Pilot community tree planting project

Halawe village, Masafr Yatta, South Hebron Hills

A project of ActionAid Australia in cooperation with Bustan Qaraaqa

November 2010 to June 2011

An investigation into the viability of establishing tree planting projects with the pastoralist communities of the South Hebron Hills, West Bank, Palestine to reverse trends of environmental degradation and enhance communities' access to resources.

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Project Concept

1.1 General project information (Table 1)

Project Name:	Pilot community tree planting project, Halawe community, Masafr Yatta, West Bank
Date Project Commenced:	11 November 2010
Date Project to be Completed:	15 June 2011 (last field visit on May 31st 2011)
Reporting period covered in this report	11 November 2010 to May 31st 2011

Abbreviations used throughout this report:

1. **'BQ' = Bustan Qaraaqa** (the field team contracted to lead in implementing the project, carrying out environmental and social research in Halawe community, and preparing the report).
1. **'AAA' = ActionAid Australia** (the funders and initiators of the project, providing technical assistance and facilitator support to the field team).

1.2 Project rationale

The Palestinian natural land base is suffering from unprecedented environmental degradation. Overgrazing by ungulates, farmed in increasing densities to meet an ever rising demand for dietary protein, is one of the principal causes of loss of vegetative cover and thus regional desertification. Land use conversion resulting in habitat loss and degradation, coupled with widespread overgrazing preventing regeneration of native ecosystems together result in rapid loss of biodiversity of the region, much of which is endemic.

Loss of natural water storage capacity in the soil, and a recent cultural move away from rainwater harvesting systems, has caused a dependence on irrigation from groundwater to make land productive. Now soil conditions are such that rainwater runs-off land almost as soon as it lands, allowing this precious resource to flow unimpeded to the Dead Sea or other areas inaccessible to Palestinian communities, while exacerbating rates of soil erosion. Most farmers are therefore dependent on incredibly unreliable and expensive municipal water resources in order to meet irrigation needs. The infrastructure of water delivery is, in turn, largely controlled by Israel. Reduction in soil fertility has caused an increase in the use of inorganic fertilisers which, coupled with irrigation, can lead to soil salinization and loss of essential soil microbial communities.

The semi-nomadic villagers of the South Hebron Hills are particularly vulnerable to resource shortage, both naturally occurring and artificially created. Living on marginal land in the *barriya*, they are not connected to any water network and must bring water to their communities in tankers filled at municipal water points. On average this water is 5 to 10 times more expensive than piped water. In addition, they are sometimes subjected to obstruction by Israeli settlers and military personnel whilst going about this vital task. Lack of access to water limits the possibility for agriculture of any kind. Most families are economically reliant upon their herds. Water vulnerability affects the animals too, and in addition, lack of available forage due to land degradation makes the purchase of animal feed necessary for most months of the year. Climate change is expected to exacerbate this situation, as water resources and vegetation become scarcer yet, with longer, hotter summers and less rainfall in winter.

The purpose of this project is to build on work previously undertaken by AAA to rehabilitate rainwater cisterns in semi-nomadic communities, and develop a pilot community tree planting initiative. Tree planting has the potential to stop the current trend of environmental degradation, reverse the loss of soil fertility and humidity, and enhance availability of food, forage, fuel and timber resources to the community. If successful, this initiative may be scaled up to be implemented with other communities in the area.

1.3 Project outline (Table 2)

Project Summary	Performance Indicators	Means/Sources of Verification	Risks & Important Assumptions
Project Goal: To develop a tree planting pilot initiative in the southern community of " Halawe" (Hebron governorate)			
Project Purpose: To mitigate environmental degradation and improve the communities' access to resources	Planting of appropriate native tree crops. Creation of erosion prevention and rainwater harvesting earthworks Increasing awareness about environmental issues in the community	The pilot project up scaled to the surrounding communities	Tree planting in this area is viable The community are interested in maintaining the trees for long enough to gain access to potential resources The Israeli Occupation Forces will destroy the project (demolish cistern/ uproot trees)
Major Project Outputs			
Output 1: Reverse environmental degradation mainly soil erosion and biodiversity loss and increase access to resources.			
1.1 Planting of appropriate native tree crops	100 trees planted. Tree resources become available to the community. Biodiversity increased.	• Planted plots with 100 trees • Photos • Field visits reports • Community feedback • Project Manager and botanical technician report	Trees die immediately There is enough water in the community to keep the trees alive during the summer

1.2 Creation of rainwater harvesting earthworks	Rainwater harvesting earthworks created Soil erosion controlled Soil humidity increased	• Photos • Field visits reports • Community feedback • Project Manager and botanical technician report	
Output 2: Increasing awareness about environmental issues in the community			
2.1 A series of environmental awareness workshops implemented with various sectors of the community (women/ youth/ shepherds).	10 awareness workshops and workdays for # of women and men in Halawe community conducted	Environmental themes tackled. Practical manifestations of ideas discussed in use in the community (e.g. grey water reuse, rocket stoves etc).	Community are willing to participate in the workshops
Output 3: Evaluation of the pilot project's success for potential scaling up.			
3.1 Survey about community perception of environmental problems and the potential of tree planting to provide vital resources developed.	Survey distributed and filled in at the mobilisation phase. Data analysis for the findings conducted. Survey distributed and filled in at the end of the pilot project	Survey Data analysis report	Participants will answer questions honestly
3.2 Soil quality test at the beginning and at the end of the project	Soil samples collected and analysed before and after the practical phase of the project	Soil samples Soil tests report	
3.3 Community feedback and assessment at the end of the project conducted.	Workshop to assess the community's response conducted. # of community members attended and participated. The result of the workshop analysed and reported.	Community's feedback and assessment determine whether to replicate the project and scale it up over the nearby hamlets or not.	

1.4 Developmental outcomes

- Reverse soil erosion and loss of vegetative cover
- Enhance soil humidity, structure and fertility (soil wealth protection)
- Maximise rainfall interception, infiltration and utility
- Forage substitution and enhanced agricultural diversity to reduce grazing pressure
- Create wildlife habitats to slow the rate of loss of biodiversity
- Re-introduction of locally extinct, but historically economically significant plant species
    - Direct products: Food (Fruits, nuts, seeds, leaves, oil); building materials (timber, fibre); fuel (firewood, charcoal, oil);
    - Indirect products: Meat, dairy and honey (by providing animal forage);
    - Services: microclimatic improvement; improvement of soil structure and fertility; protection of biodiversity; rainwater catchment enhancement.

1.5 Beneficiaries

The proposed project focuses in Bedouin communities in the South Hebron Hills. The initial phase will take the form of a 'pilot project' working with just one community (Halawe) to create a working model to trial and demonstrate the various techniques which we believe are appropriate to this context. If this pilot proves successful, we hope to be able to scale up the project to include other communities, and we believe that the existence of a successful model will increase enthusiasm and willingness to participate.

1.6 Project schedule (Table 3)

Time period	Activity
December 2010	Preliminary visit to the community to assess suitability for participation in the project
December 2010 – January 2011	Selection of participating community Development of project concept Propagation of suitable native tree species
February 2011	Community mobilisation and consultation Physical design of project (where and what) Procurement of materials Preliminary survey and soil tests Begin work on fence and earthworks
March 2011	Project implementation – earthworks and tree planting (4 workdays)
April 2011	Follow-up workshops: ➢ Soil management ➢ Rainwater harvesting ➢ Greywater re-use
May 2011	Follow-up workshops: ➢ Tree maintenance ➢ Uses for tree products ➢ Sustainability
June 2011	Project assessment ➢ Final survey and community consultation ➢ Preparation of reports

Project implementation

2.1 Project achievements and analysis (Table 4)

Activity no.	Project Activities	Achievement
Output 1: Reverse environmental degradation mainly soil erosion and biodiversity loss and increase access to resources.		
1.1	Planting of appropriate native tree crops	109 trees planted (of which 94 surviving at end of project) at 4 different locations in Halawe village
1.2	Creation of rainwater harvesting earthworks	Swales, bunds, pit planting and stone mulching demonstrated at various locations in the village. Participants trained in use of water levels for surveying land.
Output 2: Increasing awareness about environmental issues in the community		
2.1	A series of environmental awareness workshops with various sectors of the community (women/ youth/ shepherds).	4 workshops on water harvesting, soil management, functions and uses of trees and propagation of trees held. A total of 8 different participants taught (although not all people attended all the workshops)
Output 3: Evaluation of the pilot project's success for potential scaling up		
3.1	Survey about community perception of environmental problems and the potential of tree planting to provide vital resources	Qualitative data collected throughout project period Observations included in report
3.2	Soil quality test at the beginning and at the end of the project	Soil analysis implemented at the beginning of the project providing baseline data for future research
3.3	Community feedback and assessment at the end of the project	Community feedback survey administered
Additional outputs: Unplanned bonuses		
1	Water	1300 litres of water delivered to the community to help keep trees alive
2	Awareness raising/ advocacy	10 volunteers from 7 different countries introduced to the Masafr Yatta area and educated about the plight of the people living there Coverage of project on Maan News

2.2 Summary of field visits

Due to delays in starting the project caused by the impassability of the roads in February (as a result of heavy rainfall), and a few unforeseen internal issues in the community, it was necessary to compress original project schedule somewhat. A total of 13 field visits were made by the BQ consulting team, volunteers and AAA facilitators between November 2010 and May 2011 as follows:

Table 5: Summary of field visits

Date of visit	Personnel present	Duration	Actions taken
11/11/2010	Alice Gray (BQ) Thomas Fernley-Pearson (BQ) Nadim Zaghloul (AAA) Baker Amr (AAA)	5 hours	Visits to three communities in the Masafr Yatta area: Al Halaweh, Isfey Al Foga, Al Tuba Interviews with community members to assess willingness to participate in the proposed project and perceptions towards tree planting Selection of Halawe community for the pilot project on the basis of community interest and investment in tree planting
01/03/2011	Alice Gray (BQ) Thomas Fernley-Pearson (BQ) Amani Mustafa (AAA) Baker Amr (AAA)	3.5 hours	Community mobilisation meeting Two participants enlisted (Sheikh Ali and Sheikh Ahmed), two sites selected (valley and hilltop) and initial observations made
08/03/2011	Alice Gray (BQ) Thomas Fernley-Pearson (BQ)	8 hours	One additional participant enlisted (Sheikh Hanin) Three sites measured and mapped 47 soil samples taken and delivered to AAA office in Hebron to be analyzed at Hebron Polytechnic college
15/03/2011	Alice Gray (BQ) Thomas Fernley-Pearson (BQ) Sheila Lafferty (BQ vol) Anais Powell (BQ vol)	10 hours	33 trees delivered and planted at Sites 1 and 2 (Valley and Hilltop) Digging tools delivered and left with the community Water harvesting ditches (swales) surveyed and marked out at Hilltop site Participants trained in use of water level to survey for rainwater harvesting earthworks
22/03/2011	Alice Gray (BQ) Thomas Fernley-Pearson (BQ) Sheila Lafferty (BQ vol) Fadel Ewidat (AAA)	10 hours	33 trees delivered and 20 planted at Site 1 (Valley) Site 3 landowner interviewed to ascertain tree preferences Water harvesting earthworks at Site 3 (Hillside) surveyed and marked out

29/03/2011	Alice Gray (BQ) Thomas Fernley-Pearson (BQ) Max Ward (BQ vol) Lauren Stanton (BQ vol) Fadel Ewidat (AAA)	8 hours	30 trees delivered and planted at Sites 1, 2 and 3 100 litres of water delivered Previously planted trees checked and watered
******	****************	*******	Field visits temporarily suspended due to internal problems in the community regarding Site 2 landowner (Sheikh Ali) and his family
12/04/2011	Fadel Ewidat (AAA)	6 hours	Fence delivered and sites 1 and 3 enclosed. Additional site selected on valley floor: Site 4
19/04/2011	Alice Gray (BQ) Thomas Fernley-Pearson (BQ) Gawdat Sayeh (BQ vol, independent film maker) Nasser Ibrahim (BQ vol) Fadel Ewidat (AAA)	8 hours	13 trees delivered and planted at new location (Site 4) Socioeconomic survey administered to owners of sites 1 and 3 (Sheikh Ahmed and Sheikh Hanin) 200 litres of water delivered Previously planted trees checked and watered
26/04/2011	Alice Gray (BQ) Thomas Fernley-Pearson (BQ) Awad Abu Sway (BQ)	7 hours	200 litres of water delivered Previously planted trees checked and watered Water harvesting workshop implemented (4 participants)
03/05/2011	Alice Gray (BQ) Thomas Fernley-Pearson (BQ) Max Ward (BQ vol) Martin Smith (BQ vol)	7 hours	200 litres of water delivered Previously planted trees checked and watered Soil management workshop implemented (3 participants)
10/05/2011	Alice Gray (BQ) Thomas Fernley-Pearson (BQ) Awad Abu Sway (BQ) Max Ward (BQ vol) Anais Powell (BQ vol) Lorena Viladomat (BQ vol) Philip Jones (BQ vol)	8.5 hours	200 litres of water delivered Previously planted trees checked and watered Functions and uses of vegetation workshop implemented (5 participants)
24/05/2011	Alice Gray (BQ) Thomas Fernley-Pearson (BQ) Awad Abu Sway (BQ) Phillipe Varichon (BQ vol) Fadel Ewidat (AAA)	7.5 hours	200 litres of water delivered Previously planted trees checked and watered Tree propagation workshop implemented (6 participants)
31/05/2011	Alice Gray (BQ) Thomas Fernley-Pearson (BQ) Awad Abu Sway (BQ) Max Ward (BQ vol) Anais Powell (BQ vol)	6 hours	200 litres of water delivered Previously planted trees checked and watered Community feedback survey administered

Table 6: Team members and person-hours spent in field

	BQ consultants	BQ volunteers	AAA personnel
Team members	Alice Gray Thomas Fernley-Pearson Awad Abu Sway	Anais Powell Sheila Lafferty Jawdat Sayeh Nasser Ibrahim Max Ward Lauren Stanton Lorena Viladomat Philip Jones Martin Smith Philippe Varichon	Nadim Zaghloul Baker Amr Amani Mustafa Fadel Ewidat
Person-hours spent in field	206	121.5	56.5

The project implementation essentially fell into 4 phases:

- Community consultation and site selection
- Initial surveys (ecological assessment, soil survey, interviews with participants)
- Workday implementation
- Workshop implementation

2.3 Community consultation and site selection

A short-list of three prospective communities for participation in the project was identified by AAA: Tuba, Isfey Al Foga and Halawe. All are pastoralist communities whose dwellings include caves and tents. Dairy produce is the dominant economic activity. The three communities are located in the Masafr Yatta; a region where the dividing ridge of the Judean Hills comes to an end and the Judean and Naqab Deserts meet. Located south of the city of Hebron, the dry, extensively eroded foothills descend into the Naqab Desert to the south and the Judean Desert sloping to the Dead Sea Basin to the East.

All three communities were visited in a single day. Halawe Community was selected by the team for the pilot project because it offered the following opportunities over the other sites:

- Proximity of contrasting geographic conditions to community dwellings (ridge, steep valley side and valley floor) providing the opportunity to demonstrate how the different physical conditions at each site require different management techniques and appropriate species selection.
- Location and size of serviceable cisterns as an indication of water resources available for the irrigation of trees.
- Keen interest and will expressed by residents in the objectives and means of the project. Significant in the making of this decision was the observation that the community had fenced and planted a small orchard on the valley floor close to the dwellings and were irrigating the trees in the long dry summer months from their precious and scarce water reserves. This observation confirmed to the team that the people of Halawe could reap the benefits of this pilot project by deploying resources and information to improve the utility and productivity of

the land by building on and continuing their own initiative of tree planting. The team agreed this was the most culturally appropriate way to use our resources.

Having selected Halawe community and gained the consent of three families offering parcels of their land to participate in the project we selected three sites. The sites were not selected according to their vulnerability to degradation nor their potential productivity but because they were suggested by the project participants and because they, between them, represent the three main types of environment that the community has to work with. By selecting valley, hillside and ridge-top sites we aimed to demonstrate the challenges and opportunities peculiar to the conditions at such contrasting sites and thus demonstrate how the principles of system design result in different management techniques and species selection.

2.4 Initial surveys

2.4.1 Ecological Assessment

2.4.1.1 Site 1: Valley

Site description

- Narrow (20m wide), deeply incised valley ‘wadi’ draining eroded steppe towards the desert to the South.
- Deep, fertile soil although exposed by ploughing and eroded by wind and runoff.
- This site is the site located closest to the water table (but see below) and offers the possibility of harvesting large quantities of runoff from the slopes above.
- There are two cisterns nearby, one on each opposing valley side which may serve as possible sources of irrigation water.
- The site is exposed to desiccating winds but more sheltered than the other sites by the steep valley sides which also offer some crepuscular shade.
- Although the site is dry, receiving erratic sparse precipitation, the wadi has nevertheless been cultivated over millennia (shards of iron age pottery can be seen in the ploughed soil).
- Winter rain totalling up to 300mm falls on the sparsely vegetated, steep valley sides causing runoff to flow through the valley and in rare years the entire valley floor floods for hours on end.
- Vegetation loss, dropping water table and the destabilisation of the soils have resulted in massive soil erosion.

- A gulley is cutting down into the valley floor lowering the water table locally under this site.

- Close to dwellings (<50m).

- There is a very dry bustan agricultural system with ploughed soil and a few fruit trees (fig, olive, almond) and vines planted seven years ago and receiving irrigation throughout the dry months.

Table 7: Existing trees at Site 1

Species:	Number:
Opuntia ficus-indica	8
Olea europea	9
Ficus carica	8
Prunus dulcis	10
Vitis vinifera	34 (plus numerous establishing cuttings)
Cupressus sempervirens	1
Prunus armeniaca	6
Citrus	4
Punica granatum	3
Psidium guajava	2

Ecological challenges

- Soil erosion
- Runoff
- Overgrazing
- Extremely hot and long dry season
- Desicating wind

Other comments

Site lies in a valley running north to south. It is already enclosed with a fence, and contains some 7 year old vines and some young fruit trees (5-10 yrs old). Water harvesting opportunities are plentiful since there is plenty of higher ground on both sides of the valley.

2.4.1.2 Site 2: Hilltop

Site description

- Semi Arid Steppe (precip. <300m), seasonally ploughed, located on top of a limestone ridge extremely exposed to desiccating desert winds and isolation from dawn until dusk.

- Between rocky protrusions in a shallow, erosion impoverished clay soil, seasonal ephemeral vegetation of diverse herbs and few recalcitrant geophytes, such as *Asphodelus,* endure the grazing and ploughing regime.

- Situated 100 m from dwelling.

- Close (but above!) the 150 cubic metre rock cistern (bir anjas). Availability of water from the bier is limited to what remains after the household and livestock are provided for.

- An additional tanker of water may need to be bought for irrigation of the trees dependent on the number of livestock kept at Halawe.

Ecological challenges

- Soil erosion
- Runoff
- Overgrazing
- Extremely hot and long dry season
- Exposed, wind desiccated site
- No shade

2.4.1.3 Site 3: Hillside

Site description

- This site is located between the dwellings on the valley side half way down the slope between sites 2 and 1.

- The gradient is steep although two terrace walls (one on the lower boundary of the site and the other bisecting it) serve to lessen the gradient.

- Facing east the site is exposed to the desiccating morning sun and desert wind.

- The soil is deep but dry though not infertile.

- There is the possibility of collecting runoff to increase soil humidity.

- The soil is ploughed and eroding over the dilapidated terrace walls.

- Adjacent and above the site is a heap of goat manure doubtless leached into the soil.

- There is no perennial flora.

Ecological challenges

- Soil erosion
- Runoff
- Overgrazing
- Extremely hot and long dry season
- Exposed, wind desiccated site
- No shade

2.4.2 Soil survey

2.4.2.1 Soil sampling protocol

- At each of the 3 sites, a soil pit was dug in an attempt to identify horizons
- Based on horizon identification, 3 standard volume samples from three different depths were taken: top soil, sub soil and parent material (probably about 0-15cm, 15cm-60cm and 60cm-1m)
- A further 7 topsoil samples (0-15cm depth) were taken in each site in a randomized design
- All samples were labelled and taken to the laboratory at Hebron Polytechnic College for analysis of pH, Electrical Conductivity, Soil Moisture, Water Holding Capacity, Organic Matter Content, Bulk Density and Major Nutrients (NPK)
- Basic soil characterization tests were performed in the field (texture analysis etc) and results recorded

2.4.2.2 Preliminary observations of soil

- Site 1 (Valley)

Soil is very deep here and is grey-brown in character, changing to red brown when wet. Parent material is at a depth of greater than 80cm, although the soil becomes increasingly compacted from about 40cm downwards. Topsoil has a granular structure, and a clayey-silty (more clay than silt) texture, with a little sand. Soil is very moist below a depth of 20cm. Parent material is calcareous rocks, although much of this soil has presumably been carried downhill from the steeply sloping valley sides (i.e. it is accumulating from the top).

- Site 2 (Hilltop)

Soil is much thinner here than on valley floor and is clearly very vulnerable to erosion. Nevertheless it has clearly been ploughed this year (a practice that we would recommend ceasing). Soil is moist below 30cm, and parent material (large limestone rocks) and bedrock (sheets of limestone rock) occurs at a variable depth, depending on the topography of underlying outcrops. Maximum soil depth is probably 60-80cm. There is the possibility of pit-planting in selected locations. Soil has granular structure similar to other sites, and a clayey/silty consistency, grey-brown colour, transitioning to red-brown when wet.

- Site 3 (Hillside)

Soil is reasonably deep, displaying a horizon of topsoil from 0-20cm, under which a marginally stony (small white rocks) second horizon (20-60cm) sits above the parent material which is at a depth of approximately 60-70cm. We did not dig down to the bedrock. Evidence of plough-panning (i.e. there is layer of very compacted soil at a depth of 20-30cm). Top soil is granular in structure. Soil is a calcareous clay-silt, with just a little sand, parent material is limestone. The soil is browner in colour than at the two other sites, possibly as a result of the presence of a lot of rotted manure (there is a large manure heap directly uphill of the site, raising the possibility of some nutrient leaching; and in addition, wind-blown manure is being added to the soil).

2.4.2.3 Soil analysis

Summary

- Laboratory analysis of soil samples revealed that soil quality in Halawe village is of cultivable standard. The soil is in a class called 'Mollisol' (USDA classification) that is typical of semi-arid grasslands over limestone rocks.

- Average pH is 7.5 (a touch alkaline as one would expect of any soil formed over limestone), and average electrical conductivity is approximately 0.5 ds/m (medium to high), indicating a relatively nutrient rich soil, with a good deal of the nutrients existing as charged ions available for uptake by plants from the soil solution.

- Potassium and Phosphorous data also indicate a medium to high nutrient content. Unfortunately, due to equipment malfunction at the laboratory it was not possible to obtain any Nitrogen data, however, given the high electrical conductivity in combination with medium to high content of Potassium and Phosphorous, it is assumed that the soil also contains medium to high levels of Nitrogen.

- With an average organic matter content of approximately 3.6 %, the soil is in a relatively healthy state, capable of supporting a microbial community and soil macrofauna. Unsurprisingly, since most plant root activity occurs in the topsoil, the vast majority of organic matter was also found in the topsoil (3.6 % compared to 1.4 % and 1.2 % for the B and C Horizons respectively).

- The average water holding capacity of the topsoil is approximately 50 % (not too fast-draining), although average soil moisture stood at approximately 11 %, well below the potential total (not surprisingly given that the samples were taken in March, at least 10 days after the last rainfall in the area).

- Water holding capacity and soil moisture in the B horizon (15-40 cm) were somewhat higher (52 % and 13.5 % respectively), declining to lower values (48.6 % and 11.7 %) in the C horizon (40-60 %), presumably due to the presence of a larger number of big rocks.

- The average bulk density of 1.5 g/cm^3 for the topsoil indicates that it is not heavily compacted, and despite repeated ploughing, neither the B nor the C horizon of the soil were significantly denser.

- Mean values for topsoil analysis and differences between soil horizons across all sites are summarized in tables 8 and 9. The full dataset is included in Appendix A.

Table 8: Comparison of topsoil analysis for Sites 1, 2 and 3 (Valley, Hilltop and Hillside respectively)

Case Summaries

Site ID		pH	Electrical conductivity (ds/m)	Soil moisture content (%)	Water holding capacity (%)	Bulk density (g/cm3)	Organic matter content (%)	Potassium (meq/100g)	Phosphorous (ppm)
Valley	N	11	11	11	11	11	11	11	11
	Mean	7.3382	.6065	14.2227	53.7518	1.5364	4.1127	1.8800	35.4882
	Std. Deviation	.14148	.20977	5.74420	7.55924	.14403	1.36953	.48920	19.09157
Hilltop	N	10	10	10	10	10	10	10	10
	Mean	7.6060	.2989	8.1500	42.2250	1.5370	2.3890	.7210	5.5370
	Std. Deviation	.09913	.06860	1.91203	2.96059	.10111	.75728	.08517	3.04962
Hillside	N	6	6	6	6	6	6	6	6
	Mean	7.7733	.6093	9.6133	51.1850	1.5700	4.4783	2.5833	34.7800
	Std. Deviation	.09832	.19601	1.56744	4.86299	.06066	.43843	.41438	14.34255
Total	N	27	27	27	27	27	27	27	27
	Mean	7.5341	.4932	10.9493	48.9122	1.5441	3.5556	1.6070	24.2378
	Std. Deviation	.21070	.22136	4.73158	7.60661	.11147	1.34466	.82523	19.91659

Table 9: Comparison of soil horizon analysis for all sites

Case Summaries

Soil horizon		pH	Electrical conductivity (ds/m)	Soil moisture content (%)	Water holding capacity (%)	Bulk density (g/cm3)	Organic matter content (%)	Potassium (meq/100g)	Phosphorous (ppm)
A	N	27	27	27	27	27	27	27	27
	Mean	7.5341	.4932	10.9493	48.9122	1.5441	3.5556	1.6070	24.2378
	Std. Deviation	.21070	.22136	4.73158	7.60661	.11147	1.34466	.82523	19.91659
B	N	9	9	9	9	9	9	9	9
	Mean	7.7400	.5483	13.4789	52.0367	1.6089	1.3500	1.4833	4.9367
	Std. Deviation	.20982	.35182	2.56087	7.51457	.08492	.32144	1.40205	1.99008
C	N	9	9	9	9	9	9	9	9
	Mean	7.6089	.8928	11.6744	48.6644	1.5956	1.2367	1.5389	6.3878
	Std. Deviation	.11472	1.00066	1.83399	9.24035	.05876	.31233	1.50245	5.02386
Total	N	45	45	45	45	45	45	45	45
	Mean	7.5902	.5841	11.6002	49.4876	1.5673	2.6507	1.5687	16.8076
	Std. Deviation	.20791	.50827	4.00202	7.85191	.10064	1.53702	1.08297	18.01708

Differences between sites

Statistical analysis of data revealed significant differences in organic matter content, water holding capacity, soil moisture content, electrical conductivity and major nutrient content between the top-soil at the 3 different sites sampled. There were also very small but significant differences in pH between the 3 sites. Since the vast majority of plant root activity is confined to the topsoil, this is the most significant part of the soil for the purposes of assessing fertility and general health of the soil ecosystem.

Table 10: Analysis of variance for differences in the properties of the topsoil at the 3 sites sampled

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Electrical conductivity (ds/m)	Between Groups	.600	2	.300	10.667	.000
	Within Groups	.674	24	.028		
	Total	1.274	26			
Water holding capacity (%)	Between Groups	735.821	2	367.911	11.489	.000
	Within Groups	768.551	24	32.023		
	Total	1504.372	26			
Organic matter content (%)	Between Groups	22.132	2	11.066	10.676	.000
	Within Groups	24.878	24	1.037		
	Total	47.011	26			
Potassium (meq/100g)	Between Groups	14.389	2	7.195	52.056	.000
	Within Groups	3.317	24	.138		
	Total	17.706	26			
Phosphorous (ppm)	Between Groups	5556.309	2	2778.155	14.016	.000
	Within Groups	4757.127	24	198.214		
	Total	10313.436	26			
pH	Between Groups	.817	2	.409	29.109	.000
	Within Groups	.337	24	.014		
	Total	1.154	26			
Soil moisture content (%)	Between Groups	206.938	2	103.469	6.619	.005
	Within Groups	375.145	24	15.631		
	Total	582.083	26			
Bulk density (g/cm3)	Between Groups	.005	2	.003	.196	.823
	Within Groups	.318	24	.013		
	Total	.323	26			

Interestingly, nutrient content and water holding capacity were found to be considerably lower in soil from the hilltop site than in soil from the valley or hillside sites. Electrical conductivity (EC) is a measure of the number of charged particles present in the soil, and is related to nutrient content. In the graph below, it is possible to see that the same pattern applies to the three variables: EC, potassium and phosphorous; namely that all three are much lower at the hilltop site than in the valley or on the hillside (both of which have comparable levels of nutrients . Correlation between EC and Phosphorous and EC and Potassium were found to be significant at the 0.01 level.

Table 11: Correlation between Electrical Conductivity and Phosphorous content of soils sampled

Correlations

		Electrical conductivity (ds/m)	Phosphorous (ppm)
Electrical conductivity (ds/m)	Pearson Correlation	1	.800**
	Sig. (2-tailed)		.000
	N	27	27
Phosphorous (ppm)	Pearson Correlation	.800**	1
	Sig. (2-tailed)	.000	
	N	27	27

**. Correlation is significant at the 0.01 level (2-tailed).

Table 12: Correlation between Electrical Conductivity and Potassium content of soils sampled

Correlations

		Electrical conductivity (ds/m)	Potassium (meq/100g)
Electrical conductivity (ds/m)	Pearson Correlation	1	.814**
	Sig. (2-tailed)		.000
	N	27	27
Potassium (meq/100g)	Pearson Correlation	.814**	1
	Sig. (2-tailed)	.000	
	N	27	27

**. Correlation is significant at the 0.01 level (2-tailed).

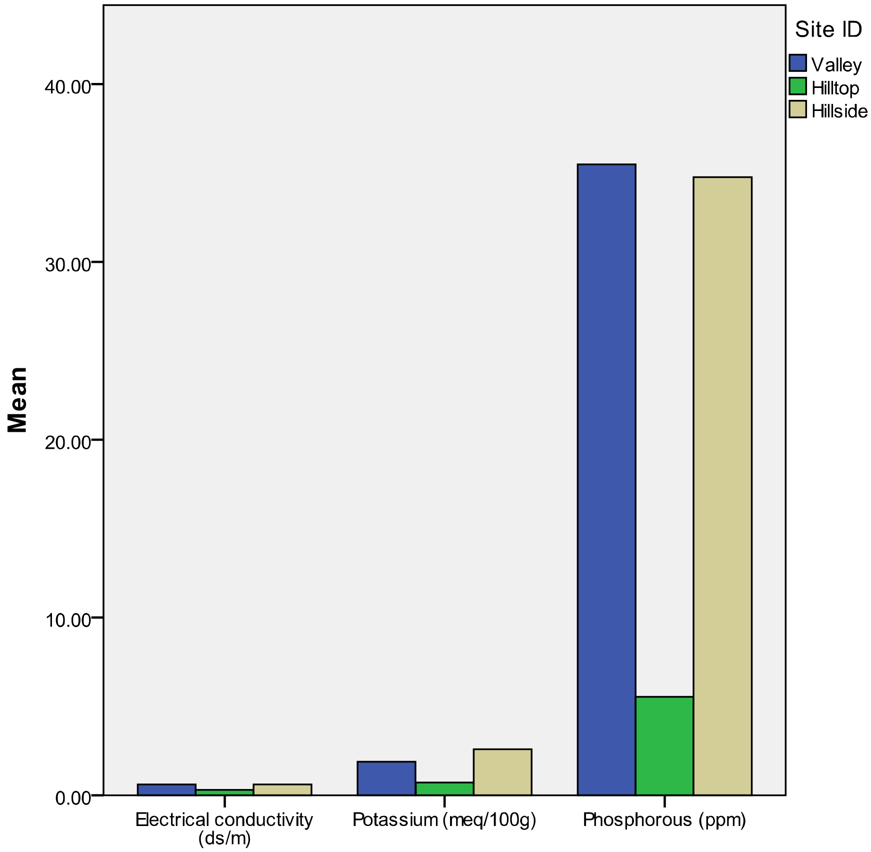

Figure 8: Bar graph showing mean nutrient availability and electrical conductivity at the 3 sites sampled

Obviously, nutrient content and electrical conductivity are related to the organic matter content (OM) of the soil, particularly in soils that are not being treated with chemical fertilizers where most available nutrients are ultimately derived from organic matter. OM and EC are also significantly correlated at the 0.01 level.

Table 13: Correlation between Electrical Conductivity and Organic Matter content of soils sampled

Correlations

		Electrical conductivity (ds/m)	Organic matter content (%)
Electrical conductivity (ds/m)	Pearson Correlation	1	.796**
	Sig. (2-tailed)		.000
	N	27	27
Organic matter content (%)	Pearson Correlation	.796**	1
	Sig. (2-tailed)	.000	
	N	27	27

**. Correlation is significant at the 0.01 level (2-tailed).

OM is not only important in determining the nutrient availability of the soil. Together with the particulate composition of the soil (sand, clay, silt), it also determines water holding capacity (WHC), which in turn affects soil moisture (SM). Therefore, at the hilltop site where OM is low, WHC and SM are also low (see graph below). The correlation between OM and WHC is also significant at the 0.01 level.

Table 14: Correlation between Organic Matter content and Water Holding Capacity of soils sampled

Correlations

		Organic matter content (%)	Water holding capacity (%)
Organic matter content (%)	Pearson Correlation	1	.802**
	Sig. (2-tailed)		.000
	N	27	27
Water holding capacity (%)	Pearson Correlation	.802**	1
	Sig. (2-tailed)	.000	
	N	27	27

**. Correlation is significant at the 0.01 level (2-tailed).

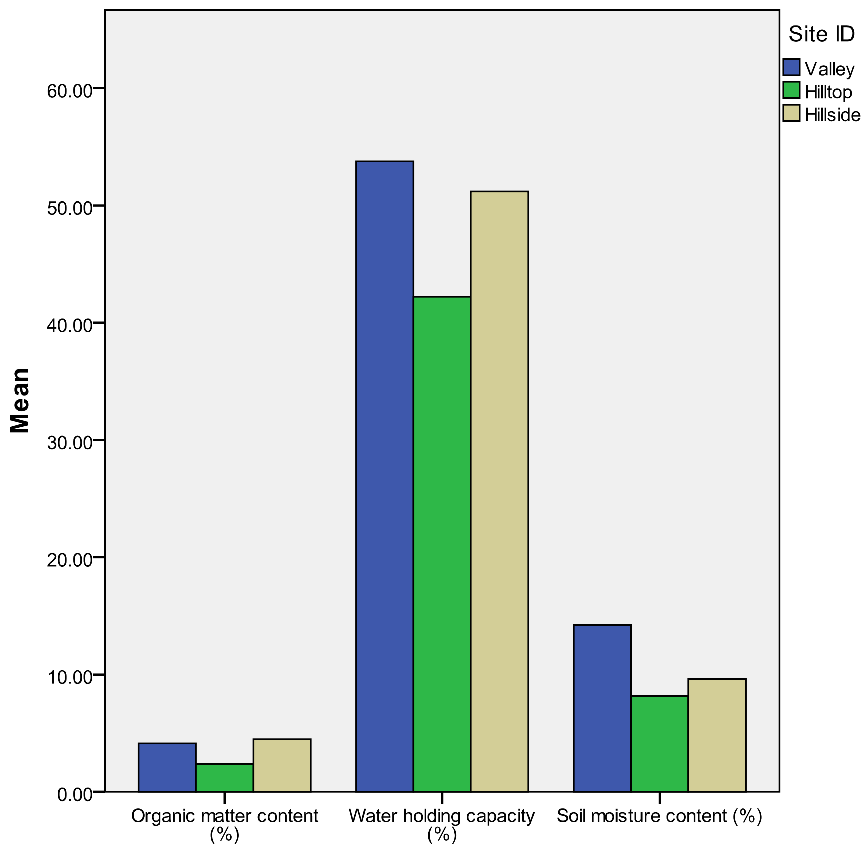

Figure 9: Bar graph showing comparison of mean Organic matter content, water holding capacity and soil moisture content of the soils at the 3 sites sampled

This highlights the importance of protecting and building soils, since a depleted soil is not only low in nutrients, but will also limit plant growth through low water availability. The depleted state of the soil on the hilltop is presumably as a result of high rates of wind erosion (the valley and hillside being much more sheltered than the hilltop) which carries away the lightest fractions of the soil: organic matter and fine silt and clay particles. Those light soil fractions are the ones that determine WHC: soils with a lot of fine particles can hold more water than sandy soils; and soils high in OM can hold more water than soils that are low in OM.

It is also worth noting that since there are such strong correlations between the different soil variables, the number of tests carried out could be significantly reduced in the future to perhaps just a handful of diagnostics such as electrical conductivity, pH and organic matter content, which would give a good enough overview of the state of the soil and from which variables such as water holding capacity could be inferred.

2.4.3 Interviews with landowners

Short interviews were conducted with project participants in order to better understand their land and resource use patterns. Not only does this help with tailoring planted orchards to the needs of the community and design of appropriate workshops, but it also provides vital information to help direct possible future projects. The interviews also provided insight into the community's relationship with and perception of the environment for qualitative analysis. Full transcripts of the interviews can be found in Appendix B. Unfortunately, it was not possible to interview Sheikh Ali (Site 2) for reasons that will be explained fully in the next section (2.5). The data below are therefore based on interviews with the owners of sites 1 and 3 (Sheikh Ahmed and Sheikh Hanin), and some *ad hoc* observations.

- Social structure

  The villagers live in family groups of around 15 people (usually including 3 generations). They live in a combination of tents and caves (often living spaces are in the caves as they remain cool during the hot days of summer, whereas people sleep in nearby tents).

  In the cases of both participants interviewed, there are family members who live outside the village and work in different professions, but apparently they do not send resources back to their families. All of the adults and the older children living in the village are involved in food production and working with the animals.

  In general, the men take care of the cultivation and herding, whereas women do the milking and processing of dairy products. Women are also involved in growing vegetables and herbs within the village (planting, weeding and watering), and maintaining the trees in the orchard (in the case of Sheikh Ahmed's family).

Plate 1: A typical dwelling in Halawe village

- **Economy**

The main source of income for the villagers is the sale of dairy products, as well as some livestock. They do not sell wool (they have tried but there is no market apparently). Each Sheikh owns between 200 and 300 head of cattle (goats and sheep), of which sheep are the more valuable. In a good year they can make between 50 000 and 100 000 shekels.

Main sources of expenditure are:

- Food to supplement products from the animals (rice, sugar, coffee, tea, flour, fruit and vegetables etc), at a cost of between 2000 and 4000 shekels per month (Sheikh Ahmed's family, who grow more fruit and veg spend the lesser amount)
- Forage for the animals at a cost of between 5000 and 12000 shekels per year (Sheikh Hanin's family, who have more land and grow more forage spend the lesser amount)
- Water, which has to be tankered in at vast expense during the summer (4 cubic metres per day at a total cost of 220 shekels including purchase of the water and hire of a tractor to drag it). This amounts to over 6660 shekels per month from April to October!


Plate 2: Sheikh Ahmed’s flock in their shelter

Plate 3: Water tanker in Halawe village, guarded by dog

- **Land use**

Sheikh Ahmed has 20 dunums of land and Sheikh Hanin has 80. Land is used to raise barley as a fodder crop for the animals, a little tobacco, and, in Sheikh Ahmed's case, vegetables for his family. This land is ploughed two times every year: once in the autumn to 'open' it for the rain, and once in the spring to 'clean' it (turn all the weeds in), before it is sown again. Land may be ploughed by either tractor (Sheikh Hanin) or mule-drawn plough (Sheikh Ahmed). All crops grown on this land are rain-fed, and yield is highly variable from year to year depending on precipitation levels.

In addition, Sheikh Ahmed has a plot of land under intensive production, where he grows fruit trees and vegetables. He ploughs this plot 4 times per year – once to open it for the rain in September/ October and every month subsequently. He irrigates the trees on this plot during the summer. All vegetables and fruit raised are consumed by his family – none are sold. They also still buy some fruit and vegetables to supplement their diets (i.e. they do not raise enough to be self-sufficient).

- **Environmental resource use**
    - Water:

      Sheikh Ahmed has 3 rainwater cisterns with a total storage capacity of 260 cubic metres. Sheikh Hanin has 2 with total capacity of 135 cubic metres. Normally these cisterns fill with rainwater during the winter, although this year rainfall was so low that the cisterns were less than half full. This water normally lasts at least until April or May, but this year it was almost completely finished in March. Harvested rainwater is not considered to be fit for drinking as there is a lot of animal manure on the hillside and bugs breed in the water. Drinking water is stored separately in small cisterns next to the dwellings.

Plate 4: Rainwater harvesting channel

    - Fuel:

      Natch (*Sarcopoterium spinosum*) is gathered from the hillsides and used as a fuel for heat in winter and for cooking (although they generally use gas for making tea as it is convenient; and zibbel for making *taboun* bread). The Natch grows in dense clumps in certain areas, and plants are dug up so that their woody roots can be burnt. Apparently the plant regenerates well from year to year so that it can be collected from the same places repeatedly. Sheikh Ahmed also burns some wood from his orchard (clippings and prunings), but the majority of his fuel is gathered from the surrounding hillsides.

Plate 5: Fuel pile of *Sarcopoterium spinosum* harvested from the surrounding hillsides

- Construction materials:

Natch is also used as a material to make shade structures for the animals (threaded onto wires, ropes or thin sticks). In addition, some structures (walls and animal pens) are built from stones, and occasionally mud renders are used.

Plate 6: Animal shelter built from natural stone and *Sarcopoterium spinosum*

- Grazing:

While the villagers grow some barley for their animals and buy a great deal more, they also rely partially on foraging in the surrounding area, particularly during the winter months when there is plenty of herbage about. Traditionally, they used to move to different grazing grounds in the summer, however these days they tend to stay where they are and just buy fodder (possibly at least in part because they are afraid to leave the village on account of potential land confiscation by the Israeli occupation forces). However, there is not nearly enough food available (either sown as crops or growing wild) to support the sizes of herds that they have – it is always necessary to buy more from the market in Yatta.

2.5 Workday implementation

2.5.1 Summary of work undertaken at all sites

Four field visits were used as workdays. Dates of workdays were: Tuesday March 15th, Tuesday March 22nd, Tuesday March 29th, Tuesday April 19th.

The first priority was to plant the trees before the spring planting season ended and the soils dried out. Failing to plant before the end of April would have caused the failure of many trees to establish sufficiently to endure the long summer drought. Consequently, the trees were planted on sites 2 and 3 even before the fences were erected (site 1 was already fenced) resulting in some grazing damage from livestock. Fortunately, all damaged trees recovered.

In total 109 trees were planted. After planting the trees were mulched with stones at first and later with sheeps' wool, hay or cut scrub. The BQ field crew delivered 200 litres of water each week for the irrigation of the newly planted trees. Where trees were planted on sloping land they each received a media luna rainwater catchment to make the most of the late spring showers.

The planned field visits of 05/04/2011 and 12/04/2011 were postponed as the AAA office resolved an intra-family dispute regarding site 2 (the hilltop site). Apparently the family of the project participant felt hostile to the planting of trees and the enclosure of the site as the land is in common to all of them, and they felt that they would be at a disadvantage if they allowed work to continue.

As a result the decision was made to discontinue work on site 2 to the great regret of all. The fence procured for site 2 was then erected on the valley floor to the south of site 1. The remaining trees brought for site 2 (olives and vines) were planted in the enclosed area (Site 4 hereafter).

All trees continued to be watered and checked weekly. 15 mortalities were recorded (until 31 May 2011) of which ten were planted at Site 2 where work was discontinued and were all of the species *Acacia radianna*. Of the remaining 5, 3 were *A. radianna* and 2 were *Zizyphus spina christi.* The mortality rate for sites 1, 3 and 4 together was 5% for the whole of the project period.

At each of the sites (except site 4) assessment was made of soil erosion patterns, runoff, and domestic wastewater flow. Where appropriate, stone gabians, swales and terrace walls were constructed, augmented or rehabilitated to maximise rainwater infiltration and minimise runoff and soil erosion by runoff and wind.

Labour and planning on the sites were conducted with the project participants and BQ team on field visits and by participants alone between field visits. On field visits the land was surveyed, the rainwater harvesting structures marked out for building and trees planted. The excavation of swales, rebuilding of gabians and terrace walls, the erection of fences and the irrigation of trees were done by the participants between field visits.

Plate 7: Project participant planting tree

2.5.2 Tree species selection

The tree species selected for planting fall into two categories:

1. Those providing services required for mitigation of environmental degradation and future remediation (i.e. soil stabilisation, fertilisation and biodiversification).
2. Those providing services and products valued and requested by the community (e.g fruit, shade firewood etc.).

All trees of both groups were selected according to the criteria:

- Species' ecological requirements: will the species survive and produce at the site?
- Availability of germplasm to propagate or introduce/restore species to Halawe.
- Risk of introducing an invasive species: because Halawe is situated in an area of extensive environmental degradation the ecosystems are vulnerable to invasion and resulting destabilistation by prolific introduced species. As a precaution species known to have become invasive upon introduction regionally or within this biome globally were excluded from this pilot project no matter how regionally abundantly they occur or how useful their products.
- Ecosystem restoration: this project aims (albeit on a small scale) to restore the diversity and ecological integrity of Halawe community area. Dead Sea Basin tree species, propagated from locally collected populations were selected to chaperone and shelter the horticultural varieties whist providing products of their own.

2.5.3 Work undertaken at Site 1 (Valley)

2.5.3.1 Water harvesting structures

Existing gabians were raised and extended to combat gulleying – a problem downstream. The existing gabians of fieldstone were preventing gulleying of the valley's soil and maintaining a near level flood plain. The first (highest) gabian was filled to the brim with soil transported down the valley by flood water. An additional file of fieldstones (abundant on site) was used to raise and extend the gabian enabling the acretion of more soil above the gabion. The fence was removed and replaced. The old patchwork fence was reused to enclose the carob trees at the cistern and by the dwelling.

Table 15: Summary of structures/techniques used at site 1 with their roles in environmental stabilisation and amelioration to increase the site's productivity and amenity

Structure or technique	Microclimatic amelioration	Soil stabilisation	Increased soil hunidity	Increased soil fertility	Decreased runoff	Reduction in grazing
Swale		X	X	X	X	
Stone gabian restoration		X	X	X	X	
Fence		X				X
Tree establishment	X	X	X	X	X	
Mulches		X	X	X	X	
Irrigation of trees during first two summers	X	X	X	X		

2.5.3.2 Tree planting

Site sector analysis identified the prevalent pernicious forces acting on the sites. With grazing, rainwater harvesting and soil stabilisation served by permanent built structures a plant community was designed to ameliorate climatic and soil environments conditions whilst diversifying plant products for the enrichment of the community (family).

Table 16: Species planted at Site 1 and their roles within the system

SITE 1	number	fruit	vegetables	animal fodder	bee fodder	fuelwood	shade	Windbreak	nitrogen fixing	livestock barrier	timber
Zizyphus spina-christi	15	X			X	X	X	X		X	X
Acacia raddiana	8			X	X	X	X	X	X	X	X
Moringa peregrina	5		X	X		X	X	X			X
Geoffroea decorticans	2	X		X	X	X	X	X	X	X	X
Punica granatum	4	X			X			X			
Prunus armeniaca	2	X			X	X					
Ceratonia siliqua	4	X		X	X	X	X	X	X		X
Morus nigra	1	X			X	X	X				
Vitis vinifera	2	X	X								
Ficus carica	1	X					X				
Prunus avium	2	X			X	X	X				
TOTAL	46										


Plate 8: Site 1 (valley site) at end of project (May 2011)

2.5.4 Work undertaken at Site 2 (Hilltop)

2.5.4.1 Water harvesting structures

A swale was dug bisecting the site to enhance rainwater infiltration into the soil and prevent runoff. The area was planned to be fenced but work at the site was discontinued before the fence could be erected. Nonetheless, we have included a summary of the species and structures used at this site since it is instructive in terms of illustrating recommended land management practices for this type of land. Furthermore, many of the trees planted were still surviving at the end of the project, and therefore we do not regard the work undertaken here as a complete loss.

Table 17: Summary of structures/techniques used at site 2 with their roles in environmental stabilisation and amelioration to increase the site's productivity and amenity

Structure or technique	Microclimatic amelioration	Soil stabilisation	Increased soil humidity	Increased soil fertility	Decreased runoff	Reduction in grazing
Swale		X	X	X	X	
Fence		X				X
Tree establishment	X	X	X	X	X	
Mulches		X	X	X	X	
Irrigation of trees during first two summers	X	X	X	X		

2.5.3.2 Tree planting

Table 18: Species planted at Site 2 and their roles within the system (N.B. This list includes trees that were eventually planted at Site 4 but are included here to illustrate the ideal system)

SITE 2	number	fruit	vegetables	animal fodder	bee fodder	Fuelwood	shade	windbreak	nitrogen fixing	Livestock barrier	Timber
Acacia Radiana	17			X	X	X	X	X	X	X	X
Cupressus sempervirens	5					X	X	X			X
Ceratonia siliqua	2	X		X	X	X	X	X	X		X
Casuarina sp.	1	X				X		X	X		X
Olea europea	10	X						X			
Vitis vinifera	2	X	X								
TOTAL	37										

Plate 9: Site 2 at end of project (water harvesting swale and cypress trees (*Cupressus sempervirens*)

2.5.5 Work undertaken at Site 3 (Hillside)

2.5.5.1 Water harvesting structures

The area was eventually fenced to exclude grazers. A swale was dug along the upper boundary of the site to increase rainwater infiltration into the soil, prevent runoff from a large area of hillside and to collect a little domestic grey water from the dwelling nearby. The stone walls of the terraces were repaired but more work could be done on them. Since much of the land is sloping, trees were planted in semi-circular bunds to increase runoff accumulation around the young saplings.

Plate 10: *Geoffreoa decorticans* sapling at Site 3, planted in a semi-circular earth bund reinforced with stones on its downhill side and with a stone mulch around the tree

Table 19: Summary of structures/techniques used at site 3 with their roles in environmental stabilisation and amelioration to increase the site's productivity and amenity

Structure or technique	Microclimatic amelioration	Soil stabilisation	Increased soil humidity	Increased soil fertility	Decreased runoff	Reduction in grazing
Swale		X	X	X	X	
Terrace wall restoration		X	X	X	X	
Fence		X				X
Tree establishment	X	X	X	X	X	
Semi-circular bunds		X	X	X	X	
Mulches		X	X	X	X	
Irrigation of trees during first two summers	X	X	X	X		

2.5.5.2 Tree planting

Table 20: Species planted at Site 3 and their roles within the system

SITE 3	number	fruit	vegetables	animal fodder	Bee fodder	Fuelwood	shade	Windbreak	nitrogen fixing	Livestock barrier	timber
Geoffroea decorticans	4	X		X	X	X	X	X	X	X	X
Punica granatum	2	X			X			X			
Prunus armeniaca	2	X			X	X					
Prunus dulcis	7	X			X	X					
Ceratonia siliqua	1	X		X	X	X	X	X	X		X
Morus nigra	1	X			X	X	X				
Vitis vinifera	2	X	X								
Ficus carica	1	X					X				
Olea europea	4	X				X		X			
TOTAL	24										

Plate 11 Project participants serving lunch of mansaf and lamb during a workday

2.6 Workshop implementation

2.6.1 Participation

Table 21: Dates and themes of workshops implemented

Date	Theme	Participants
April 26th	Rainwater harvesting	4
May 3rd	Soil management	3
May 10th	Functions and uses of trees	5
May 24th	Propagation of trees	6

A total of 8 community members (4 men and 4 women) participated in some of the workshops, although not all participants were present at all of them. Consistently present were Sheikh Ahmed, his wife, and Shufa'a (Sheikh Hanin's second wife). Occasionally present were 2 of Hanin's sons, 1 of Sheikh Ahmed's daughters, Sheikh Hanin's first wife and Sheikh Ahmed's brother. Sites 1 and 3 were therefore well represented at the workshops, but unfortunately the owner of Site 4 did not attend any of them, since he lives outside the village. Since he is Sheikh Ahmed's son however, it is assumed that knowledge gained in the workshops will be transmitted to him and used for the maintenance and further development of his site.

Plate 12: Workshop in progress in the field – discussion of tree maintenance and products

2.6.2 Workshop contents

2.6.2.1 Water harvesting

- There are 3 ways to harvest and store water. In descending order of usefulness, they are:
    - In the bodies of plants and animals
    - In the soil
    - In cisterns or tanks

- Obviously the purpose of having the water in the first place is to get it into the animals and plants

- The soil can hold many times more water than any tanks we can build and the water is already where the plants can use it (i.e. we save ourselves the job of distributing it).

- Storing water in the soil is very cheap – even free. We can use very simple structures to increase the amount of water that goes into the soil.

- Rain water is much better for the purposes of irrigation than bought water because a) it is free and b) it does not contain as many salts as groundwater from the aquifer, which accumulate over time and eventually render the soil infertile

- When we look at any site we are working with, we need to consider how we can make more water come there, and how we can best keep it there for a long time so that it works for us.

- The three main principles of storing water in the soil are to 1) slow it down, 2) spread it out, and 3) sink it.

- We can do this in a number of ways, and the best technique to use depends on the location and topography of the site.

- In valleys, small walls built horizontally across the valley (gabians) cause water to slow down and flow around them. This leads to soil accumulation in the valley. (This technique is demonstrated on Sheikh Ahmed's land).

- On sloping ground, we can build ditches on the contour to slow and spread the water all along that level.

Demonstration of the technique in miniature

- Around trees we can build small bunds (C shaped banks) to capture and sink water.

- Once the water is in the soil, we want to keep it there for as long as possible and minimize losses by evaporation (especially in a desert climate this is a big problem)

- One way we can do this is to 'dress' the soil with a mulch – it can be made of anything: stones, dried grass, paper – even old clothes. This will protect the soil from the sun, much as clothes protect our bodies from the sun; and the soil will therefore retain its moisture for longer.

Finally, we have a discussion about how to increase the water availability at Site 4. Use of channels to capture maximum possible water from the hillside, use of bunds around trees, possibility of digging another ditch to retain soil at the downhill side of the site.

2.6.2.2 Soil Management

- Soil and soil management
  - What is soil?
  - How is it produced?
  - Why is it important?
  - What makes a good soil?

- What is the status of the soil in Halawe?
  - Present basic data – good soil, reasonable nutrient content, slightly alkaline pH
  - Key differences between soils at the 3 sites

Show graphs (following) to workshop participants, explain content and discuss implications.

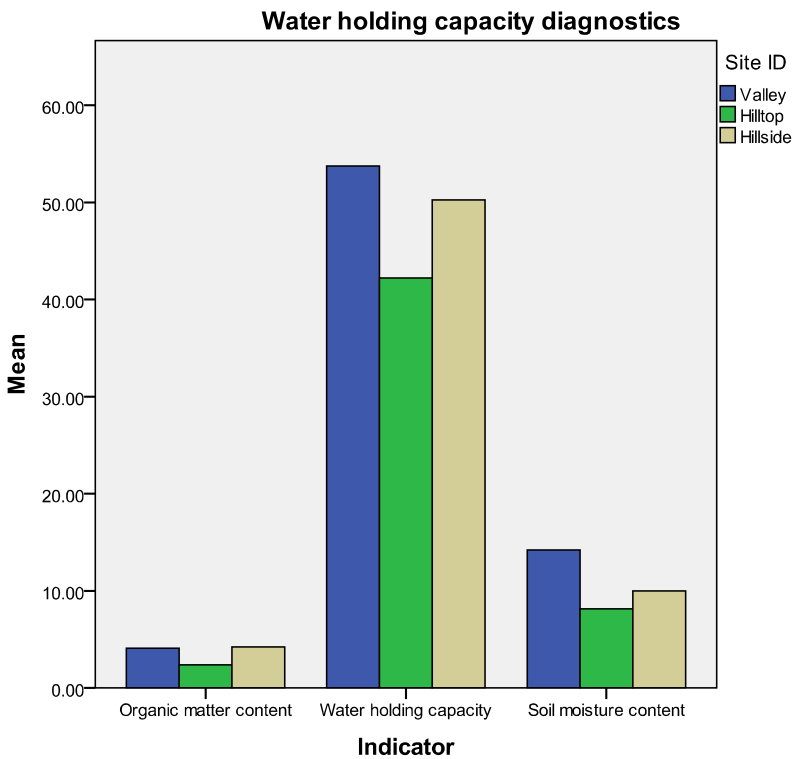

Figure 10: Bar graph showing comparison of mean organic matter content, water holding capacity and soil moisture content of soils from Sites 1, 2 and 3

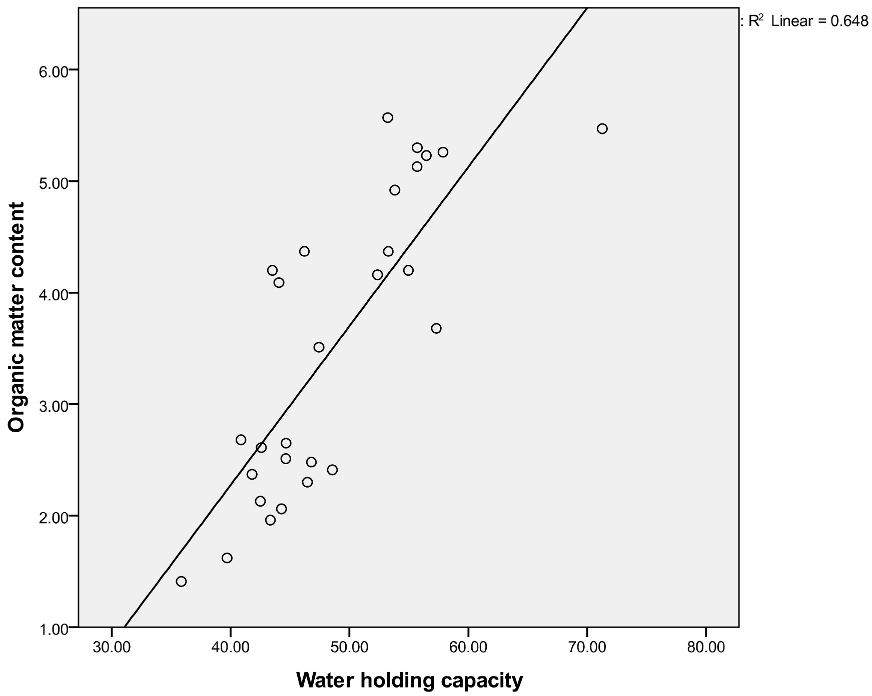

Figure 11: Scatter plot of water holding capacity against organic matter content demonstrating strong correlation between the 2 variables

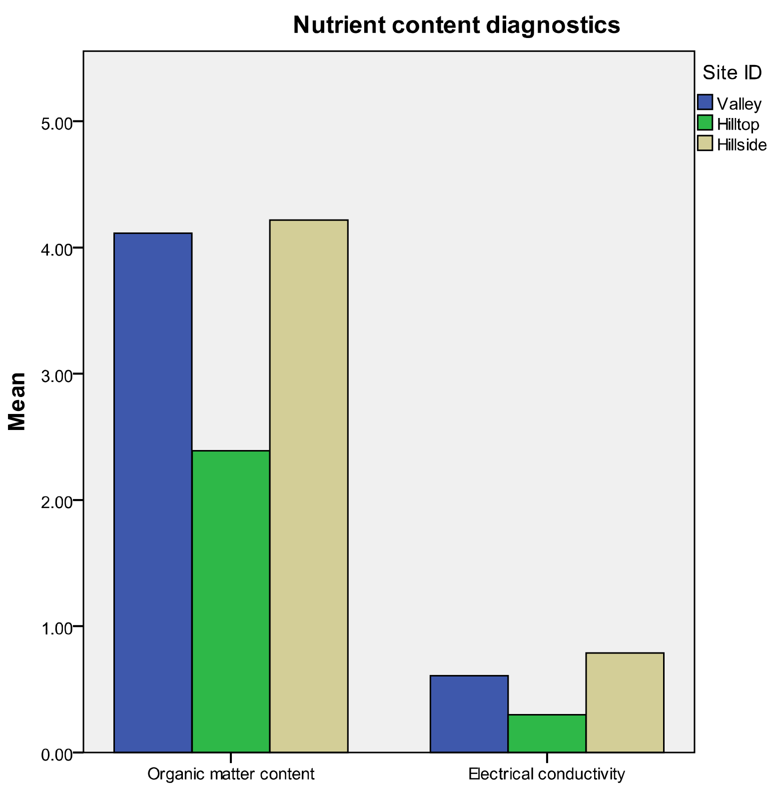

Figure 12: Bar graph showing comparison of mean organic matter content and electrical conductivity of soils from Sites 1, 2 and 3

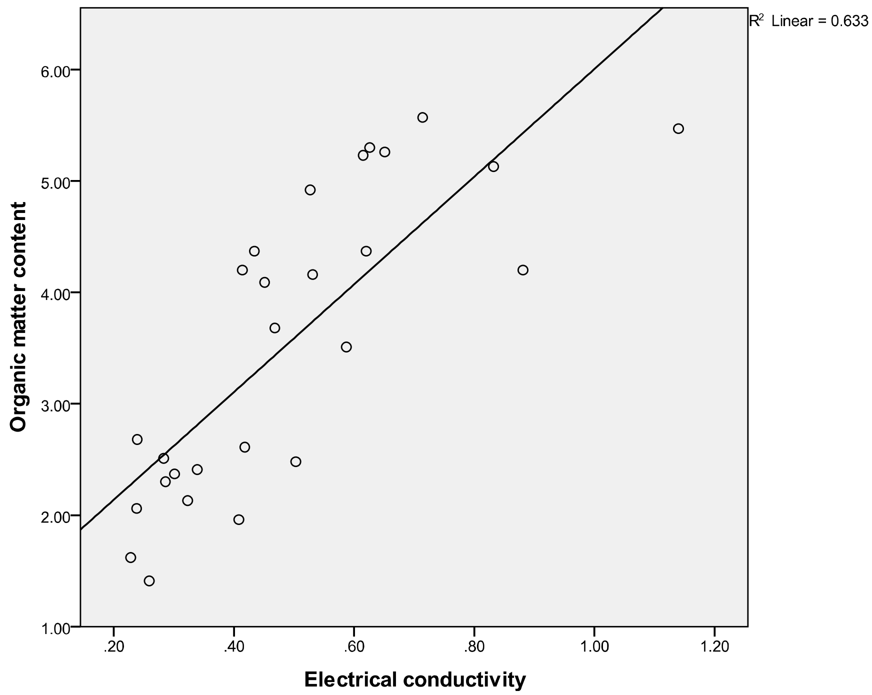

Figure 13: Scatter plot of electrical conductivity against organic matter content demonstrating strong correlation between the 2 variable

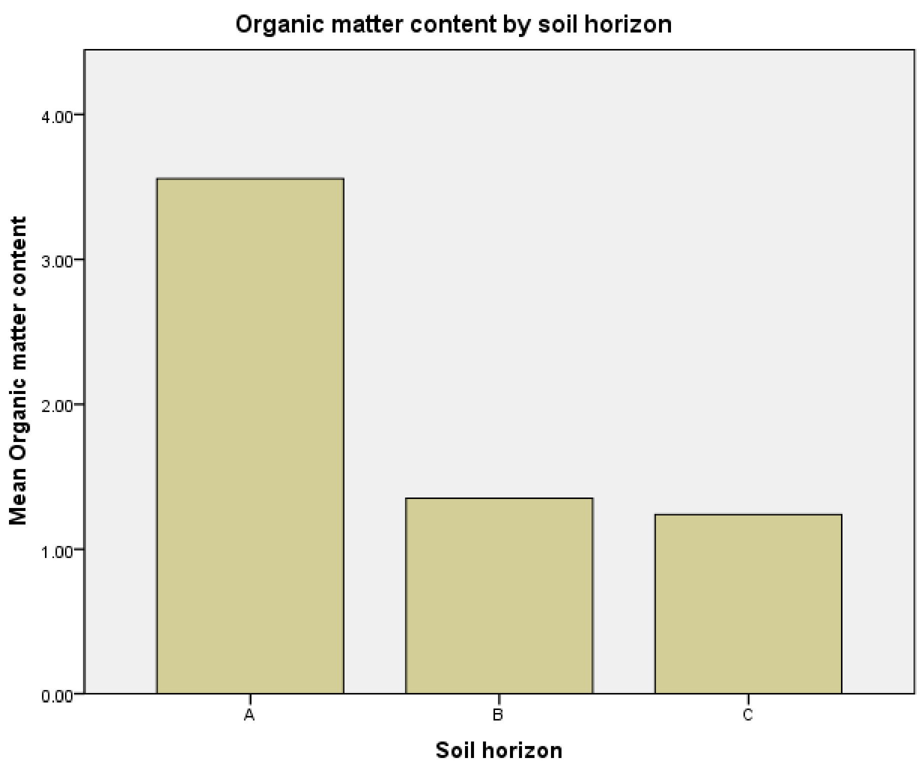

Figure 14: Bar graph showing mean organic matter content in soil horizons A (0-15cm), B (15-40cm) and C (40-60cm) across all sites sampled

Main points:

- Soil on the hilltop is low in organic matter and low in water holding capacity
- Soil in the valley and on the hillside is high in organic matter and high in water holding capacity
- Soil on the hilltop is low in organic matter and low in electrical conductivity
- Soil in the valley is high in organic matter and high in electrical conductivity
- There are significant correlations between all of these variables
- The vast majority of organic matter occurs in the top soil
- SO.......2 key questions: why is the soil on the hilltop so much poorer than the others?
- AND.......how can we protect soils to prevent the same degenerative processes occurring?

Show stratified samples of soil from all 3 sites analyzed. Comment on visible differences in particulate composition, colour and organic matter content.

- Managing the soil for sustainability
  - Wind and rain are the main erosive forces affecting soil
  - Soils in exposed places (like ridge-tops) are much more vulnerable to wind erosion; soils on sloping ground are obviously most susceptible to water erosion
  - Ploughing increases the organic matter content of the soil and loosens it; therefore increasing its water holding capacity and nutrient content BUT it also lays it open to severe wind erosion.
  - Ploughing directly up and down a slope also increases water erosion (as the water flows fast downhill, stripping away the soil)
  - Ploughing on the contour is obviously much wiser, as water is slowed and soaks in to the soil

Demonstration of comparative soil erosion between ground ploughed directly up and down and ground ploughed on the contour in miniature.

  - We can also control water erosion by digging trenches on the contour of the hill (as demonstrated last week).
  - How can we control wind erosion?
    - One way is to mulch the soil with something heavy to hold it down. Mulch could be of stones, wool, dry grass, natch, paper or even old clothes. As mentioned last week, this also helps trap moisture in the soil. Organic mulches (wool, dried grass, natch) also have the advantage of feeding the soil as they decay).
    - Another way is to grow wind-break trees. If you can slow and deflect the wind, you decrease wind erosion on a site, and can even create a scenario of soil accumulation as wind-borne dust is deposited. Belts of trees on a hillside can help to halt soil erosion by trapping all the soil that would otherwise have been swept past them.

2.6.2.3 Functions and uses of trees

- What are plants and what do they do?
  - Machines for taking energy from the sun and conducting it into the earth so that life can exist

- We can understand plants in terms of the services they do for us and the products we can take from them.
    - Key services:
        - Oxygen: before plants there was very little oxygen in the atmosphere
        - Soil: before plants colonised the land there was no soil
        - Climate:
            - where plants exist there are smaller differences between night-time and day-time temperatures; and between seasonal temperatures (i.e. they are insulating)
            - Plants drive the rain by cycling water through their bodies – without them the interior of every continent would be a desert
            - Plants slow the wind and trap moist air close to the soil
        - Habitat: Plants provide homes and food for other plants and animals upon which we rely
    - Products: can be divided into direct and indirect
        - Direct products include:
            - Food: fruit, nuts, leaves, stems, roots, oil
            - Building materials: poles, planks, thatch
            - Fibre: clothes, ropes etc
            - Fuel for warmth, cooking and light: wood and oil
        - Indirect products include:
            - Milk and meat from livestock (goats and sheep)
            - Honey from bees

- Choosing plants: the right tree for the place and the right place for the tree
    - How do we know which are the right trees for the place?
        - Trees that will grow well with little input from us
            - Low water consumption
            - Drought tolerance
            - Heat tolerance
            - Cold tolerance in winter and at night
            - The trees should work for us and not the other way around
        - Trees that will provide products that we use in everyday life (food, fuel, fodder) in a relatively easily accessible way.
            - Think about what you spend money on – is it possible to grow it yourself for lesser expenditure and without too much effort?
        - We can look to the local flora for examples (e.g. Sidr is much better suited to the desert environment than lemon)
        - All trees will require some maintenance for their first two summers to give them the best chance of long-term survival
    - How do we know which is the right place for the tree?
        - Trees live in communities (somewhat like people). If we think about them in terms of the roles that they perform in the community, then we can start to think about how to arrange them relative to each other and to the features of the place where we are planting them.
        - As with human communities, if all the people did the same job, the community would be weaker (imagine that everyone decides that they will churn butter but nobody wants to care for the goats or plant the barley – the community would fail)
        - Major roles in plant communities include:

- Mothers/ feeders: these plants make food for all the others by adding nutrients to the soil in the form of nitrogen. They fix nitrogen from the air with the help of bacteria and store it in their bodies. Eventually they give their bodies to the soil and the nutrients become available to other plants. The Acacia tree (Keneya) is an example of such a tree. Peas and beans (houmus and foul) also perform this function.
- Builders: these plants have strong roots that break the rocks and help form new soil. Eventually they also give their bodies to building more soil. Examples include Carob and Christ's Thorn (Kharroub and Sidr)
- Soldiers: Protect the community from dangerous forces such as desiccating winds and fires. These species include Cactus (Sobber) and Acacia (Keneya)

▪ The plant community also relies on input from other types of living things including fungi and animals
    - Fungi: help the roots of plants to capture nutrients and water from the soil. We can think of the fungi as a fishing net – if it is broken then the fish will be lost. Therefore we should think twice before disturbing the soil as this will break the net of fungi and the plant will not be able to capture as many nutrients.
    - Animals: perform several important roles vital to the functioning of the plant community:
        - Messengers: insects and birds carry pollen from flower to flower and ensure that fruit and seeds develop – without this function there would be no new plants and the community would grow old and die leaving nothing behind
        - Transport: birds and animals eat the fruits and carry the seeds in their bodies to new places so that the offspring do not grow up too close to their parents resulting in overcrowding and exhaustion of the soil.
        - Shoppers/ consumers: grazing animals both above and below-ground consume parts of plants and perform a vital role in cycling nutrients within the system.
    - Consumers, particularly those that stay always in one place, are the architects of their environment. Humans are an example of such a consumer/ architect.
    - As architects, we can think about the sort of community we want to live in. Is it one that is becoming poorer and poorer with every year that passes, or one that is rich, stable and diverse?
    - If we think about the living community around us in terms of the roles and needs of each species/ individual, it can help us to create and maintain a healthy and productive environment.

Go down to the orchard (Site 1) – have a conversation about the 'sectors' influencing the plants within (wind, sun, shade, water), the roles of the trees that we have planted there (in terms of their function in the community), and the products that can be expected from them (paying particular attention to new/ potentially unfamiliar trees such as Moringa, Geofforea, Sidr and Keneya).

2.6.2.4 Tree propagation

- Tree propagation
  - If we can make our own trees from the resources around us, it is clearly much better than buying them from outside sources.
  - There are 2 main ways to propagate trees:
    - Cuttings
    - From seed

- Cuttings:
  - The advantage of using cuttings is that one can be certain that the new trees are genetically exactly the same as the parent material (i.e. we know what we are getting)
  - The normal techniques for taking cuttings is to wait until the tree has no leaves if it is deciduous, and to use a sharp knife to slice through a branch just above a node.
  - Examples of trees that take well to this technique are:
    - Figs
    - Vines
    - Geoffreoa

- Seeds:
  - Not all trees can be propagated from cuttings – some grow much better from seed.
  - In addition, it is a bit risky to have many trees in an orchard that are genetically exactly the same, as they will be more susceptible to disease and pests than a more diverse population
  - Growing trees from seed takes some skill and thought. Many trees, in particular desert species, have seeds that are designed to take a very long time to germinate (so that if some germinate during a bad year and fail, others will be left to germinate later and possibly thrive)
  - Some ancient seeds have been recovered from archaeological sites and dated at over 8000 years old – when they were treated correctly and put into the soil, they germinated
  - The skill in growing trees from seeds is learning to 'wake up' the seeds, since as tree growers we do not want to wait 8000 years for our seeds to germinate!

Get out seeds (Leucaena leucocephala, Acacia raddiana, Geoffreoa decorticans, Ceratonia siliqua, Zisyphus spina-christi) and pass them around.

- In order to germinate seeds, we first have to find them.
  - In some trees they are inside a pod (e.g. Leucaena, Ceratonia and Acacia).
  - In some trees they are inside a fruit (e.g. Geoffreoa).
  - In some trees they are inside a hard case inside a fruit (e.g. Zisyphus)

Demonstrate how to get a Zisyphus seeds out of its coating

- Once we have the seeds, we need to know how to treat them.
  - Some, once extracted from their cases are easy to germinate – they just need to be soaked in water for 24 hours. The water activates them and they will germinate. Examples of seeds like this are Geoffreoa and Zisyphus.
  - Some seeds have very hard coats and need extra treatment to break it down so that water can be absorbed. These seeds can be put into boiling water to

help break their coats. The amount of time they need to be boiled for is variable.

- ✓ For Leucaena seeds, the water should be brought up to boiling and then removed from the heat. The seeds should then be added and left to stand in the water for 24 hours before being sown
- ✓ For Acacia and Carob, the treatment should be a little harsher. The seeds need to be boiled with the water for about 5 minutes before being removed from the heat and left to stand for 24 hours.
- ✓ If the treatment is successful and the seed coat is broken then the seeds will imbibe water and expand. The seeds that have expanded at the end of the 24 hour period are ready to sow.
- ✓ If there remain seeds that have not expanded then they can be treated again (i.e. boiled for 5 minutes and left to stand for 24 hours).

- Sowing seeds:
  - Once seeds have been activated by water (i.e. soaked for 24 hours), they must be sown into the soil as soon as possible – if not then they will die! So do not soak seeds unless you are sure you have time to sow them the next day!
  - Soil should be placed in a container of an appropriate size – 1-2 litres should be enough for most trees. The container could be anything – an old bottle with the top cut off, a juice carton, or an oats box.

Show the boxes from the farm

- Many holes should be punched into the bottom of the container so that the soil does not become water logged as this will kill the roots of any young seedling
- The container should be loosely filled with the best soil you can find – soil from the wadi floor would be appropriate. DO NOT COMPACT THE SOIL!
- Seeds should be shallowly planted – roughly twice the B axis of the seed (i.e. the width of the seed). If in doubt, go shallower because it is very important that the shoot of the young seedling (the plumule) finds light before its food reserves run out. DO NOT COMPACT THE SOIL OVER THE SEED – because it will dry hard and they young shoot will not be able to break through.
- You can put more than one seed in a pot – two, three or even four is fine. But if more than one germinates, either kill one or separate the saplings when you plant them.
- Keep the planted pots in the shade and water them regularly to keep the soil nice and moist. DO NOT LET THEM DRY OUT as any young seedlings will then die.
- Keep watering them every day – you should see results in between 1 and 3 weeks.

Project Assessment

3.1 Community feedback survey

A ten question survey was administered to five project participants by BQ facilitator Awad Abu Sway. The answers were given anonymously, in the absence of the Bustan Qaraaqa field workers (as we hoped that this would encourage frank responses). Questions were asked verbally and forms were filled in by the facilitator. A total of 5 participants were interviewed, representing the two major sites we worked with. Unfortunately it was not possible to interview Sheikh Ali (Site 2) or Sheikh Ahmed (Site 1), as they were away at the cattle market during our visit.

Transcripts of the survey forms and full responses can be found in Appendix C. Key findings were as follows:

- 100 % of participants said they felt 'very positive' about the project in general

- Positive aspects of the project were variously cited as:
    - Shade and green areas within the village (2 mentions)
    - Information on tree maintenance, soil management and water catchments (3 mentions)
    - Tree products to replace bought products (2 mentions)
    - Protection of the land from the Israelis (1 mention)

- 80 % of participants said there were 'no negative aspects' to the project, 1 participant cited 'shortage of water' as a problem (this was also mentioned by another participant in response to a different question)

- 100 % of participants had attended at least 1 workshop and 100 % said that they found the workshops 'very helpful'

- 100 % of participants said that they would participate in another project if there was the opportunity

- Suggestions for improvement to the project included:
    - Increasing the number of trees/ vegetables planted/ increase the work on the land (4 mentions)
    - Extending the timeframe of the project (1 mention)

- Suggestions for future projects included:
    - Continuation and expansion of tree planting
    - Focussing on water catchment techniques (channels and pools)

3.2 Environmental perceptions assessment

3.2.1 Methodology

It was decided that attempting to quantify changes in peoples' environmental perceptions in the course of the project was a futile venture: any attempt to do so would be based on a survey asking leading questions that would necessarily prejudice the data. Instead, a 'softer' approach was used, based on several open-ended interviews with project participants, as well as *ad hoc* conversations during field visits and field observations.

The research questions we will attempt to address here are:

1. How do the community interact with the environment?
    a. What are the positive features?
    b. What are the negative features?
    c. What are their priorities?
2. How do the community perceive themselves in relation to the environment?
    a. What awareness, if any, is there of environmental issues such as soil degradation, declining precipitation, overgrazing etc?
    b. Do they perceive themselves as agents of environmental change or as passive users of environmental services?

Due to the research approach used in this component of the project, the answers to these questions cannot be absolute, but consist of a set of broad observations that it is hoped may provide some basis for directing future research and development within these communities. It is also necessary to be aware that the designation of some features of environmental interaction as 'positive' or 'negative' reflects the priorities of the research team: namely the promotion of sustainable use of resources by the community, the preservation of the pastoralist lifestyle, the reversal of trends of environmental degradation and the promotion of community self-reliance.

3.2.2 Observations

1. Community interaction with the environment:

- General observations

    This community has a much more direct relationship with the environment than the majority of people living in the West Bank. They harvest many of the resources they require to sustain themselves directly from the surrounding area (see Section 2.4.3). Their knowledge of flora and fauna is extensive and relates to uses of herbs for medicinal purposes, names of trees and birds, available wild foods etc. In this respect, we can tentatively say that the community is 'environmentally aware' in the sense that they know their landscape and are aware of resource flows between the environment and themselves, and thus presumably they would also be aware of changes in their surrounding environment if these changes were taking place on a short timescale (over several years rather than over several decades).

- Positive features

  Compared to the majority of people living in the West Bank, the consumption level of environmental resources in this community is very low. Their lifestyle is much less water and energy demanding than that of people living in cities (over 65% of the Palestinian population according to UN surveys). They are net producers of food since they export a large proportion of their produce from the village, and buy only a modest amount of food products to feed themselves (although most of what they do buy is imported from outside Palestine e.g. sugar, rice, wheat flour, coffee).

  The amount of waste produced by the community is also modest since they bulk-buy a great deal of their food (less packaging), travel little (a few people take trips to Yatta to visit the cattle market and buy food/ fodder on a weekly basis), use few chemicals and reuse containers a good deal. They also use donkeys rather than motorised vehicles for shorter trips.

Plate 13: Villagers riding donkeys in fields near Halawe

- Negative features

  The lifestyle and food production system of the community is not environmentally sustainable. The soil is degenerating as a result of grazing pressure and management practices. A great deal of the surrounding area is under the plough to grow barley to feed the animals. It is not uncommon to see furrows running straight up and down a hillside promoting water erosion. Every time we visited on a windy day, it was possible to see the topsoil flying away on the breeze. Despite this effort to produce fodder, the majority of animal feed is still imported, and is grown outside of Palestine.

Plate 14: Dust storm in the village carrying away the topsoil

Plate 15: Ploughed hillside in mid-May. Note furrows running directly down the hill from the water tanker.

In spite of efforts to increase water-harvesting through the construction of new cisterns, low rainfall this year has decreased the efficacy of these attempts. The lack of water pipeline to the area means that water has to be dragged to the village from a filling point in Tawani (over 10 km away) in 4 cubic metre tanks by a tractor. This is an energy intensive way of acquiring water both in terms of fossil fuel consumption and human resources. In addition, the wastewater management system in the village (discharge into unlined cesspits) is environmentally degenerative in the long term, and has the potential to contaminate the groundwater aquifer below.

The traditional response of pastoralist communities to local resource shortages was to move to another place. Due to pressure from the Israeli Occupation resulting in large swathes of land being designated as 'military training grounds' and becoming inaccessible; and the looming possibility of land confiscation in the absence of its owners, this is no longer a viable option.

- Community priorities

  Many community members (both men and women of older and younger generations) spoke of their commitment to remaining in the village and maintaining their pastoralist lifestyle. Direct quotes from project participants include:

  "I was born in this cave and I will die in this cave. Nobody can make me leave this place." (Sheikh Ahmed)

  "I love to live in this village. Life in the city if not for me – there are too many people there, too much noise. I sleep well in this place, and every day I wake up to work that I love." (Shufa'a, Sheikh Hanin's wife)

  "I like to work with the animals. I prefer it to working in building site or a factory. I prefer to stay here in the barriya *where there is air to breathe."* (Mahmoud, Sheikh Hanin's son)

  Villagers are acutely aware of the water shortage (obviously), and always cite it as the first and most important obstacle that they face in their lives. They also frequently mention the Occupation, the Israeli military (there is a base within two kilometres of the village), their fear of harassment from that quarter (there are frequently home and cistern demolitions in the villages of this area), and their determination to resist any attempt to drive them from their land.

2. Perceptions of relationship to the environment

- Awareness of environmental issues
  - Decline in rainfall

    Several community members spoke about this as a problem without any prompting. It is something that directly affects them, both in terms of water access and in terms of yield from any sown crops. They mentioned this year as a particularly bad one – and also that there were 'more bad years than good' recently. If asked if things used to be better in the past, all said that they believed that this was true.

- Soil degradation

  There seemed to be less awareness of this as an issue. When declining yields were mentioned, water shortage was always cited as the cause, not problems with the soil.

- Overgrazing

  This was never mentioned independently as a problem: although everyone agreed that there is not enough food for the animals, there was a general acceptance that one can just buy fodder from the market and the problem is solved (except that the fodder is too expensive). All agreed that it would be better if more food could be grown locally – but were pessimistic about chances of success as ‘there is not enough rain’.

- Pollution

  This was never mentioned as a problem by anyone (possibly because the community's environmental impact is actually quite low and they live at low population density in dispersed dwellings). There was a fair amount of rubbish (broken glass, bits of plastic etc) strewn about Site 3 (Hillside) between the trees – this didn't seem to bother anyone – although the village in general was notably rubbish free.

- Perceptions of ‘environmental agency’

  This is a difficult question to answer for obvious reasons (partially because it is difficult to generalise about the attitudes of several different people, and partially because even if you ask the question ‘do you consider yourself an agent of environmental change’ directly, people hardly know how to answer). Therefore this section consists of a number of fairly general observations that may help to shed some light on this issue.

  - We discovered during the workshops that the gabians in the valley were constructed by Sheikh Ahmed himself, in order to promote soil accumulation. He waited several years for the soil to accumulate before he started to plant trees. Villagers also suggested that they had somehow created the topsoil on the ridge (possibly by moving it up there from the valley?).

  - Villagers were already planting trees before the project started (one reason why this community was selected for the pilot project).

  - Villagers routinely maintain and build new cisterns, with or without the help of the international NGO community.

  - Villagers forage pretty widely with their herds, and return to the same places from year to year to look for food and for fuel. They commented that the same areas tend to remain productive from year to year, particularly in the case of fuel collection, but also in terms of availability of forage, possibly because ‘the soil is better there’.

- In general, participants were attentive in the workshops and were excited about any new ideas that they could see the utility of. For example, when mulching was mentioned, the next time we returned, half of the trees in the valley site had natch mulches on them.

- There may be something of a commitment to doing things in the 'way that they have always been done' or a (somewhat justified) belief that most of the problems that they are facing are outside of their control and caused by outside agencies. Nevertheless, there are also issues (such as soil management practices) which are currently degenerative but are not really perceived as problematic.

- The villagers are obviously already actively managing their environment, responding to changes and resource shortages, and seeking innovations that could make their lives easier.

- Villagers are more committed to/ interested in taking actions that will have a direct, perceivable impact on their lives than in the concept of environmental protection for its own sake.

3.3 Project successes and difficulties

Table 22: Analysis of successes and difficulties during project implementation

Successes	Effect on Project	Recommendations
Successful engagement of community participants and successful implementation of intended project outputs.	Pilot project a success until now – tree survivorship at the end of the summer will provide final proof of viability.	Return to community in September/ October to assess health of trees and efficacy of rainwater catchments. If the trees are alive and the catchments are working, consider expanding/ scaling up.
100 % satisfaction with the project and the project staff amongst participants interviewed.	Good relationship between project staff and community participants. 100 % are willing to participate in future projects. AAA reputation enhanced.	Build on successful project – possibly continue and expand projects in Halawe community and use good relationship to facilitate engagement of other communities
Excellent support from driver (Ghassan).	Punctual and efficient transport of project team from Bustan Qaraaqa (Beit Sahour) to Halawe. Support with manual labour (tree planting). Help with communication issues/ general facilitation of contacts with participants.	Consider hiring the same driver for any future projects

Participation of Bustan Qaraaqa volunteers.	Help with manual labour. Raising awareness about the situation in the South Hebron Hills. Additional people educated about environmental issues and design principals.	Continue volunteer participation in future projects.
Excellent support from Awad Abu Sway	Awad accompanied us initially as a volunteer but since we found ourselves in need of a facilitator, we later sub-contracted him to fulfil this role since he proved to be an excellent communicator, and was instrumental in making the workshops a success	Consider including Awad in future project teams.
Difficulties	**Effect on Project**	**Recommendation**
Impassability of roads in winter months (January/ February).	Delay in start of project limits scope of tree planting and has possible consequences for health of trees.	Start planting earlier – preferably in the autumn after the first rain (October/ November).
Long distance of Halawe community from the main road	Lengthy journey to get to and from the community. Wear and tear on driver's vehicle. Lack of visibility for the project decreases its impact as a 'model' site.	Consider replicating project in a more visible and less inaccessible community.
Delay in procurement of fence.	Some damage to planted trees by grazing. (N.B. it was impossible to delay tree planting at this stage in the project as it was already late in the season)	Pro-active procurement of materials prior to start of project.
Internal community conflict (land dispute) caused by project activities.	Abandonment of Site 2 (Hilltop). Withdrawal from project of previously enthusiastic participant.	Extend community consultation phase. Stronger verification procedure for land ownership by project participants.
Lack of coherent design process at Site 4 and lack of participation of landowner in workshops.	Contradiction of some design principals in the training package, possibly resulting in confusion of participants. Lack of integration of this site into overall project structure.	Better coordination and communication between the project team. Making participation in workshops a condition for receiving trees (include it in the contract).
Misunderstanding of materials procurement procedure by field workers.	Delays in procuring materials, delays in paying suppliers, delays in project implementation, wasted time and energy of project staff.	Provide training in company procurement policies and specific criterion for acceptable receipts to contractors prior to start of project.
Lack of facilitator support at workshops (miscommunication in expectations between BQ field team and AAA office)	Communication problems between BQ field workers and participants. Problem solved through sub-contracting another facilitator.	Allocate more time to field visits/ hire field team with better language skills/ add budget item for hire of facilitator who is guaranteed to attend the workshops.

Recommendations

4.1 Scaling up of tree planting project

In general it is possible to say that the tree planting pilot project has been a success. Community members were interested and engaged by the idea of growing trees, and invested time and effort into participating in the project. The project team are cautiously optimistic that the community are invested enough to care for the trees throughout the summer, in spite of the severe water problems that they will be dealing with this year. Therefore the answer to the question of whether it is viable to establish tree planting projects in the Masafr Yatta district is definitely 'yes'.

However, despite its success, this has been an expensive project in terms of dollars spent to outputs produced. Therefore questions remain about how to increase the impact and efficiency of any future tree planting efforts. If several communities were to be involved for example, how could the project be structured such that knowledge and skills were transferred effectively to all participants? How can we build on and incorporate the experience gained during this pilot project to enhance any future projects? Below are listed a few suggestions for ways in which to proceed should there be funding available for tree planting projects in the future.

- Use the Halawe project as a model to show to prospective project participants.

- Get feedback from the Halawe participants about difficulties they have encountered in caring for the trees and use it to help troubleshoot future projects.

- Seek advice from pilot project participants about engaging other communities in tree planting projects. Explore their willingness to participate as trainers/ speak about their experiences at workshops. Include some remuneration for trainers in the project budget.

- Combine workshops with project implementation. Have the location of each workshop cycling between the communities involved, with participants attending workshops in other villages, and implementing what they have learned at home. It is possible that transport would have to be arranged for the participants/ people would be unwilling to attend workshops in other villages. Cultural acceptability of this project design would need to be assessed.

- Alternatively, the workshop and tree planting components of the project could be reversed, so that all participants attend a series of workshops before any trees are planted, and preparation of water catchments and tree planting are largely left to the participants themselves. This might have the added bonus of encouraging participation in the workshops as a precondition for receiving trees. It would be completely dependent on starting the project much earlier in the year however – preferably in September/October – meaning some community consultation should take place in August or early September at the latest. Workshops would have to be held in a central location – or possibly even in Halawe since the orchards there could be used as a teaching resource.

4.2 Possibilities for other future projects

These suggestions are based on the observations of the BQ consultants whilst gathering information about the lifestyle and situation of the villagers (see sections 2.4.3 and 3.2), and constitute potential interventions that we believe could have a significant positive impact on the lives of the villagers in the Masafr Yatta area and simultaneously reverse trends of environmental degradation. These foci could either be combined with future tree planting projects or proposed as stand-alone projects in their own right.

Table 23: Suggestions for additional foci for future projects

Suggested project focus	Justification
Wastewater management: Exploring the possibility of introducing compost toilets or some kind of constructed wetland system	**Water shortage:** compost toilets would reduce water consumption and provide a source of fertiliser for the orchards **Pollution:** currently the lack of wastewater treatment is creating a source of pollution threatening soil quality and the groundwater aquifer.
Conservation tillage: Exploring alternative land management practices that could conserve soil and improve yield.	**Soil degradation:** current system of land management is degenerative and promotes soil erosion. **Yield improvement:** studies suggest that various alternative conservation tillage systems (such as the use of chisel ploughs or rippers) can actually increase the yield of cereal crops in semi-arid zones by as much as 60%. This would cut down the amount of money that villagers have to spend on fodder for their animals.
Soil stabilisation: Use of swales (contour ditches) and bands of trees downhill of them to stabilize soil on hillsides. Land between the swales could then be cultivated without risk of soil erosion.	**Soil erosion:** currently there is a significant soil erosion problem throughout the area, particularly on hillsides and hilltops. **Tree products:** this is a potentially productive system that could yield fruit, building materials or additional fodder. **Yield improvement:** this system may improve the yield of crops planted between the swales through soil stabilisation and enhancement of soil water availability.

Final Project Budget

	Unit cost	Number	Total (ILS)
Materials			
Digging tools (pickaxes and mattocks)	40 ILS per tool	12	480
Trees	20 ILS per tree	109	2180
Fence	17.5 ILS per post	100	1750
	18 ILS per metre	510	9180
Soil testing			
Major nutrients, Organic Matter and			
water holding capacity tests	175 ILS per sample	47	8225
Transport			
Pick-up truck and driver	500 ILS per trip	12	6000
Salaries			
Project manager/ soil scientist	$850 per month*	6	17850
Botanical expert	$850 per month*	6	17850
Workshop facilitator	200 ILS per workshop	4	800
Grand total (ILS)			**64315**
Grand total (USD)*			**18376**
*conversion to ILS based on exchange rate of 3.5 ILS/ USD			

Appendix A: Soil survey data

Halawe community tree planting pilot project										
Spring 2011										
Soil tests										
Site 1	Valley	Horizon A	0-15cm							
Site 2	Ridge	Horizon B	15-40cm							
Site 3	Hillside	Horizon C	40-60cm							
Sample no	Site	Horizon	pH	EC	SM	BD	WHC	OM	K	P
Units:				ds/m	%	g/cm3	%	%	meq/100g	ppm
1	3	A	7.54	1.85	12.31	1.66	44.67	2.65	3.4	23.07
2	3	A	7.85	0.531	9.7	1.48	52.36	4.16	2.61	30.96
3	3	B	7.97	0.99	11.05	1.5	40.3	1.96	3.37	6.39
4	3	C	7.56	2.95	10.74	1.59	39.05	1.44	3.47	4.72
5	3	B	8.13	0.755	10.71	1.62	47.65	1.69	3.25	9.42
6	3	B	7.84	1.19	10.08	1.58	42.34	1.58	3.43	5.17
7	3	C	7.61	1.71	9.4	1.52	41.33	1.62	3.64	13.52
8	3	C	7.56	1.75	9.18	1.59	39.42	1.51	3.51	16.55
9	3	A*	7.32	6.55	42.99	0.92	88.67	6.57	4.87	95.74
10	3	A	7.78	0.881	8.55	1.62	54.96	4.2	3.18	50.99
11	3	A	7.86	0.451	8.32	1.61	44.07	4.09	2.37	12.76
12	3	A	7.84	0.434	8.19	1.58	46.21	4.37	1.96	25.5
13	3	A	7.62	0.527	10.9	1.51	53.82	4.92	2.54	45.07
14	3	A	7.69	0.832	12.02	1.62	55.69	5.13	2.84	43.4
15	1	A	7.46	0.503	8.09	1.36	46.8	2.48	1.39	6.24
16	1	A	7.65	0.339	7.82	1.63	48.57	2.41	1.18	8.51
17	1	A	7.37	0.587	8.6	1.47	47.44	3.51	1.68	41.28
18	1	A	7.28	0.62	11.69	1.51	53.27	4.37	1.98	52.96
19	1	A	7.19	0.615	18.98	1.41	56.47	5.23	2.2	51.9
20	1	A	7.32	0.626	20.32	1.62	55.7	5.3	2.34	44.62
21	1	A	7.27	0.651	21.01	1.69	57.87	5.26	2.56	51.14
22	1	A	7.39	0.468	20.36	1.61	57.31	3.68	1.65	31.42
23	1	A	7.14	1.14	16.56	1.3	71.27	5.47	2.43	43.1
24	1	A	7.24	0.714	16.49	1.53	53.22	5.57	2.06	51.75
25	1	A	7.41	0.408	6.53	1.77	43.35	1.96	1.21	7.45
26	1	B	7.79	0.476	15.55	1.7	60.95	1.14	0.56	4.11
27	1	B	7.56	0.374	16.5	1.69	61.19	1.27	0.64	4.57
28	1	B	7.52	0.444	12.04	1.53	57.59	1.07	0.62	4.26
29	1	C	7.61	0.359	10.9	1.61	61.46	0.79	0.57	3.05
30	1	C	7.48	0.317	11.9	1.69	58.41	1.27	0.62	5.02
31	1	C	7.46	0.411	11.79	1.64	56.88	1.41	0.57	4.72
32	2	A	7.67	0.283	10.25	1.66	44.65	2.51	0.71	9.42
33	2	A	7.51	0.323	8.12	1.61	42.51	2.13	0.65	9.72
34	2	A	7.6	0.239	7.37	1.44	40.88	2.68	0.62	8.21
35	2	A	7.66	0.301	9.23	1.46	41.8	2.37	0.78	7.9

36	2	A	7.54	0.418	8.76	1.65	42.59	2.61	0.81	3.66
37	2	A	7.41	0.414	6.92	1.51	43.52	4.2	0.6	2.59
38	2	A	7.65	0.259	5.16	1.61	35.85	1.41	0.68	2.14
39	2	A	7.58	0.238	11.45	1.59	44.28	2.06	0.71	1.84
40	2	A	7.74	0.286	8.32	1.36	46.46	2.3	0.84	5.32
41	2	A	7.7	0.228	5.92	1.48	39.71	1.62	0.81	4.57
42	2	B	7.57	0.241	15.65	1.59	51.66	1	0.43	2.44
43	2	B	7.59	0.243	16.15	1.53	54.59	1.24	0.54	4.41
44	2	B	7.69	0.222	13.58	1.74	52.06	1.2	0.51	3.66
45	2	C	7.66	0.174	14.28	1.65	38.37	1.27	0.56	3.05
46	2	C	7.71	0.188	14.13	1.52	50.35	0.72	0.45	3.96
47	2	C	7.83	0.176	12.75	1.55	52.71	1.1	0.46	2.9

Appendix B: Preliminary interviews with site owners

Interview 1: Sheikh Ahmed (owner of Site 1 – Valley floor)

Q1: Has this land been planted with anything before?
The land has 85 trees already planted on it as well as numerous cutting of vines. The fruit trees are between 5 and 10 years old, and the vines are 7 years old. The land owner also grows many vegetables between the trees including onions, tomatoes, peppers, chillies, courgettes, spinach, watermelons, melons, farqous, etc.

Q2: Do you plough the land?
The land is ploughed at least 4 times a year – first to 'open' it for the rain (in October), and then every month thereafter.

Q3: Do you have any other land – if so, how much?
He has about 20 dunums of land outside the fence

Q4: How do you use this land?
He grows forage for his animals on it, and also some vegetables. All this land is ploughed at least 2 times per year (once in the autumn to 'open' it, and once in the Spring, to 'clean' it) with a mule-drawn mouldboard plough. The land where he grows vegetables is ploughed 4 times per year. All the vegetables are consumed by him and his family.

Q5: Do you irrigate any of the land?
None outside the fence – the trees get a little water through the summer.

Q6: How many animals do you have?
200 sheep

Q7: What do the animals eat? Forage from the land or bought food?
Nearly all bought food – he has little land, and it produces very little forage.

Q8: How much do you spend on forage every year?
Buys about 80 tonnes which costs 12000 shekels per year.

Q9: How much water do your animals use and where does it come from?
The animals drink water from the bier in winter – but this normally runs out by January/ February. After this they drink 4 cubic metres per day.

Q10: How many biers do you have and what capacity?
3 biers – 1 x 100 CM, 1 x 10 CM and 1 x 150 CM
260 CM total.
The biers normally fill up in the winter – but this year the rainfall was low and they only half filled.

Q11: How much does it cost to bring water?
25 shekels to fill a 4 CM tank, but 200 shekels to drag it from Tawani with a tractor (so 225 shekels total)

Q12: How many people are in your household?
There are 20 people in his family, but only 15 live in Halawi. 5 sons, 3 daughters, 3 wives of sons, himself and his wife, plus a couple of grandchildren.

Q13: Do you all work on the land, or does anybody have another job?
All work on the land and with the animals. Labour is divided between males and females whereby men do most of the agricultural work in terms of ploughing, sowing and herding and women handle food production in terms of milking and processing the milk into yoghurt, butter and leban gemid (hard cheese). The women also work in the bustan, watering the trees and doing the weeding as well as tending and harvesting the vegetable gardens.

Q14: How much produce do you sell each year?
They sell only the products of the animals (mainly dairy) and occasionally some livestock (not meat, but the animals themselves) and make approximately 100 000 shekels per year. They also eat well from the animals.

Q15: What food do you buy? How much does it cost?
Flour, rice, sugar, tea, oil, salt, some veg and fruit. Costs about 2000 shekels per month.

Q16: What fuel do you use for cooking?
Often cooks on gas, sometimes uses wood, uses zibbel for the taboun oven.

Q17: What fuel do you use for heat?
Burns wood – a little from the trees he has (prunings) but mostly from the mountain (natsch and other scrub).

Interview 2: Sheikh Hanin (Owner of Site 3: Hillside)

Q1: Has this land been planted with anything before?
Never planted trees there before, but has used it to grow forage for the animals and some tobacco.

Q2: Do you plough the land?
Ploughs twice per year – once to open it to the rain and kill the weeds (autumn), once to 'clean it' in the spring.

Q3: Do you have any other land – if so, how much?
He has about 80 dunums of land outside the fence

Q4: How do you use this land?
He grows forage for his animals on it. All this land is ploughed 2 times per year with a tractor drawn mouldboard plough.

Q5: Do you irrigate any of the land?
No.

Q6: How many animals do you have?
300 goats and sheep.

Q7: What do the animals eat? Forage from the land or bought food?
Buys a lot of forage in the summer.

Q8: How much do you spend on forage every year?
About 5000 shekels.

Q9: How much water do your animals use and where does it come from?
The animals drink water from the bier in winter – from October to April – but after that he has to bring water by tractor – 4 CM per day.

Q10: How many biers do you have and what capacity?
2 biers: one of 100 CM and another of 35 CM.
Total 135 CM.
The biers normally fill up in the winter – but this year the rainfall was low and they only half filled.

Q11: How much does it cost to bring water?
25 shekels to fill a 4 CM tank, but 200 shekels to drag it from Tawani with a tractor (so 225 shekels total)

Q12: How many people are in your household?
There are 20 people in his family, but only 13 live in Halawi. 6 sons, 3 daughters, 2 wives, 3 sons' wives. 6 sons live and work outside the village but they do not send anything back in terms of resources.

Q13: Do you all work on the land, or does anybody have another job?
All work on the land and with the animals. Men do the herding, ploughing and sowing. Women do the milking and processing of milk into yoghurt, butter and cheese. Women also do some planting (herb gardens and vegetable patches), and take care of these plants (watering and weeding) – but they have not been investing heavily in this form of food production until now.

Q14: How much produce do you sell each year?
They sell only the products of the animals. Profits are variable – ranging from 25000 shekels to 50000 or more. They also eat well from the animals.

Q15: What food do you buy? How much does it cost?
Flour, rice, sugar, tea, oil, salt, veg and fruit. Costs about 4000 shekels per month.

Q16: What fuel do you use for cooking?
Uses gas for making tea and for light, otherwise mostly wood; and uses zibbel for the taboun oven.

Q17: What fuel do you use for heat?

Burns wood collected from the mountainside – mostly scrub species like natch (Sarcopoterium spinosum), which is dug up so that the woody roots can be burnt. The natch grows in dense clumps in some areas and apparently regenerates from year to year so that it can be collected from the same places repeatedly.

Appendix C: Community feedback survey

Participant 1

1. How did you participate in the project?
   a. Attended workdays Y
   b. Attended workshops Y
   c. I am involved in maintenance of the orchards Y

2. How do you feel about the project on a scale of 1-5 (where 1 is very positive and 5 is very negative)? 1

3. What was the best thing about the project in your opinion?
   The project first protects the land from being taken away by the Israelis. We get shade as well as products from the trees. We spend our free time working with the trees.

4. What was the worst thing about the project in your opinion?
   The shortage of water

5. Did you attend the workshops? If so, how many? Yes, but only one time

6. Did you find them helpful (on a scale of 1-5 where 1 is very helpful and 5 is useless)? 1

7. If you could change something about the project, what would it be?
   Increase the number of trees planted

8. Would you be interested in participating in another Actionaid project if there was the opportunity? Yes

9. Do you have any suggestions for future projects?
   To have the project last for a longer time

10. Any other comments?
    No

Participant 2

1. How did you participate in the project?
    a. Attended workdays Y
    b. Attended workshops Y
    c. I am involved in maintenance of the orchards N

2. How do you feel about the project on a scale of 1-5 (where 1 is very positive and 5 is very negative)? 1

3. What was the best thing about the project in your opinion?
   New green areas in the village, shade and tree products. Producing our own food is much better than buying it.

4. What was the worst thing about the project in your opinion?
   None

5. Did you attend the workshops? If so, how many?
   Yes, two times

6. Did you find them helpful (on a scale of 1-5 where 1 is very helpful and 5 is useless)?
   1

7. If you could change something about the project, what would it be?
   Nothing to be changed

8. Would you be interested in participating in another ActionAid project if there was the opportunity? Yes

9. Do you have any suggestions for future projects?
   No suggestions

10. Any other comments? None

Participant 3

1. How did you participate in the project?
    a. Attended workdays Y
    b. Attended workshops Y
    c. I am involved in maintenance of the orchards Y

2. How do you feel about the project on a scale of 1-5 (where 1 is very positive and 5 is very negative)? 1

3. What was the best thing about the project in your opinion?
   The best thing was the preparation of the soil and the water catchments. Also, I enjoyed learning how to take care of the trees – in particular the idea of mulching them with dried grass

4. What was the worst thing about the project in your opinion?
   Not a thing

5. Did you attend the workshops? If so, how many?
   Yes, all of them

6. Did you find them helpful (on a scale of 1-5 where 1 is very helpful and 5 is useless)?
   1

7. If you could change something about the project, what would it be?
   To plant more vegetables, but the problem is water

8. Would you be interested in participating in another Actionaid project if there was the opportunity? Definitely!

9. Do you have any suggestions for future projects?
   More water catchment channels and techniques and possibly establish a pool

10. Any other comments? None

Participant 4

1. How did you participate in the project?
    a. Attended workdays Y
    b. Attended workshops Y
    c. I am involved in maintenance of the orchards Y

2. How do you feel about the project on a scale of 1-5 (where 1 is very positive and 5 is very negative)? 1

3. What was the best thing about the project in your opinion?
   The attention from the people who started the work and the good ideas they gave us to use in taking care of the trees

4. What was the worst thing about the project in your opinion?
   Nothing

5. Did you attend the workshops? If so, how many?
   Yes - one

6. Did you find them helpful (on a scale of 1-5 where 1 is very helpful and 5 is useless)?
   1

7. If you could change something about the project, what would it be?
   Plant more trees

8. Would you be interested in participating in another Actionaid project if there was the opportunity? Yes

9. Do you have any suggestions for future projects?
   No

10. Any other comments? None

Participant 5

1. How did you participate in the project?
    a. Attended workdays Y
    b. Attended workshops Y
    c. I am involved in maintenance of the orchards Y

2. How do you feel about the project on a scale of 1-5 (where 1 is very positive and 5 is very negative)? 1

3. What was the best thing about the project in your opinion?
   We need more information from the project workers – more seeds to get more trees in the future and to do more work to get good soil.

4. What was the worst thing about the project in your opinion?

   Nothing
5. Did you attend the workshops? If so, how many?
   Yes, all of them

6. Did you find them helpful (on a scale of 1-5 where 1 is very helpful and 5 is useless)?
   1

7. If you could change something about the project, what would it be?
   More work on the land

8. Would you be interested in participating in another Actionaid project if there was the opportunity? Yes

9. Do you have any suggestions for future projects?

   To expand the current project and do more similar work in the area

10. Any other comments? No