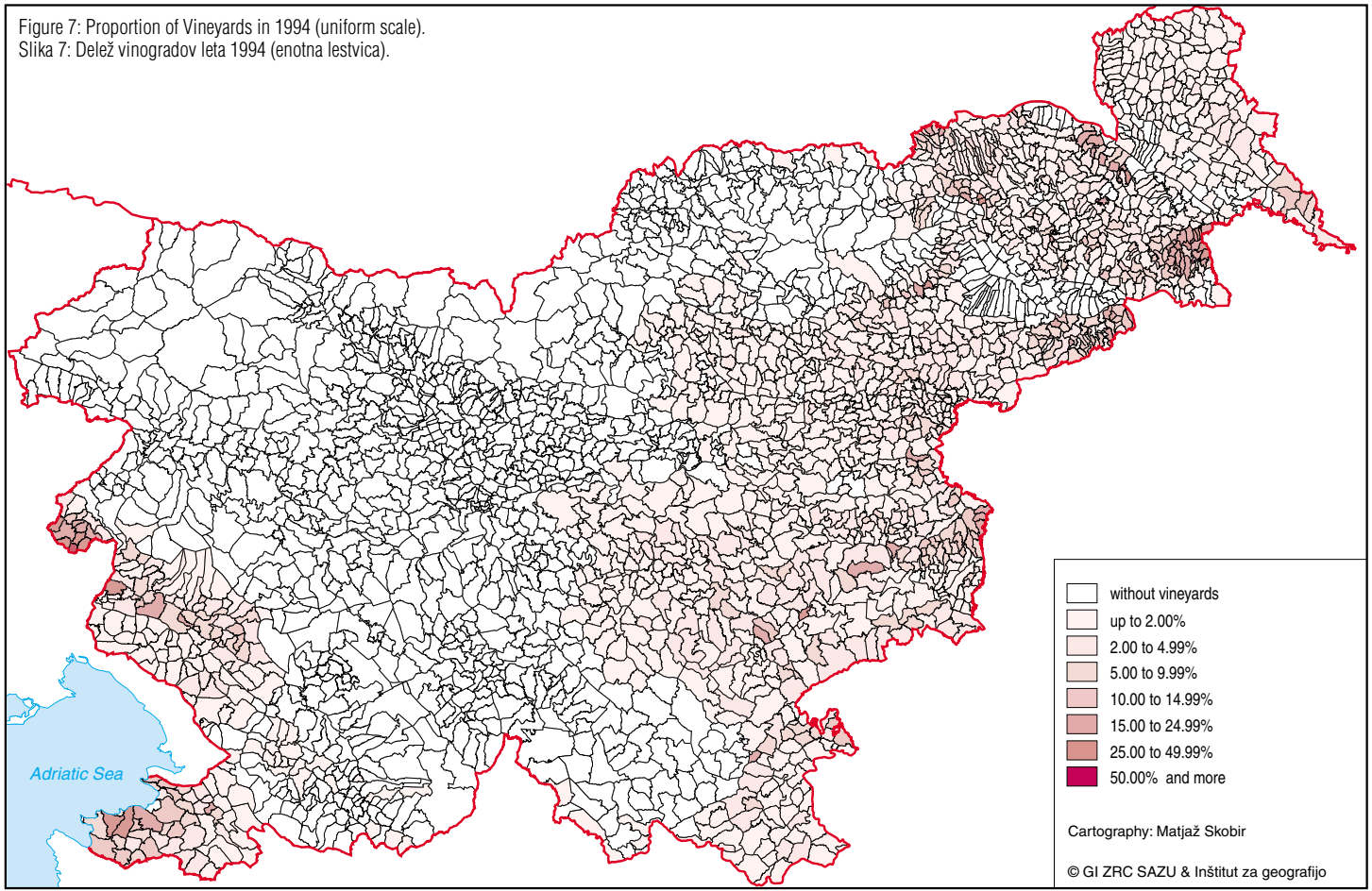


Figure 7: Proportion of Vineyards in 1994 (uniform scale).
Slika 7: Delež vinogradov leta 1994 (enotna lestvica).

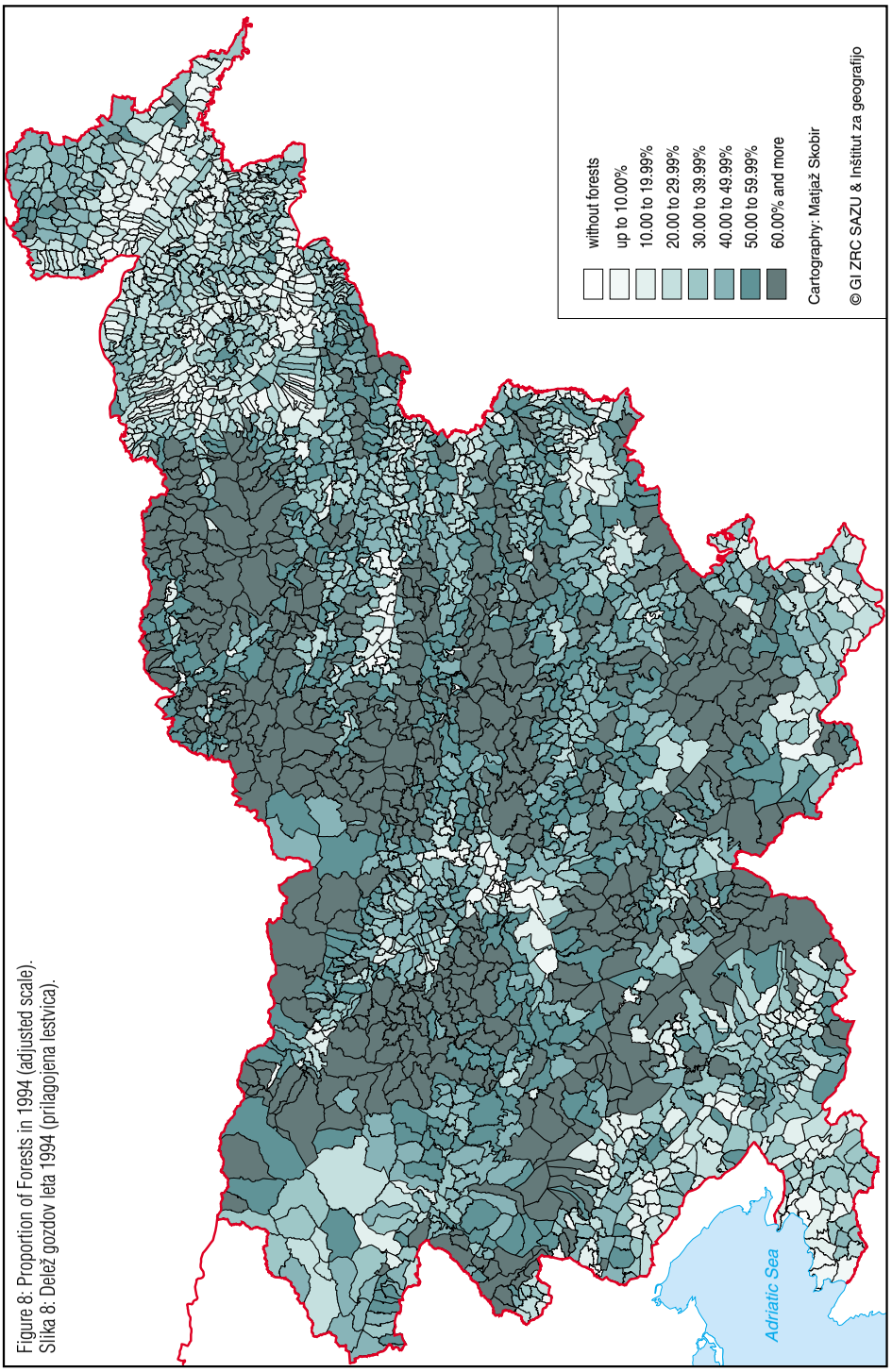


Figure 8: Proportion of Forests in 1994 (adjusted scale).
Slika 8: Delež gozdov leta 1994 (prilagojena lestvica).

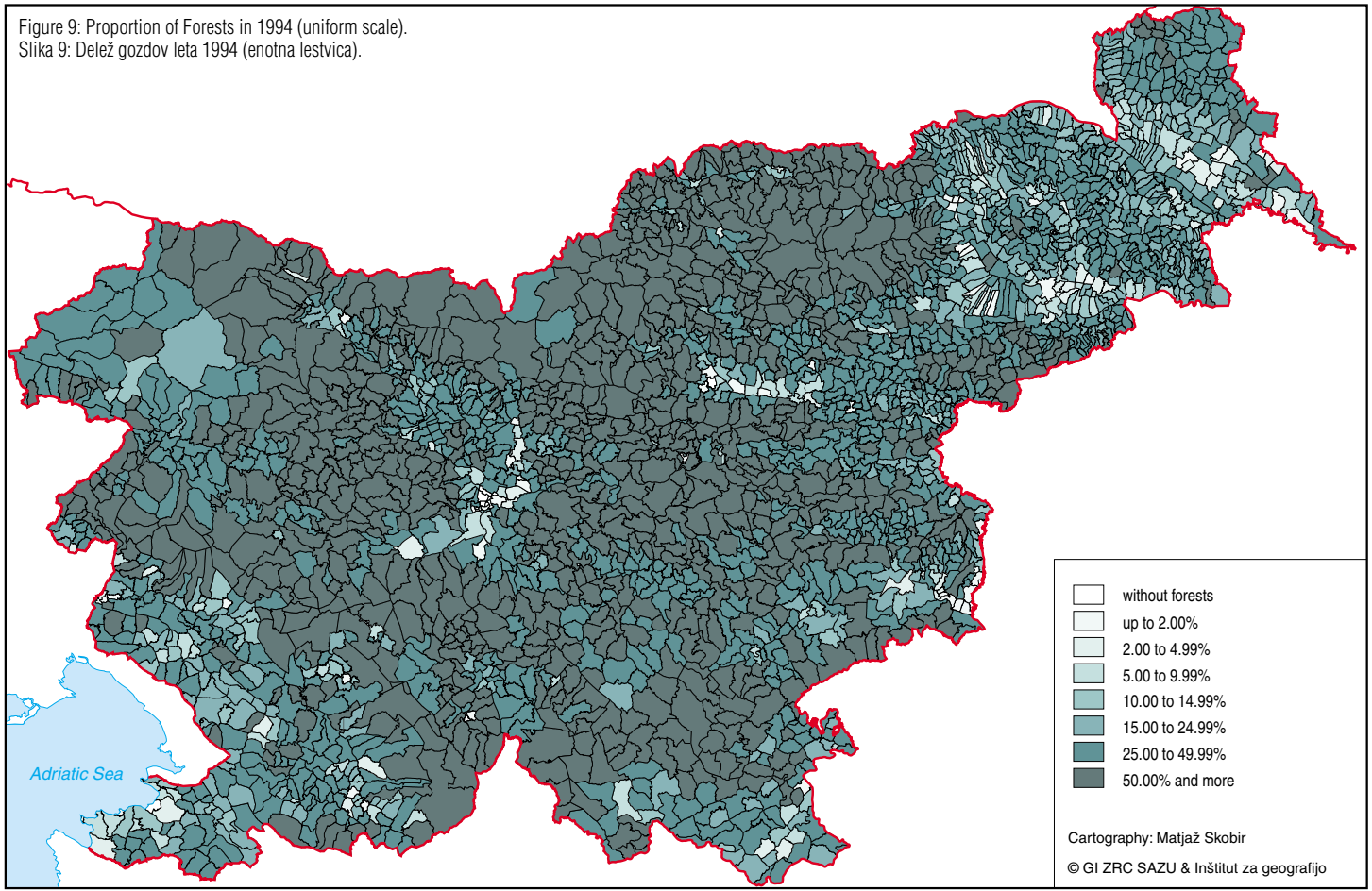


Figure 9: Proportion of Forests in 1994 (uniform scale).
Slika 9: Delež gozdov leta 1994 (enotna lestvica).

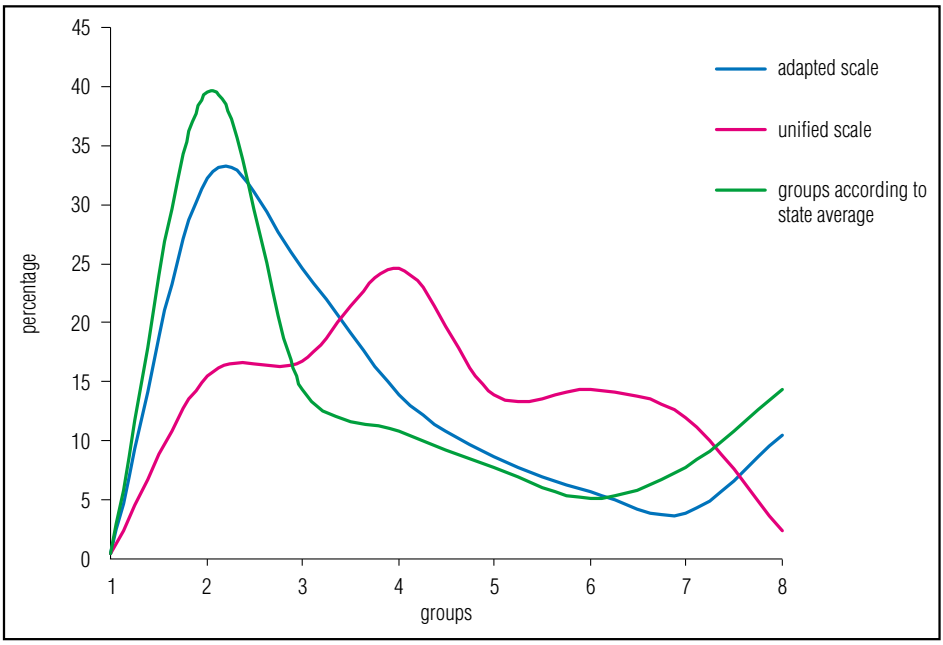


Figure 10: Distribution of Surface Proportions according to Classes for Different Presentations of the Distribution of Cultivated Fields.
Slika 10: Razporeditev površinskih deležev po razredih za različne prikaze razprostranjenosti njiv.

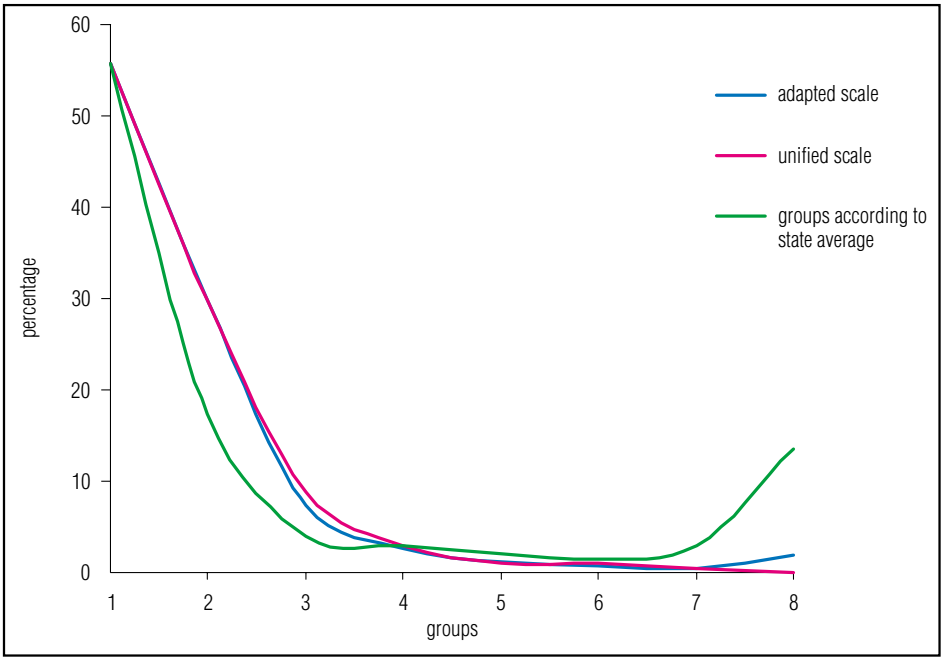


Figure 11: Distribution of Surface Proportions according to Classes for Different Presentations of the Distribution of Vineyards.
Slika 11: Razporeditev površinskih deležev po razredih za različne prikaze razprostranjenosti vinogradov.

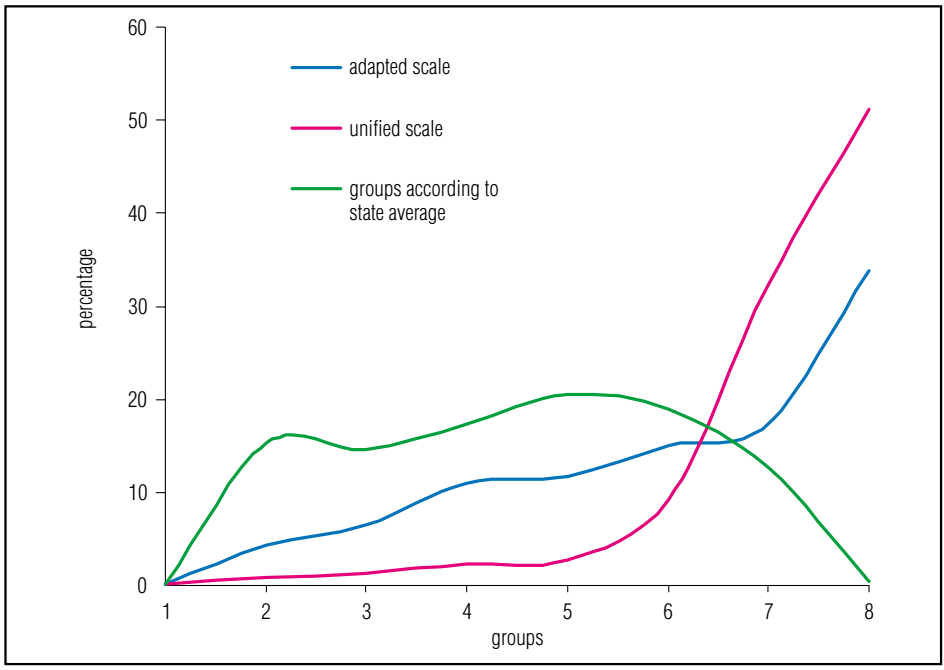


Figure 12: Distribution of Surface Proportions according to Classes for Different Presentations of the Distribution of Forests.
Slika 12: Razporeditev površinskih deležev po razredih za različne prikaze razprostranjenosti gozdov.

Although the uniform scale which presents proportionate distributions of surface proportions of cultivated fields is seemingly more useful than the scale based on averages because it approaches the normal frequency distribution, in the context of the simplified presentation of all land categories this kind of assessment loses a part of its value. Even more so when we compare the results of distribution for vineyards and forests where the curves derived from the averages differ fundamentally from the two other methods of presentation. For forests, it comes close to the normal frequency distribution. On all the maps made on the basis of averages, areas of above-average occurrence and the corresponding above-average economic significance of a particular land category can be clearly seen. Thus it is possible to ascribe to them the principle of universality, and they can be a good foundation for further studies, even for eventual territorial partitions.

4. Basic Characteristics of Land Use

Current land use in Slovenia is the consequence of rapid postwar development characterized by quite widely dispersed industrialization that stimulated urbanization. Both processes caused a flight from the land and deagrarianization. Specialization in crop production and market-oriented farming appeared (Gabrovec, Kladnik, Material for the *Geographical Atlas of Slovenia*).

Modernization of production techniques and the widespread introduction of agricultural mechanization brought about the extensive giving up of the then prevalent self-sufficient nature of farming usable land where the use of machinery was either not possible or at least not economical. As a result of politically stimulated campaigns that tried to increase the level of self-sufficiency relative to some important crops such as wheat and sugar beet, the orientation of crop production changed

in various periods as well. With nationalization and the agrarian reforms following World War II (Kladnik, 1990 a), considerable strength was gained by the social sector, which is after slovenian indepen-dene partly changed in agricultural companies. The independent use of land organized in larger consolidated parcels is typical of such companies. In the period of socialist transformation, they were universally supported by the political elite and therefore almost always had sufficient financial means to change production directions and consequently the ratios between land categories, when necessary by means of major interventions. They also acquired the most qualitative farm land through amelioration and consolidation (Kert, 1979). Along with ecological criticisms (for example, Marjeta Natek, 1990), protests regarding the economics of implementing various amelioration projects became increasingly louder due to their high costs (Kranjec, 1989).

It is possible to indirectly and gradually influence land use through the system of land ownership structure as well as through the most varied land policy instruments (Erjavec, 1994). Policies in the recent past were anything but encouraging to agriculture with their obstructive character, most clearly reflected in the policy limiting the maximum amount of land a farmer could own (Gliha, 1987).

According to the sources of information, the data on land use differs and does not reflect actual use in a certain time period. The differences between the data from the Surveying and Mapping Authority and figures from the Statistics Office are becoming smaller but are still evident. In 1994, for example, according to the second source there were 639,700 hectares of cultivated land and 790,700 hectares of agricultural land in Slovenia (*Statistics Annual*), and according to the first source (*Bilance površin* ...), 683,100 hectares and 891,800 hectares respectively. Some more detailed studies showed that the discrepancy between the actual and the official situation is as much as 20% and more of the entire surface area of a specific territory (Kladnik, 1985; Vrišer 1987). For a long time, this discrepancy concealed the substantially greater occurrence of the more extensive land categories and lately in some places, the irregular following of the change from less intensive categories to more intensive categories.

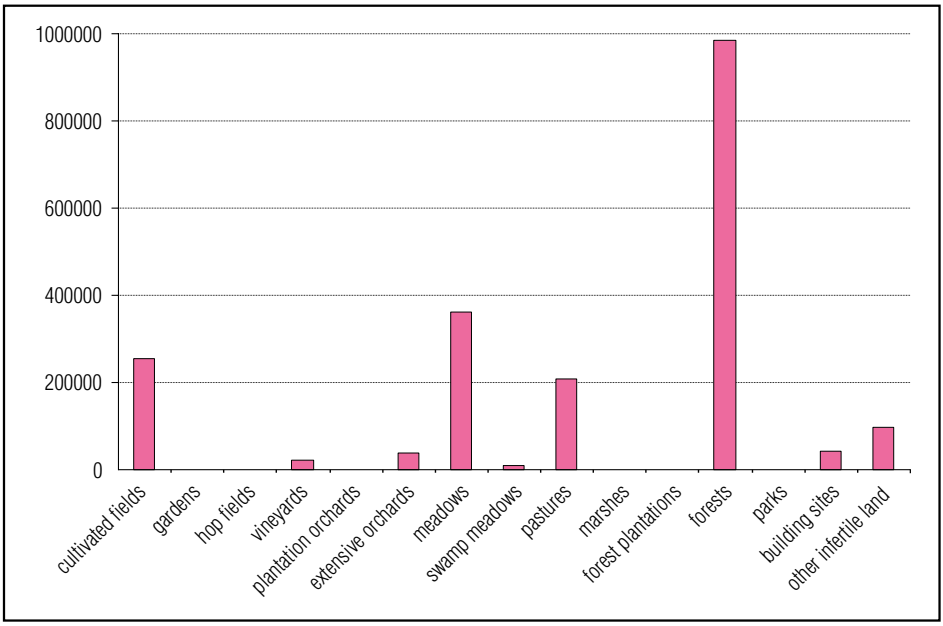


Figure 13: Surface Area of Cadastral Land Categories in Slovenia in 1991 (in hectares).
Slika 13: Površina katastrskih zemljiških kategorij v Sloveniji leta 1991 (v ha).

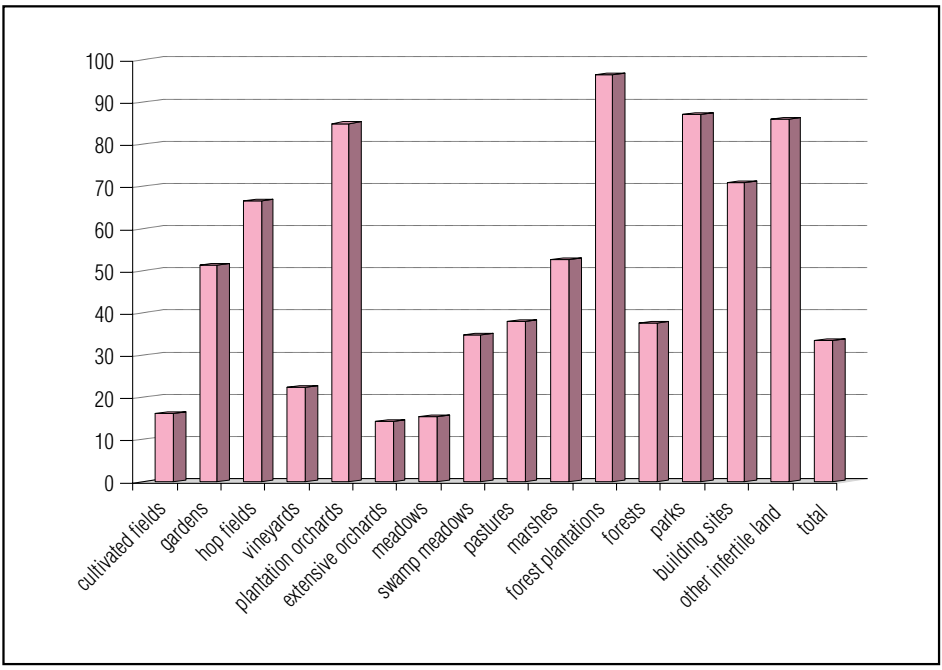


Figure 14: Proportions of Former Social Sector according to Land Categories in Slovenia in 1991.
Slika 14: Deleži nekdanjega družbenega sektorja po zemljiških kategorijah v Sloveniji leta 1991.

Forests comprise the strongly dominant land category. According to estimates, forests already cover more than half of the country, while almost 100,000 hectares or a good 10% of all the available agricultural land is in the phase of overgrowing. Two thirds of this is pasture, one quarter is meadow, and remainder falls into intensive land categories (*Strategija razvoja* …). Estimates have even appeared in the newspapers that about 300,000 hectares of agricultural land is in the process of overgrowing (*Delo*, September 1997). Occurring forms of the various phases of forest overgrowth have been studied by Marijan Klemenčič (1975 and 1978).

According to cadastral data, there are only a good six square kilometers of forest plantations. Among cadastral cultures according to surface area, forests are followed by meadows, cultivated fields, and pastures, while among the non-standard categories, swamp meadows cover the largest area (91.6 km^2). Plantation orchards, hop fields, and marsh cover more than ten square kilometers. Orchards (extensive and plantation) cover 2%, vineyards 1.1%, and unproductive surface areas (infertile, building land, transportation right-of-ways, and water) 7%. In the last category, the surface area of building land (427 km^2) still lags behind other forms (969.4 km^2) in spite of its rapid growth (*Bilance površin* …).

The majority of land remained in private hands in spite of the pressures for nationalization and socialization following World War II. A good third (33.5%) of all land but only 16.4% of cultivable land gradually passed to the social sector (*Bilance površin* …). Because of the considerable occurrence of pastures, the proportion of state-owned agricultural land was 21.4% while the proportion of fertile land was substantially higher (29.9%), influenced by an even larger proportion of forests. Above-average socialization occurred with categories of unproductive land, fertile land, forest plantations (at 96.4%, the forests were the most nationalized category overall), plantation orchards, and hop fields. All three intensive categories were to a prevailing degree placed in the social sector.

Following the independence of Slovenia, the state became the owner of the majority of social land on the basis of various laws (Lukačič, 1997). Some 560,000 hectares were passed to the Fund of agricultural land and forests that manages the property. Its basic tasks are to implement the traffic in agricultural land, farms, and forests and to lease them or grant concessions for their economic exploitation. The main problem in carrying out these tasks is the insufficient cadastral evidence of formal state ownership (Lukačič, 1994).

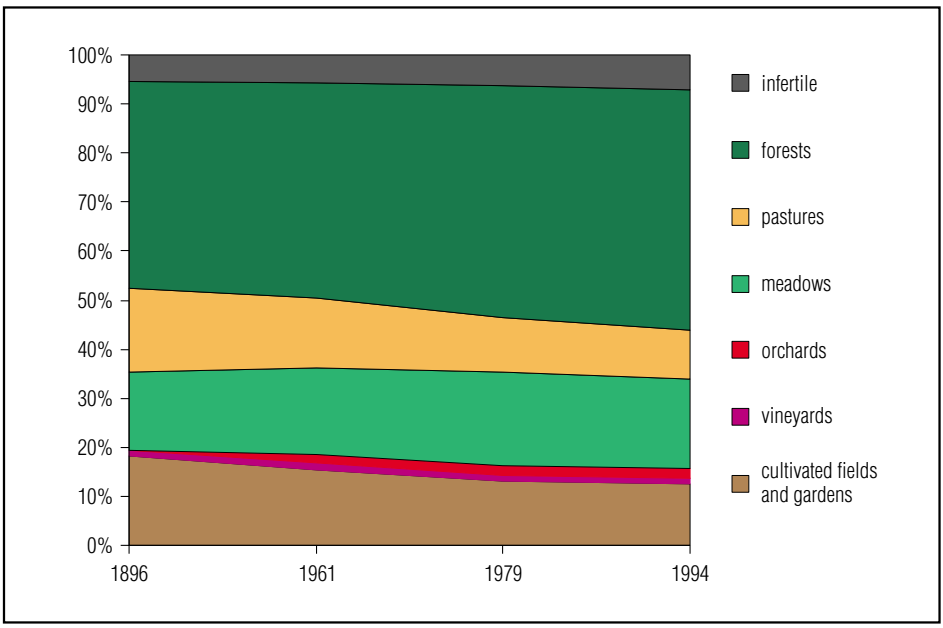


Figure 15: Changing of the Proportions of Land Categories in Slovenia between 1896 and 1994.
Slika 15: Spreminjanje deležev zemljiških kategorij v Sloveniji v obdobju 1896–1994.

The ratios between land categories change constantly. The data are relatively reliable for the period of the last century, but, unfortunately, the definitions of categories have changed. Still, it is clear that the occurrence of pastures and cultivated fields have diminished most while the proportions of forests (mostly due to pastures), meadows (mostly due to cultivated fields), and infertile areas (due to building on fertile land) have increased. It is obvious that more radical changes have occurred in the last thirty years than in the entire previous period.

TABLE 2: CHANGING OF THE PROPORTIONS OF LAND CATEGORIES IN SLOVENIA IN THE PERIOD 1896–1994.
PREGLEDNICA 2: SPREMINJANJE DELEŽEV ZEMLJIŠKIH KATEGORIJ V SLOVENIJI V OBDOBJU 1896–1994.

Year	Fields	Vineyards	Orchards	Medows	Pastures	Forests	Infertile
1896	18,1	1,0	–	15,9	17,0	41,6	5,5
1961	15,5	1,2	1,7	17,9	14,1	43,9	5,7
1979	13,2	1,1	2,0	18,9	11,1	47,3	6,4
1994	12,6	1,1	2,0	18,1	10,2	48,9	7,1

Sources: Gospodarska in družbena zgodovina Slovencev, Zgodovina agrarnih panog, 1. Zvezek.
Kladnik, D.: Problematika zemljiške strukture v Sloveniji, Elaborat.
Land cadaster data on land categories according to cadastral municipalities for 1994, Surveying and Mapping Authority of the Republic of Slovenia.

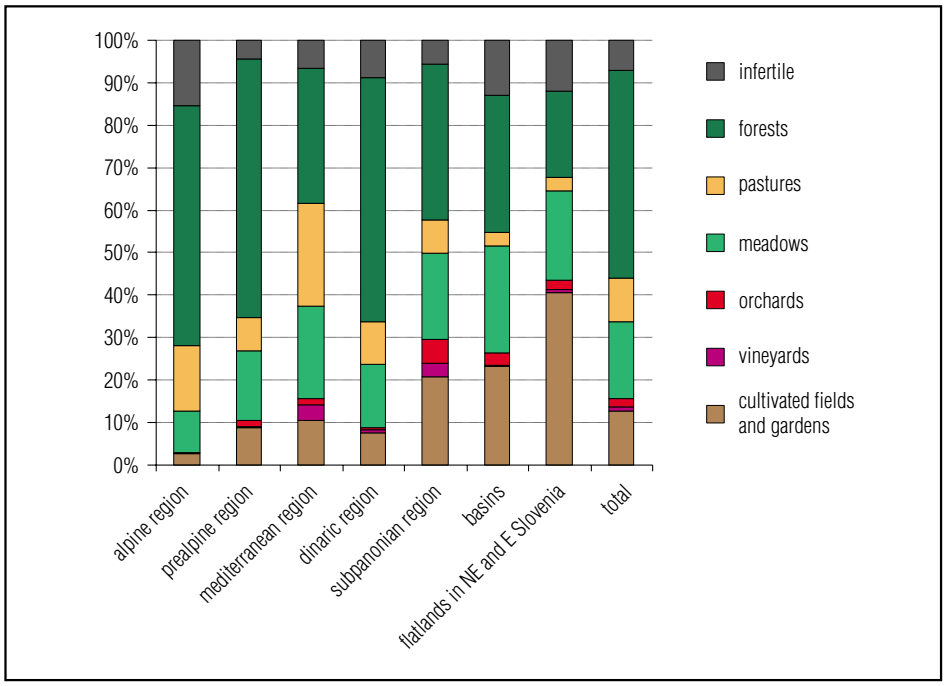


Figure 16: Land Categories according to Natural Geographic Units of Slovenia in 1994.
Slika 16: Zemljiške kategorije po naravnogeografskih enotah Slovenije leta 1994.

There are significant differences in land use among individual natural geographic units. They can be ascribed primarily to natural factors although the role of social and economic circumstances can not be ignored, which is confirmed by the findings in the continuation of the article.

TABLE 3: LAND CATEGORIES ACCORDING TO NATURAL GEOGRAPHIC UNITS OF SLOVENIA IN 1994.
PREGLEDNICA 3: ZEMLJIŠKE KATEGORIJE PO NARAVNOPOKRAJINSKIH ENOTAH SLOVENIJE LETA 1994.

	Fields	Vineyards	Orchards	Meadows	Pastures	Forests	Infertile
Alpine Region	2,6	0,0	0,4	9,7	15,3	56,5	15,5
Pre-alpine Region	8,7	0,3	1,6	16,4	7,8	60,7	4,5
Mediterranean Region	10,6	3,7	1,4	21,7	24,3	31,8	6,5
Dinaric Region	7,7	0,5	0,7	14,7	10,2	57,3	8,9
Subpannonian Region	20,7	3,3	5,6	20,4	7,7	36,7	5,6
Basins	23,3	0,1	3,0	25,1	3,3	32,3	12,9
Plains of NE and E Slovenia	40,6	0,7	2,2	21,1	3,2	20,2	12,0
Slovenia	12,6	1,1	2,0	18,1	10,2	48,9	7,1

Sources: Land cadaster data on land categories according to cadastral municipalities for 1994, Surveying and Mapping Authority of the Republic of Slovenia.
Kladnik, D.: Problematika zemljiške strukture v Sloveniji, Elaborat.

By far the most cultivated fields are found on the gravel and clay plains of northeastern and eastern Slovenia. Vineyards occur at above-average levels in the mediterranean region and in the hilly margin of the subpannonian flatland but in calculations are recorded beyond the hills as well since the cadastral municipalities include two relief categories (plain and hills). Orchards are best represented in hilly subpannonian Slovenia but also quite frequently in the Ljubljana and Celje basins. There

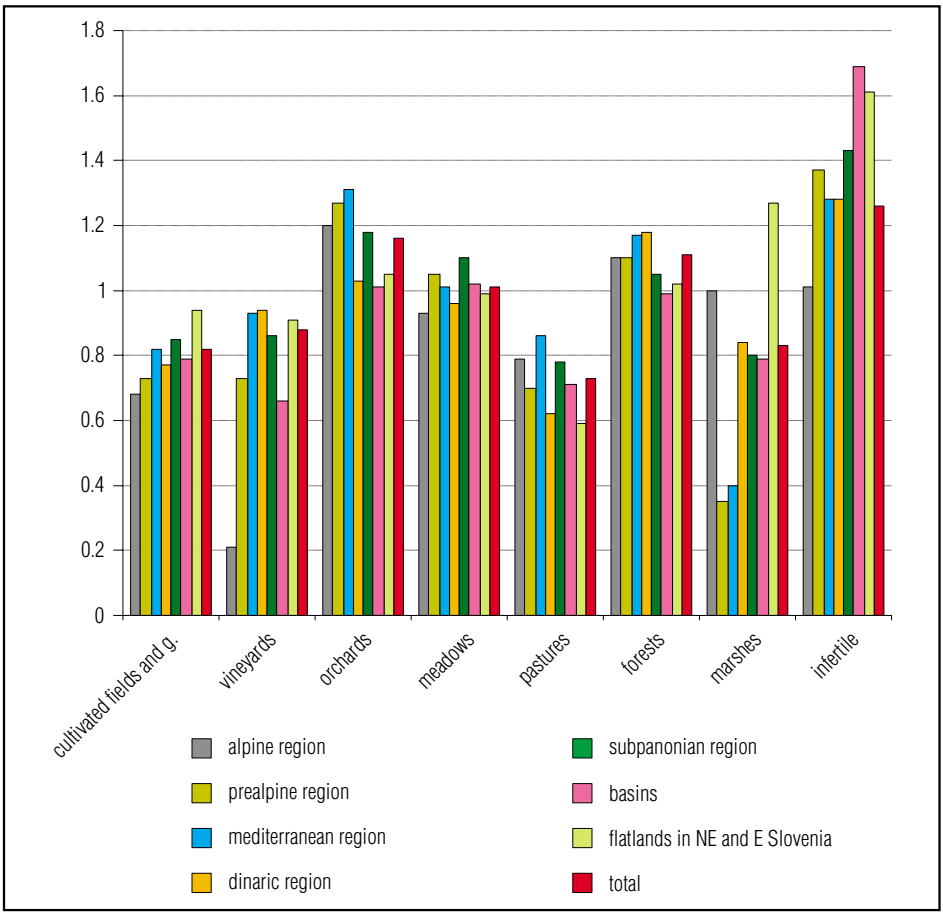


Figure 17: Changes of Surface Areas (Coefficients) of Land Categories between 1961 and 1994 according to Natural Geographic Units of Slovenia.
Slika 17: Spremembe površin (koeficienti) zemljiških kategorij med letoma 1961 in 1994 po naravnogeografskih enotah Slovenije.

are more meadows in the east than in the west of the country, and the majority of the pastures are in the coastal region and in the high mountains of the alpine region where they extend beyond the upper tree line. The largest areas of forest are in the pre-alpine region, but they also cover more than half of the territory in the alpine region and in the dinaric region of Notranjska and Dolenjska. That the greatest occurrence of infertile surface is in the alpine region is due to the rockiness above the upper tree line; however, its occurrence in the two basins and the plains in the east and northeast of the country almost achieve the same number. This large proportion is everywhere the consequence of the rapid building on formerly fertile surfaces.

The surface area of cultivated fields declined most in the alpine region and least in the plains of northeastern and eastern Slovenia. The surface area of vineyards also declined in all the natural geographic units, by far the most in the alpine region (in the Tolmin area), where the conditions for the growth of grapevine are extremely unfavourable, and the least in the dinaric region. In contrast, the surface area of orchards increased everywhere, most of all in the mediterranean region.

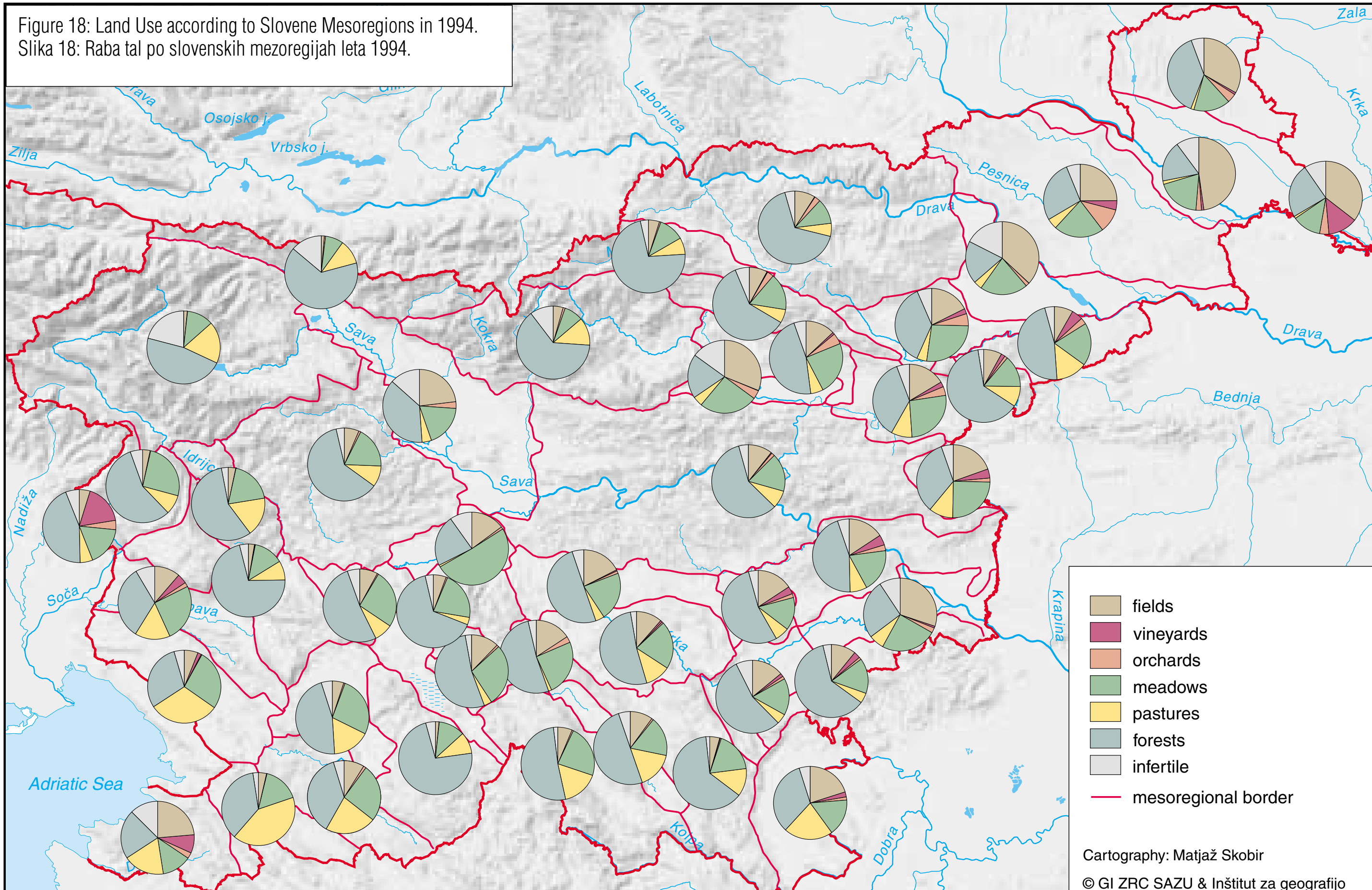


Figure 18: Land Use according to Slovene Mesoregions in 1994.
Slika 18: Raba tal po slovenskih mezoregijah leta 1994.

Due to the effects of two contradictory processes, changes to the surface area of meadows are apparently statistically negligible (the largest growth is recorded in the subpannonian hills and the largest decline in the alpine region), while pastures declined everywhere, most distinctly in the plains of northeastern and eastern Slovenia and in the dinaric region of Dolenjska and in Notranjska, and least in the mediterranean region. Forests spread everywhere, except in the area of the Ljubljana and Celje basins where they even declined slightly. They grew most distinctly in the predominantly karst regions of Dolenjska and Notranjska. Infertile surface areas increased everywhere, only symbolically in the alpine region, by more than a third in the pre-alpine and subpannonian regions, by more than a half in the plains of northeastern and eastern Slovenia, and by more than two thirds in the two large basins.

TABLE 4: CHANGES OF SURFACE AREAS (COEFFICIENTS) OF LAND CATEGORIES BETWEEN 1961 AND 1994 ACCORDING TO NATURAL GEOGRAPHIC UNITS OF SLOVENIA.
PREGLEDNICA 4: SPREMEMBE POVRŠIN (KOEFICIENTI) ZEMLJIŠKIH KATEGORIJ MED LETOMA 1961 IN 1994 PO NARAVNOPOKRAJINSKIH ENOTAH SLOVENIJE.

	Fields	Vineyards	Orchards	Meadows	Pastures	Forests	Marshes	Infertile
Alpine Region	0,68	0,21	1,20	0,93	0,79	1,10	1,00	1,01
Pre-alpine Region	0,73	0,73	1,27	1,05	0,70	1,10	0,35	1,37
Mediterranean Region	0,82	0,93	1,31	1,01	0,86	1,17	0,40	1,28
Dinaric Region	0,77	0,94	1,03	0,96	0,62	1,18	0,84	1,28
Subpannonian Region	0,85	0,86	1,18	1,10	0,78	1,05	0,80	1,43
Basins	0,79	0,66	1,01	1,02	0,71	0,99	0,79	1,69
Plains of NE and E Slovenia	0,94	0,91	1,05	0,99	0,59	1,02	1,27	1,61
Slovenia	0,82	0,88	1,16	1,01	0,73	1,11	0,83	1,26

Sources: Land cadaster data on land categories according to cadastral municipalities for 1994, Surveying and Mapping Authority of the Republic of Slovenia.
Kladnik, D.: Problematika zemljiške strukture v Sloveniji, Elaborat.

Land use is shown in even more detail in the map of Slovene mesoregions (Figure 18) where mainly the mesoregions with the largest and the smallest proportions of specific land categories appear.

The largest proportion of cultivated fields is in Murska ravan (the Mura Plain) (47.8%) and the smallest in Zahodne Karavanke (the Western Karavanke Mountains) (1.4%). Less than two percent of cultivated fields are still found in Julijske Alpe (the Julian Alps) and on Javorniki and Snežnik (the Javorniki and Snežnik Mountains), but they cover more than a third of the surface area in Dravska ravan (the Drava plain) and in Lendavske gorice (the Lendava Hills). The largest proportion of vineyards in found in Goriška brda (the Gorica Hills) (17.6%), and they cover more than a tenth of the surface area in Lendavske gorice. In numerous mesoregions, grapevines do not grow. In contrast, orchards are found in all regions, the most in Slovenske gorice (the Slovenian Hills) (10.6%) while they cover only one tenth of a percent in Julijske Alpe, Podgorski kras (the Podgorje Karst Region), Čičarija, Podgrajsko podolje (the Podgrad Valley System), and on Javorniki and Snežnik. Meadows only cover more than a half of the surface area in Ljubljansko barje (the Ljubljana Moor). They take up the least surface area, less than one tenth of the land, in Zahodne Karavanke and Kamniško-Savinjske Alpe (the Kamnik-Savinja Alps). By far the most pastures are found in Podgorski kras, Čičarija, and Podgrajsko podolje (41.5%). They also cover almost one third of the surface area in Kras (the Karst Region), while in the alpine region they are most extensive in the Julijske Alpe (18.5%). Pastures cover less than two percent of Murska ravan, Lendavske gorice, Goričko, and Velikolaščanska pokrajina (the Velike Lašče Area), and less than one percent of Ljubljansko barje. Forests cover more than two thirds of the surface area in Vzhodne Karavanke (the Eastern Karavanke Mountains), Stojna, Kozjak and Pohorje (the Stojna, Kozjak and Pohorje Mountain Ranges), the high karst plateaus of Trnovski gozd, Nanos, Hrušica, Javorniki, and Snežnik. They have declined most on the Savinjska (the Savinja Plain), Murska, and Dravska ravan where they occupy less than one fifth of the surface area. Only in Julijske Alpe is there more than 20% of infertile land while on the Dravska and Savska

ravan (the Sava Plain), the proportion exceeds 15%. Infertile land occurs least in Kočevsko (the Kočevje Region), where in the mountains of Velika Gora, Stojna, Goteniška gora, Mala gora, Kočevski rog, and Poljanska gora the proportion does not reach 2%.

5. Land Use Dependent on Selected Natural Factors

5.1. Lithology

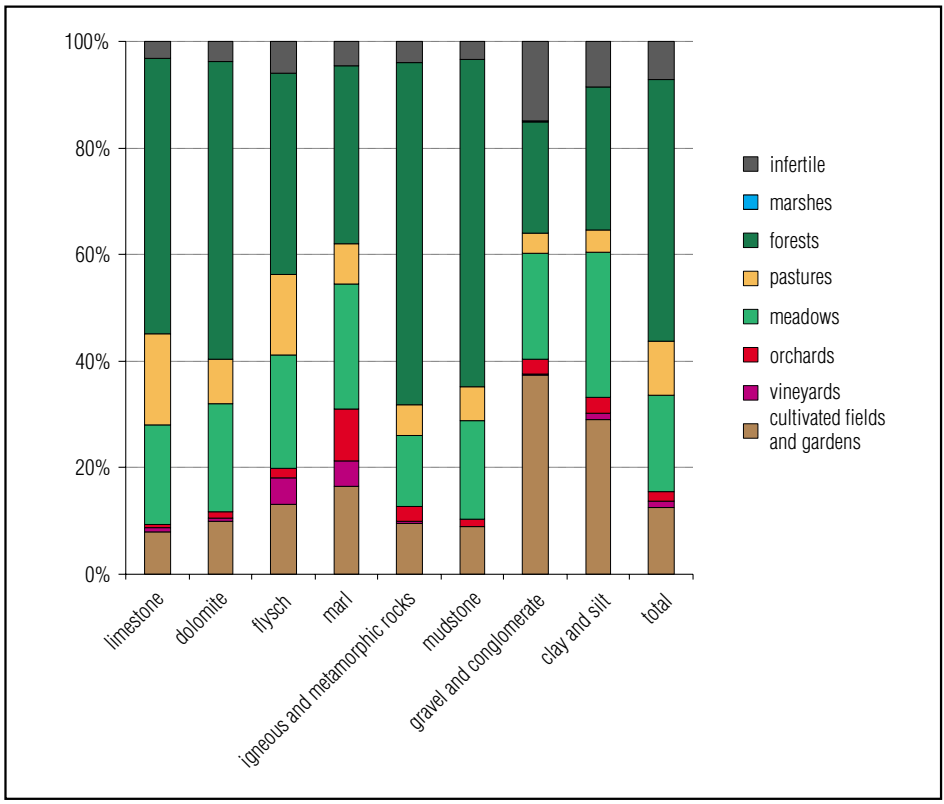


Figure 19: Land Use in Slovenia in 1994 relative to Lithological Structure.
Slika 19: Raba tal v Sloveniji leta 1994 z ozirom na litološko sestavo.

Lithological structure is one of the most important natural factors of land use. Its influence is indirect (mostly through soil, dependent on the rock structure). At least in part, the basic relief categories and their characteristic land use reflect the lithological structure. The prevalence of gravel and conglomerate and clay and silt is characteristic of the plains, while marl, flysch, and mudstone prevail in the hills. In the highlands, limestone, dolomite, and igneous and metamorphic rock are most extensively represented, while the mountains are principally composed of limestone or dolomite; only in a few places are their foothills also composed of metamorphic rock.

Cultivated fields are mostly found on the gravel and conglomerate characteristic of the dry heart of the plains. There are fewer cultivated fields on the wetter clay and silt margins of the plains and more

meadows, which are the most widespread in just this bedrock. The proportion of cultivated fields increased considerably with the drainage of wet ground, mostly replacing meadows. An above-average occurrence of cultivated fields is also found on marly hill surfaces, mostly on sunny slopes just above wet valley bottoms and on the tops of ridges. Vineyards prevail on the upper sections of sunny slopes, and below them spread orchards. Orchards are by far the most extensive on the marl of northeastern Slovenia. Many vineyards are found on the sunny flysch slopes of the coastal region where there are considerably fewer orchards. The smallest number of cultivated fields is found on limestone and mudstone. On these two lithological units, the occurrence of meadows is also below average. In spite of everything, however, meadows are relatively the most regularly occurring land category.

Pastures are by far the most frequent on limestone and flysch but are found on all types of bedrock. The most forested lithological unit is igneous and metamorphic stone where forests thrive on predominantly acidic soils. Similar soils occur on mudstone, the second most forested lithological unit. Dolomite surfaces are somewhat more forested than limestone surfaces, mainly due to the less frequent occurrence of pastures. On all the other lithological units, the occurrence of forests is considerably smaller. On flysch and marl, mostly on sunny slopes, forests overgrow a good third of the surface area; on mudstone, one fourth; and on the most fertile soil on gravel and conglomerate, only one fifth of the surface area. Because of its good bearing capacity, the gravel and conglomerate surface of the heart of the plains is the most built-up lithological unit, a fact reflected in the large proportion of infertile areas. It is interesting that an above-average occurrence of infertile land is only found on clay and silt at the margins of plains.

TABLE 5: LAND USE IN SLOVENIA IN 1994 RELATIVE TO LITHOLOGICAL STRUCTURE.
PREGLEDNICA 5: RABA TAL V SLOVENIJI LETA 1994 Z OZIROM NA LITOLOŠKO SESTAVO.

	Fields	Vineyards	Orchards	Meadows	Pastures	Forests	Marshes	Infertile
Limestone	7,93	0,74	0,67	18,73	17,01	51,66	0,00	3,26
Dolomite	9,97	0,60	1,19	20,29	8,40	55,78	0,01	3,76
Flysch	13,04	5,04	1,72	21,33	15,16	37,79	0,03	5,89
Marl	16,57	4,76	9,70	23,44	7,49	33,46	0,05	4,53
Igneous and Metamorphic Rocks	9,64	0,37	2,73	13,22	5,82	64,28	0,01	3,93
Mudstone	8,94	0,06	1,35	18,54	6,28	61,36	0,00	3,47
Gravel and Conglomerate	37,30	0,32	2,80	19,73	3,81	20,93	0,22	14,89
Clay and Silt	29,11	1,06	3,00	27,30	4,10	26,80	0,11	8,52
Slovenia	12,61	1,06	1,97	18,09	10,23	48,85	0,07	7,12

Sources: Land cadaster data on land categories according to cadastral municipalities for 1994, Surveying and Mapping Authority of the Republic of Slovenia.
Verbič, T.: Litološke enote Slovenije, GAS.

5.2. Climate Types

The most cultivated fields are in the subpannonian climate area, and the fewest in the montane climate area. Of course, at these climate extremes there are corresponding relief categories: plains and hills in the subpannonian climate area and hills and mountains in the montane climate area. Vineyards are most widespread in areas with a submediterranean climate, a subpannonian climate, and the Bela krajina subtype of the subpannonian climate. In the area of subpannonian climate, the occurrence of orchards is clearly far above average.

Meadows and pastures are most frequent in areas with a submediterranean climate. The prevalence of pastures in particular is quite distinct. The fewest meadows are in areas with a montane climate, and the fewest pastures in areas with the continental climate of central Slovenia or a subpannonian

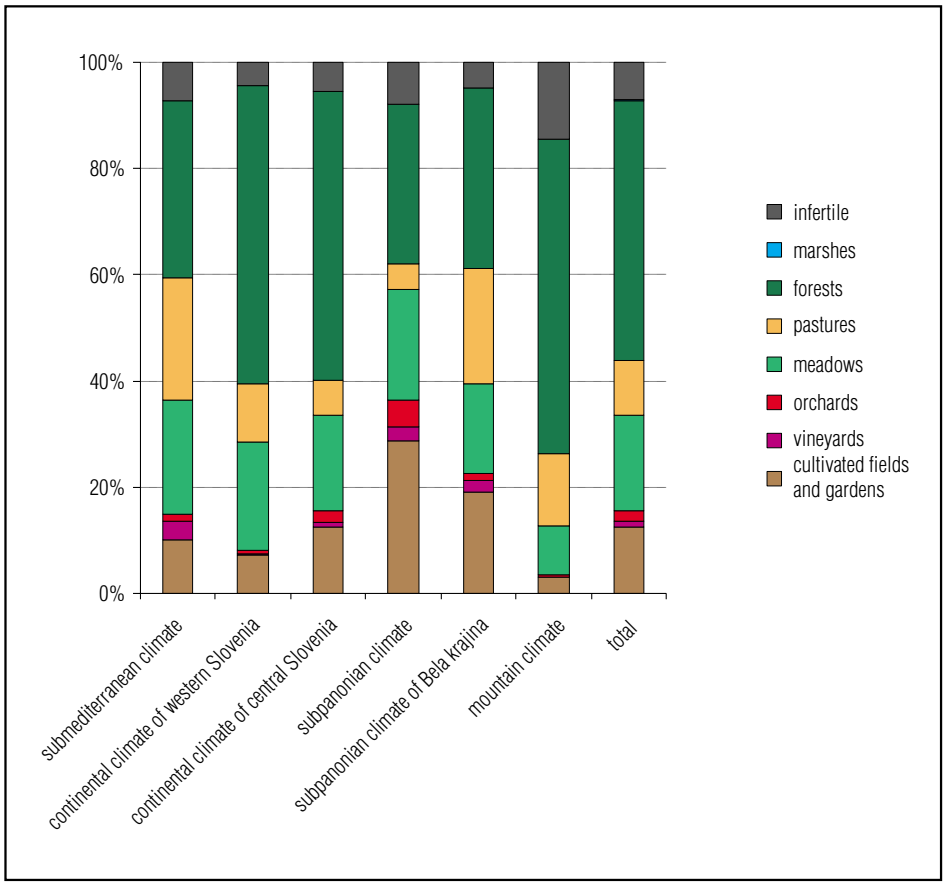


Figure 20: Land Use in Slovenia in 1994 relative to Climate Types.
Slika 20: Raba tal v Sloveniji leta 1994 z ozirom na podnebne tipe.

climate. Forests cover more than half the areas with the two subtypes of continental climate or with a montane climate. In the latter areas, the proportion of infertile land is highest due to their rockiness.

TABLE 6: LAND USE IN SLOVENIA RELATIVE TO CLIMATE TYPES.
PREGLEDNICA 6: RABA TAL V SLOVENIJI Z OZIROM NA PODNEBNE TIPE.

Climate Type	Fields	Vineyards	Orchards	Meadows	Pastures	Forests	Marshes	Infertile
Submediterranean	10,02	3,61	1,37	21,51	22,82	33,56	0,05	7,26
Continental Western Slovenia	7,32	0,03	0,86	20,24	11,05	56,10	0,10	4,30
Continental Central Slovenia	12,59	0,81	2,10	17,97	6,59	54,37	0,01	5,56
Subpannonian	28,77	2,62	5,04	20,88	4,86	29,86	0,10	7,87
Subpannonian Bela krajina	18,98	2,24	1,43	16,87	21,60	34,07	0,00	4,81
Montane	3,14	0,00	0,38	9,17	13,64	59,10	0,11	14,46
Slovenia	12,61	1,06	1,97	18,09	10,23	48,85	0,07	7,12

Sources: Land cadaster data on land categories according to cadastral municipalities for 1994, Surveying and Mapping Authority of the Republic of Slovenia.
Ogrin, D.: Podnebni tipi v Sloveniji, Geografski vestnik LXVIII.

5.3. **Altitude**

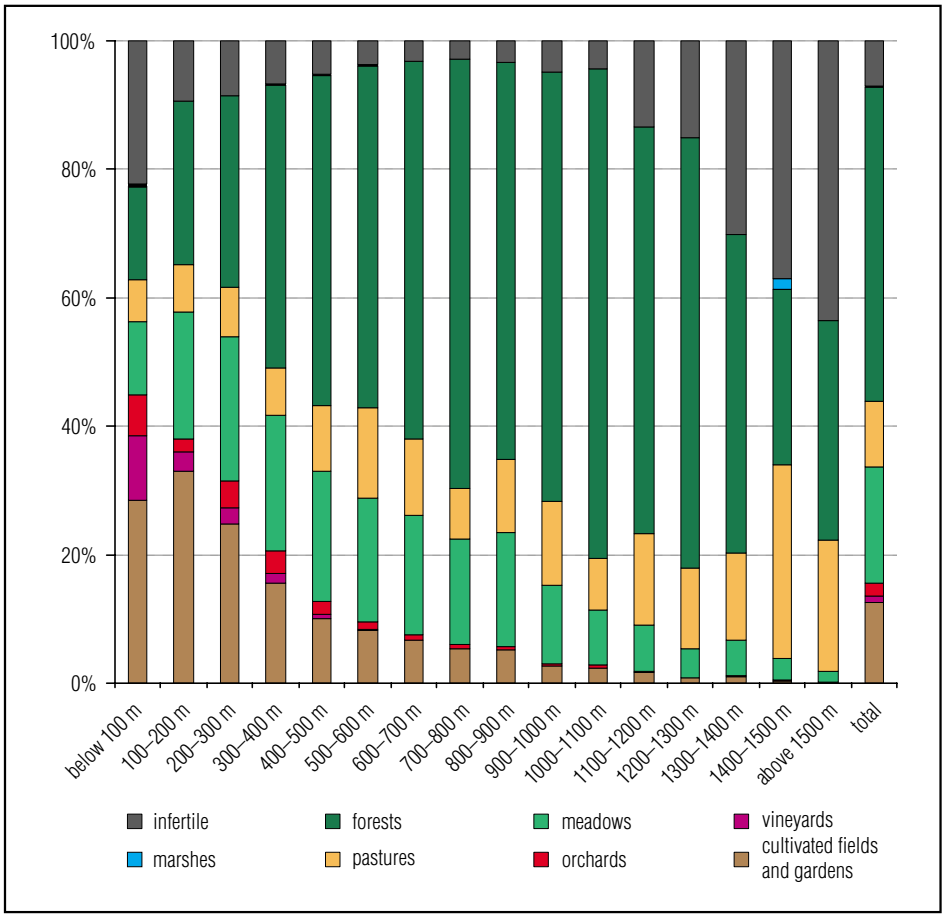


Figure 21: Land Use in Slovenia in 1994 relative to Altitude.
Slika 21: Raba tal v Sloveniji leta 1994 z ozirom na nadmorsko višino.

The link between land use and altitude is most clearly expressed. Climate characteristics depend on the latter, while lithological and socioeconomic developmental features mirror the occurrence of the main relief categories. It is necessary to consider that land use is calculated relative to the mean altitude of individual cadastral municipalities and therefore in units with diverse relief that spans several altitude belts, certain land categories can occur ostensibly higher than would otherwise be expected. The upper border of permanent settling (colonization) and growth of certain cultures was studied by Ivan Gams (1960).

In the belt up to 100 meters, orchards and vineyards are relatively dominant because this belt includes only the coastal part of the flysch Koprska brda (the Koper Hills) and the lower part of the Brestoviški dol on Kras. The proportion of cultivated fields is the largest in the altitude belt between 100 to 200 meters, and then drops gradually at very regular intervals. In the belts between 700 and 900 meters, there is a slight levelling off in the decrease in the proportion of cul-

tivated fields. Vineyards are also quite plentiful in the belt between 100 and 400 meters, while orchards to a great extent occur mostly in the belts between 200 and 500 meters.

With the exception of the lowest belt, meadows occur quite evenly in altitude belts up to 900 meters, after which their proportion decreases, although we can still find them in the highest belt above 1500 meters. In contrast, the proportion of pastures gradually increases with higher altitudes. A certain levelling off is noticeable in the belt between 700 and 800 meters. In the belt between 1400 and 1500 meters, pastures cover just under one third of the surface area; therefore, there is somewhat less forest here. The changing of the proportion of forest is very interesting. At first, the numbers increase evenly until the 700 to 800 meter belt, and a slight levelling off is noticeable at the altitude of 1000 meters. In the next altitude belt, the forests cover more than three quarters of the surface area, and then their proportion rapidly begins to drop with increasing altitude. In the belt above 1500 meters, the forests cover only one third of the territory. This is the consequence of the extensive infertile region above the upper tree line, which is, in the highest altitude belt, larger than the forested area. The proportion of infertile surface area decreases as altitude drops until the belt between 700 and 800 meters. It then increases again as the altitude drops due to the dense build-up and more extensive infrastructure. The proportion of infertile surface area is largest by far in the densely built-up coastal belt below 100 meters of altitude. It is also worth mentioning the extremely condensed marsh category in the altitude belt between 1400 and 1500 meters due to the considerable expanse of high moor in this region.

TABLE 7: LAND USE IN SLOVENIA IN 1994 RELATIVE TO ALTITUDE.
PREGLEDNICA 7: RABA TAL V SLOVENIJI LETA 1994 Z OZIROM NA NADMORSKO VIŠINO.

Altitude in metres	Fields	Vineyards	Orchards	Meadows	Pastures	Forests	Marshes	Infertile
below 100	28,54	10,00	6,36	11,30	6,67	14,44	0,39	22,30
100–200	33,05	2,92	2,09	19,65	7,43	25,43	0,10	9,33
200–300	24,71	2,65	4,06	22,52	7,72	29,78	0,08	8,48
300–400	15,50	1,62	3,51	21,04	7,36	44,17	0,02	6,78
400–500	10,07	0,60	2,03	20,28	10,31	51,36	0,09	5,26
500–600	8,20	0,21	1,18	19,25	13,98	53,41	0,07	3,70
600–700	6,67	0,08	0,82	18,51	11,89	58,81	0,10	3,12
700–800	5,33	0,02	0,71	16,32	7,98	66,80	0,00	2,84
800–900	5,15	0,02	0,58	17,73	11,28	61,82	0,00	3,42
900–1000	2,61	0,00	0,35	12,30	13,08	66,72	0,01	4,93
1000–1100	2,42	0,00	0,35	8,69	8,03	76,17	–	4,34
1100–1200	1,71	–	0,21	7,16	14,13	63,44	0,02	13,33
1200–1300	0,85	–	0,07	4,49	12,56	67,01	0,00	15,02
1300–1400	1,01	–	0,12	5,55	13,64	49,49	0,00	30,19
1400–1500	0,40	–	0,07	3,36	30,24	27,26	1,70	36,97
above 1500	0,12	–	–	1,78	20,39	34,10	–	43,61
Slovenia	12,61	1,06	1,97	18,09	10,23	48,85	0,07	7,12

Sources: Land cadaster data on land categories according to cadastral municipalities for 1994, Surveying and Mapping Authority of the Republic of Slovenia.
Digital relief model 100 m, Surveying and Mapping Authority of the Republic of Slovenia.

6. Distribution of the Main Land Categories

Farming cultivated fields occurs at an above-average level in all of northeastern Slovenia, on the Krška (the Krka Plain) and Savinjska ravan, in Bela krajina, in Dolenjsko podolje (the Dolenjska Valley System), in Kranjsko and Sorško polje (the Kranj and Sora Flatlands), and in Koprska brda. The most important agricultural area in the country is northeastern Slovenia. In the last decades, visible changes have appeared in the sowing composition of cultivated fields. Characteristic of them is that the pat-

tern of crop rotation is becoming narrower and its time interval shorter. Thus, for example, the rotation of corn and stubble wheat has prevailed in many places. Where agriculture is narrowly specialized (for example, intensive cattle breeding or the market production of potatoes), even pronounced monoculture farming has appeared (Cunder, Material for the *Geographical Atlas of Slovenia*).

Almost one half of all cultivated fields are devoted to the production of cereals (bread and fodder cereals, and corn for grains). Two thirds of cultivated fields planted with cereals are in the subpannonian Slovenia, in Pomurje, more than 70%. A large part of the crop is intended for cattle fodder. Under the influence of the relatively rapid development of cattle breeding, the proportion of fields cultivated for fodder increased (fodder root crops, fodder plants, and silage corn) and now totals 30%. The total proportion of fodder plants increased mostly due to the rapid spread of silage corn. In 1991, 13.8% of cultivated fields were planted with silage corn, seven times more than in 1971. Most of the fodder plants are grown on cultivated fields in central Slovenia where they occupy more than a half of the available field land. 17% of cultivated fields are devoted to vegetables. Potato ranks among typical vegetables and occupies three quarters of the area planted with vegetables. Potato is the leading culture in some parts of central Slovenia and in some parts of the alpine and pre-alpine valleys, while (early) vegetables are focused in the coastal belt of submediterranean Slovenia and around the larger cities. The proportion of vegetables is slowly decreasing. The smallest proportion (3.8%) in the sowing pattern of cultivated fields is occupied by industrial plants. The most important of these are hop, sugar beet, and rape. In comparison with other crops, the production of industrial plants is concentrated in a relatively small areas, often in the vicinity of processing plants. The surface area planted with them is increasing moderately (Krznar, 1995).

Winegrowing is more strongly represented in Slovenske gorice, Pekrske gorice (the Pekre Hills), the southeastern part of Goričko, Lendavske gorice, Haloze, the Podpohorje and the southern part of Dravinjske gorice (the Dravinja Hills), Posotelje, Bizeljsko, Trška gora, the Gorjanci foothills, the margins of the Bela krajina flatlands, Vipavska brda (the Vipava Hills), Biljenski griči (the Bilje Hills), Goriška brda, Koprska brda, some places in Kras, and the sunny slopes of the Krka Valley. At altitudes above 600 meters, grapevines grow poorly or are grown only on trellises. All of the central, southern, northern, and northwestern parts of the country are therefore without vineyards. Since the end of the 19th century, the proportion of vineyards has decreased by more than half, at first due to grapevine diseases, after the disintegration of the Austro-Hungarian Empire to the loss of the market, and after World War II to social stratification in the rural areas. In the latter period, there has been, above all, neither the interest in nor the financial means for the necessary renovation of vineyards at thirty-year intervals. The largest reductions or total disappearances occurred where conditions were less favourable due to a colder climate. Only recently here and there has the surface area of land planted with grapevine increased. In Goriška brda and in Lendavske gorice, the supporters of this process are private winegrowers, while in Koprska brda it is mostly the former social sector. The latter has most of its vineyards arranged so it is possible to use agricultural mechanization.

The proportion of orchards is above the average in Slovenske gorice, western Goričko, the eastern foothills of Pohorje, Celjska and Velenjska kotlina (the Celje and Velenje Basins), Zasavje, the hilly part of Posavje, the upper part of Ljubljanska kotlina (the Ljubljana Basin), Goriška brda, the lower part of Vipavska dolina, and in Koprska brda. At least symbolically, they occur almost everywhere else, but there is little trace of them in the heart of Julijske Alpe, the high karst plateaus, Čičarija, and some places in Kras. In many places it appears that fruit trees were planted in abandoned vineyard land, and therefore their surface area has increased almost everywhere. However, due to frost damage, olive orchards have decreased in the hinterland of Koper (Vrišer, 1987). Two types of orchards prevail. Extensive or »farm« orchards surround village homes that are more sparsely planted, poorly maintained, of less noble varieties, and some less fertile but at the same time better adapted to the natural surrounding and therefore less subject to plant diseases. Cattle or pigs are frequently pastured on the grass between the trees. In complete contrast are modern plantation orchards with intensive production adapted to mechanical processing. Sprays are regularly used to protect the trees from pests, and in many places, irrigation systems have been installed. The trees are planted densely in

Figure 22: Distribution of Cultivated Fields in 1994.
Slika 22: Razprostranjenost njiv leta 1994.

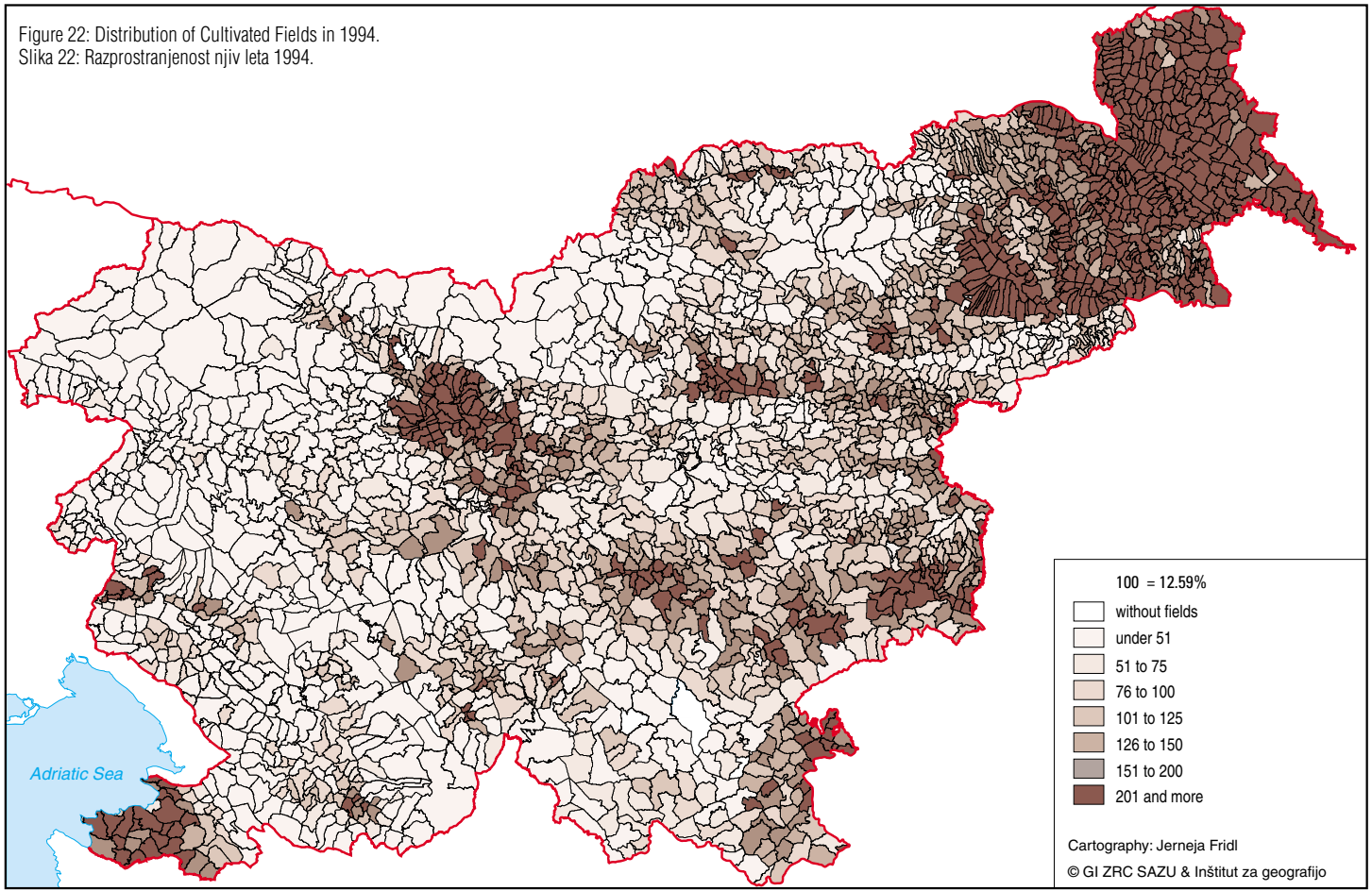


Figure 23: Distribution of Vineyards in 1994.
Slika 23: Razprostranjenost vinogradov leta 1994.

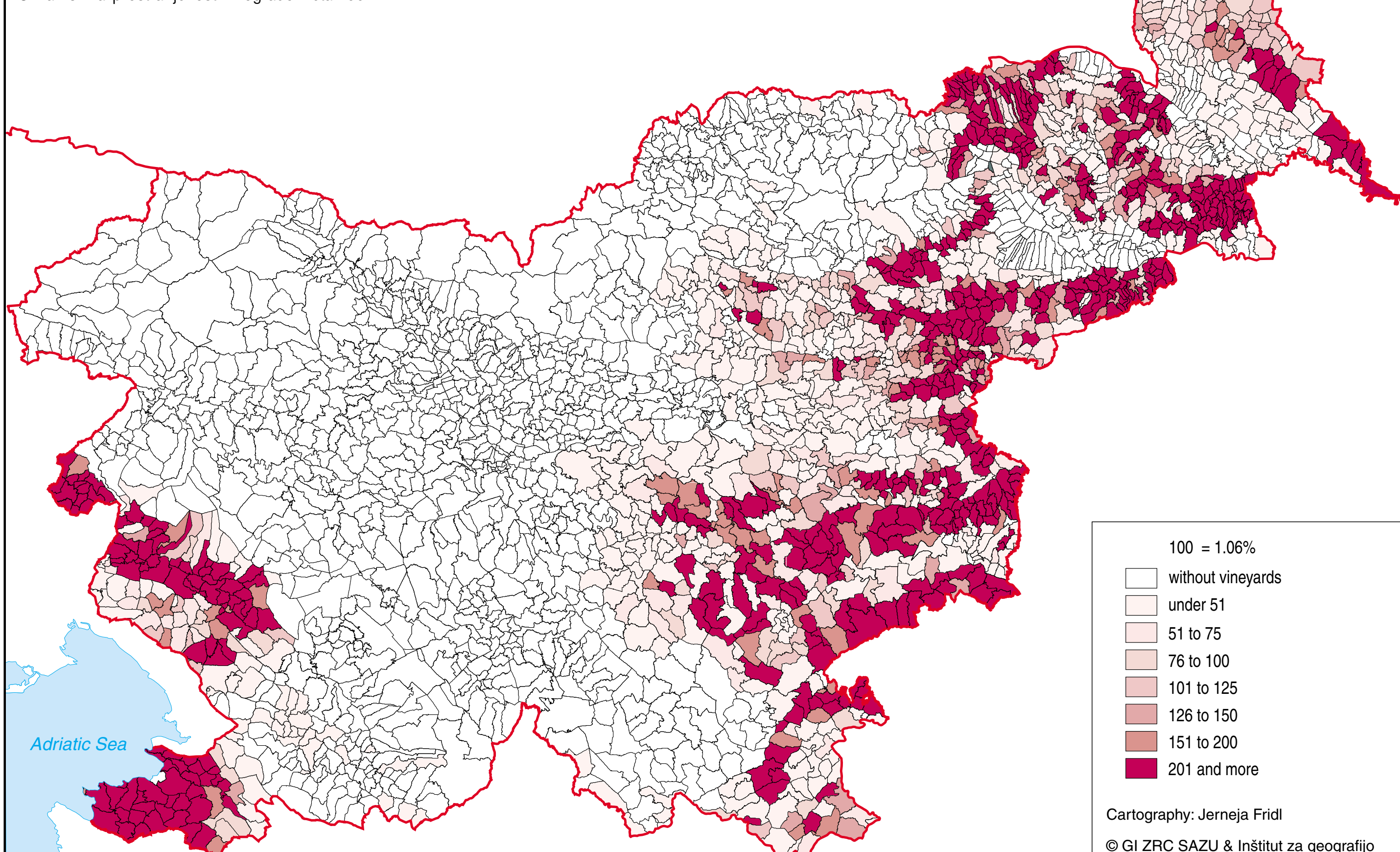


Figure 24: Distribution of Orchards in 1994.
Slika 24: Razprostranjenost sadovnjakov leta 1994.

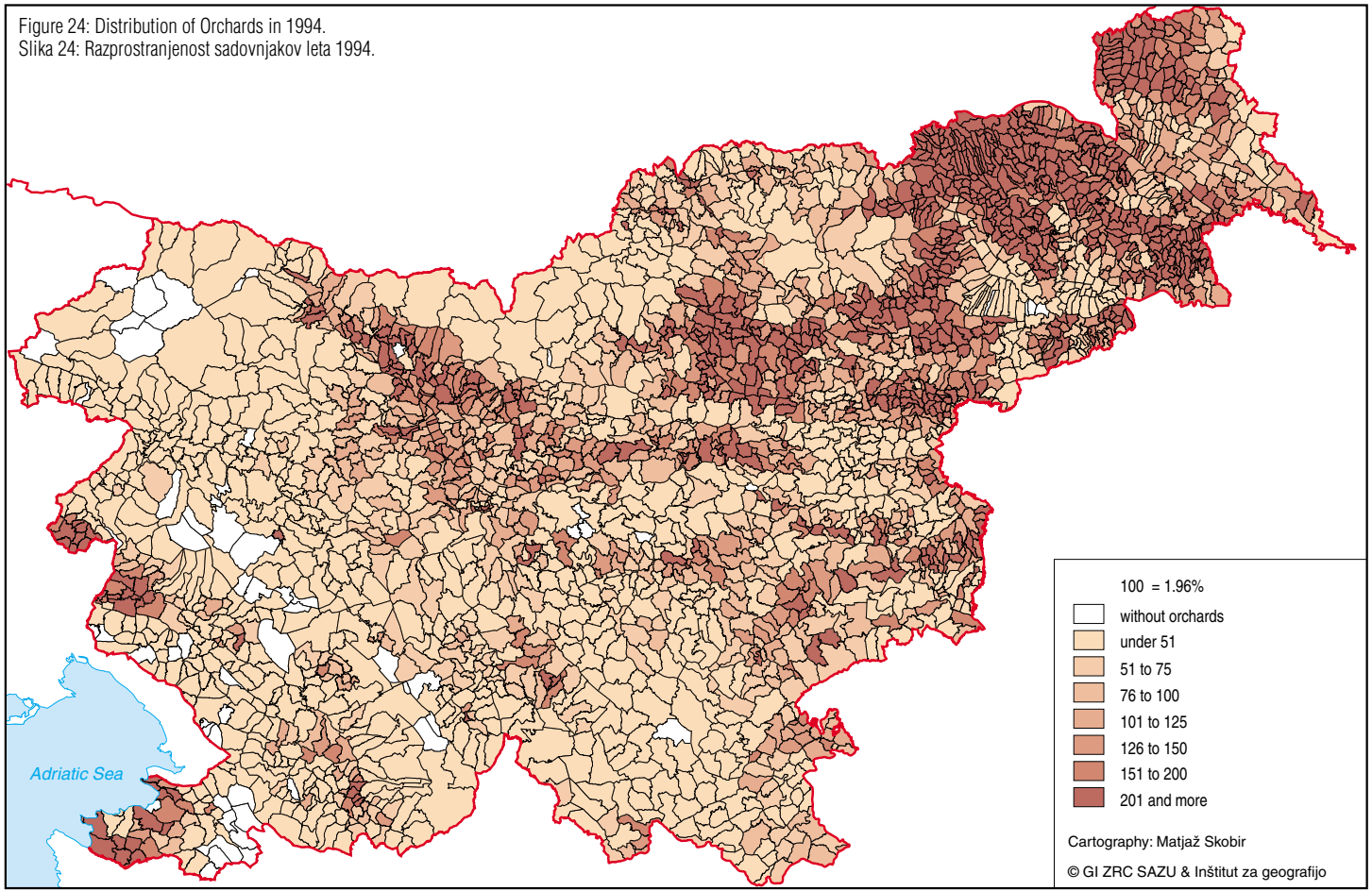
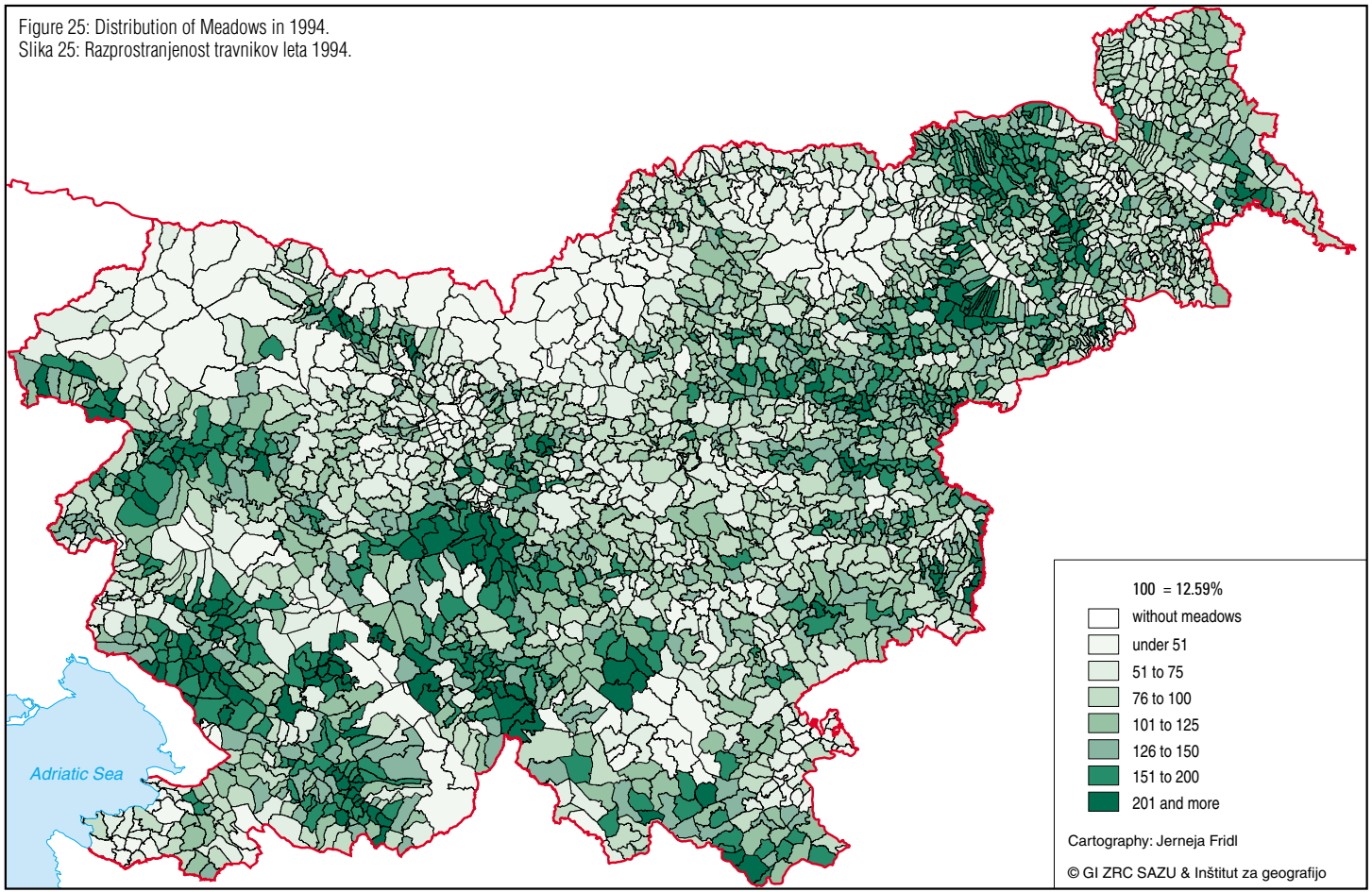


Figure 25: Distribution of Meadows in 1994.
Slika 25: Razprostranjenost travnikov leta 1994.



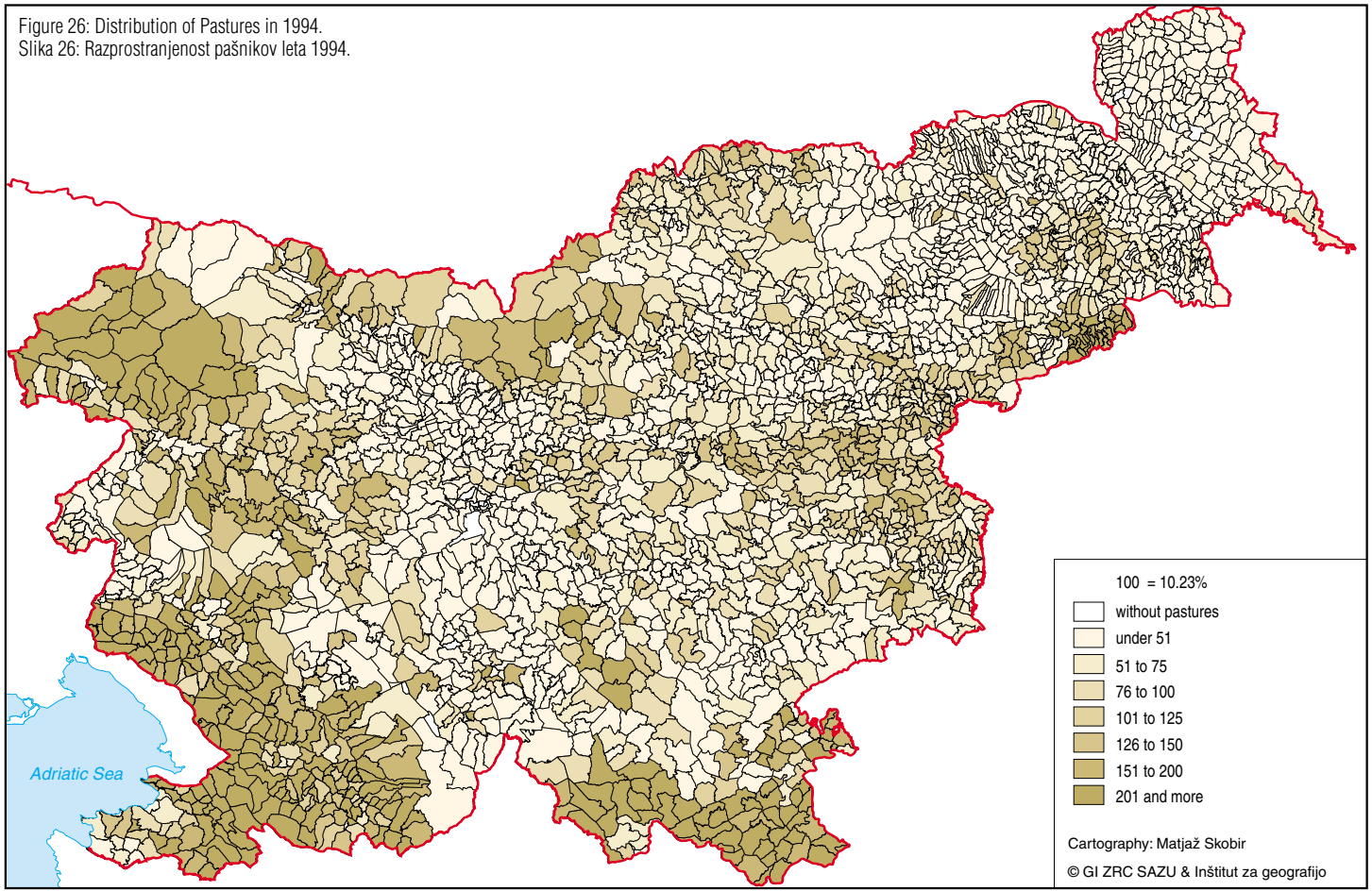


Figure 26: Distribution of Pastures in 1994.
Slika 26: Razprostranjenost pašnikov leta 1994.

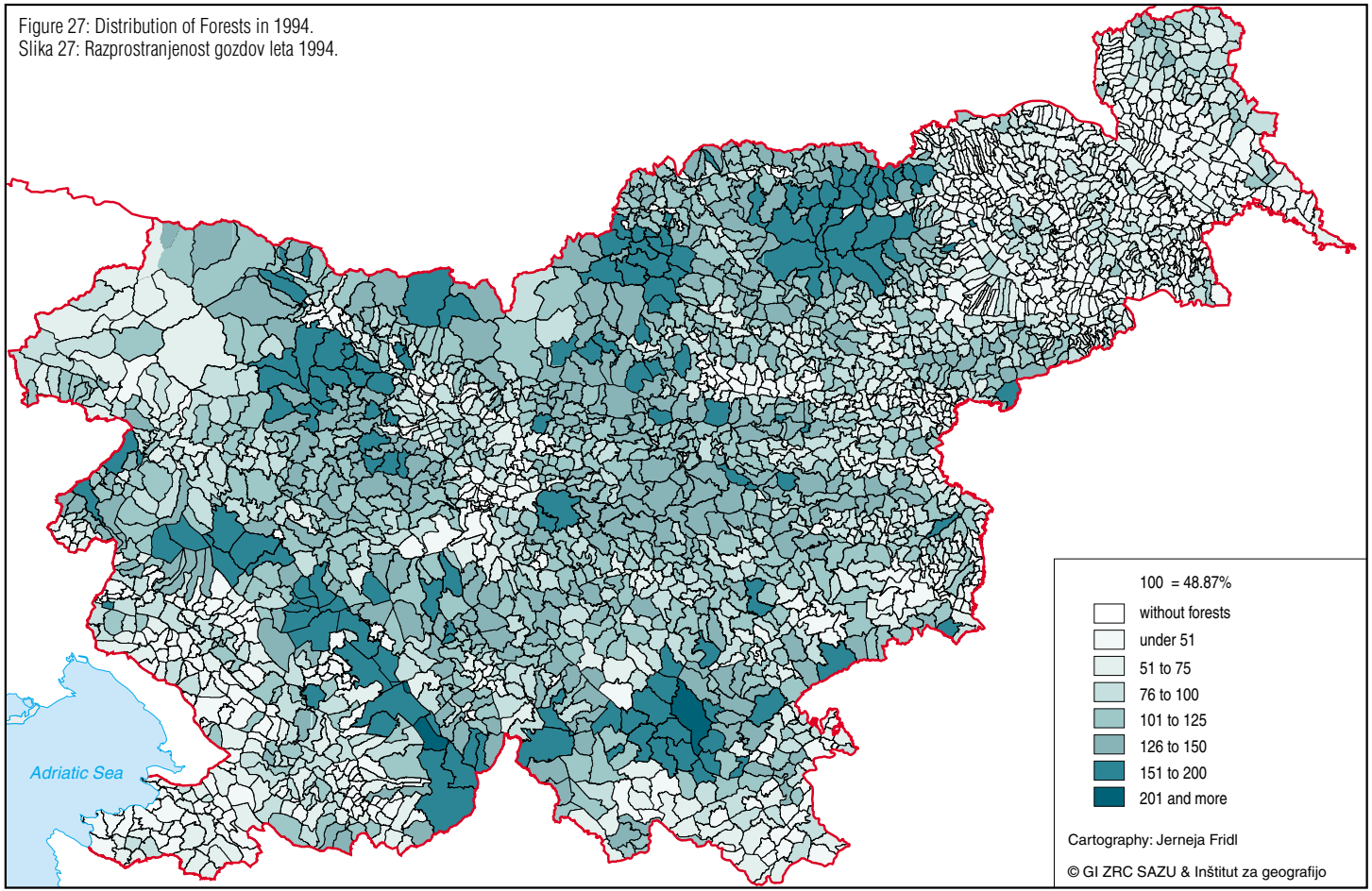
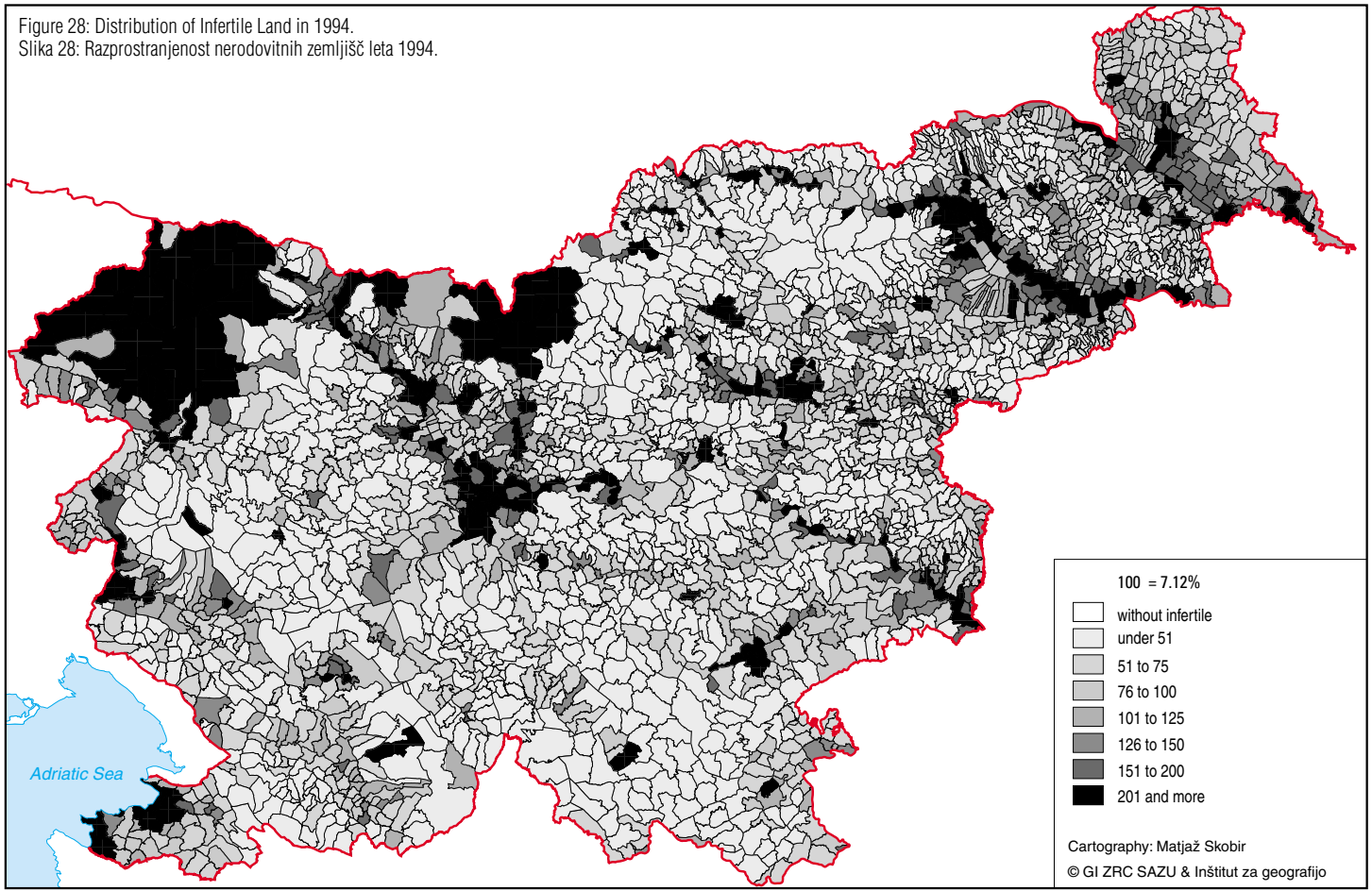


Figure 27: Distribution of Forests in 1994.
Slika 27: Razprostranjenost gozdov leta 1994.

Figure 28: Distribution of Infertile Land in 1994.
Slika 28: Razprostranjenost nerodovitnih zemljišč leta 1994.



pests, and in many places, irrigation systems have been installed. The trees are planted densely in rows, and their shorter height due to regular trimming enables easier harvesting.

The emphasized role of cattle breeding is indicated by the larger occurrence of meadows and pastures. The former are relatively most frequent in Murska ravan, the western part of Slovenske gorice, Dravsko polje (the Drava Flatland), Celjska kotlina, Posotelje, Radovljiška kotlina (the Radovljica Basin), the hinterland of the Kolpa River, Bloke, Loški potok, Ljubljansko barje, Notranjsko podolje (the Notranjska Valley System), central and lower Posočje, the upper and central parts of Vipavska dolina, Kras, Brkini, Ilirskobistriška kotlina (the Ilirska Bistrica Basin), and Pivka. Except in the highest parts of the mountain ranges, meadows also occur elsewhere but in substantially smaller proportions. Studies show that the upper border for meadows that owners mow at least once a year is about 1200 meters. On one hand, their surface area has increased due to the gradual reorientation toward cattle breeding and the grassing over of cultivated fields, while on the other, meadows on steep slopes have been abandoned or changed into pastures. The result is an apparent stagnation, and the changes in the total surface area are insignificant. Differences in the intensity of the use of the meadows are considerable. On the larger part, the production of fodder is extensive, almost without manuring and with one or two hay harvests per year. Around one tenth of the meadows are used intensively, with high levels of manuring and at least four hay harvests per year, complemented in some places with intense pasturing by sections following the harvest (*Strategija razvoja* …) This is the so-called »pasture-harvest« system.

Pastures are relatively most extensive in Zgornje Posočje (the Upper Posočje Region), Idrijsko hribovje (the Idrija Mountains), Nanos, Trnovski gozd, Kras, Brkini, Zgornja Pivka (the Upper Pivka Region), in the hinterland of the Kolpa River, Suha krajina, and the eastern part of Haloze. With the exception of individual cadastral municipalities in Prekmurje, the Ljubljansko barje, and Notranjsko podolje, pastures can be found everywhere in Slovenia. Only 60% of all pastures are exploited for economic purposes, and their surface area is steadily decreasing due to afforestation. We distinguish high-altitude and lower-altitude mountain pastures, communal pastures (Schlamberger, 1955), and post-harvest meadow-pastures; the latter are most frequent in the plains and hills. Mountain pasturing or alpine dairy farming is a special form of pasturing cattle characterized by the annual driving of cattle from areas of permanent human settlement to areas of seasonal residence in the neighbouring mountains along and above the upper tree line where they are pastured between June and September. A larger quantity of fodder is thus guaranteed and the breeding of larger herds enabled. The largest mountain pasture areas are found in Julijske Alpe, Kamniško-Savinjske Alpe, and Karavanke. They developed on both high and middle-height mountains and partly in the dinaric region, for example, on Snežnik, Nanos, and the Trnovski gozd where they have almost all been abandoned. In the east, they reached to the heart of the Pohorje, but all of these were abandoned before World War I because of the poor quality of the fodder. Elsewhere too, many others were abandoned, especially those in the highest elevations with the harshest natural conditions and poorest fodder and those most remote and hard to reach. Unexploited pastures are included in this land category mostly because of their appearance. Most of the time, this accounts for abandoned meadows and pastures that are gradually being overgrown by brushwood.

In relatively forested Slovenia, some very distinctive forest landscapes or regions may be singled out: Pohorje, the eastern part of Kozjak, Smrekovško pogorje (the Smrekovec Mountain Chain), the eastern part of the Karavanke, the Karavanke between Tržič and Jezersko, the alpine plateaus of Menina, Dobrovlje, Jelovica, Pokljuka, and Mežakla, the high karst plateaus of Trnovski gozd, Hrušica, Javorniki, Snežnik, Goteniška gora, and Kočevski rog, and the peaks of the Gorjanci mountain range. Only certain cadastral municipalities have no forests whatsoever. These are found in the built-up areas of Ljubljana and Koper, in the Savinjska ravan, and in the Dravsko polje. After large clearings in the 14th and the 15th centuries, forest land slowly but constantly increased, especially after decrees during the reign of Maria Theresa proclaimed their universal economic and security significance (Vrišer, 1987). In spite of heavy logging at the end of the 19th century and in the first half of the 20th century, their surface area did not shrink and later began to increase rapidly. Afforestation became the

most distinct type of changing land use; it was more pronounced in the western part of the country than in the east. By European standards, the Slovene forest management is exemplary, but in spite of this, many forests are estimated to be less profitable, largely due to unplanned and exaggerated logging, insufficient care, and the worsening of the environmental situation.

In spite of the distinct duality of the infertile category (rocky surface in the high mountains and built-up areas on the level surface of basins and valleys), it is possible to very easily distinguish these landscapes and their areas of greatest intensity. Due to their rockiness, the entire central part of Julijske Alpe, the heart of Kamniško-Savinjske Alpe, and the central and western parts of the Karavanke are ranked in the highest class (more than 14%). Most of the distinctly built-up land is apparently much more dispersed, less compact, and smaller, but an expert on the formation of the surface of Slovenia will quickly notice an exceptional correspondence with basins and river valleys, and only partly with the less densely settled karst valley systems. Outside the high mountain regions, the largest consolidated surfaces of the most distinctive class are in the areas of Ljubljana, Maribor, Kranj, Celje, Koper, Velenje, Novo mesto, Nova Gorica, and Murska Sobota. A very obvious axis runs along the Drava River between Maribor and Središče ob Dravi. The valleys along the Drava, Savinja, Sava, Krka, Soča, Meža, and Mislinja rivers prove quite visible. Elsewhere, the most distinct class occurs as unconsolidated and in smaller surface areas, indicating the sites of smaller towns such as Lendava, Ljutomer, Lenart in Slovenske gorice, Rogaška Slatina, Grosuplje, Trebnje, Črnomelj, Kočevje, Ilirska Bistrica, Postojna, Idrija, Kanal, Piran, Portorož, Lucija, etc.

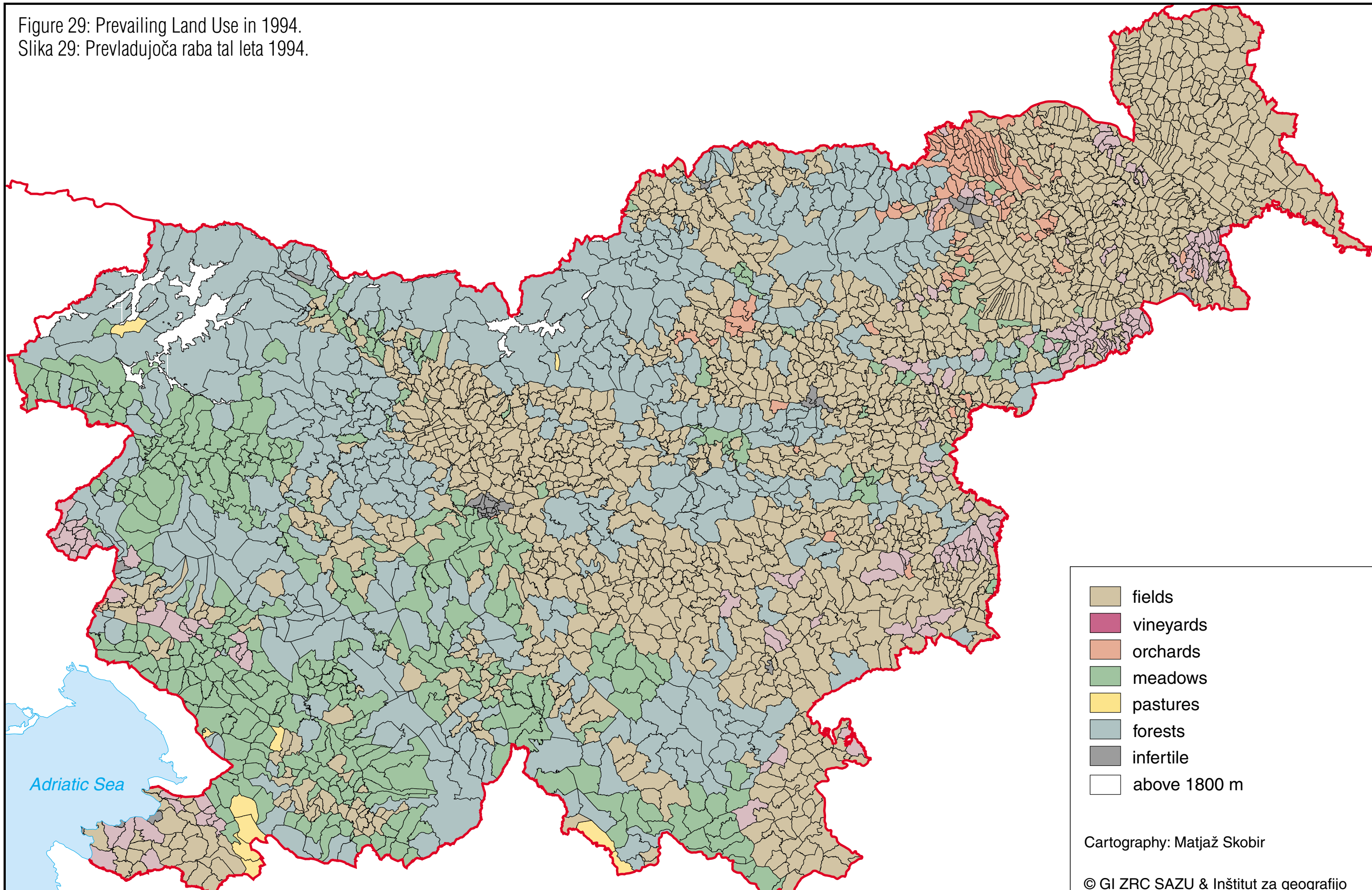
7. Prevailing Land Use

Prevailing land use calculated by means of arability equivalents differs substantially from its illustration without the stated corrections. In spite of the fact that all six land categories of fertile land appear on the map, the strong prevalence of forests and cultivated fields is obvious.

Although they have a low coefficient, forests are significantly in the foreground in almost the entire elevated region of mountains, hills, and high karst plateaus. More generally, it is possible to talk about their prevalence in northern and western Slovenia and in some places in the karst mountains of the southern part of the country. As a transverse axis, forests stretch far toward eastern Slovenia to the area of Posavsko hribovje (the Sava Mountains). The role of cultivated fields is distinctly above average in eastern Slovenia and in the flatland areas of central Slovenia. Cultivated fields with smaller consolidated surfaces occur in Kopska brda, the lower part of Vipavska dolina, on the upper areas of Brkini, in Notranjsko podolje, Ribniško-Kočevsko podolje (the Ribnica-Kočevje Valley System), the Kolpa Valley, the southern margins of Polhograjsko hribovje (the Polhov Gradec Mountains), and in Rovtarsko hribovje (the Rovte Mountains).

Meadows are the third most widespread type. They are most evident in the central and upper sections of Posočje, Baška grapa (the Bača River Valley), Idrijsko hribovje, Kras, the lower elevations of Brkini, Ilirskobistriška kotlina, Pivka, Bloke, Ljubljansko barje, the southern part of Suha krajina, the southern Kočevsko, and Poljanska dolina (the Poljanska Valley) above the Kolpa River. Pastures dominate only an insignificant part of Slovenia limited to the Podgorski Kras, the eastern part of Kras, the upper Kolpa River area, and Bovška kotlina (the Bovec Basin). Orchards appear consolidated only in western Slovenske gorice but have a prevailing role in the eastern foothills of the Pohorje, the hinterland of Velenje, the southern edge of Savinjska ravan, and in a few places in the Zgornje Sotelsko and Senovsko gričevje (the Senovo Hills). In western Slovenia, they only occur in the flatland south of Nova Gorica (around Miren). Vineyards appear as the prevailing category in Radgonsko-Kapelske gorice (the Radgona-Kapela Hills), Ljutomersko-Ormoške gorice (the Ljutomer-Ormož Hills), eastern Haloze, Bizeljsko, around Sremič, below the Gorjanci mountain range, on Trška gora, in some places in Krško gričevje (the Krško Hills), on the northern and western margins of the Bela krajina, in the coastal area of Koprska brda, east of Vipava, in Biljenski griči, Vipavska brda, and Goriška brda.

Figure 29: Prevailing Land Use in 1994.
Slika 29: Prevladujoča raba tal leta 1994.



Over half of the built-up area alone occurs on the territory of certain cities: Ljubljana, Maribor, Celje, Dravograd, Ormož, Jesenice, Novo mesto, Nova Gorica, and the three coastal towns. This depends on the correspondence of city boundaries with the borders of the cadastral municipalities, because in cases where the cadastral municipalities are substantially larger than the town areas, other land categories become involved.

8. Typological Survey of the Latest Changes in Land Use

By using the same method for several different time spans, it is possible to comparably determine the main characteristics of the changes. It is evident that the areas with afforestation, which on Medved's maps (1970) covered only one third of Slovenia, and the areas with urbanization and intensification have grown. In both graphically compared periods, the growth of the areas with afforestation was considerably smaller than the growth of the areas with urbanization, a phenomenon that is becoming one of the major problems of our time. The phenomenon of intensification strengthened proportionately the most but remains limited to only a few percent of the surface area of the country. The areas with grassing over were the only ones to regress, albeit relatively perceptibly.

Afforestation is the most evident process in the changing of land use in almost the entire western, northern, and southern parts of the country, and it also dominates eastern Goričko. It is especially distinct in the mountainous areas and areas remote from traffic.

Grassing over as a consequence of adapting maximally to optimal cultivation due to the introduction of agricultural mechanization (abandoning of too steep and too remote fields) and changing the orientation of production (increased role of cattle breeding) is a prevailing process in the east of the country, on the northern margins of Ljubljanska kotlina, and elsewhere in the hilly parts of western Slovenia. It is most obvious near the border with Croatia, in the area between Koprska brda and Snežnik.

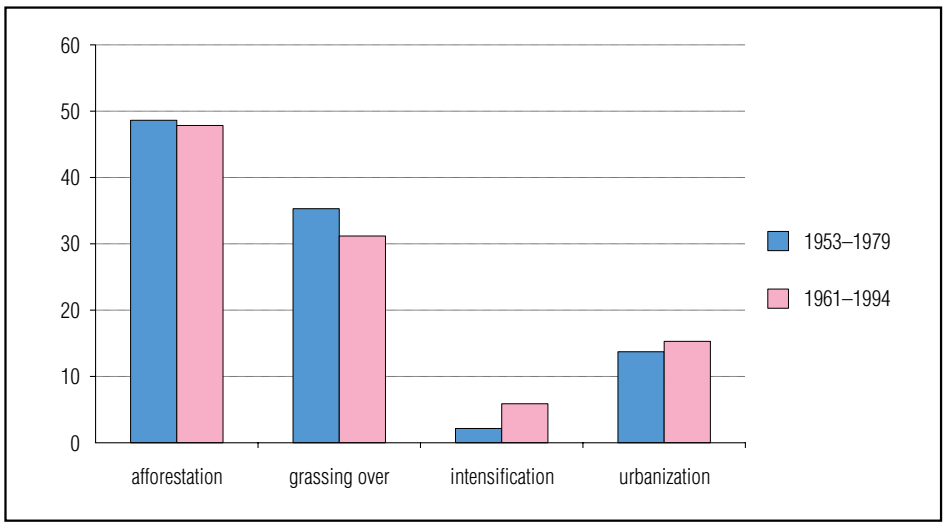
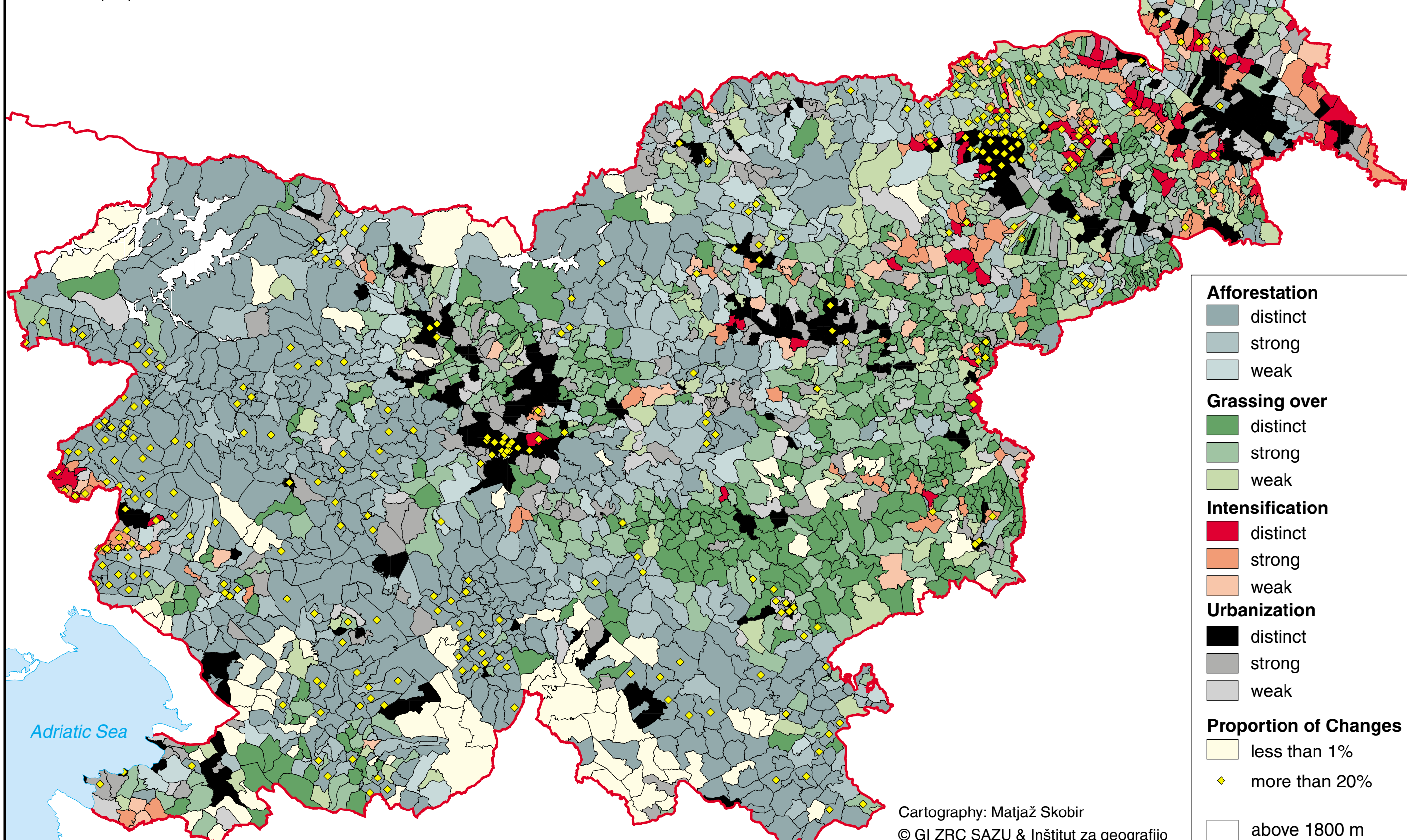


Figure 30: Proportions of the Main Types of the Change of Land Use, 1953–1979 and 1961–1994.
Slika 30: Deleži glavnih tipov spreminjanja rabe tal v obdobjih 1953–1979 in 1961–1994.

Figure 31: Types of Changes in Land Use between 1961 and 1994.
Slika 31: Tipi sprememb rabe tal med letoma 1961 in 1994.



Intensification is found mostly in areas where land amelioration (drainage) has been extensively carried out (the Pesniška and Ščavniška dolina (the Pesnica and Ščavnica River Valleys) in Slovenske gorice, Apaško polje (the Apače Flatland), the southern margins of Dravsko polje, the northern margins of Ravensko and Dolinsko flatlands in Prekmurje, the heart of Vipavska dolina, the southern edge of Ljubljansko barje, Krška ravan) or where vineyards (Goriška brda, Koprska brda) or orchards (southern margin of Savinjska ravan) have been expanded.

The areas of urbanization partly correspond with the areas of intensification and are characteristic of the most fertile land in the surroundings of towns (Ljubljana, Maribor, Celje, Žalec, Kranj, Škofja Loka, Kamnik, Domžale, Murska Sobota, Ljutomer, Ptuj, Ribnica, Novo mesto, Brežice, Krško, Koper, Izola, Piran, Nova Gorica, Sežana, Postojna, and elsewhere) so that they already prevail in the Dravsko, Mursko, Kranjsko and Sorško polje (flatlands), and Kamniškobistriška ravan (the Kamniška Bistrica plain), in Notranjsko podolje, and in eastern Kras. Such areas are also typical in the valleys of Koroška and in some places in the high mountains, mainly where ski resorts have been established, where roads were built, or where settlements of weekend houses have developed. They have also appeared to a considerable extent in the hinterland of the upper course of the Kolpa river, but the changes, as in the Bovec and Bohinj regions, are relatively modest.

It is typical for afforestation that the subtype of intensive afforestation is by far the most common. The most obvious prevalence of distinct afforestation is on the predominantly karst surfaces of Dolenjska and Notranjska. In the remaining three types, the proportions of intensive and strong changes are balanced, but everywhere substantially larger than the proportion of weak changes. It was established that the surface area of both intensive categories has increased on account of the reduction of the category of weak changes.

9. Summary

Land use reflects a complicated correlation between natural, historical, and socioeconomic factors. It changes constantly, a fact seen in the changing of the surface areas of land categories or their relative ratios. Monitoring and recording these changes is a demanding and expensive task, and a universally useful methodology has therefore not yet been recognized. In spite of the most modern aids such as satellites and computers, establishing of actual land use is still closely tied to field work. In nature, it is sometimes difficult to draw a distinction between individual land categories since in the process of changing, they fall between typical individual forms.

The study of land use is relatively well represented in geography, and a little less in other spatial planning fields. Interest in this field is apparently declining, but a deeper approach is evident that ensures more systematic work. It is possible to compare results and seek answers to possible discrepancies. The more important Slovene researchers of land use include Ilešič (1935), Leban (1947), Ingolič (1966), Medved (1970), Kladnik (1985), and Vrišer (1987), and more recent authors have sought and confirmed the links between land use and natural factors (Karel Natek, 1984; Bat, 1990 b; Gabrovec, 1994, 1995 a, 1995 b), or between land use and the complex of natural and social factors (Perko, 1989; Topole, 1990; Kladnik, Marjeta Natek, Bat, 1988). With the widening use of computer technology and improvements to its ability for use with personal computers, ever more diverse applications appeared that took advantage of the geographical information system, particularly the digital relief model.

The basic source in undertaking the study is the data from the land cadaster maintained by the Surveying and Mapping Authority of the Republic of Slovenia (*Land Cadaster, 1994*). The data is assembled on the basis of cadastral records showing current situation in all the cadastral municipalities; however, the data is not up-to-date due to the failure to record changes promptly and indeed lags permanently behind the actual situation. To follow ongoing changes in land use, data is available from

the Statistics Administration of Slovenia which attempts to monitor annual changes in land use of the basis of evaluations.

Land use is reflected in the occurrence and distribution of land categories. Of the three natural factors studied, we established the highest degree of correlation with altitude, and less with lithology and climate conditions.

We decided on the graphical illustration of the proportions of the six basic land categories (cultivated fields, vineyards, orchards, meadows, pastures, and forests) that are the basis of the activity of the primary sector, that is, the various branches of agriculture and forestry. Gardens and hop-fields are ranked with cultivated fields, plantation and extensive orchards are combined, are meadows and marsh meadows and forest plantations and forests. All these land categories are ranked among the so-called cadastral cultures (*Bilance površin* …, 1992). Along with these, the distribution of otherwise diverse infertile land is shown.

The cadastral municipality was selected as the basic unit and in comparison with other spatial units is a relatively stable territorial unit on the level of which the land category structure has been regularly recorded for almost two centuries, since the introduction of the Emperor Francis' cadaster. In Slovenia, there are just under 2700 cadastral municipalities, enough for the essential characteristics of land use in Slovenia to be reflected in the ratios between land categories. A cadastral municipality normally includes all the natural units in a particular village's territory that with their diversity dictate a diverse land structure. Therefore, apparent absurdities can appear on individual maps, for example, that cultivated fields or orchards reach far above the altitude of their actual spread (Gams, 1960), all the way to the borders of the cadastral municipalities, particularly in the alpine region and on high karst plateaus. The same applies to vineyards that in some places such as Gorjanci seemingly reach to the top of the mountains.

Because the proportions of individual land categories vary on the level of the entire state, we chose to illustrate them on the basis of equally large deviations from the average occurrence of specific categories, which were secured by means of indexation. The average proportion of a category for the whole of Slovenia has an index of 100, and relative to the deviations from the average, the indexes are ranked into seven classes; as an eighth class does not appear, certain land categories therefore do not exist in the presented cadastral municipalities. The advantage of the methodology used lies primarily in the uniform spans of classes for all land categories allowing comparison of the illustrations. To illustrate the values of the presented method (used for maps 22–28), comparative cartographic analyses were performed. Certain typical land categories were selected (cultivated fields, vineyards, and forests) for which cartographic illustrations were executed in two ways: with an *adjusted scale* in each category with equal spans between the classes (5% for cultivated fields, 2% for vineyards, and 10% for the forests), through which we tried to show the main lines of distribution of individual categories and with a *uniform scale* with various spans between the classes within individual categories. The comparison of the results of all three methods for all three categories is graphically illustrated. It is based upon surface occurrence of the proportions of all the classes in the various presentations. The course of the curve in the graphs indicates the distribution of individual classes on the maps.

On the basis of the surface occurrence of different land categories, we also attempted to assess the prevailing or so-called »primary« use. In so doing, with regard to the necessary work intensity, we used arability equivalents (Gosar, 1976) as corrections for individual land categories.

To study the typology of the change of land use, we relied on Medved's methodology (1970). It is based on determining the changes to the surface areas of individual land categories since these change constantly, some growing while others decline. The calculations are based on the changes between 1961 and 1994. To carry out the typology, all the changes had to be systematically evaluated by means of generalization and arranged on the basis of the surface prevalence of individual kinds of change.

Afforestation, grassing over, intensification, and urbanization are defined as the main types of changes, and according to the proportions of occurrence within the entire surface area of recorded changes, each main type is further divided into three subtypes. Cadastral municipalities where the proportion of the changes does not reach one percent of their entire surface area are classified into special classes; hatching is used to show cadastral municipalities with various classes of the intensity of the changes.

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11. Povzetek

Nekaj novih vidikov rabe tal v Sloveniji

Matej Gabrovec
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Raba tal odraža zapleten soodnos med naravnimi, zgodovinskimi in družbenogospodarskimi dejavniki. Nenehno se spreminja, kar se kaže v spreminjanju površine zemljiških kategorij oziroma njihovih medsebojnih razmerij. Spremljanje ter beleženje sprememb je zahtevno in drago opravilo, zato se vsestransko uporabna metodologija še ni uveljavila. Kljub najsodobnejšim pripomočkom, na primer satelitom in računalnikom, je ugotavljanje dejanske rabe še vedno vezano tudi na terensko delo. V naravi je pogosto težko razlikovati določene zemljiške kategorije, saj so v procesu spreminjanja ravno vmes med posameznimi tipičnimi oblikami.

Preučevanje zemljiške rabe je v geografiji, nekoliko manj pa v drugih prostorskih vedah, razmeroma dobro zastopano. Zanimanje zanj se na videz sicer zmanjšuje, a je opazen bolj poglobljen pristop, kar zagotavlja večjo sistematičnost. Rezultate je mogoče medsebojno primerjati in iskati odgovore na morebitne razlike. Pomembnejši slovenski preučevalci rabe tal so Ilešič (1935), Leban (1947), Ingolič (1966), Medved (1970), Kladnik (1985) in Vrišer (1987), medtem ko so v novejšem času avtorji iskali in potrjevali vezi med rabo tal in naravnimi dejavniki (Natek Karel, 1984; Bat, 1990 b; Gabrovec, 1994 ter 1995 a in b) oziroma med rabo tal ter spletom naravnih in družbenih dejavnikov (Perko, 1989; Topole, 1990; Kladnik, Natek Marjeta, Bat, 1988). S širjenjem uporabe računalniške tehnologije in izboljševanjem možnosti njene uporabe na osebnih računalnikih so se vse raznovrstnejše aplikacije naslanjale na uporabo geografskih informacijskih sistemov (GIS), še posebno digitalnega modela reliefa (DMR).

Temeljni vir za izvedbo študije so podatki zemljiškega katastra, ki ga vodi Geodetska uprava Republike Slovenije (Zemljiški kataster, 1994). Izvedeni so na podlagi katastrske evidence, ki prikazuje trenutno stanje po vseh katastrskih občinah, a so zaradi pomanjkljivega beleženja sprememb neažurni. Za spremljanje tekočih sprememb rabe tal so na razpolago še podatki Statističnega urada Republike Slovenije, ki skušajo spremljati vsakoletne spremembe v zemljiški rabi na podlagi cenitev.

Raba tal se kaže v zastopanosti in razširjenosti zemljiških kategorij. Med tremi preučenimi naravnimi dejavniki smo ugotovili najvišjo stopnjo soodvisnosti z nadmorsko višino, manj pa z litologijo in podnebnimi razmerami.

Odločili smo se za grafično ponazoritev deležev šestih temeljnih zemljiških kategorij (njive, vinogradi, sadovnjaki, travniki, pašniki in gozdovi), ki kažejo na dejavnost tako imenovanega primarnega sektorja, oziroma različnih panog kmetijstva ter gozdarstva. Vrtovi in hmeljišča so uvrščeni med njive, plantažni in ekstenzivni sadovnjaki so združeni, ravno tako travniki in barjanski travniki ter gozdne plantaže in gozdovi. Vse navedene zemljiške kategorije so uvrščene med tako imenovane katastrske kulture (Bilance površin …, 1992). Poleg tega je prikazana tudi razprostranjenost sicer raznolikih nerodovitnih zemljišč.

Za temeljno enoto prikaza je bila izbrana katastrska občina, v primerjavi z drugimi prostorskimi enotami razmeroma stabilna ozemeljska enota, na ravni katere se, od uvedbe franciscejskega katastra, že skoraj dve stoletji redno beleži sestava zemljiških kategorij. V Sloveniji jih je nekaj manj kot 2700, dovolj, da se skozi razmerja med zemljiškimi kategorijami zrcalijo bistvene značilnosti rabe tal v naši državi. Katastrska občina navadno vključuje vse pokrajinske enote na določenem vaškem zemljišču, ki s svojo raznolikostjo narekujejo različno zemljiško sestavo. Zato se na posameznih zemljevidih lahko pojavlja navidezni nesmisel, da na primer njive in sadovnjaki segajo daleč nad višinsko mejo dejanske razširjenosti (Gams, 1960), vse do meja katastrskih občin, kar je še posebej očitno v alpskem svetu in na visokih kraških planotah. Podobno velja za vinograde, ki ponekod (denimo na Gorjancih) na videz segajo vse do vrha hribovja.

Ker so deleži posameznih zemljiških kategorij na ravni celotne države različni, smo se odločili za prikaz na temelju enakomerno velikih odklonov od povprečne zastopanosti določene kategorije, kar smo zagotovili z indeksacijo. Delež določene kategorije v celotni Sloveniji predstavlja indeks 100, z ozirom na odklone od povprečja pa so indeksi razvrščeni v sedem razredov; kot osmi se pojavlja razred ni pojava, torej določene zemljiške kategorije v prikazani katastrski občini ni. Prednost uporabljene metodologije je v enakomernih razponih razredov za vse zemljiške kategorije, s čimer so prikazi medsebojno primerljivi. Za ponazoritev njene vrednosti (po njej izdelane karte imajo številke od 10 do 16) so bile opravljene primerjalne kartografske analize. Izbrane so bile nekatere tipične zemljiške kategorije (njive, vinogradi in gozdovi), za katere so bili izdelani kartografski prikazi na še dva načina: z vsaki kategoriji prilagojeno lestvico z enakimi razponi med razredi (za njive petodstotnimi, vinograde dvoodstotnimi in gozdove desetodstotnimi) ter z različnimi razponi med razredi pri posameznih kategorijah. Primerjava rezultatov vseh treh metod je za vse tri kategorije ponazorjena grafično. Temelji na površinski zastopanosti deležev vseh razredov pri različnih prikazih. Potek krivulj v grafikonih nakazuje porazdelitev zastopanosti površin posameznih razredov na zemljevidih.

Na podlagi površinske zastopanosti različnih zemljiških kategorij smo skušali ovrednotiti tudi prevladujočo oziroma tako imenovano primarno rabo. Pri tem smo z ozirom na potrebno delovno intenzivnost kot korektive za posamezne zemljiške kategorije uporabili orne ekvivalente (Gosar, 1976).

Za preučitev tipologije sprememb rabe tal smo se oprli na Medvedovo metodologijo (1970). Zasnovana je na ugotavljanju spreminjanj površin posameznih zemljiških kategorij, saj se te ena na račun druge neprestano spreminjajo. Izračuni temeljijo na spremembah med letoma 1961 in 1994. Za izvedbo tipologije je bilo potrebno vse spremembe s posploševanjem sistemsko ovrednotiti in jih razvrstiti na podlagi površinske prevlade določene vrste sprememb. Kot glavni tipi sprememb so opredeljeni ogozdovanje, ozelenjevanje, intenzifikacija in urbanizacija, glede na deleže zastopanosti znotraj celotne površine registriranih sprememb pa je vsak glavni tip razčlenjen na tri podtipe. V poseben razred so uvrščene tiste katastrske občine, kjer delež sprememb ne dosega odstotka njihove celotne površine, s šrafurami pa so prikazane katastrske občine z različnimi razredi intenzivnosti sprememb.