CHAPTER TWO

GEOGRAPHICAL AND ENVIRONMENTAL DATA

Geographical Boundaries Of The Study

The southern Jordan Valley and desert fringes of Samaria are two neighbouring geographic units, west of the River Jordan, in the eastern part of Palestine. The southern Jordan Valley is defined as the flat land between the Samarian hills in the west and the River Jordan in the east. The northern part is the southern Beth Shean Valley, and in the south it borders on the Jordan’s outlet into the Dead Sea. The Jordan Valley is about 70 km long in this section between Nahal Bezeq and the estuary. The width of this section ranges between 5 km in the vicinity of Fass ej-Jamal, and 25 km opposite Jericho (Ben-Yosef 1979: 247).

The desert fringe of the Samarian hills is a narrow elongated stretch of land extending west of the lower Jordan Valley, and east of the scarp of the eastern Samarian hills. In the north it borders on the Beth Shean Valley, and in the south Wadi 'Aujjeh and the desert fringes of the Judean Hills. Its width varies with that of the southern Jordan Valley, and ranges between 6 km at its narrowest part in the regions of Kokhav Ha-Shahar or Duma, and more than 20 km at its widest part in the area between Fass ej-Jamal and Ras Jadir.

The boundaries of the study area were fixed in these two geographical regions (Fig. 2.1): the northern border along Nahal Bezeq (Wadi Shubash), which flows west from the Zebabdeh Valley via the southern part of the Beth Shean Valley and empties into the Jordan southeast of Tirat Tzvi; the eastern border is the Jordan between the mouth of Nahal Bezeq in the north and the mouth of Wadi 'Aujjeh in the south; the southern border was set along Wadi 'Aujjeh which flows west from the vicinity of Khirbet Marjameh to its outlet in the Jordan, east of 'Aujjeh village; and the western border passes through the lower part of the scarp of the eastern part of the Samarian hills (the monocline of the eastern hills of Samaria, Spanier 1992: 122). This scarp forms a prominent boundary between the lower eastern region (inside the study region) and the higher western one outside the study region. The western boundary also overlaps the line of average annual precipitation (250–300 mm, Shachar 1995: 28). This boundary runs along the bot-
Figure 2.1. The boundaries of the study.
tom of the eastern slopes of the following ridges (from north to south): Har Bezeq, Har Gadir, Har Kabir, Neby Noon, Majdal Beni Fadil; Zahr el-Qabah, and Qubbet en-Najmeh.

The total study area was 750 km².

**Geology And Geomorphology**

The Jordan Valley is a long narrow depression extending from Sharm el-Sheikh in southern Sinai to the Galilee panhandle in northern Israel. This depression is the part of the Syro-African Rift that runs from the Red Sea in the south to Turkey in the north, and is about 1,000 km long (Mimran and Belitsky 1995: 257; Horwitz 2001: 508–513).

The valley also constitutes the contact line between two of the earth's continental plates – the African Plate west of the valley and the Arabian Plate east of it, which is moving northward relative to it (Garfunkel 1981).

The Jordan Valley depression consists of continental and marine sedimentary rock which has been forming from the Neogene period to the present. These marine sediments include rocks formed by the evaporation of water when the sea flooded the valley at the end of the Pliocene period. The youngest rocks were deposited in the section of the Jordan Valley between Hatzeva and Lake Kinneret (the Sea of Galilee). These belong to the Lisan Formation (dating to the Upper Pleistocene), above which are deposited mostly clastic rocks that were formed in the Holocene (Mimran and Belitzky 1995: 257).

According to Belitzky (1999), the Lisan Lake began to shrink and withdraw to the present boundaries of the Dead Sea about 20,000 years ago. With the retreat of the lake a sloping plain was exposed in the Jordan Valley, which descends gently from an elevation of about 200 m below sea level in the vicinity of Lake Kinneret to about 400 m below sea level at the Dead Sea. This is the Plain of Jordan (in Hebrew: *Kikar Ha-Yarden*; in some sources it is referred to in Arabic as the *Ghor*, which means depression or valley). As the Plain of Jordan was forming, removal and deposition processes occurred in it, while the River Jordan drained the entire length of the plain. Thus a landscape consisting of badlands and sediments deposited as alluvial fans was formed. The River Jordan, which is lower, formed a relatively narrow flood plain (Zor in some sources) about 1 km wide, delimited by precipitous banks 30 to 70 m high (Belitzky 1999: 439).
The *Ghor* and *Zor* are two geological levels that make up the foundation of the Jordan Valley. The *Ghor* is the high level formed by the Lisan sediments (Lisan marl) deposited on the ancient Lisan Lake (Dan and Alperovitch 1971: 6). The *Zor*, however, is the Jordan flood plain, formed by the action of the river’s erosion of the *Ghor*.

The *Zor* extends from Lake Kinneret to the Dead Sea, and is lower than the *Ghor* by an average of 25 m in the north and 35 m in the south. The slopes separating the *Ghor* from the *Zor* are sub-vertical to vertical (Nir and Ben-Arie 1993: 73), and form long terraces on both sides of the valley to the Jordan riverbed, with an intermediate terrace between the two levels.

Based on an analysis of the morphology and drainage network, Belfitzky (1999: 441) suggested identifying young folding and fracturing structures that were active after the retreat of the Lisan Lake, some of which also affected the course of the Jordan.

The main fault in the valley consists of three major sections: the northern section from Lake Kinneret to Wadi Yabis; the central section, from Wadi Yabis to the Valley of Succoth; and the southern section, from the Valley of Succoth to the Dead Sea.

The faults in the two end sections run in a north-south direction, and long depressions were formed in them (the Jericho depression in the south and Kinneret depression in the north), leading to the accumulation of thick sediments over the course of millions of years. A bottleneck about 4 km wide was formed in the vicinity of Fass ej-Jamal. This section, between Wadi Malih in the north and Wadi Far‘ah in the south, is about 30 km long, and is the narrowest section in the Jordan Valley.

The section between Wadi Far‘ah and the Jordan estuary in the Dead Sea is called the Plain of Jericho, and is 38 km long. In this section the river descends at a fairly moderate gradient. The section is 16 to 20 km wide, and is confined between steep slopes on both sides. Several fault slopes are located in the east, at the feet of which are broad alluvial fans. In the west, however, the border of the hills is irregular, and conforms to the tectonic structure of the hills of eastern Samaria and the Judean Desert monocline. In the north this section penetrates into the broad and fertile Far‘ah Valley in the Jordan Valley.

The geological structure of the desert fringes of Samaria, west of the southern Jordan Valley, is connected to the Wadi Far‘ah anticline, which runs from north-east to south-west. Its boundaries are the southern Beth Shean Valley in the north, and the region of Wadi ‘Aujjeh in the
south. In the west, it borders on the Nablus and Jenin synclines, and in the east on the Sartaba syncline and the slopes of the Jordan Valley. The escarpments of the monocline in the middle of the anticline form slopes inclined as much as 40° to the east, toward the valley. The anticline is dissected by a row of faults running mostly from southeast to northwest (Spanier 1992: 122–124), forming a series of horsts and grabens. The most prominent of the horsts in eastern Samaria and the desert fringes are Jebel Kebir, Jebel Tammun, and Ras Jadir. The Sarbata ridge, which is also prominent, is a block of soft Eocene rock that was uplifted by a series of parallel geological fractures. The eastern slopes of the horsts of eastern Samaria constitute the boundary of the study region. The prominent grabens of eastern Samaria are Wadi ‘Aujjeh, Wadi Fazael, Wadi Ahmar, Wadi Far’ah, the Buqei’ah, and Wadi Malih.

**The River Jordan**

The Jordan Valley is 105 km long from Lake Kinneret to the Dead Sea, and the River Jordan is about 220 km long in this section. The average gradient of the valley is 0.18%, and this gentle descent is a consequence of the river’s many meanders (Kline 1988: 75–76; Nir 1989: 306–307). The Jordan’s meanders are affected by the intensity of the high flow, type of soil, the flow gradient, and the nature of the load that the river carries (Schattner 1959: 157–175). All of these factors contribute to the dynamism of the annual changes that occur in the river banks.

The valley formed by the River Jordan is relatively narrow, as its average width is about 1,200 m. However, in several sections it narrows to an average width of 500 m, particularly south of the Wadi Malih outlet. Elsewhere it is 200 m wide, and in several areas the width is reduced to just the riverbed and a few metres on either side of it (Ilan 1973: 22). This might explain why few permanent settlements developed along the western bank of the Jordan.

Almost vertical badlands occur on both sides of the Jordan, and delimit the valley where the river flows (between the Ghor and the Zor): these are called al-Qatra in Arabic (meaning ‘the camel humps’). They vary in width; in the north they have a maximum width of 1 km, and at the mouth of the Yabuk on the east and the mouth of Wadi Malih in the west they can be as much as 3 km wide. The soft marl of the badlands is dissected by channels that result from flowing water, falling rocks and soil erosion, and ground collapses in the direction of the channel. Dur-
ing the course of this process the badlands erode, and are constantly being reshaped, and the great load the river transports affects its course and behaviour. This natural dynamism is probably the reason why no archaeological sites have been found on the terrace badlands.

An important phenomenon in the geomorphology of the River Jordan is its shift westward. The drainage area between Lake Kinneret and the Dead Sea, east and west of the Jordan, is 13,500 km², of which the western part comprises only about 2,000 km² (a ratio of 1: 6.8 between its two parts). This asymmetry is mainly due to the enormous amount of water drained from the major perennial streams coming from the east, while the western side is in the rain shadow and its streams have a much lower rate of flow than those to the east, or are seasonal. Most of the alluvial fans are on the east, and some reach as far as the bank of the Jordan.

The multitude of streams in the eastern part shifts the Jordan westward, enlarging the eastern side of the valley at the expense of the western side (Nir 1989: 305). Evidence of this is apparent in the area between Wadi Far’ah and Wadi Nu‘imeh. In this region there are no large streams on the eastern side between Nahal Yabbok and Wadi Nimrin, and the Jordan flows approximately in the centre of the valley. In some places the western bank is even larger than the eastern (Ilan 1973: 23–25).

Additional explanations regarding the shift of the River Jordan westward were proposed by Schattner (1962) and Ben-Arie (1965: 33). The first contends that the presence of hard infrastructure rocks between the layers of the rift also causes the river to be shifted westward, and the other suggests that the river’s gradient to the west in the central Jordan Valley is also related to the fact that the valley slopes from east to west. According to Ben-Arie, the alluvial delta of the River Yarmuk caused the flat area of the Jordan Valley south of the Kinneret to slope from east to west. This resulted in the Jordan flowing in the lower area on the western side of the valley. All the large deltas of the major streams give the Plain of Jordan an inclination from east to west, thus causing the Jordan to flow on the western side of the valley.

SOIL

Some of the different types of soil in the Jordan Valley and desert fringes of Samaria were created from the erosion of brown clay alluvium or
grey limestone of the surrounding hills, and some by the weathering of the Lisan marl. Dan and Alperovitch studied the soil extensively (1971; Ben-Yosef 1979: 257; Dan 1988: 95–128), and sampled 46 soil sections on the western side of the River Jordan, from the vicinity of Nahal Bezeq to north of the Dead Sea. The researchers sought to classify the soils in the valley according to their compositions, and determine the amount of the arable land.

The soil compositions presented below are only those that appear in the study region near Chalcolithic or EB sites, based on their descriptions by Dan and Alperovitch (1971):

1. Brown alluvial soils: *Ghor* soils mainly formed from the erosion of the high hills (these soils are referred to as brown forest soil in this study).
2. Soils formed from Lisan marl: drained, and containing large amounts of limestone (about 50%), gypsum, and easily soluble salts.
3. Solonchaks: undrained saline soils. These were mostly formed from alluvium; however, several soils were produced directly from Lisan marl. Their distribution in the study region is north of 'Aujjeh, in the vicinity of Wadi Far'ah, and some in the Fazael region and the Zor.
4. Stony brown soils: formed from old stony alluvium. These soils are common on the slopes of Wadi Malilh, in the southern Beth Shean Valley, and in the Wadi 'Aujjeh valley.
5. Light brown and greyish brown colluvial-alluvial soils: loose stony clusters of soil formed from the erosion of the surrounding hills in the north of the Jordan Valley. Soil salinity is low, and the amount of chalk in them can reach 50%. These soils are distributed between the Beth Shean Valley and Wadi Far'ah.
6. Undeveloped soils – lithosols and regosols: the shallow soils of the badlands, like the chalky desert calcareous lithosol formed from Lisan marl, belong to this group. These are shallow soils with a high degree of salinity. They are distributed on the hill slopes and in the badlands between the *Ghor* and the Zor.
7. The most calcareous types of soil: referring mainly to the grey colluvial-alluvial soils formed from the erosion of the chalk hills. These soils are common at the foot of the hills, in areas between Wadi Far‘ah and Wadi Fazael, and small amounts are also found in the Zor.

For the most part the characteristics of the soils in the Jordan Valley
limit, and sometimes even prevent, their use for farming (Dan and Alperovitch 1971: 30–31). This is due to their main characteristics, namely the amount of chalk and high degree of stoniness, shallowness, poor drainage, and salinity. This conclusion has major archaeological ramifications when attempting to reconstruct the interrelationship between man and the environment in antiquity.

The most common soils in the desert fringes are:
1. Terra rossa – fertile soil, mainly typical of the Far’ah anticline, and also found in the southern desert fringes in Wadi Far’ah and the Buqei’ah.
2. Rendzina – soil of mediocre fertility (dependent upon rainfall), mainly characteristic of the desert fringes and Wadi Malih.
3. Brown Mediterranean forest soil, mainly characteristic of the areas north of Wadi Far’ah. According to Ravikovitch (1981: 76) this soil is formed in rainy climates, and its presence in regions where the climate is that of a steppe-desert fringe might suggest pluvial conditions and a different floral covering in the past.
4. Alluvial erosion (grumusol) – this kind of soil is quite fertile, and is mostly used for field crops. It is typical of the eastern valleys of Tubas and Zebabdeh, the Buqei’ah, and parts of Wadi Far’ah.
5. Colluvium-alluvium – the fertility of this soil depends upon its origin and the amount of organic material it contains. It is found in the ravines and at the foot of hills where there are terra rossa or rendzina soils.
6. Stony-desert soils – shallow, containing a high percentage of stone, and therefore not fertile. They are commonly found in the seam between the Jordan Valley and the desert fringes, and in the flood plains of the major streams (Far’ah, Malih, Fazael etc.).

Climate

The Climate Today

The main factors for the formation of desert climatic conditions are the location of the Jordan Valley east of the Samaria hills, and its distance from the Mediterranean Sea (Gat and Karni 1995: 17). This is one of the hottest and most arid regions west of the River Jordan, and the largest number of heat-waves occur there. The average annual precipitation in the valley decreases from 270 mm in the north to 160 mm in the south. The evaporation values are especially high, and exceed 2,000 mm/year.
In terms of both heat and cold, the most extreme climate in the region occurs in the Zor.

In the winter (January) the average maximum and minimum temperatures are about 19°C and 9°C respectively. In the summer (July) the average maximum daily temperature is 37–38°C (Gat and Karni 1995: 17). The relative humidity in the Jordan Valley decreases from north to south. The lowest values are measured in the spring, and the highest in the winter. The average maximum relative humidity in the winter in the Jordan Valley and the desert fringes of Samaria ranges between 75% and 85% (Rubin et al. 1992). The average maximum relative humidity in the summer is about 70% (Gat and Karni 1995: 17–18).

The wind regime is determined by the general synoptic system and local factors. In the summer, from the early morning to midday, the winds blow from the east and south-east. From midday to shortly before sunrise the winds blow from the north-west and west, originating with the breezes from the Mediterranean. In the winter the wind regime is determined by the barometric pressure systems that pass through the region. The combination of these with the harsh topography of the Samaritan hills causes strong gusts from the west and south-west that can reach more than 100 km/hour (Gat and Karni 1995: 18). The strongest winds usually occur in the region of Wadi Far’ah, which is open in the east-west direction, thereby allowing the wind to blow directly into the wadi.

The Presumed Climate in the Chalcolithic and EB I

Most of the studies that attempted to reconstruct the climate that prevailed in the southern Levant in general, and the Jordan Valley in particular, did not focus on the Middle Holocene period (the Chalcolithic and EB I); and the trends in climatic changes in them were studied at resolutions of hundreds or even thousands of years. Studies at a higher resolution were also based on a small number of absolute dates, sometimes with high standard deviations relative to the chronology defined in the archaeology. In addition, the research record presented here shows there are no conclusive results regarding the climate in the region and in the periods we are addressing. This has not prevented numerous researchers over the years from suggesting that the climate in the Chalcolithic and EB was more humid than today (e.g. MacDonald 2001: 598), and using this supposition as the main cause of changes in the settlement patterns in the region (e.g. Bourke 2002: 24).
Many researchers have dealt with the palaeoclimate in this region. Rosen (1986; 1995), who conducted research in the Negev, the Shephelah, and the coast of Israel, pointed out alluvial and flooding activity of valleys in the Chalcolithic and EB, and argued that the prevailing climate in these areas was warmer and wetter.

Frumkin and others (Frumkin et al. 1991: fig. 8; 1994: 325–326) investigated the salt levels in view of data collected from the salt caves in Mount Sodom. Their results corroborate the hypothesis that the climate was relatively dry in the Chalcolithic period, but probably more humid than today, whereas in the EB I–II the prevailing climate was the wettest in the past 7,000 years (Bruins 1994: fig. 2). The data of the Chalcolithic are also supported by a study on land snails near Qumran (Goodfriend et al. 1986).

Bar-Matthews and others (Bar-Matthews et al. 1997; 1998) investigated the variability in stable isotope values from Soreq Cave. From this they concluded that a sharp decline in the amount of precipitation occurred in the early 5th millennium BCE, and that later there was a certain increase to values similar to those of today. The validity of this model has recently been questioned (Kolodni et al. 2005; Enzel et al. 2008).

A palynological and palaeological examination of the Hula Basin indicated that a climatic change occurred about 2500 BCE, and it was only then that the area of the lake diminished and the climate in the region became Mediterranean, similar to that today (Frumkin et al. 1994: 326, 328–329).

Netser and Gvirtzman (1996: 294) agreed that the data from the Hula Basin and Mount Sodom showed similar results, reinforcing the assumption that the climate was relatively wet in the Chalcolithic, and that the humidity reached a peak in the EB I.

Ravikovitch (1981: 76) argued that the Mediterranean brown forest soils (characteristic of the desert fringes of Samaria) were only produced in a rainy climate. Finding them in the study region suggests pluvial conditions and a different floral covering, stemming from a wetter climate in the past (without identifying the specific period).

Information collected from more distant regions corroborates this to some extent. For example, a palaeoclimate study at several sites in the Sahara Desert showed that a wetter climate prevailed there in about 2000 BCE, and only later did desiccation processes begin (Nicholson and Flohn 1980).

Yet other studies do not confirm the assumption that the climate was
more humid. For example, a study in Lake Zeribar in Iran showed that the humidity there reached today’s level 6,200 YBP (Bottema and van Zeist 1981).

The analysis by Sanlaville (1996: fig. 4) also shows that the Dead Sea reached its current level around 6,800 YBP (in the Chalcolithic), and that current climatic conditions were reached around 5,730 YBP (about the time of the transition from the Chalcolithic to the EB I). A study dealing with sedimentary stratigraphy on the coastal plain (Gvirtzman and Wieder 2001) showed that in the Middle Holocene the sedimentation was characterized by sand dunes and kurkar, which indicates a relatively dry period. Other studies dealing with sediment cores north of the Red Sea (Arz et al. 2003), and the variation rates of stable isotope values of coral from the Gulf of Eilat (Moustafa et al. 2000), present data that support the end of the humid phase of the Holocene during the course of the 5th millennium BCE.

Several attempts have been made to check the archaeological record in order to corroborate or challenge views regarding the climate in ancient times. For example, a study of the Beer Sheva region and the northern Negev in the Chalcolithic concluded that the climate was wetter, based on the archaeological evidence (Alon and Levy 1996). The study was based on three key facts: the intensity of the agricultural settlement in regions where today’s climate is marginal, the use of flood agriculture, which is typical of regions with stable and greater rainfall regimes than today, and the presence of pig bones in the faunal assemblages in the Negev sites, which is indicative of a wetter habitat suitable for raising such animals (Grigson 1995b). Nonetheless, it should be remembered that the archaeological record cannot be relied upon as evidence of climate changes.

In conclusion, the data are insufficient to make a firm determination regarding the climate in the study region during the Chalcolithic and EB I. The data allow us to assume with a certain degree of caution, a climate which was somewhat wetter, but not significantly different, from today’s. It is important to note that no ‘climate crisis’ in the Chalcolithic–EB I transition has been identified, which could explain the change in interpretation that presented the climate as a key factor in the collapse of the Chalcolithic settlement system in the southern Levant.

However, the desert fringes are affected more by climate change than the central regions, and sometimes a few years of drought or the slightest change is sufficient to compel populations to migrate to wet-
ter regions or alter their grazing practices. An example of this was in a recent study of the region, based on the author’s conversations with Bedouin shepherds in Wadi Malih, and especially in Wadi Fazael, between 2006 and 2008. Between 2005 and 2008 there was a decline in humidity in the Jordan Valley region. The change was relatively mild, but it still affected some of the grazing populations, especially those who customarily came down from the hill villages (Beth Dajjan, Majdal Beni Fadil, and Duma) to graze in the valley, and who ceased to do so because of the slight change in climate. Shepherds residing in permanent settlements in the Jordan Valley (e.g. in Fusail), did not alter their grazing practices.

**Sources Of Water**

Two kinds of water sources exist in the study region: perennial streams that flow east toward the study region (e.g. Wadi Far’ah) or within it (Wadi Malih and Wadi Fazael), and springs located inside the study region.

There is a distinct difference between the sources of water in the fertile, southern Beth Shean Valley, and those of the relative arid Jordan Valley.

In the southern Beth Shean Valley there are numerous contact springs, for example, Mehazzim, Ibrahim, Malqoah, Buleibil, Shemsiyeh, Safafa and Sakut (Zertal 2005: 25, 27). Most of the springs flow in the eastern part of the Beth Shean Valley, close to the Jordan, while those flowing in the west include Qa’un, Bardaleh, and Hammah. Their source is in the ‘topographical contact zone’ between the hills in the west and the erosion plain of the Jordan Valley on a filtering aquifer. A cluster of settlements developed in the Chalcolithic period near the springs of the southern Beth Shean Valley (the sites of Qa’un, Mukehaz, ’Ain ed-Deir, ’Ain Buleibil, etc., Sites 2, 4–5, and 10–11 in the Site Catalogue). Zertal (2005: 25, 27) argues that irrigated farming might have already developed in the Chalcolithic period.

There are almost no sources of water in the narrowest part of the Jordan Valley. There are three small contact springs along the fringes of the Ghor: ’Ain Juneidiyeh, ’Ain Saleh and ’Ain Abu Sidra, yet no sites were discovered near them from the periods that this study addresses.

A number of streams flow across the Jordan Valley, the most important being Bezeq, Malih, Far’ah, Ahmar and ’Aujjeh. Some of these
streams are fed by springs that have a high flow rate (‘Uyun Beidan, Dilb and Far’ah feed Wadi Far’ah, and Meiyiteh, Malih and Hilu feed Wadi Malih). The streams in Wadis Malih, Far’ah, Ahmar and 'Aujjeh are perennial, and it seems that they provided water for the permanent inhabitants who also depended on them in the Chalcolithic and EB I.

Different kinds of springs are typical of the southern Jordan Valley and the desert fringes of Samaria. They can be categorized according to flow rate. Spanier (1993: 269) divided them into three main groups: the first group includes springs that have a high flow rate (hundreds of cubic metres per hour), such as 'Ain 'Aujjeh and 'Enot Fazael. There is considerable evidence of human activity that took place around them from prehistoric periods until the present, and in the past aqueducts conveyed water from them for irrigated farming. The second group comprises springs that have a medium flow rate (more than 100 litres per hour), such as 'Ain Juheir, 'Ain Rashash, 'Ain es-Sukhun, etc. There was less evidence of human activity around them. The third group includes springs with a low flow rate (less than 100 litres per hour),

Figure 2.2. 'Ain 'Aujjeh spring. Photographed by the author in Wadi 'Aujjeh.
such as Hafireh, Jerusaliliyeh, etc. Human activity did not always occur around these springs. The spring flow rate can change over the years, and a spring can also dry up. An example of this is the spring near the large site of ‘Ain Mta’a (Site 54) which is presently dry, but we learned from the local Bedouin that it was flowing until about 50 years ago.

Vegetation

The Vegetation Today

The structure of the natural vegetation, its composition, and distribution are affected by diverse ecological conditions (Sabbah 1992: 48). These include: climate (precipitation, temperature, and wind regime), the edaphic factor (the relationship between rock, soil and the water available to a plant), the relief (terrain – escarpment, valley and plain – which create a unique micro-climate), and the human factor (human intervention in the area and vegetation).

The decrease in precipitation and temperature from west to east, from the hills and desert fringes to the Jordan Valley, affects plant life.

The lower Jordan Valley, around the Fazael Valley and south to the Dead Sea, belongs to the desert Saharo-Arabian phytogeographical region, where a desert climate with irregular rainfall of 50–200 mm prevails. The vegetation is meagre, and there are many areas with no plant life at all.

In the Saharo-Arabian region, and even north of it, are Sudano-Decanian enclaves that are the northernmost extensions of the tropical-East African flora in the Middle East (Zohary 1962: map 4; 1980: map 2). These enclaves are common in the desert oases and in moist non-saline soils in the southern Jordan Valley. The plant life here consists mainly of tropical trees or shrubbery, which require high temperature and moisture (Ilan 1973: 53). The ideal regions for this vegetation are around Wadi ‘Aujjeh and Wadi Far‘ah.

The Irano-Turanian region in the northern Jordan Valley (from Lake Kinneret to Wadi Far‘ah) and in the desert fringes of Samaria, is also known as the ‘Arava (Zohary 1959). Here too, annual precipitation is irregular, and does not exceed 300 mm. The vegetation consists mainly of shrubs, grasses, and isolated trees.

The vegetation in the Far‘ah anticline, west of the desert fringes, is characterized by the Mediterranean region groups, together with carob (Ceratonia siliqua) and mastic (Pistacia lentiscus) groves.
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ert fringe itself there are areas with Irano-Turanian 'Arava vegetation. It lacks trees and is typically herbaceous (Sabbah 1992: 50). The only tree species found in this region is the jujube (*Ziziphus spina-christi*, Fig. 2.3),¹ which usually looks like a large shrub. The vegetation on the slopes of the monocline is affected by the acute topographical relief and the exposed limestone. Wall pellitory (*Parietaria officinalis*), forming a continuous shrub cover, is prominent among the groups growing in the rocks. White broom (*Retama raetam*) and mountain germander (*Teucrium montanum*) appear between Ma’ale Ephraim and Gitit. Asphaltic sea-blite (*Suaeda asphaltica*) stands out on the northern and western slopes. White willow (*Salix alba*) is the characteristic tree species east of this region, and salsola (*Salsola vermiculata*) is the typical shrub.

Wadi Far’ah itself is characterized by Sudano-Deccanian vegetation (Zohary 1980), with the Jericho balsam (*Balanites aegyptiaca*), jujube and Sodom apple (*Calotropis procera*) being the most prevalent woody species.

The Jordan Valley itself is cultivated by man, hence the difficulty in identifying the natural plant life there. There are four secondary landscape units in the valley: the marl plain, the river alluvial fans, the salt-water marshes, and the desert oases. On the marl plain where the runoff flows, the salt concentrations increase, while the amount of water in its lower horizons is meagre. The plants growing here are mainly shrubs that are resistant to the salinity of the soil, among which salsola is the dominant species. The silty soil in the alluvial fans of the streams is covered with river pebbles. Jujube shrubs grow here and there in these areas. In the desert oases of ‘Aujjeh and Wadi Far’ah there is the Sodom apple and Jericho balsam, in addition to the jujube. The only plants that exist in the salt marshes are those that can cope with the high salinity of the water and soil. Most of the area is covered with woody shrubs up to 2 m tall, such as species of orache (*Atriplex*), sea-blite and glaucous glasswort (*Arthrocnemum macrostachyum*). There are also some Jordan tamarisk (*Tamarix jordanis*) and desert tamarisk (*Tamarix tetragyna*) trees.

East of Fazael there is a grove of mustard trees (*Salvadora persica*). This is a large shrub, and the Jordan Valley is the northernmost point

¹ The jujube is the most common woody vegetation growing in the Jordan Valley. When mature the bush actually looks like a tree with a thick trunk. The tree has deep roots that firmly hold the soil. In the vicinity of water it remains in bloom for more than half the year, with several fruit-bearing cycles. The jujube fruit is edible, but its pits are fairly large relative to its pulp.
of its distribution in the World.

Plants resistant to salt and arid conditions characterize the vegetation in the Ghor. Salsola (Salsola vermiculata) and silvery orache (Atriplex halimus) are predominant in the entire region.

In more arid conditions the shrubby vegetation is concentrated in the wadi channels, and in the winter the annual herbaceous vegetation appears on the badlands (in extremely arid years there is no vegetation on the badlands).

The Zor vegetation is characterized by large amounts of water and high soil salinity. A wooded area comprising three main species of trees, Euphrates poplar (Populus euphratica), Jordan tamarisk and willow of the brook (Salix acmophylla), is located along the river.

The Vegetation in the Chalcolithic and EB I

The data we have concerning the plant life in these periods drawn from archaeological reports of excavations conducted in the study area and its environs in recent years. The finds are divided into domesticated plants (agriculture) and natural plants (wild plants indigenous to the region, evidence of which was found in the different excavations). Not surprisingly, most of the information derived from the excavation of
settlement sites deals with domesticated species, and there is very little known about natural vegetation. The results below were processed by the author, based on these reports, and are presented according to the different periods.  

Chalcolithic
The data are based on the following reports: Fazael (Porath 1985), Teleilat Ghassul (Bourke et al. 2000), Fazael 2 (Chapter 10), Nahal Qane (Liphschitz 2008), Cave of the Treasure (Bar-Adon 1962), Tell Abu Hamid (Dollfus and Kafafi 1986), and Pella (Bourke et al. 1998). Most of the data are from Teleilat Ghassul.

Domesticated Vegetation

Common orchard and fruit crops: domesticated olive (*Olea europaea*), date palm (*Phoenix dactylifera*), and almond (*Prunus dulcis*).

Natural vegetation
Common species: tamarisk (*Tamarix*), wild olive, and wild herbs. Infrequent species: spiny dock (*Emex spinosa*) and Palestine pistachio (*Pistacia palaestina*).

In general, the diversity of the vegetation in the period is remarkable. The main field crops were wheat and barley, and the domesticated olive was already at its peak (Meadows 1998; Neef 1990). Legumes were also common, and fruit trees started to appear. The tamarisk was the most prevalent tree.  

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2 The number and quality of the reports affects the amount of information in a particular period, and does not indicate the lack of a specific item in that period or another period. Thus for example, the detailed report of Tuleilat Ghassul contains almost all of the plant species that exist in the other reports of Chalcolithic period, and also adds a significant number of species that were not known from other excavations.

3 Regarding some of the species added to the agriculture section, such as almonds, etc., it is unclear if they were domesticated or were gathered wild.

4 It is not known if the date palm and almond were fruit that was gathered, or intentionally grown.

5 This is based on carbon samples submitted for analysis from Fazael 2 (Nili Liphschitz, chapter Ten).
The data are based on the following reports and articles: Cave of the Warrior (Werker 1998), Jericho (Hopf 1983), Pella (Bourke et al. 1998), Tell esh-Shuna (Neef 1990), Bab edh-Dhra' (McCreery 1981; 2003), and Fazael (which was published as Fatzael 3 – Goring-Morris 1980). Most of the data are from Jericho and Bab edh-Dhra'.

**Domesticated vegetation**

Common species: European olive (*Olea europea*), English wheat (emmer – *Triticum dicoccum*), wheat (*Triticum* spp, 2 rows and 6 rows), tamarisk (*Tamarix* sp.), barley (*Hordeum vulgare*), legumes, vetch (*Vicia ervilia*), and grapes (*Vitis* sp.).

Infrequent species: flax (*Linum usitatissimum*).

**Natural vegetation**

Infrequent species: Tabor oak (*Quercus ithaburensis*), Jerusalem pine (*Pinus halepensis*), willow, pennycress (*Sinapis* sp.), hackberry (*Prunus avium*), jujube, almond, and spiny burnet (*Poterium spinosum*).

Not surprisingly, the variety of vegetation in the Chalcolithic period was similar to that of the EB I in the study region. A significant difference was the farming techniques that did not change the variety, but did change the economy of the period. According to Philip (2001: 184) the following techniques were introduced or were utilized more intensely: flood agricultural (Mabry et al. 1996, and a different opinion – Milevski 2011: Chapter 7), using animals to cultivate fields, an increase in processing olives and grapes, using donkeys as a beasts of burden, and increased agricultural output by using metal tools at the expense of flint implements (and especially replacing the bifacial flint tools, such as the adze, which disappear from the EB I tool assemblage, by metal implements).

Most significant of all was the penetration of settlements into the hilly regions of Samaria, which was almost unknown in the Chalcolithic. This change drastically expanded the growing of fruit, especially olives and grapes (which seem to have become widespread in the EB Ia).

The absence of the jujube from the assemblage of EB I sites is interesting. The reason for this is probably the small sample of sites from this period that were excavated and in which wooden finds were treated.

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6 The site Fazael 4 (called Fatzael 3 by the excavator Goring-Morris) is actually an EB I settlement site, and does not date to the Chalcolithic period as the excavator of the site incorrectly believed.
WILDLIFE AND DOMESTICATED ANIMALS

Wildlife in the Present and Historical Periods

The climatic-geological history led to the introduction and establishment of various zoo-geographical fundamentals in the study region.

The terrestrial animals represent a wide variety of regions of origin (with representatives from the tropics, Sudan, and India – Ben-Yosef 1979: 263–266). Especially prominent are porcupines (*Hystrix indica*), honey badger (*Mellivora capensis*), wild boar (*Sus scrofa*), mongoose (*Herpestes ichneumon*), mountain gazelle (*Gazella gazella*), and fox (*Vulpes vulpes*). The marine life and amphibians are characterized by fish species (about 20 different varieties that exist mainly in the Jordan); oysters and molluscs (the most prominent being *Melanopsis, Cerithidae, Theodoxus, Unio semirugatus*), freshwater crabs (mainly *Potamon potamios*), and numerous kinds of water insects. The viper (*Vipera palaestinae*) is the most prominent reptile in the region.

The Jordan Valley, being part of the Syro-African Rift, also serves as an important migration route for many birds (peaking in March–May and August–November). The birds living in the valley year-round include partridge (*Alectoris chucar*), quail (*Coturnix coturnix*), and francolin (*Francolinus francolinus*).

The Dead Sea sparrow (*Passer moabiticus*), warbler (*Prinia gracilis*), honey-sucker (*Nectarinia osea*), and bulbul (*Pycnonotus xanthopygos*) are also common. The valley is also characterized by birds of prey that nest there, among them the eagle (*Aquila* sp.), buzzard (*Buteo buteo*), and falcon (*Milvus migrans*).


Information on animals in the historical periods is found in written sources, such as the Bible, travel literature, the writings of explorers, etc. Of course the sources pay most attention to the predators – the most impressive and frightening of the region’s animals (incidentally, their relative number among animals was presumably marginal).

The lion was the most prominent animal along the Jordan. It is mentioned in the Bible in connection with the river: “Behold he shall come
up like a lion from the thickets of the Jordan against the strong habitation” (Jeremiah 49: 19; 50: 44); “there is a sound of the wailing of the shepherds; for their glory is in ruins: a sound of the roaring of young lions; for the pride of the Jordan is in ruins. “ (Zechariah 11: 3).

Lieutenant Lynch, who headed an American expedition, sailed on the Jordan in 1848. According to his notes they saw along the way: “We frequently saw fish in the transparent water; while ducks, storks, and a multitude of other birds, rose from the reeds and osiers…At one place we saw the fresh track of a tiger…At another time a wild boar started with a savage grunt and dashed into the thicket” (Lynch 1855: 107, 137).

In 1883 an American traveller and archaeologist named Merrill reported his findings, including the disappearance of leopards from the Jordan Valley: “Boars, jackals, hyenas, ichneumons, otters, and other wild animals frequent these jungles, and birds also are found here in great numbers and variety. We have already over one hundred specimens in our natural history collection…. But these creatures (leopards) are destined soon to become extinct….Large amounts have been offered for their skins…” (Merrill 1883: 204–205).

**Wildlife in the Chalcolithic and EB I**

Data pertaining to this area are derived from the archaeological reports of excavations conducted in the region in recent years. Like the flora, the faunal remains are also divided into domesticated and wild animals. The results below were processed by the author, based on these reports, and are presented according to the different periods:

**Chalcolithic**

Based on the following reports: Fazael (Porath 1985), Tell Abu Hamid (Dollfus and Kafafi 1993), Teleilat Ghassul (Bourke et al. 2000), ’Ein Hilu (Chapter 9), Pella (Bourke et al. 1998), and Fazael 2 (Chapter 10).

**Domesticated animals**

Common animals: sheep/goat (*Ovis/Capra* about 70% of the domesticated animals, and there are usually a greater number of sheep – Bourke 2001: 118), pig (*Sus domesticus*), cattle (*Bos taurus*), and equines (*Equidae*, donkey/horse).

**Wild animals**

Common animals: gazelle (*Gazella gazella*).

Rarer animals include: fish, birds, fox, dog, ram, cat (probably wild),
According to the data published from excavations in the eastern Jordan Valley the most prevalent animals among Chalcolithic livestock were sheep (a ratio of 4:1 vs. goats – Bourke 2001: 118), which indicates an increase in the use of sheep products (milk, food and textiles), followed by goats, cattle, and pigs.

According to an age analysis it seems that in the Chalcolithic period goats, sheep and cattle were mainly kept to supply milk and dairy and freshwater crab.7 According to the data published from excavations in the eastern Jordan Valley the most prevalent animals among Chalcolithic livestock were sheep (a ratio of 4:1 vs. goats – Bourke 2001: 118), which indicates an increase in the use of sheep products (milk, food and textiles), followed by goats, cattle, and pigs.

According to an age analysis it seems that in the Chalcolithic period goats, sheep and cattle were mainly kept to supply milk and dairy

7 To these we can add other wild animals discovered in Nahal Mishmar (Bar-Adon 1980), such as ibexes and hares. It should be remembered that the prevalence of some species, particularly the smaller ones, such as fish and birds, is affected by their poor preservation and the methods used to collect them in the various excavations.
products, while pigs provided meat (and this also seems to be the case from the age analysis at 'Ein Hilu – Chapter 9). The number of pigs at the sites increases northwards along the Jordan Valley (Bourke 2001: 118; this is also supported by data derived from the 'Ein Hilu and Fazael 2 excavations). This is explained by the marshy regions around the northern sites close to the Jordan (Tell Abu Hamid, Tell esh-Shuna, etc) which are habitats preferred by this species. It is still unclear if the pig was completely domesticated in the Chalcolithic period, but the finds from 'Ein Hilu contribute to this supposition.  

Surprisingly there is a fairly significant presence of wild animals (deer are especially prominent) in the faunal assemblages of the Chalcolithic, mainly in western Jordan. Despite the almost complete disappearance of arrowheads from the tool assemblages, the inhabitants still managed to hunt these animals (they might have used wooden arrows, which usually do not survive in the archaeological record – e.g., the arrowheads found in the Cave of the Warrior south of the study area – Schick 1998).

Analysis of the archaeological finds at the Chalcolithic sites excavated in the framework of this research project corroborates some of the data (Figs. 2.4–2.6):

Goats and sheep are the most prominent species amongst the do-
mesticated animals comprising the livestock in the Chalcolithic period. At 'Ein Hilu, in the desert fringes of Samaria, goats and sheep constitute 57% of the assemblage, while cattle and pig make up 5% and 6% respectively. Wild animals, particularly deer, make up a significant portion (26%) of the assemblage.

At Fazael 2 in the southern Jordan Valley (in a late phase of the Chalcolithic period), goats and sheep constitute 80% of the assemblage, cattle 6.5%, and wild animals (fox and wild cat, but no deer) about 10%.

Despite the small sampling (95 individuals at 'Ein Hilu and 62 individuals at Fazael 2), goat and sheep are dominant at both sites, as they are at other sites in the eastern Jordan Valley. The domesticated pig at 'Ein Hilu is consistent with the data from the Chalcolithic sites east of the Jordan. But unlike those sites, no evidence of donkeys has been found so far in the small sampling at 'Ein Hilu and Fazael 2. The proportion of wild animals at these sites is also large (22% of the finds) relative to the data published from the sites in Jordan. Especially conspicuous is the high percentage of deer at 'Ein Hilu.

EB I
Based on the following reports: Beth Yerah (Cope 2006), Pella (Bourke et al. 1998), Tell esh-Shuna (Croft 1994), Jericho (Clutton-Brock 1983: 802–803) and Sheikh Diab 2 (Chapter 12; Fig. 2.7).

Domesticated animals
Common animals: goat/sheep (Capra/Ovis about 60%), cattle (Bos taurus), pig (Sus domesticus) and donkey (Equus asinus).

Wild animals
Rare animals: gazelle (Gazella gazella).

The most common animals among the EB I livestock are goats/sheep followed by cattle. There is an interesting trend showing an increase in the amount of cattle and a decrease in the number of pig as the EB I progresses (Philip 2001: table 5.4). This change might imply a rise in the importance of cattle as work animals in the EB Ib, or their replacement of pigs as the source of meat. The significant decline in the percentage of wild animals in the assemblages is apparently indicative of a transition to raising animals primarily for supplying meat (a trend

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9 There are fewer reports from the EB I sites than from the Chalcolithic period, and therefore the results should be taken with some degree of skepticism until additional reports are released that will either substantiate or invalidate the conclusions stemming from the data presented.
that had already begun in the Chalcolithic period). Despite the size of the sampling, the comparison between Fazael 2 and Sheikh Diab 2 is interesting: the first site is Chalcolithic, and the second dates to the EB I; the source of water is identical for both – Wadi Fazael, and the distance between them is less than 1 km as the crow flies.

The main animal at both sites is goat/sheep, but in percentage terms it is much more significant at Fazael 2. The percentage of cattle raised at both sites is similar. More wild animals which are absent from Sheikh Diab 2 (fox, wild cat) appear at Fazael 2. At Sheikh Diab 2, pig, which does not appear at all at Fazael 2, is dominant. Equines (probably donkeys) also appear in the meantime only at Sheikh Diab 2.

Although these data are only preliminary, there are some trends that
can be identified:
1. The high proportion of sheep/goat (grazing and milk and dairy products) in the assemblages of the two periods.
2. Fluctuations in the utilization of pig in the EB I (for meat).
3. Appearance of animals used for work and trade in the EB I.

**Transit Routes**

There is no evidence indicating the use of clearly defined roads during the ancient periods of the study. It is therefore likely that people mainly moved between different settlements regions via the easiest routes, where the valley meets the hills. It is also possible that movement across the region took place near or by way of the large river valleys (Fig. 2.9). Furthermore, it seems that the Jordan could only be crossed at fords (as in later periods). We think it is possible to address the topic of movement/transit routes in this study in the absence of archaeological or historical data that identify a specific axis as a route that was used in these periods.

Such routes are identified by encampment sites along them, locating settlement regions in the hill country or north and south of the study region to which these routes logically lead (as shown by Esse 1991: 27).

There is one long possible north-south route between Nahal Bezeq and Wadi 'Aujjeh that parallels the River Jordan channel and the ridge-line of the desert fringes, together with six possible lateral routes (Nahal Bezeq – Zebabdeh Valley; Wadi Malih – Tubas Valley; Wadi Far’ah – Nablus; Fazael – Upper Wadi Ahmar; Fazael – 'Ain Rashash; Wadi 'Aujjeh). The Jordan blocks all routes from the east, and it was necessary to cross it at the fords.

**North – South**

The Jordan Valley route runs from the Beth Shean Valley in the north to the Jericho Valley in the south. It crosses the entire area from Nahal Bezeq to Wadi 'Aujjeh, probably in the region where the valley meets the slopes of the desert fringes of Samaria. In later periods a road passed through the region from Beth Shean to Jericho.

Analyses of the geography and site distribution show that in the early periods this was the only route that could link the settlement clusters of the southern Beth Shean Valley with those of Wadi Far’ah, Fazael Valley, Wadi 'Aujjeh and the Jericho Valley.
**East – West**

**Nahal Bezeq – Zebabdeh Valley**
This is a possible lateral route that runs along Nahal Bezeq (Wadi Shubash) from the southern Beth Shean Valley to the Zebabdeh Valley in the Samarian hills, along which the following sites are located: Tell Qa’un, Mrahes-Sbeh, and ‘Iraq el-Hamam (Sites 2, 8–9). Given that the last two sites and the Zebabdeh Valley sites were not inhabited in the EB I, it seems that this route was mostly used in the Chalcolithic period.

**Wadi Malih – Tubas Valley**
A possible lateral route might have run along Wadi Malih, beginning west of the ford over the Jordan near Tell Abu Sus (Site 14), via the sites of ‘Ein Hilu and Qta’at el-Khalifeh (Sites 19–20), to the Tubas Valley (about 20 km). Like the Nahal Bezeq – Zebabdeh Valley route, it seems that this route was mostly used in the Chalcolithic period.

From Tell Abu Sus the probable route could have crossed the Jordan to the eastern Jordan Valley at two possible river crossings that still exist: Mahadet Abu-Sus in the west and Mahadet Fathallah in the east.

**Wadi Far’ah – the Nablus syncline**
A lateral route might have passed through Wadi Far’ah to the Nablus region. The route runs in a south-east – north-west direction from el-Makhruq to Tirza Junction (about 30 km). Here the route could have branched off to the north, toward Tell Far’ah (North), or south-west to Nablus via Wadi Beidan. This route was widely used in the EB I, and dozens of sites from this period were discovered along it. From el-Makhruq a possible route continued east to the ford near Tell ed-Damiyeh on the other side of the Jordan, and from there eastward along Wadi Zerqa. This road is probably the most important lateral route in the study region in the EB I, owing to its location in the heart of the valley, and because it linked the main concentration of settlements in the western part of Wadi Far’ah with eastern Jordan.

**Fazael Valley – Wadi Ahmar**
This is a lateral route from the Fazael Valley along Wadi Ahmar to the hill country west of Khirbet Juraish (Site 64). Many sites dating to the study periods were discovered along Wadi Ahmar, and this was probably an important route that might have connected the valley sites with the sites discovered in the hills.
**Fazael Valley – 'Ain Rashash**
This is a lateral route from the Fazael Valley running the length of the Wadi Rashash to the hill country in the vicinity of the Rashash springs and Duma. It was probably only used in the EB I and later (no Chalcolithic sites were discovered along it, or in the region of the Rashash springs and Duma).

**Wadi 'Aujjeh**
This is a lateral route along Wadi 'Aujjeh from where it flows into the Jordan to the vicinity of the spring at 'Ain 'Aujjeh. Many sites were located in the Wadi 'Aujjeh flood plain, which is 6 km long. The route is a steep trail that is more difficult to traverse the further west from 'Ain 'Aujjeh, and it is there that the ancient settlements also stop.

**Conclusions**
The Jordan Valley is characterized by a network of ‘natural’ transit routes that relied on the topography of the region, especially along the large streams. When examining the distribution of the Chalcolithic and EB I sites relative to these routes, it clearly becomes apparent that most were built taking the transit routes into account. This is not surprising, because of the direct relationship between the routes and the streams that were the sources of water for the sites.

The main lateral routes used in the Chalcolithic were: Nahal Bezeq – Zebabdeh Valley, Wadi Malih – Tubas Valley, and Fazael Valley – Upper Wadi Ahmar. It is surprising there is no evidence of a Chalcolithic settlement in the western valley of Wadi Far'ah.

The main lateral routes used in the EB I were: Wadi Far'ah – the Nablus syncline, Fazael Valley – Wadi Ahmar, and Fazael Valley – 'Ain Rashash. Another possible route in this period, although its precise course is unclear, might have run along the slopes of the hill country between the groups of sites in Wadi Far'ah, south to the spring sites around 'Ain Juraish and 'Ain Rashash (This route is actually manifested by the distribution of Um-Hammad pottery in the EB Ib at these spring sites, and not in the contemporary sites located east of the Jordan Valley itself).

The north-south longitudinal movement seems to have been based on the seam where the hill slopes meet the valley.

The Zor was not suitable as a river crossing or for grazing, and the Jordan could probably only be crossed at the fords along the river.
Figure. 2.9. Map of possible routes in the study area during the Chalcolithic and EB I periods.