

## Agency and GIS The Neolithic Land Use Hypothesis within Southern Italy

Doortje Van Hove

Department of Archaeology, University of Southampton, Highfield, Southampton SO17 1BF, UK  
dvh198@soton.ac.uk

**Abstract.** The archaeological discipline has become increasingly interested in the relationship between individual narratives and the long-term development of cultures and landscapes. The bloom of agency theory focusing on human volition can be utilised in conjunction with GIS modelling to explicate one of the key means by which humans uniquely characterize their surroundings: land use. A link between people and their worlds is created by the act of perceiving and engaging oneself with a landscape, generating a complex network of affordance, which embodies a unity of cognitive, social and environmental values. Ongoing research, using the southern Calabrian Neolithic as a case study and integrating agency within a GIS framework, shows one way in which the concept of affordance can be used to generate alternative land use hypotheses for the Neolithic.

**Keywords:** GIS, agency, Neolithic land use, Italian archaeology, perception, affordance

### 1 Introduction

The nature and meaning of Neolithic land use have received particular focus because of the dynamic characteristics of this period, which saw the introduction of new and changing relationships between people and their surroundings. The idea of a static Neolithic landscape consisting of agricultural villages, where people's choices were determined by the natural landscapes available to them, was especially popular within Italian archaeology (e.g. Cremaschi 1989: 339-355). However, this view was based on regional biases, selective material culture studies and specific theoretical stances, which have been increasingly challenged during the last two decades. Consequently, alternative strategies are being developed for the investigation of the Neolithic way of life within Italy.

The project study region is located across the Aspromonte, the mountainous tip of Calabria. A transect incorporates a range of habitats from 0 to 1950 metres O.D. (figure 1). The research covers the Neolithic period, dating from the 6<sup>th</sup> to the middle of the 4<sup>th</sup> millennium cal. BC (Skeates 1994: 270-277).

This article aims to contribute to the understanding of the Italian Neolithic, by developing an alternative theoretical framework for understanding past human decisions regarding land use, clarifying the conditions people lived in and the way they chose their economies. The study stresses the *combination* of economic and socio-cultural land use, examining the reciprocal relationship between nature and culture, agent and environment, land use and landscape. The union between people and landscapes is generated by focussing on the act of perception (Wheatley 1993), creating affordance (Gibson 1979; Llobera 1996), emphasising the extension of the mind into the landscape (Mithen 2001: 106-110) and vice versa, adopting a consciousness of cognitive, social and material values associated with this connection.

### 2 Theory and Practice

The study of Neolithic land use involves a nuanced assessment of material/environmental components of a landscape alongside socio-cultural attitudes of the groups living within it. It is their reciprocal connection that generates meaning for land use, introducing the concept of affordance. Affordance implies a complementarity of environment and its

observer, as it is a quality of the interaction between both (Gibson 1979: 127). Does a particular space in time afford a site, a farming area, a herding territory or a foraging space for groups who engage with it? Affordances need to be expressed practically in order to work out human space relations. Human space can be examined systematically within GIS. In fact, archaeologists use GIS to work out the particular significance of spaces to humans. There is no space without humans to define it and there are no humans in a spaceless world (Thomas 1996: 18-20, 66). Space only becomes meaningful by its relationship to people, which means that spatial and agency concepts have to be dealt with in unison. Affordance is a property of this relationship. It is therefore suggested here, taking aboard the concept of affordance, that land use (within the more general concept of space utilisation) can be explained within a spatial analysis framework like GIS without losing human agency in the picture.



**Figure 1.** Location of the study area (after Robb 1997: figures 1 and 2).

For this project, agency represents human volition, a stand-alone collection of intentions, goals and thoughts. These can be shared by human groups, physically expressed through their landscapes, or embodied by powerful individuals. Agency relates both to individuals in a social context and to actors in natural environments, indicating the wider implications of the results of human actions, and emphasising individuality

(uniqueness) on different levels. Agency is a property of humans that only comes into being through their relationship with their social and natural worlds (Dobres and Robb 2000). Its application on the Calabrian case study emphasises the need for alternative Neolithic land use hypotheses, taking into account human involvement.

Major benefits of GIS modelling are its systematic capacities for analysing spatial data, its potential to generate a range of output hypotheses by varying input, its ability to run a set of simulations in sequence, and its capability to link disparate datasets without compromising their size or objectivity (Burrough and McDonnell 1998; Wheatley and Gillings 2002). However, GIS is still criticised for using readily available environmental data to predict human behaviour (e.g. critique by Gaffney and van Leusen 1996). GIS methodologies need to refocus on both the human component (agency) and the connection between people and environments (via perception and affordance). This is achieved by deconstructing the *a priori* separation between humans and environments and generating instead models in which assumptions express human decisions engaged with the relationship between groups and their land. In using strategic input from archaeological theory, GIS is able to investigate cognitive cultural landscapes as well as material-environmental ones, resulting in a wider archaeology of place (Wheatley 2000), that rejects environmental determinism.

The project is not advocating a 'one and only' Neolithic landscape but uses GIS to present a series of hypothetical scenarios of Neolithic land use, using a variety of relative and qualitative data inputs and outputs. The reciprocal relationship between environment and cultural behaviour can be analysed within a GIS model, by calculating the different environmental attributes of a landscape and recreating the relationship between natural milieu and human use through environmental, ethnographic and archaeological research, emphasising what different spaces afford for different types of Neolithic socio-economic group dynamics. The established relationship between environmental variables and resulting land use through the perception of affordances is used as a means to assess the mutual influence between environmental components and agency accountable for the Neolithic economic land use decisions. Valued choices are culturally informed and have intended and unintended consequences, both bound by environmental factors and social rules. The general simulation strategy is the combination of static (topography, geology, hydrology) and dynamic (people, vegetation, fauna) elements within a socio-economic model. Even though initial inputs might be environmental, it is the construction of the relationship between agent and landscape and the assumptions made that make the resulting output explicate the non-environmentally focused nature of human land use.

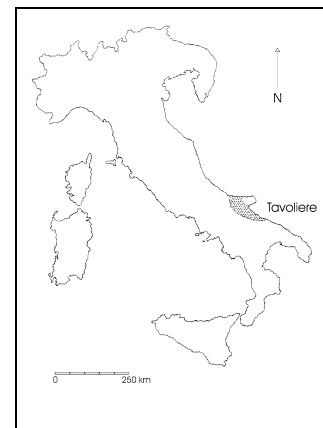
### 3 Neolithic Hypotheses for Calabria

A brief overview of biases within Italian archaeology is necessary at this point to justify the use and goals of the methodology proposed above.

Firstly, in-depth archaeological research in Calabria only started in the 1970s. Earlier Neolithic research only yielded partial information, creating unreliable Neolithic hypotheses. During the last two decades, a series of Calabrian Neolithic

research projects have been undertaken (e.g. Ammerman and Bonardi 1981, Ammerman 1985; Morter 1992). Although building on this, Calabria's current research status presents further potential for Neolithic study, demonstrated by Robb's ongoing research (Robb 2001).

Secondly, a large number of Neolithic research projects were situated in the Tavoliere (Cassano and Manfredini 1983; Whitehouse 1984; Skeates 2000; figure 2), an extensive homogeneous plain consisting of a limestone depression infilled with Pliocene-Pleistocene marine deposits and Pleistocene-Holocene alluvial material. Over large sections a calcareous stratum (*crosta*) has formed, influencing soil formation (Sargent 1983: 223-236; Skeates 2000: 157). Tavoliere studies conditioned the Neolithic hypothesis for a long time, postulating a landscape consisting of farming villages with a fixed economic strategy. However, the Neolithic is a long period during which people actively engaged with new subsistence methods. Depending on their cognitive, psychological, social and religious frameworks, and the environments in which they lived, different forms of socio-economic land use could be expected to evolve. A way of life adopted in a specific region cannot therefore be extrapolated to another. Non-Tavoliere based studies have been undertaken during the second half of the 20<sup>th</sup> century (Bernabò Brea and Cavalier 1960; Ammerman and Bonardi 1981, Ammerman 1985; Morter 1992; Robb 1998). These studies identified a variety of other material and cultural environments for study, one of which is addressed here.



**Figure 2.** Location of the Tavoliere (after Robb 1997: figure 1).

Thirdly, the southern Italian Neolithic has been predominantly studied through pottery analyses (Radmilli 1978; Cipolloni Sampò 1992; Cocchi Genick 1993). Until recently, these were part of a cultural-historic tradition (Radmilli 1978), using a stratigraphic sequence consisting of specific pottery-type phases with their own settlement, house, burial, subsistence and raw material use traditions, associated with groups coming from outside Italy. As southern Italian radiocarbon studies advanced in number and accuracy, it became clear that different ceramic styles were contemporaneous (Skeates 1994). Pottery analysis needed to be broadened to achieve more than the means to identify a cultural group. Societies can be studied via their produced, negotiated and deposited material culture. Material culture includes more than just ceramics, thus pottery is certainly not the only way of investigating a Neolithic way of life. Off-site archaeological

evidence including lithics, fauna and botanical material should assist in clarifying the broader patterns of a Neolithic lifestyle.

Lastly, within Italian archaeology past human land use is commonly linked directly to ecology (Cremaschi 1989: 339-355). People are suggested to have responded to certain ecological characteristics by using specific subsistence methods. (Sargent 1983: 223-236). The environment was the main factor influencing human economic and socio-cultural behaviour, with human decisions not involved in the process. However, how people act within their surroundings is largely related to human perception and choice, in that ‘fertility, productive opportunity, and the soil itself are all of human construction’ (Horden and Purcell 2000: 231). There is no such thing as absolute land qualities, as ‘its value and potential depend on choices and perceptions of those who make use of it’ (Horden and Purcell 2000: 231). In short, land use involves more than just material requirement. It involves people.

The above arguments clearly show the biased nature of the Neolithic land use hypothesis and the challenge of applying an alternative theoretical framework to these traditional ideas.

#### 4 Putting Dots on Maps: the GIS Analysis

The GIS model is based on IGM (*Istituto Geografico Militare*) topographic and geological data and field survey site distributions from the Bova Marina Archaeological Project (BMAP). Environmental criteria are modelled using current and historical Mediterranean literature on geography/ecology, and comparative archaeological research (e.g. Barker 1981; Barker 1985a; Barker 1985b). Annual terrain visits from 1999 until 2002 have provided personal experience of the studied environment.

figures 4, 5 and 6), literature and terrain information. The environmental relationships are illustrated schematically in figure 3.

These environmental niches are defined according to environmental characteristics *in relationship to* how agents perceive them (e.g. lowlands and highlands are referred to as separate niches based on the fact that they generate different affordances to their inhabitants or users). The concept of affordance is introduced into spatial modelling by reclassifying the environment according to parameters valid for the differential perception occurring between environment and user. A niche is a set of affordances (Gibson 1979: 128) by which people’s perception of space within the past can be assessed. The niche represents the potential starting condition for Neolithic land use, within which affordances are expressed.

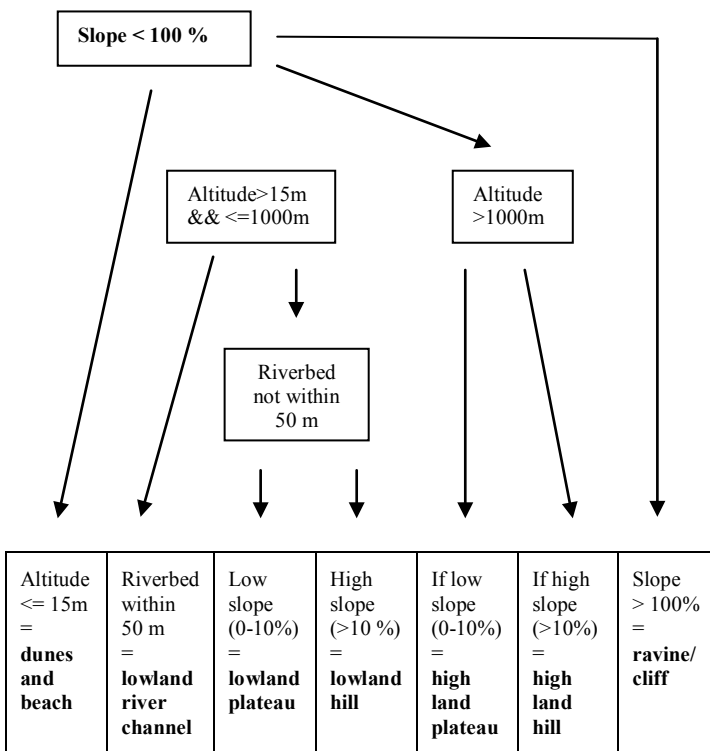


Figure 3. Environmental relationships diagram.

To articulate with the idea of affordance perception, an environmental niches map of the study area was created on the basis of elevation, slope and river proximity parameters (see

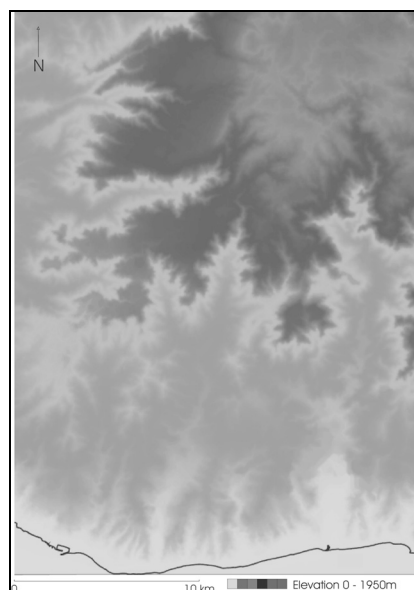


Figure 4. Digital Elevation Model.

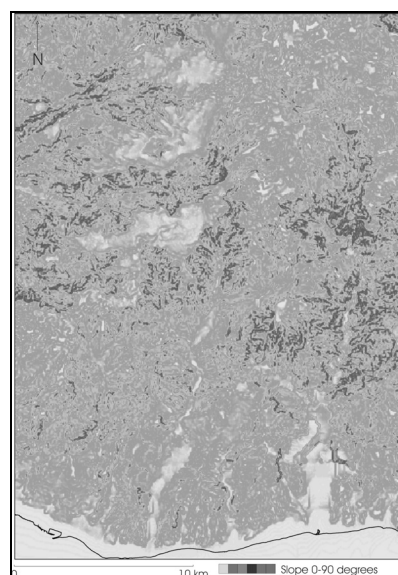


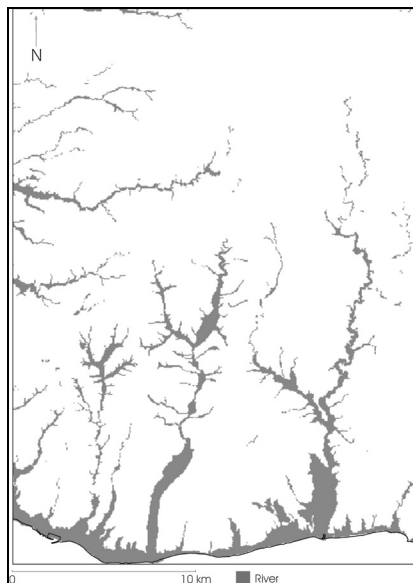
Figure 5. Slope.

Seven environmental zones (figure 7) were identified, presenting a set of current ecological niches in the study area:

1. The coastal plain (beach and dunes) is flat and up to 200 metres wide, consisting of sand and pebbles. The

area is situated under 15 m altitude, exhibits no real soil formation and has typical beach vegetation (limited dune grasses).

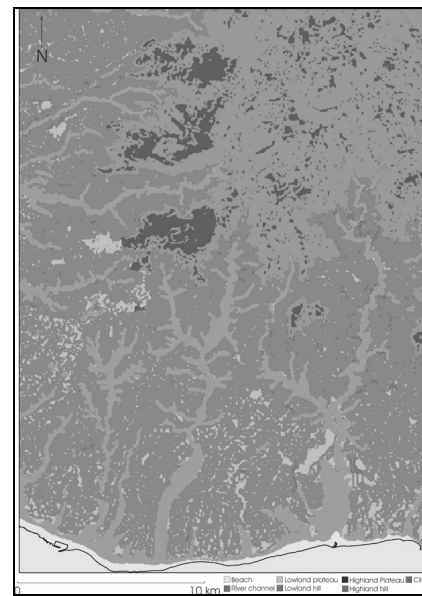
2. The river channels are up to one km wide and dry for up to nine months of each year. Erosional material is collected and transported through them in winter and after thunderstorms in summer. Wide river channels are only present below 1000 metres. They contain a very dynamic and coarsely textured soil and herbal plants that support temporarily humid soil conditions.
- 3/4. The lowland plateaus and hills are situated below 1000 metres, and provide a rich source of stone material. Their soil and vegetation is very variable because of the various geological combinations present. Soils range between sandy, silty and clay consistencies with inclusions of limestone and conglomerate material. Vegetation includes *macchia*, a dense growth of small trees and shrubs, typical for the Mediterranean.
- 5/6. The highland plateaus and hills are related to the Aspromonte massif and situated above 1000 metres. These zones exhibit very steep slopes and extensive erosion, but are ideal as raw material sources, as a result of the surface weathering of igneous, sedimentary and metamorphic rocks. The climate is ca. 10 °C colder than the coastal zones, influencing soils, vegetations and faunas. The vegetation displays elements of deciduous and coniferous forests.
7. Cliffs are present over the whole research area, often the result of erosion of metamorphic rock outcrops.



**Figure 6.** Rivers.

To assess land use, this research focussed on two elements: yield and cost. Yield is generated through the interplay between environmental elements and specific human use. For example, a beach environment might possess a high yield for seafood processing, but a low yield for farming. Yield becomes the expression of one type of affordance for Neolithic land use. Similarly, cost reflects affordance, as it is calculated on the basis of the habitat structure and how people are attempting to utilise it at specific moments in time. Cost or the grade of difficulty to reach/use a place involves material and cultural elements. Wheatley and Gillings emphasise that there is more to cost surfaces than merely slope and energy expenditure on a

physical basis, as patterns of movements within landscapes are influenced by symbolic resources (Wheatley and Gillings 2002: 155).



**Figure 7.** Environmental niches.

**Yield Values.** Yield values are one means of evaluating the affordance generated by each environmental niche in relation to different economic regimes adopted by Neolithic groups. Each zone is assigned a series of specific usefulness values. The numbers given to each environment are based upon how useful they can be according to each specific land use strategy, assigning the highest numbers to optimal environments and the smallest numbers to unsuitable ones, for three types of land use: farming, herding and foraging (table 1). The yield values are based upon what Neolithic people need in relation to what environmental niches provide.

N°	Environment	Farming	Herding	Foraging
1	Beach and dunes	1	1	2
2	River bottom/channel	1	2	3
3	Lowland plateau	3	3	3
4	Lowland hill	2	3	3
5	Highland plateau ( <i>altopiano</i> )	3	3	3
6	Highland hill	2	3	3
7	Ravines/cliffs	1	1	1

**Table 1.** Yield values for specific land use (3 = large, 2 = medium, 1 = small).

While their choice can be analysed using different criteria, the following assumptions for prehistoric foraging, farming and herding were adopted:

*Foragers:*

- Use of a diversified system of hunting, fishing and gathering.
- Utilisation of seasonal camps for the exploitation of a range of resources.
- Movement through variable regions, from hills and mountains to intermontane basins, lowland plains and river valleys.

- Use of various habitats (including beach), encouraging a large variety of resource strategies, such as inland and coastal fishing, gathering of legumes, small seeded cereals, wild barley, honey, nuts and herbal weeds, and sheep husbandry (Barker 1985b: 61-63).
- Use of a mixture of animal and plant resources, dependent upon respective natural and social environments, in conjunction with their histories and perceptions (Gregg 1988; Kelly 1995).

*Farmers* (Barker 1985b; Gregg 1988):

- Preference for light, fertile, arable and well-drained soils, as more reliance on soil fertility and other suitable soil characteristics to grow crops (Whitehouse 1992: 12).
- Avoidance of areas susceptible to heavy erosion. The research area displays a multitude of hill slopes used for crops, and it is believed that some type of land shaping was in use in the Neolithic (pers. comm. Foxhall, Lazrus).
- Avoidance of beach environments, as soils are absent.

*Herders* (Barker 1985b):

- Less focus on soil fertility but use of a variety of environments suitable for animal grazing.
- No differentiation necessary between level areas and hill slopes for the movement of animals (terrain observation).
- Avoidance of beach environments due to the lack of suitable vegetation but use of river channel environments as water resource for animals.

It is important to note that these assumptions are based on the perception of Calabrian surroundings by groups making decisions about their land use. This work is not postulating a directional dependence of people on their environments. It should be clear that these statements indicate a multitude of values generated for land use to enable socio-cultural choices to be maintained. Economy is instigated by human decisions and the yield values attached to areas are the result of the expressions of affordance through human decision making in a specific environment.

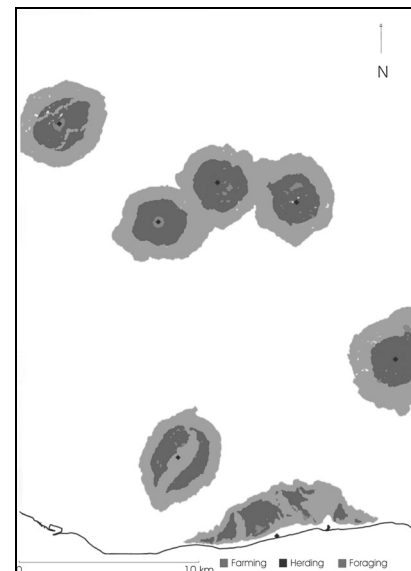
**Cost Values.** In assessing what type of affordance is generated, not only the qualitative yield but also the accessibility of the area plays a significant role. Accessibility in a GIS model can be assessed by performing a cost-surface analysis. The friction equation used is

$$\text{Friction} = \log(\text{slope in percent} + 1) + 0.5.$$

This equation oversimplifies the idea of cost as it only incorporates the environmental variable of slope. In future, this project will be using alternative frictions equations (e.g. Marble and Machovina 1997) and will take into account human factors such as body and load weight, speed and terrain factors (potentially culturally influenced).

**Land Use Iterations.** To systematically examine the affordances generated by the interaction between Neolithic people and the southern Calabrian environment, the assumption is made that people will choose the accessible and useful areas that suit their socio-economic needs. Initially, the simulation did not put any restrictions on the distance covered to avoid *a priori* biases based on site-catchment analysis (Higgs and Vita-

Finzi 1972). To assess what the landscape affords to people choosing to maintain a specific economic regime (related to social structure), they are allowed to go as far as needed to acquire enough resources for a group of predefined size to survive upon. Although some Neolithic villages elsewhere in southern Italy probably contained up to 250 people (e.g. Passo di Corvo, Tinè 1983), site sizes and house numbers indicate that most sites in Calabria were substantially smaller (Robb and Van Hove in press). Therefore, the notional value of 50 people was chosen as a reasonable estimate of people living in a Neolithic settlement in Calabria. The statistics output of the model was checked against parameters in anthropological, ethnographic and archaeological literature (Gregg 1988) with respect to acquired calories and territory sizes for group survival. According to the economy specified the type and quantity of chosen land differs. The quantity and physical distribution of selected terrain will affect time and distance covered to reach adequate territory to sustain the chosen population. The different models were evaluated for their respective viability as economic strategies for the groups/sites concerned. An example is shown in figure 8.



**Figure 8.** Resultant land use within a farming economy for 7 randomly chosen points.

## 5 Interpretations and Conclusions

Running the simulations and interpreting the results indicated the need for adjustments of the model, and demonstrated that affordance needs to be expressed through more than just yield and cost. Even though the article presents work in progress, one of the interesting results are related to Neolithic mobility issues. It seems that a much more mobile way of life is to be expected for Neolithic groups within the Calabrian environment. Farming areas were not the key determinant of site placing, yet herding and foraging territories seemed to be highly significant. It appears that the Neolithic settlers did not follow the traditional Neolithic hypothesis as it is apparent that they interacted in a more fluid way with the resources provided by reflected ecological conditions, within an agency-affordance concept. Mobility is more than an environmental issue, it is culturally instigated and agency-related. From a purely environmental point of view, one would think that many of these environments would not support a stereotypical 'agricultural landscape', as supported within

traditional Italian Neolithic archaeology. However, the Calabrian environment may have catered for a whole range of economic, social and even religious uses, although not in the particular stereotypical setting of an agricultural site within a largely flat plain. A fluidity of affordances was generated through the interaction between active agents and their surroundings.

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