Soßna, Volker

Climate and settlement in Southern Peru: the Northern Río Grande de Nasca drainage between 1500 BCE and 1532 CE

der Reihe / of the series

Forschungen zur Archäologie außereuropäischer Kulturen; Bd. 13

DOI: https://doi.org/10.34780/e4b0-b3e6

Herausgebende Institution / Publisher:
Deutsches Archäologisches Institut

1 Introduction

One of the most outstanding properties of the species *Homo sapiens sapiens* is its capability to adapt to almost all environments on the planet. This is true even in the most extreme cases, as for example, hyper-arid deserts. Fashioning a livelihood and developing a flowering culture in such a region counts as a highly astonishing and impressive achievement of humankind. Including all the deserts on Earth, the one along the Central Andean Pacific coast is among the driest. For thousands of years, it has nevertheless also been one of the most densely settled. The study area of the present thesis forms part of this fascinating desert strip: the northern Río Grande de Nasca drainage at the foot of the Andean west flank in southern Peru. The drainage comprises a couple of minor streams running from the mountains most of which only carry water during a few months of the year. Today, two small towns – Palpa in the northern and Nasca in the southern part of the drainage – are the local centers in regards to politics, economy, and culture. Nasca has reached considerable prosperity during the last decades. Much of the recent wealth comes from the flourishing tourist industry, which profits greatly from the widespread fascination with the famous "Nasca Lines." The German mathematician Maria Reiche dedicated her life to the preservation and promotion of the giant ancient ground drawings of the Nasca culture (200 BCE–650 CE) that spread across the desert plains. In 1994 she finally achieved that the geoglyphs were declared a world cultural heritage by the UNESCO. The resulting worldwide publicity triggered a tourist boom and increased academic interest in the societies that had once flourished in a region that apparently was not at all favorable to human settling.

The Nasca represent a culture that once thrived over many centuries in an extreme environment. But the region had also been inhabited long before the Nasca Period (from at least the fourth millennium BCE onwards) and it remained settled after the Nasca vanished. What happened to the bearers of the Paracas (800–200 BCE), Nasca (200 BCE–650 CE), Wari (650–1000 CE), and Ica (1000–1532 CE) cultures who inhabited the region in their respective epochs? Did they "die out," move away, or simply adopt new ways of life? Having in mind the great monumental city of Tiwanaku close to the Titicaca Lake, John Janusek states in a recent book:

> The reasons why civilizations collapse are manifold. We tend to think of collapse as the complete and unfortunate end of a past people. This assumption is continually invoked in popular romantic accounts of the past, including television specials concerned with the "mystery" of Maya collapse or the "discovery" of lost Andean cities. Overly dramatic attempts to box up and sell the past, in most cases a very complex and hazily understood past, mislead. Resonating with our deeply ingrained common sense regarding the past, they promote the idea that such civilizations ended abruptly, taking with them their people and leaving behind only abandoned ruins. Yet the question is not so much what happened to the people– for the distant descendents of many past civilizations continue to thrive around the world – but what happened to the political systems and religious ideals that inspired the exotic, and beautiful monuments that continue to intrigue today (2008:289).

Natural hazards and climate change are often suspected to have played a key role in both the rise and the decline of past societies all over the world (Clare & Weninger 2010, contributors in Anderson & Maasch et al. 2007). The Central Andes are no exception (Andrus et al. 2008, Binford et al. 1997, Craig 2011, Mächtle & Eitel 2013, Richardson III & Sandweiss 2008). This includes, of course, the Peruvian south coast, although in 1914, Max Uhle, the "father of Andean archaeology," who excavated numerous tombs in the Nasca region still thought otherwise:

> To judge from these numerous burials there must have been a dense population in these same regions, and it is difficult to understand by what ways and means they

> could subsist in this arid land as it appears to us today. The theory that the climate of that region might have undergone a change since those early days, cannot be upheld, since there are no additional circumstances to be found in support of it (1914:10).

Still in 1965, Paul Kosok, who interpreted the Nasca geoglyphs as astronomical signs[1], assumed that climatic conditions of the past were comparable to today's:

> Specific hydrological problems of the Nazca area may have furnished a reason for such elaborate astronomical observations. While the larger rivers in the north have water for a good part of the year, the branches of the Río Grande have water for only about five months. During 'bad' years there is even less water; during 'very bad' years there is none! (1965:58).

Many archaeologists working in the Central Andes seem to have become more conscious of climate impacts on cultural development after Lonnie Thompson published his frequently cited 1986 study of an ice drill core from the Quelccaya glacier near Cusco (e.g., Andrus et al. 2008, Dillehay & Kolata 2004, Dillehay 2011, Kolata 1996/2003). From the late 1980s onwards, long-term climate change was discussed more frequently in books and articles aiming at the reconstruction of the fate of ancient societies.[2] At present, a hundred years after Uhle's skeptical statement, most scholars agree that climate had always been changing on a global and regional scale throughout the past, and that these changes constantly altered the living conditions for human societies. This insight has gained additional relevance due to the pressing problems of today. Over the last two decades, climate change and its consequences for *recent* human societies have become a major topic, and in the course of this discussion the general public has also started to draw attention to the fate of *past* societies, as emphasized by Guy Middleton:

> The resurgence of explanations of collapse and historical change as driven primarily by, or profoundly affected by, long-term or abrupt climatic changes that affected the conditions of subsistence and production is unsurprising given current concerns over climate change and global warming […]. The scientific study of paleoclimatology also has revealed the profound dynamism and instability of local, regional, and global climates in the Holocene and has enabled climatic change to be mapped chronologically with a high degree of precision […]. Past climate can no longer be assumed to have been identical to today nor to have remained static, and past climate data require consideration and integration into reconstructions of the past […]. In fact, paleoclimatic studies have already profoundly impacted the study of collapse and culture change, and a new determinism is in evidence (2012:268).

Nevertheless, most major regional-scale projects specifically designed to investigate the impact of climate change on cultural development are relatively recent and still few in number, at least in the Central Andes. Further studies are needed to join the patches of information from both paleoclimate and human prehistory into a broader frame, which will enable a better understanding of interdependencies and general processes.

1.1 Research Problem

In a tropical desert, the relevance of climate change for human societies lies predominantly in the impact of water availability on food resources. This holds true for mobile hunters and foragers too, but the dependency of settled farmers on regular and sufficient precipitation is even higher. In the Central Andes, the development of agriculture as a *complementary* strategy of food acquisition started during the 10th to 7th millennium BCE (e.g., Pearsall 2008, Rossen 2011), which is long before the introduction of pottery during the first half of the 2nd millennium BCE (Lumbreras 2006). Nevertheless, it was a prolonged and gradual process that led to farming becoming the *dominant* subsis-

[1] Today, the astronomical hypothesis can be regarded as largely refuted. Although some of the ground drawings might have been oriented towards prominent celestial bodies, most were not (Aveni 2000, Hawkins 1974, Lambers 2006).

[2] The way in which Thompson's local climate proxy records were often used uncritically to interpolate the climate history of almost all of the Central Andes is problematic. As a consequence, many assumptions made by archaeologists concerning correlations between cultural and climate events in regions far away from Quelccaya have to be regarded as doubtful. More recent publications are generally aware of the problem, since interdisciplinary cooperation with paleo-climatologists is becoming a standard.

tence strategy for most coastal societies. In the Río Grande drainage, there still is a data gap between the archaic occupation of the site of Pernil Alto (approximately 3800–3000 BCE), which already includes evidence of cultivation as a complementary activity, and the earliest sites of the so-called Initial Period, which date to around 1500 BCE. For the Initial Period and all following periods archaeological remains clearly point to a developed full-time agriculture (Reindel & Isla Cuadrado 2006/2009).

Since then, as several studies have shown, the number, size, and location of settlements were subject to frequent and significant changes (Schreiber & Lancho Rojas 2003, Silverman 2002, Reindel 2009, Reindel & Isla Cuadrado 2013). What were the causes of this phenomenon? While there are a number of possible explanations, such as warfare, new social structures, new technologies, migration, or epidemics, the extreme character of the surrounding desert raises the suspicion that climate fluctuations might have had the most crucial impact on the fate of its ancient inhabitants. In particular, any substantial reduction in precipitation would have had far-reaching consequences for rain-fed and irrigation farming, the principal pillars of food production. But how did climate on the one hand and settlement behavior on the other actually change between the beginning of the Initial Period around 1500 BCE and the Spanish Conquest in 1532 CE? Were both phenomena causally linked? In other words, was the south Peruvian desert just another stage for climate-driven tragedies?

'Settlement behavior' refers to the locations where and the manner how dwelling sites were established and how these were related to each other. It is only one aspect of a society's culture but it can tell much about subsistence strategies and social structure on a regional scale. As Mark Sutton and Eugene Anderson put it:

> Settlement pattern depends on a variety of factors, beginning with the basic economic system used by a group. For example, a hunter-gatherer group would utilize a valley floor quite differently than would a group of farmers, with very dissimilar components, management practices, residential localities, and support facilities. The basic economic system would also influence the types and scales of facilities and technologies employed and the kinds of resources utilized (Sutton & Anderson 2010:100).

Settlers tend to reside close to the most important resources they use. Fishers can be expected to dwell close to a shore or lake and farmers will probably build their houses next to their most productive fields. If in a wider region all or most villages are being abandoned, possible reasons are the depletion of vital resources, a significant change in subsistence strategies (e.g., fishers becoming farmers), or threats from enemies.

If some settlements comprise special representative architecture and features pointing to administrative functions beyond the village level, a hierarchical relation between such a center and surrounding common villages can be assumed. On a regional and supraregional scale, the degree of political unity or fragmentation may be deducible from such settlement hierarchies. In this way, major changes in the political structure can be recognizable by comparing settlement patterns of different periods. Finally, fluctuations in number and size of simultaneously inhabited villages reflect the development of population levels.

All of these aspects – use of local resources, changing subsistence strategies, population levels, conflict, and political organization – *can* be influenced by climate change, especially in a hyper-arid or otherwise particularly susceptible region. This does not mean that climate change in fact triggered every new development observed in the archaeological record. Cultural aspects like innovation or simply the personal ambitions of individual rulers may also have played a major part. Consequently, the question to be addressed in the present study is:

Were major changes in settlement behavior caused by climate change?

1.2 Approach

Addressing this question requires a reliable reconstruction of both past societies and the environment they inhabited. Paleo-environmental data can be derived from geoarchives and geomorphological analyses while ancient cultures have to be reconstructed on the basis of their material remains by evaluating archaeological data, and, where available, also by interpreting preserved written sources. Only joint research efforts of environmental scientists and archaeologists can produce credible results on questions concerning prehistoric human-environment relationships in general.

It is firstly necessary to clarify what is meant by "climate change" and by "major changes in settlement behavior," respectively. Climate is a complex and multi-faceted matter but regarding its impacts on agrarian societies, three components are especially important as they directly influence the success of crop cultivation. These components are precipitation, temperature, and the variability of these two parameters. Since droughts and frosts can damage plants and reduce yields, agriculture is most productive where water supply is secured and temperatures never drop below 0°C. "Variability" refers to the degree of regularity and thus, to the reliability and predictability, of climate patterns in terms of averages and extremes of precipitation and temperatures. A high variability also means a high risk of crop failure. Major changes in settlement patterns can be asserted with relative confidence if the spatial distribution, the overall settlement area, or the inter- and intra-settlement complexity differs notably between two subsequent chronological phases.

Investigations on the impact of climate change on a local environment should bear good results in regions where fluctuations of precipitation and temperature can be expected to have an especially pronounced effect on the general environment. In these areas it is easier to identify signals in the proxy records. For example, a slight increase in precipitation in a rainforest will probably not significantly change the general environment while the same absolute amount of additional rainfall would have the potential to turn a desert into grasslands. Similarly, high mountain ranges are especially suitable for regional-scale paleo-climatic research because the altitudinal difference between its peaks and its foothills creates different climatic regimes at relatively close spatial proximity. In consequence, borders and transitions between ecozones are generally sharper than in flat open terrain, such as the Eurasian steppe.

From the archaeological point of view, ideal research conditions for regional studies would include a generally good preservation of material remains and an easy detectability of sites. Both prerequisites can generally be found in arid zones because the dry climate favors the preservation of organic material and because a sparse or even entirely lacking vegetation cover does not hide surface remains. Consequently, many sites, especially those including architectural remains, can be recorded quickly through prospection and survey without excavation. Information gathered that way will nevertheless tend to be coarse and incomplete.

In this sense, the west flank of the Central Andes offers ideal research conditions for paleo-climatologists *and* archaeologists. While the coastal strip forms one of the driest deserts on Earth, the highlands reach altitudes of more than 4000 m.a.s.l. The terrain ascends from sea level to these heights within a very short distance of only 60 to 120 km, resulting in especially pronounced temperature and precipitation gradients. In consequence, numerous different environments form at close proximity. The aridity at the coast and foothills has preserved organic material in archaeological contexts for thousands of years, and at many sites remains of the past lay openly exposed upon the barren ground.

The Ica and Río Grande drainages at the Peruvian south coast are of special importance as these belong to the first areas in the Central Andes that attracted major-scale archaeological research. Max Uhle, pioneer of Andean archaeology, worked here around 1900. In the 1960s, John Rowe and his team developed a pan-Peruvian chronological framework based on data from the Ica valley. Since the 1980s, several projects aim to understand the ancient cultures of the region in a broader context. Since 1997, the German Archaeological Institute (*Deutsches Archäologisches Institut* – DAI) and the Peruvian Andean Institute for Archaeological Studies (*Instituto Andino de Estudios Arqueológicos* – INDEA) are conducting a major research project in the northern Río Grande de Nasca drainage. Originally, the *Proyecto Nasca-Palpa* was limited to the surroundings of the small town of Palpa and focused on the Nasca culture, especially on the geoglyphs made by the bearers of that culture. Both the chronological scope and the study area soon widened when succeeding projects were set up. By now, the remains of all periods of the pre-Hispanic past found between the junction of the Río Grande and Ingenio rivers up to the water divide at 4400 m.a.s.l. are being documented and analyzed (cf. Reindel & Isla Cuadrado 2013). The data gathered during the 15 years of fieldwork were kindly made available to me for analyses in the scope of the present study. From here on, this long-term archaeological research will be referred to in general as to the *Palpa Project*.

The archaeological works of the Palpa Project have been included in two joint projects with scientists from different disciplines: the *Project Nasca: Development and Adaptation of Ar-*

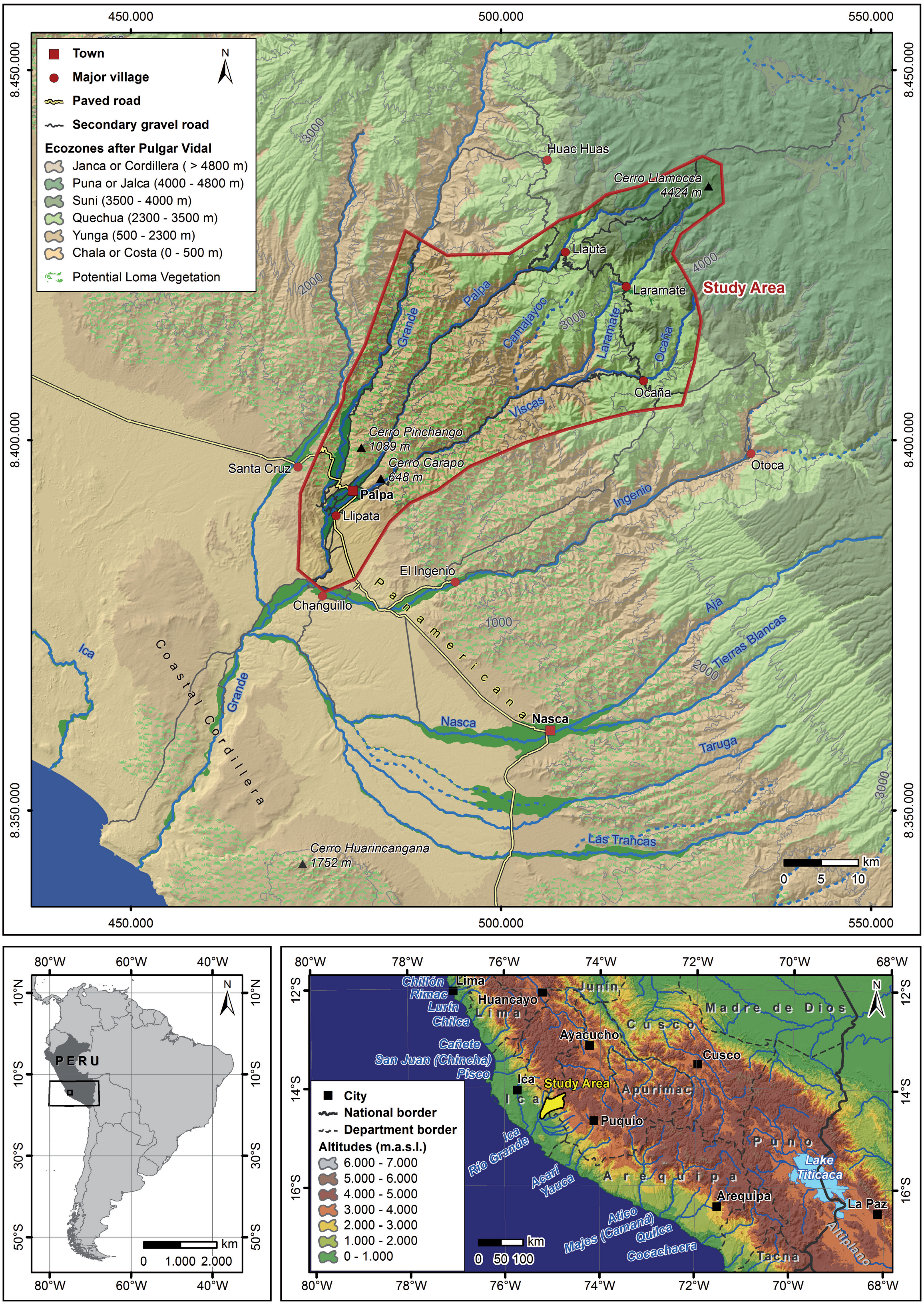
chaeometric Techniques for the Investigation of Cultural History between 2002 and 2007 (Reindel & Wagner 2009) and the *Andean Transect Project* between 2008 and 2011 (Reindel & Isla Cuadrado 2013). They were, however, continuously directed by Markus Reindel (DAI) and Johny Isla Cuadrado (INDEA). Paleo-climatic and geomorphological research in the Río Grande de Nasca drainage has been carried out by specialists from the Universities of Heidelberg, Cologne, and Jena for more than ten years now (Hesse & Baade 2009, Mächtle & Eitel 2009/2013, Unkel & Kadereit et al. 2007). Based on the results, a model for the climate history of the region has been developed which is constantly being refined. While changes in temperature patterns and inter-annual climate variability have been found difficult to reconstruct, longer periods of increased and decreased aridity could be identified with some confidence.

If major changes in climate and settlement behavior occurred at about the same time, a causal linkage between both phenomena may have existed. Caution is necessary, however, when correlating cultural and geomorphological events. An offset of a century, which is well within the error margin of dating, in some cases might lead to a reversal of many interpretations. Furthermore, non-climatic factors such as the broader political situation and organization or the introduction of new technologies and subsistence strategies also have an impact on settlement patterns. Consequently, a mere chronological coincidence alone does not evidence a causal linkage. Instead, a detailed consideration of the macro-scale cultural, social, and political background is necessary in order to identify possible non-climatic driving forces, which may lead to alternative explanations. Hypotheses in social anthropology, however, are normally not proved right or wrong, simply, but are rather considered for their coherency and persuasiveness. All factors have to be discussed together, and weighed against each other, before an overall picture of the pre-Hispanic settlement history of the study area can be drawn, and before the points in time when climate actually seems to have been the major driving force behind changes in settlement behavior can be determined.

1.3 Study Area

The Río Grande de Nasca drainage is situated about 15° south of the equator in southern Peru (Map 1). It can be divided into two major branches, each of which fans out into several tributary streams. The northern branch comprises, from east to west, the valleys of Santa Cruz, Río Grande, Palpa, Viscas, and Ingenio. Its provincial capital is the small town of Palpa. This area will be referred to as the northern Río Grande drainage (NGD) from here on. The southern Río Grande drainage (SGD) consists, from north to south, of the valleys of Nasca – which in turn splits into the Aja and the Tierras Blancas tributaries –, Taruga, and Las Trancas. The rivers have their headwaters at an altitude of around 4000 m.a.s.l. where seasonal rainfalls between December and April provoke a temporally lush shrub and grass vegetation. During their course through narrow valleys down the Andean west flank, the streams cross an ever more arid landscape, which is at first characterized by cacti but finally, below approximately 500 m.a.s.l., is almost completely barren of vegetation. Between the foothills and the Pacific coast stretches a roughly 50 km wide strip of full-blown desert where vegetation is only present in the river valleys. Close to the shore, a coastal cordillera reaching more than 1500 m.a.s.l. blocks most of the fog which in other sections of the Peruvian coast spreads inland from the sea.

The study area is identical with the spatial extension of the surveys carried out by the Palpa Project in the northern Río Grande de Nasca drainage. It extends from the confluence of the Río Grande and Ingenio rivers at 200 m.a.s.l. up to the water divide around *Cerro Llamocca* at 4424 m.a.s.l. It comprises the northern section of the Río Grande valley up to approximately 1100 m.a.s.l. as well as the complete valleys of the Palpa and Viscas rivers, including the wider valley margins and the mountainous areas between them. At the foothills, the Río Grande, Palpa, and Viscas valleys join into an extended floodplain in which the town of Palpa is located. Immediately upstream, the Grande and Palpa valleys are divided by a narrow ridge, the *Cresta de Sacramento*, which gradually becomes broader and higher before finally ascending up to the peak of *Cerro Pinchango* (1089 m.a.s.l.), the most elevated point of the surrounding area. In turn, the Palpa and Viscas valleys are divided by *Cerro Carapo* (648 m.a.s.l.). The Pan-American Highway crosses the region, connecting the present-day foothills settlements of Santa Cruz, Palpa, and Llipata. In the highland section, a secondary gravel road leads from Huac Huas over Llauta, Laramate, and Ocaña to Otoca. Additional secondary roads follow the valley margins to connect the foothills with the highlands.



Map 1. The location of the study area in southern Peru. The inlay map at the lower left uses a standard geographic coordinate system while the main map and the inlay map on the lower right are projected to UTM, zone 18 S. Map: VS.

1.4 Data

During 15 years of fieldwork, the Palpa Project has documented 1155 archaeological sites of all pre-Hispanic periods of which 835 contain remains of dwellings and related domestic activities. Several dozens of these sites have been test pitted and seven have been excavated on a larger scale. Most of the surveys and excavations were directed by Johny Isla Cuadrado and Carolina Hohmann who also are the authors of the major part of the original site descriptions, sketches, and photos. Additionally, I revisited most of these sites myself in order to get a direct personal impression and to complement or clarify data where necessary.

Archaeological data analyses have so far concentrated on some especially important sites where major excavation had taken place (Isla Cuadrado et al. 2003, Reindel 2009, Reindel & Isla Cuadrado 2001/2006/2009/2013). Additionally, some summarizing overviews over the diachronic development of settlement patterns have been published (Isla Cuadrado & Reindel 2005, Reindel 2009, Reindel et al. 1999, Reindel & Isla Cuadrado et al. 2010, Reindel & Isla Cuadrado 2013). An in-depth analysis incorporating and comparing occupations of all sites from all phases has nevertheless not yet been undertaken. The present study, based on the survey and excavation data of the Palpa Project made available to me by its directors Markus Reindel and Johny Isla, is intended to fill this gap. The full amount of archaeological data from all pre-Hispanic phases offers perfect conditions for a detailed diachronic reconstruction of settlement patterns. Published data from other parts of the Río Grande drainage, namely from its southern tributaries, and from neighboring regions are also considered for comparison. Combining a profound study of archaeological settlement data with the paleo-environmental reconstruction developed by research groups from Heidelberg, Cologne, Jena, and Kiel Universities surely has the potential to answer the question, if and when major changes in settlement behavior were caused by climate change.

1.5 Chapter Organization

Investigations on human-environment relationships in a particular study area can best be understood in the wider natural and cultural context. This is especially true for the Central Andes where very different environments can be found at close proximity and where, throughout prehistory, most peoples had cultural, economic, social, and sometimes political ties to other groups living hundreds or even thousands of kilometers away. Accordingly, the following two chapters are dedicated to a summarizing introduction to the environment and the pre-Hispanic cultures of the Central Andes in general and of the study area and directly neighboring regions in particular.

Chapter 2 – *Nature* – is split into three parts. The first part describes the study area and its natural resources in some detail while the second part treats the characteristics of the Central Andean climate and outlines the current reconstruction of past climate changes. This reconstruction is based on geomorphological evidence from the Palpa area itself, complemented by the interpretation of proxy data from remote geoarchives reflecting the supra-regional context. The third part compares different approaches to an environment classification.

Chapter 3 – *Culture* – summarizes previous archaeological research, particularly the works at habitation sites in the Río Grande drainage. Subsequently, an overview of cultural development on the southern Peruvian coast and the adjacent highland regions is given, which is structured by broad chronological periods.

Chapter 4 – *Culture Meets Nature* – contains the theoretical approach to human-environment relationships with special consideration for the unique natural setting of the Central Andes. Although such relations are manifold, the economic dimension is most important. It comprises the use of natural resources by humans for their subsistence. This aspect can best be studied by an analysis of material remains, including ancient settlements. Additionally, the effects of climate change on the limits of ecological zones and the agricultural potential will be discussed more specifically for the study area. Finally, the impact of fluctuations of the principal climatic parameters – precipitation, temperature, and variability – on rain-fed and irrigation farming will be discussed and described in eight hypothetical scenarios.

Chapter 5 is dedicated to the acquisition and classification of *archaeological settlement data* and to the methods deployed in its analysis. Acquisition includes the preparation, revision, and completion of the raw data gathered by the Palpa Project. Classification comprises the definition of settlements and their classification in terms of *chronology* (the periods during which they were occupied), *size* (their relative population size deduced from the extent of dwelling area), and *status* (their likely position in a settlement hierarchy). Raw data and classified data were organized in especially designed databases whose basic structure will also be outlined.

The threefold classification of settlements enables further comparative analyses, namely on dislocation and spatial distribution of settlements, differentiated by settlement size and status classes. Furthermore, the ranges of relative distances from the coast and relative altitude from the valley floor are considered. Finally, methods for assessing the general population development will be discussed. The necessary calculations were carried out with the help of a geographic information system (GIS) and customized database functions programed in Visual Basic for Applications (VBA). For all considered aspects of settlement pattern analyses, the problem of actual contemporaneity of settlements assigned to the same chronological unit is crucial and will be discussed in detail.

The results of these analyses will be presented in Chapter 6 – *Results: Diachronic Settlement Patterns, 1500 BCE–1532 CE* – along with a presentation of other archaeological data and descriptions of representative or especially important settlements. The chapter is organized by chronological units but starts with two sections on general observations concerning architecture and spatial distribution of certain settlement types.

Chapter 7 – *Discussion: Settlement, Migration, and Climate Change* – is dedicated to the discussion of the major changes in settlement behavior, the degree of probability of a temporal correlation with significant climate fluctuations, and the likelihood of a causal link between these phenomena. The broader cultural and environmental context presented in Chapters 2 and 3 will be taken into account, especially with respect to migration.

Finally, Chapter 8 contains summarizing *conclusions* about possible linkages between settlement behavior and climatic events as well as an outlook on future research. It is hoped that the results may stimulate future research and encourage comparison with studies addressing similar problems of long-term human-environment relationships on various scales – macro-regional, continental, and global. Some newly or further developed methodological approaches, especially with regard to population development, may also be applicable to other study areas and data sets.