Japan International Cooperation Agency (JICA)

Slovak Water Management Enterprise,
Branch Office Irrigation and Drainage (SWME-ID)

The Slovak Republic

The Study for Sustainable Development of Agriculture in Zahorska Lowland and Protection of Natural Resources

Final Report

Main Report

March, 2003

Pacific Consultants International

AFA
JR
03-17

Exchange Rate (August, 2002)		
US$ 1.00	=	45.00 SKK
SKK 1.00	=	0.02 US$
US$ 1.00	=	119.0 Yen

PREFACE

In response to a request from the Government of the Slovak Republic, the Government of Japan decided to conduct the Study for Sustainable Development of Agriculture in Zahorska Lowland and Protection of Natural Resources and entrusted the study to Japan International Cooperation Agency (JICA).

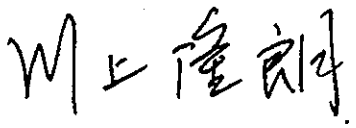
JICA dispatched a study team headed by Mr. Takashi FUJITA, Pacific Consultants International to the Slovak Republic, between June 2001 and January 2003.

The team held discussions with the officials concerned of the Government of the Slovak Republic, and conducted field survey at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of the regional agriculture and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials of the Government and those concerned in the Slovak Republic for the close cooperation they have extended to the study.

March 2003



Takao KAWAKAMI
President
Japan International Cooperation Agency

March 2003

Mr. Takao KAWAKAMI
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir,

We are pleased to formally submit herewith the Final Report of "the Study for Sustainable Development of Agriculture in Zahorska Lowland and Protection of Natural Resources. "

This report contains the Technical Guidelines for the promotion of sustainable agriculture in the Study Area and the Case Study applying the Guidelines to a selected area. The report has been prepared based on the advice and recommendation of the relative Ministries of the Government of Japan and JICA, as well as reflecting the comments of the Slovakian counterpart agency presented during the course of discussion on the Draft Final Report.

The Zahorska Lowland, which is located in the west end of the Slovakia, has good market access because of its location adjoining the capital Bratislava and border to Austria. Despite this fact, the agricultural production in this area has decreased due to the low fertility of sandy soil, which is dominated in the area, and malfunctioning of the irrigation systems developed in 1970's and 80's. Because agriculture has a large role in the regional economy, it is necessary to promote the development of agriculture by introducing appropriate farmland management in order to maintain the natural environment and rural society.

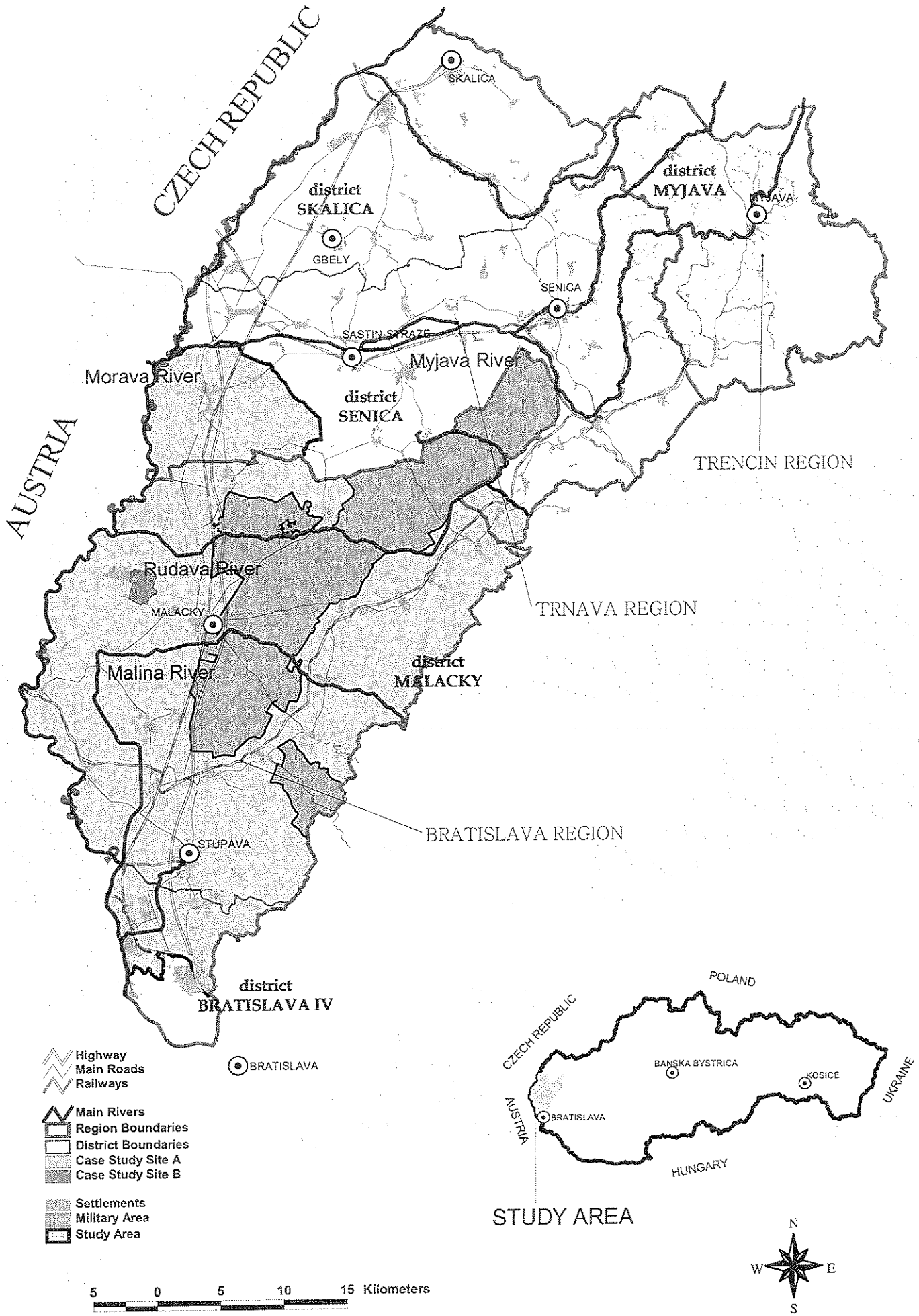
The Guideline includes land resource evaluation based on the combination of the soil condition and availability of irrigation, and expected countermeasures. The results of the Case Study are also shown in the report as an example of Guideline application. We hope that the Guidelines will be fully and effectively used for the promotion of regional agriculture and environmental conservation in the Slovakia.

We wish to take this opportunity to express our sincere gratitude to the officials of your agency, the Ministry of Foreign Affairs and Ministry of Agriculture, Forestry and Fisheries of Government of Japan and steering committee for their valuable advice and recommendations for the Study. We also wish to thank the officials of the Ministry of Agriculture of the Slovak Republic, Slovak Water Management Enterprise Branch Office Irrigation and Drainage and other related organizations involved in the Study for their devoted cooperation and support during the implementation of the Study in Slovakia.

Yours Sincerely,

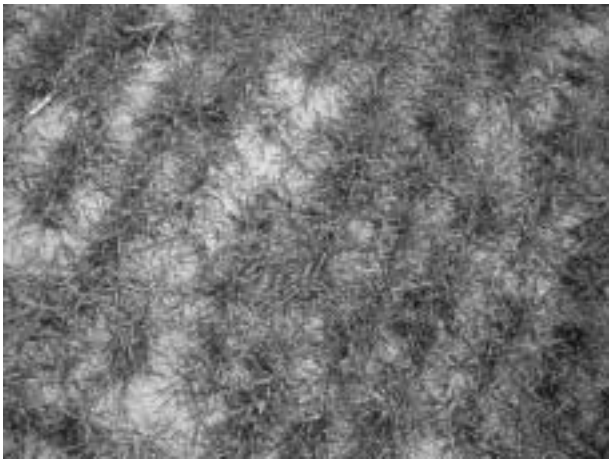
藤田 孝

Takashi FUJITA
Team leader
The Study for Sustainable Development of Agriculture in Zahorska Lowland and Protection of Natural Resources



LOCATION MAP

Harvesting wheat by a large-scale combined harvester



Condition of the plant cover with rye in the field in the early spring (April)

Ploughing before sowing summer crops

Bare field after ploughing for summer crops

Mulching in asparagus field in the early spring

Bare land due to water logging preventing germination and growing of crops.

Dolecky Pump Station, Gajary（P.St-12）

Remains of broken pump station. Pump was moved and windows were broken.

Sprinkler irrigation in wheat filed

Hose Reels

Drainage canal and outlet of underdrain in summer season. Half of outlet is buried in sand.

Inundation caused by drainage problem in maize field in summer time.

Overview of Male Levare Village

Interview survey with local residents

Interview with farmer in the field.

7th WorkShop - Operation and maintenance of Guidelines (September 2002）

1st Seminar on Guidelines in Kostlste with local participants (January 2003)

2nd Seminar on Guildlines in Bratislava (January 2003)

SUMMARY

1 BACKGROUND OF THE STUDY

1.1 BACKGROUND OF THE STUDY

In the Slovak Republic (hereafter referred to as “Slovakia”), dissolution and privatization of state enterprises and affiliation to the European Union have been set as the major objectives of the country, after the change of political and economic system. During the transition period, the production and productivity of agriculture have dropped due to the inadequacy of farm management in the market economy. The agricultural productivity of the Zahorska Lowland, which has severe natural conditions such as shortage of rain, has dropped due to reduced performance and efficiency of the irrigation systems. The Study aims to prepare technical guidelines that target the promotion of regional agriculture and the improvement of agricultural production in quantity and quality. The Slovak Water Management Enterprise (state enterprise) Irrigation and Drainage Branch Office (hereafter referred to as “SWME-ID”) is the counterpart agency. The guidelines will be based on suitable soil and water management techniques that optimize the management of irrigation and drainage systems and land use management, thus promoting sustainable agriculture in the area.

1.2 CONTENTS OF THE REPORT

The Study Area shall cover the Zahorska Lowland of 611 km^2 (including 429 km^2 of agricultural land), which spreads to the north of the Capital Bratislava in the western Slovakia and is surrounded by the Morava River, the border with the Czech Republic, and the Carpathian mountains.

2 AGRICULTURE OF SLOVAKIA

2.1 CURRENT AGRICULTURAL CONDITIONS

<Contribution of Agriculture to GDP and Employment>

The importance of agriculture in Slovakia's economy has decreased relatively. The contribution of agriculture to the GDP was 3.6% and the contribution of agriculture to employment was 4.3% (in 1999). The gross output for farming in Slovakia decreased rapidly in the four years after the change of economic system, from 80 billion SKK in 1990 to 50 billion SKK. Then there was a gradual recovery until 1997, when it started to decrease once again. The collapse of the livestock farming sector had a greater influence on the decrease of gross output of farming after 1997.

<Major Indices of Agricultural Land Use>

Agricultural land in Slovakia covers 1.46 million ha, which is the second smallest after Slovenia in the CEFTA (the Central European Free Trade Agreement) countries. The ratio of irrigation area to the agricultural land is 12.2% in Slovakia, which is the second highest after Romania in the CEFTA countries and is similar to the 16.6% average of the 15 countries of EU (EU-15). However, the irrigation area of Slovakia declined rapidly from about 300,000 ha in 1993 to 178,000 ha in 1999, due to continuous shortage of finance.

<Structure of Agriculture in Slovakia>

Half the total cultivated area in Slovakia is used for cereal products. More than 22% of the sown area is used for feeder products, and 15% for oil-plants. Potato is considered a basic food crop as well as cereal in Slovakia, but potato cultivation occupies only 2% of the sown area. In the sale of agricultural products, about one-third comes from crop products, while animal production contributes two-thirds. Mixed farming based on cereal production and livestock farming is fundamental to Slovakian agriculture as in other European countries.

<Agricultural Inputs>

The use of chemical fertilizers in Slovakia decreased from about 300,000 tons in 1991 to around 100,000 tons in 1993 during the confusion of the economic changes. This level has been maintained since.

<Farm Structures>

After the system changed in 1989, agricultural production cooperatives were privatized, and have been changed into various corporate farming organizations. Restitution of agricultural land also occurred, though it is not common for landowners to use the restituted land themselves, and most of this land is leased to agricultural enterprises to be cultivated. The annual lease fee is estimated at 0.75 to 1.0% of the evaluated land price. Landowners can make use of their rights to transaction and tenancy of land. In addition, it is possible to change the registered land use purpose with the approval of the cadaster office.

2.2 POLICY AND PLAN OF AGRICULTURAL DEVELOPMENT

Policy and plan of agricultural development in Slovakia is described in "The New Concept of Agriculture and Food Policy of the Slovak Republic until 2005" which was published by the Ministry of Agriculture in December 2000. "The Concept" was adopted with the following objectives:

i) To intensify the search for solutions to the accumulated problems resulting from the process of transformation and consolidation of the agricultural food sector,

ii) To harmonise the Slovak agricultural policy with the Common Agricultural Policy of the European Union,

iii) To respond to the liberalization of the global agro-food trade and

iv) To increase the competitiveness of the Slovak agriculture and food industry in comparison with other countries.

2.3 AGRICULTURAL SUPPORT SYSTEM IN SLOVAKIA

The agricultural subsidy in Slovakia comprises two categories, one is the support to agriculturally disadvantaged areas such as mountainous and low productivity areas, and the other is the subsidy for the agrarian and food industry, which does not have any limitation on location. The subsidy for agriculturally disadvantaged areas aims to compensate for lower revenues from crop production and it is defined according to the official land prices. On the other hand, subsidies for the agrarian and food industry comprise 1) market regime, 2) general services, 3) environmental agriculture, and 4) modernization and support of structural change in agriculture (Capital Investment). For example, there are 500 SKK/ha subsidies for production of cereals and 70% of irrigation costs are supported.

3 STUDY AREA

3.1 DEFINITION OF STUDY AREA

The Study Area, Zahorska Lowland, is located on the Slovakian territory of the Vienna Basin. It looks like an inverse triangle with a total area of 611 km^2, enclosed by the Morava River in the West, by the Myjava River in the North and by the foot of the Male Karpaty in the East. The Study Area comprises the Malacky District, which dominates the natural, social and agricultural conditions of the Zahorska Lowland, and the Bratislava IV and Senica Districts. 32 towns/villages are included in the Study Area.

3.2 SOCIO-ECONOMIC CONDITIONS

<Demography and Sectoral Structure of Employment >

In the Study Area, the total population was about 95,000 at the end of 2000. The population densities of each district are very different between 414 per km^2 at Bratislava IV to 96 per km^2 at Malacky and 50 per km^2 at Senica.

	National	Bratislava IV	Malacky	Senica
Population density (person/km^2)	110	414	96	50
Ratio of agricultural sector in the whole employment sector (%)	7.95	0.46	14.38	15.94
Average wage of employee (Indices to the national average)	100	129	99	93
Average wage of employee of agricultural sector (Indices to the average of whole sectors)	79	63	97	90

<Unemployment Rate>

Percentage unemployment at the end of 2000 was 17.9% for the national average. Bratislava IV district showed 4.6%, which was the lowest percentage in Slovakia because of its position as a suburb of the capital. Malacky and Senica districts showed 14.0% and 16.2% respectively, which were also lower percentages than the national average. The unemployment rate shows great variation between municipalities in the both districts.

<Regional Economy>

The share of agriculture, forestry and fishing in the GDP of the Bratislava region is as low as 1%, because the region includes the capital Bratislava. An industrial park named “Euro Valley” is planned and this is expected to play a significant role in the industrial development of the Malacky district. In the Bratislava IV district, owing to the proximity of the capital city of Bratislava, there are a lot of large scale industries represented by a car factory, which has investment from foreign capital.

<Individual Farmers, Restitution of Land and Household Plots>

Independent/private farmers are categorized as SHR in Slovakia. By the time the restitution of land started to take place in the 1990's, most farming families had lost their broad knowledge, techniques and experience of farming practices. Several individuals did try to start farming, but most of them found it hard to make an adequate living from this activity. Part-time farming work and house plot farming remain, but most of the restored farmland was leased to private enterprise. Since the socialist period, it is common in rural areas of Slovakia for people to have small household plots near their house and to grow a few vegetables and keep livestock. These agricultural products are used for home consumption and/or informal trade, and these activities, in effect,

supplement household income and are an important element of rural livelihoods.

<Natural Conservation Areas and Land Use Regulation>

Protected Landscape Areas are widely distributed beside the Morava River and occupy one third (200km^2) of the total Study Area. In such areas, development activities such as expansion of the agricultural fields and construction of irrigation and drainage facilities are restricted. Also, approval by the natural conservation body managed by the Ministry of Environment is required to use agricultural chemicals and fertilizer in any area larger than 2 ha. Restrictions on amounts of agricultural chemicals and fertilizers are not yet agreed but it is under discussion in the preparatory work for EU accession and might be agreed in the future.

3.3 NATURAL CONDITIONS

<Soil Conditions>

Sandy soils are dominant in the Study Area. They cover 60% of agricultural land, and have the characteristic of sand deposits in the surface or subsoil. In the fan of Male Karpaty, a better-fertilized soil could be observed in limited places. However, the sandy soil causes serious problems to farming activities in the area with thin fan deposits or slopes with exploded sandy soil layers. Because of this, the area with Eutric regosol and Fluvic deposits has been developed for cultivation where it is enclosed by the central hilly area, Morava River and the foot of Male Karpaty. In such a relatively fertile area, sandy soil problems occur where the surface is sandy, such as loamy sand or sandy loam, or a sand bed is found in the subsoil layer. The alluvial deposit developed along the Morava River is generally rich in clay, so that it is said to be the most suitable area for cultivation in terms of soil fertility.

<Meteorology and Climate>

The annual precipitation of the Study Area is 583 mm and it varies from 28 mm in January to 76 mm in June according to the averages from 1981 to 2000. These 10 years were considered to be a period of high annual precipitation, when even the 2~3-year frequency drought observed in 1994 had an annual precipitation of 523 mm. However,

the precipitation during the vegetation-growing period varies widely from 264~536 mm, and several droughts occurred, i.e., 10-year frequency droughts in 1992 (264 mm) and 2000 (269 mm), a 3~5-year frequency drought in 1994 (290 mm), and a 2~3-year frequency drought in 1991 (313 mm).

<Condition of Major Rivers and Water Resources>

The total catchment of Morava River is 26,580 km^2, and Slovakia occupies 2,228 km^2 of it, that is equivalent to 8.6% of the whole river basin. In general the amount of water increases from March to April, and decreases from August to October. The major source of surface water is Morava and its major tributaries in the Slovakian part of the lower Morava Basin. To supplement them, 24 reservoirs were constructed and the total effective capacity is about 5 million m^3. In the Study Area, there is one (1) large-scale reservoir and six (6) small-scale ones with a total effective capacity of 3.28 million m^3. Groundwater is plentiful and represented about 70% of total water use in 2000. In general, surface water is used for agriculture, including irrigation, and industrial use. Groundwater is used for domestic and industrial purposes, and is not used for agricultural activity.

3.4 AGRICULTURE

<Agricultural Land, Cultivation Area and Productivity of Main Crops>

The areas of farmland and cultivation in the Study Area are 42,931 ha and 32,889 ha, occupying 50.9% and 39.0% of the total area respectively. 80% of the agricultural land of the Study Area is in the Malacky District. The planted ratio (planted area / arable land) of Malacky decreased slightly in recent years. Accompany with that, the cultivated areas of cereals decreased rapidly from 15,158 ha in 1997 to 12,202 ha in 2002. Both the cultivated area and cultivation ratio have only increased for the oil crops. The cereals such as wheat, rye, and maize (including for feed) always account for around 60% of the cultivation area, and feed crops (silage maize and alfalfa) account for 20%. Of these cereals, most of the wheat, rye, grain maize and oats are cropped for animal feeds, and only spring barley is cropped for raw material for malt. The share of oil crops, like rape and sunflower, has increased recently. Vegetable crops include cabbage, carrot, and onion.

The unit yield of cereals reached a high level of about 6.0 ton/ha in 1989 on average for the whole country. However, after the change in the social system, it became difficult to continue production with high inputs, regardless of profit, in the same way as before. Thus, as a result of the decrease in irrigation and the amount of fertilizer used, the unit yield has been deteriorating year by year and has become less than 4.0 ton/ha in recent years. In 2000, less than 3.0 ton/ha was recorded because of the unusual drought.

<Farming Structure>

In the Study Area, there are three types of management of farming unit, i.e., cooperative, enterprise and individual private farm (SHR). In addition, there are a lot of small gardens. People carry on their private farming activity on a small scale but they are distinct from the registered farms such as SHR. Most of the cooperatives have changed to commercial enterprises or individual farmers. There is one (1) agricultural cooperative, which is reported to be undergoing liquidation as of September 2002, eleven (11) private farmers and ten (10) commercial enterprises, which occupy 97% of the total agricultural land. It is notable that several large companies occupy most of the farmland: the top six commercial enterprises share as much as 77% of the entire arable land.

The high percentage of leased land is one of the important features of agriculture in this area for both enterprises and SHRs. According to the Farm Unit Survey (JICA 2001), the average area of arable land in each enterprise is 2,300 ha, of which 95% is leased land on average. On the other hand, the average cultivated area in each SHR is 106 ha, of which 61% is leased land on average.

On average among the enterprises, the number of permanent employees is 67, seasonal employees is 190, and agronomist/engineers is 11, while the average labour force for family farming is 3 for SHRs.

In the capital structure of enterprises, the majority has their own capital, even though most land is leased. 10 enterprises were investigated in the Farm Unit Survey, and seven of these were managed with 100% of their own capital, and only a few cases had outside shareholders. One company had more than half of its capital provided by another national company while another had capital provided by a foreign company.

<Farm Management Category>

Farm management in the Study Area is categorized into three types, i.e., 1) mixed farming of cereal production with livestock farming, 2) mixed farming and other profitable crop production, and 3) combination of cereals, oil crops, vegetables, and processing.

Farming Type and Number in the Study Area

Farming Type	Number
Mixed Farming of Cereal Production with Livestock Farming This is a fundamental farming type of the Study Area as well as the whole country. In mixed farming, low profitability of crop production is compensated for by livestock farming. Crop production functions to support livestock farming by providing self-supplied feed.	5
Mixed Farming and Other Profitable Crop Production To stabilize mixed farming, profitable crops such as oil crops, i.e., rape and sunflower, and vegetables such as potato, cabbage, carrot and onion, etc. are added to the mixed cropping as supplementary production.	7
Combination of Cereals, Oil Crops, Vegetables, Processing, etc. Profitable crops such as oil crops, vegetables, fruits, etc. are also produced in various combinations without the mixed farming. Such combinations divide into 2 types according to their objectives. One aims to avoid animal production which requires a large amount of initial capital and is time consuming work, and the other aims to provide large amounts of self-supply raw material such as vegetables to private factories.	6

<Income Structure of Mixed Farming>

The profit of cereal feed production such as wheat is quite low or only compensates for the direct cost. Feed is the most costly item in the farm management of the livestock sector, and it represents 34.9% of the total cost in milk production, 51.8% in cattle breeding, and 62.0% in pig breeding. Cereal production, for use as feed, cannot be a major income generator in farm management, and its main function is to support the livestock sector, which generates most of the income. A decrease in production costs of feed should, therefore, contribute to improved farm management in the mixed farming of cereal production with livestock farming.

<Livestock Production>

In the Study Area, milk production is generally carried out by large-scale enterprises. The average number of milk cows in one enterprise is 670 and milking is not done by SHRs. The average annual milk yield per cow is about 4,500 liters, which is lower than the 8,000

to 9,000 liters yield in Austria and other Western Europe countries. Cattle breeding is carried out by both enterprises and SHRs. The average number of holding cattle is about 500 in enterprises but is only 10 in SHRs. Pig breeding is also carried out by both enterprises and SHRs.

<Marketing System of Agricultural Products>

The marketing system is under development at present. There are a lot of cases where the large-scale traders procure the cereal directly from producers in the Study Area. Generally, oil crop and raw materials are cultivated by contract with a processing company. Contract cultivation has started to extend to the vegetables market for processing. Because a wholesale market does not exist for vegetables and potato, farmers/enterprises sell their products to local traders or they are sold in the retail market by the farmers themselves.

<Agricultural Support Service>

Most of the qualifying applicants received the agricultural subsidy in Malacky district in the year 2001. The subsidy request for the purchase of irrigation equipment, such as hose reel, was also paid. Because the budget is not big enough to satisfy all the applications, the subsidy could not be obtained after the budget was spent, even though applicants qualified. Many local farmers think the payment of subsidy is not assured because there were many cases where the subsidies were not paid even though the applicants satisfied the qualifications.

<Agricultural Information Service>

Farmers generally collect necessary information from private dealers of seed, machines and equipment, etc. It was also observed that companies hired private agricultural consultants. The MoA changed the system of agricultural extension service to the Technical Guidance System, which operates by the farming units hiring registered private advisers for which the government provides subsidies.

<Agricultural Credit>

Agricultural loans are supplied by commercial banks because a public agricultural credit system does not exist in Slovakia. However, the government is assisting the farmers with interest payments on finance from commercial banks. The actual interest rate is between

11% and 12.8%, when assistance is applied for. Most farmers/enterprises have difficulty obtaining agricultural credit, in many cases, due to difficulty with providing collateral.

3.5 IRRIGATION

The present Study Area is equipped with 21 irrigation systems covering an area of 16,224 ha. 60% of the irrigated crop is grain, such as wheat and barley, with the balance shared by sunflower, maize, potato, and vegetable. In the irrigation plan, the capacity of the pump equipment and pipeline network, including water permission, is designed to cover 40% of the commanded area, based on the crop rotation system for a combination of summer crops and winter crops. During the period from 1994 to 2001, the irrigation area dropped to an average of 1,740 ha, with the utilization ratio standing at 10.7%. The main reason may be that the farming body, which has developed from a state farm or cooperative farm, is implementing economic farm management after the change in the economic system. The only crops currently irrigated are asparagus, potato, sunflower, vegetables and alfalfa, for which irrigation is very effective.

All systems are composed of a pump and pipeline network, and sprinkler irrigation, using pressurized water with big reel-hoses, is widely used for field irrigation. The irrigation facilities are state assets from the water intake to the terminals (hydrants), and managed by the SWME-PD. Management of 13 of their irrigation systems is entrusted to private water supply companies. Field irrigation equipment beyond the hydrants is provided and managed by farmers themselves.

Pumping facilities are not well utilized due to damaged or lost parts. According to the evaluation of the irrigation systems, the irrigable area in category I, in which the irrigation systems are used or repaired easily, is 9,980 ha which corresponds to about 60% of whole irrigable area.

There are also problems caused by both management and technique. The irrigation user should prepare field irrigation equipment. However, introduction of new equipment or replacement of obsolete equipment is not carried out well. This shortage of facilities is one of the major constraints on irrigation use. Furthermore, 93% of the irrigation facilities

are sprinkler systems with big reel-hoses. Most of them were designed for large scale farming during the socialist period, so they are suitable for cereal production, but cannot be used for vegetables and fruit due to the high hydraulic pressure. It is expected that small-scale irrigation or irrigation systems suitable for intensive farming will be required.

3.6 DRAINAGE

The bank of the Morava River is now being improved to cope with a 100-year frequency flood by 2003. Damage by flooding or inundation will thus be prevented in the Area. In the basin to the west of this area (17.56 km^2), which is a pumping drainage zone, water is fed by two pump stations into the Morava River. Those pump facilities were renovated recently and they work effectively. Although no areas suffer serious damage, flooding and inundation occur every year, small pools were observed in depressions and/or poor drainage areas which suffer from high groundwater.

In the present study area, underdrains cover about 10,572 ha, which is 34% of farmland. 40% of them do not function well according to SWME-PD, and it is said that this figure is increasing by about 4 to 5% annually.

4 CONCEPT OF GUIDELINES

<Current State of Regional Agriculture>

Agriculture in the Zahorska Lowland is struggling with stagnation/devastation, which is a complex combination of the decrease of irrigation and fertilizer application, the decrease of agricultural production and unit yield, and the deterioration of the profitability of farmers/ agricultural bodies who cannot respond to the changes in the economic system. The stagnation/devastation of agriculture in the Zahorska Lowland can be said to be caught in a negative chain; the deterioration of profitability, which has originated from low productivity and low prices for domestic agricultural products, has caused a reduction in the investment incentives of farmers, which causes a further decrease of productivity by reduction of irrigation and fertilizer application.

This negative chain can be solved by creating efficient farm management taking into

account the natural and social environment. The approaches shown below are proposed to break the negative chain.

- Conversion of the present agricultural system to a more efficient one by realizing rational land use, considering land conditions and using regional resources in agriculture effectively.
- Promotion of intensive farming with proper irrigation and fertilization on appropriate land by maintaining and improving existing facilities.

<Purpose of Guidelines>

The purpose of the Guidelines is to help to promote and improve regional agriculture quantitatively and qualitatively. The Guidelines provide technical countermeasures as an optimal package for the soil and water management program of the Zahorska Lowland. They target a regional agriculture that is “realizing agriculture to cope with both the stability and sustainability of farm management and the sustainable development of the natural environment and rural society, based on rational land use”.

<Target Area of Guidelines>

In the Guidelines, the Zahorska Lowland is defined, in the narrow sense, as the target area limited to the left bank of the Myjava River excluding the military zone. However, they can also be used in the remaining area because there are a lot of common issues.

<Users of Guidelines>

The users of the Guidelines are expected to be composed of the following three groups:

- Officers in charge of planning the regional agriculture or controlling the agricultural infrastructures such as irrigation and drainage systems,
- Technical advisers belonging to the Agricultural Chamber or registered in the Agricultural Advisory System, who connect enterprises/farmers to the technical support system,
- Managers and agricultural engineers of enterprises and individual farms, who are in charge of planning the farming and farm management.

<Scope of Guidelines>

Even though the animal husbandry sector is important and indispensable to the promotion of regional agriculture, the Guidelines concentrate on the improvement of crop cultivation in quality and quantity and do not treat the technical matter of animal husbandry directly. However, coordination of crop cultivation and animal husbandry is discussed in the Guidelines from the aspect of improving crop cultivation, such as organic recycling to fields using manure and compost, maintaining grazing and improving the fertility of farmland.

<Composition of Guidelines>

The Guidelines is composed by 3 components; the text of the Guidelines, the Case Study Report and the GIS database. The text of Guidelines comprise 1) concept of guidelines, 2) current situation and future of regional agriculture, 3) land resources evaluation and expected cultivation type/land use, 4) formulation of water and soil management program, and 5) technical guidelines.

5 CURRENT SITUATION AND FUTURE OF REGIONAL AGRICULTURE

5.1 ZONATION AND CURRENT SITUATION

In consideration of the geographic features, soil fertility, possibility of irrigation, and distribution of farm management and farming types, the following four (4) zones were established.

Zone-I	Fan of the Male Karpaty (The eastern part of the Study Area)
Zone-II	Malacky Plain (The central part of the Study Area)
Zone-III	Flood Plain (The western part of the Study Area)
Zone-IV	Suburbs of Bratislava Town (The southern part of the Study Area)

5.2 FUTURE OF REGIONAL AGRICUTLURE

<Direction of Future Regional Agriculture>

In examining a picture of regional agriculture in the future, the concept of regional agriculture was examined and set as; *"Realizing agriculture to cope with both the stability and sustainability of farm management and the sustainable development of natural environment and rural society, based on rational land use"*.

- Improvement of farm management through efficient use of available resources of agriculture, such as farmland, funds, infrastructures, agricultural input, etc.
  - Concentration and optimal distribution of resources of agriculture.
    - Effective use of existing infrastructures represented by irrigation systems.
    - Maintaining/increase productivity by applying appropriate irrigation and fertilizer on appropriate land.
    - Abandonment of unreasonable agriculture on unsuitable land and change to reasonable and sustainable land use.
  - Economizing on the consumption of resources of agriculture.
    - Promotion and intensification of organic matter recycling in agriculture.
    - Optimization of cultivation technology and water management technology.
- Introducing agriculture which takes into account conservation of the natural environment.
  - Land use appropriate to the natural environment.
  - Farming appropriate to land conservation.
- Introducing agriculture which takes into account the need to maintain rural community and livelihood (that is to say agriculture having low negative impact to rural community and livelihood).
  - Development of farming types corresponding to the scale and management of each farm, especially for small and extra-small farmers.
  - Stable and sustainable management of agricultural enterprises contributes to

maintaining rural livelihood by providing job opportunities.

<Expected Regional Agriculture in Future>

The typical farming type in the Study Area at present is a combination of livestock farming and cereal cultivation that supports livestock farming though feed supply. Cultivation of oil crops or other raw material crops (and vegetables in some cases) is also combined on appropriate land. In the farm types represented, the combinations of crops and the proportions of crops vary depending on the scale and type of farm. The typical farming types in the future are expected to be basically the same as the present ones.

Three aspects are pointed out as important subjects when examining the future of agriculture in the area, i.e., 1) livestock farming is the major income generator of the faming unit, 2) cereal cultivation supports livestock farming by supplying feed, and 3) cash crop production. The future of crop production should be discussed from two different viewpoints; the improvement of crop production itself and the contribution it makes to livestock farming. The contribution of crop production to the livestock sector, improvement of productivity through improving quality of feed and cost reduction through improving efficiency of feed production, are to be examined.

When deciding on the planted crop or production volume in the farming plan, farming units consider the necessity of feed in livestock farming principally, and cash crops are planted in the remaining farmland after securing necessary feed production. Each farmer or agricultural body must seek the optimal combination and proportion considering their conditions of management type, scale, available farmland, available resources, etc.

- Promotion of oil crops and raw materials cultivation in appropriate land for large-scale farms.
- For small farms, promotion of intensive crops like vegetables in appropriate land within the capacity of the labor force, in addition to promotion of oil crops and raw material cultivation in appropriate land.
- Small-scale farm specialized in intensive vegetable cultivation.
- Raw materials cultivation with specified destination or self-consumption.

<Approach to Expected Figures from Crop Production>

In the process of realizing rational agriculture and land use appropriate to the land conditions, agriculture corresponding to the characteristics of the area should be promoted. In consideration of the natural and socio-economic conditions, the status of infrastructures and the condition of present agriculture in the area, 6 cultivation types are proposed. They are expected to be applied to areas in an appropriate combination.

Cultivation type	Expected cultivation and farming activity
Cultivation of Highly Profitable Crops Using Irrigation	Highly profitable cultivation is enabled by proper irrigation and fertilizing. This type will be carried out in areas with functioning irrigation systems or the possibility to repair them economically, even if malfunctioning at the moment, in order to use existing facilities effectively.
Cultivation of Highly Profitable Crops (without Irrigation)	Highly profitable cultivation with proper fertilizing in suitable areas where there is abundant soil moisture and fertile soils. The management of soil fertility and moisture is important in this type.
Cultivation of Crops Considering Protection of Natural Environments	Even in the Protected Landscape Area along the Morava River, there are private farms and farming on the fertile soil. Low environmental stress agriculture using the natural condition as it is, needs to be promoted in this area.
Cultivation of Crops Considering Maintenance of Soil Fertility	This type is aimed at low cost production of feed for animals by improving efficiency of cultivation. Proper soil fertility management techniques such as organic matter recycling or proper field rotation using soil-resting crops will be applied based on the combination of crop production and livestock farming. Techniques and countermeasures proposed for this type also apply to other types as a component of effective soil management.
Cultivation of Crops Considering Land Conservation	Cultivation types need to take into account the fragility of the farmland, the necessity of protection from natural damage such as wind and water erosion, and maintaining the function of existing field drainage. The techniques and countermeasures proposed apply in fields where a risk of damage or other constraint is expected.
Intensive Cultivation of Vegetables/Fruits Using Irrigation	Vegetables and fruits cultivation using irrigation in the appropriate farmland. This type requires intensive cultivation. Vegetable/fruit cultivation contributes to the diversification of farm management on the large-scale farms. On the other hand, small-scale farms are able to seek high profitability by concentrating on intensive vegetable cultivation.

6 LAND EVALUATION AND EXPECTED CULTIVATION/LAND USE

6.1 LAND RESOURCE EVALUATION

<Basic Concept of Land Resource Evaluation>

The Guidelines propose land resources evaluation, which can express adequately the characteristics of sandy soils that are typical for Zahorska lowland. Because of the frequent occurrence of sand deposits with similar climatic and geological conditions and parent material, the clay content of the soil is a key determinant of soil fertility.

As regards land suitability for cropping, an area of poor sandy soil might be specified as marginal for cropping because of severe restrictions caused by the natural conditions. In such areas, some might be judged unsuitable for cropping as far as the land potential, impact on natural resources or economic balance is concerned. In some places, a particular cultivation method is required because of the natural conditions. The evaluation system will give priority to the identification of such areas in the Guidelines.

The land resources evaluation in the Guidelines comprises three aspects, i.e., 1) agricultural productivity based on soil conditions, 2) irrigation potential, and 3) restriction caused by necessity of land conservation or socio-economic conditions.

<Agricultural Productivity>

Based on the existing soil database and the assessment of agricultural productivity, soil conditions are to be classified into three categories, and then each category will be divided into 2 classes taking into account soil moisture conditions, mainly the moisture holding capacity.

Soil condition	Major soil type	Major soil texture	Existing land productivity category	Note
Good (A)	Loamy clay to sandy loam	Heavy ~ medium heavy soil (lighter)	A1~A3	
Middle (B)	Loamy clay to sandy loam	Heavy soil ~ medium heavy soil (lighter)	A4~A6	Limiting factors are perceived in cultivation condition
	Sand and sandy loam	Light soil	A2~A4	Fluvic Gley Phaeozem
Low (C)	Sand and sandy loam	Light soil	A6~A7	Eutric Regosol
	All types	all	A7 AG G	Heavy, limiting factors are perceived in cultivation condition and field condition

Category of the existing land productivity evaluation

A: Suitable for arable land (1^{st}~7^{th} grade: 1^{st} grade has highest productivity)

AG: Suitable for arable land in the condition of alternative use

C: Suitable for grassland (not suitable for cultivation)

<Irrigation Potential>

Due to the low and unstable precipitation as well as the low water retention capacity of sandy soils, irrigation has a dominant influence on crop productivity and its stability in the Area. Thus, it is also important that irrigation availability is included in the land resource evaluation. Irrigation potential is evaluated and classified into two categories, i.e., 1) irrigation is available (existing facilities are available or easy to recover) and 2) irrigation is not available.

<Other Restriction Factors>

Restriction of farming activity due to the necessity of farmland conservation, which is difficult to reflect in land productivity or irrigation potential, will be taken into account as one of the major factors for land resource evaluation in the Guidelines. The reason is that specific restrictions due to the necessity of farmland conservation may determine a possible farming and cultivation type on such land. In the Guidelines, the restrictions due to necessity of farmland conservation are 1) restriction due to wind erosion, 2) restriction due to inundation, 3) restriction in the area equipped with underdrains.

The restricting factors in land use and agriculture are not only due to farmland conservation, but are also influenced by the socio economic condition. In the Guidelines, restrictions due to socio-economic conditions will be considered such as 1) land use

regulation in natural reserve areas and 2) competition with other sectors and restriction of enlargement of farming scale in the Bratislava suburb area.

6.2 OVERALL EVALUATION OF EXPECTED CULTIVATION / LAND USE

The expected cultivation and land use were classified according to the soil fertility and water availability in each zone along with the consideration of the current farming situation and social conditions. The areas with land conservation restrictions are scattered so these issues are listed by zone.

7 TECHNICAL GUIDELINES

Subject	Item
1. Land resources evaluation and appropriate land use	1.1 Land resources evaluation 1.2 Evaluation of present land use 1.3 Appropriate land use though land resources evaluation and land use evaluation
2 Irrigation	2.1 Identification of areas where irrigation systems can be utilized 2.2 Rehabilitation of facilities 2.3 Strengthening operation and maintenance 2.4 Improvement of the functions of facilities 2.5 Improvement of water management 2.6 Provision of irrigation equipment meeting requirements of cultivation 2.7 Improvement of field irrigation systems to cope with intensive agriculture 2.8 Establishment of water-saving technique
3 Drainage	3.1 Evaluation of land resources in terms of drainage measures 3.2 Maintaining development regulations in the protected landscape area 3.3 Guideline for drainage improvement 3.4 Rationalization of operation of drainage systems 3.5 Rehabilitation of drainage facilities 3.6 Regular monitoring of the conditions of canals 3.7 Introduction of a crop planting system based on the evaluation of land resources
4 Soil conservation	4.1 Specification of dangerous areas of wind damage and erosion 4.2 Preservation and afforestation of windbreak forest and tree belt 4.3 Plant cover

Subject		Item
5 Soil moisture manage -ment	5.1 Field drainage	5.1.1 Management plan of drainage canals 5.1.2 Coordinated management of both drainage canals and field underdrains 5.1.3 Maintenance and management of underdrains 5.1.4 Improvement of field drainage 5.1.5 Improvement of field drainage management
	5.2 Improvement of water retention capacity of soil	5.2.1 Mulching 5.2.2 Non till farming 5.3.3 Reclamation of sand bed 5.2.4 Mud dressing
6 Soil fertility management		6.1 Use of recycled organic matter 6.2 Grass land farming 6.3 Grazing farming 6.4 Organic farming
7 Crop cultivation techniques		7.1 Introduction of cropping pattern suited to land characteristics (right crop for right land) 7.2 Selection of appropriate crops 7.3 Improvement of cropping system by farming type 7.4 Improvement of fertilization 7.5 Intensive irrigation of summer crops and leafy crops 7.6 Cultivation techniques of vegetables and fruits 7.7 Management of meadows 7.8 Weeding and plant protection
8 Farm management		8.1 Technical guidelines for major farming pattern 8.2 Reduction of farming costs and increase of profits
9 Other recommended measures		9.1 Agriculture supporting services 9.2 Soil pollution

8 TECHNICAL MEASURE AND ENVIRONMENTAL CONSERVATION FROM N-FLOW

It is convenient to use the scheme of N (nitrogen)-flow as a tool to understand the positioning and relations of proposed technical measures in environmental conservation. The major relations are pointed out below:

- To reduce the dependence on chemical fertilizers and the load to environments by increasing the recycling of N compounds, although an appropriate amount of N fertilizer will actually be increased.
- To increase the ratio of N fixation by leguminous crops by promoting leguminous crops such as alfalfa in crop rotation.

- To increase N recycling by promoting manure application in the field. To promote use of liquid wastes as liquid manure from viewpoints of efficient and stable consumption of animal wastes.
- To increase absorption rate of nutrient by crops through improving cultivation management considering leakage of N and improving fertility holding capacity of soil, because fertilizer element is easily leak to groundwater in sandy soil.

9 OPERATION AND MAINTENANCE OF GUIDELINES

SWME-ID is suitable to be the responsible organization of the operation and maintenance of the Guidelines. At that time, it is necessary to strengthen the function to communicate with farming entities. In addition, a lot of organization/personnel is necessary to concern with the operation and maintenance because the required activities extend widely over information flow, coordination with farming entities, technical support to farming entities, etc. The committee for the operation and maintenance of the Guidelines is proposed to set up inside of SWME-ID with participation from concerned organizations. The following organizations should be candidates for the committee membership.

- Institutes holding various information through regular contact with farmers and institutes holding knowledge of irrigation and drainage: SCAF, Bratislava Region Office of Ministry of Agriculture, SWME-PD, SWME-ID
- National organization supporting Operation and Maintenance of the Guideline: Ministry of Agriculture, Ministry of Environment
- National organization in charge of regional development: Ministry of Construction and Regional Development
- Body familiar with regional conditions through regular maintenance of the irrigation and drainage facilities: Maintenance companies
- Users of the Guideline and farmers familiar with condition of farmlands: Representative of farmers

10 FORMULATION OF WATER AND SOIL MANAGEMENT PROGRAM

The Guidelines will be applied on site by formulating a site-specific soil and water management program. The soil and water management program is defined as “a program, which presents the optimized combination of technical countermeasures according to priorities when each site tries to solve problems and improve agricultural productivity”.

The components of water and soil management programs are divided into two levels, as mentioned above, the regional and field levels. The components belonging to each level are to be planned and implemented by different groups of people. The program at regional level is to be planned by administrative bodies or public organizations and to be implemented as public works. On the other hand, farmers or agronomist/engineers of enterprises will include the program in their farm management plans and implement it in their farming activities, with the support of technical advisers. Although both programs are planned and implemented separately, a close coordination is important because the two components have a close mutual relationship.

11 CASE STUDY

11.1 OBJECTIVES AND SITES OF CASE STUDY

The case study was conducted with the purpose of reinforcing the Guidelines through detailed investigation and examination in a limited area, and with the purpose of helping user’s understanding by introducing ideal case of using the Guidelines. Two sites, i.e., Site-A, of which area is around 3,000 ha, in the Male Levare and Velke Levare villages and Site-B, of which area is around 400 ha, in the Gajary village were selected for the case study. The soil and water management plan of the case study site was formulated by 3 components; 1) farmland management, 2) irrigation and drainage management, and 3) cultivation and farm management.

11.2 SCENARIOS OF CASE STUDY

In the Case Study, the soil and water management plan for the area was formulated based on the proposed land resources evaluation and appropriate land use in the Guidelines, and the agricultural land use including crop selection and cropping pattern were examined. However, there are several restrictions or limitations to apply to the proposed farming in the field. The most significant limitation is the preparation of field irrigation equipment of farmers or farming bodies where irrigation farming is proposed. Even though the introduction of irrigation farming expects a high profit and farmers tend to introduce it, there might be some difficulty to prepare the initial investment for the equipment for some farmers or farming bodies due to the circumstance of financing. Also, the amount of investment shall be based on the management policy of each farmer or farming body. Therefore, some scenarios were set up differing in the investment level for field irrigation equipment such as reel hose system, which limits the area that can be irrigated. Basic concepts of each scenario are set out in the case study as follows:

Summary of Scenarios

Items	Unit	Scenario A	Scenario B	Scenario C
Irrigation				
Irrigated area	ha	856	403	185
Amount of irrigation water	1,000 m^3	1,999	864	438
Use ratio of capacity of irrigation system				
(Ratio of average monthly amount to pump capacity)				
Mare Levare -1 (Pump No.21)	%	72	21	10
Mare Levare -2 (Pump No.11)	%	91	68	26
Gajary (Pump No.12)	%	91	50	37
Number of necessary field irrigation equipment	pcs	59	30	17
Target crop of irrigation				
Vegetables		○	○	○
Sunflower		○	○	×
Spring Barley		○	○	×
Wheat		△	×	×
Maize		△	×	×
Alfalfa		△	×	×
Turf		○	○	○

○ Target Crop of Irrigation
△ Occasionally Irrigated Crop
× Out of Object of Irrigation

Scenario A: The available irrigation system is fully used so that the irrigation farming is expanded to a maximum. High profit farming based on irrigation will achieve the development of regional agriculture. In this case, around 850

ha are to be irrigated. Vegetables, sunflower and spring barley are the major target crops of irrigation, and wheat, maize and alfalfa will be irrigated as much as the capacity of irrigation water allows.

Scenario B: Intermediate investment level is assumed for this scenario between Scenario A and C. In this case, around 400 ha will be irrigated. The irrigation will be applied to vegetables and cash crops.

Scenario C: The existing field irrigation equipment, which is to be repaired if necessary, is used in the field, or small number of newly introduced equipment is expected. The irrigation will be limited to currently irrigated crops and to the most profitable crops such as vegetables to avoid a significant increase of initial investment and farming cost. In this case, around 180 ha will be irrigated.

11.3 FARMLAND MANAGEMENT

The farmland management treats land use plan based on the land resources evaluation, possible crop rotation and appropriate cropping pattern, soil conservation, water management of soil, and soil fertility management.

<Land Use Plan>

In the land resources evaluation in the case study site, the soils were categorized into 5 soil units in the Site A and 4 soil units in the Site B, based on the data assessment and field investigation. The land recommended for use as grassland is distinguished by the land category A-5 and B-4 in accordance with the land resource evaluation. In the Case Study area, there are 211 ha of land categorized as the land recommended for grassland, 47% (100 ha) of them are currently used for artificial meadows and it is expected they will keep their land use. The remaining 53% (111 ha) of the land are recommended to convert its land use.

Summary of Agricultural Land Use Plan of Case Study Area

(unit : ha)

Land use type	Site-A	Site-B	Total
Land for irrigation farming	869	363	1,262
Land for rain-fed farming	788	-	788
Land recommended for use as grassland	177	35	211
Total	1,834	398	2,232

<Possible Crop Rotation>

By combining the results of the land resources evaluation, limiting factors of firm fields and irrigation possibility, suitable crops and possible cropping pattern were examined by soil unit and cultivation plan was proposed for farming plots.

<Soil Conservation>

Preservation and afforestation of windbreak forest and tree belt will prevent wind damage or wind erosion permanently however it will take a long time and a large amount of investment. Thus, the introduction of cropping patterns considering the crop cover in the spring season by perennial grasses such as alfalfa or turf, winter crops such as wheat, rye and rapeseed, and some of the spring crops such as spring barley, was set as a major countermeasure to wind damage and wind erosion in the Soil Management Plan of the Case Study Site. In the case that the ratio of crop cover in spring is decreased because of promotion of irrigation, it is important to introduce the combination of countermeasures such as adjustment of seeding period of summer crops and leaving stubble and residue of last crop in the field as long as possible without interfering with sowing so as to reduce the period of bare field.

<Water Management of Soil>

In the case study site, expected areas of water logging (141 ha) and dry mounds (119 ha) were specified as permanent limitations to farmland. Because those limitations are considered impossible to solve in the short term, the farmland management plan is proposing to avoid decreases in production by reflecting the limitations in the proposed crop rotation; cultivating spring and summer crops in the water logging area to avoid negative affect of high groundwater level in the early spring or converting land use of dry mound area to grassland.

<Soil Fertility Management>

In the low and very low fertile soils categorized to A-3, A-4, B-2 and B-3 soil unit, alfalfa is promoted in the crop rotation as a soil resting crop. In the possible crop rotation proposed for the case study site, 53%~60% of farmland is expected to introduce the cropping pattern including alfalfa in each scenario. In addition, an effective use of recycling the organic matter produced in both field cultivation and animal waste is

promoted in the plan. The manure produced by animal waste is promoted mainly to improve low fertility sandy soils in Zone II in the case of the Study Sites. Because of the high cost of transportation and spreading of manures, the manure application is a priority for vegetables, asparagus, cash crops such as sunflower and alfalfa in the Case Study.

11.4 IRRIGATION AND DRAINAGE MANAGEMENT

(1) Irrigation Plan

In the Irrigation Plan of the Case Study, 3 irrigation systems, i.e., Sekule-Male Levare irrigation system, Kostoliste irrigation system and Dolecky irrigation system, are proposed to be recovered and irrigation farming are to be promoted positively in those irrigation area.

<Irrigation System>

In Site A, there are 2 irrigation systems, i.e., Sekule-Male Levare and Kostoliste irrigation system. The Sekule-Male Levare irrigation system relies its water source on the Laksarsky River and the Malolevarsky canal that takes water from the Morava River. Its gross area of irrigation facilitty is 759 ha and net irrigation avairable area is 590 ha. Water for the Kostoliste Irrigation System is taken from the Morava River. Under this irrigation system, water supplied from the Gajary Pumping Station which is boosted at the Kostoliste Pumping Station to irrigate a benefitable area of 4,407 ha, of which the case study area accounts for 372 ha (net irrigation area 294 ha). In Site B, Dolecky irrigation system covers the field. Water for Dolecky irrigation system depends on the Morava River; water is not taken directly from the river, but is similar to Kostoliste , which is boosting water at the Dolecky Pumping Station conducted from the Gajary. The total irrigable area of this system in question reaches 2,066 ha, of which 465 ha (net irrigation area 404 ha) is used for the case study area. Pump facilities of those 3 systems are in quite well condition and they are able to be used without any large-scale rehabilitation. Small-scale repair of pump facilities and repair and adjustment of hydrant and other valve equipment which have been left for years without operation are required to start operation.

<Irrigation Plan>

The irrigation area of each scenario is 856 ha for Scenario A, 403 ha for Scenario B and 185 ha for Scenario C in the Irrigation Plan. The irrigation target crops and water volume are shown in the Section 11.2.

<Irrigation Method and Facilities>

The target crops under an irrigation system in the case study area are vegetables, cereals, oleaginous crops, pasture, etc. Due to the fact that cereals and oleaginous crops are cultivated in large-scale lots and the farming system among these crops is similar, the same type of sprinkler can be applied. Generally speaking, sprinkler equipment available for irrigation systems are represented by: reel hose sprinkler, center pivot, lateral move and side-wheel sprinkler. In contrary, it is desirable that the irrigation to vegetables should be provided not by the sprinkler with high pressure but by one with medium or low pressure, because the plant body of vegetables is smaller and more fragile than cereals. Irrigation to root crops like carrot and onion may be provided by replacing the sprinkler nozzle of reel hose from high pressure type to medium pressure type. Due to the fragile plant body, the irrigation to leaf crops should be provided by a sprinkler with low pressure; it is advisable that the attachment of the sprinkler should be replaced by the arm spray sprinkler type.

(2) Improvement Plan of Drainage Management

As a result of an assessment on functioning and operation and maintenance of the drainage system, it is concluded that higher priority for improvement of the drainage system within the case study area should be given to five canals in Male Levare sector, a siphon installed at the lowest stream of the Laksarsky, outlet boxes of underdrains, etc.

11.5 CULTIVATION AND FARM MANAGEMENT

Profitable and stable farm management is expected by the combination of cultivation techniques according to the characteristics of firm filed.

<Fields in Zone-II>

In the field in Zone-II, an efficient farming is expected to be developed by appropriate crops and farming methods according to the characteristics of soil and land. The major farming methods to be selected are; selection of appropriate crops according to land conditions, development of crop-livestock mixed farming as the fundamental farming type, low cost input to cope with low productivity, etc. In the field irrigation system equipped, the combination of farming methods and techniques for high profitable farming using irrigation is important. High profitable cash crops or vegetables are positively selected for irrigation farming according to the land condition. Contract farming is to be expanded as to stabilize production and farm management and necessary input is to be invested.

<Field with High Moisture in Zone-II>

The combination of farming methods is selected in consideration with improving profitability. Even though this area has a possibility of drainage problems, the soil condition is relatively fertile in the sandy soils. The crop is to be selected considering this point. It should be pointed out that some of fields are not suitable for vegetable and winter crops due to drainage problems.

<Fields in Zone-III>

The fields in Zone-III have fertile soils and high productivity is expected there. However, careful cultivation management is necessary due to severe weed damage. Concentrated but limited application of herbicides and repeated and concentrated plowing are necessary for plant protection.

<Fields with Drainage Problems in Zone-III>

The combination of selection of resistant crops such as maize and sunflower, seeding of summer crops such as spring barley at an appropriate time in early spring, breakage of compact layers, etc. is necessary for avoiding damage by water logging. Winter crops are not suitable to this zone.

<Vegetable Growing Fields>

Farming method and techniques for improving stability and quality of product are combined so that contract farming would be expanded. Irrigation is key technique of this farming, however, the combination of effective fertilizer application, appropriate rotation of vegetable crops, consideration to micro nutrient, etc. is also important.

For the market-oriented and environment friendly farming, there are many requirements from consumers, while, from a farmers point of view, practical counter measures are limited due to economic conditions. What is important is to formulate stream-lined procedures in the agricultural development: to identify priority areas, select methods for target-cultivation and make preparations for the agricultural production.

11.6 PLAN EVALUATION

The direct or tangible benefit to be expected in the plan area is derived from the increased crop production attributed to a stable irrigation water supply and proper land management, crop rotation, fertilizer application etc. The evaluation were made through assessment of the project feasibility in view of financial and economic aspects.

Financial internal rate of return (FIRR) for Scenarios-A, B and C is very high as 242%, 101% and 57.8% respectively. In the Case Study Site, the present irrigation facilities were completed before 1985 and the costs are estimated mainly for the rehabilitation of those facilities. For the plan evaluation, only future returns to future costs are considered and the sunk costs are ignored. So, the future returns to the costs are very high. In addition, the high subsidy to agricultural production, represented by support to irrigation water charge, also supports those high values of financial indexes.

Results of Financial Evaluation

Particulars	Results		
	Scenario-A	Scenario-B	Scenario-C
FIRR (%)	242%	101%	57.8%
B/C Ratio	8.62	5.28	3.53
B-C (1000 SKK)	46,534	26,143	15,459

Based on the project costs and benefits estimated above, the results of economic evaluation are summarized below. As the results show, the plan is economically feasible with EIRR, 50.9% for Scenario-A, 16.6% for Scenario-B and 16.0% for Scenario-C. For reference, the discount rate since April 2002 is fixed at 8.25% (National Bank of Slovakia).

Results of Economic Evaluation (EIRR)

Particulars	Results		
	Scenario-A	Scenario-B	Scenario-C
EIRR (%)	50.9%	16.6%	16.0%
B/C Ratio	3.20	1.35	1.32
B-C (1000 SKK)	11,258	1,802	1,621

As discussed above, the rehabilitation of irrigation facilities and land management proposed in the Guidelines was evaluated to be economically and financially feasible from the viewpoint of the irrigation system. On the other hand, farmers or farming bodies are required to prepare the field irrigation equipment by purchasing or leasing in order to develop irrigation farming on their fields. The financial feasibility of investment of farmers in equipment was assessed from the viewpoint of their budget. FIRR for Scenarios-A, B and C is very high as 152%, 168% and 117% respectively under the condition of 70% subsidy for purchasing field equipment were obtained. Even the subsidy for equipment was not obtained due to the limitation of governmental budget, FIRR would decrease but they are still at the level of 22% ~ 30%.

11.7 CONCLUSION OF CASE STUDY

<Land Use Conversion and Sustainability of Farmland Use>

The land use conversion of arable land to grassland does not have economic advantage to farming bodies but there is an advantage in the aspects of sustainability of land use and protection of natural resources. Thus, it is necessary to operate the subsidy system for the grassland appropriately in order to promote land use conversion and secure its sustainability.

<Importance of Contract Farming in Marketing>

Securing marketing channels is an indispensable factor for promoting the major target crops of irrigation, i.e., vegetables, oil crops and raw material crops. The expansion of contract farming is considered as a key factor to promote irrigation farming.

<Economic Viability of Irrigation Recovery in the Case Study Site>

The recovery of the irrigation system in the case study area has an advantage of cost effectiveness because it is possible to recover and maintain its function with relatively low cost owing to the good present condition. As a result of economic evaluation in the case study, the irrigation recovery plan of Scenario A marked 50.9% of EIRR, and more than 16% of that in Scenario B and C.

<Increase of Farming Cost and Problem of Financing>

For the farmers/farming body side, the average farming costs are expected to increase to 1.5 times the current one in Scenario A according to the increase of irrigation farming, 1.3 times in Scenario B and 1.2 times in Scenario C, in accordance with the results of the case study. Contract farming becomes more important by lightening the load of farmers/farming bodies through support of agricultural input, equipment and financing.

<Necessity of Reviewing System of Irrigation Water Charge in Future>

The system of water charges for the high rate of irrigation usage, including the price system of water and the share of the user’s burden, is to be examined because the water cost will be changed when irrigation expands.

<Irrigation Recovery Plan and Necessity of Rotation Irrigation>

The existing irrigation system in the case study area has a capacity of water supply for irrigation farming assumed in the scenarios. In the Scenario B and C, the capacity of the system is enough and the system is able to cope with small intensive irrigation. In the irrigation in Scenario A, it is necessary to introduce rotation irrigation sequence, which requires adequate coordination of water users because of high rate of water use to capacity.

<Dependence of Regional Agriculture on Governmental Subsidy>

The high dependence of the farming budget on the governmental subsidy is pointed as a character of the regional agriculture. The income from subsidy occupies 8~9% of the gross income, which is equal to more than 70% of net return, in the case study area at present. The area is distinguished as a disadvantaged agricultural area in which soil is dominated by low fertility sandy soil. The support by governmental subsidy is indispensable to the promotion of agriculture and sustainable land use and the protection of natural resources.

12 RECOMMENDATION

<Promotion of Agriculture and Environmental Protection through Guidelines>

The Guidelines aims the promotion of regional agriculture, which is stagnant at the moment, which will be realized by two approaches: one is the conversion of the present agricultural system to a more efficient one by rational land use, considering land conditions and using regional resources in agriculture effectively: the other is the promotion of intensive farming with proper irrigation and fertilization of appropriate land by maintaining and improving existing facilities. It is expected that relevant personnel and organizations will take into account the Guidelines, and cooperate to promote agriculture and protect the natural environment in the region by improving the regional agriculture quantitatively and qualitatively.

<Further Works for Completing and Maintaining the Guidelines>

The Guidelines shown in this report provide the contents and directions of necessary technical measures for promoting regional agriculture. In order to improve accuracy and adoptability of the Guidelines it is expected to continue the effort to complete the Guidelines by establishing real indexes/standards of technical measures and new technologies specific to the Zahorska Lowland.

<Expansion of Case Study>

With the expansion of intensive irrigated agriculture and rational land use, along with enlargement of the detailed study area, the content of the Guidelines should be more substantial and some parts of the Guidelines should be adaptable to wider areas.

<Operation and Maintenance of Guidelines>

Continuous efforts of many related personnel and organizations such as farmers, farming companies, SWME-ID, regional office of MoA, etc., are necessary to operation and maintenance of the Guidelines. It is proposed to establish an organization for the operation and maintenance of the Guidelines, which coordinates the activities of concerned organizations and operates the Guidelines efficiently. Immediate establishment of such an organization through the cooperation of existing organizations is expected.

<Land Use Conversion of Unsuitable Land for Crop Cultivation>

It is necessary to have some advantage to land users by the appropriate operation of the current subsidy for grassland promotion for environmental protection, so that land users would include it in their farming plan voluntarily.

<Positive Development of Irrigation Farming>

To promote successful agriculture in a disadvantaged area, it is necessary to use the resources to maximum potential, including the existing irrigation facilities developed by great effort and investment in the past. Because the recovery of the existing irrigation facilities has a large cost effect, positive development of irrigation farming is considered a key factor in the promotion of agriculture in the disadvantaged area. It is first necessary to recover the irrigation facilities so as to realize stable water supply to users and coping with their demand.

<Enhancement of Agricultural Credit>

In the development of irrigation farming, the farming cost increases markedly due to increases in water charge and investment for equipment. Even though the expected profit from introducing irrigation farming is sufficiently large, farmers/farming companies meet the difficulty of financing. It is necessary to introduce state measures to enhance agricultural credit in the future in parallel with effort to expand contract farming.

<Future Changes to Institutions and Circumstances Surrounding Farm Management from the Viewpoint of Joining the EU>

The institutions and circumstances surrounding farm management is expected to change significantly during the preparation to join EU, and there is a lot of uncertainty at the moment. Even with these changes, the technical measures proposed in the Guidelines will remain necessary and the adaptability of the Guidelines will not be weakened. When the state institution is changed, it is necessary to review the operation and maintenance plan of the Guidelines to cope with the changes of role and responsibility of each organization.

<Future Development of Technology, Extension and Technology Transfer>

The following topics are pointed out as future development of technology, extension and transfer.

- Development of Technique of Economical Grassland Management
- Promotion of Crop Rotation for Soil Fertility Management
- Development of Preventive Maintenance Technique of Irrigation Facilities
- Improvement of Field Irrigation Techniques
- Selection of Appropriate Crops
- Development of Weeding Techniques
- Establishment of Appropriate Level or Limitation of Fertilizer Application

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THE STUDY FOR SUSTAINABLE DEVELOPMENT OF AGRICULTURE
IN ZAHORSKA LOWLAND AND PROTECTION OF NATURAL RESOURCES

DRAFT FINAL REPORT

CONTENTS

LIST OF FIGURES AND TABLES

ABBREVIATIONS

ATIS	Agricultural Market Information Slovakia
BPEU	Bonited pedo-ecological unit
CEFTA	Central European Free Trade Agreement
FAO	Food and Agriculture Organization of the United Nations
LPA、CHKO	Landscape Protection Area
MOA	Ministry of Ariculture
OECD	Organization for Economic Cooperation and Development
PHARE	Poland Hungary Aid for the Reconstruction of Economy
RIMLE	Research Institute of Melioration and Land Engineering
SAPARD	Special Accession Program for Agriculture and Rural Development
SHMI	Slovak Hydrology and Metrology Institute
SHR	Self employing farmer
SWME	Slovakia Water Management Enterprise
SWME-ID	SWME Branch Office of Irrigation and Drainage
SWME-PD	SWME Branch Office of Danube River Basin
VUEPP	Research Institute of Slovak Agricultural and Food Industry Economy
VUPOP	Soil Science and Conservation Research Institute

PART 1	*STUDY AREA*

PART-1 STUDY AREA

CHAPTER 1 BACKGROUND OF THE STUDY

1.1 BACKGROUND OF THE STUDY

The Slovak Republic (hereafter referred to as “Slovakia”) was separated from the Czechoslovak Federal Republic in 1993, after the collapse of the socialist system in 1989. In recent years, dissolution and privatization of state enterprises and affiliation to the European Union have been set as the major objectives of the country.

Slovakia has been developed as a grain center of the eastern European countries through the process of collectivization of farmlands. On average, the size of farms is 600 ha for collective farms and 20 ha for private farms. However, after the collapse of the socialist system, the production and productivity of agriculture have dropped due to the inadequacy of farm management in the market economy. The reduction of government subsidies has led to a shortage of agricultural inputs and insufficient operation and maintenance of irrigation facilities. Although the Government of Slovakia (hereafter referred to as “GOS”) emphasizes self-sufficiency in food production as a national development objective, the amount of agricultural imports from neighboring countries has increased, while domestic products are stored as a surplus due to lack of market competitiveness.

The JICA Project Study Area, the Zahorska Lowland, is considered a grain center for Slovakia with high market potential, since the area is located just north of the capital Bratislava. However, the agricultural productivity of the area has dropped due to the shortage of rain, attributable to global warming and climatic change, and due to reduced performance and efficiency of irrigation systems. Furthermore, the natural conditions, such as the low water holding capacity and fertility retention of sandy soil, cause difficulties for the agricultural activity in the area. Under such farming conditions, farmlands are increasingly abandoned, and the efficiency of irrigation systems is further in decline.

Under these circumstances, GOS made a request to the Government of Japan (hereafter referred to as “GOJ”) to extend its technical cooperation for the preparation of technical guidelines and for technical skill transfer to the counterpart personnel. The Slovak Water Management Enterprise (state enterprise) Irrigation and Drainage Branch Office (hereafter referred to as “SWME-ID”) will be the counterpart agency for the Study. The Guidelines will be based on suitable soil and water management techniques, in order to optimize the management of irrigation and drainage systems and land use management, thus promoting sustainable agriculture in the area. Technical skill transfer to the counterpart personnel will also be conducted as part of the Study.

1.2 OBJECTIVES OF THE STUDY

The major objectives of the Study are as follows:

(1) To formulate technical guidelines for suitable soil and water management, which is the priority subject of Slovak agriculture for the improvement of agricultural production both quantitatively and qualitatively, and to promote agricultural development in the Zahorska Lowland, which is considered as a priority development area.

(2) To carry out technical skill transfer to Slovak counterpart personnel, through on-the-job training, sufficient discussion and communication during the course of the Study.

1.3 STUDY AREA

The Study Area shall cover the Zahorska Lowland of 611 km^2 (including 429 km^2 of agricultural land), which spreads to the north of the Capital Bratislava in the western Slovakia and is surrounded by the Morava River, the border with the Czech Republic, and the Carpathian mountains. The Study Area is shown in the Location Map attached in the opening page.

1.4 SCOPE OF WORKS

- In Slovakia, the main agricultural issue is the alteration of administrative institutions and legislation that is necessary for accession to the EU; it is expected to proceed with assistance from programmes conducted by the EU such as SAPARD (Special Accession Program for Agriculture and Rural Development) and PHARE (Poland Hungary Aid for the Reconstruction of Economy). The Study focused on the elaboration of technical countermeasures, for the identified constraints to the improvement of agricultural production, and their effective adaptation in the Study Area.

- The Study has concentrated on integration and systematization of existing technologies for sustainable agricultural development and the elaboration of a methodology and know-how to apply these technologies to the overall development of agriculture in the region. And, the results were used to formulate the technical guidelines.

- The Study analyzed the constraints to agricultural production comprehensively, from the economical and technical aspects, and the “software and hardware” aspects of agriculture, through identifying the relationship between each constraint. Careful attention was paid to the prioritization of subjects and countermeasures so that there was consistency between theory and practice in the field.

- Technology transfer to Slovak counterpart personnel had been carried out with sufficient discussion and communication though on-the-job training and regular work shops.

The Study was carried out in two (2) phases. In Phase-I, an assessment and analysis of the present conditions was carried out and a draft of the technical guidelines was prepared. In Phase-II, technical guidelines was formulated and a case study was conducted. The Study phases were divided into eight (8) steps as summarized below:

Phase	Step	Objectives	Activities
Phase-I: Grasping and analyzing the present conditions and preparing the draft technical guidelines	1	Preparation in Japan Preparation of Field Survey and Inception report	• Familiarization with project • Development of approach, methodology and schedule of study • Identification of data items and scheduling of Field Survey (1) • Development of Technical Transfer Plan • Preparation of Inception Report
	2	Work in Slovakia (1) Analysis of present conditions, Construction of GIS system	• Explanation and discussion of the Inception Report, Identification of Case Study Area • Discussion and preparation of the technical transfer plan. • Collection of Existing Information and Review of relative plan • Survey of Present Conditions and Analysis of Problems • Review of Study conducted by related research institutions • Investigation of GIS database and detailed components • Farming unit survey • Rural survey (1) • Construction of GIS database (1) • Preparation of Progress Report (1) • Selection of Case Study site
	3	Work in Slovakia (2) Supplementary Survey to Collect Data on Conditions in the Spring Season	• Supplementary Survey of Current Conditions and Analysis (data collection in the Spring season.) • Selection of Case Study Site • Preparation of Progress Report (2)
	4	Work in Japan (1) Formulation of Preliminary Guidelines plan	• Report to JICA • Preparation of draft-Guidelines • Phase-II Study schedule • Preparation of Interim Report
Phase-II: Setling the technical guidelines and conducting the case study	5	Work in Slovakia (3) Preparation of Guidelines, conducting Case-study	• Explanation and Discussion of Interim Report • Field survey for case-study • Rural survey (2) • Elaboration of Guidelines • Case study with simulation models • Construction of GIS database (2) • Preparation of Progress Report (3)
	6	Work in Japan (2) Revision of Guidelines to reflect Case-study	• Report to JICA • Supplementary analysis for modification of Guidelines • Preparation of Guidelines • Preparation of Draft Final Report
	7	Work in Slovakia (4) Explanation and discussion of Draft Final Report	• Explanation and discussion of Draft Final Report.
	8	Work in Japan (3) Preparation of Final Report	• Preparation of Final Report

CHAPTER 2 AGRICULTURE OF SLOVAKIA

2.1 CURRENT AGRICULTURAL CONDITIONS

(1) Contribution of Agriculture to GDP and Employment

The strong recovery of the general economy has led to an overall decrease in the importance of agriculture in the Slovakia's economy. The contribution of agriculture to the GDP was 5.9% in 1993 and fell to 3.6% in 1999. The low importance also reflects the industry- and service-oriented character of Slovakia's economy. The strong performance of the general economy was able to absorb the agricultural labour force, which became redundant during restructuring. Since 1997 the pace of decline in agricultural employment has accelerated and the contribution of agriculture to employment decreased from 6% in 1996 to 4.3% in 1999.

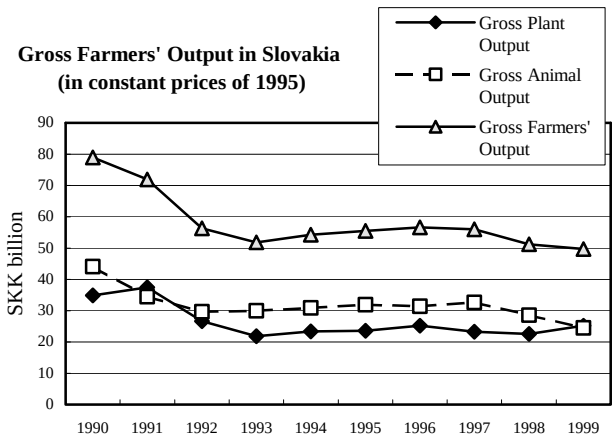
Contribution of Agriculture to GDP and Employment

	1996	1997	1998	1999	2000
Contribution to GDP (%)	4.1	4.0	3.7	3.6	
Number of agricultural employees*		117,245	106786 (-9.4%)	91,545 (-13.6%)	78,607
Contribution to employment (%)	6.0	5.8	4.9	4.3	

Source: Green Report 1999 & 2000, Directorate General for Agriculture (DGVI) Report (1998),
* Organisations with 20 employees and more

(2) Development and Composition of Gross Agricultural Output

The gross output for farming in Slovakia decreased rapidly from 1990 to 1993. Then there was a gradual recovery until 1997, when it started to decrease once again. The collapse of the livestock farming sector had a greater influence on the decrease of gross output of farming after 1997.



Source: Green Report 1999 & 2000

(3) Major Indices of Agricultural Land Use

The major indices of agricultural land use in Slovakia in comparison with CEFTA (the Central European Free Trade Agreement) and EU countries are shown in the table below. The population density of these countries is roughly on the same at 90 to 120 persons per 100 square km, except for the Czech Republic. Slovakia is the second smallest country after Slovenia in the scale of agricultural area, which reflects the total area and agricultural land use ratio. As for the arable land per capita, the tendency is the same within the CEFTA. However, apart from Slovenia, which is a very small country with an extremely low agricultural land use ratio, Slovakia is at the bottom of the scale of farmland within CEFTA.

The irrigation area of Slovakia declined rapidly from about 300,000ha in 1993 to 178,000ha in 1999 because of a continuous decrease in operation due to the budgetary deficit. The irrigation systems cover 12.2% of arable land in Slovakia, 0.8% in Czech Republic, 4.4% in Hungary, 0.7% in Poland, 28.6% in Romania, 1.2% in Slovenia, and 16.6% in EU-15. Slovakia is considered to be in a relatively good position for irrigation within CEFTA.

Agricultural Indices in CEFTA and EU-15

Country	Popula-tion (1,000)	Total Area (1,000ha)	Density (person/ 100km2)	Agricul-tural Area (1,000ha)	Arable Land (1,000ha)	Agricul-tural Land Use Ratio (%)	Agricul-tural Area per capita (ha)	Arable Land per capita (ha)	Irrigated (1,000ha)	Ratio of Irrigated area (%)
Slovakia	5,382	4,901	109.8	2,442	1,461	49.8	0.45	0.27	178	12.2%
Czech Rep.	10,262	7,887	130.1	4,282	3,096	54.3	0.42	0.30	24	0.8%
Hungary	10,076	9,303	108.3	6,186	4,815	66.5	0.61	0.48	210	4.4%
Poland	38,740	32,325	119.8	18,435	14,072	57.0	0.48	0.36	100	0.7%
Romania	22,402	23,839	94.0	14,781	9,332	62.0	0.66	0.42	2,673	28.6%
Slovenia	1,989	2,025	98.2	500	171	24.7	0.25	0.09	2	1.2%
EU-15	375,049	324,269	115.7	143,018	74,470	44.1	0.38	0.20	12,357	16.6%

Source: FAOSTAT Database

The total area of agricultural land has not changed much in the last five years as shown in the following table. However, within this the arable land has changed to the permanent growth of grass.

Area of Agricultural land as of Dec. 31 (1,000. ha)

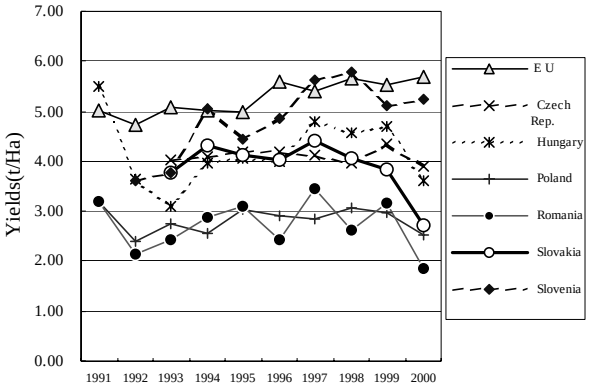
Indicator	1995	1996	1997	1998	1999
Total area of land	**4 904**	**4 903**	**4 903**	**4 904**	**4 904**
Agricultural land	**2 446**	**2 444**	**2 445**	**2 444**	**2 442**
of which:					
Arable land	1 479	1 475	1 472	1 469	1 461
Hop-gardens	1	1	1	1	1
Vineyards	29	29	29	28	28
Gardens	78	78	78	78	78
Orchards	19	19	19	19	19
Permanent growth of grass	840	842	846	848	856
Non-agricultural land	**2 458**	**2 459**	**2 458**	**2 460**	**2 462**

Source: Statistical Yearbook of the Slovak Republic 2001

(4) Productivity of Major Crops

The figures given below show the changes in yields of cereal crops in the EU and CEFTA countries. The yields of cereals in the EU are higher than those of the CEFTA and moreover they are increasing. In contrast, the decrease for the CEFTA countries is noticeable, including a rapid decrease in yields in 1999/2000, partly due to the extremely dry weather in that year.

Yield of Cereals in EU /EFTA Countires



Source:FAOSAT

The following table shows the yields of wheat in European and CEFTA countries. Wheat is a typical crop in Europe. The mean value for yields of wheat in EU for ten years is 5.4 ton/ha but the yield values vary widely from 1.6 ton/ha in Portugal to 8.2 ton/ha in Netherlands. The wheat yields vary widely from country to country in EU countries. The yield of wheat for Slovakia is the second highest in CEFTA, after the Czech Republic, and is a little below the mean value for the EU.

Yields of Wheat (1991-2000)

EU Countries						CEFTA		
Countries	Yield (t/Ha)		Countries	Yield (t/Ha)		Countries	Yield (t/Ha)	
	1991-1995	1996-2000		1991-1995	1996-2000		1991-1995	1996-2000
Ireland	7.70	8.45	Sweden	5.67	6.00	**Slovakia**	**4.38**	**4.00**
Netherlands	8.24	8.08	Austria	5.00	5.04	Czech Republic	4.47	4.43
Belgium-Luxembourg	6.94	8.06	Italy	3.46	3.25	Slovenia	4.15	4.16
United Kingdom	7.29	7.83	Finland	3.45	3.23	Hungary	4.22	3.77
Germany	6.60	7.31	Spain	2.10	2.66	Poland	3.40	3.40
Denmark	6.81	7.21	Greece	2.64	2.22	Romania	2.54	2.48
France	6.55	7.15	Portugal	1.65	1.46	Mean	3.86	3.71
Mean				5.29	5.57	Ukraina	3.23	2.41

Source:FAOSAT Database

(5) Structure of Agriculture in Slovakia

Half the total cultivated area in Slovakia is used for cereal products. More than 22% of the sown area is used for feeder products, and 15% for oil-plants. Potato is considered a basic food crop as well as cereal in Slovakia, but potato cultivation occupies only 2% of the sown area. In the sales of agricultural products, about one-third comes from crop products, amounting to 12.2 billion SKK, while animal production contributes two-thirds, equal to 22.4 billion SKK.

Mixed farming based on cereal production and livestock farming is fundamental to Slovakian agriculture as well as in other European countries. In this farming system, a large part of cereal production is used for self-supply, comprising about 60% of production in Slovakia in 1999. Even feed is the priority of major crop consumption, feed production has been decreasing, while consumption for food and processing was maintained at a similar level in the same period. As an example, wheat consumption for feed and food were 1,056 thousand tons (62%) and 456 thousand tons (27%) respectively in 1993. However in 1999, consumption for food increased to 585 thousand tons, and wheat for feed decreased to 700 thousand tons. Levels of meat production have been maintained. Pig meat has a high share of production, while beef production, having low feed efficiency, has decreased and production has shifted to poultry, which has the highest feed efficiency among the three.

It is common for each household to cultivate vegetables for family consumption in Slovakia. This is a habit dating back to the socialist period. Vegetables are produced in small gardens, not always adjoining the house. Householders consume the produce themselves or trade it informally. The total amount produced and the amount of informal trading could not be measured. The sown area for the products indicated below is the area of vegetable production for formal marketing.

Sown area as of May 20, 1999 (ha)

Indicator	1999	Percentage for Total (%)
Cereals in total	739,475	50%
of which :Thickdrill	609,976	41%
Grain maize	129,498	9%
Legume	31,728	2%
Potatoes	27,182	2%
Sugar-beet	34,623	2%
Oil-plants	229,613	15%
Flax	1,595	0%
Tobacco	792	0%
Market vegetables	47,002	3%
Feeding root-crops	5,275	0%
Fodder on arable land	332,179	22%
Fodder on arable land Annual	172,131	12%
Lasting more years	160,048	11%
Sown area in total	1,492,237	100%

Source: Statistical Yearbook of the Slovak Republic 2001

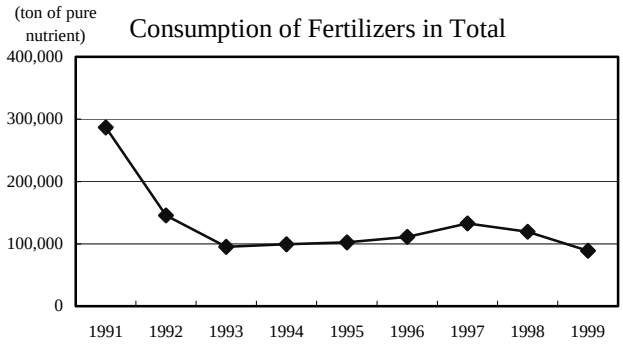
Receipts from sold products in primary producers

Crop products including seed and seedling for sowing	12 246.0
Cereals in total	7 124.4
Potatoes	534.0
Sugar-beet	1 024.8
Vegetables	345.4
Fruit (excluding grapes)	222.3
Grapes	293.8
Animal products	22 434.4
Slaughtered animals in total	9 434.7
Slaughtered poultry	2 859.0
Cows milk	6 895.8
Consumer eggs	1 229.6
Sheep wool	5.6
Market fish	61.3

(in mil. SKK)

(6) Agricultural Inputs

The use of chemical fertilizers in Slovakia decreased from about 300,000 tons in 1991 to around 100,000 tons in 1993 during the confusion of the economic system. This level has been maintained since.



Source: Statistical Yearbook of the Slovak Republic

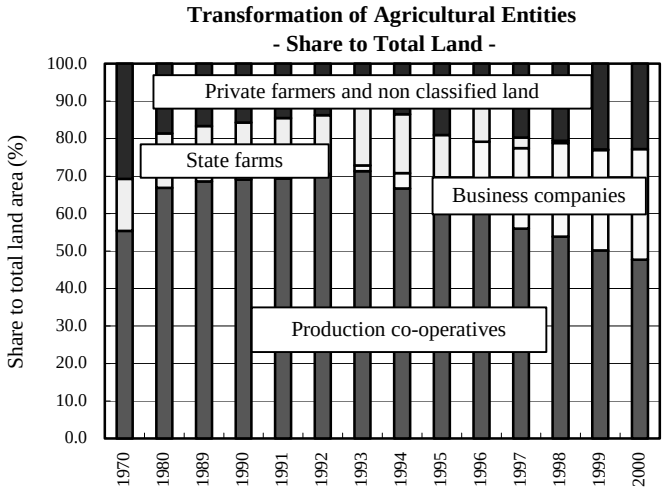
Consumption of fertilizers (t of pure nutrient)

Indicator	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99
Consumption of fertilizers in total	286,718	145,916	95,009	99,101	102,233	111,078	132,988	119,417	89,084
of which:									
Nitrogenous	146341	90186	64852	68669	69 587	74 464	88 017	81 842	65 393
Phosphate	71379	28790	16472	16623	17 714	20 030	24 494	20 475	13 115
Potash	68998	26940	13685	13809	14 932	16 584	20 477	17 100	10 576

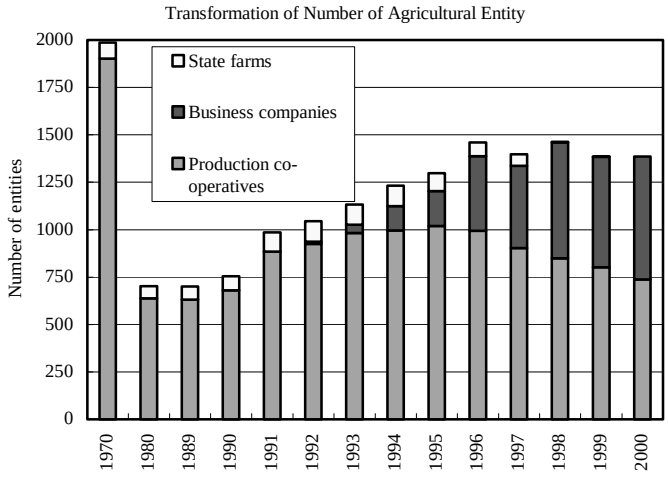
Source: Statistical yearbook of the Slovak Republic 1996, 2001

(7) Farm Structures

After World War II, "Agrarian reform" was carried out on about 1,250,000 ha of farmland, and the farms of large-scale landlords were distributed to the peasants. Collective farming started after the communist take-over in 1948. The agricultural production cooperative was established, and individual farmers were obliged to participate in this system.



Source: Report of Gejza Blaaas (19.6.2001) and Green Report 1999 & 2000



Source: Report of Gejza Blaaas (19.6.2001) and Green Report 1999 & 2000

With the industrialization policy in the 1960s, the key agricultural labour force decreased in the rural areas. There was an integration of low-level and high-level cooperatives, and the integration of low-level cooperatives into the state farms advanced. As a result the

number of cooperatives declined while the size of farms grew. When the collectivisation of farming was completed at the end of the 1980s, the size of one field had expanded from 25 - 40 ha in the 1970s to 200 - 300 ha. This expansion of field size to improve the efficiency of machine use was promoted by clearing the farmland boundary woods (wind protection forest).

After the system changed in 1989, the agriculture in Slovakia changed greatly. Agricultural production cooperatives were privatized, and have been changed into various corporate farming organizations. The revenue management of the co-operatives is generally poor, and the conversion from the co-operatives to the business companies has been advancing. Since the land ownership was not clear, the procedure for privatization of state farms was delayed and then finally carried out in 1997 - 1999. Because of the “price gap” between increasing agricultural inputs and relatively low outputs, half the agricultural entities are running at a loss. It is therefore forecast that the shift from co-operative to private company will continue.

(8) Land Use System

Restitution of agricultural land proceeded after the changes in the economic system. However, ownership titles for some fields, especially those in poor condition, have not yet been clarified. Such lands are maintained by the Slovak Land Fund. Under the present system, landowners can make use of their rights to transaction and tenancy of land. In addition, it is possible to change the registered land use purpose with the approval of the cadastre office. It is not common for landowners to use restituted land themselves, thus most of the land is leased to agricultural enterprises to be cultivated. The annual lease fee is estimated at 0.75 to 1.0% of the evaluated land price. Permanent leasehold is obtained by the lessee in the lease agreement. However, the landowner can end the contract when he wants to sell the land to another person. In this case, the owner has a duty to notify the lessee one year in advance.

2.2 POLICY AND PLAN OF AGRICULTURAL DEVELOPMENT

Policy and plan of agricultural development in Slovakia is described in “The New Concept of Agriculture and Food Policy of the Slovak Republic until 2005” which was published by Ministry of Agriculture in December 2000. “The Concept” was adopted with the following objectives:

i) To intensify the search for solutions to the accumulated problems resulting from the process of transformation and consolidation of the agricultural food sector,
ii) To harmonise the Slovak agricultural policy with the Common Agricultural Policy of the European Union,
iii) To respond to the liberalization of the global agro-food trade, and
iv) To increase the competitiveness of the Slovak agriculture and food industry in comparison with the other countries.

The key strategic framework of “the Concept” is to establish an efficiently producing multifunctional agriculture that would be fully capable of integration into the union of the EU member countries. The main objectives of the Concept are linked with this understanding. This model presumes a focus of agricultural policy which pursues objectives following from the production functions of agriculture, i.e. provision of affordable, high-quality and safe food for the population, as well as objectives related to the fulfillment of its other tasks, which it carries out for the benefit of the whole of society, such as conservation and development of natural resources, preservation of the cultural character of the landscape, maintenance of employment and the structure of rural of settlement.

Strategic intention and basic orientation of the Concept are as follows;

- To stabilize the sector and creating a viable agri-food sector,
- To strengthen the competitiveness of the agri-food sector in the domestic and foreign markets,
- To restructure the food processing industry,

- To change the support policy,
- To strengthen the marketing infrastructure of the agri-food sector,
- To adjust to the European Union,
- To improve the foreign trade balance in agricultural and food products and temperate zone products,
- Co-participation of agriculture in preserving and developing the rural environment and maintaining rural settlement, and
- To strengthen domestic research in the sector and the educational level of workers in the agriculture and food processing industry.

The measures for implementation of the main goals and medium-term strategic intentions of the agriculture and food industry are categorized into 5 pillars and 13 programs, as described below.

Pillar I: Market regimes for decisive commodities

Programme 1 - Market reorganization for selected commodities

Programme 2 - Improvement of the conditions of agricultural foreign trade

Pillar II: Support for operating in the poorer production conditions

Programme 1 - Support for less favoured areas

Programme 2 - Sheep and goat breeding

Pillar III: Modernisation and support for corporate sector restructuring

Programme 1 - Modernisation and diversification of agriculture

Programme 2 - Modernisation and restructuring of the food sector

Programme 3 - Support for the execution of ownership rights

Programme 4 - Support for speeding up the restructuring of businesses

Pillar IV: General services and preparation for EU accession

Programme 1 - General services for the agriculture and food processing industries

Programme 2 - Human resource development in the agriculture and food processing industries

Programme 3 - Preparation for EU accession

Pillar V: Environmental measures

Programme 1 - Agri-environmental programme

Programme 2 - Environmental investment

Within these 5 pillars and 13 programs, Program 1 of Pillar III is most linked to the Guidelines, i.e. the program objective is as follows:

i) To increase the competitiveness of agriculture through modernisation of production capacities, machinery and equipment,
ii) To increase jobs in the countryside through diversification of activities in agricultural businesses,
iii) To extend and modernise the production of grapes, fruit and vegetables and other higher added value products.

Proposed instruments and measures are as follows:

- Purchase of efficient machinery and technology in keeping with the technical policy of the sector,
- Reconstruction and modernisation of production capacities, production lines in agriculture, including purchase of the appropriate modern technologies in the whole vertical production of commodities are suitable for foreign markets,
- Afforestation and planting with grass any agricultural land unsuitable for agricultural production (titles to which have been settled).

2.3 AGRICULTURAL SUPPORT SYSTEM IN SLOVAKIA

The agricultural supporting services of the Ministry of Agriculture are aimed at registered agricultural companies and SHRs. Agricultural subsidy is the most direct and influential form of support.

(1) Agricultural Subsidy

Agricultural subsidy is provided to farming units, which produce agricultural products for market sales. Informal gardens producing for home consumption are excluded from the subsidy. Recipients are required to have minimum annual revenues ranging from 50,000 SKK to 125,000 SKK per farming unit, as of 2002, according to the agricultural productivity of their land.

The agricultural subsidy consists of two categories. One is the support to agriculturally disadvantaged areas such as mountainous and low productivity areas. The other is the subsidy for the agrarian and food industry, which does not have any limitation on location.

1) Subsides for Agriculturally Disadvantaged Areas

Agriculturally disadvantaged areas are defined according to the land prices, which are decided for the whole country by the Institute of Agriculture and Food Industry Economy. The land price is based on the Soil Quality Ecological Unit (BPEU), which takes into account socio-economic conditions. These land prices are categorized into 20 classes. The subsidy for disadvantaged areas is applied over the whole cadastral area, where the average price of agricultural land is lower than Class 15 (52,800 SKK/ha, as of year 2002). Land that is lower than Class 15, even in non-disadvantaged cadastral areas, also qualifies for this subsidy.

Subsidies to compensate for lower revenues from crop production in such areas range from 475 SKK/ha up to 1,850 SKK/ha, according to land prices. A subsidy is also provided to maintain the quality of land in permanent grassland, ranging from 950 SKK/ha up to 3,700 SKK/ha, according to the field conditions and livestock conditions. To obtain these subsidies, farming units are required to produce minimum annual revenues or breeding ratios.

2) Other Subsidies for the Agriculture Sector

Subsidies for the agrarian and food industry are aimed at promoting the development of the agriculture and food industry and are offered for four major areas: 1) market regime, 2) general services, 3) environmental agriculture, and 4) modernization and support of structural change in agriculture (Capital Investment).

The major subsidies for crop production are summarized in the following table.

Major Subsidy Items for Crop Production

	Year 2002 in Maximum
Compensatory payment	
Plant production	
Cereal including maize	500 SKK/ha
Vegetables, asparagus and herbal plant in filed	3,000 SKK/ha
Vegetables in greenhouses, foils, including	10,000 SKK/ha
Late ware potato	16,000 SKK/ha
Potatoes – reproduction stands, purchase of seeds of SE1 to C1 degrees	15,000 SKK/ton
Oil seeds (including flax and maize for oil)	300 SKK/ton
Poppy seed	500 SKK/ton
Legumes	200 SKK/ton
Soy bean	1,500 SKK/ton
Fibre flax	2,500 SKK/ton
Chicory	400 SKK/ton
Tobacco	20,000 SKK/ton
Sugar beet	170 SKK/ton
General Services for agriculture	
Irrigation Cost	
Cost support to farmer for the consumed water	70 % of cost
Cost support to Operater of the system	190 SKK/ha (functional Area)
Envronmatal Agriculture	
Grassing	
for grassed arable land (abandand land)	6,000 SKK/ha
for the replacement of permanent grass cover	4,000 SKK/ha
in the disadvantage area	+20% Up
Modanization and support of the restructuring	
purchase of new technology for plant and animal production	
tractors	600,000 SKK or 40 % of loan instalments
Sowing machinery	70,000 SKK or 40 % of loan instalments
purchase of new irrigation techonology	
new irrigation technology and reconstruction of irriga	50 % of the costs

Source: MoA

(2) Condition of Subsidy in Slovakia

The % PSE (PSE：Producer Support Estimation), which means the share of gross subsidies to total agricultural production, is used to express the level of agricultural support in a country. During the 1980's, under socialism, the % PSE for Slovakia

was quite high at 55%. It decreased rapidly to an average of 24% in 1998 - 2000.

It is similar to the level in adjacent eastern European countries such as Czech Rep., Hungary and Poland. However, it is lower than the average of 35% in OECD and the average of 40% in the EU. The Ministry of Agriculture declares its intention to maintain the level of subsidy for agriculture after EU accession.

Producer Support Estimate (%PSE) by country

	1986-88	1998-2000	1998	1999	2000P
OECD	39	35	34	37	34
European Union	44	40	39	43	38
Czech Republic	59	19	20	20	18
Hungary	39	20	19	23	18
Poland	12	21	21	21	20
Slovakia	**55**	**24**	**27**	**24**	**22**

Source: Agricultural Policies in OECD Countries 2001

CHAPTER 3 STUDY AREA

3.1 DEFINITION OF STUDY AREA

The target area of the study (hereafter called the Study Area) is lowland plain in and around the Malacky district. It has typical natural, social and agricultural conditions. The total area is about 611 km^2, in 3 districts, with 32 towns/villages. The 286 km^2 of military area in the Malacky district are not included.

Much of the statistical data for the Study Area are impossible to divide into plain area and mountainous area, so the statistical data include the Male Karpaty Mountains area of about 232 km^2.

Structure of Study Area

Region	District	Of which the Study area				Whole district		
		No. of Town /Village	Population (person)	Area (km^2)	Population Density	No. of Town /Village	Population (person)	Area (km^2)
Bratislava	Bratislava IV	3	26,100	63	414	6	98,303	97
	Malacky	25	63,678	663	96	26	64,202	949
Tarnava	Senica	4	5,816	117	50	31	60,622	684
TOTAL		32	95,594	843	113			

*1：Population date 31.December. 2000

Source:National Statistic Office, Geogetic and cartography institute data

The administrative system of Slovakia comprises of three levels in the state administration, i.e., regional (kraj) level administration, district (okres) level administration and cadastres. Besides them, there are towns (mesto)/villages (obec) which have elected representatives, mayors, of municipalities.

3.2 SOCIO-ECONOMIC CONDITIONS

3.2.1 DEMOGRAPHY

In the Study Area, the total population was about 95,000 at the end of 2000. Age structure of each district is shown in the following table. Comparing the population density of each district in the Study Area, it range from 414 per km^2 at Bratislava IV, where the number is significantly higher due to the proximity of the Capital City, to 96 per km^2 at Malacky and

50 per km^2 at Senica. The reason for the high population density in Bratislava IV is that industrial areas are included in 3 villages in Bratislava IV district. The villages also function as commuter towns for the Capital Bratislava. Malacky town is the largest municipality within the Study Area with a population of 18,293, Devinska Nova Ves (16,915) is the second largest and Stupava (7,854) is the third largest. 32 villages/towns are in the Study Area and 11 of these are large villages/towns with 2,000 people or more, 13 are of medium size, with a population of between 1,000 and 2,000, and the remaining 8 villages are small with less than 1,000 people.

Age and Race Structure of Demography

Age structure

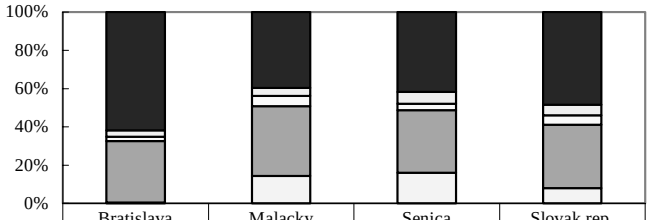
	Bratislava IV***		Malacky**		Senica***	
	Person	%	Person	%	Person	%
Pre-productive age (Lower than 14)	17798	21.11%	15,331	24.6%	12,075	19.9%
Productive age(15 up to 59)	54277	64.37%	35,640	57.3%	37,711	62.2%
Post-productive age (over 60)	12250	14.53%	11,234	18.1%	10,836	17.9%

Data: **: 31.Dec.1997 ***: 31.Dec. 2000
Source: Socio-economic Analysis of Malacky District, District Office of Malacky, July 1999
Monitoring of Economic and Social Situations in Senica District, District Office of Senica, April 2000

3.2.2 SECTORAL STRUCTURE OF EMPLOYMENT

The sectoral structure of each district comprising the Study Area is shown in the following figure. The importance of the agricultural sector is quite low in Bratislava IV district making up 0.46% compared with a national average of 7.95%. On the other hand, Malacky and Senica districts make up 14.38% and 15.94%, respectively, higher than the national average. Agriculture is as important as industry in both districts. The extremely low level of employment in

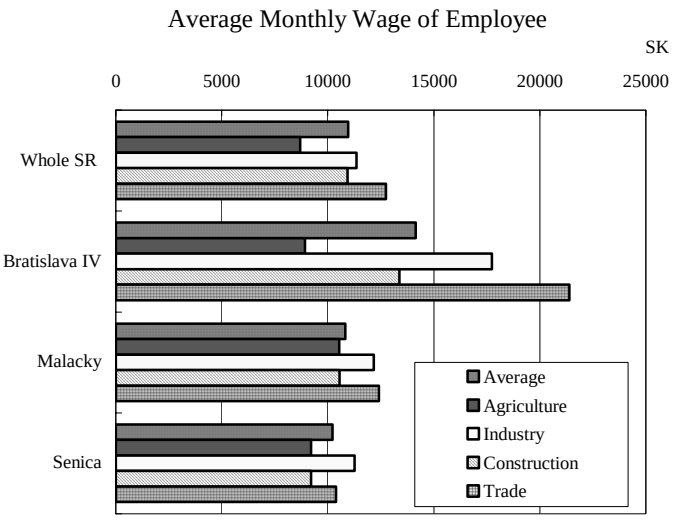
Employment structure in National and Related District in
(Average of 1999 in %)



	Bratislava	Malacky	Senica	Slovak rep.
Other	61.76	39.65	41.68	48.52
Trade	3.36	4.22	6.19	5.42
Construction	2.34	5.25	3.41	4.9
Industry	32.08	36.5	32.77	33.2
Agriculture	0.46	14.38	15.94	7.95

Source: The Regional Comparisons in the Slovak Republic for the year of 1999,
Statistis Office of the Slovak Republic, November 2000

agriculture in Bratislava IV district is explained by the character of the district, which has large scale industrial areas and is within commuting distance of the Capital Bratislava.



To the average monthly wage in Bratislava IV is 129% higher than the national average due to the advantage of access to the Capital. While Malacky, and Senica's are slightly lower than the national average at 99% and 93%, respectively. The average wage of the agriculture sector is relatively lower than in other industries and it is only 79% of the national average for all industries. It is especially remarkable in Bratislava IV where it is as low as 63% because it is developing as a suburb. In the Malacky district, the average wage in the agricultural sector is as high as 125% of the national average and the difference between the other sectors is smaller than the national average.

3.2.3 UNEMPLOYMENT RATE

Percentage unemployment at the end of 2000 in the Study Area is shown in the following table. Bratislava IV district showed the lowest percentage in Slovakia because of its position as a suburb of the capital. Malacky and Senica districts also showed lower percentages than the national average.

Unemployed percentage in each district and national (31.Dec.2000)

Bulatislava IV		Malacky		Senica		Slovak rep.
%	No.	%	No	%	No	%
4.60%	81/81	14.00%	67/81	16.20%	55/81	17.90%

Source: Selected Data on Regions in SR, Statistics Office of SR, April 2000

The unemployment rate shows great variation between municipalities in the Malacky district. Zahorska Ves has the highest with more than 30%, followed by Plavecky Stvrtok with 30%, then Gajary with 28% and Velke Levare with 23%. The lowest rate was recorded at Borinka with 5.9% and Mrianka with 7.5%. It is said that 56% of workforce from Stupava and 32% from Malacky town commute to Bratislava.

3.2.4 REGIONAL ECONOMY

The gross domestic product and its share in the region including the Study Area is shown in the following table. The share of agriculture, forestry and fishing in the Bratislava region is extremely low because the region includes the capital Bratislava. The major industries in the Malacky district are machine engineering, electrical, chemical, textile and construction. The economic and industrial base of the district is mainly mineral resource. An industrial park named "Euro Valley" is planned in the district and this is expected to play a significant role in the industrial development of the district. In the Bratislava IV district, owing to the proximity of the capital city of Bratislava, there are a lot of large scale industries represented by a car factory with investment from foreign capital.

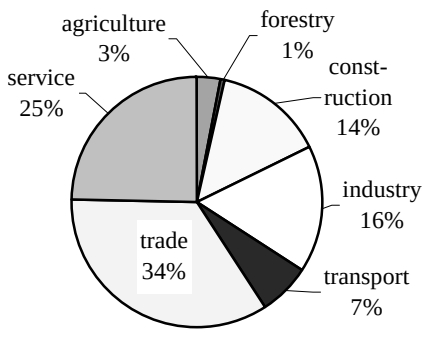
Regional gross domestic product at market price in 2000

	Slovak Repiblic		Bratislava Region		Tarnava Region	
	Mill. SKK	%	Mill. SKK	%	Mill. SKK	%
Agriculture, Forestry, fishing	36003	5%	2119	1%	6915	8%
Minig, industry,electricity and water supply	233147	29%	45700	24%	31877	39%
Construction	42279	5%	8498	5%	3298	4%
Trade Hotel, transport	224330	28%	56039	30%	18361	22%
Financial realestoimate	145833	18%	48029	26%	12313	15%
Other market service	113579	14%	27341	15%	9639	12%
Total	795171	100%	187726	100%	82403	100%

Source: Selected data on Regions in the Slovak republic 2000.4

The share of enterprises registered in the Study Area is shown on the right. The share of the agriculture is only 3%, and it becomes smaller in the southern part of the Study Area.

Sectoral Proportion of Number of Registered Enterprises in the Study Area



Souce: Regional Statistic (1998, Senica 1999)

3.2.5 RURAL SOCIETY

(1) SHR (Individual Farmer)

SHR is the registration category for occupation. Independent/private farmers are registered with the Regional Department of the Ministry of Agriculture and with the village/town as SHR. Some of them are registered only with village/town, and some with both. It could be concluded that the SHR register with the MoA because they wish to receive a subsidy, and that this kind of SHRs were likely to make a living by agricultural activities. Conversely, it appeared that SHRs registered only with the village/town had not done so with the intention of seeking a living from agriculture. Some of these SHRs did not cultivate the land acquired by restitution themselves, but leased it to a larger farming enterprise. Because of this, it is difficult to understand the total picture of SHRs, so, only the SHRs registered with MoA form the target group of this study according to the common concept of “active” farmer.

(2) Household Plots

Since the socialist period, it is common in rural areas of Slovakia for people to have small household plots near their house and to grow a few vegetables and keep livestock. The same situation occurs in the Study Area, with household plots maintained around the village. The major crops are potato, vegetables and fruit in household plots. These agricultural products are used for home consumption and/or informal trade, and these activities, in effect, supplement household income and are an important element of rural livelihoods. Household plot owners, typically, also work in an agricultural enterprise or another economic sector, so the main income is from paid employment.

(3) Restitution of Land and the Private Farmer

In the example of Male-Levare village, the cooperative farm was established in 1957. Between 1957 and 1964 all private farmers gave up their land to the cooperative, so that the close contact between farmers and their land was disconnected. Therefore, by

the time the restitution of land started to take place in the 1990's, most farming families had lost their broad knowledge, technique and experience of farming practices. Several individuals did try to start farming, but most of them found it hard to make an adequate living from this activity. Part-time farming work and house plot farming remain, but most of the restored farmland was leased to private enterprise. The very few farmers who succeeded in becoming independent farmers now continue with this activity.

3.2.6 NATURAL CONSERVATION AREAS AND LAND USE REGULATION

The natural conservation areas in Slovakia are protected by regulation with five protection levels. In the Study Area, the Protected Landscape Area (level II) occurs along the Morava River, and other small conservation areas (level IV) and natural reserve (level V), are located in the west part of the Study Area. The riverside land of Morava River and Rudava River, nearly included in the Military Area, is designated a Ramsar Site. Moreover, the river course of the Morava River is designated an Important Bird Area (IBA). Both are Special Protection Areas.

Protection Level	Name	Type of Area and Protection	Strength of protection
I	-	Whole Country	Low
II	Protected Landscape Area (and National Park buffer zones)	Large area, usually more than 1,000 ha, with fragmented ecosystems which are significant for conservation of biological diversity and ecological stability, with characteristic landscape features or specific forms of historical settlements.	▲
III	National Park core zones	Large area, usually more than 1,000 ha, with mainly ecosystems substantially unaffected by human activities, or with unique and natural landscape structures that form national biocentres and the most significant natural heritage in which nature protection is a higher priority than other activities.	▲
IV	Protected Site	Small area, usually up to 1,000 ha, representing mainly biocorridors, inter-active elements, or biocentres of local or regional importance.	▲
V	(national) Nature Reserve Natural Monument	Small area, usually up to 1,000 ha, of mainly original or those ecosystems not generally affected by human activity and biocentres of national importance.	▼ High

Source: Act 287/1994 *On Nature and Landscape Protection*

Land designated as Level II protection or more is regulated in land use according to its category. Protected Landscape Areas are widely distributed beside the Morava River and occupy one third (200km^2) of the total Study Area. In such areas, development activities

such as expansion of the agricultural fields and construction of irrigation and drainage facilities are restricted. Also, approval by the natural conservation body managed by the Ministry of Environment is required to use agricultural chemicals and fertilizer in any area larger than 2ha. Restrictions on amounts of agricultural chemicals and fertilizers are not yet agreed but it is under discussion in the preparatory work for EU accession and might be agreed in the future.

3.3 NATURAL CONDITIONS

3.3.1 GEOGRAPHY AND GEOLOGY

The Study Area, Zahorska Lowland, is located on the Slovakian territory of the Vienna Basin. It looks like an inverse triangle with a total area of 611 km^2, enclosed by the Morava River in the West, by the Myjava River in the North and by the foot of the Male Karpaty in the East.

This area, on the whole, rises gently from the foot of the Male Karpaty (with an altitude of 250m above sea level), towards the flood plain of the Morava River at an altitude of 145m, with some rolling hills. The core stratum of the Male Karpaty belongs to the Proterzoic of the Pre-Cambrian. At the end of the Mesozoic and beginning of the Tertiary, mountain blocks of the Male Karpaty were elevated above sea level again, and formed the fundamental relief of the Vienna Basin. This basin was closed from the open sea and was filled mostly with detrital material washed out from rising parts of the Karpaty mountain blocks. Deposition was mainly by marine sediments, gradually changing to marine – brackish, lacustrine, and finally fluvic sediments.

The most important facts with regard to the surface geology in this area, which characterize the parent materials and properties of the soils, are the wide occurrence of sand deposits and depressed spots all over the area. The sand deposits derive from the shallow-sea deposits, which filled in the basin. Fine particles were washed away by tidal action, and the limited water flow of the Morava and Myjava could not wash out the sand deposits.

3.3.2 SOIL CONDITIONS

The major soil types found in the area are, 1) Dystic Regosols, 2) Eutric Regosols, 3) Rendzinas and Pararendzinas, 4) Eutric Fluvic Phaeozems, 5) Eutric Fluvisols and 6) Cambisols.

Generally speaking, soils can be classified mainly by variation in parent materials within the limited area. It is true in this case because of the uniformity of formation and climate. The fertility levels of these soils also depend on texture, nature and property of the parent material. The clay rich alluvial soils (Fluvisols) give higher fertility, and the sandy soils with slight clay content give low levels of fertility.

Soil type	Character of each category
Dystic Regosols (Sandy Soil)	・ Carbonate deficit immature soils formed from the sand deposit and the wind blown sand. ・ This type of soil has slight amount of clay, close to zero, and is ranked the lowest level of fertility unsuitable for farming.
Eutric Regosols (Sandy Soil)	・ It originates from the redeposited sand which had been partly affected by water flow of the small streams. ・ Texture of the soil varies spot by spot. The higher the content of clay the higher the fertility level.
Rendzinas and Pararendzinas	・ They are particular soils from calcareous rocks such as, limestone, marl and chalk. ・ These types of soils cover the foot of the Male Karpaty, and major areas are occupied by forest and residential areas. Pararenzinas can be ranked fertile soils unless gravel contents are low.
Eutric Fluvic Phaeozems	・ It is the blown soil developed on the river side terrace of the Fluvic deposits. ・ Textures, clay contents of this soil vary from spot to spot, and clay rich soils can be found only along the bottom of small streams
Eutric Fluvisols	・ It covers only the alluvial deposits of the Morava and Myjava rivers. ・ This type of soil is under the influence of floods and significant fluctuation of ground water level. ・ This type of soil generally contains large amounts of clay and is rich in nutrient supply.
Cambisols (brown soil in older classification)	・ They are a typical zonal soil, blown, colored soil, rich in carbonate, in the climate of this area. ・ The brown soil is divided into two types; Cambisols without accumulation of clay in sub layer and Luvisols with accumulation.

Most soil in the Study Area is called sandy soil and has the characteristic of deposited sand in the surface or subsoil. The wind blown silt and sand deposits which are

widespread on the central hilly area are categorized as Dystric Regosol. Most of this area is occupied by the Military Area and reforested with pine trees, and forest has remained in the rest. This soil is composed mainly of silt particles of quartz powder or gravel mixed soil, thus this soil is not suitable for cultivation because of low water and fertility holding capacity, low fertility supply capability and high risk potential of wind erosion.

In the fan of Male Karpaty, a better-fertilized soil could be observed in limited places. However, the sandy soil causes serious problems to farming activities in the area with thin fan deposit or slope with exploded sandy soil layer. Because of this, the area with Eutric regosol and Fluvic deposits has been developed for cultivation where it is enclosed by the central hilly area, Morava River and the foot of Male Karpaty. In such a relatively fertile area, sandy soil problems occur where the surface is sandy soil, such as loamy sand or sandy loam, or a sand bed is found in the subsoil layer.

The alluvial deposit developed along the Morava River is generally rich in clay, so that it is said to be the most suitable area for cultivation in terms of soil fertility. Alluvial deposits were also observed along the Myjava River, a middle sized river in the area, but it is small and narrow just beside the river. Also the alluvial deposits were observed in a small area along the Rudava and Marina Rivers, which are small rivers, but the fertile layer was thin.

Distribution of Soil Texture in the Study Area

Soil Texture	Area (km^2)	Percentage for total agricultural area（%）
Sand and Loamy Sand (Light Soil)	269	60
Sandy Loam（Medium heavy soil-lighter）	21	4
Loam（Medium heavy soil)	140	31
Loamy Clay（Heavy soil）	20	4
Clay and Heavy Clay（Very heavy soil）	2	1
Total	452	100

Source: BPEU above area is calculated with GIS database, therefore the number is not same as the following agricultural area based on the land registration.

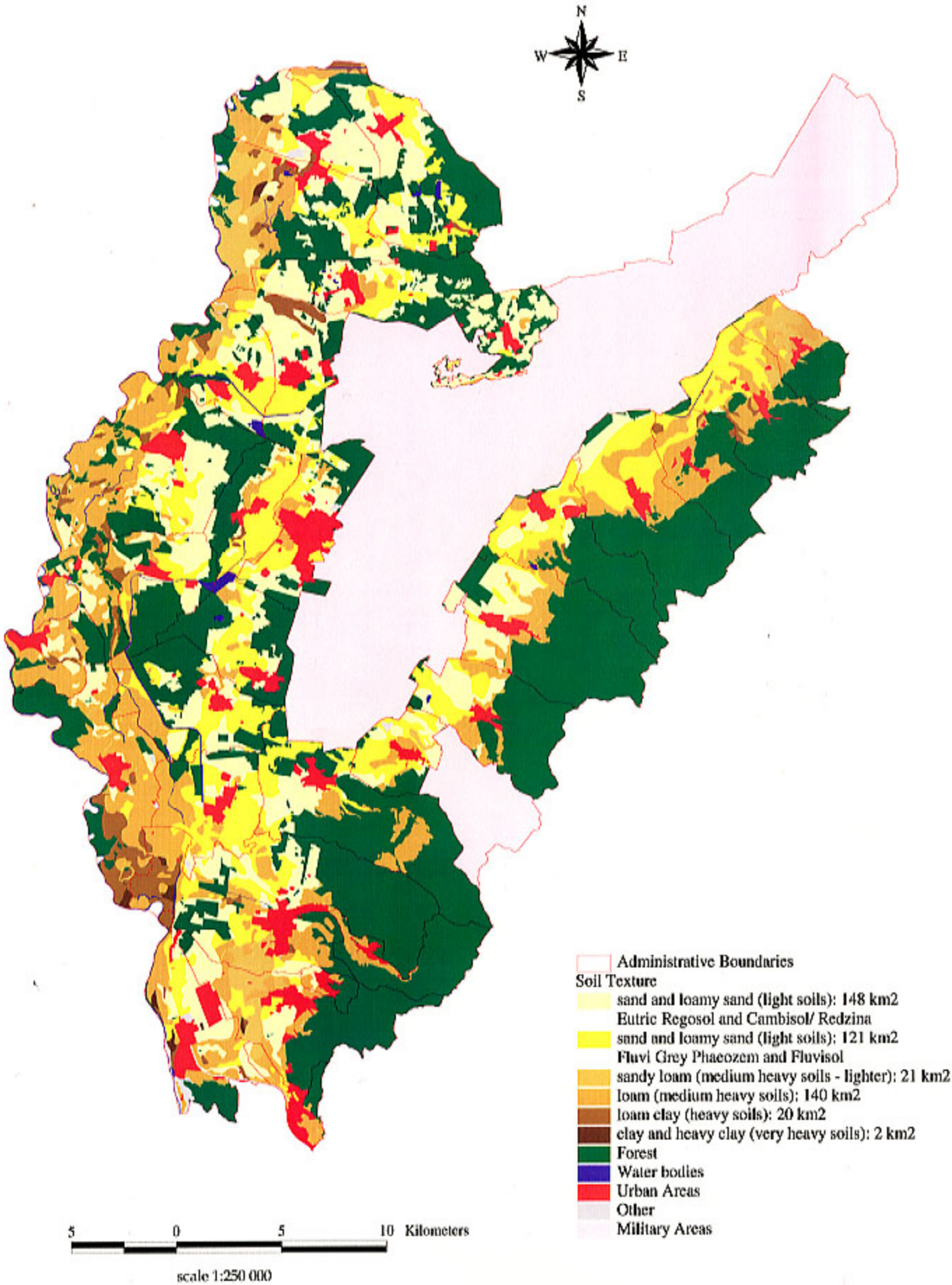


Figure 1.1 Soil Texture Map

Source: SSCRI, original map scale: 1:5000

3.3.3 METEOROLOGY AND CLIMATE

(1) Meteorological and Climatic Summary

The major climatic data of the Study Area is summarized as below. Malacky Station (165 m of altitude) is located in the center of the Study Area and Stupava Station (179 m) is located at the south end of the Area. Senica Station (218 m), which is at the northern end of the Area, is shown too for reference. The spatial variation of the climatic conditions is caused by relief such as altitude, land coverage, orientation of mountains, etc. and the prevailing flow of air. There is no significant difference in climatic conditions in the Study Area due to the unity of geomorphologic setting.

Monthly Average of Climatic Data from 1981 to 2000

Precipitation (mm)

Station	1	2	3	4	5	6	7	8	9	10	11	12	Sum
Senica	31.8	32.7	34.6	36.1	56.9	65.5	67.5	52.6	57.2	38.1	44.6	49.7	567
Malacky	27.9	31.1	35.6	39.2	62.1	76.0	67.8	55.4	60.0	35.4	48.4	44.3	583
Stupava	25.5	34.3	36.6	44.6	62.3	76.0	66.5	52.5	69.0	39.6	46.4	41.4	595

Monthy

Station	1	2	3	4	5	6	7	8	9	10	11	12	Average
Senica	-1.4	0.1	4.5	9.8	14.9	17.6	19.7	19.5	15.0	9.9	3.7	0.0	9.4
Malacky	-0.7	0.7	5.1	10.3	15.6	18.4	20.6	20.2	15.5	10.3	4.2	0.6	10.0
Stupava	0.2	2.4	5.4	10.5	15.3	18.2	20.3	20.1	15.6	10.7	4.5	0.9	10.3

Humidity (%)

Station	1	2	3	4	5	6	7	8	9	10	11	12	Sum
Senica	87	82	77	70	72	73	70	70	77	79	86	89	78
Malacky	84	80	74	67	68	69	67	69	76	78	84	86	75
Stupava	84	78	74	68	68	71	69	68	76	77	84	86	75

Coudy Ration (10-grade system)

Station	1	2	3	4	5	6	7	8	9	10	11	12	Average
Senica	6.9	6.1	5.8	5.0	4.4	4.6	4.1	3.9	4.7	5.1	7.0	7.5	5.4
Malacky	7.0	6.1	6.2	5.2	5.0	5.3	4.6	4.2	5.0	5.2	7.0	7.3	5.7
Stupava	7.2	6.2	6.5	5.8	5.2	5.4	4.9	4.5	5.6	5.7	7.6	7.6	6.0

Wind Velocity (m/s)

Station	1	2	3	4	5	6	7	8	9	10	11	12	Average
Senica	2.4	2.4	2.5	2.7	2.3	1.9	1.7	1.7	1.8	2.3	2.5	2.4	2.2
Malacky	2.0	2.2	2.3	2.5	2.2	1.9	1.7	1.6	1.6	2.0	1.8	1.8	2.0
Stupava	2.8	2.9	3.0	3.1	2.8	2.5	2.3	2.1	2.3	2.7	2.6	2.4	2.6

Summary of Evapolation (mm)

Station	1	2	3	4	5	6	7	8	9	10	11	12
Malacky	-	-	-	58.9	85.3	100.7	113.8	113.3	70.7	48.1	-	-

Source: Based on data prepared by SHMI

(2) Drought Condition of Recent Years

The drought condition of the Study Area can be represented by the observed data of the Malacky Station. These 10 years were considered to be a period of high annual precipitation, even the 2~3-year frequency drought with 523 mm of annual precipitation was observed in 1994. However, the precipitation during the vegetation-growing period varies widely from 264~536 mm, and several droughts

occurred, i.e., 10-year frequency drought in 1992 (264 mm) and 2000 (269 mm), 3~5-year frequency drought in 1994 (290 mm), 2~3-year frequency drought in 1991 (313 mm).

Precipitation at Malacky Station : Last 10 Years

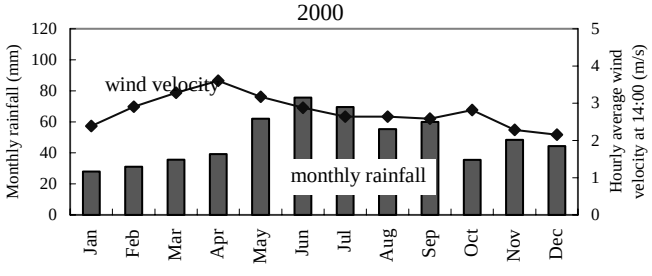
Source: Based on data prepared by SHMI

(3) Wind in Spring Season

This area suffers from strong winds from March to May and the precipitation is relatively low in early spring from February to April. The fields are not covered with plants in this season because the summer crop, especially maize, is sown in the middle of April. Because of this, it could be said that the risk of wind erosion is high in light sandy soil areas.

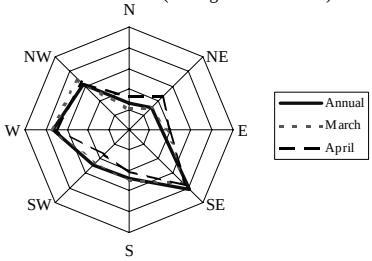
According to the wind erosion risk evaluation prepared by Slovakia Soil Science and Conservation Research Institute, the whole Study Area is classed as a high-risk area. At the Malacky station, which is representative of the Study Area, the monthly hourly average wind velocity from March to May at 14:00 was 3.3 m/s, 3.6 m/s and 3.2 m/s respectively and the monthly precipitation from February to April is between 28 and 39 mm (Average of 1981 to 2000). Wind direction is concentrated to the Northwest and Southeast through the year.

Anual Climate Condition of Malacky in Average 1981-2000



Source: Based on data provided by SHMI

Wind Direction at Malacky (Average of 1981-2000)



The wind conditions in Spring 2002 are measured in the field at Gajary, which is mentioned as one of the most high-risk areas for wind erosion in the Study Area. In these results, the maximum instantaneous wind velocity is 18 m/s, the maximum 2 minutes continuous wind velocity is 10.5 m/s and the hourly average wind velocity at 14:00 is 7.3 m/s. The accumulated time that a strong wind, with a 2 minutes continuous wind velocity of 7 m/s or more blows, was 16.3 hours.

Record of Strong Wind at Dolceky in April 2002

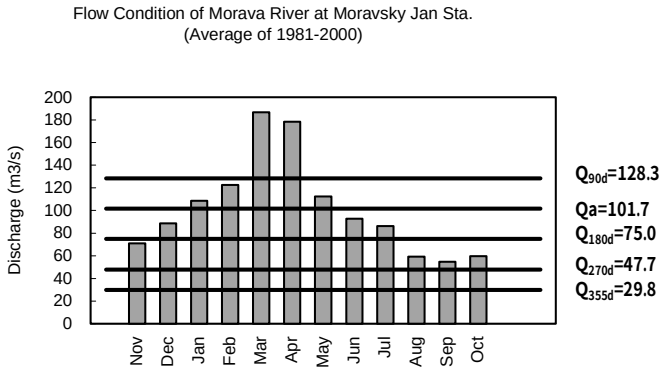
Accumulated time ofwind velocity of	3 m/s or more	5 m/s or more	7 m/s or more	10 m/s or more	12 m/s or more
Number of days	29	24	8	2	0
Accumulated hours	228.2	81.2	16.3	0.1	0.0

Source: Data for 30 days from March 31 to April 29, 2002 Observed by Study Team

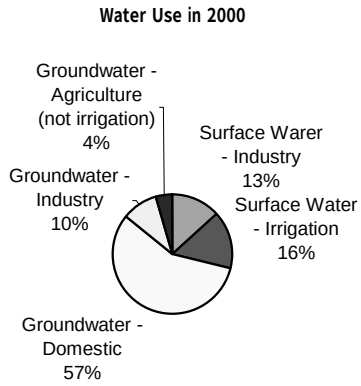
(4) Condition of Major Rivers and Water Resources

The Zahorska Lowland is located on the left bank of the lower Morava river basin, this River flows along the border of Slovakia and Austria. The total catchment of Morava is 26,580 km^2, and Slovakia occupies 2,228 km^2 of it, that is equivalent to 8.6% of the whole river basin. The major river network in the Study Area is described with Morava River as the main stream, Myjava, Rudava and Marina rivers are major tributaries and a prepared drainage canal running along the Morava river. The average discharge of Morava River at the Moravsky Jan is 102 m^3/s. In general it increases from March to April, and decreases from August to October. The high water season in the spring from March to April is caused by the concentration and run off of snow melting in the upper Morava basin. The period of such season and water level varies according to the amount of snowfall in winter and the time of rising temperature in early spring. The dike embankment constructed as flood mitigation measures were started in 1930' along the Morava River and major tributaries, and it will be improved to cope with 100-year frequency flood in 2003. In the spring season, the water level of Morava River becomes higher than ground level, so that gravitational drainage is difficult. The discharge is becoming low in the summer season, but sometimes a flood happens between July and October because of intensive rainfall in the upper stream.

The major source of surface water is Morava and its major tributaries in the Slovakia part of the lower Morava Basin. To supplement them, 24 reservoirs were constructed and the total effective capacity is about 5 million m^3. In the Study Area, there is one (1) large-scale reservoir and six (6) small-scale with a total effective capacity of 3.28 million m^3.



Groundwater is plentiful and represented about 70% of total water use in 2000. In general, surface water is used for agriculture including irrigation and industrial use. Groundwater is used for domestic and industrial purposes, and is not used for agricultural activity.

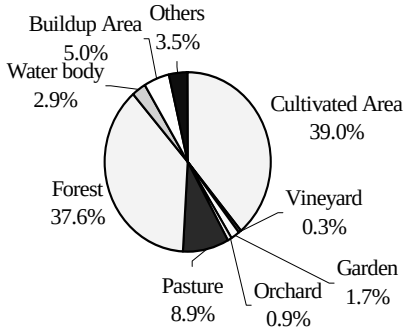


3.4 AGRICULTURE

3.4.1 AGRICULTURAL LAND

The areas of farmland and cultivation in the Study Area are 42,931 ha and 32,889 ha, occupying 50.9% and 39.0% of the total area respectively. The proportion of farmland above is similar to that of 49.8% for the whole country. The proportion of farmland for Malacky District is 50.4%, with 55.1% for Senica District and 49.4% for Bratislava IV. The Malacky District occupies about 80% of the farmland in the Study Area.

Share of Land Registration in the Study area
(As of 31.Dec.1999)



(Unit:ha, %)

Agricultural Land					Non-Agricultural Land			
42,931 50.9%					41,394 49.1%			
Cultivated Area	Vineyard	Garden	Orchard	Pasture	Forest	Water body	Buildup Area	Others
32,889 39.0%	294 0.3%	1,460 1.7%	776 0.9%	7,511 8.9%	31,725 37.6%	2,435 2.9%	4,243 5.0%	2,992 3.5%

Souce:National Geodetic and Cerograph Institute
Note: Male Karpati foothill area(232 square km) is included in total area

There are various sizes of farming plots according to location, but it can be said that large plots characterize the farmland use of the area. In Male Levare village, large plots between 50~100 ha occupy 50% of the total farmland while medium sized plots make up 40%, and the rest are generally around 10 ha. In general, cereal and feed crops are planted in large plots, with maize and sunflower in medium sized plots.

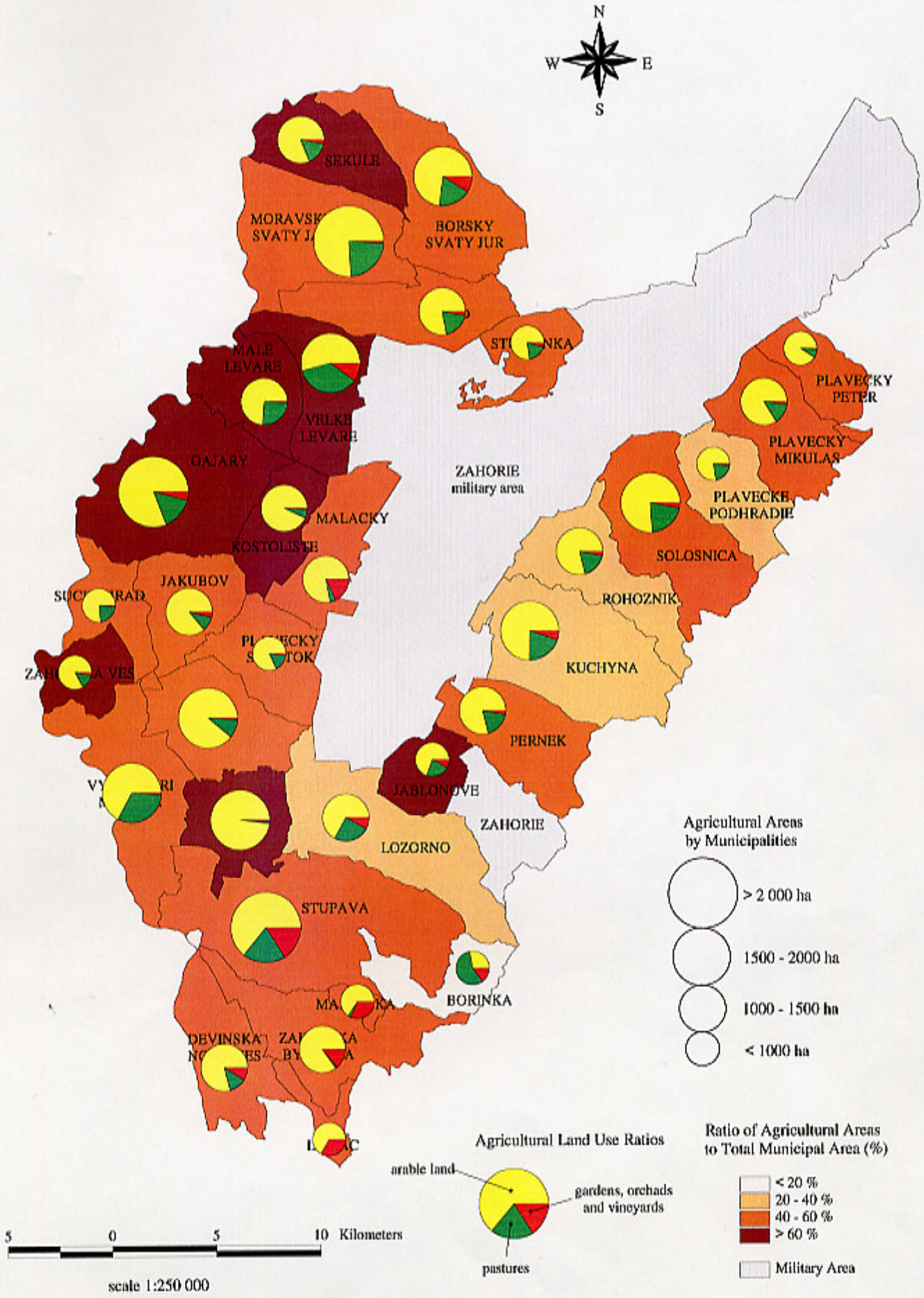


Figure 1.2 Land Use Registration Map