Chapter 5
Suitability classification
Presentation of the results

5.1 Introduction

5.1.1 General

In this chapter, all data concerning the (reconstructed) land systems in the three research areas (Pon-tine region, Salento Isthmus and Sibaritide; chapter 3) are evaluated with respect to the data concern-ing the Bronze Age, Iron Age and Roman Age land utilisation types (chapter 4).

The land systems are evaluated regarding to their:

- *agro-ecological characteristics*, which affect the growth and development of the crop, such as water availability and nutrient availability.
- possibilities to be cultivated in terms of *workability*, for example soil texture, stoniness and slope percentage.
- *In contrast to modern farmers, ancient farmers probably did not consider fertility to be the most important factor determining soil suitability. In this context, workability is mentioned much more in the literature (for example Columella’s *De re rustica*; see also chapter 5 on Roman soil perception) next to land characteristics such as water content, depth of soil, light and heavy soil, and structure. Sometimes colour is mentioned, merely as a diagnostic indicator of a specific kind of soil (Verhagen in: “New Developments in Italian Landscape Archaeology: proceedings of a 3-day conference held at the University of Groningen, April 13-15, 2000”, theory and methodology of field survey; land evaluation and landscape perception; pottery production and distribution).
- *degradation hazard* with accompanying soil loss caused by surface erosion. The risks are described in terms of, for example, slope percentage and type of cropping system.

In order to classify soil suitability, I assume that farmers choose to settle in the vicinity of the best soils for optimal yields using minimal effort (according to the *least effort principle*; chapter 1), although it is realised that other factors may influence settlement location as well. These other factors (such as safety or distance to an urban site) have not been taken into consideration in this study.

5.1.2 Structure of this chapter

Chapter 5 is divided into three main sections. In the first sections (5.2, 5.3 and 5.4), the land use re-quirements (such as workability of the soil) of the various land uses (such as subsistence farming) for the three research periods are described in detail. Each land use poses specific requirements to the soil, which are expressed in specific land characteristics (such as slope percentage and soil texture). Finally, for each land use requirement, the severity levels are determined. These levels concern the suitability of a certain area for the kind of land use: limited, marginally suitable or suitable (definitions were given in 2.3.1). As was explained in the previous chapter, the suitability of a soil depends on various factors, for example agricultural technology and crop type.
The second section (5.5) shows the definitive evaluation results of all land utilisation types for all landforms during the first millennium BC; these are presented both in tables (including the limiting factors) and on maps. For the Agro Pontino, the reconstructed landforms are also incorporated.

The final evaluation results, especially those for grape and olive cultivation, are compared with the modern agricultural equivalents in order to test the validity of the evaluation (5.6). The last section (5.7) also describes the main differences between the three areas in terms of suitability. Some concluding remarks are given.

Table 12 of Appendix C-I shows the ALES data entry form of all data described in this chapter.

5.2 Land use requirements (LURs) of Bronze Age land utilisation types (LUTs)

In section 4.3.5, three LUTs were defined for Bronze Age Central and Southern Italy and an additional LUT for Southern Italy only:

1. Self-subsistence farming, using ignicoltura with long fallow and sectorial fallowing systems,
2. Permanent cultivation of favoured plots, with or without continuous water supply, with sporadically utilised hinterland (infield-outfield system),
3. Medium-sized, rotational farming systems associated with cereal farming, animal-drawn ploughs and manure, and
4. Small-scale cultivation of olives and grapes, in Southern Italy only (table 4.1).

5.2.1 Self-subsistence farming, using ignicoltura with long fallow and sectorial fallowing systems

Both in Central and Southern Italy, it is assumed that Bronze Age autarkic farmers lived in or near centralised settlements\(^1\) and cultivated relatively small plots using hoes only. Since these farmers produced crops for their own subsistence and in most cases did not aim at surplus production, the land use requirements of the LUT for a mix of crops will be examined, instead of individual crops. Land use requirements such as moisture availability and workability are assumed to be important.

We can assume that Bronze Age farmers avoided wet areas, because drainage systems were not common in this period (Forni 1990). Therefore, moderately sloping areas were preferred. For lack of irrigation facilities, the self-subsistence farmers probably also will have disliked dry soils. Whether these farmers manured their land is uncertain. In general they will have desired fertile or rather fertile soils. Lastly, heavy clayey areas were not used because they could not be worked (easily) with simple equipment.

To enter these requirements into ALES, the data have been classified in sequence of importance.

1. Soil humidity is considered to be the main LUR, associated with soil depth and soil moisture availability. Soils had to be deeper than 30 cm. Drainage classes provide a useful tool to classify soil humidity: poorly drained soils were limited, well-drained soils provided no problem, excessively drained soils were also limited (because of their low water holding capacity).
2. Next, workability is assumed to have been important. Although various researchers examined workability with regard to Roman perception, it is assumed that Bronze Age farmers valued their land accordingly, having even lesser technological resources. Slope classes and soil texture were considered to be the main requirements: soils with a clayey texture were limited and very steep slopes were limited for self-subsistence farming. In situations where ploughs were

\(^1\) Survey is unable to detect isolated farmsteads till now (chapter 13, Van Leusen 2002)
not used, stoniness and rockiness probably would not have been a serious problem, with the exception of rubble land or land with more than 90% rock outcrop.

3. *Nutrient availability* (or soil fertility) is expressed in terms of soil type classes (section 2.2). For example, thin soils (Leptosols) were limited and relatively well-developed soils (such as Luvisols) were suitable. A range of soils with intermediate fertility was marginally suitable for autarkic farming.

4. Presuming that these farmers did not take measures to prevent *water erosion*, flat, almost flat and gently sloping areas posed no problem, sloping to moderately steep areas were slightly limited and steep to very steep areas were unsuitable.

Table 1 (Appendix C-I) shows schematically and systematically the land use requirements previously discussed in terms of accompanying land characteristics. In the last column (severity level names), the suitability of 'specific' land for the functioning of self-subsistence farming is determined on basis of its land characteristics. For example, in terms of moisture availability, well-drained soils pose no problem for subsistence farming activities; wet and dry soils must be avoided.

A few land use requirements (or land qualities) relate to similar land characteristics, such as soil depth for moisture availability, which influences workability in a distinct manner too. But it is no relevant to reiterate the land characteristic, because in the first procedure (moisture availability) all unsuitable soils have been left out already. However, the effect of slope percentage on both workability and erosion hazard differ significantly and therefore slope class is repeated (in this case) twice.

This land utilisation type (self-subsistence farming) with accompanying land use requirements (or land qualities) has been incorporated in order of importance into ALES. Suitability of a LUT is determined according to the limiting factor principle: when an area is classified to be unsuitable for the optimal functioning of a LUT in terms of, for example, moisture availability, it is unsuitable for all other land use requirements too.

5.2.2 Permanent cultivation of favoured plots, with (in southern Italy) or without continuous water supply

Permanent cultivation of fields without fallowing and without the use of drainage or irrigation systems and fertilisers required very specific properties (for the same reasons as stated above, the land use requirements of the individual crops will not be examined here). We must also bear in mind, that heavy clayey soils (although presumably fertile) could not be readily worked with a plough with a wooden ploughshare (chapter 4). According to Allan (1972) and Sherratt (1973), alluvial and volcanic areas, locations with high ground water level, lower river terraces and moderately sloping sandy or calcareous areas (Forni 1990) were highly appreciated (chapter 4, table 2 in Appendix C-I).

1. In these cases, soil depth must be suited (more than 30 cm). Also, the soils should not be too wet or too dry (in case irrigation and drainage methods were not common), which, again, we can classify by drainage classes (*moisture availability*). If irrigation methods were used, dry soils were slightly limited.

2. Permanent cultivation of favoured plots preferred flat to moderately steep areas (*workability*) and stoniness and rockiness played a role: extremely rocky and exceedingly stony areas were less favoured and rubble land or areas with rock outcrop were unsuitable.

3. Well-developed, fertile soils were probably favoured, excluding heavy clayey soils (*nutrient availability*).
5.2.3 Short-term fallowing systems associated with cereal cultivation, animal-drawn ploughs and manure in medium-sized farms

As shown in section 4.5.6, optimal cultivation of cereals (for self-support and the market) was restricted to areas with particular land characteristics.

Emmer wheat (*Triticum dicoccum*) thrives best in deep, clayey, moist soils, which are marginally fertile and non-calcareous. Hilly terrain poses no problem, but is limited by the capabilities of the animal-drawn plough. During growth, it is not necessary to irrigate the crop or manure the ground when grown in the most appropriate soil. Emmer wheat still grows on mountain hills to about 1100 m above sea level (Van Joolen and Woldring 2000). This last land characteristic will not be incorporated in the research, because no land system reaches this altitude, so height is not a diagnostic criterion for land evaluation in this research.

Translating these requirements into land characteristics gives the following result (table 3 in Appendix C-I):

1. Excessively drained soils (*moisture availability*) were limited for emmer wheat cultivation, well-drained soils posed no problem and poorly drained soils were slightly limited in Bronze Age Italy, because no drainage systems were made.
2. Since emmer wheat prefers a clayey texture, clayey soils were unsuitable for Bronze Age farmers, because the soils were too heavy for cultivation. In fact, in terms of lithology, all soils were slightly limited or limited for emmer wheat cultivation in Bronze Age Italy.

The soil requirements for the other wheat varieties somewhat differed from that of emmer: they preferred deep, fertile, clayey soils, which were rather warm and dry in a non-sloping position. Farmers used animal dung to improve soil fertility, so also less fertile soils were appropriate and fertility as such is considered less important than workability. In terms of land characteristics, excessively drained soils were suitable for wheat cultivation (because the crop prefers dry soils), well-drained soils were slightly limited and poorly drained soils were avoided. Hindrance from stones or rocks resembled the LUTs mentioned before. According to Forni (personal communication), barley was important only in Sicily, while in the rest of the country the crop was not highly praised. Therefore, it is not treated here.

5.2.4 Small-scale cultivation of olive and grapes

While olive and grape production was not common in Bronze Age Italy, recent evidence (4.3.2) exists for some small-scale production in the southern regions of the country (Elevelt 2001), so this land utilisation type is included in the research as well.

5.2.4.1 Olive cultivation (table 4 in Appendix C-I)

Although olive trees thrive in many locations, they dislike wet ‘feet’ the most (4.6).

1. So *soil humidity* is the first constraint for optimal cultivation. Olive trees root horizontally, so soil depth was a less important factor than, for example, for cereals.
2. Fertile, calcareous soils were highly favoured, so *soil fertility* is the next important land use requirement.

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2 According to Attema (personal communication), in the Sibaritide highland surveys, Hellenistic farmsteads were found at an elevation of 1000m.
Workability in terms of soil cultivation is left out of the evaluation, because after the olive trees were planted no additional ploughing was necessary.

Figure 5.1 As can be seen from the photo above, stoniness class is not considered to be an important land characteristic for olive cultivation (Sibaritide, 2000). The black hose-pipes are used for drop irrigation

Olive groves could be planted on very steep slopes. However, the risk for surface runoff increased with accompanying soil loss. Therefore, I included water erosion hazard to be the third land use requirement (or land quality), assuming that the undergrowth was not capable of holding the soil (because of so-called clean cultivation or bare ground as the result of grazing). The classes were adapted from Soil Survey Staff (1951; chapter 2).

5.2.4.2 Grape cultivation (table 5 in Appendix C-I)

Other than olive trees, the soil need to be deeper, looser, wetter and less fertile for optimal grape production. Almost flat to gently sloping areas were favoured. It turned out to be difficult to classify the most important land use requirements in order of importance. That is the reason why the requirements mentioned below are described in an arbitrary sequence.

1. The drainage classes (moisture availability) provide a useful tool in order to find those soils, which were generally moist. Well-drained soils were classified to be suited for grape cultivation, poorly drained soils were less suited, whereas dry soils had to be avoided.
2. In order to prevent the grapes to grow too fast (see also 4.6), grapes ought not to be cultivated on very fertile soils (nutrient availability).
3. Rooting conditions refer to the ease by which plants can root and depend on (amongst other factors; see 2.2) soil texture. Sandy soils were well suited for grape cultivation, loamy soils were less favourable and clayey soils were the worst.

5.3 Land use requirements (LURs) of Iron Age land utilisation types (LUTs)

As we have seen in section 4.4, Iron Age agriculture can be considered as a continuation of the farming systems of the previous period, but a few new developments must be added. Probably only rich farmers could afford a plough with an iron ploughshare to cultivate heavier soils (but most Iron Age farmers still used wooden ploughshares). Manuring techniques improved (animal dung, ashes) and cereal, olive and grape cultivation increased. Still, farmers avoided wet and steep areas.
Three LUTs were common in Iron Age Italy:

1. Self-subsistence farming, increasingly associated with *ignicoltura*,
2. Permanent cultivation of favoured plots, with or without continuous water supply,
3. Extensive cultivation of cereals together with olives and grapes (*Mediterranean polyculture*) in southern Italy.

5.3.1 Self-subsistence farming, increasingly associated with *ignicoltura*

The land use requirements of Iron Age autarkic farming systems resemble those from the Bronze Age, although we must reckon with increasing deforestation. Of course, more land was brought under cultivation and probably production increased, but this datum cannot be expressed into land characteristics. In ALES, the Bronze Age LUT with associated land use requirements were copied for the Iron Age LUT.

5.3.2 Permanent cultivation of favoured plots, with or without continuous water supply

The soil and management requirements of this LUT were the same as those in the Bronze Age, except for the fact that knowledge about soil improvement increased and heavier soils were brought under cultivation due to technological improvements (table 6 in Appendix C-I). So we can copy the Bronze Age requirements and add to them improving soil fertility skills (spreading of animal dung and ashes: 4.4.5) and the use of naturally fertile clayey areas (for example alluvial plains: 4.4.5). Therefore, marginally fertile soils (such as Cambisols) were classified to be suitable (1 = no problem) for permanent cultivation without fallowing on the condition that the soil was manured regularly. In terms of workability, clayey soils were slightly limited for Iron Age permanent cultivation. Despite the fact that the soils could be brought under cultivation, it still required much effort.

5.3.3 Extensive cultivation of cereals (especially wheat) together with olives and grapes (*Mediterranean polyculture*) in Southern Italy

One of the main consequences of this kind of farming compared to the previous mentioned olive cultivation, was that the risk of soil erosion significantly reduced, for cereals protected the soil against the impact of precipitation and improved water infiltration by their root system. Also, in terms of land use requirements, therefore, a significant change occurred, since these crops were cultivated on the same field. We must reckon with a more complex situation.

Ideal fields for cereal cultivation in combination with olives require deep, dry, loamy soils in flat to almost flat areas. Both crops preferred fertile to marginally fertile soils. Moreover, olives disliked non-calcareous soils.4

The land use requirements of a *polyculture* of grapes and cereals closely resembled those of olives with cereals: it preferred deep, dry, sandy (on the condition that the grapes are locally irrigated), marginally fertile (provided that nutrients were added to the cereals) soils in flat or almost flat areas (table 7 in Appendix C-I).

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3 I was not able to find any information concerning Bronze Age *polyculture* in the literature. Therefore, the farming system is excluded from the evaluation for that period.

4 It is noteworthy to say that emmer wheat disapproved any chalk in the soil. So theoretically, emmer can never flourish in an olive yard.
5.4 Land use requirements (LURs) of Archaic and Roman land utilisation types (LUTs)

In agriculture, important changes were witnessed during the Archaic and Roman periods. Olive and grape cultivation was practised both in Central and Southern Italy and the use of iron ploughshares and improved drainage systems enabled farmers to cultivate clayey and wet soils. These innovations implied an extension of arable fields and an increase in production for the market.

For the central part of the peninsula, five land use types can be distinguished (section 4.5):

A. Land utilisation types in Central Italy

1. Small self-subsistence farming with increasing ignicoltura,
2. Cereal farming on large estates,
3. Mediterranean polyculture of olives and grapes, together with cereals in one field,
4. Roman Age specialised olive cultivation,
5. Mixed farming for self-support and the market.

5.4.1 Small self-subsistence farming with increasing ignicoltura, using a simple plough

In section 4.5.2, a farming system of cereal cultivation (especially millet) was described, working the ground with small-scale manual tillage (Spurr 1986). Forests were increasingly burnt for arable land. The soil and management requirements are considered to be the same as in the previous periods.

5.4.2 Cereal farming on large farms, using a variety of soils and plough types

5.4.2.1 Wheat cultivation

On large Roman estates, a polyculture of cereals was common, such as emmer wheat (Triticum dicoccum), einkorn wheat (Triticum Monococcum), bread wheat (Triticum aestivum), barley (Hordeum vulgare) and millet (Panicum aestivum). The land use requirements for emmer wheat and other wheats were discussed already (5.2). In contrast to earlier periods, clayey soils could be cultivated from now on. So in terms of workability all soils were suitable for ploughing. In terms of nutrient availability, wheat needs a fertile soil, and marginally fertile soils could be manured thereby increasing its suitabil-
ity. The tables for wheat cultivation have been copied in ALES and similar land use requirements have been omitted in table 8 (Appendix C-I). Those that differ from the previous periods are shown.

5.4.2.2 Cultivation of barley and millet

Table 9 (Appendix C-I) shows the land use requirements for barley and millet. Barley favoured growing in dry, loose and fertile soils. Soil depth was an insignificant land characteristic since the crop needed less nourishment than, for example, wheat. Below, the main land use requirements for barley cultivation are shown.

1. In terms of land use requirements, we start again with moisture availability. In Roman times, drainage systems were used to convert water from wet to dry areas. So, excessively drained soils were suitable for cultivation of barley; poorly drained soils were slightly limited, because it took additional efforts to prepare the soil for cultivation. A loose texture was provided by sandy soils, loamy soils were slightly limited and clayey soils had to be avoided.
2. Perception of the soil in terms of workability resembled the Bronze Age, except for the fact that all soils could be ploughed with the use of an iron ploughshare.
3. Nutrient availability is expressed in soil type as we have seen before.

For millet cultivation, dry, unfertile and calcareous soils were avoided. The crop preferred growing in well-drained, non-calcareous, loose soils, with sufficient nutrients. Sandy soils were used, provided that they were regularly irrigated.

5.4.3 Mediterranean polyculture of olives and grapes, together with cereals

The land use requirements for Archaic and Roman polyculture of olives, grapes and cereals closely resembled those from the previous periods. However, heavy soils could be cultivated as well (as said before) and improving soil fertility and drainage techniques enlarged the available arable fields. Table 10 (Appendix C-I) shows the land use requirements, which are different from those for the Iron Age polyculture.

5.4.4 Roman Age specialised olive cultivation

Table 11 (Appendix C-I) shows the severity levels for Roman Age specialised olive cultivation. Although the soil and management requirements resemble those of the Bronze Age (Appendix C-I: table 4), the severity levels differ. In the Roman Age, farmers were able to drain and irrigate soils and build terraces, thereby reducing slope percentage and, consequently, decreasing the risk of surface runoff. Below, the main land use requirements for large-scale olive cultivation are shown.

1. Firstly, moisture availability was important, because olive trees dislike 'wet feet' (as indicated before in 5.2.4.1). Poorly drained and excessively drained soils were slightly limited for olive cultivation, because preparatory work was needed before planting the trees and also during the cultivation process. Well-drained soils, obviously, caused no problems.
2. For optimal growing conditions, olive trees need fertile, calcareous soils. Improving soil fertility was common practice in Roman Italy, and all soils were acceptable for olive cultivation.
3. Slope class, indicated by slope percentage, also was of lesser importance than in the Bronze Age, but building terraces required lots of time and effort. Therefore, sloping to very steep areas were marginally suitable for olive cultivation.
5.4.5 Mixed-farming for self-support and the market on isolated estates

On more or less remote farms, cereal cultivation (emmer and barley were grown as a mixed crop, millet and fodder in rotation without fallow) was common, together with grapes and olives and growing of vegetables and fruits (4.5.2: Brunt 1971, Ampolo 1980, Spurr 1986).

A combination of emmer and barley must have posed difficulties, because the soil requirements more or less conflict with each other. Probably, the combination was utilised in case of ‘emergencies’. The land use requirements for millet, olives and grapes have been described above.

B. Land utilisation types in Southern Italy

In Southern Italy, four land utilisation types described before could be reconstructed (5.5.2 B). These include:

1. Mixed-farming for self-support and market,
2. Cereal cultivation on large farms,
3. Mediterranean *polyculture* of olives or grapes, together with cereals,
4. Roman Age specialised olive cultivation.

The soil and management requirements of these four LUTs were similar to those in Roman Age Central Italy and are copied in ALES as such.

One additional LUT, small self-subsistence farming, especially sheep-rearing on isolated farmsteads, probably resembled the Bronze and Iron Age LUT. Sheep-rearing did not require any specific land characteristics. So consequently, only self-subsistence farming is entered in ALES.

5.5 Evaluation results

This section describes the final land evaluation results. For each research area and each research period, the evaluation results are shown both in concluding tables and on maps. The tables, which were derived from the ALES program, are given in Appendix C-II.

5.5.1 Salento Isthmus

5.5.1.1 Bronze Age farming

*General*

Table 1 in Appendix C-II (suitability classification for Bronze Age agriculture in the Salento Isthmus) and figure 5.3 show the results from the suitability classification for Bronze Age farming in the Salento Isthmus. In the table, horizontally, the reconstructed land utilisation types are shown for the particular period (in this case the Bronze Age), whereas vertically, the examined landforms are expressed. The figures show the degree of suitability of a given LUT for a landform: 1 indicates that the LUT was very suitable, 2 that it was marginally suitable and 3 that it was not suitable for this particular landform. The small characters behind the figures explain why a LUT is unsuitable or marginally suitable for a specific landform:

- \( m = \) moisture availability (too wet or too dry),
- \( w = \) workability (lithology, slope percentage, stoniness or rockiness),
However, the accompanying land characteristics (such as soil depth, lithology and slope percentage) can only be consulted using the ALES “why?” procedure. Those land characteristics, which are important to mention, are explained in the text below.

The suitability classification
A quick view at the table demonstrates that the physical environment of the Salento Isthmus was rather unsuitable for the Bronze Age land utilisation types. Cultivation of emmer wheat (figure 5.3a) and other cereals (figure 5.3b) was difficult on all landforms, mainly because of moisture and/or nutrient availability (e.g. fertile soils are unsuitable for emmer wheat cultivation, because of the risk the plants started to bend: see 4.5.6). On some landforms, such as the Brindisi depression, the top of the Mottola hill and the Palagiano singular steep slope, workability formed the limiting factor, because of
shallow soils and steep slopes. Marginally suitable areas for both wheat cultivation and cultivation of other cereals were the floors and terraces of the Mottola canyon-like river valleys and the flat parts on the slopes of the Mottola hills. Other cereals (except for emmer wheat) could also grow, though marginally, on the deeper soils of the Brindisi plain and the deeper soils of the Mottola Undulating gently sloping land.

Only one landform was suitable for Bronze Age permanent cultivation (figure 5.3c): the Mottola undulating gently sloping land with its deep soils. Four areas were marginally suitable: the deeper soils of the Brindisi plain, the floors and terraces of the Mottola canyon-like river valleys, the flat parts on the slopes of the Mottola hills and the deeper soils of the Palagiano straight gently sloping land. Workability constantly forms the limiting factor.

The Salento Isthmus area showed the best opportunities for Bronze Age self-subsistence farming (figure 5.3d), because four landforms were suitable and two were marginally suitable. The deeper soils of the Brindisi plain and the Palagiano straight gently sloping land, the floors and terraces of the Mottola canyon-like river valleys and the Mottola undulating gently sloping land near Pulsano (with deep soils) are supposed to have been preferred by Bronze Age autarkic farmers. The Brindisi depressions and the flat parts on the slopes of the Mottola hills were slightly limited by their insufficient nutrient availability, so they were marginally suitable for this land utilisation type.

Small-scale cultivation of olives (figure 5.3e) was profitable on the steeper slopes of the Brindisi plain, the Brindisi undulating land and the floors and terraces of the Mottola canyon-like river valleys. Mainly because of rather poor drainage conditions in the Brindisi depression and the thin soils of the Mottola undulating gently sloping land, these landforms were marginally suitable for crops. Finally, the floors and terraces of the Mottola canyon-like river valleys and the flat parts on the slopes of the Mottola hills were marginally suitable for the small-scale cultivation of grapes (figure 5.3f).

5.5.1.2 Iron Age farming

General
Table 2 in Appendix C-II (suitability classification for Iron Age agriculture in the Salento Isthmus) and figure 5.4 show the suitability classification of Iron Age land LUTs for the landforms in the Salento Isthmus. More plots could be cultivated permanently in the Iron Age, mainly because clayey areas were brought under cultivation and soil fertility practices improved (5.3).

The suitability classification
Bronze Age self-subsistence farming (figure 5.4d) resembles the Iron Age autarkic farming, because the soil and management requirements did not differ in the two periods (chapter 4) and these farmers had not yet access to the technological improvements.

While unsuitable for Bronze Age permanent cultivation, the Brindisi depression was marginally suitable for the same Iron Age farming (figure 5.4c). The deep soils of the Mottola undulating sloping land remained suitable. The deep soils of the Brindisi plain, the floors and terraces of the Mottola canyon-like river valleys, the flat parts on the slopes of the Mottola hills and the deeper soils of the Palagiano straight gently sloping land still were marginally suitable.

The Mediterranean polycultural systems of olives and grapes with undergrowth of cereals (figure 5.4a and b) probably cannot have been widespread in the Salento Isthmus, because most of the landforms were unsuitable for this kind of agriculture, mainly because the soil moisture probably was insufficiently available. Also, cereals need rather fertile soils and nutrient availability is often inadequate. The Brindisi depression and the valleys and terraces of the Mottola canyon-like rivers all have soils that are marginally suitable for both olive and grape cultivation with cereals. The deeper soils of the Brindisi plain are marginally suitable for olive trees and cereals, whereas the flat parts of the Mottola hills can be used marginally for cereal cultivation with grapes.
5.5.1.3 Archaic and Roman Age farming

**General**

Archaic and Roman Age agriculture was characterised by a larger variety of land utilisation types as ever before, as is shown by table 3 in Appendix C-II (suitability classification for Archaic and Roman Age agriculture in the Salento Isthmus) and figure 5.5. As a consequence of technological improvements (which were described in the previous chapter), more landforms could be cultivated with lesser effort. However, in spite of the knowledge about drainage, irrigation and soil fertility techniques, most landforms still were unsuitable for agriculture, for instance because of soil moisture deficiencies, shallow soils and steep slopes.

**The suitability classification**

The Salento Isthmus landforms were best suited for specialised olive cultivation (figure 5.5h) and barley cultivation (figure 5.5a). Most of the landforms in the western part of the research area were marginally suitable for olive cultivation, mainly because of moisture and nutrient problems. The deeper soils of both the Brindisi plain and the Mottola undulating sloping land were suitable for this kind of land use. For barley cultivation, the most suitable area was the Mottola undulating gently sloping land. Most other landforms with deeper soils were classified as marginally suitable, all because of moisture availability problems.

Self-subsistence farming (figure 5.5g) probably was extensively practised on the deeper soils of the Brindisi plain and the Palagiano straight gently sloping land, the valley floors and terraces of the Mottola canyon-like rivers and the Mottola undulating gently sloping land-

The polycultural system of grapes with undergrowth of cereals (figure 5.5f) thrived best in the soils of the Brindisi depression and the flat parts on the slopes of the Mottola hills.

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5 Due to technical computer problems, some maps are not presented in figure 5.4 and 5.5.
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Tables 3 (Appendix C-II) shows three landforms, which were suitable or marginally suitable for five land utilisation types or more. These include:

* The Brindisi depressions, which were suitable for the Mediterranean polyculture of grapes and cereals grown in the same field, but these landforms could also be used, though with slight limitations, for the cultivation of barley, other cereals than emmer wheat (figure 5.5d), olives with an undergrowth of cereals (figure 5.5e) and self-subsistence farming.

* The valley floors and terraces of the Mottola canyon-like rivers and the flat parts on the slopes of the Mottola hills closely resemble the suitability classification of the Brindisi depression. Generally speaking, all LUTs could be employed, though with some difficulty, mainly because of soil moisture or workability problems.

On the map (figure 5.5), the suitability classifications for all LUTs described before, are presented.

Figure 5.5  Map showing the evaluation results of Archaic and Roman Age land utilisation types in the Salento Isthmus: a = cultivation of barley, b = cultivation of millet, c = cultivation of emmer wheat, d = cultivation of other wheats, e = polyculture of cereals with olives, f = polyculture of cereals and grapes, g = self-subsistence farming, h = specialised olive cultivation
5.5.2 Pontine region

5.5.2.1 Bronze Age farming

General
The evaluation results of the suitability classification of the Pontine region for Bronze Age land utilisation types are shown in table 4 (Appendix C-II) and figure 5.6. In the Bronze Age, the so-called ‘Amaseno area’ was part of a lagoonal environment with open water bodies and marshes. The Latina plain Amaseno phase 1 represents this first phase in landscape development (see also 3.4.5). Obviously, the other two phases are left out of the evaluation for the Bronze Age.

As became clear from chapter 4, in the Bronze Age, there is no evidence of significant cultivation of olives and/or grapes in Central Italy. Therefore, four land utilisation types were reconstructed for Bronze Age agriculture in the Pontine region.

Figure 5.6 Map showing the evaluation results of Bronze Age land utilisation types in the Agro Pontino: a = cultivation of emmer wheat, b = cultivation of other wheats, c = permanent cultivation of favoured plots, d = self-subsistence farming
The suitability classification

Similar to the Salento Isthmus, self-subsistence farming (figure 5.6d) turned out to be the best-suited land utilisation type for the Agro Pontino. The fertile soils in the aeolian areas of the Borgo Grappa plain and the beach ridges of the Borgo Grappa undulating land, the fertile Lepini river valleys and the small Lepini alluvial fans are classified as suitable for autarkic agriculture. Most other landforms showed problems with moisture and/or nutrients availability.

Furthermore, table 4 (Appendix C-II) reveals that the alluvial fans, which cover the Latina plain (also called the Sezze alluvium; 3.4.3.1), were marginally suitable for all Bronze Age land uses, mainly because of nutrient deficiencies and difficulties of soil cultivation (expressed in workability: heavy soils and high percentages of stones in the fields).

Figure 5.7 Map showing the evaluation results of Iron Age land utilisation types in the Agro Pontino:
\( a = \) polyculture of cereals with olives, \( b = \) polyculture of cereals with grapes, \( c = \) permanent cultivation of favoured plots, \( d = \) self-subsistence farming
All clayey areas were unsuitable for Bronze Age farming, which was explained in chapter 4 by the fact that clayey soils could not be ploughed by wooden ploughshares. Workability of soils was a serious constraint for optimal farming.

5.5.2.2 Iron Age farming

General
Table 5 (Appendix C-II) and figure 5.7 show the results from the Iron Age suitability classification for the Agro Pontino. The second phase of the Amaseno landscape development is added to the list of landforms. From the first millennium BC, the Amaseno alluvial sediments were deposited in the plain covering the lagoonal environment. Although the northern area quickly faced lithological changes, the southern part remained stable for some hundreds of years. Therefore, the first phase (the lagoonal phase) is still present in the evaluation.

The suitability classification
Even in the Iron Age, self-subsistence farming (figure 5.7d) is considered to be the most appropriate crop growing system for the Pontine landforms. The aeolian soils of the Borgo Grappa plain and the slope deposits of the Monti Lepini landform were marginally suitable for the cultivation of cereals with olives (figure 5.7a) and/or grapes (figure 5.7b). Most other landforms, such as the Borgo Grappa lagoonal clayey soils and the Lepini river valleys, were unsuitable because of insufficient drainage, heavy soils or abundance of nutrients.

Interestingly, the Amaseno region evolved from a highly unsuitable area to a marginally suitable area for permanent cultivation (figure 5.7c) and to an even suitable area for self-subsistence farming. Also, the Sezze alluvial fans (the alluvial fans of the Latina plain landform) remained marginally suitable for the cultivation of cereals and grapes, permanent cultivation and self-subsistence farming.

5.5.2.3 Archaic and Roman Age farming

General
Table 6 (Appendix C-II) and figure 5.8 show the suitability results of Archaic and Roman Age land utilisation types for the Pontine landforms. It is assumed that during the Roman period the Amaseno region was completely covered with alluvial sediments, so the lagoonal facies is left out of the evaluation.

The suitability classification
In general, the suitability of the Pontine region improved during the Archaic and Roman Age, for the reason that (as said before) wet soils could be drained, dry soils could be irrigated, infertile soils could be fertilised on steep hills terraces could be built. Below, some notable evaluation results are explained.

The clayey areas of the Borgo Grappa plain were classified marginally suitable and limited for emmer (figure 5.8c) and other wheat cultivation (figure 5.8d). This is explained by the fact that two groups of soil types were present:

- The Solodic Planosols, which have an E horizon showing stagnic properties. These soils were poorly drained and unsuitable for arable farming.
- The Luvisols, Vertisols and Fluvisols theoretically could be drained. Therefore, these soils were marginally suitable for wheat cultivation.

Millet cultivation (figure 5.8a) on the Borgo Grappa aeolian plain still was difficult because the aeolian sediments were too calcareous. Also, in this area, cultivation of emmer wheat and polyculture of cereals and grapes (figure 5.8f) turned out to be complicated, because of the high fertility of the soils.
The Sezze alluvial fan (in the Latina plain) was suited for Roman Age cultivation of cereals and grapes in one field. This LUT was marginally suitable in the Borgo Grappa lagoonal area, whereas the rest of the Pontine region had to be avoided. Also, most landforms were suitable or marginally suitable for self-subsistence farming (figure 5.8g) in the Archaic and Roman Age.

The suitability classification for specialised olive cultivation shows a quite different picture (figure 5.8h). Obviously, the former Pontine Marshes were unsuitable for this kind of land use, but the rest of the landforms in the research area were suitable or marginally suitable.

The beach ridges and the aeolian part of the Borgo Grappa land system could be successfully used for olive cultivation, whereas the other areas needed some adjustments for growing this crop.
5.5.3 Sibaritide

5.5.3.1 Bronze Age farming

Table 7 (Appendix C-II) and figure 5.9 show the suitability classification for Bronze Age land utilisation types in the Sibaritide research area. Most of the landforms were unsuitable for these land uses,
mainly because of insufficient soil moisture and/or nutrients availability. Self-subsistence farming forms the only exception: the terraces of the Lauropoli rivers, the Lauropoli undulating sloping land and the Sybaris plain were suitable for this kind of agriculture.

5.5.3.2 Iron Age farming

Table 8 (Appendix C-II) and figure 5.10 show the evaluation results of Iron Age land utilisation types for the landforms in the Sibaritide. Although for the Iron Age different LUTs were determined self-
subsistence farming still remained the best suitable agricultural practice in the same areas as was classified for the Bronze Age.

![Fig 5.10](image)

**Figure 5.10** Maps showing the evaluation results of Iron Age land utilisation types in the Sibaritide (the river shown is the Raganello-river, for other locations and scale see figure 3.37)

5.5.3.3 Archaic and Roman Age farming

Although it can be expected that the suitability of the research area improved for Archaic and Roman Age land uses, the table below (table 9 in Appendix C-II) shows similar results as compared to the previous period, although most landforms changed from limited into marginally suitable. This is explained by the fact that the landforms have the kind of land characteristics that cannot be improved easily, for example steep slopes or very stony soils.

5.6 Testing the evaluation results with modern crop equivalents

5.6.1 Salento Isthmus

The archaeological land evaluation results were compared with modern equivalents shown at the *carta dell'utulizzazione del suolo* (1956). Only the Roman Age land evaluation results are used, because they resemble modern agriculture the most. Also, cereal farming cannot be taken into this test, because with the use of modern machinery and techniques, the soil suitability is changed considerably. To avoid comparing apples with pears, only olive and/or grape cultivation is taken into account.
A first glimpse on the map shows the following main land use types: grape cultivation, olive cultivation, polycultural system of grapes and olives, fallow agricultural land, meadows and forests. Figure 5.5h shows the area was suitable or marginally suitable for Roman Age large-scale olive cultivation.

5.6.2 Agro Pontino

According to the land use maps mentioned above, the main land use type of the horst and graben is irrigated and dry agriculture. The mountains show a variety of uses of which meadows, olive and vine cultivation (also on the northern part of the graben) and forests are the most important. Figure 5.8h shows that the mountains were marginally suitable for olive cultivation, whereas the graben was suitable to marginally suitable. The land use map does not wholly confirm this last result. It may be explained by practices of deep ploughing nowadays.

5.6.3 Sibaritide

The main land use types in the vicinity of Francavilla Marittima are, as indicated by the land use map (1956), olive cultivation and cereal farming. Figure 5.11g shows that the entire Sibaritide research area was marginally suitable for olive cultivation.

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**A. Cultivation of barley**

**B. Cultivation of millet**

**C. Cultivation of emmer wheat**

**D. Cultivation of other wheat**

*Figure 5.11a Maps showing the evaluation results of Roman Age land utilisation types in the Sibaritide (the river shown is the Raganello-river, for other locations and scale see figure 3.37)*
5.7 Summary and conclusions concerning the evaluation results

5.7.1 The research areas

Salento Isthmus

During the Bronze Age, the Murge landform and the Brindisi undulating land were unsuitable for all kinds of land use, except for olive cultivation, which was suitable on the undulating land only. The valleys and terraces of the Mottola canyon-like rivers and the flat parts on the slopes of the Mottola hills were suitable for all kinds of agricultural Bronze Age systems (except for olive cultivation). The suitability of the remainder of the landforms in the area varies according to the requirements of the LUT: suitable, marginally suitable or limited. The Salento Isthmus area is best suited for Bronze Age cultivation of olives and self-subsistence farming.

Also in the Iron Age, the Murge area and the undulating land remained unsuitable for agriculture. However, the deeper soils of the Brindisi plain could be marginally used for all Iron Age LUTs, which also was acceptable for the valleys and terraces of the Mottola canyon-like rivers and the flat parts on the slopes of the Mottola hills. Self-subsistence farming experienced only few restrictions in the area.

Finally, during the Archaic and Roman Age, the Murge turned out to be marginally suitable for the cultivation of barley, cereals and olives. Also, the valleys and terraces of the Mottola canyon-like rivers remain suitable for all kinds of agriculture.
Cultivation of millet and emmer wheat and the polyculture of cereals and grapes remained difficult in the area, whereas cultivation of barley and other wheats than emmer wheat, polyculture of cereals and olives and self-subsistence farming was possible almost everywhere.

**Agro Pontino**

Most Bronze Age landforms in the Pontine region were unsuitable for any kind of agriculture, with some exceptions. The Latina alluvial fans (Sezze alluvium) were marginally suitable and the aeolian area of the Borgo Grappa plain was suitable or marginally suitable for all LUTs except for emmer wheat cultivation. Self-subsistence farming was the most profitable (in terms of minimum effort) LUT in the area.

During the Iron Age, the Amaseno region, which was covered now by alluvial sediments, was marginally suitable for all land use types. The suitability of the aeolian area resembles the Bronze Age. The Sezze alluvium was unsuitable for cereal cultivation in combination with olives or grapes.

Most landforms in the Pontine region were suitable or marginally suitable for all Roman Age land use types, with wheat, barley and millet cultivation experiencing the fewest restrictions.

**Sibaritide**

During both the Bronze Age and the Iron Age, the Sibaritide research area was unsuitable for all LUTs, except for self-subsistence farming. However, during the following period, the area turned out to be marginally suitable for most agricultural systems, except for the Cerchiara hilly land with its steep slopes and thin soils.

![Charts showing the suitability of the various landforms for the farming system 'polyculture of cereals and olives' in the three research areas for two research periods](image-url)
5.7.2 Land utilisation types in the research periods

Finally, some examples are given which show the suitability of a specific land use expressed as percentage of the area. Figure 5.12 shows, that the three research areas became increasingly suitable for the more or less simultaneous cultivation of cereals and olives in one field during the periods under investigation. However, none of the landforms classified were suitable. A remarkable change is witnessed in the Sibaritide research area: whereas no landform was suitable for this kind of polycultural agriculture in the Iron Age, in the following periods cereals and olives could be grown together in 80 % of the landforms in the same area.

The suitability of the research areas for permanent cultivation also changed during the first millennium BC, as shown by figure 5.13. In the Pontine region especially, almost 40 % of the landforms was suitable or marginally suitable for this kind of farming in the Iron Age, against only 14 % in the Bronze Age. However, the Sibaritide research area remained limited for permanent cultivation in both the Bronze and Iron Age.