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Chapter 24
Aquaponics and Social Enterprise

Sarah Milliken and Henk Stander

Abstract This chapter presents some examples of recent initiatives by social enterprises using aquaponics. Aquaponics offers an innovative form of therapeutic horticulture, which can provide employment and promote well-being for people with disabilities. If implemented as a program to be managed by local communities, aquaponic systems also have the potential to address issues such as food security and food sovereignty, especially in urban areas. Increasing public familiarity with aquaponics has seen a number of social ventures being set up around the world. However, the viability of these depends not only on stakeholder commitment, thorough market analysis, clear governance structures, and a robust business plan but also on external factors, such as the local political context and regulations.

Keywords Health · Well-being · Skills · Food security · Food sovereignty

24.1 Introduction

Social enterprises, as distinct from traditional private or corporate enterprise, aim to deliver products and services that cater to basic human needs. For a social enterprise, the primary motivation is not maximizing profit but building social capital; economic growth is therefore only part of a much broader mandate that includes social services such as rehabilitation, education and training, as well as environmental protection. There is growing interest in aquaponics among social enterprises, because it represents an effective tool to help them deliver their mandate. For example, aquaponics can integrate livelihood strategies to secure food and small

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incomes for landless and poor households. Domestic production of food, access to markets, and the acquisition of skills are invaluable tools for securing the empowerment and emancipation of women in developing countries, and aquaponics can provide the foundation for fair and sustainable socioeconomic growth (Somerville et al. 2014). This chapter presents some examples of recent initiatives by social enterprises using aquaponics.

24.2 Health, Well-being, and Skills

Aquaponics offers an innovative form of therapeutic horticulture, a nature-based approach that can promote well-being for people with mental health problems through using a range of green activities such as gardening and contact with animals. Over the past decade, a number of social enterprises have emerged that provide therapeutic horticulture programs for improving the well-being of local communities. The social enterprise approach builds on "social firms" by facilitating people with mental health problems to develop new skills and re-engage with the workplace. A social firm is a specific type of social enterprise where the social mission is to create employment, work experience, training, and volunteering opportunities, within a supportive and inclusive environment, for people who face significant barriers to employment and in particular for people with a disability (including mental ill health, and learning disability), abuse issues, a prison record, or homeless issues (Howarth et al. 2016).

There are particular qualities of the plant–person relationship that promote people's interaction with their environment and hence their health, functional level, and subjective well-being. Plants are seen to bestow non-discriminatory rewards on their carer without imposing the burden of an interpersonal relationship and, by responding to care or neglect, can immediately reinforce a sense of personal agency. The efficacy of practicing horticulture in a group context has also been demonstrated. Many people with mental and physical health problems face social exclusion because they do not have equal access to opportunities in society, including paid employment, housing, education, and leisure. Social networks such as those provided by community horticulture initiatives can act as buffers to stressors, provide a structure for acquiring skills, and validate and enhance an individual's self-worth (Diamant and Waterhouse 2010; Fieldhouse 2003).

To date there are few examples of social enterprises using aquaponics for therapeutic horticulture. In the United States, a small farming business called Green Bridge Growers in Indiana (www.greenbridgegrowers.org) is growing

produce all year-round, primarily using aquaponics. The company now employs a number of individuals with autism spectrum disorder (ASD) and finds that the scheduling, precision, and monitoring required in aquaponics perfectly match with their skills (Fasciglione 2015). A core value of the business is to engage their workforce through leadership training, active participation, and team building, and provide them with the opportunity to gain new skills and competencies. Similarly, the ACRES Project (Adults Creating Residential and Employment Solutions; https://acresproject.org/aquaponics) in Pennsylvania uses aquaponics to provide horticultural therapy, employment, and community integration for adults with autism and intellectual disabilities. They are involved in all facets of the aquaponic system, from care and maintenance to harvest and sales, and the scheduled procedures and daily routines that aquaponics requires provide them with the stability and structure that they find reassuring. By fostering social, vocational, and self-advocacy skills, ACRES therefore uses aquaponics to help autistic individuals optimize their potential, develop practical life skills, increase social capacity, and transition to work and independence.

The FabLab Nerve Centre in Northern Ireland has set up a social enterprise aquaponic farm to teach people with learning difficulties entrepreneurial and digital skills. Using state-of-the-art digital equipment, such as 3D printers, CNC routers, and laser cutters, students will receive hands-on training and experience in a range of digital design and making techniques that will allow them to design, build, and operate an aquaponic farm. As part of the project, a newly created social enterprise will be developed by the young people, allowing them to sell the produce from the farm to local businesses, thereby developing their skills in social entrepreneurship, business, and marketing (www.nervecentre.org/news/fablab-nerve-centre-launches-aquaponic-digital-farm).

Solutions for Change, a social enterprise which is dedicated to solving family homelessness, runs Solutions Farms in California (www.solutionsfarm.org). The aquaponic farm provides training for homeless families in growing tilapia and seasonal leafy greens and herbs, which are then sold to local restaurants, markets, and schools. It functions as a laboratory for teaching important work values and preparing people for re-entry into the workplace, thereby raising hope, as well as produce.

Asociacíon Huerto Lazo (www.huertolazo.eu) is a social enterprise in the province of Malaga, Spain, which offers internships to young people from troubled backgrounds. The interns are given practical training in aquaponics in a safe environment. The catfish, tilapia, and tench are sold to El Sollo restaurant in Fuengirola (Fig. 24.1).

Fig. 24.1 Aquaponic facilities at Asociacíon Huerto Lazo – anticlockwise from top left: catfish tanks in the aquaponic greenhouse; tilapia tanks with *Gynostemma pentaphyllum*, which is sold for medicinal purposes; the water filtration tanks at Huerto Lazo; Ulrich Eich demonstrating his aquaponic system (Photographs: Sarah Milliken)

24.3 Food Security and Food Sovereignty

Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (Allison 2011). There are four food security pillars, which define, defend, and measure food security status locally, nationally, and internationally. These are food availability, food accessibility, food utilization, and food stability. Food availability is achieved when nutritious food is available at all times for people to access, while food accessibility is achieved when people at all times have the economic ability to obtain nutritious food available according to their dietary preferences. Food utilization is achieved when all food consumed is absorbed and utilized by the body to make a healthy active life possible, and food stability is achieved when all the other pillars are achieved (Faber et al. 2011).

Urban and peri-urban agriculture are increasingly recognized as a means by which cities can move away from current inequitable and resource-dependent food systems, reduce their ecological footprint, and increase their liveability (van Gorcum et al. 2019; Dubbeling et al. 2010). On account of being almost completely dependent on produce imported from other regions, urban consumers are particularly vulnerable to

food insecurity. For those of low socioeconomic status, this dependence means that any fluctuation in food prices translates into limited purchasing power, increased food insecurity, and compromised dietary options. Community-based aquaponics enterprises offer a new model for blending local agency with scientific innovation to deliver food sovereignty and food security, by re-engaging and giving communities more control over their food production and distribution (Laidlaw and Magee 2016). If implemented as a program to be managed by local people, aquaponic systems have the potential to address food sovereignty. In turn, food security is boosted by consuming the fish, which is a significant source of protein, essential amino acids, and vitamins. Even when consumed in small quantities, fish can improve dietary quality by contributing essential amino acids, which are often missing or underrepresented in vegetable-based diets.

British social enterprise Byspokes Community Interest Company (CIC) set up a pilot aquaponic system and training program at the Al-Basma Centre in Beit Sahour, Occupied Palestinian Territories (OPT), a region where availability of space for food production is a serious problem, particularly in the 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." Aquaponics therefore offers a water- and space-efficient solution to growing fresh, local produce, including a high-quality protein source (fish), thereby helping to combat malnutrition and food insecurity, while at the same time providing new opportunities for income generation. 40% of the population in the OPT (25% in the West Bank) are classed as "chronically food insecure", and unemployment stands at around 25%, with highs of 80% in some refugee camps. From an economic viewpoint, the project demonstrated that an aquaponic system could contribute significantly to household incomes and so help lift families out of poverty, while also providing a range of fresh vegetables and fish to families least able to afford such high-quality food (Viladomat and Jones 2011).

Since 2010, the Food and Agriculture Organization (FAO) of the United Nations has been implementing an *Emergency Food Production Support Project* for poor families in the Gaza Strip, where 11 years of Israeli sea, land, and air blockade, combined with low rainfall resulting in drought, have severely compromised the possibilities for domestic food production in one of the most densely populated areas of the world. With so many restrictions, fresh vegetables are expensive and hard to find. 97% of the Gaza Strip population are urban or camp dwellers and therefore do not have access to land. Poverty affects 53% of the population, and 39% of families headed by women are food insecure. Enabling families to produce their own affordable fresh food is therefore a highly appropriate and effective response to the current situation. Food-insecure female-headed households living in urban areas were given rooftop aquaponic units, and other units were installed in educational and community establishments. Having an aquaponic unit on their roof means that the women can simultaneously improve their household food security and income while still taking care of their children and homes. All of the beneficiaries have increased their household food consumption as a result (FAO 2016).

Through its Adaptive Agriculture Program, INMED Partnerships for Children is dedicated to establishing sustainable food programs that improve food security, conserve natural resources, promote strategies for adapting to climate change, and provide opportunities for income generation in developing countries. INMED has developed a simple and affordable aquaponic system for small-scale farmers, schools, government institutions, and home gardeners using easily accessible off-the-shelf local materials. Over the past decade, INMED has established a highly successful *Adaptive Aquaculture and Aquaponics Program* in South Africa, Jamaica, and Peru. In South Africa, INMED focuses on achieving food security and sustainable income generation by strengthening local capacity to understand and address climate change, while resolving interrelated issues of environmental degradation, increasing water scarcity, and poverty. It offers business-planning links to markets and assistance with applications for development grants and loans to expand enterprises. At the core of this far-reaching vision, in addition to intensive traditional cultivation, is aquaponics. Several projects have been successfully implemented in different provinces in the country. An aquaponic system was installed at the Thabelo Christian Association for the Disabled in a remote area of the Venda region in Limpopo province. Because INMED's system requires no heavy labour or complex mechanical systems, it is ideal for individuals with disabilities and those unable to perform traditional farming activities. Since the installation, the co-op has increased its revenue by more than 400%. Co-op members receive stable monthly salaries and have invested in breeding animals for additional revenue. Communities that have embraced this new way of farming have strengthened their ability to ensure food security and to provide new and adaptive opportunities for income generation (https://inmed.org) (Fig. 24.2).

Another good example of community upliftment in South Africa is Eden Aquaponics (www.edenaquaponics.co.za). Eden Aquaponics (Pty) Ltd. is the brainchild of Jack Probart who, with the realization that food security is fast becoming just as vital as a healthy economy, had the vision of developing a commercial business with a community focus. Using aquaponics to produce fish and vegetables in the Eden area of the Garden Route in the Western Cape, Eden Aquaponics supplies fish for consumption, as well as fingerlings for fish farming, and grows a variety of organic vegetables for distribution to the local farmers' markets, restaurants, and retailers. The Community Upliftment division manufactures and installs customized commercial systems of various sizes including DIY backyard aquaponic equipment, and supplies seedlings and fingerlings. They also teach less fortunate communities to become self-sufficient in growing, marketing, and selling their produce, thereby enabling previously unemployed people to develop skills, self-confidence, self-esteem, and the ability to provide for themselves.

Food Basket for Africa (www.foodbasketforafrica.org.za) is a similar initiative. They focus on men's development work, which is done through Men's Fraternity, by providing social and emotional counselling to men in rural areas. Men's Fraternity works in association with Effective Living Centres, a reputable counselling organization. Food Basket for Africa runs a number of agricultural development projects in rural areas around Southern Africa. Food tunnels (not hydroponic but mainly

Fig. 24.2 Some illustrations of INMED's Community Projects in South Africa. (Photographs supplied by Janet Ogilvie from INMED)

wicking beds) are placed in communities, which adopt them, and initial training for tunnel care watering and fertilizing techniques is given. An aquaponic system was commissioned at one of the projects, in Kommetjie, Cape Town.

Issues of food security and food sovereignty are not only pertinent to the developing world. In Seville, Spain, social enterprise Asociacíon Verdes del Sur has set up an aquaponic greenhouse in the grounds of a school in Polígono Sur, the most socially deprived part of the city which is characterized by long-term unemployment and a high incidence of drug-related crime. The aquaponic unit is used as part of an environmental education program for local residents, including teaching the benefits of eating locally grown fresh food and developing skills for the unemployed (http://huertosverdesdelsur.blogspot.com). A prototype domestic unit has also been set up in the house of one of the local residents, Soledad (Fig. 24.3).

The Well Community Allotment Group (Crookes Community Farm) is a social enterprise run by volunteers in Sheffield, UK, that is on a mission to connect the local community with their food by actively involving them in its production, and by educating them about the benefits of local food. In 2018, the association was awarded an Aviva Community Fund Award in order to build an aquaponic unit which will be used to educate individuals, schools, youth groups, and other organizations (https://www.avivacommunityfund.co.uk/voting/project/pastwinnerprojectview/17-6291).

Fig. 24.3 Aquaponic facilities in Polígono Sur – anticlockwise from top left: the aquaponic greenhouse at the school; Soledad with a frozen tilapia raised in her domestic unit; tomatoes and an aubergine saved for their seeds; the domestic aquaponic unit. (Photographs: Sarah Milliken)

In the United States, a number of social enterprises using aquaponic systems have been set up across the country as part of a growing social movement focusing on using urban agriculture to increase food security and community cohesion. One of the first was Growing Power, which was founded by Will Allen in 1995, with the objective of using urban agriculture as a vehicle for improving food security in central Milwaukee and for the long-term strengthening of its neighborhoods, and to give inner-city youngsters an opportunity to gain life skills by cultivating and marketing organic produce. Growing Power provided facilities or land, guidance in food growing, and overall project maintenance, and the produce was either donated to meal programs and emergency food providers or sold by the youngsters at local farm shops and farmers' markets, with the stipulation that one-quarter of the proceeds be returned to the local community (Kaufman and Bailkey 2000). By all accounts, Growing Power was doing exactly what they had set out to do: they were feeding, training, and exposing thousands of people to a more autonomous relationship with their food. But while their mission was being fulfilled, it carried significant costs. More money was exiting than entering Growing Power's doors, and by 2014, the social enterprise had a debt of more than $2 million (Satterfield 2018). Faced with insurmountable debt and legal pressure, Growing Power was eventually dissolved in 2017. However, the legacy of the enterprise lives on in the form of

other social ventures that were inspired to start similar initiatives. One such venture which acknowledges Will Allen's influence is the Rid-All Green Partnership in Cleveland, Ohio, whose mission is to educate the next generation to not only learn to grow and eat fresh foods but also to operate and grow their own businesses in the food industry, ranging from selling fresh produce and fish to food distributors to processing and packaging fresh food products (https://www.greennghetto.org).

The urban agriculture movement in the United States has been fuelled by the US Department of Agriculture (USDA) Community Food Project (CFP) competitive grant program, which was established in 1996 with the aim of fighting food insecurity through the development of community food projects that promote the self-sufficiency of low-income communities. Since 1996, this program has awarded approximately $90 million in grants. One social enterprise which has benefited from this scheme is Planting Justice (www.plantingjustice.org) which built an aquaponic system on a vacant lot in East Oakland, California, which is run by former prison inmates. Twelve living wage jobs have been created, 5000 pounds (2268 kilos) of free produce has been given to the community, and the project has put $500,000 in wages and $200,000 in benefits back into the neighborhood (New Entry Sustainable Farming Project 2018).

The GrowHaus (https://www.thegrowhaus.org) was founded in 2009 as a social enterprise, which focuses on healthy, equitable, and resident-driven community food production; 97% of the food consumed in Colorado is produced out of state, and the neighborhood where The GrowHaus is located has been designated a "food desert" based on characteristics of low income, race/ethnicity, long distance to a grocery store, lack of access to fresh affordable food, and dependence on public transportation. The residents have come to rely on fast food, convenience stores, petrol stations, and food banks for the majority of their food staples. Due to these factors, many people face significant challenges in terms of food security and access, resulting in dramatic increases in related health issues. Initially in partnership with Colorado Aquaponics (www.coloradoaquaponics.com), and since 2016 independently, the GrowHaus operates a 3200 square foot (297 square meter) aquaponic farm, and the produce is sold through a weekly farm fresh food basket program at a price point comparable to Walmart, as well as to restaurants, with a portion donated to the local community. To help the transition to healthier eating, the GrowHaus also organizes free training and community events focused around food. In the 2016–2017 fiscal year, the GrowHaus generated an income of $1,204,070, of which $333,534 was earned income, and $870,536 was raised through government grants, charitable foundations, corporate contributions, and individual donations. With operating costs of $934,231, the net annual income was $269,839 (https://www.thegrowhaus.org/annual-report).

Trifecta Ecosystems (formerly Fresh Farm Aquaponics; http://trifectaecosystems.com) was founded in 2012 in Meriden, Connecticut. Their mission is to address urban food security by creating incentives for communities to grow their own food while also raising awareness about sustainable farming through education, workshops, and city projects. The enterprise employs six staff who provide aquaponic systems to organizations for educational purposes, workforce development,

therapeutic gardening, and high-quality food production. The aquaponic systems range from commercial scale production facilities to small educational units for use in classrooms. In 2018, the South Central regional Water Authority (RWA) awarded a $500,000 grant to facilitate the creation of a series of custom-controlled environment agriculture aquaponic systems, an urban farming technology platform, and workforce training programs aimed at improving food security.

The SchoolGrown social enterprise (www.schoolgrown.org) was set up in 2014 by aquaponics enthusiasts who felt that children weren't getting enough hands-on experiences growing food and learning about their connection to the world about them. Situated next to the commercial aquaponics operation at Ouroboros Farms, California, the aquaponics 'classroom' is run by volunteers and is used to provide training. Their main focus, however, is on spreading aquaponic systems to schools and communities around the United States in order to teach sustainable agricultural practices, environmental stewardship, and resource conservation, and at the same time produce fresh and local food, thereby building a deeper connection between communities and the food they eat. The LEAF (Living Ecosystem Aquaponic Facility) is a 1800 square foot (167 square meter) greenhouse with a solar-powered aquaponic system that was specifically designed for this purpose. Costing $75,000, which includes salaries for two part-time staff responsible for maintaining the system and harvesting, the greenhouses are funded by a combination of a Community Supported Agriculture (CSA) vegetable box scheme, local community or business sponsorship, and crowdfunding. Each LEAF is intended to be financially self-sustaining through the generation of revenue from the produce.

24.4 The Viability of Aquaponics Social Enterprises

The examples above illustrate some of the different business models adopted by aquaponics social enterprises. Whether they will continue to thrive and grow or, like Growing Power, ultimately fail, remains to be seen. In the case of Growing Power, potential reasons for its collapse include Will Allen's inability to empower and retain an operational management team, and a lack of oversight by board members, which compromised the organization's financial health (Satterfield 2018). An in-depth analysis of two aquaponics social enterprises conducted in 2012–2013 revealed four distinct factors what were significant to their survival (Laidlaw and Magee 2016). Sweet Water Organics (SWO) began as an urban aquaponic farm in a large, disused, inner city industrial building in Milwaukee in 2008. It was funded primarily by its founders in order to develop creative capacity, employment opportunities, and chemical-free, fresh, and affordable food for the local community. In 2010, a new organization, Sweet Water Farms (SWF), was split from SWO, with the idea that they would grow as a mutually supportive, cohesive hybrid organization, including both a for-profit commercial urban farm (SWO) and a not-for-profit aquaponics "academy" (SWF). SWF managed volunteer operations and hosted training and education programs at the Sweet Water urban farm, while developing programs on a local (Milwaukee and Chicago), regional, national, and international scale. Sweet

Water had a loyal following among local restaurateurs and fresh food stores for its lettuce and sprouts produce, and sold its fish to a single wholesaler. However, the hybrid not-for-profit/for-profit enterprise model proved to be challenging, as both sides of the organization struggled to identify their role in relation to the other. While each side had a different structure relating to their operational character, and although their operations frequently overlapped, their strategic planning and visions sometimes did not. After 3 years of operation, SWO had still not managed to make a profit, and in 2011 the Milwaukee municipal government awarded a $250,000 loan on condition that 45 jobs would be created by 2014. In October 2012, SWO had 11–13 permanent employees, but was still being sustained through loans financing and equity investment. By June 2013, as loan repayments fell due and the job creation targets were not met, the for-profit arm of Sweet Water went into liquidation, and SWF took over as the primary operator of the Sweet Water urban farm. Currently, SWF operates entirely as an educational and advisory enterprise run by volunteers and a small team of part-time employees, and no longer supplies restaurants with produce (Laidlaw and Magee 2016).

The Centre for Education and Research (CERES) in Melbourne, Australia, opened its aquaponics facility in 2010. The system was designed as a suboptimized commercial system with the production capacity to support a single wage for the farmer who maintains it. This wage varies based on how much he/she produces, with the vegetables being sold through the CERES Fair Food organic box delivery service. The scale of the operation does not generate a return that would permit the setting up of a fish-processing facility. Stakeholders at Sweet Water Farms and CERES identified that the principal factor behind their survival was ongoing commitment, in the form of continued support of personnel with technical and business management skills combined with an enduring leadership, and the willingness of the stakeholders to remain involved and prepared to cooperate without strong financial incentives. The second factor was the local political context. While the city of Milwaukee supported Sweet Water both through policy initiatives and direct financial aid, which allowed it to expand its fixed assets and human resources, build market awareness, and acquire a sizeable regular commercial customer base, the CERES project had little such support, beyond an initial grant, and it had struggled to generate revenue, which would have allowed it to expand. Costs of compliance and licensing also made it difficult to engage with local markets in more than a token way, which dampened its motivation to market and sell the produce, and made it untenable for the operation to develop beyond a small part-time income-generating enterprise. The third factor was the availability of markets for urban aquaponics produce. While urban aquaponics is attractive to a customer base that is increasingly responsive to issues of food security and ethical consumption, such as in Milwaukee, this was not the case in Melbourne. The final factor was diversification. Both CERES and SWO/SWF benefitted from translating social and technical experimentation into a range of training and educational services. SWO/SWF, being a larger concern, obviously had greater capacity for developing these services, and these proved vital in sustaining the social enterprise when commercial plans failed to materialize (Laidlaw and Magee 2016).

24.5 Conclusions

In "Ten technologies which could change our lives" (European Parliamentary Research Service, 2015), aquaponic systems were singled out as a solution for developing innovative and sustainable food sources for Europe which, through shortening of supply chains, could improve food security and food systems resilience. However, the technology is still newly emerging and as yet relatively undeveloped, and as the study by Laidlaw and Magee (2016) highlights, the viability of an aquaponics social enterprise depends not only on stakeholder commitment, thorough market analysis, clear governance structures, and a robust business plan, but also on external factors, such as the local political context and regulations.

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