byspokes

Annual report November 2011

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1: Introduction

The following report details the projects and activities undertaken by Byspokes in 2011. The focus of our work is development and implementation of projects to help sustainably enhance food security in communities in the West Bank by integrating aquaculture with plant agriculture. We work in collaboration with Bustan Qaraaqa, a permaculture farm based in Beit Sahour that was established in 2008 and has since then developed a good track record of undertaking innovative sustainability and environmental projects both on-site and in communities.

Since commencing activities in the West Bank in the summer of 2010 with a pilot sustainable aquaculture project in the village of Artas, near Bethlehem, Byspokes has been developing capabilities in different areas. Our current activities can be categorised into:

- Sustainable aquaculture projects
- Aquaponic projects
- Consultancy work
- Training

The projects we develop, and consultancy and training we offer, are all aimed at empowering individuals and communities to develop and manage aquaculture and aquaponic projects independently. Our goal is to provide sufficient transfer of skills and knowledge that projects remain fully self-sustaining and independent in the future, i.e. requiring no long term external support or intervention. In addition to individual project sustainability, our ultimate objective is that ideas we have seeded in the local community spread organically without our long-term involvement: by assisting in the establishment of sufficient example projects we hope to enthuse individuals to consider starting their own projects, and we aim to provide sufficient training to partners that they are able to assist others in establishing projects.

2: Sustainable Aquaculture

Intensive fishponds in Israel

Unlike modern, high intensity aquaculture, sustainable aquaculture is not heavily reliant on technology, power, and fishmeal based fish food. Instead, the aquaculture systems we advocate rely on fairly low stocking densities and enhancing natural pond productivity through fertilisation of the water with manures and/or supplemental feeding with domestic and agricultural vegetable and cereal wastes. When integrated with existent irrigation infrastructure, sustainable aquaculture can offer additional benefits that are particularly relevant in the Palestinian context:

Sustainable fishponds in Artas, Palestine

- It allows for the production of an additional crop (food fish) from already existing resources.
- Fresh fish is virtually unavailable inside the West Bank; imported frozen fish is very expensive.
- Fertilisation of the water combined with wastes from fish mean that the water ends up with a high nutrient content; this can reduce the need for costly, imported chemical fertilisers on the irrigated crops, and reduce labour required to apply fertilisers as nutrition is delivered with the water.

2.1: Aquaculture projects

The valley of Artas

Our sustainable aquaculture projects in Bustan Qaraaqa and Artas village remain on going. In October 2010 we started to deliver training workshops to participants in Artas, and in November 2010 we stocked common carp (*Cyprinus carpio*) fingerlings to six agricultural cisterns in Artas (see January 2010 progress report, available online, for details), and a mix of common carp and tilapia (*Oreochromis aureus*) fingerlings to the cistern at Bustan Qaraaqa. Since January we have delivered the remainder of the workshop series to Artas participants, and have made periodic follow-up visits to Artas to check on water quality and system health.

In Bustan Qaraaqa, our primary interest was to see if tilapia would survive the Beit Sahour winter in an unprotected cistern. Unfortunately we found that the water temperature got too cold; not low enough to kill the tilapia directly, but low enough to cause chronic stress and disease outbreaks which subsequently resulted in full mortality by March 2011. The carp, on the other hand, have shown no signs of distress through the year. We have noticed infection by anchor worm (*Lernaea* sp.) and fish louse (*Argulus* sp.) in the Bustan Qaraaqa cistern, but neither seems to have caused serious problems yet. If affected fish are captured, then we remove the parasite with tweezers and treat the fish with a salt bath.

Some of the larger fish in the Artas cisterns should now be approaching harvest size of around 500g. During September 2011 we constructed some fish traps from readily available materials (shade cloth and irrigation pipe) and, after testing them in Bustan Qaraaqa, deployed them in the cisterns in Artas in an effort to catch some fish. Unfortunately, the traps proved ineffective in capturing the larger fish, and so we are left with two options:

Catching carp in Artas

Deploying fish traps

1) To re-design the fish trap, developing one which is effective in catching lager, wary fish thus enabling continuous, "on-demand" fish harvesting.
2) To partially drain the cisterns and use a weighted seine net to catch the fish, enabling "batch" harvesting.

Seine net being used in Israel

Visiting fish pond in Artas

The latter option is perhaps the most efficient method of fish capture, but there are several factors to consider for future project management and design:

- The cistern can only be fully drained (allowing harvesting at the farmer's convenience) during the winter months when irrigation is not such a priority.
- During the summer months irrigation will often cause water levels to drop low enough to use a seine net (allowing occasional harvesting, but only as water depth dictates).
- Draining, netting and re-filling the cistern is quite a time consuming task, and requires several people.
- Suitable nets are not available in the West Bank, and will have to be bought in Israel.
- Batch harvesting will yield a lot of fish at a time, increasing the immediate workload to include post-capture cleaning, preparing and storing/selling.

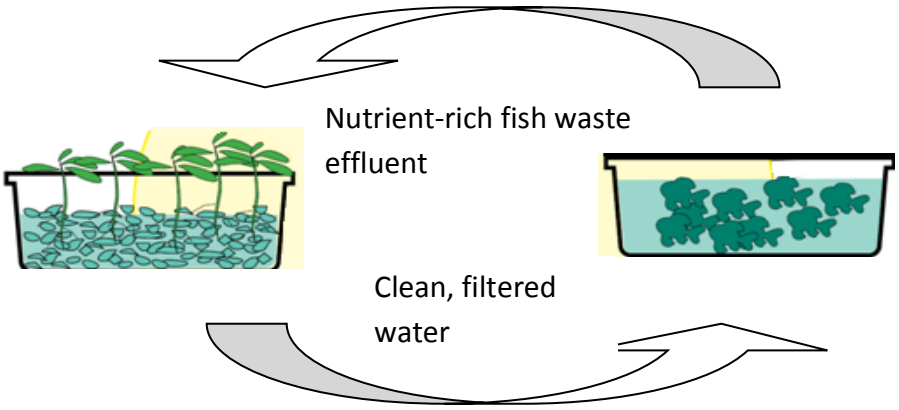
Regarding the community implementation aspect of the project in Artas, we found that several of the participants seemed to lose interest in the project soon after they had received the fish. This meant that they did not turn up on time (or at all) to subsequent workshops and training sessions. Ideally, we would have delivered all workshops before bringing any fish for participants, only distributing fish to participants who attended all the workshops. Unfortunately, we were unable to co-ordinate activities as efficiently as we would have liked as we had difficulty obtaining a reliable translator, and the donated fish were available at short notice and for one day only. In an attempt to mitigate this problem (which we envisaged from the outset), we charged a token 1 Israeli Shekel (ILS) for each fish in order that each participant had a financial investment at stake, and thus motivation to see a return. However, given the ranging socioeconomic backgrounds of participants it was hard to select an appropriate, fair price per fish; the 1ILS /fish investment obviously was not enough incentive for some participants to devote the necessary attention to their aquaculture project, while at the same time was too high for other participants to be able to afford to fully stock their cisterns.

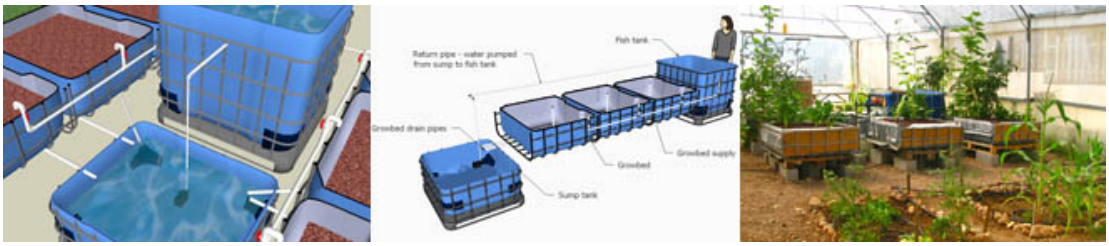
The end result is that some of the cisterns have not been managed correctly, as their owners did not receive the full training course. We expect to see reduced fish growth in these cases. Hopefully, observation of higher yields from other cisterns will encourage some participants to commit a little more time to managing their cisterns.

Working with project participants in Artas

3.1: Aquaponics

Byspokes is proud to be able to claim to have pioneered aquaponics in the OPT, building the first aquaponic systems behind the wall during 2011. Aquaponics is the fusion of recirculating aquaculture (production of food fish) with hydroponic plant growth (production of fresh vegetables and fruits) in a single system, in which fish wastes provide nutrition to the plants, and microbial activity and plant growth.



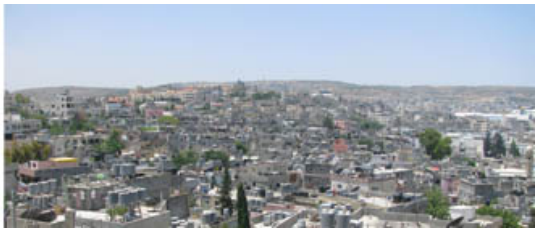


An aquaponic system design by Byspokes

There are many reasons why aquaponic systems are gaining in popularity around the world, but particular to the Palestinian context, aquaponic systems offer a lot of potential benefits:

- Aquaponic systems recirculate a volume of water to grow both fish and plants. Water is added only to compensate for evaporative losses and plant growth. In the OPT, access to water is a serious constraint both to agricultural development and to standards of living. Thus, a recirculating system for food production enables maximum use to be extracted from the limited water resources.

The Judean desert



Rooftop view of Aida refugee camp, Bethlehem

- Aquaponic systems are space efficient and can be placed almost anywhere, a significant advantage in the OPT where availability of space for food production is a serious problem, particularly in urban areas and refugee camps. Even in agricultural areas, land access is being lost through Israeli controls and through effective annexation by the Israeli "Security Fence".
- The plants have ample nutrition (in the form of fish wastes) and water around their roots at all times, potentially enabling crops to be planted at higher densities, or to give higher yields and grow faster than in traditional agriculture. Nutrient conversion and uptake by the plants maintains good enough water quality to stock fish at fairly high densities, making a viable harvest of food fish possible even in small spaces.
- By producing abundant fresh, organically grown produce, including a high quality protein source (fish), aquaponic systems can help combat malnutrition and food insecurity, and provide new opportunities for income generation in the OPT. At present up to 40% of the population in the OPT (25% in West Bank) are classed as "chronically food insecure" (OCHA 2010), and unemployment stands at around 25% (PCBS 2009).

The Israeli "Security Fence"

3.2: Aquaponic projects

3.2.1: Bustan Qaraaqa experimental aquaponic system

In February 2011 we started construction of a domestic scale aquaponic system at Bustan Qaraaqa. In addition to providing an extra source of food for Bustan Qaraaqa, the purpose of this project was to provide an experimental system from which we could try various configurations, plants and fish to develop an aquaponic system appropriate for use in the West Bank, i.e. one which:

- Uses cheap, locally available materials, ideally recycled or reclaimed.
- Works with the high alkalinity and high pH of the groundwater in the West Bank.
- Grows plants which thrive in the local conditions and are already part of the local diet
- Offers the opportunity to grow “exotic” plant species that are not commonly consumed locally, such as basil, lemongrass butternut squash and green tomatoes.

With the help of Bustan Qaraaqa’s volunteer workforce it took only a couple of weekends to construct the aquaponic system from mud-filled car tyres, re-claimed IBCs (white tanks) and irrigation plumbing. However, the system took several months to cycle and become established, owing to the very low temperatures through February and March. Sudden surprise cold snaps saw the water temperature drop from 18°C to 8°C in just 24 hours, killing some fish and retarding bacterial activity in the growbeds.

Preparing IBC’s for use

Initially, we were using stored rainwater in the aquaponic system, and the growbeds were filled with cheap limestone gravel. This worked fine until we ran out of rainwater, and had to switch over to groundwater. Unlike rainwater, the groundwater here has a pH around 8.2, and is very hard – meaning that it can resist changes in pH. Unfortunately, an aquaponic system needs to be running at a pH of around 7 for the plants to be able to access all the nutrients they need. The strong buffering power of the groundwater, coupled with the strong buffering power of the growing medium (limestone) meant that we were unable to decrease the pH by adding acid.

Ultimately we resorted to changing all the gravel for volcanic rock, which has no effect on water pH. This cost significantly more, but has enabled us to control the pH.

Construction and devlopment of the aquaponic system at Bustan Qaraaqa.

In trying to keep material costs as low as possible, our original system design used irrigation plumbing to link components, and used the sump tank (the lowest part of the system, which receives water from the draining growbeds) as the fish tank. As Water was pumped from the sump tank to the growbeds, and would drain back to the sump tank. In this arrangement, as the growbeds flood and drain the water depth in the sump tank changes. This tidal environment was causing stress to the fish, especially as on occasion the growbeds did not drain correctly and the water level would remain very low. We decided that it was worth increasing the size and materials requirement for the system by including a separate fish tank with a water surface level higher than the growbed surface levels. Water overflows from this fish tank to the growbeds by gravity, and from the growbeds to the sump. From the sump, water is pumped back to the fish tank. By arranging the system in this manner, the fish tank water volume (and depth) remains constant – even if a leak develops somewhere else in the system.

We found that the irrigation pipe and fittings used had a tendency to kink, and clogged very easily with fish wastes. To solve this we replaced all the pipework with slightly more expensive, but wider-bore and rigid, PVC plumbing.

The system has been running well with a mix of carp and tilapia stocked, growing cucumbers, green tomatoes, lettuces, watercress, lemongrass, chards, chives, basil, chillies, parsley and coriander. We found that it was necessary to shade the system from the intense summer sun, and now as we move into the winter we would like to investigate options for maintaining the water temperature high enough for fish growth.

3.2.2: Al-Basma aquaponic pilot project

In March of 2011 we started an aquaponic project in al-Basma centre, a centre for young adults with learning disabilities. The centre has a greenhouse that used to be used for growing cucumbers as an activity for the clients. However, this project transpired to be a financial drain to the centre and was discontinued.

Preparing the greenhouse for the aquaponic system with the help of al-Basma centre clients.

We proposed developing an aquaponic project in the greenhouse to the centre's director, and were met with enthusiasm. The objectives of this project were to:

- Construct a pilot domestic scale aquaponic system and evaluate its effectiveness in terms of water and cost efficiency in producing vegetable and fish harvests compared to growing crops in soil.
- Prepare a training manual and workshop series, to assess the effectiveness as tools for knowledge transfer, and training participants to set up and maintain aquaponic systems independently in the future.

The aquaponic system we built at al-Basma centre was based on the same design and materials as the Bustan Qaraaqa system, but with twice the capacity. It has six growbeds, each of $1m^2$; we prepared six irrigated soil patches, also of $1m^2$, to mirror each growbed. The same plants were planted in the aquaponic system and the soil patches at the same times, and used water meters to measure water consumption by soil irrigation and aquaponic topping-up.

Left: The planned layout of the aquaponic system and soil patches inside the greenhouse.
Right: The finished aquaponic setup - a flood and drain system comprised of 6 separate $1m^2$ growbeds, with 900L fish and sump tanks.

The investigative phase of this project ran for 136 days, during which time we regularly monitored water quality and consumption, plant growth and yields and fish growth. We investigated the following plant crops for their performance and suitability: Aubergine, basil, butternut squash, chard, chilli peppers, chives, corn, dill, fennel, lettuce, melon, okra, peas, rocket, runner beans, strawberries, sweet peppers, tomatoes and watermelon.

During the course of the project we delivered training workshops to centre staff, and invited their participation in the day-to-day system operation and maintenance to further knowledge transfer. Workshop themes were as follows:

Giving workshops at al-Basma centre

March 30: Workshop 1 – Introduction to aquaponics
April 2: Workshop 2 – Construction of aquaponic system
April 6: Workshop 3 – Water quality and monitoring
April 9: Workshop 4 – Fish and plant management
April 20: Workshop 5 – About fish
April 27: Workshop 6 – Fish feeding
May 11: Workshop 7 – Fish health

May 18: Workshop 8 – Plant maintenance session
May 25: Workshop 9 – Plant health
June 1: Stocking fish
June 15: Workshop 10 - Troubleshooting
July 6 – 16: Daily 8am system maintenance practice sessions
July 16: Feedback session

The system was stocked with 109 tilapia brought from a supplier near Nablus in the West Bank. Some unexplained disappearances, attributed to theft by children breaking into the centre, brought the number of fish in the system down to 90. The fish were being fed 250g of pellet food per day, divided into two servings – morning and evening.

Water and growth comparison between to soil patches and the aquaponics system

The study revealed that the aquaponic system consumed only half as much water as the soil patches, but with electricity and fish food taken into consideration the daily running cost of the aquaponic system was 5 times greater than that of the soil patches: 3.6 ILS/day compared to 0.71 ILS/day (table 1). However, this increased input requirement was more than compensated by comparably increased yields (table 2); the aquaponic system's daily vegetable production value of 8.53ILS/day was almost 4.5 times greater than that of the soil patches' 1.91 ILS/day.

Growth comparison: mangold/chard plants after 40 days in aquaponics (left) and soil (right).

Table 1: Daily resource consumption of the aquaponic system and soil patches during the pilot study. Prices in Israeli Shekels (ILS).

	Value (ILS/unit)	Unit	Aquaponic daily consumption		Soil daily consumption	
			Units	Value (ILS)	Units	Value
Water	5	m^3	0.0647	0.32	0.1425	0.71
Electricity	0.56	kWh	2.28	1.28	0	0
Fish food	8	kg	0.25	2	0	0
Total (ILS/day)				**3.6**		**0.71**

Table 2: Daily production of the aquaponic system and soil patches during the pilot study. Production is shown in grams per day per plant, total grams per crop per day, and total value at current market prices in Israeli Shekels (ILS).

	Number of plants	Value (ILS/kg)	Aquaponic daily production			Soil daily production		
			g/plant	g (total)	Value (ILS)	g/plant	g (total)	Value (ILS)
Basil	6	167	5.02	30.12	5.03	1.66	9.96	1.66
Mangold/chard	12	20	5.83	69.96	1.4	NA		
Tomato	6	4	35.6	213.6	0.85	8.3	49.8	0.19
Okra	2	17	14.88	29.76	0.51	1.19	1.19	0.02
Sweet pepper	4	4	7.82	31.28	0.13	1.06	4.24	0.017
Chilli pepper	4	5	0.33	1.32	0.007	NA		
Butternut squash	4	7	18.64	74.56	0.52	0.43	1.72	0.01
Melon	4	3.5	6.1	24.4	0.09	NA		
Total (ILS/day)					**8.53**			**1.91**

The fish growth rate was found to be 2.26g/ fish/day. Given the very high market value of fresh fish locally (50 ILS/kg), this equates to a daily production of 0.11 ILS/fish/day, or 10.17 ILS/day for the whole system.

Considering daily input costs and production values, the daily net income generation potential of the aquaponic system was found to be 15.1ILS, compared to just 1.2ILS/day from the soil patches. The average daily salary in the West Bank and Gaza is 76.9ILS and 46.2ILS respectively (PCBS 2011). Thus, an aquaponic system such as this could generate the equivalent of 19.6% (West Bank) or 32.7% (Gaza) of the median daily salary.

Plant growth comparison photos of soil patches (outside left and right), and aquaponic growbeds (centre left and right). Photos were taken on April 10th (top), May 7th, May 18 and June 12th (bottom).

Once we had completed the investigative phase of this project we prepared the aquaponic system for handover to the staff of al-Basma centre.

We discussed with them the harvest and maintenance requirements of various plant types, and ascertained which crops they would be interested in growing, and for what

purpose (selling, consumption at the centre or at home). Following this meeting we gradually replaced and re-located plants to layout the growbeds as per their wishes. Now the system produces easy to maintain, mainly "cut and come again" plant varieties: basil, chives, lettuces, mint, parsley, rocket and spinach. With the exception of basil, these plants are also always in high demand in the West Bank. Basil, though not as popular, fetches a high price.

The al-Basma centre staff are always very busy, and so do not have a great deal of time to devote to maintaining the aquaponic system. The crops they selected to grow do not require much attention, and even harvesting and replanting is quick and straightforward. This not only means that the staff can take over management of the system without it impacting heavily on their work schedule, but also that they can start involving the clients in the day to day maintenance activities.

3.2.3: Al-Basma aquaponic demonstration site

The aquaponic pilot project in al-Basma centre generated a lot of interest in the community. Individuals and representatives from various organisations approached us and the centre enquiring about aquaponics, and the potential for developing food security and commercial aquaponic projects in other locations.

Encouraged by this increasing interest in aquaponics, and the al-Basma centre as a whole, we proposed to the director that we turn their greenhouse into an aquaponic "showcase"; a focal point for aquaponic demonstrations and training. In order to achieve this we would construct a second aquaponic system incorporating NFT (nutrient film technique) growing tubes, floating raft growbeds and vertical grow towers. We also proposed to show an increased variety of crop production, including flowering plants, wild rice and crayfish.

The new system at al-Basma centre. This system incorporates NFT, Floating raft and tower growing techniques.

The new system, combined with the existing flood and drain system, would allow us to demonstrate all the common aquaponic techniques under one roof. The objectives of this project are to:

- Demonstrate the versatility of aquaponics by showing different techniques and system configurations.
- Provide an accessible location for demonstration and training purposes.
- Raise the profile of the al-Basma centre through increasing visitor numbers.
- Increase the potential revenues for al-Basma centre by increasing the quantity of fish and crops produced.

We started construction of the new aquaponic system in August 2010, again using readily available materials to ensure that the design is replicable within the community. The fish tank and floating raft tanks are made from IBCs, and the NFT pipes and vertical grow tubes from 4" drainpipe. We chose to stack the NFT tubes in two levels, and include a corner in the layout to demonstrate the flexibility of this growing method – ideal for space restricted environments or along walls.

Plants germinating in Nutrient Film Technique grow tubes

In September we stocked the system with approximately 100 small tilapia fingerlings that had been born in the other aquaponic system, and on the 6th October were able to bring several crayfish (*Cherax quadricarinatus*) from the Dor fisheries research facility in Israel, which we stocked into the floating raft tanks. As the fingerlings grow, and we increase the feed rate accordingly, we will be able to increase the number of plants in this system. We envisage that by the early spring this system will also be flourishing, and ready for use as a demonstration model.


Australian redclaw crayfish (left and centre) and Tilapia fry (right) growing in the new aquaponic system at al-Basma centre

4: Consultancy work

As part of our mission to promote and develop sustainable aquaculture and aquaponic systems in the OPT, Byspokes has started to offer consultancy to individuals and organisations in the West Bank wishing to establish independent projects. We started offering this service in April 2010; after 8 months working in the field and developing our knowledge and experience here we felt comfortable that we could provide assistance to people outside of our immediate projects.

Field visits with Palestinian fish farmers

Interested individuals approach us to request our assistance, having heard about our work either through occasional articles in the local media or through a partner who works in the Ministry of Agriculture. So far we have provided assistance to four individuals with four quite different projects:

- A new development just outside Bethlehem incorporating a restaurant and a recreational pond. We were approached as a number of fish were dying mysteriously. We advised on alternative fish food and pond management strategies to increase productivity and pond ecosystem health.
- An established fish farm near Nablus. The owner no longer wanted to purchase fish food from Israel, and so we suggested alternative feed options for rearing tanks and a fertilisation/feed regime for the growout pond. This meeting proved to be very fortuitous to us, as this farmer is able to provide tilapia fingerlings inside the West Bank.
- A newly established fish pond near Tulkarem. The owner had just returned from a fish farming course in China, and purchased tilapia fingerlings from the farm near Nablus. He was keen to discuss how to develop his project incorporating his knowledge gained in China and our experiences more locally.
- A domestic aquaponic system near Ramallah. We are currently drafting some design options for an individual in Kobar village who came to see the al-Basma aquaponic system, and is now very interested to build one to provide food for his household.

So far, thanks to funding we have acquired and by teaming up with Bustan Qaraaqa and their on-going programmes of environmental consultancy, we have been able to offer our services free of charge to individuals. We feel that this is important, as generally the people that stand to benefit most from developing small aquaculture and aquaponic projects do not have the available means to pay for assistance, even if our costs are restricted to transport. It would be a great shame, and contrary to our goals to allow financial barriers stand in the way of interested individuals receiving the help they need. These self-motivated individuals will ultimately be the leaders of aquaculture and aquaponic development in the West Bank, and if we can support them now, they will be better placed to assist others in the future.

5: Training

Training is an integral part of our projects, as we aim for participants to be able to assume full responsibility for activities once our involvement with the project is over. During the course of developing aquaculture and aquaponic pilot projects in Artas and al-Bamsa centre respectively, we have written and field tested training materials for sustainable aquaculture and aquaponics. We are in the process of having both translated into Arabic, and so shortly we will have two very useful training tools at our disposal.

Delivering a workshop

Aside from training incorporated into projects, we are starting to offer training courses for individuals interested in learning more about sustainable aquaculture and aquaponics and maybe establishing their own projects. We aim to offer these courses both to private individuals and to representatives of organisations that may be interested in further developing these areas in the OPT into the future.

As with our consultancy services, we hope that financial situation will not exclude interested participants from attending training courses. We hope to be able to offer reduced cost or free places where necessary, subsidizing costs either through funds we are able to raise, or by charging a slightly higher fee to participants whose attendance is funded by a wealthier organisation.

6: Future work

In the coming year we intend to build on our successes of the last 12 months, continuing to develop aquaponic and aquaculture projects within communities, and increasing the number of individuals we can reach through consultancy and training. We shall continue to work in partnership with Bustan Qaraaqa to achieve these goals.

We hope to start our next aquaponic project in the Jordan Valley during the next month. This will also be a pilot project, focussing on community implementation and knowledge transfer, in which we shall construct six new systems in separate locations. The proposed objectives of this study are to:

- Assess the potential socioeconomic contribution of aquaponic systems to actual household incomes.
- Assess the ease of transfer of knowledge and skills necessary for individuals to manage aquaponic systems independently.
- Further our investigation into water use efficiency and plant performance in traditional and aquaponic farming systems, with a more scientifically rigorousinvestigation involving up to 6 replicate systems.
- Investigate aquaponic system performance using manufactured fish feeds and on-site produced feeds.
- Assess over-winter growth rates and survival of tilapia in the Jordan Valley.

We will keep working with Bustan Qaraaqa to research and develop innovative solutions to technical problems which, at present, restrict where aquaponic and aquaculture projects can be implemented. Of particular interest are low-cost, sustainable solutions for raising water temperatures during the winter months, and alternative power sources for moving and aerating water. Suitable solutions would enable adoption of aquaponics in “off-grid” areas with no mains electricity supply, and extend the growing season into the winter months in areas which receive low temperatures.

We have already identified a number of individuals living in urban areas who are keen to develop personal rooftop aquaponic systems. Based on experimentation with the new system at the al-Basma centre we hope to be able to design a suitable system for rooftop use, and subsequently assist these individuals in establishing their systems. We would like to be able to establish a match fund to contribute up to 50% of the costs of these systems if necessary. While we are generally against the principle of free hand-outs so common in top-down development projects, we feel that carefully managed financial assistance can be an important tool enabling the inclusion of the most appropriate participants, and that having more independently managed systems

and trained operators in the community will greatly help the wider uptake of these technologies without the need for further external input or assistance.

Visitig Deheisha refugee camp to see potential sites for aquaponic systems

We would like to offer regular training courses on aquaponics and sustainable aquaculture in the coming year, reaching individuals in our immediate community and further afield. We also intend to revise and update the training materials we have already prepared, incorporating new information and experiences – such as NFT construction and operation and crayfish husbandry – so that our training programmes can become even more comprehensive. In addition, we hope to be able to continue to offer free consultancy to individuals wishing to start new, or develop existing, projects; inviting these individuals to participate in training courses to enable exchange of ideas as appropriate.

Summary of objectives for the coming year

- Construct six aquaponic systems in the Jordan Valley to investigate knowledge transfer, water use and plant performance.
- Publish a scientific report on our findings from the above study.
- Assist at least three individuals in the construction of their own domestic aquaponic systems.
- Assist in the establishment of sustainable aquaculture ponds in at least three communities.
- Develop an affordable method for maintaining adequate water temperatures through the winter months.
- Investigate alternative power supply options; convert or construct one aquaponic system to run entirely “off-grid”.
- Deliver a training course each month in either aquaponics or sustainable aquaculture, reaching a total of 60 participants.
- Train and provide practical experience to Bustan Qaraaqa staff in order that they become able to deliver aquaculture and aquaponic training courses.
- Train and provide practical experience to staff of one local NGO in order that they become able to deliver aquaculture and aquaponic training courses.

- Continue to offer free consultancy to individuals, making two consultancy visits each month.

The list of objectives above shows our targets for the coming year. Obviously, all our planned activities are highly dependent on our ability to secure appropriate funding, and this will reflect in the number of objectives we are ultimately able to achieve. Even if we are unable to secure sufficient finding, we shall endeavour to achieve as many of these objectives as possible, by finding alternative sources of income such as charging participants for training courses, or charging for consultancy visits to subsidize other activities.



7: Financial report

Below is a summary financial report of all Byspokes activities during the period October 2010 – October 2011, and projected expenditure for the coming six months. For detailed budgetary information please refer to individual project reports and proposals available online at www.byspokes.org and www.bustanqaraaqa.org.

Income summary for the period October 2010 – October 2011

Source	Type	Amount	Amount US $
Elsamex S.A. de C.V.	Donation	140,000 MXN	11,760
Operation Blessing International	Project funding	35,112 ILS	9,753
Bustan Qaraaqa	Financial cooperation	14,734 ILS	4,093
Other	Private donations	£80	128
Total			**US$ 25,734**

Expenditure summary for the period October 2010 – October 2011

Activity	Cost (ILS)	Cost (US$)
Aquaculture pilot projects in Artas and Bustan Qaraaqa	36,932	10,259
Aquaponic system construction at Bustan Qaraaqa	2,884	801
Aquaponic pilot project at al-Basma centre	36,352	10,098
New aquaponic system construction at al-Basma centre	1,972	548
Consultancy visits	3,600	1,000
Additional training materials preparation costs	11,062	3,073
Administration costs (printing, visa extensions etc.)	2,768	769
Total		**US$ 26,548**

Projected expenditure from October 2011 to April 2012

Activity	Cost (ILS)	Cost (US$)
Jordan valley aquaponic pilot project	74,617	20,727
Winter heating experimentation	1,000	278
Off grid- power supply experimentation	14,400	4,000
Training courses (x6)	27,660	7,683
Consultancy visits (x12)	11,760	3,267
Match fund for assisting individuals construct aquaponic systems	7,200	2,000
Administration costs	1,500	417
Total	**138,137 ILS**	**US$ 38,372**

We still need to raise funds in order to be able to continue with our work here in Palestine. For individuals interested in supporting us, then donations can be made via our website (www.byspokes.org). Alternatively,

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

In Mexico: Bank Transfer to: **Santander**
Account holder 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.

8: Conclusions

Our activities over the past year have demonstrated that aquaculture and aquaponic projects can be very useful methods for enhancing food security or developing micro-enterprise in the OPT. In addition, we have found that there is considerable interest in the community for developing such projects.

Given the high unemployment in some areas of the OPT (17.2% in the West Bank, 37.8% in Gaza and reaching highs of 80% in some refugee camps – PCBS 2011), then systems which enable households to increase domestic productivity could become very effective tools in helping lift families out of poverty. Our findings from the al-Basma centre aquaponic pilot project were that the aquaponic system, requiring no more than 10-30 minutes of attention each day, was producing food with a daily value equivalent to approximately 20% to 30% of the average daily salary in the west Bank and Gaza respectively.

By integrating aquaculture with plant agriculture, either in the form of aquaponics or sustainable aquaculture systems, then resource use efficiency is increased. This is particularly true with regard space and water resources, both of which are in incredibly short supply in the OPT. In the case of sustainable aquaculture systems, no additional resource is consumed, yet an additional crop of food fish becomes available. In aquaponic systems, water use was found to be half that of equivalently sized irrigated soil patches, but plant production was increased 4.5 times. In addition, production of a significant quantity of food fish is possible in aquaponic systems.

We hope that our work in the OPT will help to impulse independent development of sustainable aquaculture and aquaponic projects. Aquaculture and aquaponic systems are very different in terms of input requirements, output potential and appropriate locations. For example, in agricultural areas where land is currently irrigated from water stored in cisterns, developing aquaponic systems would not be a sensible use of resources. Likewise, it would be impossible to develop a sustainable aquaculture project in an urban environment. Between these two extremes lies a wide range of possible conditions, the exact nature of each case determining the best approach to take. For this reason we feel that it is important to assist in the establishment of a range of different example systems in different locations, and more importantly facilitate local capacity building to empower individuals to design systems appropriate for their own situations rather than taking a “one size fits all” approach.