

**Draft Desk Study**  
**Biodiversity Conservation and Community Development in Al-Makhroul Valley in Bethlehem, Palestine**



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## Preface

This project titled “Biodiversity Conservation and Community Development in Al-Makhroul Valley in Bethlehem, Palestine” is a British and Palestinian collaboration to conserve biodiversity in Al-Makhroul Valley of Bethlehem (Palestine) benefitting the local communities through sustainable use of ecosystem services. The area is recognized as a UNESCO world heritage site. The objectives included (a) full biodiversity assessment including producing a management plan, (b) promoting agriculture/green practices and ecotourism, and (c) reducing human impact via environmental awareness and education programs while promoting sustainable lifestyles. Project outputs delivered will focus on biodiversity conservation, traditional farming reviving, eco-tourism enhancement, and capacity building. All activities will be done supported with project committees’ consultation, gender inclusion, media coverage, and evaluation. The main partner is the Palestine Institute for Biodiversity and Sustainability (PIBS) and the Palestine Museum of Natural History (PMNH) at Bethlehem University (BU) and with three junior partners: PCC (Pioneer Consultancy Center for Sustainable Development, represented by Ms. Roubina Ghattas), Byspokes CIC Sustainable Community Development (England, represented by Alice Gray), and the Institute for Community Partnership at Bethlehem University (represented by Moussa Rabadi) and with collaboration and consultation with the Environmental Quality Authority (EQA) and other key stakeholders (Ministry of Tourism and Antiquities, Ministry of Education, Ministry of Agriculture, local authorities, farmers, environmentalists and more, see below). The project is funded by Darwin Initiative (grant number 25-030; internal BU grant number 10-295). We have a complimentary grant from National Geographic Society that covers exploratory issue of the valley and helped us cover some work unfunded by this grant (ie. the two grants are mutually reinforcing but not competitive).

### Project structure

#### **I. Assessing and Conserving Biodiversity of Al-Makhroul area**

1. Analyse relevant literature through desk study and collection of data.
2. Hold town meetings in targeted localities for SWOT analysis.
3. Conduct biodiversity inventory for Al-Makhroul valley; including studying habitats, flora/fauna/birds, values of biodiversity, threats using scientific methods such as RSCN (2005) and Braun and Blanquet methodology (species richness, distribution and others)(CMP 1978).
4. Establish ecology, biodiversity databases including monitoring indicators
5. Prepare biodiversity Conservation Action and Master plan for the valley with conservation frameworks and restoration schemes for selected habitats using CMP model (1978) IUCN guidelines and GIS/RS analysis
6. Restore key habitats, upon consultation (mostly cultivation of native tree species).

#### **II. Provide economic benefits to the local communities in proximity to Al-Makhroul valley**

1. Establish committees from key stakeholders to facilitate and follow up this intervention.
2. Revive the traditional farming through providing selected farmers with necessary friendly agriculture inputs and enhance their products’ marketing through exchange visits, local festivals, and partnerships with cooperatives (gender inclusion).

Promote ecotourism through (1) developing the valley’s trail (2) Support women to establish marketing points, (3) Build partnership between tourism operators and locals.

#### **III. Capacity building and awareness program; supported with gender inclusion**

1. Conduct three workshops and three training sessions with the aim to build capacities and raise awareness of local beneficiaries such as active farmers, local tourism initiatives, cooperatives in the project fields. Specialised experts will lead those different workshops with support of all necessary educational materials and tools. Theoretical and practical sessions will be conducted; supported with field exchange visits and others.
2. Advocacy campaign and Media coverage to support all project activities
3. Hold meetings in schools to raise awareness, initiate environmental clubs

### **Acknowledgements**

*We are grateful to our partners and numerous supporters and stakeholders. [more on this will come in the final study- this is just the desktop part and related to report o activities for one month only- September 2018].*

## **1. Introduction**

In the late 20<sup>th</sup> century the conservation of biological diversity became recognized as an urgent issue for humanity. This is largely due to the scientific observation of significant decline in biodiversity accompanying the industrialization that spread widely in the 19th and 20th centuries. Two key texts emerged from a number of preparatory meetings that rang the danger bell at the global level: Publication of the Global Biodiversity Strategy and the adoption of the Convention on Biological Diversity (CBD) signed at the Earth Summit in Rio de Janeiro (both in 1992).

Palestine connects Africa with Eurasia and is in the western part of the Fertile Crescent where the first humans migrated out of Africa and also where the first human agriculture developed (Qumsiyeh, 1996). The geologic activities over the past 100 million years and especially the formation of the Great Rift Valley ensured rich varied topography which resulted in a burst of speciation producing many endemic species of plants and animals. This is because of diverse habitats covering five ecozones (Central Highlands, Semi-Coastal Region, Eastern Slopes, Jordan Rift Valley, and Coastal Regions) and four biogeographical regions (Mediterranean, Irano-Turanian, Saharo-Arabian, and Sudanese/Ethiopian) (Whyte, 1950; Zohary, 1947; Por, 1975; Qumsiyeh, 1985). Climate is varied from cold winters with semi-permanent frost in mountains 1,000 meter above sea level (Mount Hermon) to semi-tropical climate in the lowest point on earth in the Dead Sea region at 400 meter under the sea level. Rainfall is between 1,000 mm in the highest mountains to less than 50 mm in arid regions. Temperatures also vary from freezing to over 35 C in summer months in the Wadi Araba areas (Isaac, 2002, Qumsiyeh, 1996). It is thus not surprising that this small country is biologically more diverse than some countries 10 times its size (Qumsiyeh, 1996). The mild weather, diverse fauna and flora, rich soils, and presence of wild seed species and certain animals in the Fertile Crescent stretching from Palestine to Iraq also allowed humans to go from being hunter-gatherers to developing an agricultural and nomadic shepherd life (McCorriston and Hole 1991; Eshed *et al.*, 2004). The Fertile Crescent thus provided the first domesticated animals and plants (wheat, barley, lentils, goats, donkeys) and the first human civilizations.

Our region has undergone significant human-induced environmental changes including those caused by migrations, industrialization, climate change, and colonization among others. This had a huge impact on biodiversity but few studies have addressed this. In this chapter we review what is known about biodiversity in Palestine (a small but critical part of the Fertile Crescent) including highlighting threats and opportunities for conservation and sustainable living for both people and fauna and flora.

## **2. Study Site**

### **2.1 General**

The four biogeographical zones identified in Palestine (Mediterranean, Irano-Turanian, Saharo-Arabian, Ethiopian-Sudanese) identified in Palestine were mapped based on plant distribution by Zohary (1947) and have been used with little modification since. Soto-Berelov *et al.* (2015) refined and added to these things and noted changes both recent and in historic and prehistoric times. The Mediterranean Zone has special and rich biodiversity that is threatened and considered key hot-spot for biodiversity conservation (Myers *et al.*, 2000). This Mediterranean Zone in Palestine stretches from the Haifa and Galilee region across the hills and slopes (especially those facing west to the Mediterranean zone all the way down to Hebron. In the southern region, we have areas designated as protected areas with Mediterranean Habitats especially in the Hebron region such as Al-Quff and Al-Qarn areas (Qumsiyeh *et al.* 2016).



Wadi Al-Makhrou is a valley located about 7 km south of the old city of Jerusalem and about 6 km northeast of the old city of Bethlehem. It is connected to other valley systems stretches from the Walaja and Cremisan valleys to the South of Jerusalem and takes in the water of the Makhrou itself (between Beit Jala, Al-Khader, and Al-Walaja) to drain into the Battir and then Husan and Nahhalin valleys. Al-Makhrou is an important part of the system that refills the water aquifer of Bethlehem District area and the fresh water springs pass from the center of old trees plant there. The area is the last remaining biodiversity-rich area south of Jerusalem and in Bethlehem and Jerusalem districts. The valley is mentioned early in travel books (e.g. Robinson, 1856). Excavations in the valley show humans used the bounty of the valley from Middle Bronze Age (Rapoport 2006) going through use in the Iron Age, Persian, Hellenistic, and early Islamic Periods until today (Dagan 2010).

Wadi Al-Makhrou *sensu strictu* is 2.6 Km<sup>2</sup> of natural areas interspersed with agriculture and rich flora and fauna (Amr *et al.*, 2016) also with an equivalent buffer zone of an area more than 5 km<sup>2</sup> was initially selected for study (Fig. 1). [See section below for adjustments done by expanding the target area]. It is also one of the rich biodiversity areas according to the government (Fig. 2) and of 13 important bird areas per BirdLife International (see below) in Palestine. It is also rich in cultural heritage, including old Roman tombs, wells along with old Palestinian watchtowers. However, no environmental management plans or conservation programs have been implemented by any organization in the area. As the valley is located in Area C it suffers from diverse pressures: (1) habitat loss and land fragmentation; causing biodiversity loss, (2) challenging livelihood conditions as a result of the lack of economic motivations, no subsidies for farming practices, and inadequate markets for extra production and others. It is an area estimated to have rich biodiversity (see maps in Levin & Shmida 2007) and was designated by the Palestinian authority as a biodiversity hotspot (Fig. 2). The Bethlehem Governorate between Hebron and Jerusalem has only one remaining rich habitat based on our preliminary studies: that is the Makhrou Wadi and Hill System.

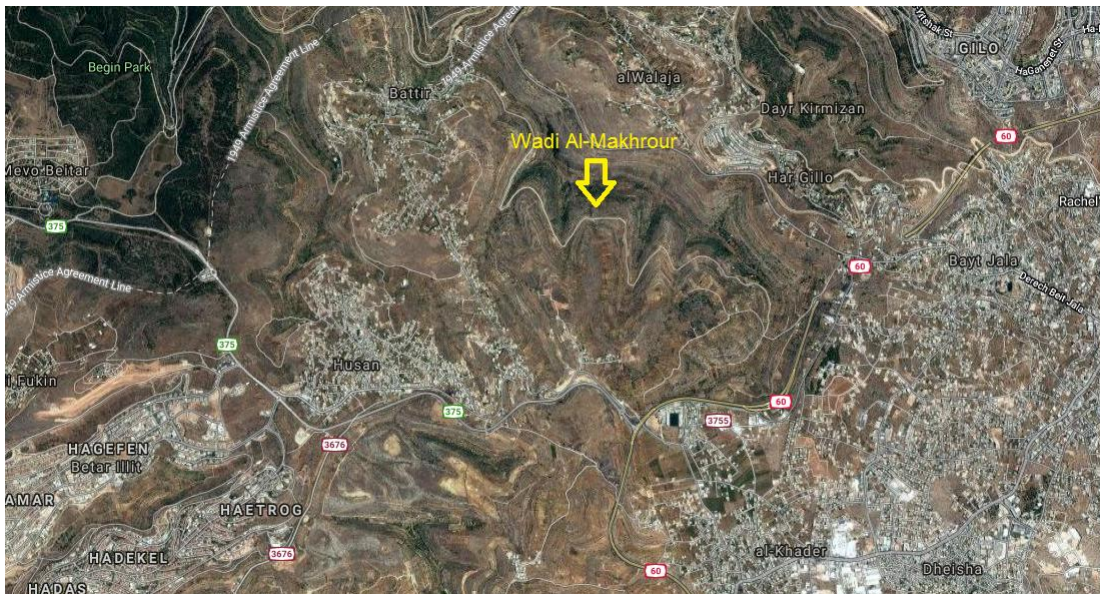
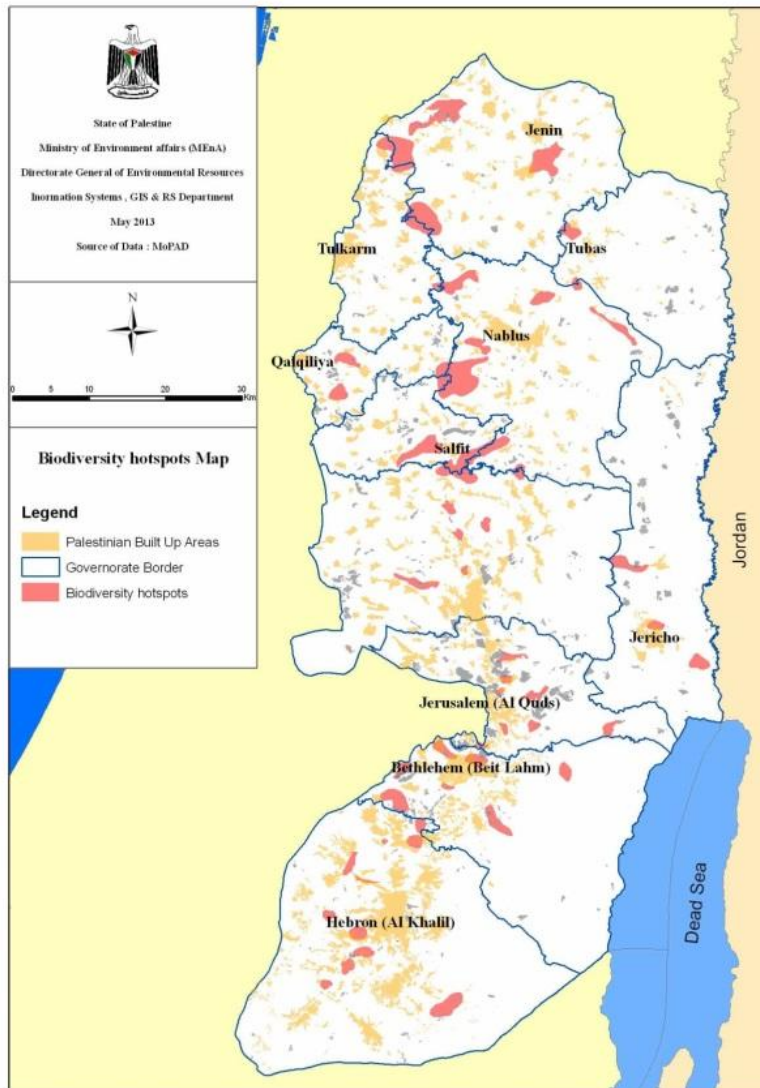


Figure 1. A map shows the location of Wadi Al-Makhrou in Bethlehem district.



**Fig 2.** Biodiversity hotspots in the occupied West Bank

## 2.2 The Valley and Battir as a UNESCO world heritage site

Battir in 2014 was submitted for UNESCO under title “ Palestine, lands of Olives and Vines , Cultural Landscape of southern Jerusalem” and immediately included on the List of World Heritage in Danger, after it was acknowledged that the landscape was threatened by emerging and intensifying sociocultural and geopolitical transformations with the potential to cause irreversible damage to the site’s authenticity and integrity. The World Heritage Site stretches from Al-Makhroul Valley to Battir village to Al-Aion Valley in Hussan including traditional footpaths , various human settlements that developed around the many springs that dot the slopes of the mountains, that have contributed to the creation of a unique cultural landscape composed of agricultural terraces that are supported by dry-stone walls, agricultural watchtowers (manatir or qusoor), olive oil presses, ancient irrigation pools to collect the water flowing from the springs, ancient irrigation canals, and the remains of human settlements (khirab), were conserved by the local villagers (Battir, Hussan, and Beit Jala) for centuries.

As a part of its commitment, the Ministry of Tourism and Antiquities prepared a draft management and conservation plan for the WHS and buffer areas. The final management plan aims to expand on the existing MOTA (2018) draft management plan for this UNESCO site but also to improve self-sustainability in order to conserve the outstanding universal value (OUV) for this area. The management includes a SWOT analysis for the area and detailed recommendations including an action plan. It also includes human capacity building activities.

Al-Makhroul Valley that goes around Battir starting from Beit Jala with the villages of Al-Walaja, Al-Khader and Husan was chosen for this study and action plans towards sustainability because of rich fauna and flora but also because as a UNESCO World Heritage Site listed in 2014 (Fig. 3 & 4). The world heritage property which covers an area of 481 hectare core property, 631 hectare buffer zone, and 133 hectare residential areas inside Battir for a total of 1112 hectares (see Fig. 3).

In its application to UNESCO, this is what was written to justify the inscription of the property on World Heritage List, which was approved in 2014 (MoTA 2018):

“The village of Battir, to the south of Jerusalem, was historically considered to be the *jinan* of Jerusalem, that is the garden of Jerusalem. Battir lies almost at the center of a system of very deep valleys that are very well supported by the yearlong availability of spring water that permits the cultivation of vegetables and fruit trees. In the areas along the slopes where water is not abundantly available, olives and vines were planted. The cultivation of these plants, on the very steep sloping sides of the valley, was only possible due to the creation of terraced fields with the use of dry-stone walls all along the valley. The terraces, together with a multitude of archaeological and architectural remains, testify to the presence of man in these green valleys that have been settled for at least 4,000 years.

The spring water is controlled by a unique system of distribution among the families of the village, using a very unique system of measurement to make sure that water benefits all the community. In areas of the valley that are far from the village, watchtowers or “palaces” were built for protection of the terraces. The olive trees, some of which are many hundreds of years old, are a testimony to the cultivation of olives in Palestine. Grapevines were also cultivated, though to a lesser quantity. The continuous dependence of the inhabitants of the area on agriculture as a major source of income has indeed contributed to the sustainability of this significant and harmonious landscape, which is evidence of the adaptation of the steep mountains into arable land. Also, their commitment to and hard work in maintaining the hundreds of metres of dry-stone walls has preserved a landscape that is thousands of years old as a spectacular testimony to an ancient agricultural tradition. Farmers continue to tirelessly plant their land with seasonal vegetables and aromatic herbs, to take care of the vines and fruit trees and irrigate them using the Roman pools and irrigation channels, in addition to taking care of their olive trees, the symbols of peace.

The terraces are still in use today, despite the fact that the 1949 Armistice Line marking the boundary between Palestine and Israel cuts right through them, ignoring the natural contours of the valley. The emergency status of this nomination is linked to the fact that there is a plan in advanced stages to start the construction of the Israeli Wall, which would cut through this pristine valley landscape, marring this cultural landscape and cutting off farmers from fields they have cultivated for centuries. A railway link between Jerusalem and Jaffa, still in use today, winds its way along the lowest part of the valley. The people of Battir have always respected this link.

Battir is rightly considered to be the green heart of Palestine, even though its links with Jerusalem are not as strong as in the past. This dossier is the first of the serial nomination of Palestine, Land of Olives and Vines, which will present the agricultural and cultural landscape of Palestine in all its variations of landscape.

The draft management and conservation plan (MCP) stated: “realizing that a holistic Management and Conservation Plan is key to ensuring adequate respect and effective safeguarding of the property and its inherent Outstanding Universal Value (OUV), the MCP has been drafted taking into account the Desired State of Conservation (DSOCR) and the key Corrective Measures adopted by the World Heritage Committee” (MoTA 2018).

The maps below show the area included as core zone and buffer zone for the UNESCO world heritage site



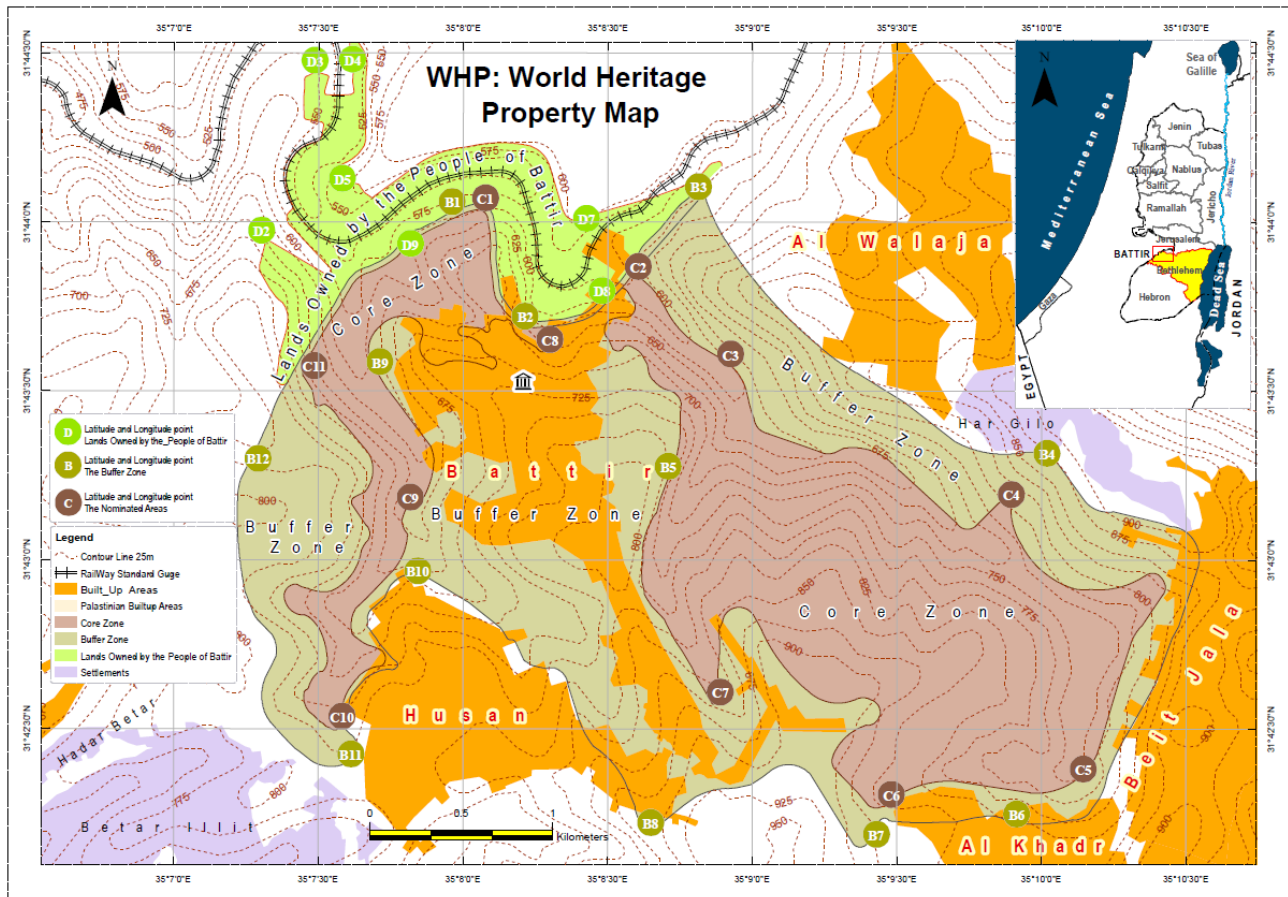


Figure 3. World Heritage site that includes Al-Makhroul valley near Husan and Battir (MOTA, 2018).



Figure. 4. Satellite image showing core area (orange line) and included buffer zone (purple line) for the World Heritage site (MOTA, 2018).



In order to submit based on landscape considerations, the people of Battir with help of international experts from France and Italy performed a thought and highly detailed mapping of the whole area including Al-Makhrou. The resulting maps (e.g. Fig. 5 and 6) are a treasure trove of information on topography, land use etc.



Figure 5. Map of the area used in supporting documents submitted to UNESCO.

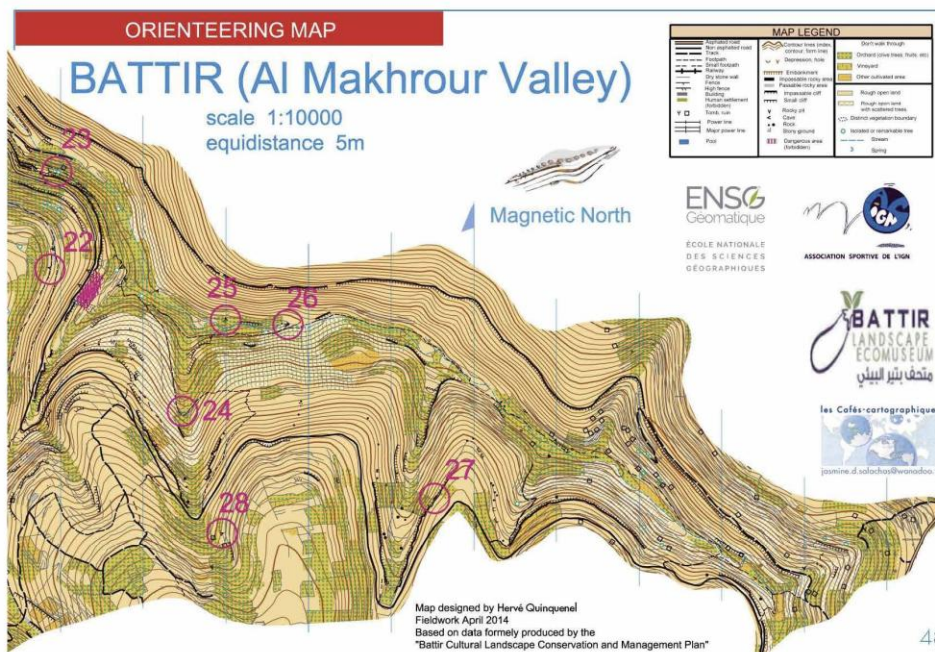


Figure 6. Topographic map of the Al-Makhrou valley used in supporting documents submitted to UNESCO.

The study site is very picturesque with deep valleys some of them terraced for hundreds or thousands of years (part of the reason it is a UNESCO World heritage Site) with typical Mediterranean vegetation (Fig. 7 and 8).





Figure 7. Typical valley structure in Al-Makhrour. Note different vegetation and terracing on the side facing the sun.



Figure 8. Wadi Al-Makhrour photo taken from the southern hill towards the north showing the Israeli colony of Har Gilo.

### 3. Literature Review

#### 3.1 Introduction

Studies of biodiversity in the OPT were very limited in contrast to those of nearby areas of Palestine (called Israel since 1948) and Jordan. Research in general still lags behind in the OPT (Qumsiyeh and Isaac, 2012). There are even less studies on the area of Al-Makhrou. Here-in we review available data.

As early as 1950, scientists warned of an environmental disaster in Palestine should the trends then evident persist (Ives, 1950). The environmental impacts of the geopolitical changes of the past 100 years have been dramatic (see relevant chapters in Qumsiyeh, 1996; Qumsiyeh, 2004), but direct studies of our environment are still in the early stages. Most studies of fauna and flora within Palestine were completed by Western visitors who came on short trips to study the "Holy Land" and many of those visitors were connected to Western imperial powers such as France and England (e.g. Tristram, 1884).

The area has been sporadically studied before by visitors to the "Holy land" from Tristram (1866, 1884) to Morton (1924) to David Harrison in the 1960s (Harrison and Bates, 1991). In the 1950s and 1960s there were some studies of fauna and flora by Israelis (mostly immigrant settlers). The most notable of these was a series called "Fauna Palaestina" issues by the Israel Academy of Sciences, and good published work continued to flow into the 1980s (Levy and Amitai, 1980a, Tchernov and Yom-Tov, 1988, Zohary, 1973, Werner, 1988).

When Zionism was established in the late 19th century and the "Jewish Colonization Association" and later the "Jewish National Fund" ("Keren Keyemet l'Yisrael") were formed, some Zionists saw the value of cataloging and understanding native animals and plants (including the native Palestinian people) and undertook studies of the region. An example of such a Zionist scientist was F. S. Bodenheimer (Bodenheimer, 1935). After Israel was founded, such studies of fauna and flora became commonplace and a number of studies were conducted including for example those on plants (Zohary, 1972, Zohary, 1966), spiders (Zonstein and Marusik, 2013), and birds (Shirihai *et al.*, 1996).

Very few studies were published by Palestinian scientists. Among native Palestinian zoologists Dr. Sana Atallah (d. 1970) focused on mammals (Atallah 1977, 1978). Additional significant studies of mammals followed (Qumsiyeh, 1985, 1996, Werner, 1988, Harrison and Bates, 1991, Whitaker Jr *et al.*, 1994, Qumsiyeh *et al.*, 1996, Qumsiyeh *et al.*, 1998, Mendelssohn and Yom-Tov, 1999, Amr *et al.*, 2006, Benda *et al.*, 2010) reptiles and amphibians (Disi, 1985, Damhoureyeh *et al.*, 2009, Amr and Disi, 2011, Disi and Amr, 2010, Salman *et al.*, 2014, Bar and Haimovitch, 2011, Disi, 2001), Arachnids (Levy, 1985, Levy, 1998, Levy and Amitai, 1980b, Qumsiyeh *et al.*, 2013, Amr *et al.*, 2004b), mollusks (Heller and Arad, 2009, Amr and Abu Baker, 2004a and references cited therein), and insects (Halperin and Sauter, 1991, Katbeh-Bader *et al.*, 2002, Katbeh-Bader and Amr, 1998 [2003]).

After the establishment of the Palestine Museum of Natural History (PMNH) in 2014, one of its obligations is to identify the neglected biodiversity elements in the State of Palestine. Within the past three years, PMNH has produced a number of publications in peer reviewed journals on groups of local fauna, including freshwater snails, scorpions, butterflies, amphibians and reptiles. Vulnerable areas are of particular interest for further study because environmental degradation in Palestine has been accelerated with industrialization and large-scale deforestation mainly by Israeli occupation and the colonial settlers.

In the past 25 years there has been a revival of interest in studies of biodiversity among native Palestinians. Of course we have in no way even approached the level of publications or interest in nearby countries like Jordan or Israel, but we must guard against a decline of that interest in biodiversity research seen, for example, in Israel in association with industrialization (Dayan *et al.*, 2011). We will discuss below examples of this revival of interest, including the establishment of a number of programs at universities (e.g. master programs in Environmental Studies at Al-Quds and Birzeit, and the Institute of Biodiversity and



Sustainability at Bethlehem University). But we must also separate scientific work from anecdotal notes and opinions on the Palestinian environment.

### 3.2 Geology

Palestinian geologic studies proliferated with the increased interests of Europeans in Palestine in the second half of the 19th century (see Benzinger 1895; Blanckenhorn, 1896, 1925; Lartet 1873; Lynch, 1852; Russell 1888). Recent literature showed that the tectonic movements resulted in multiple openings and closing of the sea basins and uplifts that produced the rich fossil fauna of the Eastern Mediterranean region (Lewy 1990; Ben-Avraham et al. 2002). Of the various geologic eras studied in our region, the Mid Cretaceous (particularly Cenomanian 93-100 MYA) provided an interesting assemblage of geological and paleontological material (Braun and Hirsch 1994; Philip 1978).

Most of the outcropping rocks in Bethlehem area were deposited under shallow warm sea conditions in the late Cretaceous times from the Late Cenomanian (95 million years ago) to Late Santonian (82 million years ago). The rock column starts with medium-thick fractured hard dolomitic limestone with thin marl interbeds that grades upward to be of thick marls and chinks which dominate the whole geologic column with occasional occurrence of medium-hard, thin limestone beds. A major fault directs NE-SW lead to the sinking of the eastern part of the area relative to its western part. The outcropping of these soft and thick rock successions made them target for erosion factors leading to the formation of steep hillsides around the city of Bethlehem, especially in the eastern and northern side. As well-known in geology, these thick limy strata were also suitable sites for karst phenomena and the formation of many caverns and underground caves making the area good as shelter for first man and his cattle (Fig. 9).



Figure 9. Caverns that provide shelter for humans, domesticated animals, and also wildlife in the area.

### 3.3 Geography, Climate, and Ecology

Interest in geography of Palestine before the modern era started with Greek philosophers like Herodotus who mentioned the Dead Sea in a “province of Syria” to studies by travelers like Ibn Batuta to work in the late Middle ages (see Avi-Yonah, 1962; Hüttersoth and Abdulfattah 1977). In the 19th century there was renewed interest and now using more scientific principles in the geography of the area (Ritter 1866; Hull and Fund 1888; Albright, 1921). Further geographic studies were done by Israeli geographers (e.g. Karmon 1971).

The geography of the area and especially the human change to the landscape was most prominently studied in the case of Battir which is part of the area under study here (Abu Hammad 2016). Al-Makhroun is in Mediterranean climatic zone; local elevations ranging from 710-920 m above sea level with annual rainfall is 550 mm. This zone is the largest in Palestine (Katsnelson 1964).

There will be dramatic impact of climate change on biodiversity and human health and sustainability (Harvell *et al.*, 2002, Portnov and Paz, 2008, Rinawati *et al.*, 2013) and this requires us to integrate educational, evolutionary, and ecological responses into models and potential remedies (Settele *et al.*, 2005, Lavergne *et al.*, 2010, Sternberg *et al.*, 2015). Since Ecosystems play a significant role in human well-being, human beings must rise to the challenges especially the one that threatens life on earth as we know it and that is climate change (UNDP, 2007). The world is now fully aware of the potentially devastating impact of human induced activities on climate change. While it is common sense that climate change impacts biodiversity mostly via habitat alterations, there is a challenge of how to perform these studies (Rinawati *et al.*, 2013). Benefiting industries and countries that burn a lot of carbon into the air attempted to slow down work to stop the deterioration and at least moderate the human impact on our atmosphere. However, the scientific evidence was so compelling (for example Intergovernmental Panel on Climate Change, 2007). International meetings were held and all serious scientists warned of the impending global challenge (see for example United Nations Framework Convention on Climate Change <http://unfccc.int>). The effect of climate change on biodiversity in our region is still poorly understood (Sternberg *et al.* 2015).

Al-Makhroun valley is located to the northwest of the city of Bethlehem and is part of a valley system that starts from Beit Jala (the Cremisan Monastery or Wadi Ahmad area) around Al-Walaja then through villages of Al Khader, Battir, Husan, and Nahhalin continuing to collect runoff along the way to reach major discharge on the Mediterranean via Wadi Es-Sant while also filling the Western water aquifer (unfortunately much of the water resources here are extracted for the benefit of Israeli colonial settlers who now control 93% of the water of the West Bank). The rainfall on the Western sides of the Jerusalem hills is much higher than on the Eastern sides.

Al Makhroun area is well-known as the governorate's most fertile land and its traditional breadbasket. The valley is announced as Important Bird Area (IBAs) (Birdlife International, 2018a) and was designated as a Key Biodiversity Area (Birdlife International, 2018b) at national and global levels. AL Makhroun Valley and its surroundings falls in the Mediterranean botanical and zoogeographical region (Zohary, 1973) and the Mediterranean biogeographical zone (Soto-Berelov, *et al.* 2012). It is also an important part of the hydrological system that replenishes the western aquifer. The mean annual temperature in this area is 16°C. The annual precipitation is between 601mm-688 mm, with highest elevation that reaches up to 804m above sea level. The soil is mainly a mixture of terra rossa and brown rendzina (Isaac, J. *et-al.*, 2010).

The valley also encompasses series of agricultural valleys extending along Al Makhroun Valley towards the west of Beit Jala, then towards the village of Husan, encircling the village of Battir, and extending to the neighboring village of Al Walaja to the northeast. The valley enjoys a strategic location and the availability of springs that attracted people to settle in the area and adapts its steep landscape into arable land, through developing complex irrigation system for the water supply that has led to the creation of dry walls terraces, agricultural watchtowers (manatir) locally known as palaces (qusoor), and olive presses. All were the basis for a strong presence of agriculture of olives and vegetables and others. The traditional system of irrigated terraces is an outstanding example of technological expertise, which constitutes an integral part of the cultural landscape. The existing landscape reflects one of the oldest farming methods known to humankind and are an important source of livelihood for local communities (MoTA, 2013).

Hence, it is also an important eco-touristic asset in the area as it provides beautiful green scenery, clean air, shadow and humidity, soil stability and fertility, and most importantly a unique recreational site. Further, it offers great potential for environmental, cultural and historic education, as it is close to Palestinian urban centers and rural villages.

### 3.4 Vertebrates:

#### 3.4.1 Reptiles and Amphibians

Reptile studies in Palestine started in the 19<sup>th</sup> century (Festa, 1894, Boettger, 1878, Tristram, 1884). There is a rich biodiversity of reptiles, both endemic and non-endemic elements, from various biogeographic zones: Ethiopian, Mediterranean, Saharo-Arabian, and Irano-Turanean (Werner, 1988). While significant studies on the reptiles in the areas occupied by Israel since 1948 were conducted, there are few studies by local scientists on the herpetology of the State of Palestine. A single publication on the reptiles of Gaza Strip was published by (Abd Rabou *et al.*, 2007b) and included 18 species of reptiles. Recently, the Palestine Natural History Museum reported on a collection of reptiles from several localities within the Palestinian Territories. Distributional data for 36 species belonging to 13 families are given (Handal *et al.*, 2016). Reptiles are diversified and include 17 families (Tortoises: Bataguridae and Testudinidae; Lizards: Agamidae, Anguidae, Chamaeleonidae, Gekkonidae, Phyllodactylidae, Lacertidae, Scincidae and Varanidae; Snakes: Leptotyphlopidae, Typhlopidae, Boidea, Colubridae, Atractaspididae, Viperidae and Elapidae) with a total of 81 species and subspecies.

We documented three species of reptiles in Al-Makhrou (Handal *et al.* 2016): *Testudo graeca terrestries*, *Chamaeleo chamaeleon* and *Micrelaps mulleri*. We also reported some reptiles like *Stellagama stellio* from Owl Pelet in Wadi Makhrou (Amr *et al.* 2016) (Fig. 10)



Figure 10. Lower jaw of *Stellagama stellio* recovered from Owl Pelet in Wadi Makhrou (Handal *et al.*, 2016).

Salman *et al.* (2014) studied amphibians (frogs and toads) from the West Bank – Palestine, results shows two species of frogs (*Pelophylax bedriagae* and *Hyla sp.*) that exist around our study area in Hussan and Artas. The area has three water springs (Kabryano spring, Umdan spring and Khdayer spring) two of them are not functioning anymore and the third could have amphibian species PMNH team observed a dead toad (*Bufo variabilis*) in the Wadi Makhrou area path in 16.X.2015 (Fig. 11). Surviving amphibians are represented by three families (Bufonidae, Ranidae, Hylidae) and three species. Toads, water frogs and tree frogs are represented by a single species (*Bufo viridis*, *Rana bedriagae* and *Hyla savignyi* respectively).



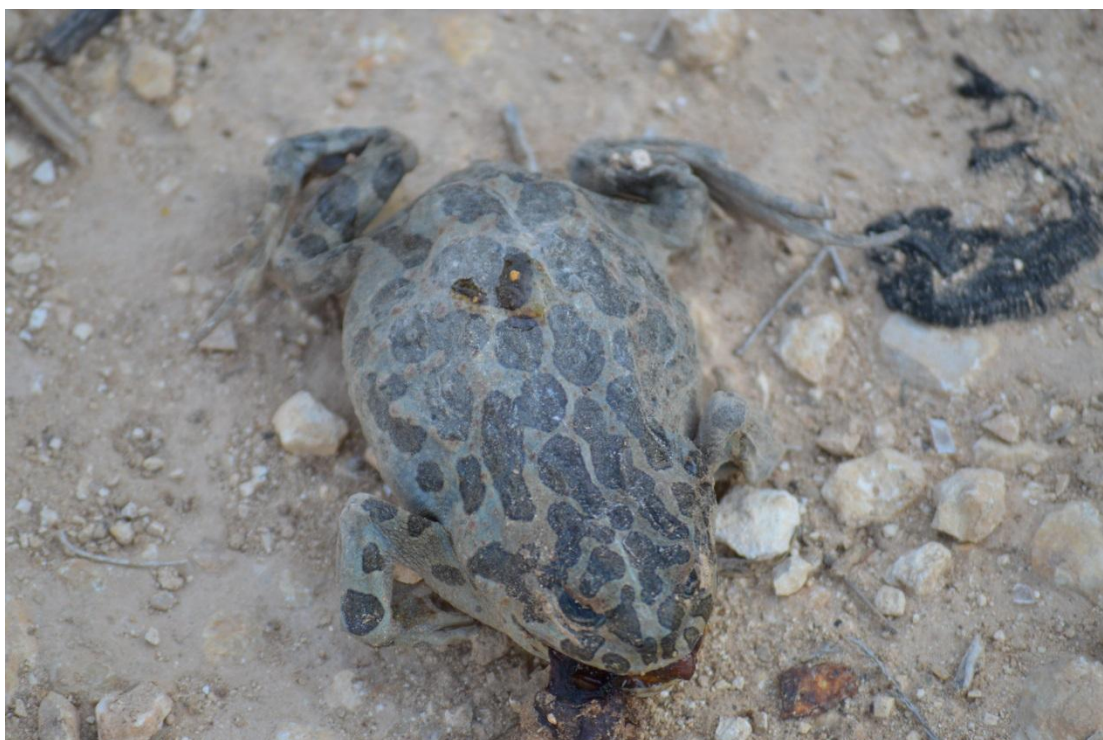


Figure 11. Dead toad found in Wadi Al- Makhroun in 2015.

### 3.4.2 Birds

Birds were the most visible of the Palestinian fauna and much earlier scientific work was done on them. But unlike the studies of other groups, there were also “layman” books and booklets that appeared for this visual group (Kharoob, 1992, Awad, 2009). Brett (1988) reported on the birds of prey in Palestine. The birds of Gaza Strip were studied on several occasions. Abu Shammalah and Baha El-Din (1999) gave an account of the birds of Gaza. Abd Rabou *et al.*, (2007c) recorded 118 bird species. Al-Safadi (1997) presented a comprehensive study on the breeding cycle of the Spur-winged Plover, *Hoplopterus spinosus*, in the sewage lagoon of Beit Lahia, Gaza Strip. So far, 373 bird species belonging to 23 Orders, 69 families, 21 Subfamilies, and 172 genera have been recorded from Palestinian areas (Awad *et al.*, 2016). Birds have been studied intensively in the Historic Palestine by Israeli ornithologists in the past 50 years, but still the Palestinian territories (West Bank and Gaza) poorly known and need work (Shirihai *et al.*, 1996). Few studies start to appear on birds from the West Bank on different field like birds parasite (Awad *et al.*, 2013; Awad and Rzaq, 2014), status of raptors like lesser kestrel, eagle owl and passerine status from EEC ringing station (Amr *et al.*, 2016; Awad *et al.*, 2017; Backleh and Atrash, 2007) and studding protected areas like: Wadi Quff and Wadi Zarqa Al-Ulwi (Khalilieh, 2016; PMNH, 2018).

Al-Makhroun is considered part of the chair of hills that go from Jerusalem to the West towards the Mediterranean. This and eastern areas of Jerusalem are considered as Important Bird Areas per international criteria (see Important bird areas <http://datazone.birdlife.org/site/results?cty=240&fam=0&gen=0> ). We published one paper on the diet of the Eagle owl in Wadi Al-Makhroun (Amr *et al.* 2016). Environmental Education Center (EEC) is a ringing station for birds located at Taleta Qumi which is near WM, this data could give prediction for the Avifauna that could found in the valley. EEC shows data of more than 70 species of passerine that ringed at the ringing station (Awad *et al.*, 2017).

### 3.4.3 Mammals

Our knowledge of mammals in our area depend on literature from the 19<sup>th</sup> to the late 20<sup>th</sup> century but with few studies in the West Bank (Tristram 1866, 1884; Bodenheimer , 1935; Atallah 1977; Harrison & Bates 1991; Qumsiyeh, 1985, 1996; Mendelssohn and Yom-Tov, 1999). In a study on two protected area: Wadi Zarqa Al-Ulwi and Wadi Quff, mammals data start to appear on what we have in the West Bank (PMNH,

2018; Qumsiyeh, 2016). So far, a total of 92 species and subspecies of mammals are known to live in Palestine. These species belong to eight orders (Artiodactyla, Carnivora, Chiroptera, Soricomorpha, Erinaceomorpha, Hyracoidea, Lagomorpha and Rodentia).

Two studies done on in Bethlehem area related to Wadi Al Makhroul area with connection to mammals. In Qumsiyeh *et al.*, (2014b) they shows the diversity of mammals that exist in Bethlehem district with 31 record of species from 16 family, which includes data from Al Makhroul. In the other hand a study done on the Eagle owl diet from Al Makhroul shows five species of mammals (*Erinaceus concolor*, *Rattus rattus*, *Meriones tristrami*, *Microtus guentheri*, and *Rousettus aegyptiacus*) and a domesticated cat (Amr *et al.* 2016).

Other observation in the past three years from the PMNH team recorded several species of mammals including (*Vulpes vulpes*, *Canis aureus*, *Hyaena hyaena*, *Gazella gazelle*, *Procavia capensis* [in Taleta Qumi], and *Sus scrofa* [in Battir]). According to Dolev *et al.* (2004) *Hyaena hyaena* is an endangered species in our region and near threatened globally, and the mountain gazelle is a near threatened species globally which need to be re-assessment for our area.

### 3.5 Invertebrate

#### 3.5.1 Gastropods

Previous studies on the freshwater snails of historical Palestine include Tristram (1884) and Germain and de Kerville (1922). Azim and Gismann (1956) included data on freshwater snails collected from the West Bank during a study on the snail intermediate host for schistosomiasis in south-western Asia. Recent studies on the snails of the genus *Melanopsis* including records from the West Bank were published by Heller *et al.* (2005). Recently Bdir and Adwan (2011, 2012) investigated the presence of larval stages of trematodes among freshwater snails collected from the Palestinian Territories. A recent study by Handal *et al.* (2015) reported on the taxonomy and distribution of the freshwater snail fauna in Palestinian. A total of 10 species of freshwater snails belonging to four families (Neritidae, Melanopsidae, Pulmonata and Thiariidae) in seven genera (*Galba*, *Haitia*, *Lymnaea*, *Melanoides*, *Melanopsis*, *Pseudoplotia*, and *Theodoxus*) were collected (Handal *et al.* 2015).

A recent master thesis on land snails in the West Bank showed the following species in the study area (Handal 2018): *Granopupa granum*, *Buliminus labrosus*, *Paramastus episomus*, *Pene bulimoides* (Fig. 12), *Euchondrus septemdentatus*, *Euchondrus chondriformis*, *Eopolita protensa jebusitica*, *Sphincterochila fimbriata*, *Monacha obstructa*, *Monacha syriaca*, *Metafruticicola fourousi*, *Xeropicta krynickii*, *Levantina caesareana*, *Levantina lithophaga*, and *Helix (Pelasga) engaddensis*.

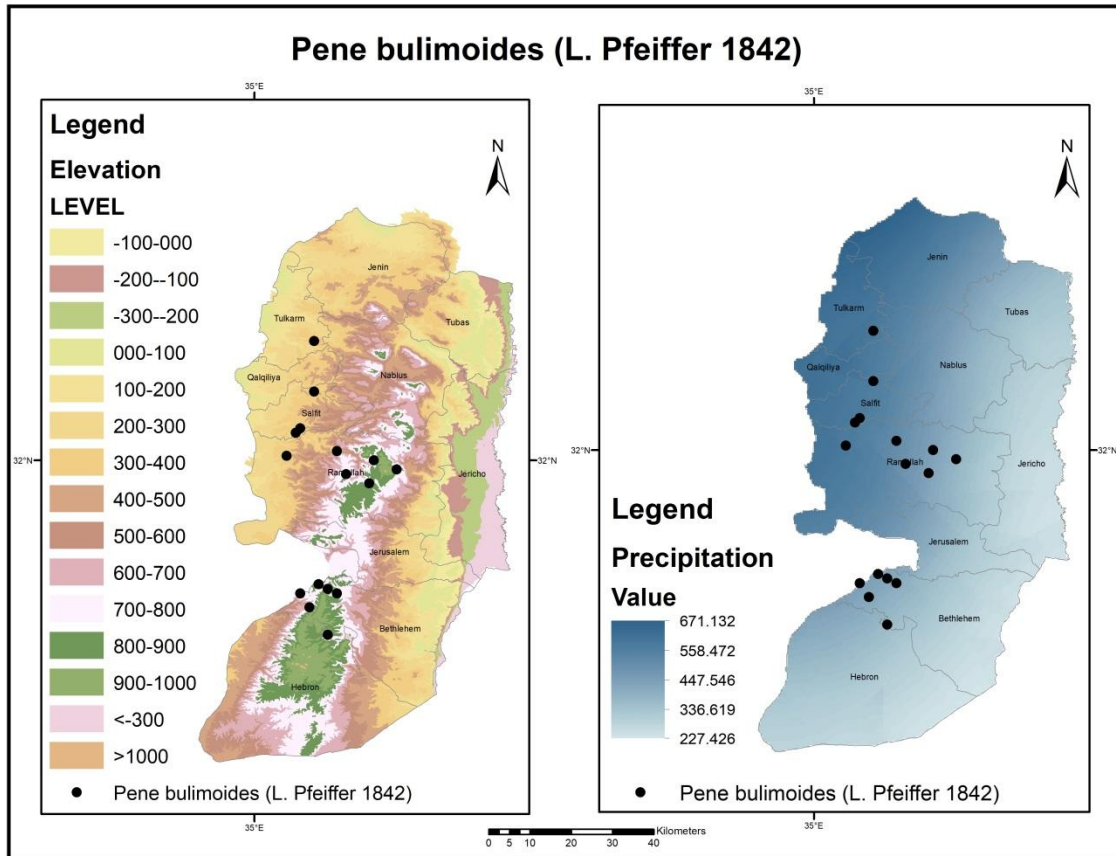


Figure 12. Distribution and morphology of one of the land species reported in Al-Makhrouf (Handal 2018).

### 3.5.2 Arachnids

In the Eastern Mediterranean region some initial faunal work on scorpions was done by Vachon (Vachon, 1953, Vachon, 1966) followed by some studies in Palestine (Levy and Amitai, 1980a). Qumsiyeh *et al.* (2013) reported on a collection of scorpions from the occupied Palestinian territories, including the first karyotypes of species from the Eastern Mediterranean region. They later published paper on a species of scorpion from the protected area of Wadi Al-Quff (Qumsiyeh *et al.*, 2014a). Spiders in historic Palestine were studied by Zonstein & Marusik (2013).

Arachnids including different order like: scorpion, spiders, camel spiders, and pseudoscorpions are poorly studied in the Palestinian territories, and only few data shows the distribution and systematics of them in the West Bank (Levy and Amitai, 1980; Qumsiyeh *et al.*, 2013; 2014a). *Nebo hierichonticus* and *Scorpio*



*maurus palmatus* were recorded from the area of Al Makhroul Valley (Amr *et al.*, 2016; Qumsiyeh *et al.*, 2013).

### 3.5.3 Insects

Insecta is a big group of living creatures containing around 7 million species; the biggest biomass of living animals on earth (Erwin, 1982; Stork, 2018). Our estimation is that Palestine could have more than 35,000 species of the class Insecta. Few studies were conducted in the Palestinian territories and we discuss those below.

Grasshoppers: Orthoptera is an order studied well in the Historic Palestine in the year between 1893-1939 by Uvarov, Swinton and Giglio-Tos (see Abusarhan *et al.*, 2018). The most comprehensive recent study on the Orthoptera of Palestine was published by Fishelson (1985) but still did not show the distribution of species in the Palestinian territories. According to Abusarhan *et al.*, (2017) four species of grasshopper were recorded from the area (*Calliptamus coelesyriensis*, *Acrotylus insubricus*, *Oedipoda aurea*, and *Tmethis pulchripennis asiaticus*) and still need more study to get list of specie that have.

Dragonflies: Odonata is an order of insects divided into three suborders: Anisoptera (true dragonflies), Zygoptera (damselflies) and Anisozygoptera (a very small suborder considered intermediate between damselflies and dragonflies). A study shows some of the Anisoptera that exist in Wadi Al Makhroul and surrounding area (Al Walaja and Hussan), and it shows the existence of three species : *Trithemis arteriosa*, *Trithemis annulata*, and *Orthetrum chrysostigma* (Adawi *et al.*, 2017).

Praying mantids: Mantodea is an order of huge group of insects. Handal *et al.* (in Press) review the praying mantis in the west Bank and shows existence of 16 species out of 30 species from the Historic Palestine, four species recorded from Al Makhroul and Batter (*Blepharopsis mendica*, *Empusa fasciata*, *Rivetina byblica*, and *Iris oratoria*).

Beetles: Coleoptera is a huge order rich with species and reach to 1.5 million worldwide (Stork, 2018). Many studies on beetles done in the Historic Palestine but none of them shows the species that exist in the Palestinian territories – the West Bank. One study done by the Palestine Museum of Natural History on subfamily Cetoniinae and shows that 2 two species exist *Tropinota suturalis* and *Oxythyrea noemi* (Handal and Amr, in Press). More studies need to be done on this field to have a list of species that exist in the area. A study of Coccinellidae in the Southern parts f the West Bank and the Jordan valley was recently completed by Najajreh (2018) at PMNH/PIBS-BU for a master thesis at Birzeit University (see Fig. 13).

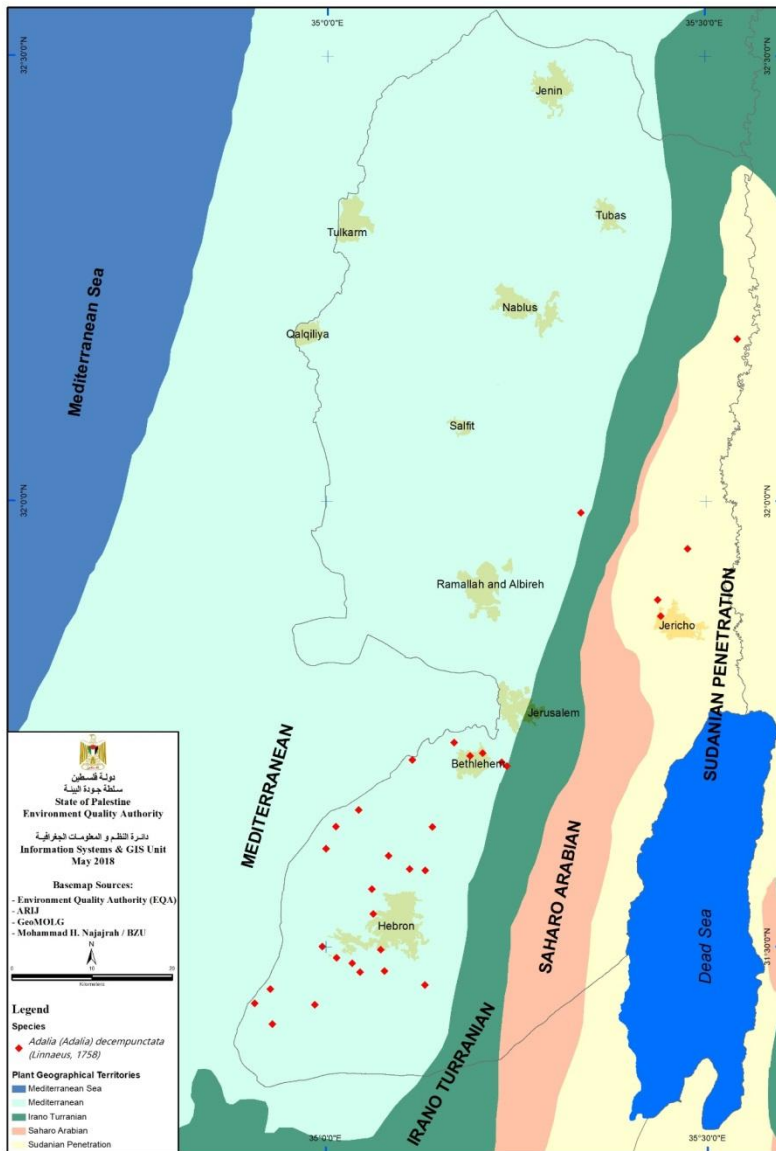


Fig. 13. Distribution and morphologic variation of one of the species of Coccinellidae in the area including Wadi Al-Makhroul (from Najajreh 2018).

**Butterflies:** Butterflies are poorly studied in the West Bank – Palestine and most studies done around the Palestinian territories in the Historic Palestine with more than 90 species (Benyamini, 1983; 1997). Few studies show the diversity of butterflies in the Palestinian territories which focus on the southern West Bank with 54 species and two protected areas, Wadi Zarqa Al-Ulwi with 30 species and Wadi Quff with 23 species (Abusarhan *et al.*, 2016; PMNH, 2018; Qumsiyeh, 2016). Abusarhan *et al.*, (2016) shows 12 species of butterflies collected from Wadi Al Makhroul area belonging to four families and without including the family Papilionidae which two species observed by the PMNH team before but not published (*Papilio machaon* and *Achon apollinus*), species that recorded from WM: (Pieridae: *Aporia crataegi augustior*, *Pieris brassicae*, *Pieris rapae leucosoma*, *Pontia daplidice*, *Colias croceus*; Nymphalidae: *Limenitis reducta schiffmuelleri*, *Melitaea telona*, *Polygonia egea*; Lycaenidae: *Lycaena thersamon*, *Polyommatus Icarus*; Hesperiidae: *Spialia orbifer hilaris*, *Syrictus tessellum nomas*).

### 3.6 Flora

In terms of the scope of literature available on flora in Palestine, there are records on this topic dating back to the late 19th century, when Guerin (1852), and Tristram (1892) wrote the Natural History of Palestine, which drew on the work done by the Palestine Exploration Fund to produce Flora of Palestine in the late 1880s. Palestine has a rich flora in spite of its small area due to its geographical position as a meeting point





### 3.7 Anthropological issues including agriculture

Palestine including areas like Al-Makhroun are part of the fertile Crescent where humans first developed agricultural practices including domestication of plants and Animals. Wadi Al-Natuf as a valley in the northern West Bank was the first place archeologists identified such areas and hence we speak of Natufian Agriculture (see Bar-Yosef 1998). Our cultural heritage relating to nature and agriculture is very extensive for example on use of plants from nature for medicinal purposes (Said et al. 2002). Further knowing and using this cultural heritage is intertwined with biodiversity conservation (Alves 2012; Hjelle et al. 2012). Wadi Al-Makhroun is a prime example of this because of existence of agricultural models practiced over thousands of years (Fig. 15). Cultural protection of this landscape is critical (Tengberg et al. 2012). Few ethnoecological work in our region starting in the 19<sup>th</sup> century (Canaan 1928; Crowfoot & Baldensperger 1932; Dafni 1984; Ali-Shtayeh 2000; Issa 2007; Nabulsi 2007; Lev 2006; Levin 2006; Gilbert and Mandaville 2013).<sup>1</sup>

Ecosystem benefits come from reexamining human-nature interactions; i.e. the cultural-ecological landscape (Mitchell et al., 2009; Tengberg et al. 2012). Ethnobotanical methods are available with support from UNESCO (e.g. Martin 2004). In the context of Palestine, such studies can also enhance the attachment of people to their lands (Tsykalova 2015; Qumsiyeh 2018).



<sup>1</sup> For some Arabic studies, see:

- معهد الأبحاث التطبيقية / القدس / "أريج" التاريخ الزراعي في فلسطين ٢٠٠٢.
- مجلة التراث والمجتمع / ع ٥ / مجلد ٢ / ١٩٧٦ والصادرة عن لجنة الأبحاث الاجتماعية والتراث الشعبي الفلسطيني في جمعية إنعاش الأسرة .
- فلسطين الفصول الأربعة عادات وتقاليد ومواسم / نادي البطمه/ مركز القدس للإعلام والاتصال ٢٠١٢ .
- عبد اللطيف عاشور التداوي بالأعشاب والنباتات / مكتبة ابن سينا / القاهرة \_ مصر .
- جاد اسحق وعيسى اسحق ١٩٩٢ / "الحاكورة دليل العملي للعناية بالحديقة " التربية من اجل الوعي والمشاركة / القدس / فلسطين.
- تانيا تماري ناصر وماري جبجي تماري / "طلع الرنجنس والحنون"، أزهار مطرزة من ربيع فلسطين / ٢٠٠٩

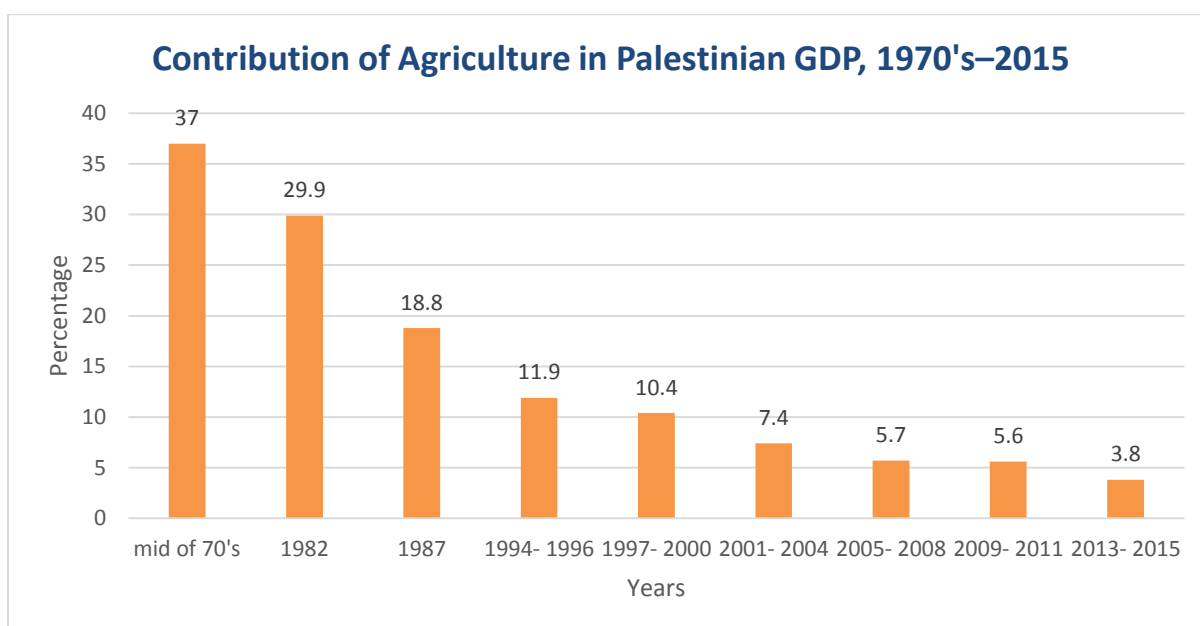
Figure 15. Ancient Canaanitic stone terracing and typical stone home in the valley.

Population projections (NPC & UNFPA, 2016) reveals that the population of Palestine would increase from 4.8 in 2017 to 6.9 in 2030 and will double in 2050 reaching 9.5 million, in spite of the significant fertility reduction. This is expected to be accompanied by a shift in the age structure of the population as youth's ratio (0-14) will drop to 35% in 2030 and up to 25% in 2050, with a slight increase in the percentages of older people (65 and above). In addition, percentage of working age population (15-64) is expected to increase from 57.8% to 61% in 2030 and will continue to rise for up to 67% of the total population in 2050. These trends will lead to increased pressure on the labor market and the need to create new jobs for large numbers of working age population, in addition to the increasing pressure on natural resources, especially land, water and forests (MoA, 2016).

The Agriculture sector comes as cushion to the mentioned changes. It is an integral component of Palestinian communal, cultural, economic and social life. To date, agriculture has remained of great significance to Palestinians and their identity and culture, to which land and crops are central. Over and above their traditional roles in Palestinian economic, food and their life, agriculture in Palestine is a symbol of Palestinian identity and stability on their land to face of ongoing land confiscation due to prolonged occupation and the expansion of Israeli settlements and depriving the Palestinians from their rights. Agriculture is an important productive sector in Palestine and has been the backbone of the Palestinian economy. The agricultural sector played a major role in the formation of the Palestinian gross domestic product (GDP). It is considered the main source of income for thousands of the Palestinian households either directly or indirectly, and it is contributing to the provision of food to the Palestinian people and absorption a large numbers of the Palestinian labors, especially during times of crisis.

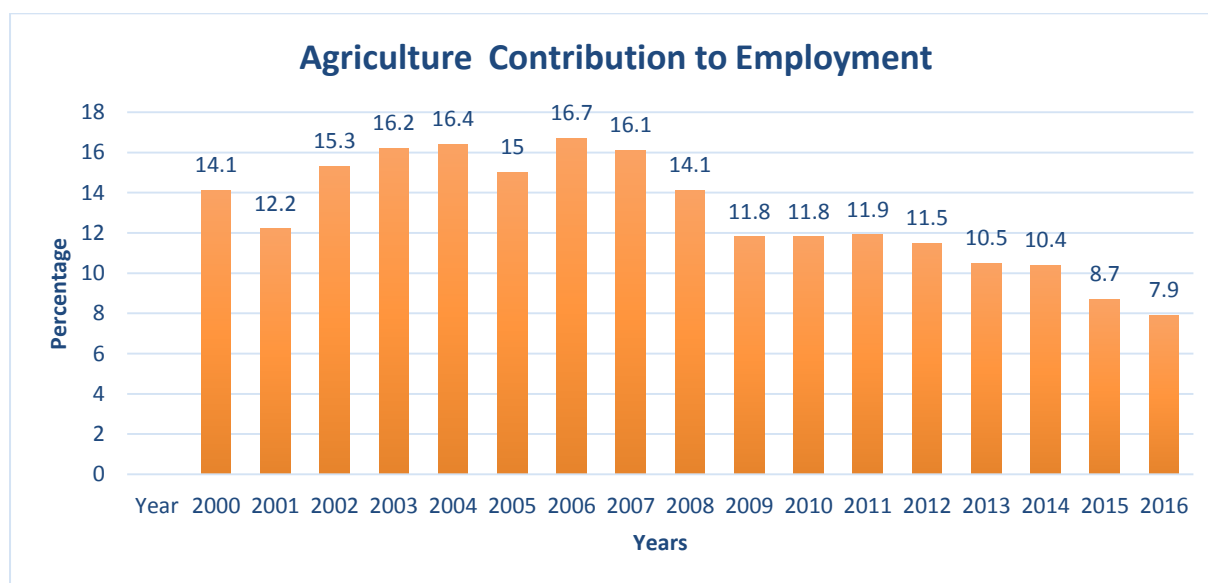
Historically, the agricultural sector has played an important role in providing employment opportunities, especially in times of crisis, during which it was difficult to work in other sectors. Nevertheless, the area of cultivated land in Palestine has been rapidly declining over the years. For example the cultivated area decreased from 1,904, 000 dunums during the growing season of 1994/1995 to 1,612,000 dunums during the growing season of 1998/1999, then it decreased to 1,034,901 dunums in the growing season of 2010/2011 (PCBS, 1997, 2001, 2011).

Data from the agricultural census published by the Palestinian Central Bureau of Statistics (PCBS) indicates that, the agriculture sector contribution to GDP has been declining over the years. Where the contribution of agriculture to GDP was about 37% in the mid-seventies, but reached to 2.8% only in the year 2016 (see Figure 16).



**Fig. 16.** Source: MoA, 2016 and El Zein R., 2017

There are several reasons behind the declining of agricultural sector's contribution to GDP over the years, but of main reasons is the growth in other sectors such as services, construction, and information technology. This caused significant reduction of agriculture contribution to employment over the years. Since 2006, the agricultural sector has witnessed significant decline in the number of agricultural workers, for both women and men, due to restrictions imposed on the sector's development and its low production. In 2006, labor force in the agricultural sector constituted 16.7% of total labor force (12.6% male, 35.1% female), falling to 8.7% in 2015 (PCBS, 2000-2015). Percentage of men working in the sector was estimated at 7.8% of the total male workers in 2015, while 13.1% of the total female workers were employed in agriculture, which indicates the relative importance of the agricultural sector to women (MoA, 2016) (see figure 17).



**Fig. 17.** Source: PCBS, 2000-2016

This is in addition to the continuous Israeli policies and procedures against the Palestinian agriculture including land confiscation, and control over water resources and the difficulty of exporting to foreign markets. Other reason is the climate change and harsh weather conditions have also negative impact on the production of some of the main Palestinian agro products such as olives, olive oil, vegetables and field crops and forages, as it also has a negative impact on the numbers and production of livestock.

Not forgetting that the whole sector is facing diverse challenges including the expansion/encroachment of urban areas on agricultural lands, land fragmentation, lack of sovereignty on land and natural resources, weak capacities and human resources, weak basic agriculture infrastructure, weak internal and external assistance to the sector and many others.

### **Agriculture at Al Makhrou**

Thousands of meters of dry-stone walls compose the terraces that extend along the valley of Wadi Al-Makhrou towards Battir. The dry-stone walls (senasel) create a flat earthen surface known as habaleh, and thus prevent soil erosion and preserve soil moisture. The traditional cultivation of olive trees is an essential component in the historical development of the cultural landscape systems in this area, and has multiple functions and meanings at the environmental, agricultural, socio-cultural, and symbolic levels.

The cultivation of the olive tree involves low-density plantations, sometimes planted in an irregular pattern, low labor and material inputs, and a manual harvest. Most of the olive tree plantations are rain-fed, along with other crops such as fruit trees and field crops, and occupy extensive hilly and mountainous areas that are susceptible to soil erosion due to water runoff (MoTA, 2014). The Palestinian natural trees such as oak



tree can be found amongst the olives in terraces that are away from the village, while vines and fruit trees, such as apricots, almonds, and plums are planted near the villages. The agricultural activities related to olive cultivation are usually managed by individual families, and the olives and oil produced is used prevalently for self-consumption and for the local market.

The route from Wadi Al-Makhroun towards Battir is dotted with agricultural watchtowers. The majority of the agricultural watchtowers were constructed at an intermediate level of the property, and are used by the farmers to watch over their fields during the harvest season. Accordingly, the agricultural watchtowers spread away from the village.

Although the terraces near the villages have a few scattered olive trees, they are mainly associated with other crops, including grapevines, fruit trees, seasonal vegetables, and herbs. Some citrus trees, mainly lemon trees, are also found in these fields, but they are planted for domestic use only. The majority of the cultivation near the terraces depends on irrigation. The ancient pools and the water canals are used during the dry season to irrigate the terraces, and the distribution of the water among the farmers follows a traditional system known as shares (al-ma'dud).

### **Agriculture at project localities:**

The four project targeted villages; Battir, Al Walaja, Husan and Beit Jala are Palestinian localities that surrounds Al Makhroun valley and rely on practicing farming for securing either their own consumption or for enhancing their income through marketing their production at local level. The agriculture production in those areas is the backbone for food security at household level. The cultivation production of the four localities forms the food basket for Bethlehem distribute including mainly vegetables, fruits, and field crops. A summary for the population number, the cultivated areas and livestock by locality is below.

*Table 2: Total population number, locality area, and cultivated area (in dunums) by targeted locality*

<b>Village</b>	<b>Population Number (2017)</b>	<b>Area (dunum)</b>	<b>Cultivated Area (dunum)</b>	<b>% of cultivated land of total area</b>
<b>Battir</b>	<b>4696</b>	<b>6,795</b>	<b>3352</b>	<b>28.9</b>
<b>Husan</b>	<b>7048</b>	<b>7,361</b>	<b>1026</b>	<b>8.8</b>
<b>Al Walaja</b>	<b>2671</b>	<b>4,328</b>	<b>1942</b>	<b>16.7</b>
<b>Beit Jala</b>	<b>13484</b>	<b>9,749</b>	<b>5289</b>	<b>45.6</b>
<b>Total</b>	<b>27899</b>	<b>28,233</b>	<b>11609</b>	<b>41.12</b>

Source for Population: PCBS, 2017.

For locality Areas: ARIJ, 2010.

For Cultivated Areas: Agricultural Directorate of Bethlehem, 2018

*Table 3: Total area (in dunums), crop type, and number of livestock, in the targeted localities, 2017*

<b>Village</b>	<b>Numbers of livestock</b>				<b>Crop type</b>				
	<b>Sheep &amp; Goats</b>	<b>Bee hives</b>	<b>broiler farms</b>	<b>layers farms</b>	<b>No. of Plastic houses</b>	<b>Area of plastic houses</b>	<b>Area of Field crops &amp; forages</b>	<b>Area Fruit trees</b>	<b>Area Vegetables</b>
<b>Battir</b>	<b>635</b>	<b>169</b>	<b>2</b>		<b>6</b>	<b>4</b>	<b>24</b>	<b>3187</b>	<b>137</b>
<b>Husan</b>	<b>558</b>	<b>72</b>	<b>13</b>		<b>4</b>	<b>2</b>	<b>41</b>	<b>767</b>	<b>216</b>
<b>Al-Walaja</b>	<b>846</b>	<b>73</b>	<b>0</b>		<b>4</b>	<b>2</b>	<b>42</b>	<b>1844</b>	<b>54</b>
<b>Beit</b>	<b>567</b>	<b>56</b>	<b>7</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>33</b>	<b>5199</b>	<b>55</b>

<b>Jala</b>									
<b>Total</b>	<b>2606</b>	<b>370</b>	<b>22</b>	<b>1</b>	<b>17</b>	<b>10</b>	<b>140</b>	<b>10997</b>	<b>462</b>

**Source:** Agricultural Directorate of Bethlehem, 2018

### **Battir Village**

Battir is a Palestinian village in Bethlehem Governorate located 6.4 km (horizontal distance) north-west of Bethlehem City. Battir is bordered by Beit Jala town and Al Walaja village to the east, Husan village to the west, Husan and Al Khader to the south, and the 1949 Armistice Line to the north (ARIJ, 2010a).

Battir is a major Palestinian cultural landscape; now is a world heritage UNESCO site as a results of the traditional terrace farming system that is supported by a unique ancient egalitarian water distribution system and irrigation channels, as it continues to fight the occupation peacefully though its cultural and natural heritage. Battir has always been considered the vegetable garden of Jerusalem due to the abundance of springs in the area. The traditional system of irrigated terraces within the nominated property is an outstanding example of technological expertise, which constitutes an integral part of the cultural landscape. The inhabited farmers who worked and still work the land, attests to the sustainability of this system and to its continuation for the past 4,000 years (MoTA, 2014). The farmers at this village use this system until today that delivers water to the terraced agricultural land based on a simple mathematical calculation and a clear time-managed rotation scheme. The Battir cultural landscape encompasses ancient terraces, archaeological sites, rock-cut tombs, agricultural towers, traditional footpaths, olive oil presses and most importantly an intact water system, represented by a collection pool, channels, etc. The integrity of this traditional water system is guaranteed by the families of Battir, who depend on it.

The vegetables of Battir have always been well appreciated in the nearby towns and villages. The eggplants of Battir (beitinjan battiri) are considered to be the best and the most famous landrace in the area. Vegetables are grown in the terraces all year around, and were once mainly sold in Jerusalem, although this situation changed after Battir was completely cut off from Jerusalem after the 1967 war. Still, even today, Battir is considered one of the major sources for vegetables for Bethlehem district.

The total area of Battir is about 6,795 dunums, of which 3352 dunums are cultivated land (3187 dunums of fruit trees, 137 dunums of open field of Vegetables, 4 dunums of vegetables are planted under plastic houses, and 24 dunums of field crops and forages). Agriculture activities in Battir depend mostly on rainwater. As for irrigated fields they depend on water springs and domestic harvesting cisterns. For the livestock production in Battir there is 635 head of sheep and goats, 2 farms of broiler chickens, and 169 bees' hives (Agricultural Directorate of Bethlehem, 2018).

### **Al Walaja Village:**

Al Walaja is a Palestinian village in Bethlehem Governorate located 5km (horizontal distance) west of Bethlehem City. Al Walaja is bordered by Beit Jala town to the east, the 1949 Armistice Line to the north and west, and Battir and Husan villages to the south (ARIJ, 2010b).

The total area of Al Walaja is about 4,328 dunums of which 1942 dunums are cultivated land (1344 dunums of fruit trees, 54 dunums of open field of Vegetables, 2 dunums of vegetables are planted under plastic houses, and 42 dunums of field crops and forages). Agriculture activities in Al Walaja depend mostly on rainwater. As for irrigated fields they depend on water springs and domestic harvesting cisterns. For the livestock production in Al Walaja there is 846 head of sheep and goats, and 73 bees' hives (Agricultural Directorate of Bethlehem, 2018).

### **Husan Village:**

Husan is a Palestinian village in Bethlehem Governorate located 6.5km (horizontal distance) west of Bethlehem City. Husan is bordered by Al Khader town to the east, Battir village to the north, Nahhalin Village to the south, and the 1949 Armistice Line and Wadi Fukin village to the west (ARIJ, 2010c).

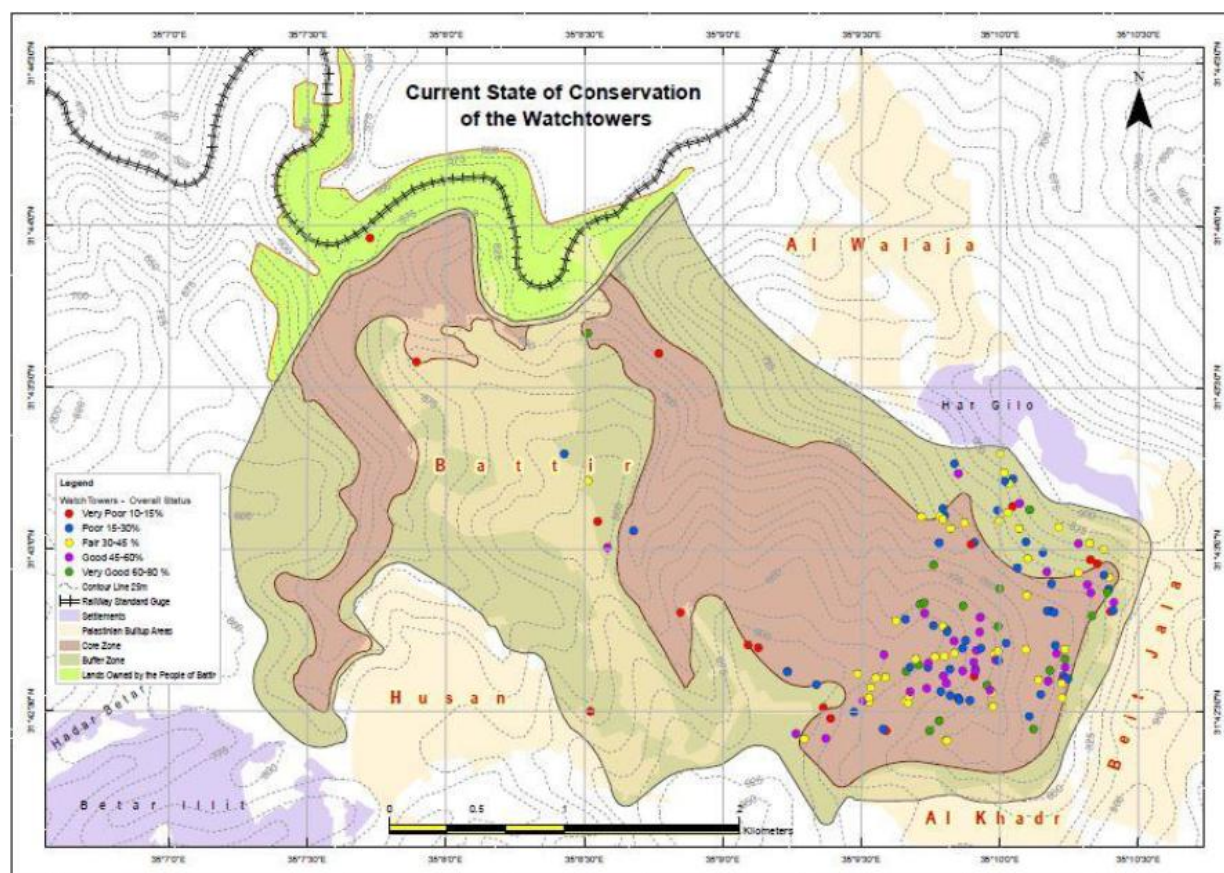
The total area of Husan is about 7,361 dunums of which dunums 1026 dunums are cultivated land (767 dunums of fruit trees, 216 dunums of open field of Vegetables, 2 dunums of vegetables are planted under plastic houses, and 41 dunums of field crops and forages). Agriculture activities in Husan depend mostly on rainwater. As for irrigated fields they depend on water springs and domestic harvesting cisterns. For the livestock production in Husan there is 558 head of sheep and goats, 13 farms of broiler chickens and 72 bees' hives (Agricultural Directorate of Bethlehem, 2018).

### Beit Jala City:

Beit Jala is a Palestinian city in Bethlehem Governorate located at 1.8 km (horizontal distance) west of Bethlehem City. Beit Jala is bordered by Bethlehem city to the east, Jerusalem city and Gilo settlement to the north, Al Walaja and Battir villages to the west, and Ad Doha city and Al Khader town to the south (ARIJ, 2010d). The total area of Beit Jala is about 9,749 dunums of which dunums 5289 dunums are cultivated land (5199 dunums of fruit trees, 55 dunums of open field of Vegetables, 2 dunums of vegetables are planted under plastic houses, and 33 dunums of field crops and forages). Agriculture activities in Beit Jala depend mostly on rainwater. As for irrigated fields they depend on water springs and domestic harvesting cisterns. For the livestock production in Beit Jala there is 567 head of sheep and goats, 7 farms of broiler chickens, 1 farm of layer chickens and 56 bees' hives (Agricultural Directorate of Bethlehem, 2018).

### Other Human Issues

The village of Battir and the valleys surrounding it including Al-Makhrouf which is now a World Heritage Site due to many factors including the ancient but still in use agricultural heritage (like stone terracing, watch towers, irrigation systems, ancient olive presses etc) (Figs. 18-21).





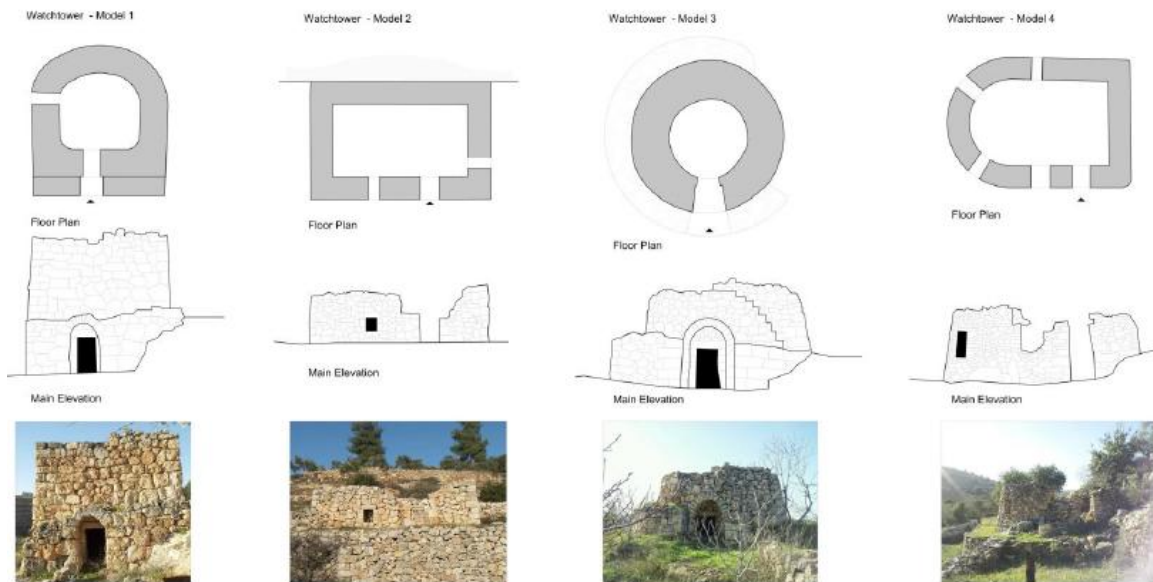


Fig. 18. Map of agricultural watchtowers and their state of conservation in the area of Battir and Wadi Al-Makhrour (note concentration is near Beit Jala) and sample watch towers (from MOTA 2018).

There are also lime kilns called locally *qabbara* or *lattoun* ((Sarhan, 1989) which were used to produce limestone for thousands of years (Kingery et al. 1988) (Fig. 17)



Fig. 19. Lime kiln near Battir (MOTA 2018)

There are also very ancient olive presses in the area (Fig. 18).



Fig. 20. Ancient olive press near Battir (MOTA 2018)



Fig. 21. View of irrigated terraces in 1892 (Palestine Exploration Fund).

The village has an interesting history in having returned to their village after the ethnic cleansing of 1948 by acts of civil resistance in 1948-1949 (Botmeh 2006; Shokeh 2012).

The human caused climate change will have a great impact on agriculture and food security going forward (FAO 2018). Permaculture is now a dominant trendy form of ecological agriculture but it is a modernization of the methods used by our ancestors in agriculture in harmony with nature (see Anabtawi 2016).

Agroecological practices will be essential to sustainable agriculture (Wezel et al. 2014) and to biodiversity conservation (Scherr and McNeely 2008; Qumsiyeh et al. 2017).

### 3.8 Ecotourism

The global tourism industry is huge and growing with all attendant positives and negatives. The Middle East accounts for only 2% of that tourism economy (Neto, 2003). The concept of ecotourism (nature tourism with social and environmental conservation benefit) was developed in the 1980s as alternative to mass tourism (Orams, 1995). Ecotourism is a tiny segment of a “tourism industry” that is valued at trillions of dollars worldwide (roughly 10% of world GDP). But ecotourism, if done properly and with well-designed programs, may play a significant role in reversing negative trends of world development and contribute significantly to the world Millennium Development Goals (Bricker *et al.*, 2012).

In Palestine, the dominant form of tourism is religious pilgrimage but other forms were considered in the national strategy on tourism (MNE 2013) and in the National Development Plan (MOPAD 2014; PEC DAR 1999). Further, most of the tourism economy has been taken over by Israel over the past few decades (Isaac, 2010a, b; 2016). For the State of Palestine, there is very limited tourism (again largely due to political issues) and this is essentially a trickle down economy from the tourist industry now largely Israeli (Isaac *et al.*, 2016). Tourism indirectly contributes to 14% of Palestinian GDP but only 4% from direct tourism and only 2% of employment directly (PCBS, 2014). The Israeli occupation impact is highly destructive, especially the lands closed to settlements which suffer daily attacks from burning trees to settlers wastes (Isaac *et al.*, 2016). But outside of this, there is lack of a clear national tourism development strategy or having strategies written but not implemented let alone a specific national ecotourism plan. There is also a lack of resources, financial and human, to manage, develop and promote Palestinian destinations. There still a narrow vision of tourism, without connections to the different key attractions and with other sectors such as agriculture and nature. Agricultural tourism for example (Jolly and Reynolds, 2005) can be promoted because Palestine is rich in agricultural traditions and history being part of the Fertile Crescent where humans first developed domestication of plants and animals. Palestinians do not seem to have adequate awareness of the advantages found in the cultural and natural heritage and what it can offer to local development plans and the local economy.

Most natural sites are under Israeli control in historic Palestine and in most of the occupied territories (see section on protected areas). Thus it is not surprising that, like religious tourism, the nascent sector of ecotourism is also mostly dominated by Israel (see for example <http://www.ecotourism.org.il/>). In the past 20 years, alternative tourism (alternative to mass tourism) has developed in Palestine involving for example political tourism and cultural tourism that is small scale, involve mostly home-stays, and organized by NGOs (like the Palestine Center for Rapprochement Between People, Holy Land Trust, and Alternative Tourism Group). A conference on development of eco-tourism in Palestine was held 8 November 2007 by The Centre for Cultural Heritage Preservation (CCHP) in partnership with Bethlehem University. This alternative tourism sometimes led people in nature walks to enjoy the rich biodiversity and landscape beauty.

One of the best practices that our project has to consider while implementing the eco-tourism component is the one summarize as an outcome of the “Mediterranean Experience of Eco-Tourism” project; an ENPI – CBC MED project (1-A/1.2131/ MEET). The report within the Work package #4 “Methods and tools for survey of eco-tourism state of the art” is to be considered. The methodology approach will support the project to set best methods to enhance ecotourism at AL Makhrou valley as; as it suggests best international tips for a successful ecotourism activity or product (Mauro *et al.* 2014). It identifies some success determining factors encountered during Best practices analysis including management, infrastructure, facilities, services, conservation, local communities, cultural heritage, monitoring, and marketing aspects.

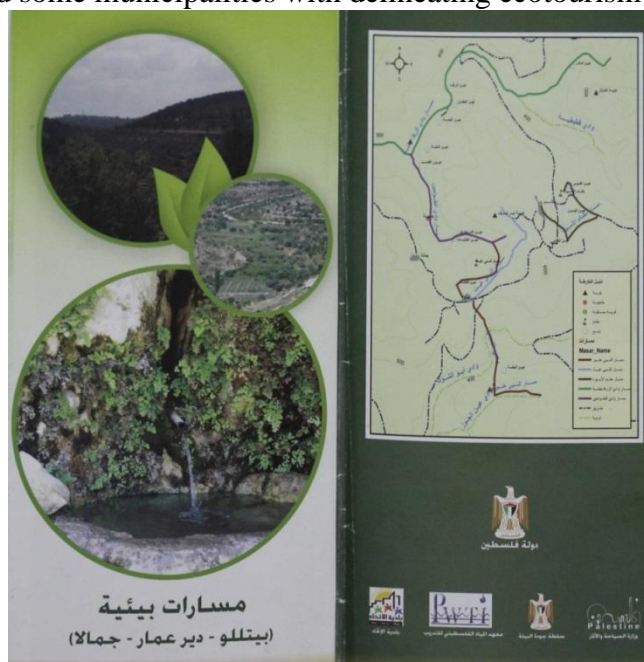
According to Ghrouf (2010) asking people about ecotourism suggests the important areas in the Southern Jordan Valley are the Dead Sea, Mount of Temptation, and Ain Fashkha while the obstacles to ecotourism there are lack of tourism investment, poor publicity, and lack of sovereignty over these areas. Another master thesis from Al-Quds University suggested the need for evaluating destinations of ecotourism in terms of certain indicators focused on local community development while conserving nature (see Rueff *et al.*



2008; Quttaineh 2015). Yet, in Palestine we have not one person qualified or trained professionally in ecotourism as a field. Much can be done to develop the tourism sector in Palestine in general but most of it is dependent on having sovereignty and political stability which is not forthcoming as long as the conflict and occupation continues (PECDAR, 1999). But even under occupation, we can develop for example having qualified human resources and structured programs that cater to different forms of tourism including ecotourism. The largest alternative tourism in Palestine today is not ecotourism but is political tourism including ‘dark tourism’ which is tourism of troubled spots and areas where human dark history happened like in Deir Yassin and visits to refugee camps (see Isaac 2010a; Isaac and Ashworth 2011). But we do see some very hopeful signs that some things can be done even under occupation and not just in areas of dark tourism and recruitment of international solidarity activists. For example interest in walking and hiking through nature (much of this is ecotourism) has increased in the past two years. Some books came out regarding these such as (Szepesi 2012) with attendant website <http://www.walkingpalestine.org/>

There is a very good book “Palestine & Palestinians” issued as a tour guide by the Alternative Tourism Group in Beit Sahour and available in many languages (<http://atg.ps/guidebook>). It includes also elements of nature and helped many tourists practice at least partial ecotourism. Other groups promoting tourism including ecotourism include <http://visitpalestine.ps/>. There are also individual initiatives in ecotourism such as Bawadi Desert Eco-Tourism <https://www.facebook.com/Bawadi-Desert-Eco-Tourism-Palestine--بوادي-للسياحة-البيئية-والصحراوية-فلسطين>

Additionally the EQA helped some municipalities with delineating ecotourism paths (e.g. Fig. 22).



**Fig. 22.** EQA Environmental path for Beitulla area.

The biggest project (in terms of overall funding and number of tourists participating) focused on ecotourism in Palestine is Abraham's Path “*Masar Ibrahim Al Khalil*” (Fig. 23 and 24). This path has an attractive website <http://masaribrahim.ps/en/> and describes itself as “a trail of community-based tourism which follows the footsteps of Ibrahim through the Middle East. The Abraham's Path runs from the Mediterranean olive groves of the highlands of the north to the silence of the deserts in the south, from the area west of Jenin to the area south of the Sanctuary of Abraham (known in Arabic as *Al-Haram Al-Ibrahimi*) in the city of Hebron.” The vision is “Vibrant Palestinian communities in a sustainable environment for an enticing experience of Palestine's cultural history along *Masar Ibrahim Al-Khalil*. The local partners who formed this initiative include Rozana Association, Siraj Center, PWLS, and Bethlehem University's Institute of Community Partnership and the network now has good links to government offices, local communities, and international groups.

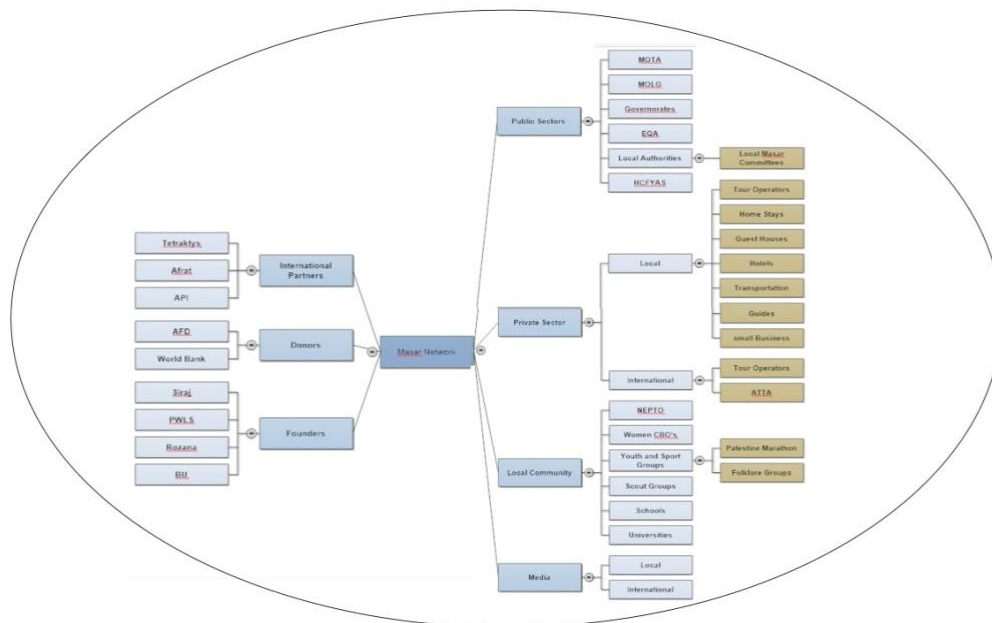


Fig. 23. Masar Ibrahim network.

**MASAR IBRAHIM AL KHALIL**  
**ABRAHAM PATH**

Walk  
a path of history.

Experience  
nature and hospitality.

**Weekend Walks - Spring 2015**

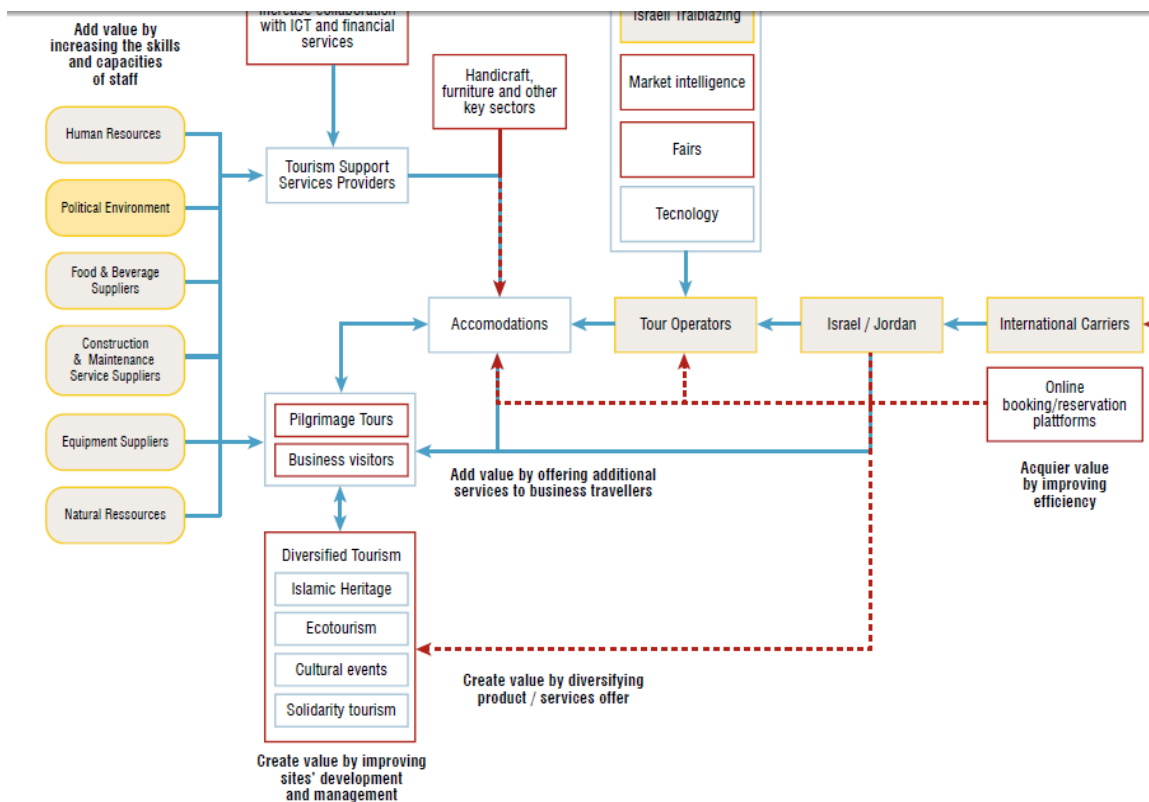
Explore  
Palestine's serene landscape, flora and fauna.

Discover  
lovely people and their warm hospitality.

Experience  
Palestinian traditional food and culture.

#	Walk	Day	Date	Km	Difficulty	Walking hours
1	Romana to Burgin	Saturday	7 Feb	17.8	Difficult	5-7
2	Burgin to Araba	Sunday	8 Feb	15.1	Moderate	3-4
3	Araba to Sanur	Saturday	14 Feb	12.1	Moderate	2-3
4	Sanur to Sebastia	Saturday	21 Feb	15.6	Difficult	4-7
5	Sebastia to Nablus	Sunday	22 Feb	10.1	Easy	2-3
6	Awarta to Duma	Saturday	28 Feb	18.6	Moderate - Difficult	5-6
7	Duma to Kafr Malek	Sunday	1 Mar	14.9	Moderate - Difficult	5
8	Aqraba to Duma, includes a cooking class	Sunday	8 Mar	10	Moderate	2-3
9	Ain Samia to Auja	Saturday	14 Mar	10.5	Difficult	4-5
10	Nebi Musa to Jericho	Saturday	21 Mar	16.8	Moderate - Difficult	5-7
11	Bike Tour in Jericho	Saturday	28 Mar	12	Moderate	4-5
12	Nebi Musa to Mar Saba	Saturday	18 Apr	19.5	Moderate - Difficult	5-8
13	Artas to Tequa	Saturday	25 Apr	8.6	Moderate	3-4
14	Tequa to Reshayda	Sunday	26 Apr	25.6	Easy - Moderate	5-8
15	Reshayda Sunset Walk, includes cultural evening	Saturday	2 May	14	Moderate - Difficult	4
16	Reshayda Sunrise Walk	Saturday	9 May	8	Moderate	2-3
17	Reshayda to Bani Naim	Saturday	16 May	18.6	Difficult	4-7
18	Bani Naim to Hebron	Sunday	17 May	7	Easy	2
19	Bani Naim, includes a cooking class	Sunday	24 May	8 - 10	Difficult	2-3

Fig. 24. Masar Ibrahim brochure.



There is an existing path in Wadi Makhroul already used for hiking (Figures 26 and 27) but it passes through private lands in many parts and is not marked and will need to be redesigned based on new criteria adopted at the ministerial level (EQA, Ministry of Tourism, Ministry of Agriculture) with help of this and other projects in the valley.



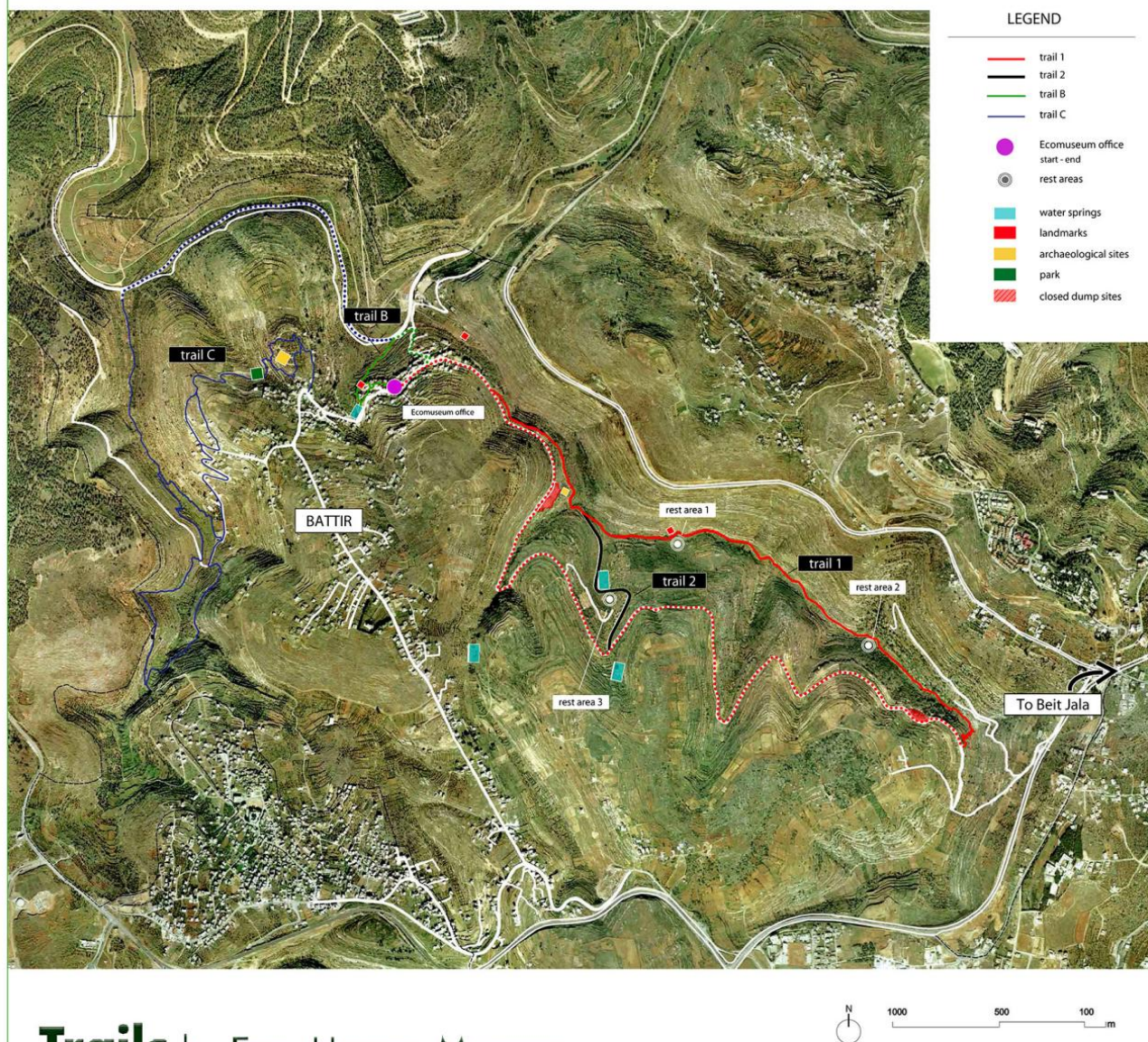


Fig. 26. Trail map of Wadi Makhroul.



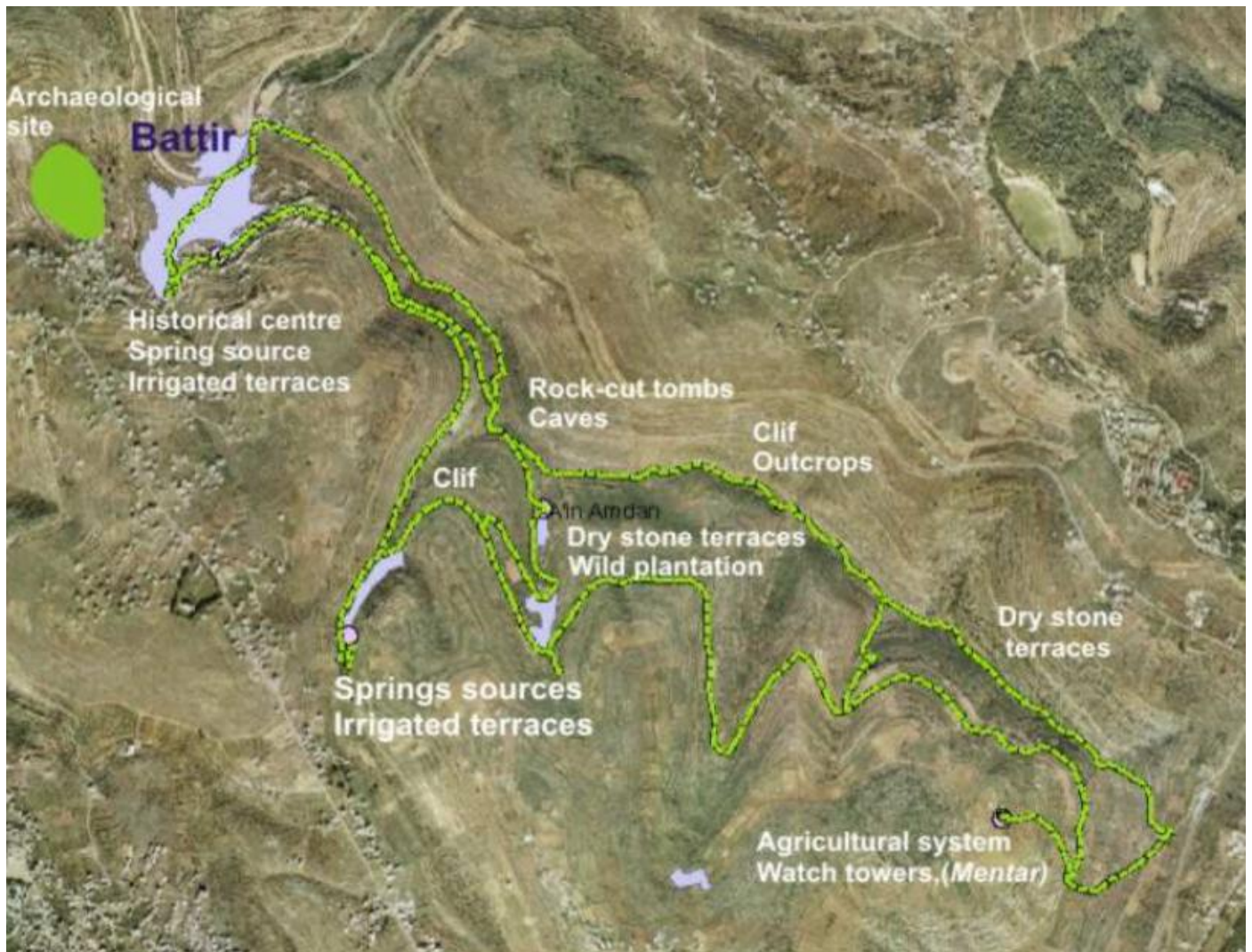


Fig. 27. Trail maps of Al-Makhrou (Gola et al. 2010).

Gola et al. (2010) explained why the case of the tourism paths in this area of Battir is critical for social and territorial development of the local people especially that all locals still connect to each other as if it is pre-1948 despite the obstacles (see Fig. 28)

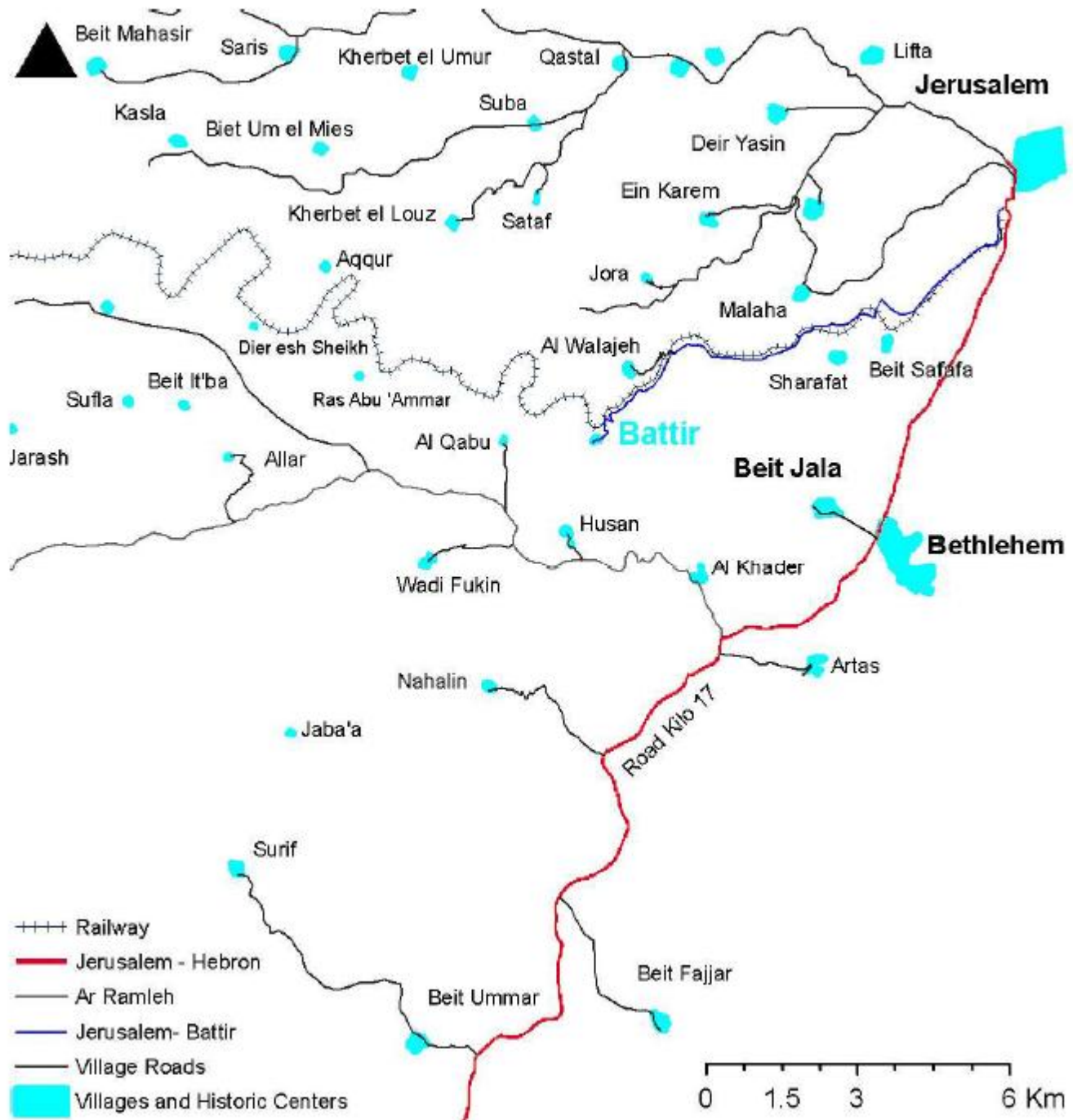


Fig. 28. Battir and surrounding villages and their connections before 1948. This conception of space around Al-Makhrouf is important to peoples' culture and history and self-identity (after Gola et al. 2010).

In our plans to develop ecotourism in the area, it is also important to take existing ruins (ancient human habitations in the valleys) into consideration (fig. 29) in addition to the other items discussed above./



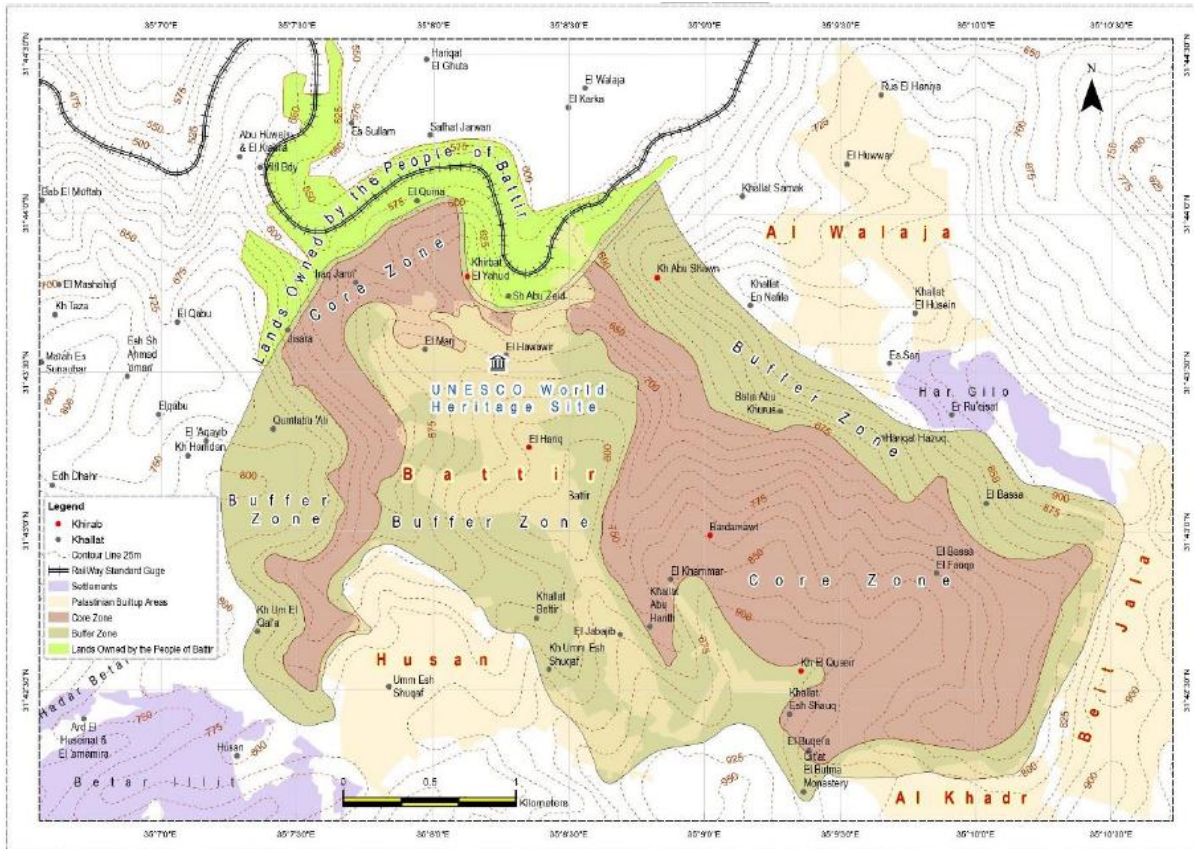


Fig. 29. Location of ancient human habitations (ruins) which could be rehabilitated and used as tourism attraction site and/or in redesigning ecotour paths (MOTA 2018).

Maqam's (holy sites associated with saints) are also found in the valley (Fig. 28).



Fig. 30. Maqam Al-Sheikh Khattab (MOTA 2018).

### 3.9 Threats and conservation issues

There are few scientific research studies published in the last 25 years on nature conservation in Palestine. However there were important larger reports that we considered that contributed to our understanding of environmental issues in the State of Palestine including biodiversity conservation (Table 4)

**Table 4.** Key documents related to this project.

Document	Source
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The EQA's fifth national report in compliance with CBD	EQA, 2015
United Nations Environment Program's Desk Study on the Environment in the Occupied Palestinian Territories	UNEP, 2003
ARIJ's Status of the Palestinian Environment	ARIJ, 2015

#### Biodiversity

conservation and protected areas in particular are covered by the National Biodiversity Strategy and Action Plan (NBSAP, 1999). Objectives related to the protection of biodiversity and protected areas can be summarized as follows:

- Conservation of the Palestinian biodiversity, and the development and establishment of a representative protected areas system is listed as an immediate priority action. The Plan also includes project concepts on the "Development and management of a Palestinian protected areas system", and the "Development of management plans/ structures in designated protected areas based on biodiversity surveys and inventories".
- Ensure involvement in management of local communities in the establishment of protected areas.
- Assessment of capacity building needs and Palestinian priorities in biodiversity.

The plan also addressed gaps that are very essential to develop concepts in biodiversity and protected areas conservation. These gaps include: lack of primary scientific data, information and documentation on biodiversity in Palestine, lack and/or limited human resources. There are very few (biologists especially marine and wildlife biologists and taxonomists, oceanographers, conservation managers, etc., an adequate legal frameworks and environmental policy and legal framework on which to base all activities for the conservation and sustainable use of biodiversity in Palestine, lack of coordination among national and local stakeholder agencies in biodiversity and Inadequate awareness and commitment to biodiversity. The objectives of the NBSAP for Palestine (1999) are as follows:

- The conservation of Palestine's biodiversity.
- The sustainable use of Palestine's biodiversity.
- The enhancement of local knowledge and skills and the improvement of people's attitudes for the conservation of biodiversity and the sustainable use of biodiversity.
- The equitable sharing of biodiversity benefits within Palestine.
- The development of Palestinian institutional and human resource capacity in the field of biodiversity.

The plan was addressed in the Palestinian Fifth National Report for CBD which is discussed in the next subsection.

There has to be benefit sharing from conservation and biodiversity (Schroeder and Lucas, 2014). Görlach *et al.* (2011) summarized potential economic benefits from environmental conservation efforts (if successful) in the State of Palestine. Though this benefit assessment was mostly based on little data collected on the ground, it does highlight the significant potential impact of saving our environment financially. Here are examples:

- Air: If air pollution is cut by 50% modeling suggests premature mortality could decline by 220 and morbidity by 440 per year. Monetary benefit could be of 68 million euros per year.
- Water: Improved access to water services could significantly improve the quality of life for 1.2 million Palestinians. Improved wastewater treatment (perhaps concomitant with reduction of waste water in general) could have significant impacts on biodiversity, groundwater quality, and human health.
- Waste: Reducing solid waste would have significant impact on air quality, on environmental health, on human economy, and on biodiversity.

The use of plants and animals for humans is a field that needs much examination as it related to environmental conservation directly especially in terms of sustainable use of resources. In Palestine as

elsewhere, there is an interest in ethnobotany and ethnozoology (Ali-Shtayeh and Jamous, 2006; Ali-Shtayeh *et al.*, 2014; Palevits and Yaniv, 2000; Said *et al.*, 2002).

Poverty reduction and environmental conservation are directly linked and we are not able to do proper conservation without tackling poverty in developing countries (Adams *et al.*, 2004). Further it is possible to use socioeconomic incentives at periphery of protected areas or even allow managed use of natural resources as a form of poverty reduction which also incentivizes the local people to protect their environment (Sunderlin *et al.*, 2005).

Modern conservation philosophy argues that the local buy-in is critical for success of conservation efforts. We in Palestine certainly need to think strategically about how people around protected areas are to benefit from protection. There are models in nearby areas for example the way the Royal Society for Conservation of Nature (RSCN) in Jordan worked with local communities to ensure active buy-in via direct benefit from things like ecotourism and environmentally sensitive agriculture.

Religious attitudes can be of potential use to promote environmental awareness and conservation. Religious clerks (Moslem and Christian) can introduce many concepts of conservation and environmental practices in the Friday and Sunday sermons. Several authors dealt with the ethical and divine relation of Islam to environment conservation (Amr & Quatrameez, 2002). Islamic teachings are full of orders and events that encourage conservation as the concept of “*Al Himma*”, to save water, clean environment and many others. Similarly in Christianity, basic teachings include many environmentally friendly practices. In Palestine, The Holy Land, with so many religious connections and about a million devout pilgrims per year, it is incumbent upon policy makers and stakeholders to research ways to reach out to those who are religious with the message of environmental conservation.

Though the dangers facing the Palestinian environment were articulated nearly seven decades ago (Ives 1950), are few studies of threats effecting the biodiversity in the West Bank (e.g. Abdallah & Swaileh 2011; Hosh *et al.* 1992; Obeidi 2001; Weizman 2012; Qumsiyeh 2013; Qumsiyeh & Amr 2017). Solid waste issues (Abu Thaher, 2005; Al-Khatib *et al.* 2007; Dudeen 2012). It is difficult to manage our nature reserves when most of them are under direct Israeli rule (ARIJ 2005; Garstecki *et al.* 2010). The biggest threat to human and biodiversity (fauna and flora) sustainability in Palestine is the issue of water (Tamimi 1996; Daibes & Daibes-Murad 2003; Gasteyer *et al.*, 2012). There are many other threats including hunting (Helal & Khalilieh 2005; Yom-Tov 2003), climate change (Lautze and Kirshen 2009; Verner 2012), excessive use of pesticides (Sa’ed *et al.* 2010), colonial activities (Amr *et al.* 2016; Qumsiyeh *et al.* 2014, 2017), and pollution (Tal 2002).

Wadi Al-Makhroun area under study here faces many threats. In its management plan of this world heritage site, MOTA (2018) stated some of these and suggested that there are certain **Corrective Measures** that can/should be adopted:

- *Agreement to dismiss plans to build a “Wall” along the property, or within its surroundings,*
- *Implementation of projects to restore an appropriate state of conservation for the agricultural terraces and their components, including the watchtowers and dry stone walls throughout the property,*
- *Implementation of a project to restore traditional irrigation systems,*
- *Implementation of a project to put in place an adequate sewage system to protect water quality on the property,*
- *Preparation, approval, and implementation of a Conservation and a Management Plan for the property,*
- *Development and implementation of an active system of management that involves local communities and stakeholders,*
- *Preparation of a set of indicators for monitoring the property and implementation of a monitoring system,*
- *Development of protection methods for the property and its buffer zone.*



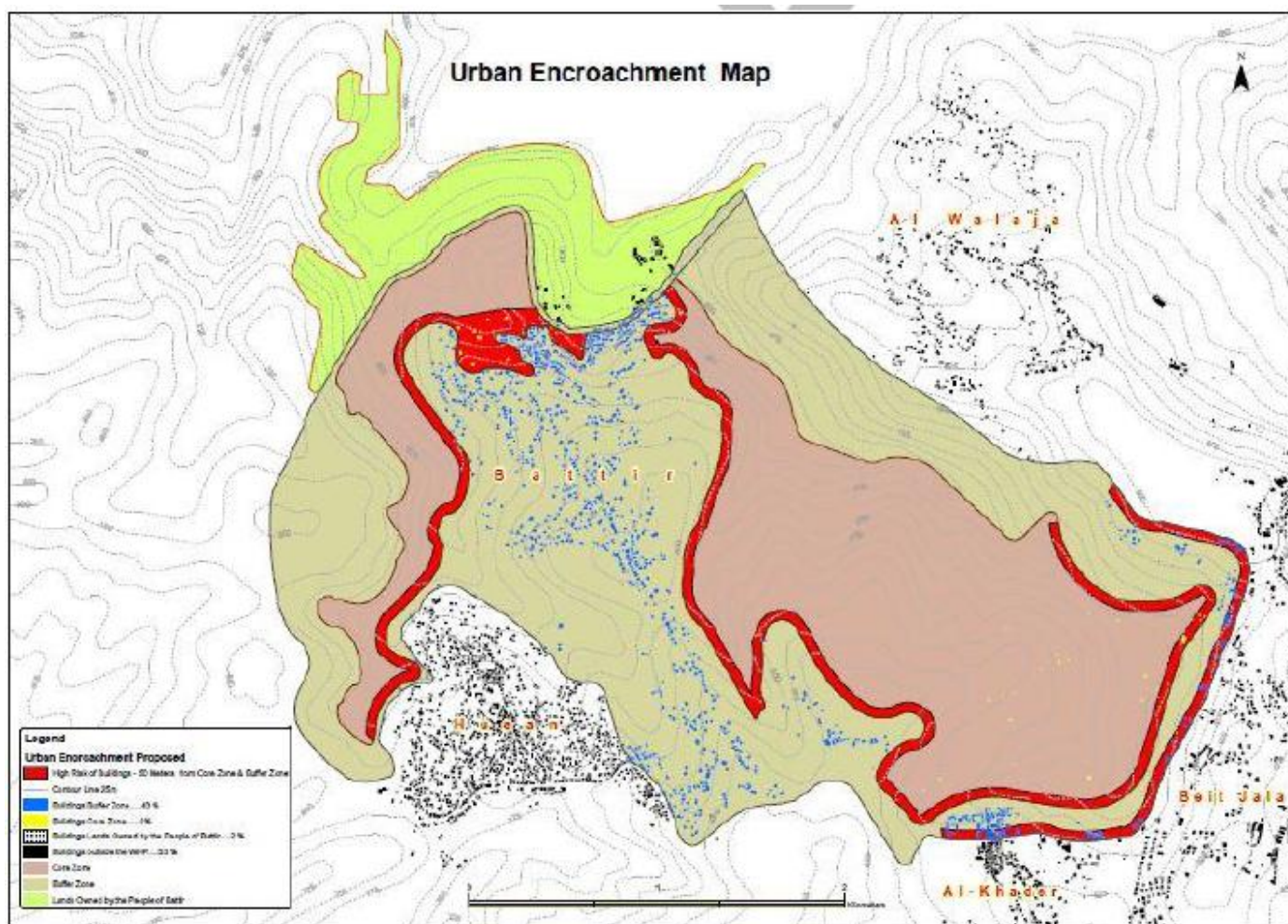


Fig. 31. Urban encroachment on the World Heritage site area including Al-Makhrou (MOTA 208).

Biodiversity as a concept in biology evolved in the 20<sup>th</sup> century as we started to understand the threats faced by ecosystems (Wilson & Peter 1988). International treaties after WWII started to address the needs for ecosystem maintenance / biodiversity conservation. We in Palestine as a nascent state need to ensure not only that we have signed all the relevant treaties but that we actually implement them. An excellent review entitled “*Legal implications of accession of the State of Palestine to international conventions on resources and protection of natural resources*” was published (Jaradat and Awad Allah, 2015). Joining international agreements consolidates the legal, political and international personality of the newly formed Palestinian State. In addition, it promotes momentum of the international solidarity, the sovereignty of the Palestinian State over its natural resources and geographical boundaries. These conventions and treaties are excellent podiums to address the world the Israeli occupation violations on all aspects of Palestinian people rights. Here are some relevant agreements either signed or that Palestine tries to relate to on issues of the environment.

**Convention on Biological Diversity (CBD):** This is an international legal instrument for the conservation and sustainable use of biological diversity that came into effect in December 1993. It has been an important instrument to set goals and priorities to preserve biodiversity. The State of Palestine signed the agreement 2 April 2015. However, the agreement is not ratified yet and still in the stage of accession. To comply with the convention, EQA is looking to update the national biodiversity strategy and action plan. This includes preparing lists of endangered species and to build its capacities and the national stakeholders capacities in the field of biodiversity. The Palestinian Authority submitted its fifth report in 2015 (EQA, 2015a). In 2012, the EQA published the report “*The National Strategy, Action Programme and Integrated Financial Strategy to Combat Desertification in the Occupied Palestinian Territories*”. It laid out plans and sought funding for many projects to educate about and combat desertification. However, lack of funding and other challenges impede compliance and implementation.

### **Basel Convention Controlling Trans-boundary Movement of Hazardous Wastes and their Disposal:**

The convention was adopted on 22 March 1989 by the Conference of Plenipotentiaries in Basel, Switzerland, in response to a public outcry following the discovery, in the 1980s, in Africa and other parts of the developing world of deposits of toxic wastes imported from abroad. The State of Palestine accessed this agreement in 2.1.2015 and entered in force in 2.4.2015. In the past, it participated in meetings of the Arab States related to the Convention. Articles 12-13 of the Palestinian Environment Law are the legislative basis to prevent the entry of waste and hazardous substances to the Palestinian Territories. The EQA has also prepared a master plan for the management of hazardous materials and wastes and prepared as well a draft list of hazardous substances and wastes. Accession to this Agreement constitutes a fulcrum for Palestine to prevent waste and hazardous materials smuggled from Israel to Palestine. But waste continues to flow into the Palestinian areas from Israel (e.g. electronic waste from Israel recycled in Idhna near Hebron causes genotoxic damage (Khlaif and Qumsiyeh, 2016).

**Cartagena Protocol:** The Cartagena Protocol is an international treaty governing the movements of living modified organisms (LMOs) resulting from modern biotechnology from one country to another. It was adopted on 29 January 2000 as a supplementary agreement to the Convention on Biological Diversity and entered into force on 11 September 2003. Palestine is listed on Accession in Cartagena protocol, and was entered into force on April 2, 2015. This could be beneficial to Palestine though as of now no studies exist on LMOs coming into the Palestinian territories (data needed).

**United Nations Framework Convention on Climate Change (UNFCC):** This treaty was negotiated at the earth summit in Rio de Janeiro in 1992 and aims to address the threat to human life and life on earth caused by climate change. Palestine accessed the UNFCC in 18.12.2015. The EQA prepared the national strategy to adapt to climate change and the formation of a national committee on Climate Change and the establishment of a unit for climate change within EQA. There are no direct materials in Environmental Law addressing the issue of climate change. And little is being done for example to curb amount of hydrocarbon energy use in the OPTs. It is essential to deal with this issue.

**United Nations Convention to Combat Desertification:** This legally binding international agreement links environment and development to sustainable land management in order to combat desertification. The State of Palestine is not a member of this agreement. The EQA was the national focal point, and then transferred to Ministry of Agriculture. Efforts were made to prepare a national strategy to combat desertification and its action plan. Besides, EQA initiated the formation of a National Committee to Combat Desertification and in the process to host international experts to assist Palestine scientist in this sector, and to draft project proposals in sustainable management of arid land. It is worth mentioning that the articles 16-18 of the Environment Act form the basis of legislation.

**Unsigned Agreements but have Active Role:** Palestine accession to the above and other conventions is listed here <http://www.birdlife.org/datazone/country/palestinian-authority-territories/policy>. The State of Palestine, even not a signatory, is active in a number of other international treaties that are not directly concerned with conservation and biodiversity, but related to other environmental issue.

**The Barcelona Convention for the Protection of the Mediterranean Sea Against Pollution** adopted in 1976 includes legal protocols on Dumping Protocol (from ships and aircraft), Prevention and Emergency Protocol (pollution from ships and emergency situations), Land-based Sources and Activities Protocol, Specially Protected Areas and Biological Diversity Protocol, Offshore Protocol (pollution from exploration and exploitation), Hazardous Wastes Protocol, and Protocol on Integrated Coastal Zone Management (ICZM). Even though Palestine is not a member of this agreement, the EQA is involved in some of the meetings and programs related to this Agreement, such a plan and program of the Mediterranean Action (MAP) and ICZM. The EQA have prepared a national plan for the protection of the marine environment and coastal areas. Some articles in the Environmental Law related to the marine environment constitute a national legislative basis for this agreement.

Two other important international treaties are the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Convention on Migratory Species (CMS). CITES would be highly beneficial in curbing trade in endangered species even though now Palestine has no control of its ports of entry (still done by Israel). The potentiality of independence would make it more urgent to do this and prepare to implement our national strategy relating to the environment (EQA 2010). CMS should likewise be joined because 500 million birds migrate through Palestine (on annual migrations between Eurasia and Africa). This would ensure protection of this important migratory site.

We can do some things to conserve nature in Palestine despite these persistent threats discussed above and thus also begin to comply with International treaties signed like those listed above (Qumsiyeh et al. 2017). For example ethnical consumption can be encouraged (Dajani and Isma'il 2014). Another area of significant work already done in other parts of Palestine (not Al-Makhroul) is to use systems of enhancing socio-economic value for local people from conservation (see Slocombe 1993; Görlach et al. 2011). The current project will address this need in Al-Makhroul Valley. We also have some partners like the UNEP which already funded many conservation projects under its small grants program of the Global Environment Facility (GEF 2012, 2013). For example they funded one of our (PMNH/PIBS-BU) projects that dealt with a buffer Zone for the Wadi Qana protected area. Similar study is envisioned for the buffer zones of Wadi Al-Makhroul which is of significant ecological value (EQA 2017)

Palestinian national legislation is also needed to protect the traditional resource knowledge rights of local villagers and farmers as well as the rights of sovereignty over their cultural and genetic property. Thus, PGRs' collectors, cultivators and protectors, who work in this sector after their fathers and grand- fathers and are going to teach their skills to their children (especially those living under poverty line, without employment), and utilize the wild PGRs from generation to generation should have the priority to be protected and their knowledge since they are the closet to nature. The indigenous knowledge forms the main reference on which Palestinians mainly rural communities rely while implementing conservation and production activities (ARIJ 2011). There has been little in depth participatory research into plant and animal indigenous knowledge in the West Bank and Gaza strip; for instance those of the Palestinian Bedouins.

It is also necessary to strengthen taxonomic and systematic research, ecology, habitats and wildlife population studies, indigenous genetic resources, GIS and remote sensing, and popular knowledge assessments. Implementing field measurement and assessment surveys to get a grip on existing biodiversity and the identification of those under threat or are presumed lost or extinct is a first step that should be taken. The results of the Palestinian research should also be used as an incentive to aware the public towards the secure measures while utilizing PGRs and emphasizing the importance of such resources and their methods of conservation. In addition, the Palestinian species lists and research findings should be documented and interlinked to the international databases, reports and/ or lists. There is a necessity to enhance the level of cooperation and coordination among academic and research institutions whether they are governmental or non-governmental organizations that work in the field of biodiversity and to set out participatory investment in relevant projects, plans, and actions at international and national levels to raise quality of Palestinian biological resources at its different components.

We share the vision of MOTA (2018) that includes a “well-managed, conserved and protected property [] it's Outstanding Universal Value and the conditions of authenticity and integrity of supporting attributes, socioeconomic status of the local community, presentation and interpretation are sustainably conserved, improved and enhanced enabling present and future generations to enjoy and appreciate it.”

### **3.10 Exploratory trips to the valley and map re-focus**

We carried three exploratory trips to valley to plan our future work and visit the key sites and select sites for study. The dates were, , and. The first trip focused on Al-Makhroul valley itself lus Cremisan Valley (done on 5.9.2018). The second n the villages of Battir and Al-Walaja (19.9.2018), and the third on Husan Village



(24.9.2018). The three trips considered ideas of adding three areas to our study (see Fig. 32, highlighted in yellow).

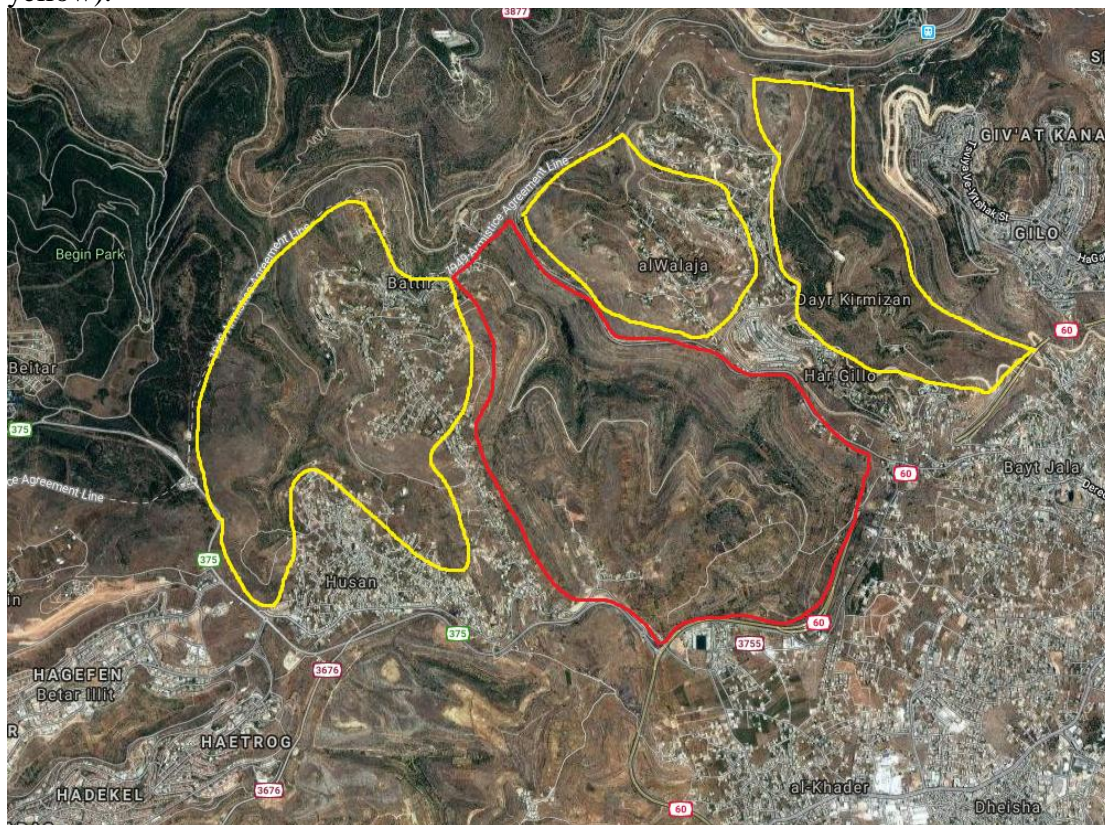


Fig. 32. Three areas considered around Al-Makhrour valley for further study highlighted in yellow. From left to right: area 1 is between Husan and Battir, area 2 is downhill from Al-Walaja and area 3 is the Cremisan valley.

The evaluation also considered the matching with the UNESCO world heritage map (Fig. 33).

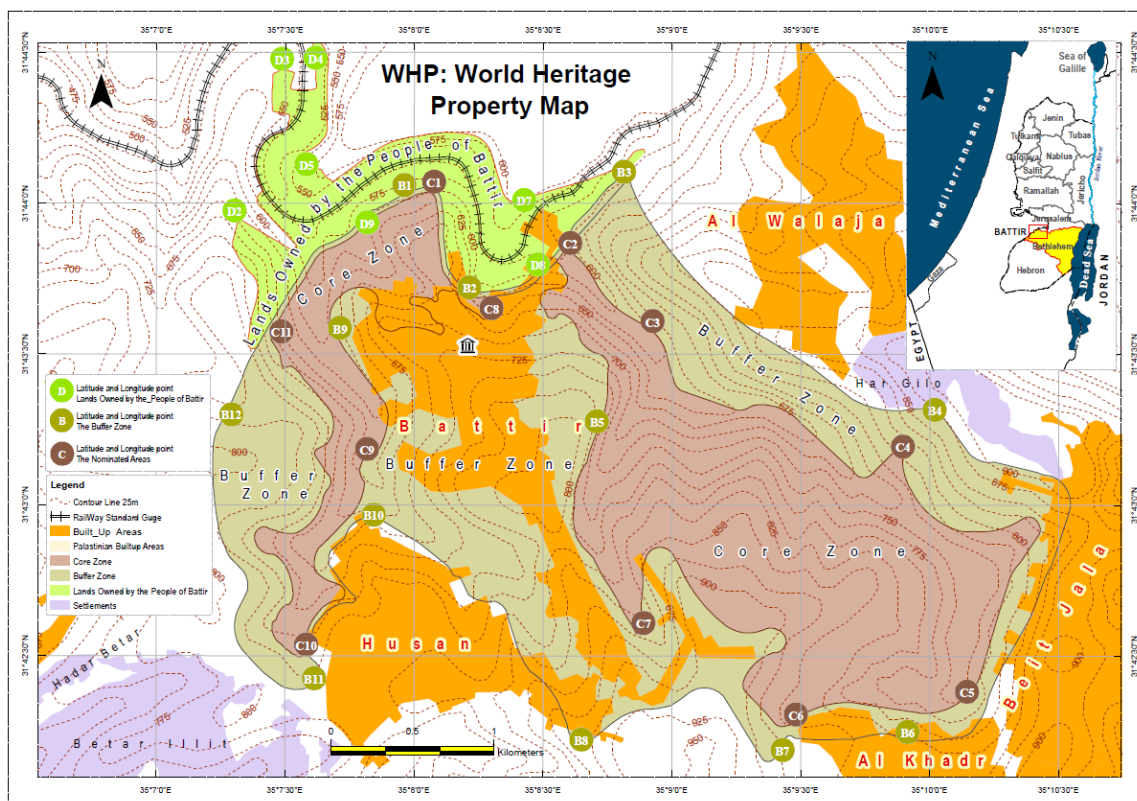


Figure 33. Map of core and buffer zones as accepted by UNESCO for a World Heritage site.

Based on these maps and that initial exploratory field work, we decided to focus our work for the biodiversity inventory on the UNESCO map. This also meant that for our work with villages we needed to replace the village of Al-Khader (now isolated behind the wall from Al-Makhrou valley and has similar characteristics to the parts of Beit Jala still covered in our work) with the village of Husan whose lands seem rich and are included in the World Heritage site. Thus, the four towns/villages we focus on are now Battir, Al-Walaja, Beit Jala, and Husan and the two valleys as indicated in Fig. 29.

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## 5. Preliminary list of Relevant Websites (under development)

<http://visitpalestine.ps/wadi-makhrour-just-sunset/>  
<http://datazone.birdlife.org/country/palestinian-authority-territories> and <http://datazone.birdlife.org/site/results?cty=240&fam=0&gen=0>  
<http://whc.unesco.org/en/list/1492>  
<https://gc21.giz.de/ibt/var/app/wp342P/1844/index.php/al-makhrour-valley-the-house-of-birds-and-apricot-in-palestine/>  
<http://www.travelpalestine.ps/en/article/41/Battir>  
<http://thisweekinpalestine.com/wp-content/uploads/2015/05/MUSEUM-REVIEW.pdf>  
[http://www.environment.pna.ps/ar/files/Third\\_national\\_Report\\_On\\_Biodiversity.pdf](http://www.environment.pna.ps/ar/files/Third_national_Report_On_Biodiversity.pdf) (page 57)  
<https://www.unrwa.org/userfiles/2011081763638.pdf> (more about the political situation of Al Walaja but also good one)  
<http://www.bic.com.ps/bcc/images/BaNF%20Final.pdf>

### Stop: Below are items that will go in Final report

<https://defra.bravosolution.co.uk/esop/guest/go/public/opportunity/current>

-Hani Abu Dayyeh [hani@netours.com](mailto:hani@netours.com)

-Please see this article and share it with Roubina

<http://www.maannnews.net/Content.aspx?id=962713>

-Jasmine SALACHAS <[jasmine.d.salachas@orange.fr](mailto:jasmine.d.salachas@orange.fr)>

Hima Model of Assad Serhal the Director General of SPNL (Birdlife Lebanon) <http://www.spnl.org>

Natural Trees on farms Bit.ly/treesonfarms

<http://www.worldagroforestry.org/search/node/trees%20on%20farms>

John Woollard <[john.woollard@concordia.ab.ca](mailto:john.woollard@concordia.ab.ca)> has photos from wadi makhrour of plants (I have also others on my computer)

Effective landscape approaches – see Satoyama Initiative and also these very good papers

<https://onlinelibrary.wiley.com/doi/epdf/10.1111/rec.12475>

<https://onlinelibrary.wiley.com/doi/epdf/10.1111/rec.12560>

**Kristin Sunde** <[kristinksunde@gmail.com](mailto:kristinksunde@gmail.com)>

Dondina, O., Saura, S., Bani, L. and Mateo-Sánchez, M.C., 2018. Enhancing connectivity in agroecosystems: focus on the best existing corridors or on new pathways?. *Landscape Ecology*, 33(10), pp.1741-1756.

### Indicator development

We took time to develop indicators for M&E activities using standard international guidelines (e.g. Biodiversity Indicator Development Framework, 2011 Biodiversity Indicators Partnership, found at <https://www.bipindicators.net/national-indicator-development/bidf>

# Research Wadi Al-Makhrou

## Biodiversity Inventory

- Plant survey/inventory and looking for key habitats (Roubina)
- Mammal survey/inventory (Mazin & M. Abusarhan)- we already have significant data using camera traps for large mammals, small traps for rodents and shrews, and echolocation data showing 10 species of bats
- Bird survey/inventory (Anton)
- Reptiles/Amphibians survey/inventory (Elias)
- Snails- Very interesting data on snail biodiversity being collected from different parts of the valley, different sides of hills showing microhabitat variation
- Tenebrionidae & other beetles (Aysha)
- Leaf Litter & Soil micro fauna- again interesting data on material underneath different trees like oak and carob etc (M. Abusarhan)
- Mushrooms (Max & Alea)
- Spiders
- Dragonflies & Mantids (Elias & Shadi)
- Coccinellidae (M. Najajreh)
- *Endemic species*

## Species Diversity – in microhabitats not depending on human activities

- Elevation
- Sides of the valley (Sun and shadow site – control for other variables like human habitation!)
- Species richness (Simpson's index)
- *Species richness among Palestine, elevating from Dead sea (lowest Point) to Hebron Hills (highest)*

## Threats/Human effects

- Variable of closeness to human habitation
- Wall effect/settlements
- Climate change (Decline in Vertebrates in Bethlehem region, maybe look for owl pellets)
- Pollution
- Environmental concern vs wealth
- Think of complexities & uncertainties

## Other

- Invasive Fauna: *Acrdithores*, Starling, *Rattus norvegicus* & *R. rattus* etc
- Invasive Flora:
- *Status of Beekeeping*
- Connectivity of habitats around olive groves via wild corridors (Ahmed Al-Omary)

## Materials and Methods

Wadi Al Makhrou is a large valley with varied in vegetation habitat, and geological sites that could potential for studying the area. To understand what kind of variation and habitat we have, first we need to go in a field survey trip in Al Makhrou area to have a basic idea on what kind of habitat and area we are facing. Second to pick ten preliminary site and study them intensively to find out what biodiversity we have to use the proper methods.

### 4.1 Fauna

Fauna methods varied for each group of animals (Vertebrate and Invertebrate), so in this case we will describe the most important kind of methods that we will use in our study to cover as much as we can of the variation in fauna specially the invertebrate groups.

Vertebrates (Birds, mammals, reptiles and amphibians).

### Methodology for Mammals:

Signs of mammals are looked for during day and night walks. This included things like footprints, feces, burrows, other potential hideouts (caves and crevices), other remains (like quills for porcupines) etc. Just before sunset (at this time around 7-8 PM), Sherman traps are set for small mammals and mist-nets were set for bats. Traps are collected before sunrise (at this time of year about 5-5:30 AM) and then a subsequent area sweep was done for morning animals. We will leave bait for large carnivores (sardines and raw meat but observed no activity around these except in one case by a feral dog). Bats are observed by looking for roosting sites and by echolocation calls registered between sunset/dusk and midnight. 'For bats roosting in caves, daytime collecting was undertaken by exploring caves by flashlight and specimens were collected by hand'(M. Qumsiyeh, Sami, & Musa, 1998). We use a simple recorder that allows frequency detection. However, by using a simple tape recorder, we can also study spacing of clicks for hunting echolocation signals. 'In this expanded study we will organize a more sophisticated recorder that can be left for hours'. (M. B. Qumsiyeh, 1996)'The arrangement and order of genera and species' (M. B. Qumsiyeh, 1997)

#### **Methodology for Reptiles:**

Both during night walks and day walks, reptiles are observed and photographed. Any signs of reptiles were also observed (such as tracks on soft surfaces or eggs in crevices or under logs). Non-poisonous reptiles were simply captured by chasing or surrounding them and then by hand. Poisonous snakes are handled with a snake stick.

#### **Methodology for Amphibians:**

Frogs are best observed at night via flash light and are captured by hand. We can also identify tadpoles directly taken from the water (scooping or small net).

#### **Methodology for Mollusca:**

Snails are simply picked up where they occur (usually under rocks, in crevices, around trees or shrubs).

#### **Methodology for Scorpions:**

Scorpions are collected via turning rocks and other objects they use to hide under during daytime or at night-time (usually 10 PM to midnight) by sweeping the area using a UV light.

#### **Methodology for other invertebrates:**

Butterflies and some other flying insects are captured with a butterfly net. For moth, a fluorescent light is used at night in some locations and with a white cloth under it. This attracts moths which then can be picked up into containers directly or transferred to containers via aspirator. Other arthropods are simply picked up. 'We will also include previous field observations during field trips conducted in different parts of Palestine during the last several years'. (Katbeh-Bader, Amr, & Isma'el, 2003)

Invertebrates (Insects, arachnids, Mollusca, arthropoda).

For invertebrate collection many different methods are exist, for flying insects always butterfly net use (see figure XX), for collecting order coleopteran and other bugs pitfall trap and cloth to collect insects from trees used (Figure XXX, XXX, XXXX). Other methods used like using light trap at night to collect moths and insects males from different orders.





Figure XX. Butterfly net.



Figure XXX. cloth to collect insects from trees.



Figure XXX. Aspirator.



Figure XXX. Berlese funnel



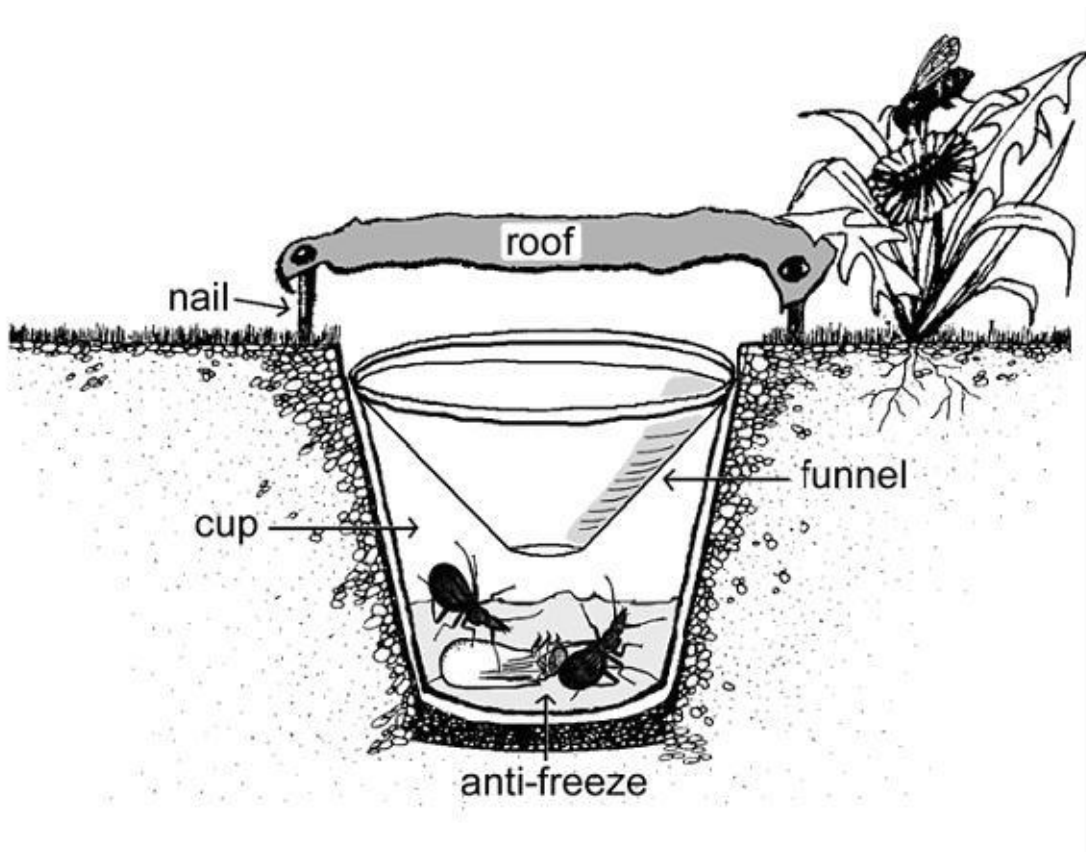


Figure XX. Pitfall trap.



Figure XX. Pitfall traps with barriers to collect more insects.



### 4.3 Ethnology

Wadi Al-Makhrou is an old location the Palestinian villages use it as a path to connect between villages usually Battir and Bethlehem. This area contains a lot of old houses with more than 100 years old use by the owner of the land to sleep in it when they are working.

### RESULTS

Graves ????



Cremisan monastery (fig xx) history xxxxxxxxxxxxxxxxx

Observations of PMNH team increased the reptiles number of species to ten with recording (*Ptyodactylus guttatus*, *Stellagama stellio*, *Phoenicolacerta laevis*, *Ablepharus kitaibelii*, *Chalcides ocellatus*, *Hemorrhois nummifer* and *Daboia palestinae*). Amr *et al.*, (2016) reported the remains of the *Stellagama stellio* in the diet of an eagle owl found in AL Makhrou (see Figure XX).

While ecotourism remains a relatively emerging concept in Palestine (Isaac 2010a, b; 2016), as well as in the Middle East, it has a strong potential for expansion. The site being studied through this project has even higher potential for the fact that ecotourism is already taking place there. Al Makhrou Valley path, which lasts for around 3 hours, is considered one of the most visited paths in Bethlehem as well as in Palestine. It has become a major destination for hiking for both locals and internationals as well. Part of the valley is now recognized as a World Heritage Site by the UNESCO. The path, that starts from Beit Jala and ends in Battir, gives people the chance to admire their rich local fauna and flora.

Modern conservation philosophy argues that the local buy-in is critical for success of conservation efforts. We in Palestine certainly need to think strategically about how people around protected areas are to benefit from protection. There are models in nearby areas for example the way the Royal Society for Conservation of Nature worked with local communities to ensure active buy-in via direct benefit from things like ecotourism and environmentally sensitive agriculture.

Earlier we discussed governmental, non-governmental and educational groups promoting ecotourism in Palestine with the aim of sustainable development in conjunction with nature conservation (sections 3, 4, and 5 respectively). We noted many NGO's claiming doing ecotourism and indeed many have helped with taking groups in ecotour trips or in hiking and other paths (for details see section 4). Yet, much of this is uncoordinated and uncharted. Most paths are not marked and most areas little researched not only in terms of what actually exists worth seeing but also in terms of potentiality and capacity for ecotourism (without having the tourists actually damaging what is here worth seeing). For example after a few "ecotours" to Wadi Al-Qelt, more and more Palestinians started going there for picnicking and enjoying nature. In the process much damage was done and trash is accumulating.

However, for good or bad and without good data, Palestinians have already started doing ecotourism. The concept of ecotourism in Palestine is still relatively new. Nevertheless, as a destination, Palestine does have much to offer besides in many religious and historical shrines and attractions and there is a significant interest to go beyond pilgrimage to alternative tourism (Isaac, 2010b; Isaac *et al.*, 2006). Palestine generally has unique and promising rich landscape and wildlife habitats and ecosystems which are very important for the ecotourism potential. There are several examples of nascent projects in ecotourism. Nativity Trail, which is offered by ATG among other programs, is a 160 km journey throughout West Bank for 11 days (<http://atg.ps/>). EEC also has four pathways (masarat) in Bethlehem (Battir and Mar Saba) and Jericho (Wadi Al Qelt and Al Auja).

What can Palestine offer besides historical and religious sites, great food, and culture? Since the Nakba of 1948, most people who came to Palestine as tourists came for religious tourism, cultural tourism, and occasionally political tourism. But most of world including Palestine is still "wilderness". Thus ecotourism is another kind of "alternative" tourism that has grown significantly around the world in the past few decades to appreciate our "untamed" nature. This was tied to the growth of the environmental movement especially since the realization of destruction of habitats caused by humans (and of human induced climate change). Ecotourism should help the environment by also helping people near key areas value and benefit from these rich areas. We learn to respect nature and the environment. Ecotourism is now a catch word used by many around the world.

We in Palestine are very familiar with terms like nuzha and shat'ha which refer to going out to enjoy nature hikes. The older generations tell us of times when agriculture coexisted with the natural environment creating a tapestry of sustainability. Palestine is located between Europe, Asia and Africa with an area of 27000 km<sup>2</sup> in the western part of the Fertile Crescent where humans first developed agriculture. The unique geography and geology gave Palestine more biological diversity than some countries ten times its size. The diverse habitats cover five ecozones: the central highlands, the semi-coastal region, the eastern slope, the Jordan valley and the coastal region. Palestine also spans four biogeographical regions (Mediterranean,



Irano-Turanian, Saharo-Arabia and Sudanese). Climate is moderate with mild winters and warm dry summers in most areas but this is also variable within rather short distances. Snowy Mount Hermon is barely a 100 miles away from the semi-tropical climate in the Jordan valley. The landscape is spectacular from lofty mountains in the Galilee and the central highlands to the lowest point on earth in the Dead Sea region at 400 meter under the sea level. Rainfall is between 1000 mm in the highest mountains to less than 50 mm in arid regions. Temperatures also vary from freezing to over 35 C in summer months in the Wadi Araba areas.

The Mediterranean Zone flora has characteristic trees like oaks and pistacia. The plant cover decreases proportionally as we head south and east into Irano-Turanian then Saharo-Arabian flora with pockets of Ethiopian-Sudanese flora. This creates diverse habitats for animals which include over 500 species of birds, over 100 mammals, over 100 reptiles and thousands of species of invertebrates.

In the past few decades and with movements growing to attract visitors that could help the local economy (devastated by colonialism), several initiatives were launched to bring alternative tourists to Palestine. Ecotourism seemed a logical choice considering the beauty of the landscape and the rich fauna and flora. Thus paths were structured that sometimes mixed local cultural tourism with ecotourism (e.g. Masar Ibrahim, see <https://masaribrahim.ps> ). This is a new phenomenon but with some significant successes. Now is the time to grow such paths and people are asking about the best method to do this in a way that produces maximum benefit to people and the environment (causing no damage). Paths must be structured based on scientific principles to be respectful of the ecosystems (including nature and people) they hope to serve. We at Bethlehem University's Palestine Institute for biodiversity and Sustainability are devoting significant resources and expertise to address these issues. Let us take two examples with a great potential for ecotourism as case studies:

**Case Study 1:** In Bethlehem district there is a spectacular valley called Al-Makhrou, the name referring to the water seepage over ancient limestone rocks. Al-Makhrou is located in the northwest of the city Bethlehem with its World Heritage Site of the Church of Nativity. Its Mediterranean habitats are the last natural pristine areas in the increasingly urbanized Bethlehem district. Surrounding the valley are the ancient communities of Beit Jalla, Husan, Al-Walaja, Al-Khader, and Battir. The latter village (including parts of Al-Makhrou valley) are also on UNESCO's list of World Heritage Sites. But the valley is also threatened by expanding Israeli colonies like Gilo, Har Gilo and the Gush Etzion settlement complex. We started to investigate this valley carefully nearly three years ago and we now have three projects related to this area. They aim to map the biodiversity in the area and generate a management plan that protects, values, and promote the humans, animals, and plants of the valley. This is not an easy task. Our team is supported though by our partners like the National Geographic society and British scientific colleagues who will help us not only do a great scientific study but also work with local farmers and schools to ensure the valley's cultural and natural heritage is valued and protected.

Al Makhrou become a place for tourists (international and local) to travel from Beit Jalla near Deir Kremezan to Battir and vice versa after declare Battier as a Heritage site, which increase groups of people who start to walk in the valley.

In figure XX, it is shows a prepared trails for tourists to walk in, and there are two trails (in red and red line intermittent) to cross Al Makhrou valley and in the black line shows a path connect between both major trails.