بستان قرقعه

Būstān Qaraaqa

byspokes

# Artas aquaculture project progress report

# January 2011

Prepared by Philip Jones and Lorena Viladomat

**PO Box 31316 Jerusalem 91002 Israel**
**info@byspokes.org +972 (0) 598021647**

# Artas aquaculture project progress report

## Contents

## 1. Executive summary

The following report details the progress and activities of a project to develop domestic scale aquaculture systems integrated with irrigation infrastructure in the village of Artas, near Bethlehem, Palestine. The project's primary aim is to provide a sustainable means of enhancing food security in rural communities of the West Bank.

Food security is a serious issue in the Occupied Palestinian Territories (OPT) – nearly 40% of the population are chronically food insecure. Part of the reason for this food insecurity is the inability of the agricultural sector to provide adequately for the population, and thus the OPT are heavily reliant on food imports. Two of the major constraints limiting the agricultural sectors ability to realise its full potential are a lack of access to water resources, and severely restricted access to agricultural lands; in the West Bank, Palestinians are only permitted to use 20% of the sustainable yield from the mountain aquifer, and denied access to the Jordan River entirely, and farmers have access to only 37% of their agricultural lands. Both of these factors can be directly related to activities and policies of the Israeli occupation.

**Image 1: An irrigation cistern (bir) and irrigated lettuce field in Artas**

The present project promotes a means for sustainable food production that can maximise the use of the existing water and space resources. Agricultural cisterns (bir) are relatively commonplace in the West Bank. They are used as small reservoirs of irrigation water, which are periodically filled with spring, rain or purchased water depending on availability. By growing food fish in these bir we are able to provide a double use for the both the water within and space occupied by the bir. In order to keep food production as sustainable and low-cost as possible, the systems are not reliant on technological inputs or purchased fish food. Instead, the bir are fertilised with animal manure to promote algal and plankton growth which in turn provide a natural source of fish food.

**Image 2: Stocking a bir in Artas with carp fingerlings**

The project activities commenced in August 2010. Artas was selected as a suitable location for piloting this project for a variety of reasons, one of which being a dependable water supply in the form of a permanent spring. The project is working directly with six farmers who expressed interest in participating. A socioeconomic investigation was conducted to learn the importance of agriculture, and to assess dietary habits of the families concerned. In only one case was it found that agricultural production did not contribute at least 100% towards domestic food consumption.

Having been trained in how to prepare the bir for receiving fish, and how to apply manure to fertilise the water, participants were provided with a share of 600 common carp (*Cyprinus carpio*) fingerlings, at a cost of 1 ILS each (between 48-126 each, the exact number depended on the size of their bir, and how many they wanted). Fingerlings were delivered during the first fortnight of November 2010.


**Image 3: Some of the project participants**

The project aims to train participants in aspects of aquaculture such that in the future they may be able to manage their own systems independently, and to help others in setting up similar systems. For this reason participants are expected to attend a series of eight capacity building workshops covering relevant topics. The first three workshops were given in late November and early December 2010, and the rest will be scheduled for the new year.

Water quality analysis was performed on the Artas spring and the bir being used prior to stocking fish. Water quality was found to be adequate for aquaculture development in all cases, though one erroneous result required re-testing. Unfortunately, financial constraints mean that we are unable to test water quality independently, and as often as we would like. Instead we are reliant on the generosity of the Palestinian Water Authority's (PWA) laboratory in Ramallah who have been kind enough to test some samples for us. However, we would ideally monitor water quality regularly throughout the project, and although the PWA can assist to some degree we hope that we will be able to afford water testing equipment in the near future.

Other activities for the future include finishing the workshop series and establishing a bir in Artas as a breeding area to allow for local fingerling production in the spring. Also, in the spring it will be warm enough to stock tilapia, a fast growing and very popular food fish. Polyculture of different fish species allows for more efficient use of natural food resources. It is hoped that gradual harvesting of both carp and tilapia can commence in the early summer. Once harvesting has started, we shall interview participants to assess the success and accessibility of the project with a view to assisting other communities develop aquaculture systems in the future. Obviously the range of future activities we will be able to undertake is highly dependent on the amount of funding we are able to secure.

## 2. Acknowledgements

We would like to extend our gratitude to all who have helped us during the development and early implementation stages of this project. Thanks go to Michael New of Aquaculture Without Frontiers and Professor Amir Sagi of Ben Gurion Univeristy for helping us to make good contacts. We are grateful to Alon, Ayana and Tawfik of the Dor institute for fisheries research, and to Chris, Kyle and Tim for their assistance and generosity in donating fish. We would like to thank Awad abu Sway and Danna Massad for their help in community liaison and translation for the workshops, and Nael Ali-Ahmad, Hanadi Bader and Majeda Alawneh of the Palestinian Water Authority for their readiness to assist us with water analysis.

We would like to thank Soluquimpa S.A. de C.V., Proaindsa S.A. de C.V., LEA International, Grupo Sol Rey, ELSA Mex S.A. de CV., our families and a host of individual donors for much needed financial support, without which we would not have been able to proceed with the project.

# 3. Rationale

## 3.1. Problem statement

The Occupied Palestinian Territories (OPT) are suffering from an economic crisis, which threatens the food security of the population – nearly 40% of the Palestinian population is food insecure (25% West Bank)[1].

The rural areas of the West Bank are home to approximately 54% of the West Bank population[2], and these people are heavily reliant on some form of agriculture as their main or only form of income and subsistence, with as much as 80% of agricultural production being for domestic consumption[3]. Although only 20% of agricultural produce is destined for direct sale, the agricultural sector still contributes about 10% to the GDP of the Occupied Palestinian Territories[4] and is one of the most robust and consistent sources of economic growth in the OPT[5].

Unfortunately the whole of the OPT is suffering from a wide range of environmental problems, many of which are exacerbated, if not caused directly, by the ongoing occupation of the area by Israel. These problems, coupled with a lack of suitable infrastructure and development, have an immediately tangible impact on agricultural capability, and thus the well-being of the Palestinian population.

Two of the biggest problems facing the Palestinian agricultural sector are water availability and space available for cultivation. Palestinians have been denied access to the Jordan River and its water since the start of the occupation in 1967, and although the West Bank sits on top of (and is the recharge area for) the mountain aquifer, 80% of the water in this resource is utilized by Israel[6]. Palestinian abstraction is strictly controlled, and as a consequence the only way that Palestinians can meet their water needs is to buy water back from the Israeli water company Mekorot (for example, this accounted for 39% of Palestinian water consumption in 2005[7]).

Of the 5661km$^2$ total area of the West Bank, about 2880km$^2$ (51%) can be classed as agricultural land. However approximately 3304km$^2$ (58%) of the total area of the West Bank has become inaccessible to Palestinians as a result of various strategies imposed by Israel; the "separation wall" isolating roughly 555km$^2$ on the west, a further 1664km$^2$ effectively lost in the Jordan Valley and eastern slopes through access controls and military zones, and finally 1085km$^2$ classified as "Area C"

[1]OCHA 2010. Consolidated Appeal Process

[2] World Food Programme (WFP), 2006. "Vulnerability Analysis and Mapping" Vulnerability Analysis and Mapping Report 5, April 2006.

[3] ARIJ (Applied Research Institute – Jerusalem). 2007. Status of the environment in the Occupied Palestinian Territories. Bethlehem, ARIJ.

[4] Palestinian Central Bureau of Statistics (PCBS), 2005. Statistical Abstract of Palestine No. 6. PCBS, Ramallah.

[5] World Bank. (WB), 2006. West Bank and Gaza update: A quarterly publication of the West bank and Gaza Office, September 2006

[6] Viladomat, 2009. Access to water is a right. To what extent are the Palestinian Authority and the Israeli State accountable in denying Palestinians their right to water? B.A. dissertation, University of Middlesex, London

[7] Palestinian Water Authority (PWA.), 2005. Quantities of Water Supply in the West Bank Governerates. PWA, Ramallah

(under full Israeli control). The end result is that Palestinian farmers only have proper access to about 37% of their agricultural lands[8].

At present the OPT are totally dependent on external aid, and if for any reason this input to the economy should be withdrawn, the country would slump into abject humanitarian crisis.

### 3.2. Priority needs

**Long term sustainability in food production**: In order to increase Palestinian self reliance, and alleviate dependency on Israel (and thus the susceptibility to manipulation by the occupying power), it is imperative that the OPT develop sustainable strategies for food production and income generation which can function within the constraints they face. The OPT are in a state of "protracted crisis"[9]. According to the Food and Agriculture Organisation of the United Nations (FAO) and World Food Programme (WFP), assistance to areas in protracted crisis needs to focus on long term solutions which enhance the areas ability to "support life saving and livelihoods protection activities".

**Water and space efficiency**: As discussed, two of the most serious constraints facing agricultural development are space and water availability, and so proposed interventions must be both space and water efficient. If a secondary use can be provided for existing infrastructure and resources then this is provides an optimal situation, not only in terms of efficient resource use but also terms of minimizing initial capital investment.

**Dietary improvement**: A "protracted crisis" is defined by the WFP and FAO, in part, as a food crisis extending for more than eight years in a country that receives more than 10 per cent of foreign assistance as humanitarian relief[10]. As a consequence a significant proportion of the population is food insecure and can be expected to suffer from malnutrition. Assistance should therefore focus on increasing the availability of quality nutrition, in particular increasing the production of food items for which there is an already identified production deficit, such as fish[11].

### 3.3. Approach

The approach of this project is to utilise the standing water resources created by agricultural cisterns for the development of domestic scale aquaculture projects. The main activities consist of facilitating the acquisition of suitable fish stock for culture, and providing training to participants to enable them to independently manage their aquaculture systems into the future.

This project can address the priority needs thus:

**Long term sustainability in food production**: Low (or zero) technology green-water aquaculture systems are being implemented. In these systems, stocking densities are kept low to remove the

---

[8] ARIJ 2007

[9] FAO 2010. *The state of food insecurity in the world: Addressing food insecurity in protracted crises*. Food and Agriculture Organization of the United Nations. Rome 2010

[10] Ibid.

[11] ARIJ 2007

need for technological inputs such as mechanical aeration and to reduce the likelihood of health problems in fish. The fish feed primarily on natural foods, generated in-situ through natural productivity in the pond system. The water column is fertilised with animal manures in order to enhance the natural productivity, and if desired domestic or agricultural wastes (kitchen scraps, “unsightly” leaves on marketable salad crops etc.) can be provided as a supplementary feed for the fish. Another projected benefit of integrating aquaculture with irrigation systems in this manner is that aquaculture enhances water nutrient content, potentially reducing the dependency on inorganic fertilisers on crops, thus reducing cost, preventing soil salinisation and protecting soil health.

An important aspect of ensuring sustainability of the project, and thus food production, is the dissemination of skills and knowledge to participants through capacity building workshops. In this manner we can be confident that participants will be able to benefit from this form of food production into the future even after cessation of the project activities.

**Water and space efficiency**: This project takes advantage of existing agricultural cisterns. By finding extra functionality for these existing water and space resources we are increasing resource use efficiency. In addition, by making use of existing water supply and storage infrastructure we are able to keep set-up costs to a minimum.

**Dietary improvement**: Domestic production of food fish will obviously increase the availability of this healthy protein source in the diet. Fresh fish is an expensive foodstuff in the OPT, and so domestic fish production also has potential economic benefits – both in terms of reduced expenditure on groceries (direct replacement of purchased fish with home-grown fish) and as a source of income from sale of home-grown fish. The subsequent increase in domestic budgets could ultimately help to further enhance standards of diet and living.

**Image 4: Palestinian agricultural practices: lettuces on drip irrigation (left) and beds prepared for traditional flood irrigation (right) in Artas**

# 4. Project aims

## 4.1. Project goal

The long-term objective of this project is to integrate sustainable domestic scale aquaculture into agricultural activities in rural areas of the OPT to support Palestinian rural communities with a water efficient system for enhanced domestic food production. This will lead to greater food independence, greater variety of food, enhanced nutrition and increased domestic productivity.

## 4.2. Project objectives

The specific objectives of the project are:

- To provide training in order to educate farmers about the benefits and processes of aquaculture
- To demonstrate the effectiveness of sustainable aquaculture systems to community members
- To help individuals establish private sustainable aquaculture systems
- To enhance rural food security

## 4.3. Project outputs

The outputs of the project are:

- Conduct a series of workshops in target communities in the West bank
- Prepare and stock participants' birs with fish for grow out (demonstration aquaculture systems)
- Facilitate local fish seed production in target communities (preparation for private systems)
- Reduce household expenditure

# 5. Target group

The project is currently being implemented in the village of Artas. We selected Artas as a suitable location for the first community implementation of this project due to the abundance of irrigation cisterns (*bir*) and ready access to water provided by a spring. Artas has always been a farming community, and most of the village's residents are heavily reliant on agricultural production as both a source of food and income.

After conducting preliminary meetings we were able to identify six individuals who were interested in participating. Three potential participants ultimately decided not to join the project at this stage. One was concerned that fish wastes and manures applied to fertilise the ponds could potentially cause problems with his drip irrigation system; the second was already growing large numbers of goldfish in his bir which he sells every 3-4 years to generate income and decided not to try adding food fish right away; the third cannot afford to repair his bir at present.

**Image 5: Artas monastery**

Once identified, participants were each offered approximately 100 common carp (*Cyprinus carpio*) fingerlings for the modest of investment of 1 ILS each. It is hoped that by demanding a small financial investment, the participants will be keen to recover their expenditure, and thus more inclined to continue with the rest of the project activities.

The participants are expected to commit to attend a series of workshops and to study the materials provided in order to gain the necessary knowledge and skills to successfully rear fish. In addition, participants are encouraged to perform a few activities to ensure adequate conditions for healthy fish growth.

## 6. Project implementation

### 6.1. Activities to date

The project activities commenced in August 2010. The focus of the first two months was primarily networking to seek contacts and suppliers of fish, aquaculture supplies and water testing equipment in the OPT and Israel. Through the organisation Aquaculture without Frontiers (AwF) we were able to make contacts in the Ben Gurion University of the Negev (BGU, Beer Sheva) and the Dor Institute for Fisheries Research (near Haifa) from whom we acquired common carp fingerlings. We also arranged with the Palestinian Water Authority (PWA) to be able to conduct water analysis in their Ramallah laboratory.

Once we had the necessary contacts we progressed to the stage of consultation with farmers in Artas. During October we held several meetings in Artas to introduce the project, explain the potential costs and benefits, and to find interested participants. The participants were then interviewed to ascertain the current usage pattern of water in their birs, and crop production and fertiliser use on land irrigated from the bir. A water sample was collected from the bir of each participant and also from the Artas spring (the source of water of all but one of the birs) and taken to the PWA laboratory for analysis.

**Image 6: Discussing bir water quality with Aras farmers**

The safe carrying capacity of each bir was calculated (see Table 1) according to the minimum expected water depth (and thus volume) during normal use, taking 3kg/m$^3$ as the quantity of fish supportable without mechanical aeration based on consultation with an aquaculture specialist working on similar systems in Mexico (the actual recommended figure was 4-5kg/m$^3$, we chose to start with 3 for conservatism, and to allow later increase once systems and protocols are better developed). Obviously, the deeper the water the greater the volume, and thus the greater the potential carrying capacity of the cistern. However, the maximum effective volume is always limited to about 2m, as beyond this depth the deeper layer of water can become oxygen depleted; in standing water oxygen transfer from the surface to deep water is very slow. Additionally, plankton in the upper water column will reduce light penetration to deep water, accordingly reducing the potential for photosynthetic oxygenation of deep water. This is a particularly important consideration when rearing bottom feeding species such as carp.

Participants were asked to prepare their birs for the arrival of fish; preparation included removing rubbish and surface algal blooms, and applying manure to fertilise the water and ecosystem therein. The initial suggested fertilisation rate was 6g/m$^2$/week (dry manure), a relatively low value, but one which is unlikely to cause water quality problems if not applied correctly. As the water temperature increases in spring, the metabolic demands of fish will also increase, and this figure will be gradually increased up to a maximum of about 15g/m$^2$/day. These figures have been derived from an extensive study of literature, particularly Bhakta *et al.* 1994[12]; Boyd 2004[13]; Edwards *et al.* 2004[14] and the FAO[15].

**Table 1: Participants' Bir size, capacity and stocking information**

| | **Bir surface area (m$^2$)** | **Depth (m)** | | **Min volume (m$^3$)** | **Refill frequency** | **Max fish weight (kg)** | **Number *C. Carpio* given** | **Capacity at 500g (%)** |
|---|---|---|---|---|---|---|---|---|
| | | Max | Min | | | | | |
| **Participant 1** | 64 | 2 | 0.5 | 32 | Every 12 days | 96 | 102 | 53 |
| **Participant 2** | 150 | 2.5 | 1 | 150 | Every day | 450 | 100 | 11 |
| **Participant 3** | 16 | 5 | 1 | 16 | Every 12 days | 48 | 48 | 50 |
| **Participant 4** | 72 | 6 | 0.5 | 36 | Every 15 days | 108 | 118 | 49 |
| **Participant 5** | 16 | 4 | 2 | 32 | Every 12 days | 96 | 102 | 53 |
| **Participant 6** | 50 | 5 | 1 | 50 | Every 10 days | 150 | 126 | 42 |

In mid October we visited the Dor research centre, where carp strains are grown along with crayfish in earth ponds. The crayfish are grown for experiments at the BGU, and the carp are produced for hybridization investigations at Dor. The ponds are drained regularly to harvest the crayfish, and the majority of the carp are left over as a waste and eaten by birds as the institute has very little space available for growout to marketable size. We were able to capitalise on this for the benefit of the

[12] Bhakta, J. N., Sarkar, S. J. and Jana, B. B. 2004. Optimizing fertiliser dose for rearing stage production of common carps under polyculture. *Aquaculture* **239**: 125-139

[13] Boyd, E. C. 2004. *Farm-Level Issues in Aquaculture Certification: Tilapia.* Report commissioned by WWF-US in 2004. Auburn University, Alabama 36831

[14] Edwards, P., Pacharaprakiti, C. and Yomjinda, M. 1994. An assessment of the role of buffalo manure for pond culture of tilapia. I. On-station experiment. *Aquaculture* **126**: 83-95

[15] FAO 1986. *Carp Cultivation and the Highlands Aquaculture Development Centre, Aiyura*. FI:TCP/PNG/4503 Field Document 1 May 1986

project, and were invited to collect common carp (*C. carpio*) when they next had to drain a pond. The estimate was that we would be able to collect about 600 fish from Dor, and so we calculated an equitable division of fish for the Artas farmers based on bir volume. The carrying capacity of each bir was calculated based on the maximum number of fish assuming a harvest weight of 500g; with the available fish we would be able to stock each participants' bir to approximately 26% capacity (at harvest). However, one participant elected to decrease his share, and so we ended up calculating stocking rates of approximately 50% growout capacity for 5 birs, and one at approximately 11% (see Table 1).

We visited Dor again at the start of November, and were only able to obtain 315 medium sized *C. carpio* (100-200g) from the pond. However, we managed to source a further 285 smaller (50g) carp fingerlings from a project in Jerusalem. As we had stocked the majority of the smaller fingerlings in the Bustan Qaraaqa cistern for temporary storage, we subsequently had to net them to be able to transport them to Artas. Due to the severe financial limitations we are working with we were unable to purchase suitable fishing nets, so this process took far longer than expected. Unfortunately most locally available net-like materials are very buoyant, ruling out the possibility of seining the cistern in one go, and after several failed or time consuming drop-net type methods of fish harvesting we eventually developed a very successful fish-trap. It took us 15 days to stock the 6 bir in Artas.

**Image 7: Harvesting fish from Dor fishponds**

During November we conducted an initial socioeconomic questionnaire of participants to establish a baseline dataset. The same questionnaire will be used towards the project's completion to highlight any change in participants' situations as a result of the project.

We have also commenced the workshop series, providing participants with study materials themed "an introduction to aquaculture" and "water quality parameters" and subsequently reviewing the topics. The initial feedback and impression from participants is very positive; study materials appear to be pitched at the right level, and have prompted lively and interested discussions.

The project has caught the attention of the Palestinian Ministry of Agriculture (MoA), who have decided to invest significantly into aquaculture development within the next 5-6 years. We gave a tour of the Artas project sites to ministers visiting from Bethlehem and Ramallah, and learned about a couple of commercial projects they are developing in the north of the West Bank. They are very interested to see how the Artas project develops as there is a growing awareness that water scarcity is going to increase in the OPT, and sustainable and water efficient aquaculture development could well provide a means to maintain a viable agriculture sector into the future.

## 6.2. Future activities

Workshops covering the following topics have been scheduled for the forthcoming months: Problem management; Disease prevention and cure; Pond management; Fish biology and ecology; Carp reproduction; Tilapia culture; Harvesting and re-stocking. We also hope to be able to arrange a visit for participants to one of the MoA's projects in the northern West Bank, and to invite a technician from Dor to give a talk in Artas.

In addition to continuing with the training, we shall continue to monitor water quality throughout the growing season. If we are able to secure sufficient funding we shall provide participants with water testing kits to allow on-the-spot analysis of stocked and un-stocked bir. If not, we shall continue to take samples to the PWA for laboratory analysis.

Once the water temperatures start to increase in the spring we shall change the fertilisation and feeding regime to increase fish growth rate. We would also like to set up one bir in Artas for carp reproduction, enabling community based fingerling production for future project development. Also dependent on water temperatures we intend to offer participants the opportunity to add tilapia (*Oreochromis aureus*) to the bir which will grow out to edible size during the warm months. The polyculture of carp and tilapia enables greater nutrient conversion efficiency within the pond thanks to their different feeding habits. As we were able to bring some quite large carp from Dor, it should be possible to commence gradual harvesting in April.

Aside from continuing this project in Artas, we are keen to take this project model to other communities with similar infrastructure, and work with NGOs involved in bir rehabilitation to provide an additional end use for newly created/recreated standing water resources. We are also interested in developing an aquaponic pilot project for areas that have reduced space and water availability, particularly focussing on "Area C" in which Israeli imposes a ban on permanent structures and prohibits construction of water storage infrastructure such as bir. However, all future activities, both in Artas and elsewhere, are dependent on being able to raise sufficient funds to be able to see new developments through to satisfactory conclusions.

## 7. Monitoring and assessment

### 7.1. Agricultural practices

The majority of farmers in Artas grow the same crops: lettuce, spinach, rocket, cabbage, broccoli, cauliflower, aubergine, tomatoes, peppers and onions. Crops are grown in open land and inside plastic houses, either with drip irrigation or traditional trench irrigation.

All irrigation water is stored in birs, used as needed and topped up usually every 12 days as access to the spring water supply rotates throughout the community. In general, the outlet for irrigation water is situated some distance above the floor of the bir (5-30cm), and is always covered with a screen to prevent large particles entering, and potentially blocking, the irrigation systems. Some farmers have only one bir, others may have several smaller ones each irrigating a separate patch of land.

Land is fertilised prior to planting by ploughing in manure. Some farmers supplement this with chemical fertilisers. In most cases manure is free, though some farmers pay to transport it by the truckload. Table 2 summarizes current agricultural practices in Artas on the land irrigated by the birs selected for use in this project.

**Table 2: Agricultural water and fertilizer use for land irrigated by the bir selected for aquaculture development**

| Participant | Area irrigated (dunam) | Manure usage (₪/year) | Chemical fertilizer usage (₪/year) | Irrigation rates ($m^3$/day) |
|---|---|---|---|---|
| 1 | 3 | 2,500 (10 trucks) | 4,000 | 2.5 |
| 2 | 5 | 3,000 (12 trucks) | 5,000 | 7.5 |
| 3 | 0.5 | 750 (3 trucks) | 1,200 | 3.2 |
| 4 | 2 | Free | Not used | Unknown |
| 5 | 1 | Free | 4,000 | 2.4 |
| 6 | 2 | Free | Not used | 7 |

Integration of aquaculture into the irrigation system should cause no overall change in agricultural or irrigation practices, as the systems have been designed to work with present usage patterns. However, long term water quality monitoring may reveal that regular fertilisation of the bir increases nutrient content of the irrigation water, thus potentially reducing the need for chemical fertilisers.

### 7.2. Socioeconomic data

A socioeconomic survey of participants was conducted in November. This survey highlighted the importance of agriculture to domestic food security. In some cases, participants' households consume the majority of their agricultural produce; in others agricultural produce is sold at market, (Table 3, column 4) and the money then used to buy groceries. Meat is generally consumed 2-3 times a week, and fish once every 2 weeks. In all cases, purchased meat accounts for a significant amount of the total household grocery bill (25-75%) (Table 3, column 2).

In order to assess the importance of agriculture to domestic food security, we collected data on domestic consumption and production in financial terms (amount spent on groceries; profit from agriculture; value of home produce consumed). The contribution of agriculture to food security (%) was quantified thus:

$$\frac{Production}{Consumption} \, X \, 100$$

In which:

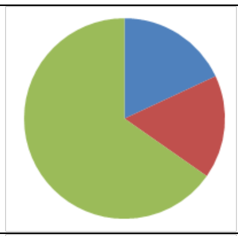
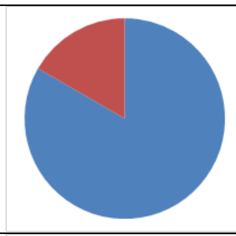
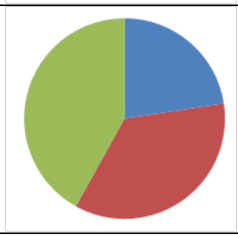
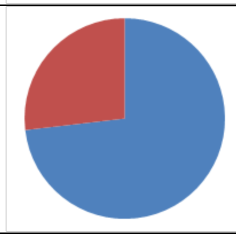
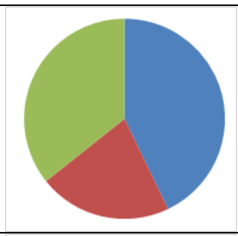
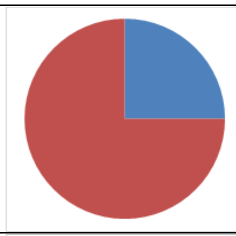
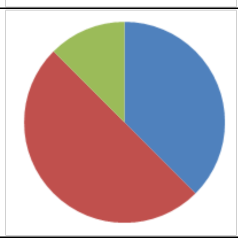
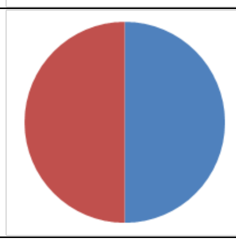
PRODUCTION = Total profit from agricultural production
+ Total value of agricultural production consumed domestically

CONSUMPTION = Total expenditure on groceries
+ Total value of agricultural production consumed domestically

In all cases it was found that agriculture contributes significantly to domestic food security. In one household (4), in which more people work away from home than on the land, agriculture only provides for 29% of domestic consumption, the shortfall being met by earnings from employment.
In 2 households, agriculture provides for 100% of domestic consumption – i.e. employment earnings (if present) do not need to be spent on food. However, there is no surplus; in 1 household, agriculture contributes 132%, i.e. provides for all domestic consumption and provides a small profit (Table 3, column 5).

By repeating this questionnaire towards the end of the project, we hope to be able to discern whether domestic scale aquaculture has had any discernable impact on domestic food security. Probable indicators would be an increased frequency of fish consumption (suggesting dietary improvement) and reduced grocery expenditure or increased profit from agriculture (suggesting greater food security). Agricultural profitability may also increase by a reduced expenditure on chemical fertilisers. However, it is not expected that will become apparent immediately, though water quality analysis should be able to indicate if this is a likely outcome.

**Table 3: Findings of first socioeconomic survey – Importance of agriculture to food security in 6 households in Artas village, November 2010**

| | Household information | Consumption habits<br>Home grown food<br>Purchased groceries<br>Purchased meats | Destination of agricultural produce<br>Sold produce<br>Home consumption | Contribution of agriculture to domestic food security (%) |
|---|---|---|---|---|
| 1 | Household size: 15<br>Work on land: 6<br>Work away: 2 |  |  | 100 |
| 2 | Household size: 7<br>Work on land: 1<br>Work away: 0 |  |  | 132 |
| 3 | Household size:<br>Work on land:<br>Work away: | Awaiting response | Awaiting response | Awaiting response |
| 4 | Household size: 22<br>Work on land: 2<br>Work away: 4 |  |  | 29 |
| 5 | Household size: 7<br>Work on land: 7<br>Work away: 1 |  |  | 100 |
| 6 | Household size:<br>Work on land:<br>Work away: | Awaiting response | Awaiting response | Awaiting response |

### 7.3. Water quality analysis

Maintenance of adequate water quality is an important factor in this project; fish, plant and human health is dependent on this. Prior to stocking the bir, water samples were collected from each bir and the Artas spring (the source of water for all but one of the bir). The samples were taken to the PWA laboratory in Ramallah to analyse a range of important parameters (Table 4).

A programme of continual (weekly) water quality monitoring is being gradually implemented alongside workshop days; however, due to funding constraints the range of field tests we are able to perform is severely limited. Until such time as we have access to the full range of field tests we plan to take samples to the PWA on a monthly basis.

At present, the low stocking densities, relatively low fertilisation rates and routine water exchange from normal bir use will ensure water quality does not deteriorate. By stocking the fish gradually we were able to avoid a sudden spike in ammonia and nitrite concentrations, and so avoided fish mortalities commonly associated with stocking.

It is expected that over the course of the project, especially once fertilisation rates increase in the spring, the nutrient (particularly nitrate) content of the water will increase noticeably.

**Table 4: Water quality data from analysis of pre-stocking water samples from 5 of the bir used in this project, and the Artas spring. Water samples were taken on 27 October 2011; DO (and temperature) readings were taken between 15:45 – 16:45 on 1 December 2011, and converted for temperature and altitude.**

| | 1 | 2 | 3 | 4 | 5 | Spring |
|---|---|---|---|---|---|---|
| **pH** | 7.17 | 7.17 | 7.06 | 7.77 | 6.96 | 7.55 |
| **Temperature (°C)** | 20.2 | 19.8 | 17.6 | 22.1 | 18.6 | 22.3 |
| **DO (daytime) ($O_2$ ppm)** | 16.7 | 17 | 6.6 | 16.1 | 9.1 | 7.6 |
| **Electrical Conductivity** | 685 | 666 | 2240 | 874 | 807 | 894 |
| **Nitrite ($NO_2$ ppm)** | 0.28 | 0 | 0.52 | 0.52 | 0.52 | 0 |
| **Nitrate ($NO_3$ ppm)** | 58 | 35 | 41 | 46 | 3 | 72 |
| **Ammonia ($NH_4$ ppm)** | 0 | 0 | 150 | 0 | 0 | 0 |
| **Chloride ($Cl^-$ ppm)** | 89 | 82 | 87 | 87 | 75 | 122 |
| **Alkalinity ($HCO_3$ ppm)** | 135 | 161 | 242 | 373 | 301 | 130 |

As can be seen in Table 4, the quality of the spring water and water in four of the five birs examined is fine for aquaculture purposes. The one exception is bir number 3, which gave an incredibly high result for conductivity and ammonia. However, we can only assume this resulted from some post-sampling contamination of the water sample, as on visual inspection this bir is the "healthiest" of all, and presents the most diverse pond ecosystem of all the birs; if ammonia levels really were this high, then pond life and fish would have suffered. We are currently awaiting results of the next (post-stocking) water samples. In some birs, DO levels were well above saturation at time of sampling, a result of the high levels of phytoplankton, and these birs receiving full sun.

## 8. Budget

### 8.1. To date

| Description of Activity/Item | | Unit | Unit Price | Amount |
|---|---|---|---|---|
| **1.1** | **Project Staff** | | | |
| | Staff subsistence (x2) | Per month (5) | ₪2,000 | ₪20,00 |
| **1.2** | **Initial Assessment** | | | |
| | Transportation for assessment exercise | Per trip (x3) | ₪60 | ₪180 |
| | Transportation Laboratory | Per trip (x3) | ₪72 | ₪216 |
| | Water testing equipment: | DO meter (x1)<br>pH meter (x1)<br>EC meter (x1) | ₪924<br>₪300<br>₪200 | ₪1,424 |
| **1.3** | **Training Programme** | | | |
| | Printing | Paper and ink | ₪149 | ₪149 |
| | Translation (6hrs per session) | Per hour (18hrs) | ₪100 | ₪1,800 |
| | Transportation for staff | Per session (3) | ₪60 | ₪90 |
| **1.4** | **Stocking costs** | | | |
| | Fish cost | Per fish (600) | Donated | Donated |
| | Boxes | Per box (X25) | ₪17.4 | ₪435 |
| | Bags | Per bag (X56) | ₪2.3 | ₪130 |
| | Transportation costs | | | ₪1,408 |
| **1.7** | **Direct Costs** | | | |
| | Stationery | | ₪200 | ₪200 |
| | | | **Grand Total ₪** | ₪26,032 |
| | | | **Grand Total US$** | **$7,231** |

### 8.2. Future

| | Description of Activity/Item | Unit | Unit Price | Amount |
|---|---|---|---|---|
| **1.1** | **Project Staff** | | | |
| | Staff subsistence (x2) | Per month (6) | ₪2,000 | ₪24,000 |
| **1.2** | **Monitoring** | | | |
| | Transportation Laboratory | Per trip (x6) | ₪72 | ₪432 |
| | Water testing equipment: | Ammonia photometer<br>Ammonia reagents kit (x4)<br>Nitrate kit (x4)<br>Nitrite kit (x4) | ₪680<br>₪342<br>₪540<br>₪146 | ₪4,792 |
| **1.3** | **Training Programme** | | | |
| | Printing | Paper and ink | ₪400 | ₪400 |
| | Translation (6hrs per session) | Per hour (54hrs) | ₪100 | ₪5,400 |
| | Transportation for staff | Per session (8) | ₪60 | ₪480 |
| | Transportation field trip | Per day (x2) | ₪800 | ₪1,600 |
| | Guest speaker | Per day (x1) | ₪600 | ₪600 |
| | Follow up trips | Per trip (x6) | ₪60 | ₪360 |
| **1.4** | **Stocking costs** | | | |
| | Fish cost | Per fish (600) | ₪2 | ₪1,200 |
| | Boxes | Per box (X10) | ₪17.4 | ₪174 |
| | Bags | Per bag (X20) | ₪2.3 | ₪46 |
| | Transportation costs | Per trip (X1) | | ₪1,000 |
| **1.7** | **Direct Costs** | | | |
| | Stationery | | ₪200 | ₪200 |
| | | | **Total** | ₪40,684 |
| | | | **Contingency 10%** | ₪4,068 |
| | | | **Grand Total ₪** | ₪44,752 |
| | | | **Grand Total US$** | **$12,431** |

We still need to raise funds in order to be able to continue with this and other projects. For individuals interested in supporting us, then donations can be made via our website (http://byspokes.org). Alternatively:

**In the UK:** Bank Transfer to: **HSBC** Account name: **Philip Jones**
Sort code: **40-09-03** Account number: **61625950** Reference: **bsp1**

**In Mexico:** Bank Transfer to: **Santander** Account name: **Lorena Viladomat Davila Galindo**
Account number: **20-00552719-2** Reference: **bsp1**

**Worldwide (Paypal):** email: **philipjones@ekit.com** Paypal ID: **CK2SAJNM36HMN** Ref.: **bsp1**

For tax deductible donations, please contact us at info@byspokes.org for information.

## 9. Conclusion

So far, the Artas aquaculture project has been advancing satisfactorily. After investing a couple of months in networking and seeking contacts and suppliers we were then able to make fairly rapid progress. The project idea was met with interest and enthusiasm in Artas, and we were able to distribute 600 common carp fingerlings, which were donated by the Israeli Dor institute, between six keen farmers. More farmers seem to be interested to participate but for a variety of reasons have held back from starting immediately. We hope that in the spring we will be able to establish a cistern in Artas as a carp breeding site, enabling future participants to source livestock locally. This is very important for long term project sustainability as there is no fingerling production within the OPT as yet, and it is usually not possible for fish to be brought from Israel as Palestinians are unable to travel to Israel, and it is illegal for Israelis to enter the OPT.

**Image 8: A large common carp - something to look forward to**

We learned from our meeting with ministers from the MoA that the Palestinian Authority (PA) is very keen to develop aquaculture in the OPT, and so we feel that we have been able to start this project at a very opportune time. Not only can we provide an interesting model of sustainable aquaculture development for the PA to observe, but also the participants and involved family members will be in a good position to benefit from the planned development of an aquaculture sector, such as enhanced employment potential.