

# Chapter 1

## Introduction

### 1.1 General

#### 1.1.1 RPC project (Regional Pathways to Complexity)

In 1997, the former Organization for Historical Sciences (SHW) of the Dutch Organization for Scientific Research (NWO) funded the multiple project 'Settlement and landscape in Central and South Italy' conceptualized by professor Peter Attema and directed by Attema and dr. Gert-Jan Burgers. Two universities were involved: the Groningen Institute of Archaeology of the University of Groningen and the Archaeological Institute of the Free University of Amsterdam. Initially, the RPC-project (Regional Pathways to Complexity) ran for a period of four years. The NWO project proposal was entitled:

*Towards an archaeology of early forms of urbanization in the Italic culture landscape: Central and South Italian Mediterranean coastal landscapes caught between internationalization, exploitation and marginalization (1400 BC – 400 AD; Attema 1996).*

Project descriptions were published in Attema et al. (1999). The results of the project have provided a better understanding of Bronze Age to Roman Age urbanization processes in the spatial, ecological, technological, social, economic, religious and political context of the Pontine region (Lazio, Central Italy) and two areas in South Italy (Sibaritide, Calabria and Salento Isthmus, Apulia; figure 1.1). Especially the relations between the indigenous influences and Greek and Roman colonization and urbanization were investigated.

Since 1977, the Pontine region has been the survey and excavation area of both the University of Groningen and the University of Amsterdam. The University of Groningen excavated and surveyed in the Sibaritide since 1991, while since 1981, the Salento Isthmus has been the area of interest of the Free University of Amsterdam (figure 1.1). Including the present-day archaeological and geographical knowledge of the three areas from the late Bronze Age onwards, a comparative research was possible.

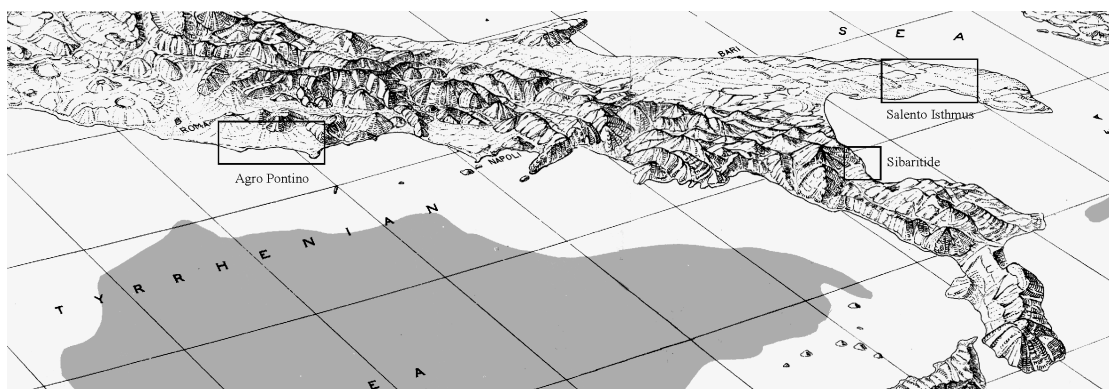


Figure 1.1 Location of the research areas (adjusted from Squyres 1975)

Within the framework of the multidisciplinary project, three colleague researchers worked on a Ph.D. thesis as well: settlement patterns and structures by Van Leusen (2002), pastoral land use by Veenman

(2002) and pottery and metal production by Mater (forthcoming). The main aim of my thesis is: *to analyze the long-term relations between people and their natural environment by means of an archaeological land evaluation of the RPC study areas.*

### 1.1.2 Archaeological land evaluation in archaeology

Archaeological land evaluation compares the capabilities of the (reconstructed) landscape (in terms of, for example, fertility, drainage and slope angles) with the growth and management requirements of ancient crops and agriculture. Suitability maps visualize the results.

Although land evaluation was already known in the early seventies (Beek & Bennema 1972; Brinkman and Smith 1973; Young 1973; Beek 1975; Vink 1975), the concepts and methods of qualitative land evaluation were fully described by the Food and Agriculture Organization of the United Nations (FAO) in 1976. In the framework for land evaluation (FAO 1976), the method is defined as “*the assessment of land performance when used for specific purposes. It involves the execution and interpretation of basic surveys of climate, soils, vegetation and other aspects of land in terms of the requirements of alternative forms of land use.*”

This framework for land evaluation is in principle constructed for present-day or future land uses. But, as stated before, archaeological land evaluation tries to establish the suitability of *ancient* landscapes for *ancient* land uses (as has been done already by, for instance, Kamermans 1993, Finke et al. 1994 and Farshad 1997). This implies a rather different approach, because the present landscapes may have experienced (significant) changes in the past, while agricultural technology also has evolved throughout the first millennium BC *e.g.* from the use of wooden simple ploughs to more sophisticated ploughs with iron ploughshares. Therefore, reconstruction of landscape, land use and technology plays a fundamental role in archaeological land evaluation. A full explanation of the various steps for archaeological land evaluation is given in chapter 2 (Methodology).

## 1.2 Aims of the research

In the aim of this thesis two main goals can be summarised:

1. *To optimise land evaluation for archaeological purposes to produce models which can be applied to determine the potential suitability of various landscapes for various land uses in the three research areas and in three periods (Bronze Age, Iron Age and Archaic/Roman Age)*

The results of the archaeological land evaluation show the suitability of a specific area for a specific kind of land use. In other words, it reflects the agricultural capability of an area, without taking into account other factors that can influence settlement location, such as safety or socio-economic considerations. Soil suitability maps may help to clarify why people decided to settle in or to leave a specific area.

Although land evaluation has been carried out in Archaeology before, some points of criticism still are valid. For example, only little attention has been paid to the probability that the present-day landscape does not resemble the ancient landscape. Also, the reliability of historical information concerning land use types and technology is often not tested against archaeological discoveries. Therefore, this thesis provides a more thorough guideline for the method of land evaluation in Italian archaeological research. The land evaluation procedure of the FAO (1976) was scrutinised and adjusted for Archaeology. Special attention is paid to:

- the development of agricultural tools and technology during the periods under investigation,

because with the increasing robustness of the tools and growing knowledge about land improvement methods, less favourable soils could be taken into cultivation,

- the reconstruction of the landscapes for the relevant periods,
- the soil and management requirements of crops, especially of those crops that have not been changed genetically at the species level during the last two millennia BC,
- the suitability classification of the various land uses in the three regions for each research period.

## 2. *To reconstruct the vegetation history of the Pontine Region (Central Italy)*<sup>1</sup>

The main aim for reconstructing the vegetation history of the Pontine region was to provide independent information that could be used to test the results of the archaeological land evaluation (next to archaeological evidence). The vegetation history elucidates our present-day knowledge concerning the use of the various landscapes during the three periods.

Therefore, information on published pollen diagrams from the Pontine plain was gathered, while three additional local cores were analysed. The vegetation history is determined both by natural and by anthropogenic factors. Human interference with the landscape, for instance deforestation and agriculture, can be established from pollen diagrams.

### 1.3 Earlier land evaluation

During the 1970s and 1980s, Sevink and his students studied the soils in two areas in Central Italy, including the Pontine region. The results from their research are visualized in a map (*The soils of southern Lazio and adjacent Campania*, Sevink et al. 1984). Inspired by the work of Sevink et al., Kamermans used prehistoric land evaluation to compare the Neolithic archaeological data (which were collected and investigated during the Agro Pontino Survey project, directed by Voorrips et al. 1991) with his suitability classification (Kamermans et al. 1985). In 1993, Kamermans published his thesis regarding Archaeology and land evaluation in the Agro Pontino. A similarity between his thesis and mine seems noticeable and frequently, during lectures, I was asked to highlight the difference. Below, these differences are shown.

Kamermans' approach:

- To test the applicability of land evaluation for archaeological problems;
- To investigate the relationship between humans (socio-economic processes) and the natural landscape through analysis of archaeological and palaeo-ecological data;
- To determine the best-reconstructed land use for a given land unit and to test the results with the archaeological data.

Although sometimes similar, the differences between my research and Kamermans' research are:

- There is a difference in the research period: Kamermans examined the Middle Paleolithic till Bronze Age, whereas the Bronze Age until the Roman Age is focused on in this thesis,
- Whereas Kamermans evaluates the Pontine landscape in as far as presently exposed, I have tried to reconstruct the dynamics of the whole area in terms of erosion and deposition. A

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<sup>1</sup> Within the available research time, I was able to collect various cores from the Pontine region only. Besides, both other research areas turned out to be fairly unsuitable for pollen analysis, mainly because of their dry climate (unfavourable pollen preservation circumstances) and calcareous geology.

clearer picture of the physical landscape during the periods investigated has emerged (chapter 4),

- Kamermans (1993: 6) excluded human perception of the landscape, *e.g.* in terms of workability of soils, based on an assumed cultural discontinuity between historical and prehistorical perceptions. For the periods concerned in this thesis, this perception can be (and – in my opinion – has to be) rather easily included into archaeological land evaluation (chapter 2 and 5),
- During the research into the land use requirements of ancient crops, it became clear that most present-day crops are genetically altered and their soil requirements have changed. Therefore, a more detailed examination into these requirements of ancient crops has taken place (chapter 4),
- Other than Kamermans, in co-operation with dr. Abbas Farshad (ICT, Enschede), I applied a computerized land evaluation system (ALES, Automated Land Evaluation System), in which all research data can simply be entered and soil suitability can be determined without much difficulty. In a replicable manner, other researchers can use the program too.

## 1.4 The research areas

This section briefly discusses the physical characteristics of the three Italian research areas Agro Pontino, Salento Isthmus and Sibaritide. First, I present a short overview of the geology and climate of the Italian peninsula. Next, the physiographic and geological characteristics described.

### 1.4.1 Italy: physiography and climate

#### 1.4.1.1 Physiography

A full description of the geology is presented in chapter 3. Here a brief outline of the physiography is presented.

From north to south, the Italian peninsula can be divided into the calcareous Alps, the alluvial Po plain, the Northern, Central and Southern Apennines and Sicily, running in north-west to south-east direction. Kamermans (1991) summarizes the geological history as follows:

*It is generally accepted that the Apennines resulted from a tectonic wave, running from SW to NE. During the Middle and Late Miocene this orogenic wave folded and overthrust a thick complex of Mesozoic sediments (Upper Triassic to Paleocene), resulting in the formation of a number of NW-SE running ridges (Sestini 1970).*

At least 23 volcanoes (active and dormant) arise in the Italian landscape as a consequence of the collision of the Eurasian continental plate with the African continental plate.

#### 1.4.1.2 Climate

The areas of study have mild and moist winters and dry and hot summers, characterized as a Csa-climate (Köppen-Geiger 1954) or meso-mediterranean (UNESCO-FAO 1963). Mean monthly temperature is always above 0° C and 45 to 75 days are dry during the summer period (Sevink et al. 1991). Soil moisture regime is xeric, indicating a water deficiency for more than 90 days a year (Soil Survey Staff 1975).

For the Pontine region, data from Latina airport show a mean annual precipitation between 800 and 900 mm. The mean annual temperature there is 15° C (Sevink et al. 1984). In the Salento Isthmus

area, the Brindisi climate table (1946–1956) shows a mean annual temperature of 16.7 °C, whereas the mean annual precipitation is 548 mm. However, evaporation exceeds precipitation, leading to water deficiency during summer (Bijlsma and Verhagen 1989).

Finally, the Sibaritide mean annual temperature lies between 16.5° C and 17° C. Mean annual precipitation is 500 mm per year (Di Silvana D'Angelo et al. 1994).

## 1.4.2 Salento Isthmus (Puglia, South Italy)

### 1.4.2.1 Physiography

This study area is situated in the south of the Italian peninsula (Puglia), roughly between Taranto and Fasano in the west and from Brindisi to the south, forming the eastern border (figure 1.2). The research area can be subdivided into a hilly landscape in the northwest (Murge), with elevations up to 500 m above sea level, a lower, but severely dissected area near Taranto in the southwest and a relatively flat area in the east (Brindisino plain).

Impressive canyon-like valleys (locally called ‘Lame’) and more gentle valleys with seasonal rivers drain the area in northern and southern direction. Net precipitation also percolates into the relatively soft limestone and consequently, water flows underground too. Karst phenomena, such as dolines, occur in the Murge area.

The most important cultivated crops in the area are olives and grapes, which are respectively grown on thin, stony soils and on deeper loose soils. The fertile alluvial deposits are used for other crops such as citrus and cereals.

Earlier pedological research has been executed near Li Castelli and Muro Maurizio (north and northeast of San Pancrazio) by Hillenius and Visser (1991), near Muro Tenente and Cellino San Marco by Schoorl and Siefkens (1994) and near Valesio by Bijlsma and Verhagen (1989).



Figure 1.2 Map showing Apulia and the Salento Isthmus (Puglia) research area

#### 1.4.2.2 Geological description

The geological setting of the Salento area and the Murge (between Brindisi and Bari) is rather complex. The areas form part of an extensive non-deformed foreland area, situated on the northern part of the African plate (Pieri 1990). In the Mesozoic and Cenozoic eras, the African and European plate collided, leading to the formation of the Alps and Apennines. However, the Salento area remained stable (Lort 1971, Fabricius et al. 1985, Stanley and Wezel 1985). The carbonate Salento and Murge area is characterized by various transversal fault systems, dividing the region into blocks (Gargano, Murge, Salento), which were differentially uplifted (Pieri 1990).

The research area covers six of the standard series of geological maps 1:100,000: Carta Geografica d'Italia 190 (Monopoli), 191 (Ostuni), 202 (Taranto), 203 (Brindisi), 204 (Lecce) and 213 (Maruggio). When comparing these maps it was clear that the maps showed incomplete similarity in legend units and some units were cut at the borders of the map. Therefore, uniformity of legend units was needed and an adjusted map was created (figure 1.3: adjusted geological map and table 1.1: adjusted legend). This legend shows those geological units, which resemble each other to a high degree in age and composition.

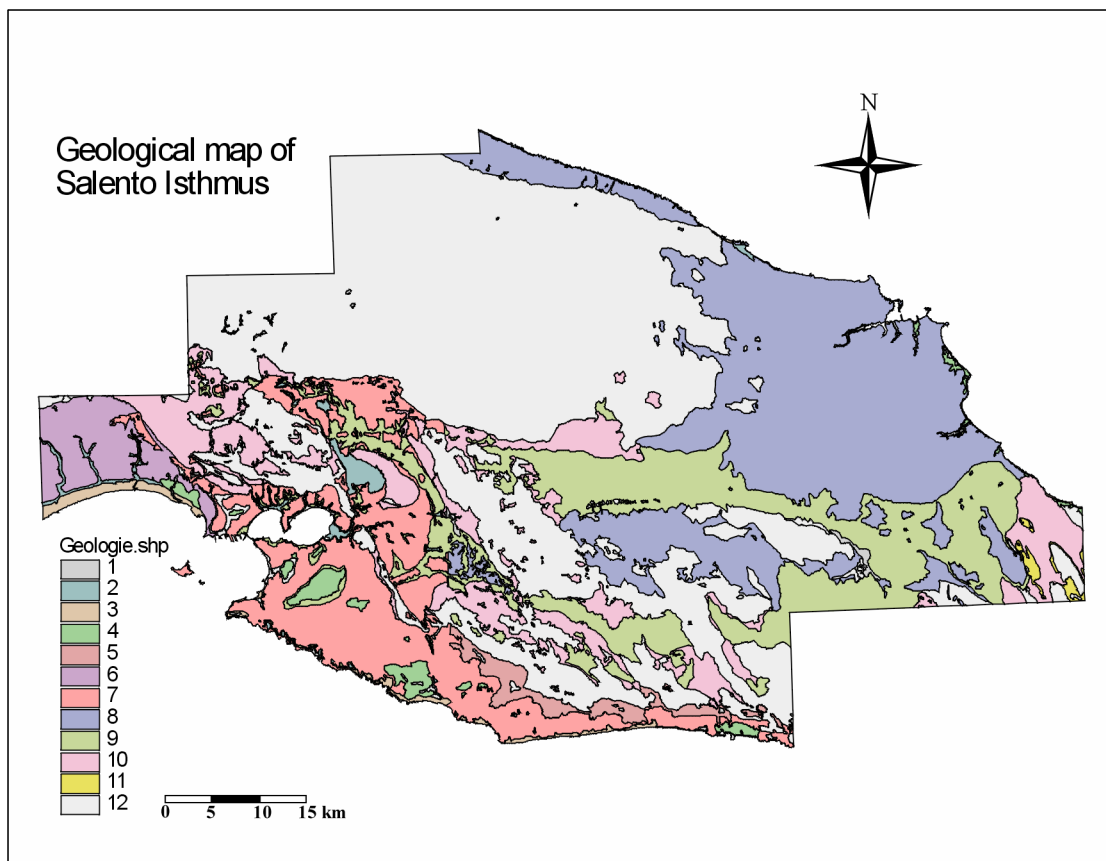


Figure 1.3 Adjusted geological map of the Salento Isthmus: Carta Geografica d'Italia 190 (Monopoli), 191 (Ostuni), 202 (Taranto), 203 (Brindisi), 204 (Lecce) and 213 (Maruggio)

In the research area (as shown by table 1.1), the outcropping rocks largely date from the Tertiary and Quaternary and can roughly be subdivided into four geological units:

- The oldest deposits, dating from the Cretaceous, outcrop in the Murge region and the south and southeastern Salento (*Calcari di Bari and Altamura* and *Dolomi di Galatina*).

- In the central part of the area, Pleistocene calcareous sands, clayey sands and blue marl cover the surface.
- The Pleistocene *Formazioni di Gallipoli* outcrop in the northeastern Brindisi-plain.
- The southwestern area shows a complex of various deposits from different ages: from Cretaceous limestone to actual coastal dunes.

| 202                  | 203                                   | 204                                   | 190                                    | 191               | 213                            | Legend number | Description  | Age                           |
|----------------------|---------------------------------------|---------------------------------------|--|-------------------|--------------------------------|---------------|--|-------------------------------|
| -                    | de                                    | de                                    | de                                     | -                 | de                             | 1             | Terra rossa (calcareous residues) and colluvial deposits   | Holocene                      |
| a <sup>2</sup>       | -                                     | -                                     | a <sup>2</sup>                         | qa                | -                              | 2             | Actual sands, loam and alluvial gravel; actual lagoonal clays and loam; actual coastal sands   | Holocene                      |
| qd                   | -                                     | qd                                    | S/d                                    | qd                | Qd                             | 3             | Grey or red/yellow sands, usually coarse with cross-stratification; actual coastal dunes   | Holocene                      |
| ql                   | S                                     | s                                     | -                                      | -                 | S                              | 4             | Lagoonal and marshy yellow and black loam  | Holocene/<br>Pleistocene      |
| -                    | -                                     | -                                     | af                                     | -                 | -                              | X             | Alluvial (gravelly) deposits at the base of the erosive slopes of the Murge, accompanied by Pleistocene deposits   | Holocene/<br>Pleistocene      |
| -                    | Q <sup>2</sup>                        | -                                     | -                                      | -                 | Q <sup>2</sup>                 | 5             | Well-cemented bioclastic limestone   | Holocene/<br>Pleistocene      |
| Qcg/<br>qcg          | -                                     | -                                     | -                                      | -                 | -                              | 6             | Conglomerates, gravels and heterogeneous sands, fossils  | Pleistocene                   |
| Qc <sup>c</sup>      | Q <sup>3</sup>                        | -                                     | -                                      | -                 | Q <sup>3</sup>                 | X             | <i>Calcarenti di M. Castiglione</i> : calcarenite and limestone  | Pleistocene                   |
| -                    | Q <sup>1</sup> s/<br>Q <sup>1</sup> c | Q <sup>1</sup> s/<br>Q <sup>1</sup> c | -                                      | -                 | -                              | 8             | <i>Formazioni di Gallipoli</i> : yellow, clayey sands, sometimes weakly cemented, in layers of a few cm thick, on top of clayey sand and gray-blue clay. Often the unit has layers of arenite and calcarenite.                   | Pleistocene                   |
| Q <sup>a</sup>       | Q <sup>1</sup> -P <sup>3</sup>        | Q <sup>1</sup> -P <sup>3</sup>        | -                                      | -                 | Q <sup>1</sup> -P <sup>3</sup> | 9             | <i>Argilla di Bradano</i> : weakly cemented calcareous sands and gray blue clayey sands; gray blue marl alternated with sandy layers   | Pleistocene                   |
| -                    | -                                     | -                                     | -                                      | Qcs               | -                              | X             | Yellow sands, mainly fine-textured, well-stratified with arenite layers  | Pleistocene                   |
| -                    | -                                     | -                                     | Q <sup>c</sup> ca                      | -                 | -                              | 7             | <i>Tufi delle Murge</i> : calcarenite and calcareous sandy clays, well or poorly cemented. Residual deposits on the abrasion platforms.  | Pleistocene                   |
| P-<br>Q <sup>c</sup> | P <sup>3</sup>                        | P <sup>3</sup>                        | -                                      | -                 | P <sup>3</sup>                 | 10            | <i>Calcarenti di Gravina</i> : clayey yellow calcarenite; white yellow 'tufi' and calcareous gravels. Occasionally, partly cemented with red calcareous breccias in the vicinity of the southern border of the Murge. Limestone. | Pliocene                      |
| -                    | -                                     | M <sup>5-4</sup>                      | -                                      | -                 | -                              | 11            | Compact gray or black limestone with macro-fossils   | Miocene                       |
| C <sup>11-7</sup>    | C <sup>8-6</sup>                      | C <sup>7-6</sup>                      | Cc <sup>8-6</sup><br>Cc <sup>7-6</sup> | C <sup>10-6</sup> | C <sup>7-6</sup>               | 12            | <i>Calcare di Bari/calcare di Altamura/dolomi di Galatina</i> : bright gray and with dolomitic limestone and black brown or dark gray dolomite. Detritic limestone can be porous. Sometimes red breccias.                        | Upper/<br>Lower<br>Cretaceous |

Table 1.1 Adjusted legend for the Carta Geologica d'Italia Foglio 190, 191, 202, 203, 204, 213

In a stereogram, Giaccio (19??) explains the landscape north of Ostuni (figure 1.4).

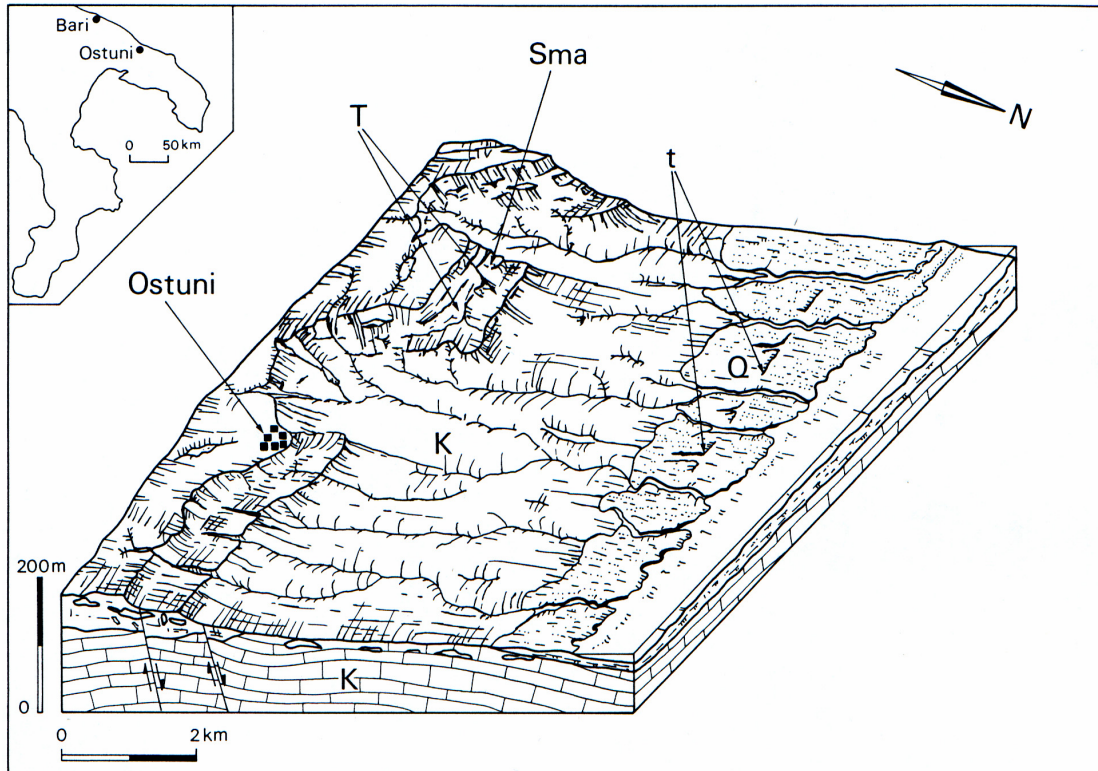


Figure 1.4 Schematic overview of the landscape and geology north of Ostuni: **K** = Cretaceous limestone, **Q** = Quaternary deposits, **T** = Pleistocene marine terraces, **t** = Tyrrhenean coastline, **Sma** = cave of Maria d'Agnano (adjusted and translated from Giaccio 19??)

From the inland to the sea, Bijlsma and Verhagen (1989) counted sixteen terraced surfaces, the highest is situated 360 m above sea level, the lowest just reaches an elevation of 10 m above sea level. Tectonic uplift and glacioeustatic oscillations determined the formation of terraced surfaces and deposits as a consequence of transgression and regression phases during the Middle and Upper Pleistocene (Ciaranfi et al. 1983, 1988, 1994, Guarnieri et al. 1990).

Chapter 3 provides a more detailed discussion concerning the geological units in the research area.

### 1.4.3 Pontine region (Lazio, Central Italy)

#### 1.4.3.1 Physiography

The Pontine region can be subdivided into four main areas (figure 1.5):

1. The volcanic area in the northwest,
2. Carbonatic Lepini and Ausoni mountains in the north and the east,
3. An isolated hill in the south-east, Monte Circeo and,
4. The Pontine plain at the footslopes of the mountains, running to the south.



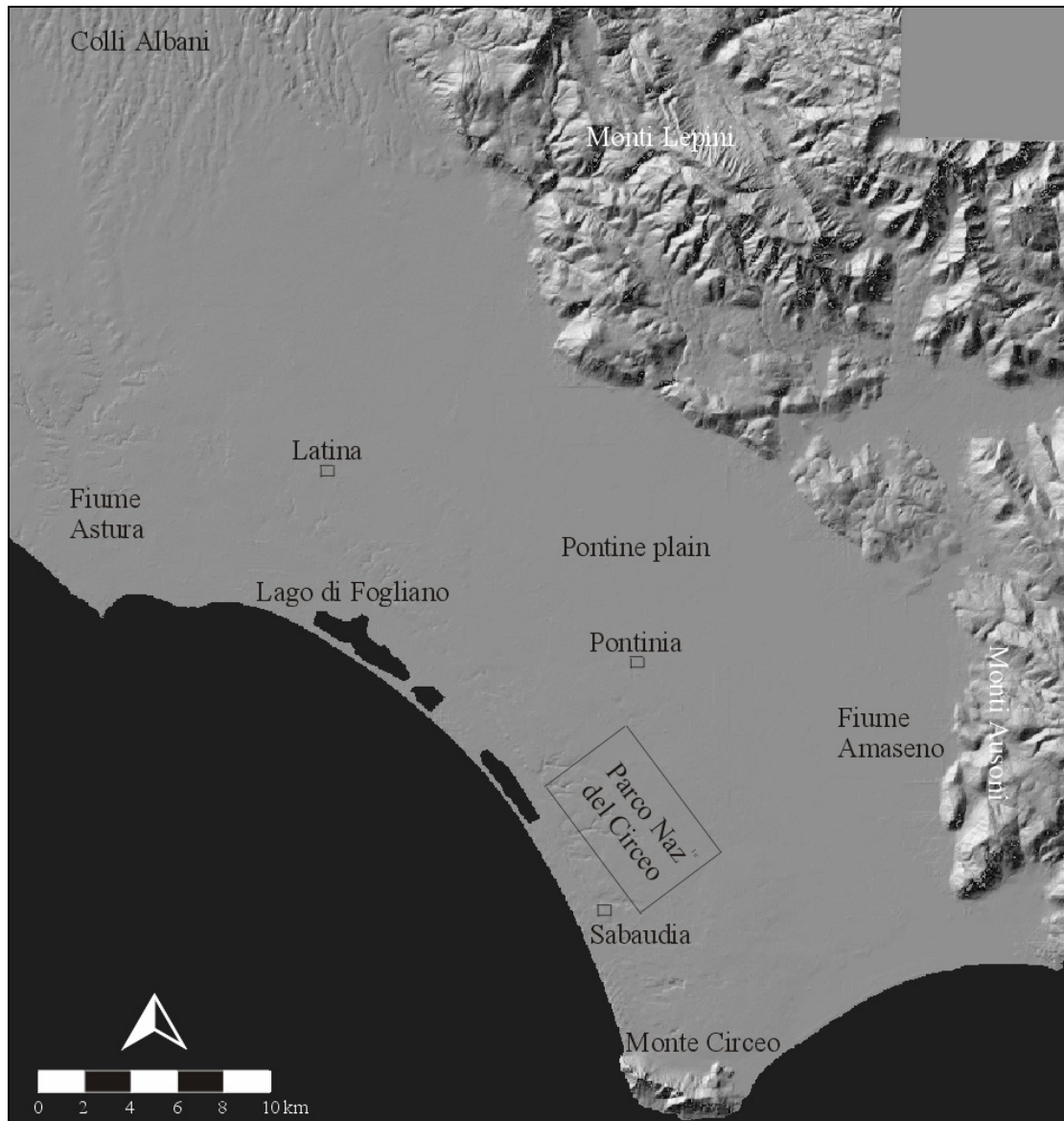


Figure 1.5 Map showing the Pontine region (Lazio) research area

Several (canalized) rivers, such as the Fiume Amaseno in the east and Fiume Astura in the west drain the plain. Olive and grape cultivation at the footslopes of the carbonatic mountains and grape, fruit and cereal cultivation on the beach ridges characterize the present-day agriculture. The fertile volcanic soils are used for various crops.

The Parco Nazionale del Circeo is roughly situated between Pontinia in the north and Sabaudia in the south. Although the park can be entered at various locations, large parts are forbidden to trespass. It was generally assumed that the original vegetation more or less survived the *Bonifica* (land reclamation) drainage activities (see below).

Large parts of the present-day plain were altered significantly, most recently during the 1930s and earlier during the reign of Pope Pius VI (1775–1800) and in Roman Time. For example, no more than a small peaty area remains of the large Pontine Marshes in the Early Roman Period, which fringed the Monti Lepini to the north. Attema (1993) describes the activities in the 1930s:

...huge areas of *macchia* and marshland in the coastal plain in the Pontine Region were turned into arable land and provided with a new infrastructure. The project was in the hands of the *Opera Nazionale per I combattenti (O.N.C.)* ...which by the 1930s had become the official status of a fascist state department (...). In the period 1928–1931 no less than 20.330 ha of land was parceled out, while 41.600 ha had by then already been under the plough, while 1756 km of canal and 9.800.000 m of *scoline* (small drainage canals) had been dug and 416 km of roads had been constructed (Attema 1993: 28).

#### 1.4.3.2 Geological description of the research area

The Quaternary genesis of the Pontine Region has been described by many authors (Blanc 1936 and 1962, Segre 1957 and 1969, Dessing 1972, Sevink 1977, Remmelzwaal 1978, Sevink et al. 1982, 1984 and 1991 with references to internal reports of the University of Amsterdam). The four main areas in the Pontine region are described below (figure 1.5).

##### *a. Volcanic area: Colli Albani or Vulcano Laziale or Alban Hills volcano*

In the north-western part of the area, the Vulcano Laziale rises to an altitude of 949 m above sea level. The volcano most recently erupted some 22,000 years ago, forming two craters. The lakes of Albano and Nemi fill them now (De Rita 1993). The first lake, Lago Albano is 170 m deep (its lake level lies at 293 m above sea level), whereas Lago di Nemi is very shallow (its lake level lies at 316 m above sea level).

The geological history of the volcano is generally subdivided into three stages (De Rita 1993):

- Tuscolano-Artemisio phase (from 600 ka until 360 ka BP): during four eruptive cycles pyroclastic sediments, air fall tephra and lava were deposited. The so-called *Pozzolane Rosse* or *Pozzolane di San Paolo* was accumulated in the second cycle, *Tufo litoide* and *Villa Senni Tuff* in the fourth cycle.
- Campi di Annibale or Faete phase (from 300 ka until 200 ka BP): in the center of the caldera a new stratovolcano was constructed; relatively small amounts of eruptive volumes compared to the first phase.
- Final hydromagmatic phase (the latest activity occurred 22,000 years BP): formation of the craters of Albano and Nemi and hydromagmatic eruptions.

##### *b. Monti Lepini and Monti Ausoni*

The carbonatic Monti Lepini and Monti Ausoni, located between the Colli Albani and the Amaseno valley, form part of the Volsci mountain chain. They parallel the Tyrrhenean coastline in a northwest-southeastern direction. Elevations reach some 1500 m above sea level.

The Mesozoic rocks have been formed in a warm and relatively deep marine environment, as indicated by the imbedded fossils. Since the upper Tertiary (7 million years ago), tectonic activities started and the Monti Lepini area was uplifted. Its karst morphology, dolines (which diameter varies between 10 and 300 m) and caves, formed as a consequence of dissolution processes of the highly fractured, permeable rocks, characterize the Monti Lepini. Occasionally, the karst area is covered by volcanic pyroclastic deposits and *terra rossa* (weathering product).

Water-filled courses are scarce in the Monti Lepini, because circa 80 % of the precipitation infiltrates the subsoil by the numerous fractures and caves in the rocks, from where it flows underground to the Pontine plain re-emerging in numerous springs. The most important spring is located near Ninfa (for location: figure 1.5). It roughly delivers 2,000-liter water per second.

##### *c. Monte Circeo*

Monte Circeo is located at the southern end of the Pontine region. Its summit reaches an elevation of 541 m above sea level. The calcareous mountain is generally considered to be an isolated part of the Appennines (Kamermaans 1991).

#### *d. Pontine plain*

As a consequence of Plio-Pleistocene tectonic activities, major fault lines run in north-western to southeastern direction through the Pontine plain, dividing the area into a horst (in the southwest) and graben (in the northeast).

The present-day graben (partly also called the Former Pontine Marshes, which were drained in the 1930s as was said before) is filled with lagoonal peat and clay, locally covered by colluvial-alluvial sediments (for the genesis of these sediments: see chapter 3). Near Cisterna, travertine is found at the surface.

#### *Four marine terraces*

The present-day horst shows four marine terraces or complexes of various ages, elevations and composition. These terraces were formed as a consequence of Pleistocene eustatic sea level changes and tectonic changes. Present-day soil types are described in table 1.2 (see below), in chapter 3 and in detail in Sevink et al. (1984 and 1991).

- *The Terracina complex* consists of a recent (Holocene), rather simple beach ridge and a lagoonal area behind. The beach ridge is composed of well-sorted sands, whereas clay, peat and peaty clay are found in the lagoonal area, which lies more or less at sea level (Sevink et al. 1982).
- *The Borgo Ermada complex* was probably formed during the Tyrrhenian III transgression (about 90.000 years before present; Sevink et al. 1982). The rather complicated system consists of four sub-units:
  - Relatively pronounced elongated ridges with elevations around 2 to 3 m above sea level. The upper few meters consist of well-sorted fine sands, underlain by fine to medium-textured marine sands. Locally, coarse sandy gravel beds occur.
  - A complicated system of small elongated sandy ridges (at elevations between 2 and 9 m above sea level) and depressions.
  - A relatively thin (less than 1 meter) layer of well-sorted fine (probably aeolian) sands at elevations between 4 and 9 m above sea level. The sands form a slightly undulating cover over elongated sandy ridges and clayey depressions.
  - A thicker (more than 1 meter) aeolian sand layer covering earlier fluvial incisions between 5 and 10 m above sea level (Sevink et al. 1982).
- During the later regression phase (period of low sea level in the Würmian), the Borgo Ermada complex was covered by aeolian sands.
- *The Minturno complex* was formed during the Tyrrhenian II transgression (about 100.000 years BP; Rimmelzwaal 1978, Sevink et al. 1982, de Wit et al. 1987). At elevations between 8 and 15 m above sea level, the elongated ridges consist of sandy clay loam to sandy loam or loamy coarse sand. In between, at elevations between 11 and 16 m above sea level, a subsequent dissected area with greenish, non-stratified clays, shells and corals, slopes in southwestern direction (Sevink et al. 1982).
- Finally, the incomplete *Latina complex* probably was formed some 560,000 years ago (de Wit et al. 1987) at 20 to 25 m above sea level. The dissected level plateau consists of horizontally bedded well-sorted fine augitic sands of 12 to 15 m thick. These sands are locally covered by a layer of greenish clay to sandy clay loam of 1.5 to 3 m thick (Sevink et al. 1982). An accompanying beach ridge system has never been found.

| Marine complex       | Texture     | Dominant soils                    |
|----------------------|-------------|-----------------------------------|
| Terracina complex    | Coarse      | Calcaric Regosols                 |
|                      | Fine/medium | Eutric Gleysols                   |
| Borgo Ermada complex | Coarse      | Chromic Luvisols                  |
|                      | Medium      | Solodic Planosols/Gleyic Luvisols |
|                      | Fine        | Chromic Vertisols                 |
| Minturno complex     | Coarse      | Ferric Luvisols                   |
|                      | Medium      | Solodic Planosols/Gleyic Luvisols |
|                      | Fine        | Chromic Vertisols                 |
| Latina complex       | Coarse      | Gleyic Luvisols/Orthic Luvisols   |
|                      | Medium      | Solodic Planosols/Gleyic Luvisols |
|                      | Fine        | Chromic Vertisols                 |

Table 1.2 Soil classification of the marine complexes (after Sevink et al. 1982)

#### 1.4.4 Sibaritide (Calabria, South Italy)

##### 1.4.4.1 Physiography

The Sibaritide, the third research area, is situated in Calabria (figure 1.6), which stretches between the Tyrrhenean Sea and the Ionian Sea.

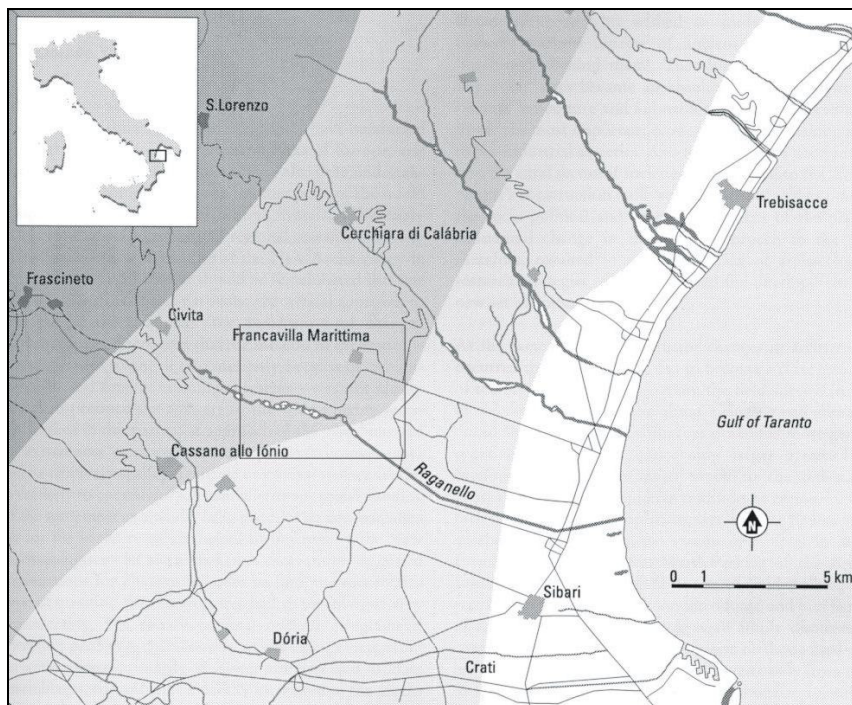


Figure 1.6 Map showing the Sibaritide (Calabria) research area

For the reason that the university of Groningen is involved with excavations at Timpone Motta (near Francavilla Marittima: figure 1.6), the area in the vicinity of the site was intensively studied. The area comprises the foothills (with elevations up to around 700 m above sea level) of the Pol-

lino/Dolcedorme massif and the Sila and Mula mountains and part of the plain of Sibari between Broglio di Trebisacce in the north and just south of the Crati River.

In the plain, both olives and grapes are important cultivated crops, whereas the stony hills can only be used for olive cultivation. Various rivers, including the Torrente (river) Raganello and Crati river, drain the hinterland in an eastward direction towards the Ionian Sea.

#### 1.4.4.2 Geological description of the research area

*The Calabrian Apennines have vast outcrops of crystalline terrain with limited outcrops of Mesozoic/Paleogene sedimentary covers. Post-orogenic deposits are found on the slopes facing the Ionian and Tyrrhenian Sea (Pieri 1975).*

In the research area, from the east to the west, small dunes and actual beaches border the Ionian coast. Holocene clayey silt and occasionally sand cover the alluvial plain of Sibari, which is dissected by rivers, depositing gravel and sand in and adjacent to their river beds.

Further west, at least four marine terraces (with an alluvial cover) have been formed in the foothills of the research area, they all are of Upper and Middle Pleistocene Age (Carta d'Italia; Foglia 221: Castrovillari). Sedimentologically, the first (and oldest) terrace is composed of gravel and sandy alluvial material, whereas the other three terraces are gravelly, with occasionally, sandy and clayey layers. Elevations range from 300 to 400 m above sea level for the first terrace, from 140 to 250 m for the second, from 50 to 150 for the third and less than 50 m for the fourth terrace.

Giannini et al. (1963) describe the genesis and chronology of the terraces as follow: at the end of the Calabrian-era (early Pleistocene), the whole area was uplifted characterized by the formation of faults. This slow and gradual uplift, associated with eustatic movements, happened in intervals during which marine terraces were formed and subsequently new sediments were deposited. The precise age of these terraces remains questionable, because no reliable paleontological remnants have been found (Giannini et al. 1963), but hypothetically, they are from post-calabrian age. Finally, limestone mountains in the north border the research area.

## 1.5 Brief archaeological overview of the three research areas from the Bronze Age until the Roman Age

### 1.5.1 Introduction: archaeology in the three research areas

Following the broad description given above of the geology, the geomorphology and the climatic circumstances of the research areas, we will now turn to the current opinions on the developments in the late second and the first millennium BC of settlement dynamics, societal forms and accompanying agricultural and pastoral activities in the three RPC study areas.

Chapter 4 describes various land uses types for the Bronze Age, the Iron Age and the Archaic/Roman Age based on Forni (1990). The historical outline below follows the division made by Forni (1990).

According to Barker (1985), traditional Mediterranean agriculture can be divided into two different types:

- A specialised system of long-distance transhumance<sup>2</sup> with sheep and goats. The low-land plains and river valleys were used during winter, while the upland pastures were preferred during summer.

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<sup>2</sup> Movement of stock and shepherd into the hills for the summer and to low ground in winter (Barker 1985).

- A mixed polycultural system of peasant economy with limited stock keeping.

The latter system is often involved with short-distance transhumance. Cereals were sown in autumn and they were harvested in late spring or early summer. Farming activities were carried out by using hand implements and simple ploughs, which were designed to scratch the ground, to prepare the seed-bed and to trap soil moisture. Furthermore, farmers cultivated olives and grapes, separately or together (*interculture* or *polyculture*). The advantage of growing olives and grapes together are manifold (Barker 1985) as:

- the growing season could be extended due to a rise of the ground temperature
- this system guaranteed minimal competition since the roots of olives grow horizontally at shallow depth, while the roots of grapes penetrate the soil vertically
- olive trees provided shade and grapes helped resist superficial erosion.

Below, the socio-economic and agricultural history of Central and South Italy of the late second and first millennium BC is briefly described in the light of Barker's (1985) model of traditional Mediterranean agriculture. At the end of this thesis (chapter 7), this description is compared with the newly derived information as is described in chapter 4 (land utilisation types) and chapter 6 (pollen analysis). It is found that the generally accepted models know regional variation and accordingly can be adjusted with the information provided in this thesis.

### 1.5.2 Archaeology and ancient agriculture in Salento Isthmus

#### *Bronze Age till early Iron Age*

While the late Bronze Age settlements in the Salento were rather complex and 'rich' (Veenman 2002: 126, Yntema 1993), at the start of the Iron Age, they lost their wealth.

The inland hills and plains may have been used for extensive pastoralism, whereas a few autarkic communities inhabited the coastal areas (Burgers 1998: 174).

#### *Iron Age*

In the Iron Age, the native settlement pattern was characterised by areas with dispersed huts (Burgers 1998: 295), inhabited by people who were socially organised on the basis of *segmentary kinship* (Burgers 1998: 296). Different from the Bronze Age, the plains and hills in the interior of the Salento peninsula were colonised in order to gain more land for agriculture and animal husbandry. Veenman (2002) argues that Iron Age farmers probably cultivated cereals and used meadows for stock grazing, while hunting took place on a small-scale.

#### *Archaic and Roman Age*

In the Archaic period, changes took place in the native settlement pattern, in the social organisation (elite) and the international contacts. The Iron Age huts were replaced by stone built houses accompanied by funerary plots. The increasingly urbanised settlements diverged both in size and form. An intensification of contacts between the natives with the Greek led to the foreign exchange of products in the light of coexistence (Burgers 1998: 298–299).

In Archaic Salento, agriculture was more and more focused on surplus production (Burgers 1998: 297), while later on (during the Hellenistic period) this expansion of agriculture was accompanied by an intensification of wine and olive oil production (Burgers 1998: 300).

The urbanisation process continued and urban sites with a centralised authority and rural hinterlands emerged. Veenman (2002: 127) describes an example of this changed use of the landscape: surrounding the urbanised site of Oria, 30 *farm houses* (Yntema 1993) emerged in the late 4<sup>th</sup> century BC, indi-

cating stock specialisation and anthropogenic interference of the landscape. The archaeological data from Roman Age Salento show diverse agricultural activities, such as sheep-raising, cereal farming (Yntema 1993) and cultivation of wine and olive oil (Cato, Varro, Burgers 1998: 255–259).

The Salento was colonised by the Romans in the third century BC. In the second century BC, many pre-Roman farms disappeared, while the remainder farms enlarged significantly. However, only after 150 AD, the so-called *Roman villae* or *latifundia* emerged.

### 1.5.3 Archaeology and ancient agriculture in the Pontine region

#### *Bronze Age (2000–1000 BC)*

In the long period between the first permanent Bronze Age settlements in South Lazio which are found especially in the area of the Alban hills, the Bronze Age tribal society of the Pontine Region faced a gradual change into a hierarchical organized and functionally differentiated society. This process becomes especially evident in the recent and final Bronze Age when a complex settlement system develops here, most probably in concert with the developments in the Alban hills (Angle et al. 1992, Attema in press).

For the early period of the Bronze Age, however, subsistence in the Pontine region is probably still characterised by hunting and fishing activities, assumed by the fact that many sites have been found in the vicinity of marshy and lacustrine areas (Guidi 1986, Attema 1993: 213). In the recent and final Bronze Age special activity sites appear that are involved in the preparation of fish or salt (coastal area) and metallurgy (slightly more inland) (Allessandri unpublished). Recently also evidence for Bronze Age settlement has been found in the Monti Lepini (Attema 1997).

Barker postulates a spectrum of activities between two main types of subsistence for this period (Barker 1972, 1975, 1976a, 1976b, 1981: 153–154, 1985: 80):

- Sedentary mixed farming, cultivating cereals and legumes, raising stock (which had originally been argued by Östenberg 1967) and
- Specialised transhumant pastoralism (which had originally been argued by Pugliesi 1959).

Variations in land use depended on the environmental circumstances (lowlands or highlands) and time (Barker 1981: 154).

According to Veenman (2002), the Campoverde pollen diagram (Veenman 1996, see also chapter 7) proves permanent settlement in the Pontine region since the late Bronze Age and early Iron Age. From the results of the diagram it is clear that cereals were cultivated, at least from 3730 ± 100 BP. However, up till now, there is little support from archaeological survey data for a substantial rural infill in this period (Voorrips et al. 1991, Attema 1993). An increase of highly intensive survey might, however, change this picture.

#### *Iron Age (1000–750 BC)*

Also during the early Iron Age, still no firm evidence is available up till now that substantial permanent settlement with rural infill was common in the Pontine Region. In the initial stages of the Pontine Region Project, Attema (1993: 217) still argued that *the early protohistoric sites may (thus) initially have had a function as gathering places of people frequenting the region in the winter and would (thus) have functioned as territorial markers, to develop in the course of the 8<sup>th</sup> century into sites that were inhabited all-year round*. This hypothesis is under revision now that archaeological evidence for the Final Bronze Age and early Iron Age along the coast is accumulating.

In spite of these new insights into the complexity of late Bronze Age and early Iron Age society we must assume that agriculture still was relatively primitive and probably pastoralism formed one of

the most important components (Attema 1993: 217, Bietti Sestieri 1981). Grassy areas were used for winter pasture.

The late Iron Age (8<sup>th</sup>–7<sup>th</sup> century BC) was characterised by proto-urbanisation and an increasingly socially stratified society (development of an aristocratic class in the 7<sup>th</sup> century BC), as is proved by the results from both field surveys and excavations of settlements and cemeteries (Attema 1993: 220). The late Iron Age settlement pattern was made up of substantial often-fortified settlements that functioned within a developing rural landscape. Most settlements were located at the slopes of the Alban hills and Monti Lepini (Attema 1993); proto-urbanization did not take place on the wet lagoonal clays.

The exploitation of the landscape was characterised by a system of mixed farming on a larger scale than before (Attema 1993: 219), based on the cultivation of cereals and, for instance, beans. However, *animal husbandry and transhumance (...) still formed the main component in the subsistence economy* (Attema 1993: 219).

#### *Archaic and Roman Age (750–600 BC/600 BC–400 AD)*

The Archaic and Roman periods were characterised by the development of urban settlements with monumental architecture and a developed infrastructure. These settlements relied for their economy on increasingly important rural areas for which they in turn assumed the role of supply of certain services and products. The construction of underground waterways (*cuniculi*, chapter 4) in the volcanic hills indicated the arrival of a central authority and the investment in agricultural collective supplies (Attema 1993: 223). For reasons yet unknown, but which may have had to do with political unrest (early Roman colonisation versus pressure from mountain people such as the Volsci in the 5<sup>th</sup> and 4<sup>th</sup> centuries BC), post-Archaic settlements decreased in size and number. However, from 350 BC onwards, the Pontine Region was subjected to Roman colonisation and pacification, leading to the development of the colonies of Cora (present-day Cori), Norba and Setia (Sezze) and a rapidly developing Roman villa economy.

In Etruria, olive and grape production occurred on some scale in the 6<sup>th</sup> century BC. In the rest of peninsular Italy agriculture was predominantly based on the system of mixed farming (cultivation of cereals and legumes, sheep and goats). Only since the 5<sup>th</sup>/4<sup>th</sup> century BC, a change to polycultural systems emerged (Barker 1985). Transhumance (whether at large-scale or localised) maintained important into even the Roman Age (Barker 1985, Pasquinucci 1979, White 1970).

From 350 BC onwards, a new system of rural exploitation was introduced in the Pontine region, in which land was assigned to colonists. At places this had the form of centuriation patterns such as these have been documented near Terracina and near the Via Appia south-east of Sezze. An increasing variety of crops were grown, in which olive cultivation on the footslopes of the Monti Lepini became progressively more important (Attema 1993: 230).

However, after 200 BC, the peasant economy was gradually replaced by “capitalistic” *latifundia*: large farms, which were specialised in stock-raising or cultivation of olives and grapes (Attema 1993: 237). According to Attema, the abandonment of the Pontine region by local small farmers was the result of the relative marginal environmental characteristics of the area, when compared to, for instance, Campania. The expansion of Rome in search for better soils for cereal cultivation and the import of grains from abroad led to the decline of small-scale farming in the Pontine region (Attema 1993).

### 1.5.4 Archaeology and ancient agriculture in the Sibaritide

#### *Bronze Age*

From the excavations at Broglio di Trebisacce by Renato Peroni and his team, it is assumed that Middle Bronze Age farmers in the Sibaritide cultivated the local terraces of conglomerates which were suitable for dry farming (depending on precipitation only) of vegetables and barley (Maaskant-Kleibrink 1996–1997: 82). Hunting was practised on a small-scale and animal husbandry on a larger



scale was common. The archaeological evidence contains indications for animal husbandry, wheat cultivation while also remains of oak, figs and olives were found. Like in many other regions in Italy the Middle Bronze Age society gradually became more complex. The late Bronze Age in the Sibaritime, for instance is characterised by Kleibrink as *a clear case of expansion of people, technology, ideas and products* (Kleibrink forthcoming), *with autonomous settlements occupying all viable river-delimited territories (...), and powerful leaders controlling the means of production and redistribution*. This process is both attested by the excavations of the Timpone della Motta at Francavilla Marittima (Maaskant-Kleibrink 1996–1997), at Broglio di Trebisacce where contacts with Myceneans have been attested (Peroni and Trucco 1994) and in analysis of the regional settlement pattern.

### *Iron Age*

Due to the Greek colonization and foundation of Sybaris in the plain at the end of the 8<sup>th</sup> century BC (historical date), a process of cultural interaction started between the indigenous peoples and the Greeks. Native Iron Age necropoleis and hut settlements indicate that the Oinotrian native society had reached a high cultural level that did not differ from contemporary Greek society. The interaction between the Oinotrians and Greeks is profitably being studied in the early cult center on the Timpone della Motta at Francavilla Marittima where Greek influence in the indigenous cult place is evident in the late 8<sup>th</sup>/early 7<sup>th</sup> century BC (Kleibrink 1993, 2000). In the plain the study of this interaction is, however, more difficult. Little is known of the early Greek phase at Sybaris as this Greek colony was first overbuilt by the pan-Hellenic Greek colony of Thuriori and later by the Roman colony of Copiae. A second reason why changing patterns of settlement and land use are poorly known is due to the heavy sedimentation that has covered up the archaeological landscape of the plain and which hides any evidence for a developing rural landscape in this period due to Greek expansion.

### *Archaic/Roman Age*

In the Archaic and especially Hellenistic period, this process of interaction resulted in an unprecedented rural infill of the foothills of the Sibaritime as mapped in the Rossi et al. (1969; see also Van Leusen 2002: chapter 2, p.8). It can be argued from this and the more recent survey results by the RPC-project that from the 6<sup>th</sup> century BC *Sybaris became the regional urban administrative and economic center for an expanding rural hinterland of villages and isolated farms with associated rural sanctuaries and cemeteries* (Van Leusen et al. in press). Recent survey in the highlands has shown that Hellenistic farms appeared to ca. 1000 m altitude. The small-scale cultivation came to an end in the Roman period for which we have fewer sites.

## **1.6 Structure of the thesis**

In the second chapter (*Methodology*), the land evaluation method is explained. To carry out a land evaluation, various steps must be followed in order to achieve a reliable land suitability map for different land uses. Some examples of these steps are the investigation of the physical landscape (geomorphology, dynamics, and present-day land use) and the reconstruction of the probable ancient land uses (self-sufficient farming or market-orientated farming). This information can be entered conveniently arranged into the computer program ALES (Automated Land Evaluation System).

Chapter three (*Landscape reconstruction and description of the research areas*) starts with a section concerning landscape reconstruction for land evaluation purposes. Next, the physiographical units of the Salento Isthmus are described.

During the research, the Pontine Region proved to enclose highly dynamic areas caused by both natural and anthropogenic agents and a detailed landscape reconstruction for the last 3000 years is presented. Subsequently, the section describes the various landscape units.

Finally, the Sibaritide research area is shown including a landscape reconstruction.

*Ancient agriculture in Central and South Italy* forms the main subject of the fourth chapter. For each period (Bronze Age, Iron Age and Archaic/Roman Age), the land uses are depicted including their characteristic components, such as the agricultural tools used, the cultivated crops, the size of the farms and the farming system. An overview is given of the ancient ploughs or parts of ancient ploughs found in Italy. Some famous discoveries are focused upon.

The last part of chapter four describes the soil and management requirements of (ancient) crops. Most present-day crops have been genetically altered and, as a consequence, their soil requirements. A thorough research into the ancient requirements was necessary before the information could be used in the land evaluation procedure. In northern Italy, the unchanged Emmer wheat (*Triticum dicoccum*) is still being cultivated. A visit to this area enlarged the knowledge about the soil and management requirements of the crop.

In chapter five, the *suitability classification* is performed and the results of the land evaluation are presented. For each area and each period, the suitability is determined for the various land uses. Suitability is divided into three classes: suitable, marginally suitable and not suitable. The results are entered into ALES and visually shown on maps.

The results of the pollen analysis are given in the sixth chapter (Pollen-analytical investigations in Late-Holocene Central and South Italy (from the Neolithic until the Roman Age)). As said before, in the Pontine Region, three pollen cores were analysed in order to obtain a better understanding of the changes in vegetation in the area. Gathering additional information from earlier researches resulted in a detailed reconstruction of the climate and vegetation in the Pontine Region. Anthropogenic influence, such as agricultural and deforestation activities, were clearly visible.

In the last chapter (*Discussion*), the land evaluation results are tested against the results from the pollen analysis and archaeological evidence, as described in the second chapter. Differences are examined and explained. Finally, recommendations for further research, a summary and conclusions are presented.