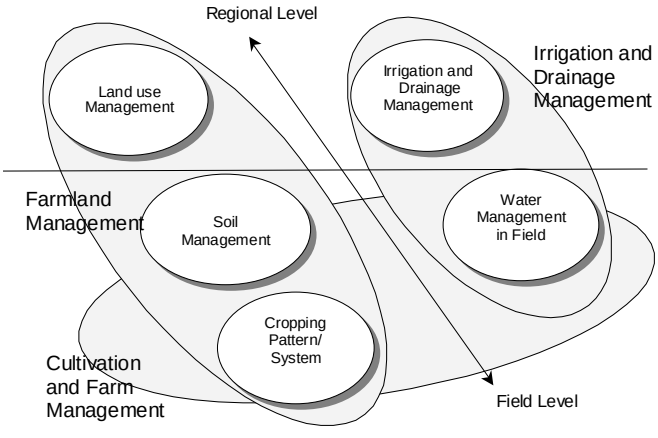
CHAPTER 3 SOIL AND WATER MANAGEMENT PLAN

3.1 FORMULATION OF SOIL AND WATER MANAGEMENT PLAN

3.1.1 OBJECTIVES AND APPROACH

The objectives of the Case Study are to conduct detailed investigation and examination in a limited area so as to reinforce the Guidelines, and to clarify the problems expected in the extension of the Guidelines to farmers and related people when applying the measures. For this purpose, the soil and water management plan was examined for the case study area.

The soil and water management plan is formulated as a combination of several technical measures to improve the conditions of agriculture in order to achieve the expected agriculture introduced in the Guidelines. The components of the plan consist of two levels, i.e., the regional level and the field level, in accordance with the character of each measure. The measures at the regional level are mainly conducted by the governmental agencies, public organization and private companies having contracts with public organizations. On the other hand, the measures in the field level are carried out by the farming body. Those technical measures proposed in the soil and water management plan are combined into three management plans by their character of implementation, i.e., a) the farmland management, b) the irrigation and drainage management, and c) the cultivation and farm management.



Components and Implementation Levels of Soil/Water Management Plan

3.1.2 BASIC UNDERSTANDING OF CASE STUDY SITE

(1) Problems of Case Study Site

The productivity of agriculture in the case study site is generally low due to the low fertility sandy soil, and cereal production is dominant in the area. The mixed farming of cereal production and livestock is the typical style of farm management. The mixed farming enables steady farm management however the profitability is not high and it takes a long time till the profit appears. In order to solve that, cash crops such as oil crops, raw material cereals and vegetables, of which demands are increasing through the expansion of contract farming, are promoted in the case study site. Under the circumstance, farming bodies are required to solve the following objectives:

- To establish highly profitable farm management through realizing efficient land use and appropriate crop selection.
- To put emphasis on improving profitability rather than increasing production considering that agricultural products are potentially in over production.
- To promote market-oriented agriculture in closer cooperation with food processing and trading companies so as to achieve viable farms to cope with privatization.
- Support to farmers by subsidy is required and to be continued in order to promote agriculture in the area due to the disadvantages of the land. At the same time, self-effort of farming bodies to improve farm management is also indispensable.
- Improvement of technique of irrigation, soil conservation and cultivation is required to stabilize production and improve quality.

(2) Expected Agriculture and Farm Management

Considering the above conditions, the expected agriculture and farm management of the case study area to be established in 5 to 10 years ahead are set out as follows:

- To develop highly profitable mixed farm management through enhancing the cooperation of cereal production and livestock.
- To promote eco-farming, decreasing agricultural input such as agricultural chemicals and pesticide, etc.
- To stabilize farm management by an increase of production and profit through appropriate input of technology factors such as irrigation, fertilizing, chemical application, etc.
- To promote market-oriented agriculture as a steady and diversified management by cooperation with food processing and trading companies.
- To protect natural environment and rural landscape.

3.1.3 SCENARIOS OF CASE STUDY

In the Case Study, the soil and water management plan for the area is examined based on the proposed land resources evaluation and appropriate land use in the guidelines. Principally, the agricultural land use including crop selection and cropping pattern are to be decided by the results of land evaluation. 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. This issue cannot be discussed in the case study because the financing system for agricultural loans should be discussed as national policy. To avoid the confusion caused by including this matter in examining the case study, 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:

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. Necessary repair and recovery work for the irrigation system will be implemented appropriately by SWME-ID and farmers will prepare the necessary field irrigation equipment. 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. Appropriate improvement of crop cultivation technique will be introduced in both the irrigation and rain-fed farming area.

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. Necessary repair and recovery work of irrigation system will be implemented appropriately by SWME-ID and farmers will prepare necessary field irrigation equipment. Appropriate improvement of crop cultivation technique will be introduced in both the irrigation and rain-fed farming area.

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. Appropriate improvement of crop cultivation technique will be introduced in both the irrigation and rain-fed farming area.

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

(1) Relation with Livestock Sector

When examining the case study, the production level of the regional livestock sector must be considered due to the character of the regional agriculture being mixed farming. Considering the trend of domestic demand for products and the requirement of joining the EU, the following preconditions were set:

- Number of milking cow will be kept at the current level. The increase of milk production by improving the productivity is expected.
- Breeding meat weights of beef cattle and pig will be kept at the current level in total. The proportion of livestock types will be changed within the total meat weight and the shift from beef cattle to pig is expected.
- Self-supplied feed for livestock will be kept.

These preconditions lead to the expectation that significant increase of livestock production will not be realized and the necessity of producing self-supplied feed such as wheat, maize and pasture will be kept in future even though the proportion of livestock types will be changed. .

(2) Irrigation Farming

Irrigation farming expected in the case study is divided into two types from the viewpoint of farming activity, i.e., the semi-intensive irrigation of oil crops and raw material cereals and the intensive irrigation of vegetables.

1) Oil Crops and Raw Material Cereals

- Sunflower and Spring Barley for malting are currently cultivated as contract farming with processing factory or traders. Trading is expected to remain in future and the expansion of the farming contract is a precondition of expansion of production.
- Quantitative and qualitative stability of crop production must improve to achieve the expansion of the farming contract.
- Wheat can be sold as food cereals, which is more profitable than self-supplied feed or selling as feed cereals, in which case high quality is achieved by introducing irrigation and appropriate fertilizer application.
- Irrigation is indispensable for wheat for food cereals and soybeans introduced as a soil resting crop.
- Maize and alfalfa are also considered as irrigation crops but they are only irrigated when irrigation water (or field irrigation equipment) is enough for them.

2) Intensive Vegetable Irrigation

- Vegetable cultivation by enterprises aims to ship crops as raw materials for the food processing factory and will be carried out mainly by contract farming. Expansion of contract farming is a precondition for promoting vegetable production in the area.
- Vegetables are expected to be cultivated on certain farming plots with irrigation and appropriate management including fertilizer application and soil fertility improvement.

(3) Rain-fed Farming

Rain-fed farming is to be improved at the same time as the promotion of irrigation farming because large areas of rain-fed farming will remain and it still has an important role in the regional agriculture. The following issues are considered for the rain-fed farming in the case study.

1) Rain-fed Farming in Zone II

- Big rise of field investment or input such as fertilizer or agricultural chemicals will not be expected.
- In the rain-fed farming area with the sandy soil that is dominant in Zone II, self-supplied feeds such as winter wheat are cropped.
- Improvement of rain-fed farming by changing crops and improving quality will contribute to increase profitability through the livestock sector.
- Consideration of keeping or improving soil fertility in farming practice is indispensable to sustainable farmland use. From this viewpoint, the crop rotation including soil-resting crops such as alfalfa or legumes will be promoted.
- Land use diversion to permanent grassland is promoted where crop cultivation does not have economic advantages.
- On land that is marginal for crop cultivation two types of land use are recommended in accordance with its conditions, i.e., to introduce the cereal crop rotation with pasture and to convert land use to permanent grassland.

2) Rain-fed Farming in Zone III

- The area between the embankment of the Morava River and the Laksarsky Canal is considered as a positive development area for farming. It is necessary to consider the introduction of appropriate crop rotation and farmland management to increase productivity and sustainability of land use.
- The land possessing disadvantage due to low fertility, water logging or frequent inundation, etc, is recommended to be used as natural grassland because

development or the high level input of chemicals are restricted in the environmental protection area.

3.2 FARM LAND MANAGEMENT

3.2.1 FARM LAND MANAGEMENT

On the premise of sustainable development of agricultural production in the market economy, farm land management should be built up on the basis of rational land-use planning. In planning, particular consideration must be paid to following items :

(1) Coordination with Farm Management and Rural Demand

Land use plans should be adaptable to the sound farm management of each farming unit as well as adaptable to the total demand of the rural community. Sound and profitable farm management is essential to assure continuous rational land use as well as to fulfill their responsibility to the rural community.

On the contrary, in European standards of farming, total planning of production must be adapted to the total demands of the rural area, the country and the other European countries. The first priority should be set by the internal demand of their own farm, followed by rural demand, country demand and total demand in European countries. One sided large-scale production, aiming at one unilateral export at low price, cannot harmonize the common policy of European society. Production targets of cereal crops, feed crops and oil crops as well as milk, beef, chicken and eggs should be set by the real demand.

(2) Adjustment with Ecological Management to Protect Rural Environment

Protection of a sound environment has the first priority for sustainable development of agriculture in European society. In principle, use of chemicals and industrial

fertilizer should be minimized, particularly in environmental protected areas and in sources of drinking water. Effective use of domestic manures such as animal wastes, harvest residues and other domestic resources should be included in the farming plan with a high priority. Organic farming where only domestic natural resources are in use should be another target of a future program of farming.

(3) Verification of Individual Technical Measures under Actual Conditions

Individual technical measures, which will be applied to the farming in this area, should be verified in their validity, effectiveness and profitability as well as their limitation under actual farming conditions. Blind use of common technical measures cannot always bring good results, and should be avoided without verification on the ground. Every technical measure has limitations in some way, and use of them without realistic verification sometimes brings undesirable effects.

3.2.2 LAND USE PLAN

(1) Land Use Plan

The land use plan is examined based on the results of land resources evaluation shown in Chapter 2. Because it is necessary to consider the field management of farmers / farming bodies, the results of land resources evaluation were converted to the farming plot base evaluation. The evaluation of farming plot is shown in Figure 3.9. In addition, the possibility of irrigation farming was considered, to identify appropriate land use type. The farming plots located in the Case Study area were categorized into 1) irrigation agriculture area, 2) rain-fed agriculture area, and 3) land recommended for use as grassland as shown in Figure 3.10.

Summary of Agricultural Land Use Plan of Case Study Area

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

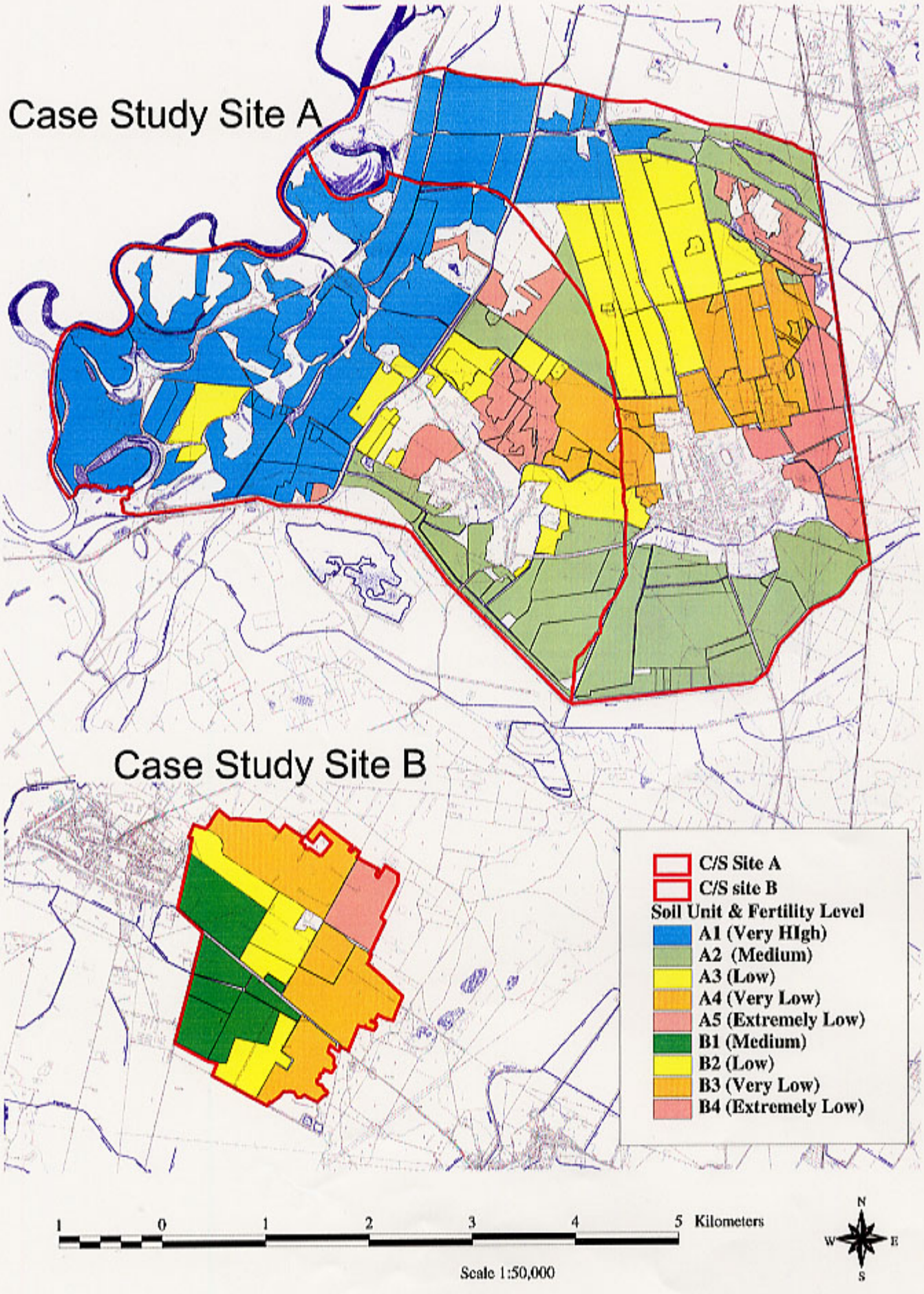


Figure 3.9 Soil Unit by Farming Plot

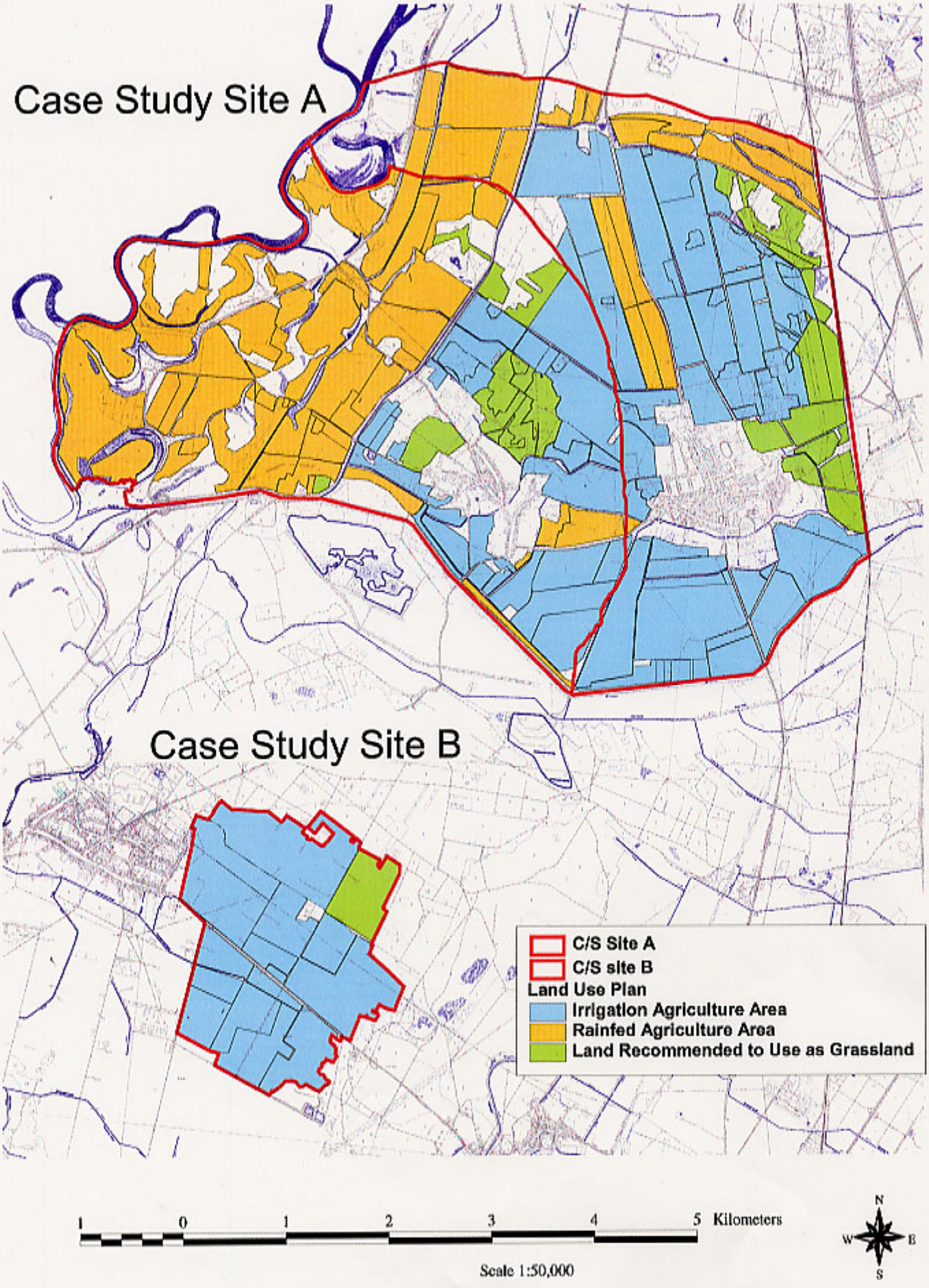


Figure 3.10 Land Use Plan of Case Study Area

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 111 ha of the land are used for crop cultivation, that is 57% (63 ha) of cropping area is used for rye, 20% (22 ha) for oat and 20% (21 ha) for wheat in 2001, and 64% (71 ha) for sunflower, 20% (22 ha) for oat and 18% (20 ha) for rye in 2002. If irrigation water is secured for these farmlands, there is a possibility to use those areas for cropping. However, as mentioned in the examination of irrigation water use in Chapter 3.3, it is difficult to secure water for this area. It is recommended that the areas cultivating sunflower and cereals are shifted to grassland use, from the viewpoint of sustainable agricultural land use under these conditions.

Current Land Use of Conversion Recommended Farm Land

(unit : ha)

Land use	Year 2001	Year 2002
Grassland		
meadow	94	94
turf	35	35
Cropped		
not using	5	0
oat	22	22
rye	63	18
sunflower	0	71
wheat	21	0
Total	111	111

(2) Expected Land Use and Cultivation Type

The expected land use and cultivation types proposed in the Guidelines were applied to each land use types in the land use plan of the case study site. The cultivation types applied to the case study sites are:

- Cultivation of highly profitable crops using irrigation: highly profitable cultivation type, which is enabled by proper irrigation and fertilizing through fully using existing irrigation facilities.

- Cultivation of crops considering maintenance of soil fertility: low cost production of feed for animals by improving efficiency of cultivation, which is achieved by proper soil fertility management techniques such as organic matter recycling or proper field rotation using soil-resting crops based on the combination of crop production and livestock farming.
- Cultivation of crops considering protection of natural environments: low environmental stress agriculture using the natural condition as it is, needs to be promoted in this area.

In Zone II of the case study site, cultivation of highly profitable crops using irrigation and cultivation of crops considering maintenance of soil fertility are applied. Marginal land for cropping is recommended for use as grassland. Land for irrigation farming is expected to develop highly profitable irrigation farming even the development rate varies depending on the condition set in each scenario. The remaining part of the land for irrigation farming and the land for rain-fed farming are the area which is developed cultivation of crops considering maintenance of soil fertility. Some of land for rain-fed farming, of which fertility level of soil is very or extremely low, are expected to be used as grassland in addition to the land recommended for grassland use in the land use type.

In Zone III of the case study site, which is categorized to land for rain-fed farming in land use type, cultivation of crops considering protection of natural environments is expected to be developed in fertile soils and natural grassland use is expected in the low fertile soils.

3.2.3 POSSIBLE CROP ROTATION

(1) Possible Crop Rotation

By combining the results of the land resources evaluation and the recommended cropping pattern proposed from the viewpoint of proper crop selection and sustainable farmland use, crops and their cropping pattern are proposed for farming plots considering the category of land and possibility of irrigation use. The possible

crop rotation of the case study site is examined and proposed as shown in the table below with consideration of the expected land use and cultivation types and the principles of crop selection and cropping pattern discussed in Chapter 2.7.1 Crop Rotation and Cropping Pattern.

Possible Crop Rotation in Case Study Site

Zone	Land Evaluation			Code	Crop rotation
	In Draf Land Evaluation	In Case Study			
II	A(1)	Irrigation Area	A-1	IR-1	sunflower <4-11> s. barley <4-8> rapeseeds <9-6> food wheat <10-7>
				Veg	vegetables <3-11>
	B(1)		A-2, B-1	IR-2	sunflower <4-11> food wheat <10-7> rapeseeds <9-6> food wheat <10-7>
				IR-3	sunflower <4-11> soybean <4-10> food wheat <10-7> s. barley <4-8>
				veg	vegetables <3-11>
	C(1)		A-3, A-4 B-2, B-3	IR-4	maize <4-11> maize <4-11> s. barley <4-8> alfalfa alfalfa alfalfa
				IR-5	maize <4-11> maize <4-11> s. barley <4-8> maize <4-10> w. wheat <10-7>
	A(2)	Non Irrigation Area	A-1	RF-1	rapeseeds <9-6> food wheat <10-7> /s. barley <4-8>
	B(2)		A-2, B-1	RF-2	food wheat <10-7> maize <4-11> maize <4-11> alfalfa alfalfa alfalfa
				RF-3	w. wheat <10-7> maize <4-11> maize <4-11> rapeseeds <9-6>
	B(3)		A-2, B-1	RF-4	w. wheat <10-7> rye <10-8>
	C(2)		A-3, A-4 B-2, B-3	RF-5	w. wheat <10-7> rye <10-8> maize <4-11> alfalfa alfalfa alfalfa
	C(3)			rye	rye <10-8> pasture
III	A(2)		A-1	NR-1	sunflower <4-11> s. barley <4-8> food wheat <10-7> maize <4-11>
	C(3)		A-3, A-4	pasture	pasture

<Notes> 1. High soil moisture areas for alfalfa will be used for the cultivation of red clover.
2. Triticale will be included to the cultivation of rye.

Figure 3.11~13 shows the possible crop rotation for each scenario and those areas are summarized in Table 3.2 and the summary of expected cultivation area of crops in accordance with the applied cropping pattern is shown in Table 3.3. The samples of cropping of Scenario A are shown in Figure 3.14.

Summary of Scenarios (Unit: ha)

Items	Scenario A	Scenario B	Scenario C
Crop Cultivation			
Expected cultivation area by crop			
Wheat	219	271	243
Spring Barley	264	201	122
Maize	420	288	300
Vegetables	204	145	101
Sunflower	167	179	93
Alfalfa	198	185	288
Rapeseed	28	41	58
Rye	41	78	207
Soybeans	18	32	0
Asparagus	105	104	104

During the application of the proposed crops and cropping patterns to farming plots, the following issues were considered.

1) Vegetable Irrigation

The intensive cultivation of vegetables using proper irrigation is proposed as a major topic in the proposed cropping pattern. Because the soil improvement during cultivating vegetables is one of the most important measures in vegetable cultivation, the farm land for vegetables is expected to be located in the most fertile land with irrigation in the area. The farming plots categorized as medium fertile soil (soil A-2 and B-1 of the soil unit) are proposed as the vegetable irrigation areas in the Case Study Area. The vegetable irrigation area, including existing asparagus plots, is set from 205 ha to 306 ha for each scenario.

2) Sunflower in Zone-II of Site-A

Sunflower is cultivated on the plot of 212ha in Zone-II of Site-A. They are cultivated over the proper area without considering the land conditions. Sunflower is only cultivated in 30% of the A-2 land category and the remainder is distributed in the land categories A-3 to A-5. Even in the A-5 Zone, which is categorized as unsuitable land for crop cultivation, 21% of the area has been used for sunflower cultivation.

The location of 212 ha of sunflower in this area is considered to be unstable because the agricultural body cultivating sunflower here started it a few years ago and they are still seeking the optimum agricultural land use. Also the body has a large farming area other than the Case Study area and the farming plots in the case study area consists of only one part of their rotation. Due to that, it is proposed to limit sunflower in this area to farming plots, which have enough suitable land condition and are able to use irrigation.

(2) Expected Production

The expected production amounts according to the cultivation area in existing year and each scenario are shown in the table below.

Expected Production Amount by Scenarios

(Whole C/S Site) (Unit: ton/year)

	2001*	2002*	Scenario A	Scenario B	Scenario C
Wheat	61.0	13.0	351.9	713.0	605.5
F.Wheat	940.0	481.0	566.4	349.0	349.0
Spring Barley	106.4	202.4	1,093.1	839.5	451.0
Maize	1,221.5	1,213.5	2,155.3	1,185.4	1,228.0
Vegetable	684.0	684.0	7,344.0	5,220.0	3,636.0
Sunflower	172.0	618.0	415.4	446.4	223.0
Alfalfa	160.0	160.0	1,932.0	1,457.4	2,318.2
Rape Seed	158.0	109.0	50.2	74.4	104.8
Rye	1,383.0	1,138.0	114.0	207.0	569.1
Soybeans	0.0	0.0	36.3	47.5	0.0
Apple	0.0	0.0	0.0	0.0	0.0
Meadow	1,809.0	1,836.0	1,896.0	2,206.0	2,211.0
Asparagus	416.0	416.0	420.0	420.0	420.0

* They are culculated based on the existing cultivated area and expected average yield in Crop Budget.

The production amount is increasing more than the existing condition in vegetable, barley, wheat and alfalfa as the scenario is adopted. On the other hand, the one in rye is decreasing.

The total amount of feed demand in the case study area is calculated as 1,615 ton in

TDN based on the total demand of Malacky district, which is mentioned in 2.8. In the expected production of existing year 2001 and 2002, the total amount is less than this demand at 1,420 ton-TDN, 1,381 ton-TDN when it is calculated from feed crops as wheat, maize, alfalfa and meadow. Due to that rye is used to supplement this shortage of feed. In each scenario, the total production amounts of the four feed crops mentioned is getting larger in scenario B, C and A sequentially. However, the smallest expected production in scenario B is still accounted as enough to meet total demand. The surplus amount of feed is less than the total amount of maize, thus it can be sold as feed crop.

The consumed amount in each feed crop could be estimated based on actual feeding as in the following table.

Demand and Presupposed Consumed Amount by Scenarios

	Demand	Comsumed Amount for livestock (Ton)				
	Ton/Year	2001*	2002*	Scenario A	Scenario B	Scenario C
Wheat	399	61	13	352	544	543
Maize	613	1,222	1,214	656	434	434
Alfalfa	1,090	160	160	1,166	1,090	1,090
Meadow	2,059	1,809	1,836	1,896	2,206	2,211
Rye		252	304	0	0	0

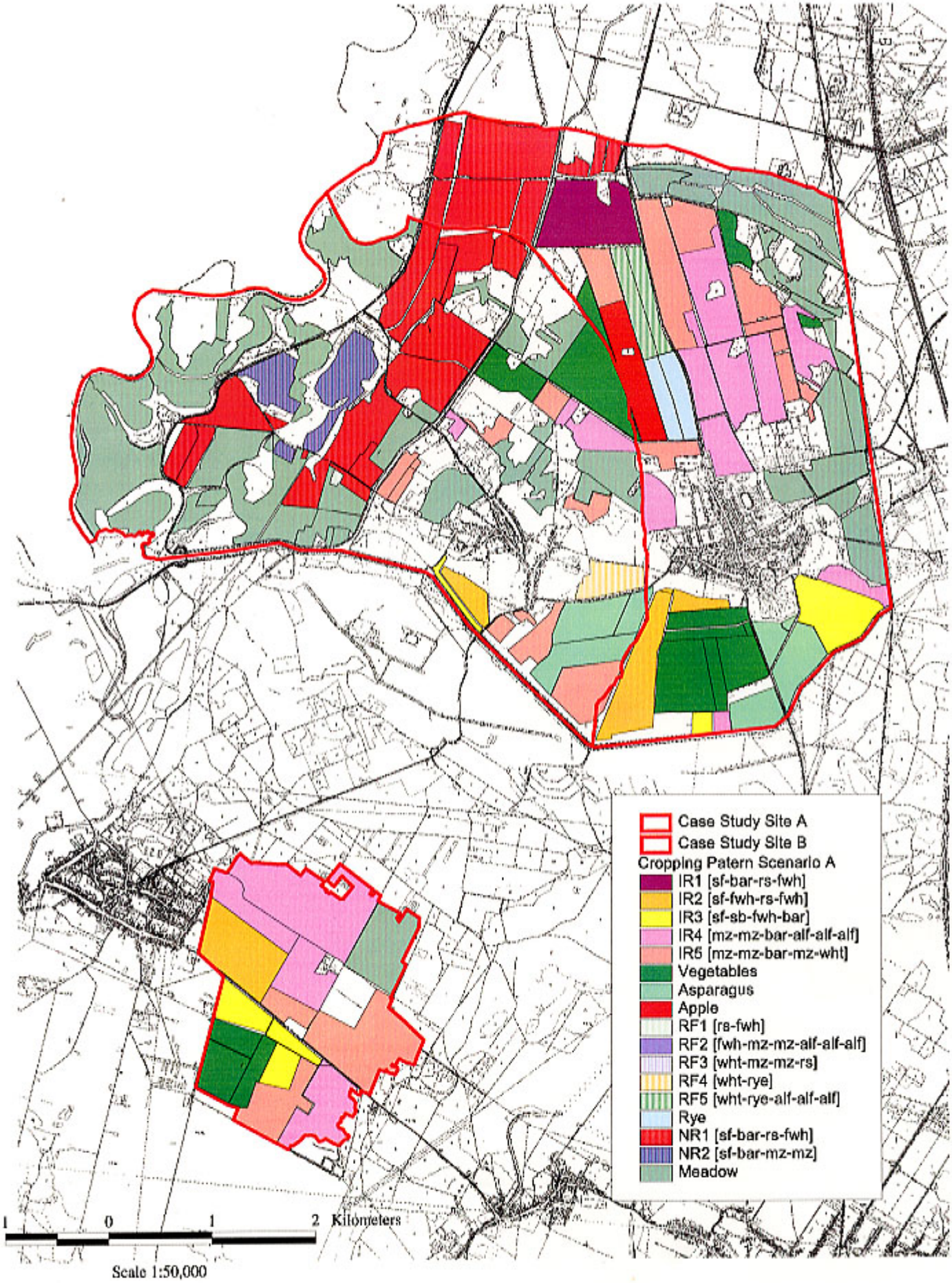


Figure 3.11 Expected Crop Rotation - Scenario A

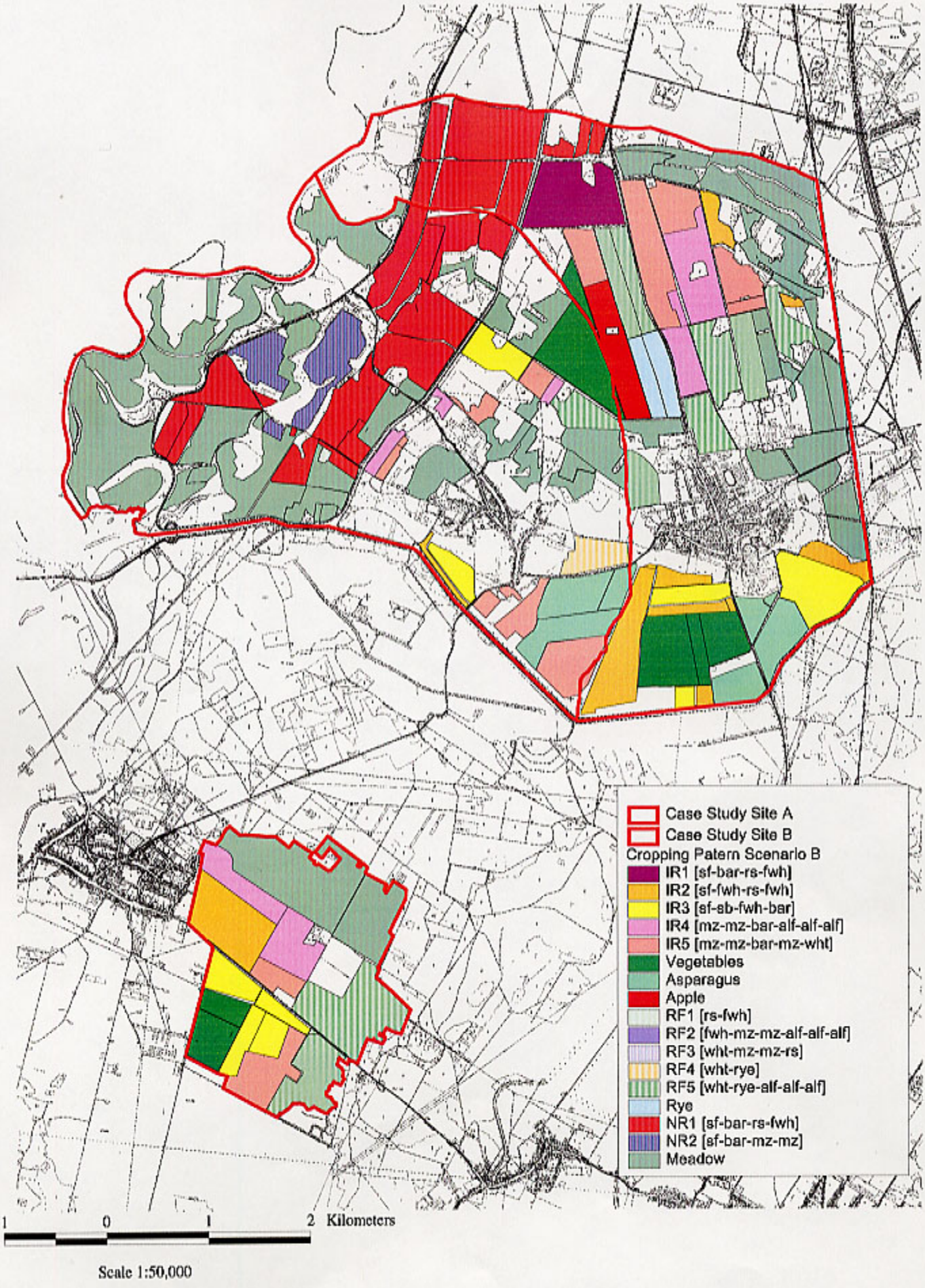


Figure 3.12 Expected Crop Rotation - Scenario B