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**Agriculture connected to ecosystems and sustainability:  
A Palestine World Heritage Site as a case study**

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### **Abstract**

Food security is a broad subject but many of its branches revert back to connectivity of land and people. Israel like any colonial power created conditions and programs that separate native people from their land while creating new economic structures that benefit the colonizers to create a new foreign society on that same land. This paper uses the example of a world heritage site (Battir and surrounding communities in South Jerusalem) to argue that agricultural resistance and food security can be done even under difficult circumstances by leveraging three areas: permaculture, biodiversity conservation and cultural heritage.

### **Introduction**

The significant and rather catastrophic changes that are facing our planet epitomized in habitat destruction and climate change have significant impact on agriculture and thus adaptation and mitigation must start via changes in agricultural practices (Rigby and Cáceres 2001; Wratten et al. 2013; Lamine 2015). In context of developing countries, environmental and agricultural practices are important even under the political stresses such countries face such as colonization and economic deprivation (Yu et al., 2010; Qumsiyeh et al. 2017). Colonization clearly aimed to separate people from their land and create a new reality of a Jewish state in a land whose natives were predominantly Muslim and Christian (Qumsiyeh 2004). In 1948, Palestinians were dispossessed of 78% of their land to form Israel, and the remaining 22% continues to face threats of dispossession due to Israeli policies and actions that lead to unemployment, low incomes, high living costs, and restrictions on freedom of movement and production. According to a United Nations Office for the Coordination of Humanitarian Affairs survey in 2017, an estimated 1.6 million Palestinians, or 31.5% of households in occupied Palestine, lack food security (OCHA 2018). In May 2015, annual farming revenue decreased by \$2.2 billion since 1995 due to the establishment of Israeli settlements, military zones, wall construction, and other policies and border closures. As a result, Palestinians lost 60% of their farmland and 80% of their water supply in the West Bank and Gaza Strip (Visualizing Palestine 2010). The lack of access to food led to increases in plant diseases and an increase in agro-processing, harming rural communities (Figuerola et al 2018). Resistance to occupation and colonization in the case of Palestine can also be done via agriculture/return to the land (Abdelnour et al. 2012; Zurayk 2012).

Working toward increased sovereignty in food production requires attention to agricultural practices as well as biodiversity and cultural heritage, which both frequently intersect with agriculture in rural areas. This study aims to explore the role and state of agriculture in the West Bank as a means of non-violent resistance aimed at establishing food sovereignty and at preserving Palestinian biodiversity and cultural heritage. This study also details some of the methods used and actions taken by Palestinians in response to their limited resources, struggling economy, and other obstacles that negatively impact the practice of agriculture and food production in the West Bank. This study specifically describes some traditional agricultural techniques and how they adapted to current conditions; the importance of certain crops, systems, and sites to the cultural heritage of the area; challenges and improvements that West Bank farmers are currently dealing with; organization, community, and government involvement in agriculture; and the importance and the future of the agricultural

sector in the West Bank. Palestinian farmers are actively working to counter the above mentioned challenges and to identify potential ways for organizations, the community, and the government to support agriculture, including the aspects of its cultural heritage and the biodiversity it brings to the West Bank. Despite the challenges that West Bank agriculture faces because of the Israeli occupation which limits much needed resources from entering the region, farmers' desire for self-sufficiency and their love of the land helps to create a resilient agricultural sector, and serves as a strong motivator toward establishing food sovereignty.

### Case Study

Battir is a village in Bethlehem Governorate located northwest of the city of Bethlehem and surrounded by Beit Jala and Al Walaja in the east, Husan and Al Khader in the south, and the 1949 Armistice Agreement Line, also known as the Green Line, in the north and west. Battir lands fall under Areas B, 23.7% of the total area, and C, 76.3% of the total area. Area B certifies the Palestinian Authority's control except for security matters while Area C is fully controlled by the Israeli government (ARIJ 2010). Although 6,435 of 6,795 dunums<sup>1</sup> of land in Battir are considered arable land, the Israeli labor market absorbs 65% of the Battiri workforce and only 10% of the village's population work in agriculture (ARIJ 2010). This displays that although Battir consists primarily of agricultural land, only few are able work in agriculture as the Green Line cuts off access to much of the arable land and Israeli jobs offer more income than work as a farmer. The area is a UNESCO World Heritage Site (WHS) because of its Canaanitic systems of agriculture (MOTA 2013). Battir was previously known as the "vegetable garden of Jerusalem" due to the presence of natural springs, permanent crops and arable land, and proximity to the city for marketing. The village is specifically known for growing its variety of eggplant, called the Battiri eggplant. Since the 1967 war, however, Battir has been cut off from Jerusalem, forcing Battiri farmers to market their produce in the city of Bethlehem rather than Jerusalem. It had 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 WHS encompasses series of agricultural valleys extending along Al Makhroun and Husan Valleys (Fig. 1). The valley enjoys a strategic location and the availability of springs that attracted people to settle in the area and adapts its steep landscape via ancient terraces into arable land (Fig. 2), and 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 (MOTA 2013).

Water is either supplied by local springs or by the municipality. There are three springs in Battir — Ein Hamdan, Ein Baladi, and Ein Jamaa — in addition to municipality water. Those who are not part of the families that have land irrigated by the spring must use municipality water or buy water tanks from other sources.

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<sup>1</sup> A dunum is 1/4 of an acre.

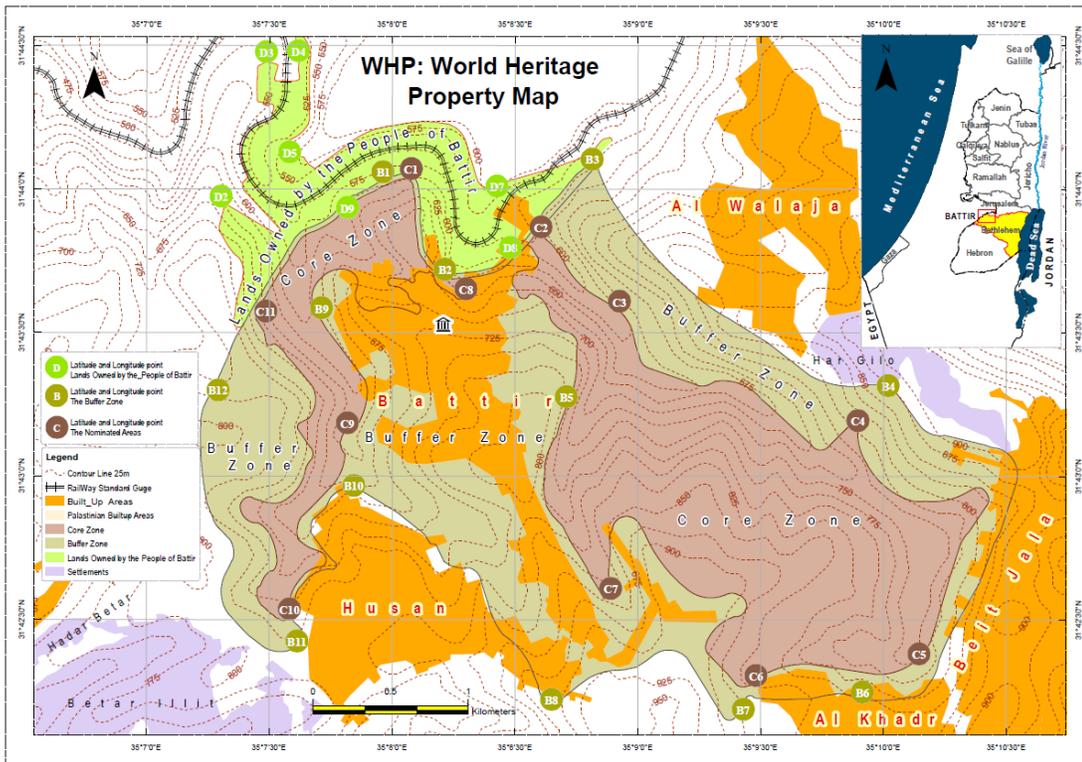


Figure 1. World Heritage Site that includes Al-Makhrour valey and valey near Husan and Battir.



Fig. 2. View of irrigated terraces in 1892 in the valley (Palestine Exploration Fund).

After the establishment of the Palestine Museum of Natural History (PMNH) in 2014, one of its obligations is to identify the neglected biodiversity elements of the OPT. 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. 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.

Our work in in this WHS focused on maintaining natural and human communities. Our interventions in this area focused on understanding and conserving biodiversity, promoting food security in thus area via promotion of sustainable agriculture (in the form of Permaculture) and leveraging biodiversity and cultural knowledge towards sustainability (as in the UN SDGs). Here in we discuss the three areas: agriculture, biodiversity, and cultural heritage.

## **Agriculture**

Dozens of interviews were conducted with farmers (in Battir, Al Walaja, Al Khader, Beit Jala, and Husan) and other interviews with key stakeholders (like Ministry of Agriculture, village couyncils etc). Interviews included anthropological questions on agricultural practices, challenges, and their connection to purpose and identity, as well as a series of yes/no questions to gauge the severity of challenges farmers face in Battir. This anthropological approach focuses on the actions taken in this WHS, especially given history of resistance to counter challenges that are known to negatively affect agriculture. By recording the growth of the sector and those who participate in it, the study provides a clearer picture of what direct resources are needed to address these challenges, how outside organizations can support these efforts, and recommendations received from the farmers themselves to promote food sovereignty.

Agricultural techniques extend over hundreds of years as generations of farmers pass down knowledge and best practices in farming, as well as the farmland itself, to their children. When asked about the oldest techniques used in farming, farmers noted the essential parts of the agricultural landscape — the irrigation channels and terrace system — for which Battir was nominated as a world heritage site. Aside from the landscape’s features, locals use water basins for irrigation, animals for plowing, ashes for seed preservation, and manual labor more generally in harvesting and caring for the land intentionally. We did notice that terraces closer to the populated areas like Battir are better maintained than terraces farther in the valley where Israeli forces normally harras farmers (Figs. 3 and 4).

Battir’s irrigation system as a network of ancient channels using water from the central spring Ein al Balad similarly led to its nomination as a world heritage site. The system rotates every eight days — each day an elder of the family divides the water between the family members so that each farmer gets a block of time, determined by the sun’s shadow, to irrigate their land based on the size of their land.



Fig. 3. Well maintained terraces and agricultural areas in Battir (2019)



Figure 4. Less used and less maintained stone terracing and stone muntar in the valley.

Israeli policies negatively affect agriculture in Battir including in building settlements, walls, bypass roads and more. One farmer's terraces were destroyed by settlers and other Israeli groups who put a caravan on his land and subsequently brought a tractor to uproot the olive trees and demolish the terraces. Despite proving his ownership of the land with old documents and filing a court order to Israel, the farmer is still waiting on a court decision and compensation for the land lost. Every barrier in place aims to create empty land by pushing farmers out of their livelihoods. For example, the court order which commanded the farmer to stop planting on his land was only written in Hebrew, which is an accessibility issue for those who do not read Hebrew, which the government then uses to justify the demolition of their homes. All farmers expressed that since Israeli policies and actions are unpredictable and often illegal, they can do whatever they choose, thus creating a looming psychological effect that nothing is guaranteed.

Along with traditional agricultural techniques, informal networks of farmers continue through generations of families in villages. Such systems provide support and facilitate sharing of best practices for farmers in Battir. Through these networks, members exchange seeds, lend tools, and share information about effective practices. In the exchange of seeds, farmers preserve and give each other local seeds in order to maintain self-sufficiency and to protect local varieties of crops. For example, one farmer noted that he would turn to an informal network to which he belongs if his crops — which are produced from local seeds — were infected to obtain advice on healing the crop or if necessary new seeds. Within the Battiri agricultural community there is a well-established system in place for farmers to share processes, tools and advice so that the community will benefit and refrain from using imported commercial seeds. To preserve the use of local seeds, several farmers donate their seed surplus to the municipality, which then distributes seeds to farmers who are in need of different varieties. Local agricultural networks evolved naturally due to the local farmers' care for the quality of local varieties and desire to be self-sufficient and secure in food production. It is through these local networks that local seed sharing, exchanges and preservation evolved.

Furthermore, the maintenance of land through the family by passing down the land itself and information on how to care for it is critical to agriculture in Battir and the West Bank as a whole. Local opportunities to learn agriculture are limited and there are not always awareness campaigns or curriculums that focus on this field. Most information on soil, crop and water management and disease prevention is handed down from parents to their children. Where the family support structure does not exist, the community will step in to fill this role. For example, one farmer did not learn how to prune correctly and had no family members to lean on. When he asked members of the Battir farming community to assist, he received several offers of support and through this mechanism learned how to properly prune.

Agricultural practices tend to quickly adapt when new challenges surface, which frequently happen. The local Battiri population has learned to use resources effectively, and to adapt economically if production needs to be increased or costs minimized. Thus agricultural adaptation most frequently prioritizes low cost and higher effectiveness and efficiency given the limited resources that are available to locals. In Battir, examples of agricultural adaptation are found in the use of drip irrigation, use of machinery for plowing and harvesting, and chemical pesticides. Such practices, however, are limited due to their high cost, lack of natural resources such as water, and lack of materials and resources such as electricity. Drip irrigation, for example, requires less effort than irrigation using channels and basins, but is sometimes impossible to implement as it requires electricity and high and sustainable inputs of water to fill tanks which supply the water pipes. Machinery similarly requires a large initial capital investment and its maintenance and sustainment can be impacted by Israeli policies. For example, Israeli forces seized a tractor that one farmer was using for land rehabilitation. Even though the tractor was seized before the farmer finished the land rehabilitation, the farmer was nevertheless forced to pay for the full cost of the truck. Similarly, certain Israeli structures such as the train tracks in Battir create an artificial barrier that prevent use of machinery in certain areas. The use of pesticides, though not favored by farmers since organic crops produce greater revenue, is a cheap and sometimes necessary means of protecting crops during troubled times. Farmers referred to grafting — combining two different types of plants — as an improvement to agriculture as it protects crops against diseases and increases their resistance. This was the case with the Battiri eggplant which was grafted onto a tomato plant. This process is not widely used, however, due its required cost and expertise, as well as the desire to plant local seeds rather than grafted ones.

Although new agricultural practices have developed over time, many locals return to more traditional practices which span generations. One farmer, for example, switched back to using channels for irrigation due to the lack of water to fill up tanks for drip irrigation. This return to traditional agricultural practices was directly due to the inavailability of water from the municipality's system which at times is controlled and sometimes used by Israel as political leverage. Organic pesticides such as smoking crops by burning hay or planting repellent plants in a row of crops continue to be used due to their effectiveness and care for the land rather than harming it with chemicals.

Of the sixteen farmers asked, marketing was mentioned nine times as one of the most challenging aspects of farming. From the farmers' responses, the Israeli economy drives down Palestinian prices. Moreover, there is a lack of coordination between farmers in how they market and sell products. For example, one farmer shared that it was difficult to market products because everyone was planting the same crops during the same time period and selling them in the same markets throughout the West Bank. As the location and number of markets are limited due to the occupation, farmers are forced to sell the same products in the same markets at the same time. For example, in Battir and the other surrounding villages of Bethlehem, farmers must all sell their products in Bethlehem city rather than Jerusalem ever since the beginning of construction of the separation wall in 2002. In addition, getting ones produce to markets is challenged by the distance and time it takes to get to the city and depending on the location the checkpoints through which locals must maneuver. To fully gain from a harvest, fruits and vegetables must be picked every day and sold fresh, but that requires significant human labor.

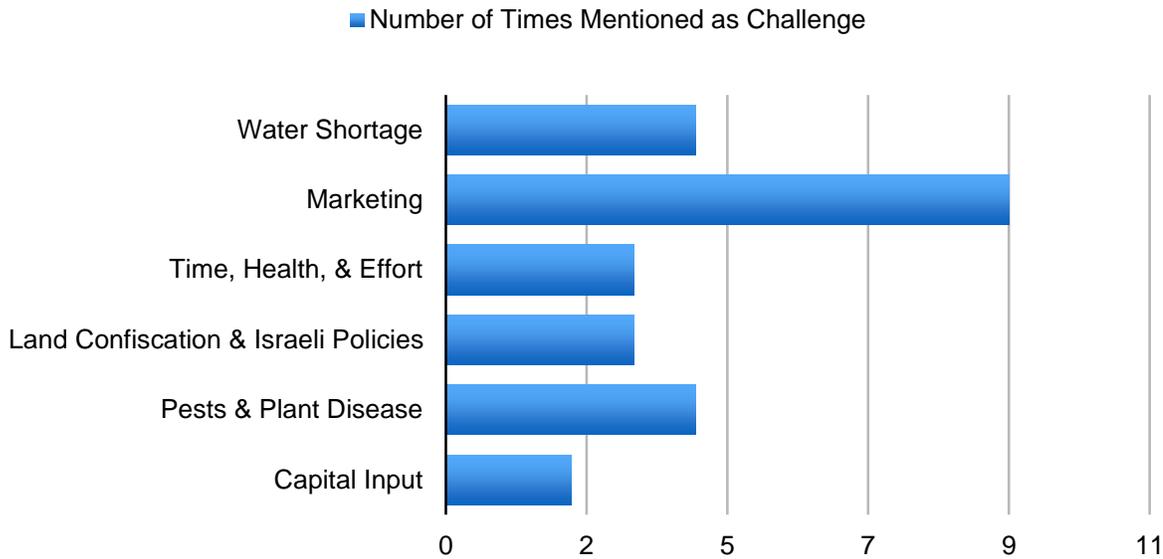


Fig. 5. Farmers view of main challenges they face.

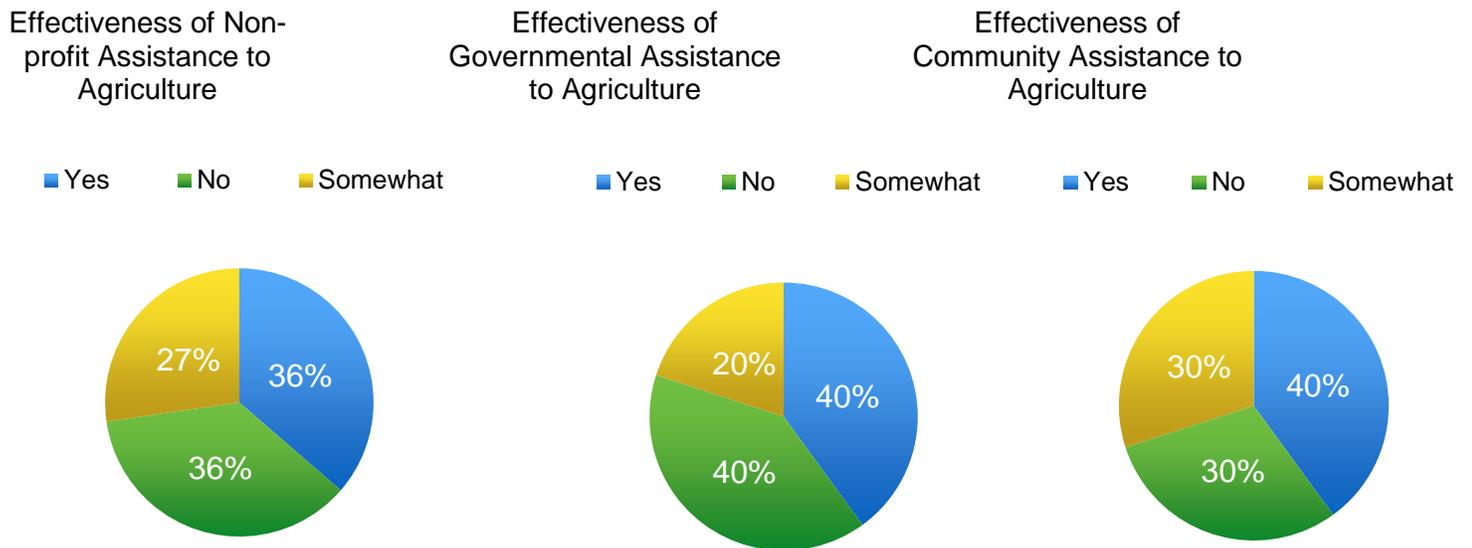


Fig. 6 More farmers' views on levels of assistance they get.

Furthermore, the price of Palestinian products are driven down by the Israeli economy. As produce is significantly cheaper in Israel, people will choose the Israeli product over the Palestinian despite its use of pesticides, GMOs, and other chemicals which are not present in most Battiri farms. There is also no Palestinian government support in the West Bank to subsidize production or support farmers in order to keep prices of Palestinian products low.

**As part of our agricultural interventions,** local agricultural committees were created in 4 targeted communities around the valley (Battir, Husan, Al-Walaja, Beit Jala) The local agricultural committees included representatives from civil society, local cooperatives members, and other key persons (farmers). The number of the participated organizations reflects the interest of the local bodies to engage such activities and the good relationships among the agricultural and heritage-interested organizations. The following table presents the dates, the number of participants, and the participated organizations. The project team explained to these participants the project objectives and the planned interventions for their communities and their responsibilities

as partner organizations/ stakeholders and the project facilitators as well. Both of project announcement and the applications were discussed. Applicant forms were distributed to the main person from every local committee at this meeting, in addition to discuss the text of the agreement with the committee members. Participants were informed about the project including the donor which is the Darwin Initiative and the implementing organizations for this activity (PIBS/ PMNH and ICP- BU).

The project team started project activities through preparing announcements and beneficiary application forms, which were distributed at the main public sites and on the main page of the village council's/ municipality's social media of the targeted villages to inform the largest number of the targeted community about the project activities and giving them the opportunity to apply to the project. The announcements were distributed specially at village council and municipality buildings' where most of local people can see the announcement as well in other main places (mosques, shops, and schools). Further to these procedures, a period of one week and a half was given to each community to complete the beneficiary's applications. The applications were distributed to all targeted communities, and one of the participating village council or municipality staff was selected (during the local committee meeting) to distribute and receive the completed applications. By adhering to this method, the largest number of households was encouraged to apply for the project activities. The announcement period for all targeted communities included both social media and via flyering in the targeted communities. The project team worked closely with the local committees during the beneficiaries' verification and selection processes. The project team and local committees spent several days to visit all of 108 applicants to select the suitable beneficiaries and to verify the provided information by each applicant and to assure the transparency and fairness of the selection process to match the criteria of selection, bearing in mind the socio-economic and agriculture indicators and gender considerations. 80 were thus selected by the committees for support (29 in Beit Jala, 19 in each of Battir and JHusan, and 13 in Al-Walaja). The selected farm families had a mean of 6.5 individuals/family unit. The estimated average family size in the West Bank in year 2017 was 4.8 (PCBS, 2018). The income/Year average was 25,865 NIS (per month = 2155 NIS) per family (1 NIS= 0.21 GBP). The land area for each family had a mean 3.9 dunums (min = 0.3 / max = 22 dunum). In surprising positive news, 9 farmers preferred/used chemical fertilizer (13.4% ) while 58 (86.6%) already preferred/used organic fertilizers.

Three day training workshops were conducted for the project beneficiaries on the Principles of Permaculture and Biodiversity. This workshop focused on the general definition of biodiversity and the humans' fingerprint in Palestine and worldwide about this issue, land preparation, intercropping, irrigation and water harvesting system, and the usage of organic and liquid fertilizer. The farmers committed to attend the workshop where they reflect an obvious idea about their desire to learn and benefit of the scientific information that presented to them. The project team distributed all of the agricultural inputs for the all selected beneficiaries. Each piece of land was provided with all required equipment and tools to establish well-functioning sustainable agriculture system.

We also set up marketing points for the farmers. Fig. 7 shows the invitation for opening of the marketing hub for farmers. Although this is still in its infancy, we anticipate that significant marketing help will increase economic benefits to farmers.



Fig. 7. Invitation for opening of marketing hub in Beit Jala as an example of the activities.

## Biodiversity

We did research on status of biodiversity including threats to biodiversity (publishing many papers in the process), then engaged young people (students at schools and universities) empowering them to actually protect nature. We did research on permaculture and other forms of food sovereignty issues like aquaponics and then transferred the knowledge to farmers and others. Researchers from our team collected tangible and intangible cultural heritage related to nature and agriculture. Through this program: a) our researchers gathered endangered tangible and intangible heritage, b) we created an exhibit on ethnography at Palestine Museum of Natural History (only one in Palestine focusing on agriculture and nature), c) we created a web-based public database (again unique), d) did capacity building in this arena of cultural heritage valuation and preservation, e) contributed to scientific knowledge, e) community well-being/pride and reconnection to land. Culture is relevant to community sense of belonging, building volunteerism, reconnecting to the land and much much more.

Our work in the case study of Battir and surrounding areas started by surveying fauna and flora. A total of 16 field trip from June 2018 to June 2019, showed the diversity of different fauna groups. The fauna data showed 3 species of Amphibians, 12 species of reptiles, 30 species of mammals including hyenas, gazelles, and golden jackals (found in a pak of 7), other mammals like bats need more studies to conduct it function and important in the valley ecosystem. Many species of invertebrates were collected; 19 species of land snails show important species like *Monacha crispulata* that could be indicator for the health of the environment back to it habits need for living. Other important invertebrates studied are the leaf letter (Collembola, pseudoscorpion, ticks) but need more studied for identification and they are good indicator for environmental health and could have many new species. Around 20 species of Butterflies and more are still recorded, some invasive species found and it was recorded for the first time in the Historic Palestine (*Leptoglossus occidentalis*) which is lives on affected the coniferous tree. 19 species of mushrooms collected and identified for Al Makhroul Valley, little known about them but studies still on going. 417 species of vascular plant recorded in Al Makhroul Valley.

This rich fauna and flora as well as the ancient human existence in this WHS area face 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 (see Fig. 3)
- 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.

Though increasing biodiversity was not a main driver of change for farmers in Battir, farmers indirectly preserved biodiversity through techniques to better their own production. Around 60% of farmers noticed a decrease in biodiversity, specifically the loss of animal species through chemical use and other malpractice, since the previous generation. The older generation is considered to have protected the land in a more careful manner, and several farmers pointed to this to support their assertions that preserving old practices is the best solution to increasing biodiversity. Biodiversity conservation plans were laid down for the area and a number of focus groups and workshops held with stakeholders (e.g. experts, Ministry of Tourism, Ministry of Agriculture, Environmental Quality Authority) that resulted in developing ideas and plans and starting to implement them (e.g. on the creation of an ecotourism path).

## **Cultural Heritage**

Ecosystem services including agriculture are connected to culture organically; it is the cultural-ecological landscape (Mitchell et al., 2009; Tengberg et al. 2012; Smith et al. 2016). 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). Agriculture is widely seen as being an integral part of Palestinian cultural heritage. Battiri eggplants and olive trees are the most important crops in Battir due to their cultural importance and produce for income and self-sustainability. Main features of the Battiri landscape — the terraces and water channels — are also effective and old practices that have shaped agriculture in Battir today. Support for cultural heritage far exceeds support for agriculture itself, thus indirectly assisting the agricultural sector through the protection of cultural sites. Official preservation of sites under organizations such as UNESCO is viewed as positive due to its ability to protect the land itself, especially under occupation, but can be viewed as having negative effects for farmers in the area who face administrative obstacles in efforts of rehabilitating their land. Overall, in the efforts to preserve cultural heritage in Battir, agriculture is supported through the saving of local seeds and protection of agricultural land.

The Battiri eggplant is culturally connected to the heritage and namesake of Battir. For example, farmers mentioned it is mentioned in school curriculums, and thus it is known around the world as being connected to Battir. Farmers view the olive tree as having similar cultural value due to its presence in the region for thousands of years; its strength and resistance as a perennial plant that can withstand a variety of circumstances; and its versatility of products such as fresh olives, olive oil, and pickles. Both crops are important in displaying the continuation and value of agricultural practices over time as such practices have been preserved and are still used today due to their high quality outputs. For example, olives are spread out and stored in a clean cold place at medium depth and then crushed with a press. Although there have been some changes such as the type of press used to crush the olives, the process has been preserved and thus the quality remains high in its production of extra virgin olive oil.

Since they were built thousands of years ago, stone terraces are central to Battiri agriculture and culture. If abandoned terraces are destroyed by Israeli forces or rain, the municipality and community will often work

together to repair the terrace. This collective action (called ‘awna in Arabic) proves the sustainability and effectiveness of an agricultural system that has lasted until today.

For crops having cultural significance such as the olive tree and the eggplant there is insufficient support as a whole to preserve them. During the olive harvest there are not enough workers to pick all the olives and land access is cut off due to Israeli policies — leading to the waste of thousands of trees. For example, one farmer faced challenges in harvesting his olive trees as he could only access his land for several hours each day and only his family could assist him. For crops that do not have the attention of cultural organizations, there is even less means of support, especially regarding physical inputs such as plowing. Despite agricultural systems in place such as the terraces and irrigation system, the sites themselves face challenges. The irrigation system specifically faces constraints such as time and geographical barriers. One farmer, for example, explained the difficulties of watering within a time limit as inefficient depending on the distance between the farmer’s land and the spring and inconsistent with a rotating time schedule. The spring is also threatened by the occupation as Israelis come a few times every year to measure the depth of the reservoirs in Al Khader and Al Ubediya which are the sources for the Battiri springs, ultimately decreasing the overall water level.

Support from non-profits, the government, and community to Battiri farmers is limited. NGOs do not have a large presence in supporting farmers in Battir and other villages outside of Bethlehem. The work that has been done has focused on cultural heritage and the rehabilitation of water channels, but many noted that the work was not finished and threatened by Israel due to land grabbing. For example, there was a deal with a local NGO to construct an irrigation network for the local olive trees, but the farmers decided not to continue as there was a high threat of confiscation.

Our interventions in this area included developing an ethnography section of PMNH, developing a web-based database of thousands of intangible cultural heritage items including a good section covering the case study valley (<http://Turathna.palestinenature.org> ) and a mobile game application on cultural heritage (apple store <http://apple.co/2n5f1Ww>, google play store <https://play.google.com/store/apps/details?id=pmnh.learning.game>). Schools were engaged in the area to disseminate this information.

## **Discussion**

Food sovereignty is the right of peoples and communities to create their own policies on agriculture, labor, food, and land, appropriate to its environmental, social, economic, and cultural circumstances — ultimately including the right to both food security and production, and placing the needs of those who produce, distribute, and consume food at the focus of food systems (Altieri et al. 2012). The Israeli government is able to restrict access to Palestinian territories, thus limiting the supply of food entering the region. This political leverage disenfranchises Palestinians and impacts their livelihoods. The limited access to food causes greater reliance on highly processed food which then results in changes in food manufacturing — drawing a connection between control of production and access to food (Harrigan 2014). For example, Israeli forces have systematically uprooted trees and destroyed agricultural infrastructure like wells and solar panels, dominated markets due to control of imports and cheaper Israeli prices for replacement products, and built settlements that confiscate further resources and cut off access to land with physical barriers and complex permit regimes. As a practice rooted in the land, farming and local food production can therefore be used as a means of non-violent resistance (Abdelnour et al. 2012; Zurayk 2012). To return food sovereignty to the locals, communities and development organizations have established initiatives to move supply structures into the Palestinian territories.

Farmers face many challenges such as water shortages, land and resource threats from the occupation, and markets/the economic situation/cost of capital inputs. Through its occupation, the Israeli government controls water, resources, the ability to rehabilitate land, movement of goods, and prices which determine income of farmers. Other challenges include poor health care, lack of organization among farmers to provide better support and production, the new generation’s lack of experience leading to under-cared and abandoned land,

and pests. There will be dramatic impact of climate change on biodiversity and agriculture including in our region (Mizyed 2009; 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. 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). When asked about climate change, 80% of farmers indicated that climate change has had negative effects on production. All noted the increase in temperature — affecting working times, soil nitrogen levels, consumption of water, plant life cycles, and the atmosphere. One farmer asserted that capitalist countries were to blame for causing such negative effects with industrial development. As seasons are shifting due to climate change, plants flower at different times than in the past, and production has ultimately decreased. Water scarcity was mentioned more by farmers in Al-Walaja and Beit Jala than Battir and Husan.

As tourism increases, it has affected agriculture both positively and negatively especially in Battir. Negative effects include destroying of local crops by tourists, stealing of produce, crowding the town, and littering. Positive effects, however, include more consumers and investment in the local economy — although only few benefit. One entrepreneurial farmer decided to combine both agriculture and tourism with the creation of a *farm to table* restaurant that helps provide income but also educate tourists on where their food is produced.

Outside support for agriculture is limited and is derived mostly from non-profits, the Palestinian government, and the local community. Non-profits primarily focus on cultural heritage preservation, which indirectly supports agriculture in the case of Battir, but does not support farmers' livelihoods further. For example, the government helps distribute seedlings, especially for olives and eggplants due to their cultural importance, but fails to address more immediate issues, such as distributing requested materials such as new plastic for greenhouses or water tanks, coordinating marketing strategies, or helping solve water shortage issues. Non-governmental organizations are not widely influential as they do not have a large presence in Battir, and what support they provide is limited to a small number of farmers. For example, organizations bring agronomists to offer advice which only a small, select group of farmers receive.

To further improve agriculture in this WHS as in the rest of Palestine, farmers suggested educational resources for farmers and the community, sustainable and natural farming techniques, and economic and resource improvements. Further education for farmers included farmer extensions provided by the government or different organizations, awareness campaigns for farmers to show the benefits of certain more recent practices such as drip irrigation, which some farmers doubt due to their departure from old practices. This could address farmers who only receive agricultural information from their families, which although effective, don't draw attention to developments in farming. For example, the Palestine Museum of Natural History now sends an agronomist to villages in the Al-Makhrour valley to teach new techniques to increase biodiversity — a project in which over 60 farmers have benefitted (PMNH). Sustainable farming techniques include the integration of different farming systems such as fertilization and irrigation; the increased use of natural techniques such as using compost, organic pesticides, or solar energy; and innovative techniques such as aquaponics or using treated waste water to save water. Their presentations stressed the importance of sustainability in new techniques which were well received by the farmers. For example, one farmer mentioned that chemical pesticides were cheaper and more effective than other pest control solutions, but added that this was not sustainable as pests become resistant to the chemicals. Most farmers noted the benefits of grafting, especially

with the eggplant over the tomato, which include increased resistance to disease and production, but none used it due to the high cost and expertise. The main limitation to such improvements, however, is high cost of new systems and materials.

Farmers also suggested community-based improvements such as coordination in selling products and encouraging the future generation to continue in agricultural fields. As marketing was one of the main challenges farmers faced, many suggested created a system of sharing information on what crops people are planting and selling in which markets so that a majority of produce could be sold. This solution, however, only addresses one aspect of the difficulties of marketing in the West Bank, and in no way solves the larger economic crisis caused by the occupation as markets are inherently limited under the occupation. Further community-based improvements focused on planting on abandoned land to protect it and actively encouraging youth to stay in agriculture.

To address water scarcity, farmers suggested to invest in the availability of water reserves as it is not secured or readily available at all times. Some suggested a switch to drip irrigation despite the cost barrier due to its ability to increase productivity of land and varieties of crops which would pay off the initial costs, even if it was a small area. Others suggested to build more wells instead as there are restrictions on building them for farmers with less than five dunums of land. Most farmers, however, have less than five dunums and are therefore restricted from improving their agricultural land and forgotten among organizations that target those with more land.

Other recommendations focused on self-improvement, such as more effort and care, in order to be more productive on the land itself. For example, farmers noted that if there was more effort to sell their products every day, their output would be better. Selling products, however, is not only limited by effort but also by time as farmers must travel to sell their products, taking a full day to complete. Farmers also pointed to physical health as a limit to agricultural success as it allowed them to work the land but with time prevented them from completing their duty to serve the land.

The farmers unanimously agreed that there is a generational gap in agriculture and the younger generation has less care and experience than the older generation. This is due to technology, laziness, lack of care, and movement to other sectors providing more income. As the cost of serving the land is high and the income is low, shifting to other jobs, specifically in Israel, has become more common. As people shift to other sectors or even work in two, less attention is focused on agriculture and thus the land and knowledge is forgotten. All farmers saw their work as important and meaningful past its economic value because of love for the land, a sense of duty toward it, and its role in resisting the occupation. Multiple farmers mentioned that they go to their land even on holidays or days off to take care of it. The personal connection has extended since they were children assisting their parents in the land and continues to extend as they teach their children the same. It often also helps farmers put their children through school or give them better opportunities — further emphasizing such a personal connection. Others mentioned the psychological and physical benefits of the work.

Regarding its role in resistance, agriculture allows farmers to be self-sufficient and occupy land before it is taken after abandonment, whether forced or by choice. They produce their own home consumption — food that is healthier that they can trust unlike larger agriculture companies. One farmer seconded this notion of self sufficiency by quoting an Arabic proverb, saying “The house which has flour and olives will not starve.” The physical presence, which many farmers compared to roots, on the land is also important as it prevents land grabs and the uprooting of peoples by Israel. By pushing people out, Israel creates abandoned land, which they can take with that justification for further settlements.

When asked about the connection between agriculture and heritage, all farmers immediately responded that agriculture was Palestinian heritage itself or the origin of it. Duty and love for the land are so closely

intertwined — ultimately contributing to lasting care for the land and a desire to stay present in it to work on it. One farmer stated that it was “better for him to wear a thawb [traditional clothing of Bedouins]” and “be close to nature and scorpions” than “wear soft clothing for relaxing.” This displays the high valuation of hard work in efforts of serving the land. Yet heritage itself cannot change the political situation or ensure a future for agriculture. Only family structure, care for the land, and a realization of its value will guarantee some sort of continuation. As knowledge and land continues to be passed down through generations of farmers, parents often force their children to help until the land is later theirs and they must take care of it. Many farmers are forced to work in the Israeli labor force to earn more money, but many return to agriculture activities when they realize the value of the land both symbolically and economically.

Suggestions to encourage the youth included agricultural classes in school curriculums, education for children in the field so they learn from their parents and form a relationship with the land, governmental support to provide resources and allow youth to realize the economic benefits of the land, and further trainings from agronomists or the older generation to transfer agricultural knowledge. As the hardest challenge is to shift the new generation’s interests to farming, multiple farmers suggested educational initiatives to provide the information for youth, which could later evolve into interests and responsibilities. For example, one farmer stated that values of self-sufficiency should be emphasized in school curriculums to give students an understanding of what they consume and where it comes from.

### **Conclusions**

Natives care for the land out of necessity of income, self-sufficiency, and patriotism. The way they view the future depends on how they interpret the future political situation. Some expected the agricultural sector to decrease to only home consumption as land is confiscated by Israel, but others saw the commitment of the Battiri farmers as hope for a growing sector as they resist occupation of their land. In its broader context, agriculture in the West Bank is widely used as a means of resistance under occupation to regain food sovereignty due to its ability to protect the land from confiscation by planting on it and allowing for self-sufficiency. The integrated approach we developed in this case using permaculture, cultural heritage, and biodiversity conservation gives us hope for the future even under the difficult circumstances articulated above.

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