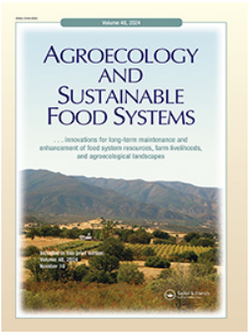

Agroecology and Sustainable Food Systems

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/wjsa21

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To cite this article: Mazin B. Qumsiyeh, Caila McHugh, Summer Shaheen & Mohammad H. Najajrah (2024) Bio-cultural landscape and eco-friendly agriculture in Al-Arqoub, South Jerusalem, Palestine, Agroecology and Sustainable Food Systems, 48:10, 1489-1513, DOI: 10.1080/21683565.2024.2392652

To link to this article: https://doi.org/10.1080/21683565.2024.2392652

Published online: 05 Sep 2024.

AGROECOLOGY AND SUSTAINABLE FOOD SYSTEMS
2024, VOL. 48, NO. 10, 1489–1513
https://doi.org/10.1080/21683565.2024.2392652

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Bio-cultural landscape and eco-friendly agriculture in Al-Arqoub, South Jerusalem, Palestine

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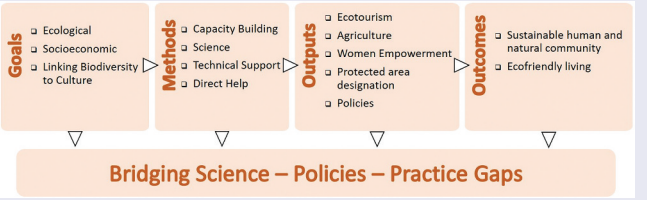
ABSTRACT

Biodiversity conservation is impossible without empowerment and benefit to local communities. This happens through a cultural landscape that supports sustainable human and natural communities. We report on a 3-year project to help four local communities sustainably create semi-natural ecosystems in an area under threat in south Jerusalem that is a candidate World Heritage site. One part of the project involved biodiversity assessment with local participation and resulted in the designation of the area as a protected area. A second part of the project reported here focused on enhancing ecosystem services via enhancement of ecotourism, agricultural production, and marketing in eco-friendly ways all done via community participation. This agroecological approach for 80 farmers in four communities enhanced their production of organic health produce, marketed their products, while learning about local biodiversity (benefiting more than 500 individuals). This happened via agricultural inputs and capacity building (by professionals and by exchanging knowledge). The socioeconomic status of women cooperatives was also improved through the project creating sustainable income and empowerment.



KEYWORDS

Cultural heritage; permaculture; biodiversity conservation

SUSTAINABLE DEVELOPMENT GOALS

SDG 1: No poverty; SDG 2: Zero hunger; SDG 11: Sustainable cities and communities; SDG 15: Life on land; SDG 16: Peace, justice and strong institutions

Introduction

Sustainability of human and natural communities is critical in light of global threats: climate change, habitat destruction, overexploitation, pollution, invasive species, food insecurity, and conflicts/wars. Most countries failed to meet the earlier Aichi targets for biodiversity conservation (CBD 2021; Xu et al.

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2021). One of the many reasons for this failure was having enough engagement from local communities and thus, the 2022 Kunming-Montreal Global Biodiversity Framework (GBF) emphasized protecting biodiversity while enhancing nature's benefit to people. The GBF also recognizes that indigenous people and their knowledge should be integral to reach the global targets. This is especially challenging in developing countries with limited resources to deal with threats like climate change, pollution, habitat destruction, invasive species, and overexploitation (Roberts et al. 2021).

Planners and governments increasingly recognize that mitigation and adaptation to threats to biodiversity and human sustainability need to focus on our food production and consumption systems (Ericksen, Ingram, and Liverman 2009; Springmann et al. 2018). Further, to achieve the UN Sustainable Development Goals (especially SDGs 1, 2, 13, and 15) requires ensuring humans can feed themselves while also protecting nature. Food includes the right to both food security and production, and places the needs of those who produce, distribute, and consume food at the focus of food systems (Altieri, Funes-Monzote, and Petersen 2012; FAO 2021). Bio-cultural landscapes are increasingly being emphasized as areas where eco-friendly and endogenous-led agriculture (not "industrial agriculture") produces food sovereignty while also protecting natural ecosystems (Bignal and McCracken 1996; Rössler 2006; Wratten et al. 2013). Such systems are also critical to maintain sustainability, including via "ecosystem services" or nature's benefit to people (Assandri et al. 2018; Garnett et al. 2013; Mazid, Shideed, and Amri 2014; Tscharntke et al. 2012; Wezel et al. 2014). These systems also work better if indigenous people knowledge is used (Singh and Singh 2017; Thrupp 2000) and this has indeed been noticed in the limited work done in Palestine (Tesdell et al. 2020; Tesdell, Othman, and Alkhoury 2019).

Palestine is in the western part of the Fertile Crescent where humans first developed agriculture and domesticated plants and animals some 11–12 millennia ago. Wadi Al-Natuf, a valley in the northern West Bank, was the first farmed place identified and hence we speak of Natufian Agriculture. The area is highly fertile and includes rich biodiversity due to its location at the intersection of continents and to its topography, climate, and geologic history (e.g., lowest point on earth in the Dead Sea). Accumulated knowledge has been passed on from generation to generation for thousands of years. The conflict and modernization over the past 100 years has had a significant negative impact on the environment including eco-friendly indigenous agriculture (Alhirsh, Battisti, and Schirone 2016; ARIJ 2016; EQA 2021; Husein and Qumsiyeh 2022; Qumsiyeh and Abusarhan 2021). The nascent State of Palestine is not only a developing state but is subject to decades of stress from settler colonialism that impacts the environment (Qumsiyeh 2024; Qumsiyeh and Abusarhan 2021). The question then arises of how people and nature can coexist harmoniously in ways that lead to sustainability.

A bio-cultural landscape in the South Jerusalem area was submitted as a candidate World Heritage Site (WHS) on an emergency basis due to threats (MoTA 2013, Figure 1). The landscape encompasses land belonging to the towns of Battir and Beit Jala and the villages of Al-Walaja, Husan, and Al-Khader. Collectively, these (and a few other communities in the valley system) constitute "Al-Arqoub" cluster. Subsequently, research resulted in declaring a number of valleys around the area as a protected area (PA) based on the rich biodiversity of the area and threats it is facing (Qumsiyeh, Zavala, and Amr 2014, 2023). This study reviews work we have done to valorize this WHS/PA in terms of its cultural landscape by working to enhance farmers' knowledge and benefit from nature (ecosystem services). In particular, we emphasize the role of supporting farmers to engage in restructuring their relationship to nature while utilizing ecofriendly and traditional agricultural practices and to market their products via women cooperatives. We provide an example of enhancing nature's benefit to people leading to fulfilling SDG goals. We demonstrate that sustainable human and natural communities can be achieved even under difficult circumstances. This study demonstrates potential for enhancing agroecological systems in ways that both enhance nature's contribution to people and biodiversity conservation.

Materials and methods

Study site

Two targeted villages (Al Walaja and Husan) and two towns (Beit Jala and Battir) were chosen for this study because they surround the designated UNESCO WHS (Figures 1 and 2) and are representative of the Al-Arqoub cluster of villages and towns economically dependent on the same valley system. The area is to the south of Jerusalem and to the West of Bethlehem, areas occupied by Israel in 1967. East Jerusalem was subsequently expanded (as Greater Jerusalem) and annexed to Israel but no country recognizes this annexation, which is contrary to the 4th Geneva Conventions. The annexed areas in the South include agricultural and natural lands belonging to Al-Walaja and Beit Jala. Most of the remaining agricultural lands of the four communities fall under "Area C" designating occupied areas that are under both civil and military rule by the Israeli authorities. For example, 6,435 of 6,795 dunoms (a dunom is 1000 m^2) of land in Battir are arable land and most of this is in area C (ARIJ 2010). Battir was cut off from Jerusalem, forcing Battiri farmers to market their produce in the city of Bethlehem rather than Jerusalem. The natural areas were studied extensively in terms of biodiversity, and based on that we recently declared the area a protected area (Qumsiyeh et al. 2023).

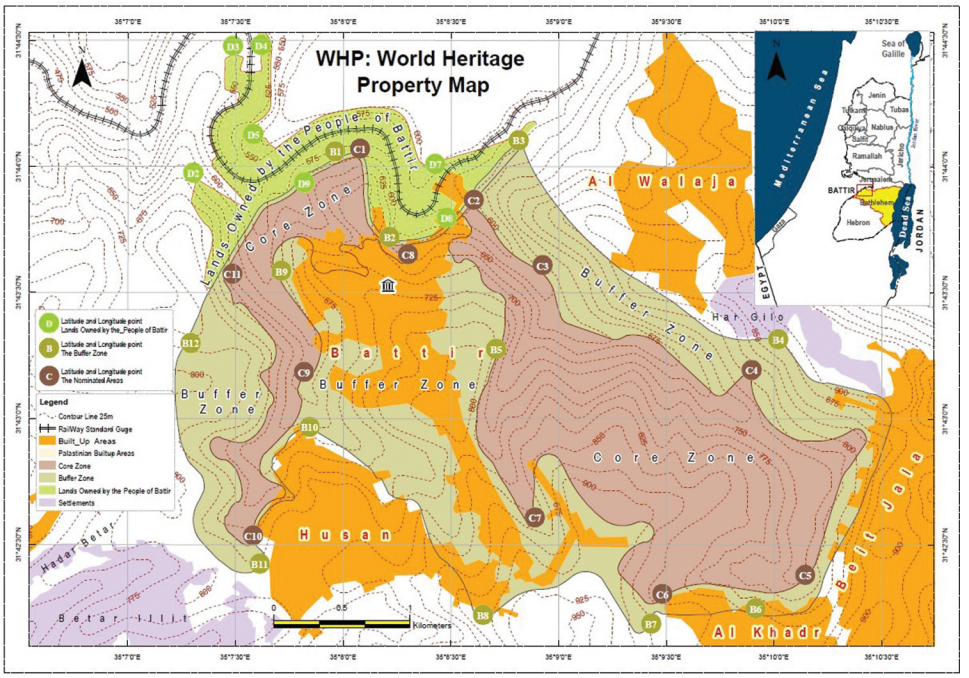

Figure 1. World heritage site that includes Al-Makhrour valley and valley near Husan and Battir. (Courtesy MOTA).

Involvement of farmers and stakeholders

Five focus-group meetings were held involving local communities (of various professions including farmers and government officials). This helped assess community needs while introducing local farmers to concepts of agroecology and sustainable food production (Gliessman 2018). The outcome of these meetings showed a special focus on economic needs to support farmers, job creation, and empowering communities in areas with ecotourism. Thus, we tailored activities to farming and ecotourism. Regarding ecotourism, a professional was hired to assess tourism development potential in the four communities. Regarding farming, local announcements were made to the local communities in four communities (in Battir, Al Walaja, Beit Jala, and Husan) to recruit farmers. The applications included general demographic questions, questions of motivation, on finance, agricultural methods used in the past (including crops and crop rotations, fertilizer and pesticide use) and on basic knowledge regarding agriculture. Applications were distributed by the village or staff who also collected the completed applications. 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 visiting all of 108 applicants to select the suitable beneficiaries and to verify the provided information by each applicant and to assure the

Figure 2. View of targeted area including irrigated terraces in 1892 (Palestine Exploration Fund) and 2022 (photo from PIBS).

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. Eighty were thus selected by the committees for support (29 in Beit Jala, 19 in each of Battir and Husan, and 13 in Al-Walaja). The selected farm families had a mean of 6.5 individuals/family unit, higher than the average for the West Bank of 4.8 in 2017. 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 dunoms (min = 0.3/max = 22 dunoms) but the total areas rehabilitated and planted ranged from 400 to 500 m2 (total for the farmers nearly 40 dunoms). In surprising positive news before starting, only nine farmers preferred/used chemical fertilizer (13.4%), while 58 (86.6%) used organic fertilizers. One hundred and eight farmers applied and were interviewed for their needs and to explain to them what support and

Table 1. Criteria used in farmer selection.

Criterion	Max. mark	Indicators		Mark for Indicator
		An agricultural area outside of the targeted WHS		Excluded
Breadwinner	10	Father/husband		5
		Mother/wife		10
		Sons		8
Averagemonthly income for family	5	500-1500		5
		2000-2500		3
		3000-3500		2
		More than 3500		1
Source of water	10	Spring		10
		Collective well/cistern		8
		Municipal water		8
		Water tank		5
		No source		0
Totalfamily members no.	5	1-5		2
		5-10		4
		More than 10		5
Disabilities	5	Disabilities: one		3
		Disabilities: more than one		5
		No disabilities		0
The area of the land	5	400-500 m2		5
		Other		0
Readinessto commit to serve the land	10	Yes		10
		No		0
Land ownership	10	Own property		10
		Shared with other heirs		8
		Rented		0
Benefitedof similar project in past years	5	During2017- 2018		0
		Before 2017		5
Technical criteria?	10	Soil depth	Shallow	0
			Medium	5
			Deep	10
	10	Presence of rocks (percentage)	0-5%	10
			6-10%	5
			11-25%	1
			More than 26%	0
	5	The slope of the land	Less than 5%	10
			6-15%	5
			More than 15%	0

interventions were possible. Eighty were selected initially based on the criteria shown in Table 1.

Data gathering and stakeholder engagement

Other interviews were held with key stakeholders (like Ministry of Agriculture, village councils, etc.). Interviews included 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. This approach focused on the actions taken in this study area, especially given the 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. Our work in the area focused on maintaining natural and human communities. Our interventions in this area focused on understanding and conserving biodiversity, promoting food security in this area via promotion of sustainable agriculture (and leveraging biodiversity and cultural knowledge toward sustainability (as in the UN SDGs).

Agricultural interventions

Following focus group meetings and individual meetings to assess needs, local agricultural committees were created in the four targeted communities to ensure proper agricultural interventions. The local agricultural committees included representatives from civil society, local cooperative members, and other key persons (farmers). 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 the project announcement and the applications were discussed. Three-day training workshops were conducted for the project beneficiaries on the principles of eco-friendly agriculture, relation to cultural heritage, and biodiversity (led by both local and international experts). This workshop focused on the human fingerprint in Palestine and worldwide, land preparation, intercropping, tangible and intangible cultural heritage related to agriculture (this included a visit to our ethnography museum), irrigation and water harvesting systems, and the usage of organic liquid fertilizer ("compost tea"). This was informed by agroecological models rooted in tradition and empowered by modern technology. The project team distributed all of the agricultural inputs to all selected beneficiaries only after successful completion of the workshop and a commitment to engage in ethical and eco-friendly practices discussed that advance social justice and sustainability. Each piece of land was provided with the required equipment and tools (derived from the needs assessment and the training) to establish a well-functioning sustainable agriculture system. This included irrigation network and accessories, a water tank, and gardening and soil tillage tools. For the first season (spring 2019), organic animal manure and plant seeds (Okra) and seedlings (various) were also delivered. Over the two summer seasons and the two winter seasons, we delivered 234,550 seedlings, and 490 kg of seeds and bulbs divided equally among the 80 selected farmers. The plants included herbal plants like mint, parsley, sage, fennel, basil, and thyme and decorative plants like chrysanthemum and marigold. They included irrigated summer plants like tomato, cucumber, hot pepper, sweet pepper, and Battiri (local) eggplant. The winter crops were rain fed and included lettuce, spinach, chard, beans, cabbage,

cauliflower, parsley, peas, and onions. We also experimented with new crops like kohlrabi, broccoli, fennel, red cabbages, and arugula. Farmers already planted trees that did not need watering (rain-fed-like Olives and Almonds).

We also educated farmers about weed control (manually) and organic material disposition (composting not burning). Field day visits were performed to the farms of each farmer with a minimum of two times per year (Spring and Fall seasons) for the three-year duration of the project (2019–2021). The purpose was to listen to farmers, guide them, solve problems, and record progress for each farmer. Notes were taken regarding biodiversity in or near fields and the impact of human activity on local biodiversity (summarized in Qumsiyeh et al. 2023). A representative of the local committee at each location participated in the visit. The training workshops included discussion of agro-ecological farming and its political and environmental significance, as well as feedback from farmers on the challenges they face on a day-to-day basis. Topics mentioned by farmers included: water, pest management, marketing, sourcing appropriate seedlings, infrastructural challenges (e.g., lack of agricultural roads and water supply), which are a result of the repressive policies of the Israeli occupation, settler damage to property, and the threat of physical violence. The consultant gave a presentation about her own farm in Wales and how they are using agro-ecological principles to manage soil, water, and pests and to make themselves more resilient to climate change, as well as their marketing strategy, and outreach to their local community as part of a Community Supported Agriculture project. Several practical demonstrations were carried out including: compost, aerated compost tea, swales, trench beds, mulching, hugel culture, and natural alternatives for pesticides.

Measurement of improvement/transformation

Our work focused on improving food production and marketing in an eco-friendly way by using principles of agroecology. The training provided supported indigenous communities to transform lives and livelihoods via principles of ecology (sustainable agriculture, permaculture, eco-friendly interventions) with social justice and empowerments. Improvements were assessed in three areas: a) total farm production of the participating farmers and the mix of farmers (emphasizing women farmers in impoverished communities), b) knowledge change in farmers especially about issues of biodiversity, c) marketing improvement, and d) long-term local committee work that enhances both food sovereignty and ecosystem services.

The data collected included farmer's perceptions of their needs before and after, data on size of land cultivated, use of pesticides, use of fertilizers, amount and type of produce, savings realized, sale or gifting of produce, use of

composting, and methods of controlling weeds. Simple quantitative statistical tools were used, and the results are summarized below.

Results

Over 30 meetings were conducted that included farmers and other stakeholders. Some meetings were held with the Union of Agricultural Work Committees (UAWC), with local stakeholders (like village councils), with marketing centers (supermarkets – many agreed to sell products). Farmers also visited the botanic and community gardens and the natural history museum at the Palestine Institute for Biodiversity and Sustainability. We had several exchange visits between the four communities. For example on 25/8/2020, 19 farmers from Battir visited their fellow farmers in Al-Walaja in a cross-village exchange visit. Al-Walaja farmers, local committee members, and representatives of Al-Walaja village council welcomed Battir farmers and showed them their products, gardens/planted pieces of land, watering techniques, and historical places like Alhadafa water spring, in addition to the Albadawai olive tree. Five farmers' gardens in different locations were visited in Al-Walaja. They demonstrated how they overcame challenges, such as movement restrictions. Battir farmers in turn introduced themselves and focused on their own challenges and main interests. One farmer showed some of the rare crops like black beans and pear-shaped small tomato (a variety of cherry tomato) that he grows in Battir close to the train-tracks. Farmers also discussed the importance of preserving the Baladi (local) seeds.

The interviewed farmers identified their needs as follows (in order of importance): marketing their produce, plant pests, water shortage, time/health/effort (many farmers were aging), and lack of money. A minority of farmers indicated they got assistance from their community (40%), NGOs (36%), or NGOs (40%). The farms selected cover different parts of the valley system (see Figure 3) and the farmers selection criteria noted in methods allowed us to work with them to advance a bio-cultural approach to revamping eco-friendly traditional agricultural systems

The training in eco-friendly agriculture that the farmers received was judged productive both by change of knowledge and by production. **Production** sheets were collected from farmers who committed to filling. Others who were not able to fill them were asked about the amount of harvested crops. For the first summer season in 2018, total production for the benefitting farmers was 8525 kg of produce. Figure 4 show production per site per crop for the 2020 summer season, which reached 11,356 kg (an increase in 2 years of 33%). Husan farmers produced a higher amount of the vegetables than Al-Walaja, Battir, and Beit Jala, respectively. Table 2 shows detailed production in 2020 and disposition of produce by the farmers.

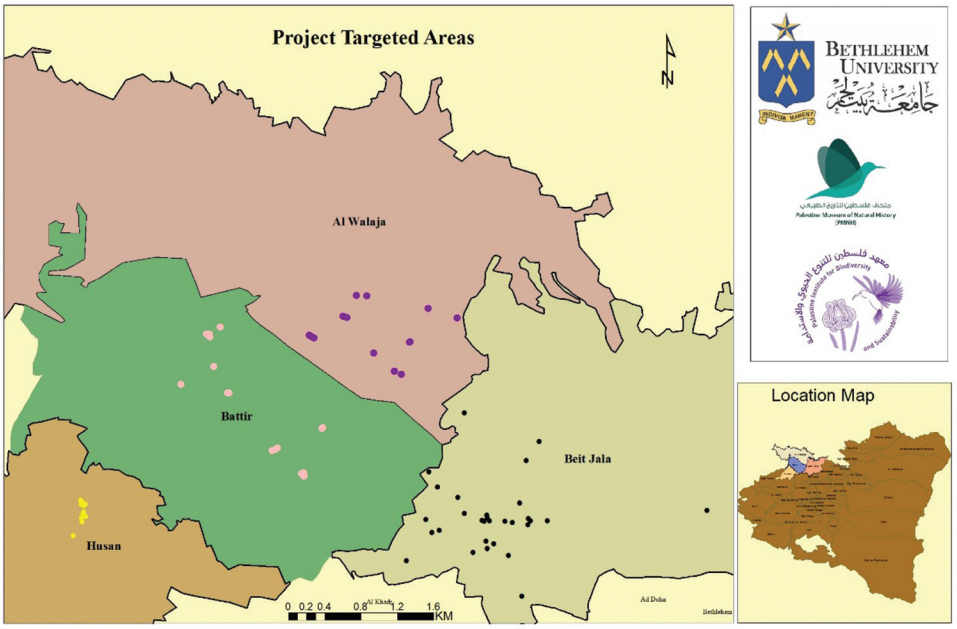

Figure 3. The farms selected for development included 80 farms: 29 in Beit Jala, 13 in AlWalaja, and 19 in each of Husan and Battir. Boundaries shown are for the village or municipal boundaries.

Suggestions to encourage youth included agricultural classes in school curricula, 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 influence the new generation's interests in farming, multiple farmers suggested educational initiatives to provide 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 curricula to give students an understanding of what they consume and where it comes from. The project farmers participated in marketing festivals we organized, where they sold some of their products, such as grapes, quince, mint, pomegranate, and some eggplant (Figure 5). In addition to the processed products were those they prepared before such as: pickled eggplant, pickled olive, Labneh (like soft cream cheese), thyme, dry yogurt, grape molasses, preserved grape leaves, and jams. The farmers and other women members of the cooperatives attended workshops where they learned from experts and from each other, showing effective knowledge acquisition (see Figure 6).

Farmers were questioned at the end of March and early April 2021 for final feedback to demonstrate practical knowledge acquisition and improvement in lives and livelihoods. Here is what we learned:

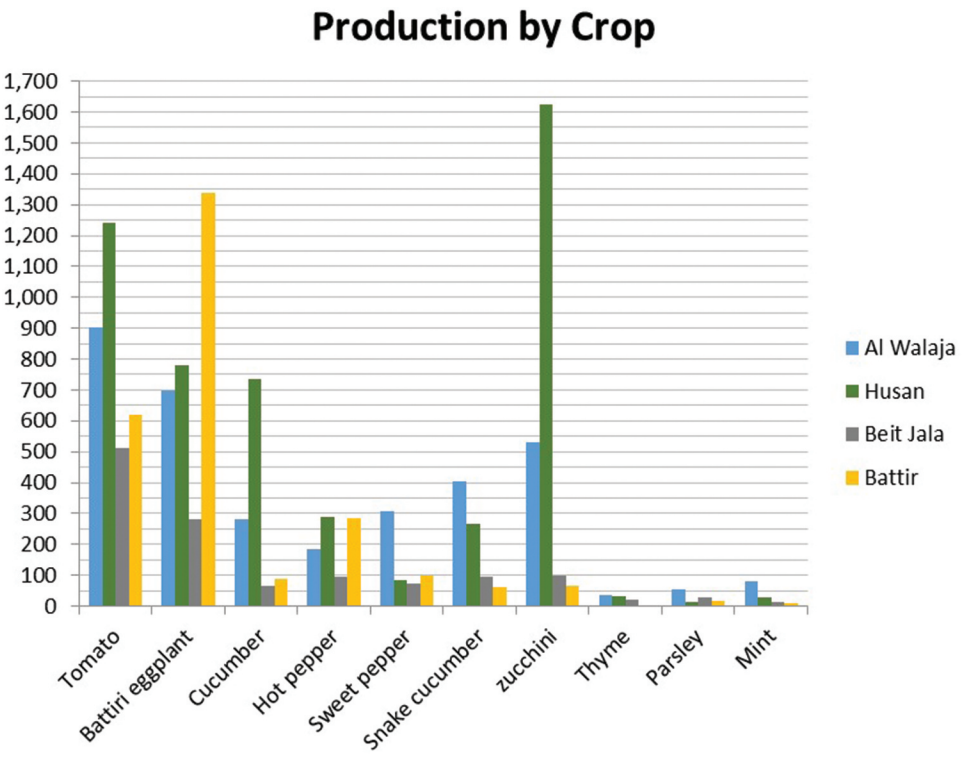

Figure 4. Sample production for some crops from benefitting farmers in summer 2020 (left axis in kilograms produced).

Table 2. Sample measured quantities of vegetables production and total selling value for summer cultivation 2020 for the 80 farmers from four communities targeted.

Crop type	Total Production (Kg)	Consumption by households (Kg)	Gifts (Kg)	Selling quantity (Kg)	Selling value (NIS)
Battiri Eggplants	2698	1277	421	1000	7440
Ajami Eggplants	162	147	15	0	0
Tomatoes	1266	1141	100	25	125
Squash	2062	1410	356	296	2300
Beans	1573	731	187	655	6040
Cowpeas	143	118	10	15	120
Cucumber	688	636	52	0	0
Snake cucumber	941	759	82	100	700
Hot pepper	238	213	5	20	180
Sweet pepper	184	180	4	0	0
Pumpkin	839	644	125	70	510
Sweet corn	562	532	30	0	0
Total	11356	7788	1387	2181	17415

- The marketing skills and selling points established at Bethlehem area markets were deemed most beneficial and farmers wanted more work along those lines. Women cooperatives especially appreciated the inputs

Figure 5. Women farmers with organic processed foods at selling point.

given to them both in buying them equipment and supplies (for example, for food preparation and marketing) but mostly in knowledge acquisition that helped them supplement income for over 60 families.

- Sustainable agricultural productivity increased at targeted sites where vegetable production increased by 30% of yearly production.
- The average percentage of savings in spending of households on buying vegetables during the season due to availability of the production was about 61%. During implementing the project, all the farmers achieved self-sufficiency from their vegetables. Whereas 69% of the production was consumed by the households, 18% of the production was distributed as gifts to farmers' relatives and friends, and 13% of the production was sold.
- The average percentage of the savings in the production input costs due to the production inputs provided by the project to the farmers (fertilizers, irrigation networks, seeds and seedlings, agricultural tools, etc.) was 71%.
- The average increase in crop productivity due to the use of permaculture practices was 22%.
- All farmers agreed that the quality of the products was better and free from any chemical contaminants.
- The total area that was cultivated by the farmers interviewed before the implementation of the project was 8.55 dunoms per growing season,

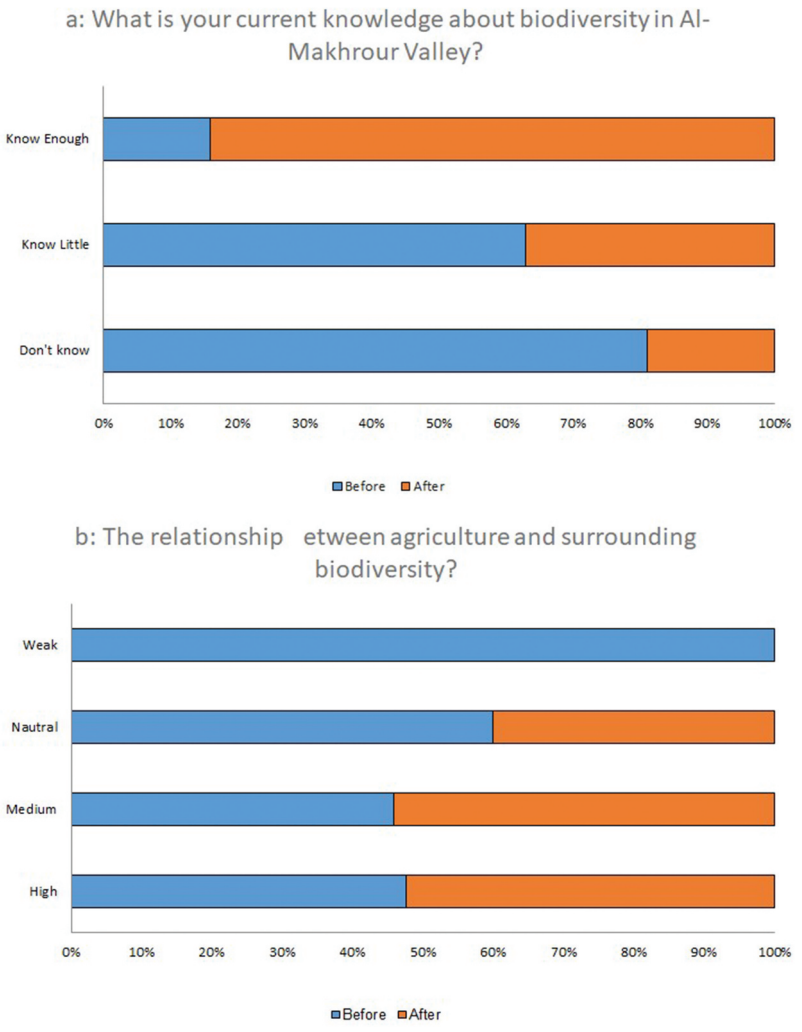

Figure 6. Change in knowledge about biodiversity for 80 participating farmers.

while the total cultivated area during the last growing season increased to 13.3 dunoms (55.6% increased).

- The project introduced some new types of vegetables to the farmers that were not grown before the implementation of the project such as kohl-rabi, broccoli, fennel, red cabbages, and arugula. These types have won the farmers' satisfaction and they will continue to cultivate them in the next seasons.
- Before implementing the project, 85% of the farmers interviewed used pesticides, 5% used natural alternatives, and 10% did not use anything to control the insects and diseases that affect the plants. During implementation of the project, all the farmers used only natural alternatives.

- Before implementing the project, 15% of the farmers interviewed used chemical fertilizers, 35% used both chemical fertilizers and unfermented animal manure, 45 used unfermented animal manure alone, and 5% did not use anything. During implementation of the project all the farmers used both natural fermented animal manure and compost. Ninety-five percent of the farmers now control the weeds manually and 5% by hoeing and plowing.
- Before implementing the project, 20% of the farmers interviewed used the weeds as food for the animals, 10% threw the weeds on borders of the field, 65% burned the weeds, and 5% either threw the weeds on borders of the field or burned them. During implementation of the project, 10% used the weeds either as food for the animals or composting, 45% used them either as soil cover or for composting, 10% used the weeds as soil cover, or turning it in the soil, or composting, 10% used them either for composting or turning it into the soil, 15% used the weeds for composting, and 10% used them either as soil cover or turning into the soil.
- Thirty-five percent of the farmers sold the surplus in production. These farmers stated that the demand for buying products that resulted from safe agriculture increased by an average of 26%, and the average selling price of the products increased by 21%. The average percentage of the savings in spending of the household for buying vegetables in the season due to availability of the production was about 61%.
- During implementation of the project, all the farmers achieved self-sufficiency from their vegetables produced. Sixty-nine percent of the production was consumed by the households, 18% of the production was distributed as gifts to farmers' relatives and friends, and 13% of the production was sold.
- The average percentage of the savings in production input costs due to the inputs provided by the project to the farmers (fertilizers, irrigation networks, seeds and seedlings, agricultural tools, etc.) was 71%.
- Because of the use of permaculture practices, the average production costs decreased by about 25%.

The impact of training workshops, educational field visits, and experience exchange visits on the awareness and knowledge of farmers was significant. All the interviewed farmers stated that, the training workshops held, agriculture extension and educational field visits, and experience exchange visits between farmers organized during the project had a significant impact on increasing farmers' knowledge and awareness of agroecological principles. All of the farmers who were interviewed said that they learned to apply eco-friendly agricultural practices and encourage other farmers to apply them leading to transforming toward agroecological systems. Ninety percent of the farmers

interviewed rated the project as excellent and 10% rated it very good. Notes and recommendations from the farmers included the importance of such projects, especially exchange visits and experience sharing and the need for regular support and consultation.

Farmers also suggested community-based improvements such as coordination in selling products and encouraging the future generation to engage in the agroecological field. As marketing was one of the main challenges farmers faced, many suggested 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, since 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 investing in securing availability of water resources. Some suggested a switch to drip irrigation despite the cost barrier due to its ability to increase productivity of land and varieties of crops.

Although new agricultural practices have developed over time, many locals return to more traditional practices. The project helped farmers understand that it is not an either/or situation but that agroecological methods can bridge the traditional methods with newer knowledge. One farmer, switched to using channels for irrigation due to a lack of water to fill up tanks for drip irrigation. This return to traditional agricultural practices was directly due to the lack of water from the municipality's system which at times is controlled and sometimes used by Israel as political leverage. Organic pesticides such as smoke from burning straw or planting repellent plants in a row of crops were used due to their effectiveness and care for the land rather than harming it with chemicals.

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 a lack of understanding the value of food sovereignty rather than the movement to service sectors providing more income. As the cost of caring for 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. Indigenous people traditionally feeling reconnected to their threatened land is a form of resistance to colonialism.

Multiple farmers mentioned that they go to their land even on holidays or days off to take care of it. The personal connection has existed since they were children assisting their parents in the land and continues to be strengthened 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.

Farmers faced many challenges such as climate change, water shortages, economic aspects (like cost), pests, lack of government support, etc. There will be dramatic impact of climate change on biodiversity and agriculture, including in this region (Lavergne et al. 2010; Mizyed 2009; Sternberg et al. 2015). When asked about climate change, 80% of the 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 (both agricultural and ecological), 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 by creating new jobs such as restaurants. 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 educates tourists on where their food is produced.

Closure and restriction of movement on the national level during the **COVID19 pandemic** halted normal movement of the project team, beneficiaries, and suppliers, which caused major problems, but the project team did adapt and even published a paper on the impact of the pandemic on biodiversity (Qumsiyeh and Abusarhan 2022). Delay in many operations were evident because of the lockdown on a national level. Measures taken by the project team to mitigate this included online work and flexibility in operations and movements (facilitated by special permits from appropriate authorities). We acquired some permits from the ministry of agriculture to distribute the seeds and transplants to farmers, so it should be stated that the project team has been functional despite the closure on two levels. That enabled the project team to function, to farm, and maintain conservation activities during the closure. In addition to what was accomplished with the farmers, other outputs were approached. Three dunoms as key habitats in the valley have been restored. Online communication with farmers, in addition to acquiring legal

permission to move, helped us transcend the limitations imposed due to the pandemic. The project team had formed social media groups for farmers who had access to the internet and were able to use smart media, and there was continuous communication and work with farmers, regarding advising and counseling related to farming activities. For the farmers, most of them were able to tend to their lands. The only exception was some farmers from Beit Jala because Al-Makhrour Valley falls under area C and Beit Jala main town is in Area A (areas of differing jurisdictions per the PLO-Israel interim agreement) so there was some restriction of movement. With flexibility, they were able to manage.

Discussion

Most Palestinians were subsistence farmers before 1948, when Israel occupied the West Bank and Gaza (22% of historic Palestine) in 1967. In the occupied Palestinian territories, there was then a dramatic decline in the contribution of the agricultural sector to the GDP from 50% in 1967 to less than 5% (UNCTAD 2015). The state of Israel directly targets indigenous people's agriculture (Ajarma et al. 2016; Kittaneh 2020; Reynolds 2015). 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 the 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). These more recent transformations resulted in food insecurity but also in loss of knowledge in ancient villages (e.g. Mourad Hanna, Friberg, and Qumsiyeh 2021). Other occupation actions do affect Palestinian bio-cultural landscapes (Husein and Qumsiyeh 2022; Reynolds 2015). There are limited data on agroecology work in Palestine (Hassouna 2024; Tesdell et al. 2020; Tesdell, Othman, and Alkhoury 2019). This project proposed to help local communities sustainably maintain semi-natural ecosystems in the target area. Our methods were predicated on first researching the area's biodiversity, conservation efforts (via education, and restoration), traditional agriculture practices, and socioeconomic status to guide us in empowering local people

The data summarized above show that it is possible to help farmers transition to an agroecological and sustainable model that leverages both indigenous knowledge and modern technology. This depended on research and knowledge of area biodiversity, conservation efforts (via education, and restoration), traditional and modern eco-friendly agricultural practices, and socioeconomic development of empowered local people. Socioeconomic status was improved through supplying the farmers with agricultural inputs and building their

capacities which resulted in enhancing their resilience. The project supported women groups in creating sustainable income generation SMEs by the project. The project has created a positive impact for 80 farmers in four communities, benefiting more than 500 individuals. Biodiversity conservation was improved by affecting positively the behaviors of the communities, through more friendly and traditional agricultural practices and through creating accountability among women, youth, & children toward saving the biodiversity. Awareness creation programs, which included workshops, training, & activities, were directed to the general community beyond the targeted communities, in addition to the mainstream and social media spots.

Outside support for agriculture is limited and derived mostly from nonprofits, the Palestinian government, and the local community. Nonprofits 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 extension 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.

Bio-cultural landscape as resistance and resilience

Israeli policies like building settlements, walls, and bypass roads negatively affect agriculture in Palestine, including in the targeted area. 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. Furthermore, the prices 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 that 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. Before 1967, villages in the targeted area depended largely on agriculture. More recently, the Israeli labor market absorbs 65% of the Battiri workforce and only 10% of the village's population work in agriculture (ARIJ 2010). This community 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 change in Palestinian society from subsistence farmers in harmony with nature to a service and humanitarian aid-dependent society over the past seven decades has severe ramifications for both humans and nature. Lack of food sovereignty creates unstable and unsustainable ecosystems (Harrigan 2014).

To return food sovereignty to the locals, communities, and development organizations have established initiatives to retain supply structures in the Palestinian territories. Resistance to occupation and colonization in the case of Palestine can be done via agriculture/return to the land (Abdelnour, Tartir, and Zurayk 2012; Zurayk 2012). Agroecological practices will be essential to sustainable agriculture (Wezel et al. 2014) and to biodiversity conservation (Qumsiyeh et al. 2017; Scherr and McNeely 2008). 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 and that they can trust unlike food from 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 be taken with the justification for further settlements.

Ecosystem services including agriculture are connected to culture organically; it is the cultural-ecological landscape (Mitchell, Rossler, and Tricaud 2009; Smith et al. 2016; 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 (Qumsiyeh 2018; Tsykalova 2015). 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. The 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 to rehabilitate 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.

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 connected. 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. 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 returns to agriculture activities when they realize the value of the land both symbolically and economically.

The Battiri eggplant it culturally connected to the heritage and namesake of 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.

There was insufficient support for farmers growing crops with cultural significance such as the olive tree and the eggplant. During the olive harvest, there are not enough workers to pick all the olives and land access is cut off due to Israeli policies. 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.

Our interventions in this area included developing an ethnography section of the Palestine Museum of Natural History, 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.

This study specifically describes advancing agroecological and sustainability models in a small area benefitting women cooperatives and farmers. Grassroots involvement, organization, community empowerment, and government involvement in agriculture at a larger scale could potentially improve the agricultural sector in the West Bank. Palestinian farmers in the targeted areas like other areas of Palestine (Kohlbry 2022; Perrier 2021; Tesdell et al. 2020; Tesdell, Othman, and Alkhoury 2019) are actively looking to counter the challenges. This pilot project showed that it is possible to enhance resilience of communities in the context of a biocultural landscape, thus creating sustainability and biodiversity conservation despite the challenges. The delivered outcome and outputs need to be replicated and expanded, but this also requires government actions to facilitate wide-scale transformation.

Conclusions

The paper demonstrates that a carefully designed biocultural and agroecological project to support farmers and communities can help protect nature and increase food sovereignty. Lessons learned from the three-year work undertaken with farmers include: 1) farmers themselves have a central role in transformation and were involved in all stages from planning to implementation; 2) there is an importance for including indigenous people's cultural heritage as a motivational factor but also because of the richness of this knowledge and its applicability; 3) indigenous farmers valued the use of farming as a tool to resist hegemony of a colonizing power; 4) the principles of eco-friendly agriculture go hand-in-hand with indigenous knowledge, ecosystem services, and food sovereignty; 5) many beneficiaries highlighted the need to enhance alternative tourism while conserving the environment (e.g., via ecotourism and agricultural tourism) which also diversifies sources of income; 6) women entrepreneurship enhanced sustainability and empowered the marginalized; and 7) the biocultural landscape in this area will serve

as a model for other Palestinian areas and maybe beyond to other developing countries. The project has already attracted national attention, and we are working with other communities in the north of the West Bank to create similar projects.

Acknowledgments

We would like to thank the team at the Palestine Institute for Biodiversity and Sustainability. We acknowledge the financial support of the Darwin Initiative (25–030) and the National Geographic Society [NGS-160C-18] for the biodiversity and agriculture component of this work. We thank the British Council for support of the cultural component [grant CPS-776-18].

Disclosure statement

No potential conflict of interest was reported by the author(s).

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