



Alternative fodder production for vulnerable herders in the West Bank

Increasing profitability of livestock production to strengthen resilience to drought and market volatility within protracted crises

Objective



Fresh barley fodder from hydroponic units (© FAO WBGS/ Amro Kalouti, 2014)

This promising practice fact sheet focuses on the work of FAO to strengthen resilience of vulnerable herders within the West Bank. In this environment, the protracted crisis as well as recurrent droughts and overgrazing have resulted in herders facing decreased access to grazing land, which increases their dependency on imported fodder and making them more vulnerable to fodder price volatility.

In an innovative effort to help mitigate the adverse impacts of this situation on the livelihoods of Palestinian herders, FAO has promoted the use of hydroponic technology (soil-less plant propagation) by vulnerable herders and their cooperatives. This provides them with a low-cost, high quality, sustainable source of fodder which is available year-round.

The approach increases the profitability of livestock production and helps herders stay in

business. This practice has been implemented under the project **“Prepare and respond to shocks affecting low resilience farmers and herders in the West Bank and Gaza Strip”** funded by Canada.

Introduction

The 1993 and 1995 Oslo accords resulted in the classification of the West Bank into three zones, referred to as Areas A, B and C. Area A is under Palestinian civil and security authority; Area B is under the Palestinian Authority while security responsibilities are shared by both the Israeli and the Palestinian authorities. Area C which comprises around 60 percent of the West Bank is under Israeli law enforcement control with planned transfer of power halted since 2000.

Area C remains one of the most fragile and volatile environments in the West Bank. The majority of families are dependent on livestock as their main source of income; however access to grazing land and water is shrinking due to new settlements, the barrier and Israeli military zones which herders cannot access.

Unfavorable conditions due to various restrictions imposed by the controlling authority have contributed to the fragility of local production systems for herders in the West Bank. A small deterioration in trade can have a devastating impact on those who derive their livelihood from herding in Area C, and the challenging situation leaves little margin for herding households to cope with such shocks. The recurrent economic, climatic and man-made shocks (i.e. demolitions of livelihood structures) have increased the vulnerability of herding communities and seriously reduced their ability to recover. Herders are particularly exposed to the

threat of transboundary and common animal diseases, drought, irregular rainfall patterns and sudden price fluctuations. All of them have experienced such challenging situations over the last three years, threatening their food security and livelihoods.

The West Bank imports most of its animal feed (around 500 000 tonnes per year) which makes the country highly permeable to price fluctuations in international markets and increases the vulnerability of marginalized livestock herders. Feed prices in the West Bank are among the highest in the world.

FAO's experience clearly indicates that if farming households are forced to sell their productive farm assets (land, animals, etc.) to buy feed, it is almost impossible for them to later re-establish their farming activities and they enter into a vicious cycle which can result in their being forced to take on casual labour, and ultimately becoming dependent upon food-aid. In this context, female-headed households are particularly vulnerable due to the limited alternatives available to them.

Considering the fact that more than 70 percent of the livestock production costs are to cover feed needs, and based upon extensive consultations with livestock herders, NGOs, and the Ministry of Agriculture (MoA), FAO has identified increase in fodder production as the primary area of focus in the West Bank region.

FAO has cooperated with the MoA and the partners of the Food Security Sector (FSS), and increasing the local fodder production was identified as a top strategic objective in the national Agriculture Sector Strategies of 2011-2013 and 2014-2016 as well as in the first national Livestock Subsector Strategy 2015-2019.

To increase their resilience, herders need a high quality, low-cost source of green fodder available throughout the year. This intervention is designed to urgently minimize the devastating effects of external shocks, while a longer-term developmental approach for tackling the root causes of vulnerability to shocks is being assessed.

As feed for livestock is the largest expense needed to sustain herders' livelihoods, use of hydroponic technology as an alternative method of sustainable feed production in the form of green fodder all year round can stop these negative coping mechanisms.

Geographical coverage

This fact sheet is based on experiences implemented across the entire West Bank in all eleven governorates (Jenin, Tubas, Tulkarem, Nablus, Qalqiliya, Salfit, Ramallah, Jericho, Jerusalem, Bethlehem, and Hebron). Activities were undertaken within areas A, B and C.



Stakeholders and partners

Within the project funded by Canada, 15 existing livestock cooperatives were selected based on the number of herders within the cooperative, the number of animals they own, and their capacity to efficiently manage and utilize the fodder production units. Each of the cooperatives has roughly 50 members, totaling 750 beneficiary herders who benefited from this promising practice.

The **Palestinian MoA's engineers** participated in the design of the hydroponic units by adapting the standard international design to the geographic and climatic conditions of the West Bank.

Methodological approach

Among an array of technologies being investigated in the region, **hydroponic technology** is one that can produce green fodder throughout the year. The practice of using hydroponic technology was identified and implemented following a continuous participatory and engagement approach with local herders and their cooperatives, village councils, local grassroots assertions and NGOs in close cooperation and joint working with the MoA and its local directorates.

In order to receive a hydroponic unit, the livestock cooperatives were requested to submit a business plan or proposal, detailing their budget and distribution plans for implementation. The fodder produced by the 15 livestock cooperatives was for use by all members.

Implementation was designed to ensure maximum participation and involvement of the beneficiaries, while engaging the local private sector to supply materials needed for fabricating the hydroponic unit.

A technical committee, involving FAO, the Ministry of Agriculture and NGOs Action Against Hunger (ACF) and Union of Agricultural Work Committees (UAWC), was established for the design development, unit fabrication and implementation of the hydroponic technology. The group received technical support from a local company, "Green Tree", with extensive experience in installing hydroponics in Africa and Asia.

FAO organized a technical training abroad in Tunisia, where similar hydroponic fodder production activities had previously been successful in similar ecological, cultural and economic conditions. This training was attended by MoA, FAO, and NGO staff involved in the design of the hydroponic units. Subsequently, through Training of Trainers (ToT), all the beneficiaries who received the units were trained on how to utilize the method.

Each hydroponic unit is housed in a small mobile unit/room (6m x 4m x 3m height), and consists of a framework of shelves on which plastic trays are stacked.

A layer of seeds is spread over the base of the trays and supplied with water via drip or spray irrigation. The seeds usually sprout within 24 hours and produce a 6 to 8 inches high grass mat in 5 to 8 days.

Each hydroponic unit produces approximately 200-250 kg of fresh green barley per day on full capacity, which (mixed with dry concentrate supplements) is sufficient for feeding for 400 animals.

Hydroponics is a subset of hydroculture and the most common soil-less method of growing plants (including agricultural crops).

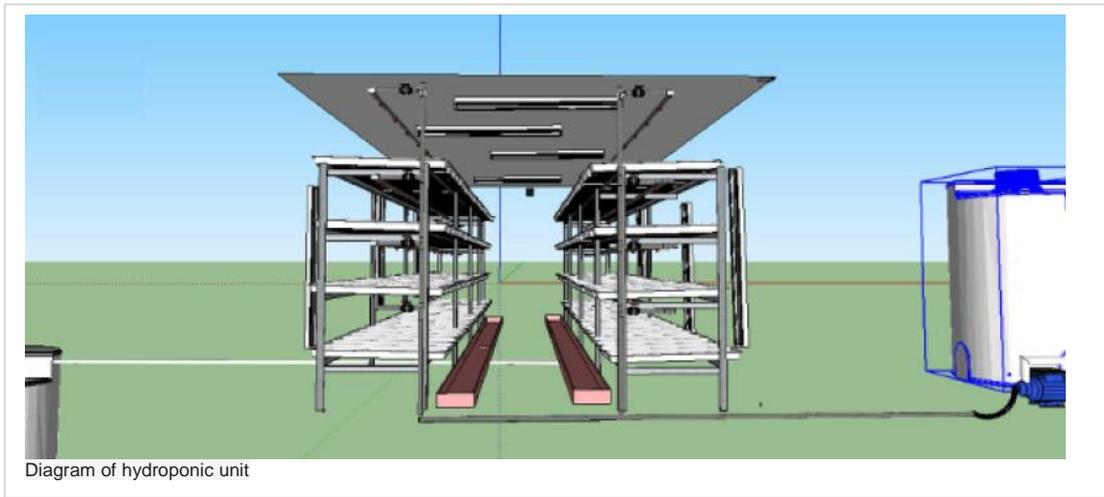
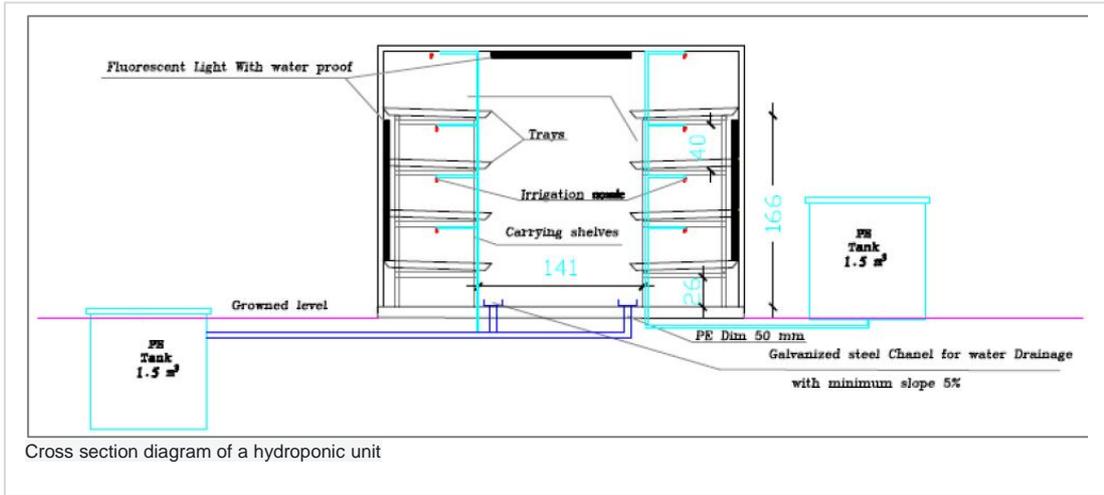
Plants can be grown either on an inert substrate such as sand, perlite or gravel, in an aqueous medium with bare roots, without (as is the case in the current study) or with mineral nutrient solutions. The substrate can provide plant support and moisture retention.

Irrigation systems are integrated within these substrates, thereby introducing a nutrient solution to the plants' root zones. The hydroponic fertilizer solution provides not only nitrogen, phosphorus and potassium, but also all of the essential micro-nutrients for plant growth.



Artificial animal feed manufactured by a hydroponic unit (©FAO/Amro Kalouti)

Each hydroponic unit costs around \$15,000 and requires access to water as well as a stable supply of electricity. The expected life duration of a unit is 30 years with an estimated average annual maintenance cost of around 200 USD.



Validation

All participating livestock cooperatives were visited after the project's closing date for follow up.

From a **quantitative** standpoint each unit was found to produce a quantity of fodder to international standards (every 1 kilo of barley seeds yields 7 kilos of green forage; barley seeds have approximately 10 percent moisture while the green forage has approximately 90 percent moisture).

From a **qualitative** perspective, the resulting fodder from the hydroponic units has a much higher nutritional value (15-17 percent crude protein on dry matter basis) than the traditional feed ingredients, dry barley or wheat bran sold in markets (10-13 percent crude protein on dry matter basis). As a result of green forage feeding, quality and quantity of dairy products and animal health improved.

In the local context, where the cost of other feed ingredients is very high and green fodder is rarely available, the hydroponic method of alternative fodder production constitutes a low cost fodder for herders. It also provides the herders independence from internationally imported feeds, which have high and fluctuating costs and unassured availability. Overall, the hydroponic units benefited members of the livestock cooperatives by decreasing fodder production cost and increasing profitability.

Impact

For optimum productivity, livestock are generally fed a mixture of fresh green fodder, and a dry concentrate mixture, which in the West Bank is most often a mix of cereals and cereal bran. Therefore even those herders using the hydroponic units continue to purchase concentrate feed to add to the green fodder. Farmers are also experimenting with different combinations of feed ingredients, mixing the green forage produced through hydroponic technology with other feedstuff items such as vetch, lentils and corn to augment the nutritional status, livestock productivity and profitability.

The herders using the hydroponic fodder production units reported that the cost of production of one kg of green fodder is 0.4 NIS (0.1 USD).

For a flock of 10 sheep, the cost of feed comes to 12 NIS per day (1 USD): 4 NIS for the green fodder, and 8 NIS for the dry cereal and cereal bran which makes up 50 percent of the feed. This compares to a cost of feed of roughly 16 NIS per day (4.4 USD) if a herder buys the standard dry feed for the same 10 animals.

Overall, a typical herder saved approximately 30 percent by using fresh, green barley fodder produced through the hydroponic unit, as opposed to buying other feeds from the market, as well as benefitting from the green fodder's higher nutritive value.

An in-depth study on the nutritional quality of the fodder produced, and its impact on the quality and quantity of the animal products, including a financial analysis, is ongoing. This study is being undertaken by the Palestinian MoA's National Agricultural Research Center under another FAO project that began in late 2014.

As currently 90 percent of feed and fodder is imported from outside the West Bank the potential economic benefits of utilizing an indigenously produced fodder are clear.

Many of the livestock cooperatives have female members in their constituency, allowing these most vulnerable herders and their households to benefit from hydroponic fodder.

Innovations and key success factors

The innovative aspects of this practice of fodder production are wide-ranging. Firstly, this practice has dramatically shortened the cultivation time. Green fodder of high quality can be harvested in a one week period, compared to the traditional method which requires an average of 6 months from planting to grazing (November to May).

Agricultural engineers from the MoA participated in the design of the hydroponic unit. An international design was adapted to the local conditions of the West Bank in order to reduce the unit's operational costs. Generally glass is used in hydroponic systems of this type to allow heat and light to enter the unit. However in the units fabricated in West Bank it was not used, as the hot climate would make the cost of cooling during summer months higher than any potential costs for heating during cooler months.

Each unit is fully mobile, approximately the size of a caravan. This feature allows for greater flexibility for the livestock cooperatives – if a location becomes unsuitable due to political or security conditions, the unit can be transported easily to another location.

This project has generated in-country know-how to produce hydroponic units and with increase in demand of hydroponic units the cost per unit is expected to go down.

Constraints

The fabrication of the first hydroponic unit was challenging, since this was the first time it has been undertaken in the West Bank. The first unit took 3-4 months to complete, due to several cycles of feedback and adjustments. However, once the first unit was completed, the 14 remaining units took less than 2 months to complete.

Farmers and herders can be apprehensive or skeptical about innovative and unfamiliar practices. Use of a hydroponic unit as an alternative fodder production method is not a well-known or established practice in the local context of the West Bank. A hesitation to adopt new practices is mainly rooted in financial considerations, since the agricultural community has an established set of practices for trade and production. Any new practice introduced to this ecosystem is viewed with some suspicion, as farmers and herders worry

that it could negatively affect their livelihoods. However, all beneficiaries who have tried the hydroponic method are pleased with, and convinced of, the practice's added value.

The quality of seeds used in hydroponic fodder production is very important. Due to fluctuating quality of imported seeds (which are often bought in bulk, may arrive dusty and damaged, and can be difficult to germinate), it is preferable to utilize local seed suppliers. However the limited local seed market in the West Bank has also been a constraint to the project.

Lessons learned

An early technical lesson learned during the design stage was that the use of plastic sandwich panels instead of glass panels reduced heat transfer and associated cooling costs. These sandwich panels were locally produced according to the design of the technical committee.

In an attempt to conserve resources, the project experimented with recycling water from one growth cycle to the next. Unfortunately this approach was not successful, due to proliferation of bacteria and fungi in the water during the growing cycle. A suggestion for overcoming this problem is to utilize infrared filtering of the water before reuse.

During the course of the project it became apparent that the livestock cooperatives would benefit from additional follow up for the maintenance and upgrading of the hydroponic fodder units as well as dissemination of additional alternative fodder practices, such as production of silage from plant residues. MoA extension workers visiting livestock cooperatives who were not targeted by the project facilitated information flow and sparked interest in alternative fodder practices in these groups.

As mentioned in the section above, there is a preference for use of local seeds in hydroponic fodder production, and this suggests that another important intervention would be to strengthen the local seed market and suppliers.

Sustainability

Although a detailed evaluation of the project's sustainability is required, the hydroponic method can be considered economically, socially and environmentally sustainable because the herders' income has increased, the technology is in use (suggesting its social acceptance) and it has benefitted women herders, and as the fodder is grown without land, soil, fertilizers or pesticides. The resources used are water, seeds and energy for climate control (electricity).

The institutional sustainability depends upon the livestock cooperatives, all 15 of which were actively engaged at the outset of the project, and remain so today.

Replicability and up-scaling

This practice needs further verification and validation before it is considered for replication in additional projects. However, it should be relatively easily scalable if resources (space, water, quality seeds, etc.) are available.

Key considerations to be taken into account before replication or up-scaling are:

- Market constraints for availability of seeds locally, as the other inputs used (water and electricity to run the production units) are easily accessible.
- Local climate conditions, which may necessitate changes to the existing design of the hydroponic units.

To successfully replicate this practice at a larger scale the existing livestock cooperatives would need to be enlarged, either in membership or in the creation of new cooperatives to meet the increased demand.

Conclusion

The hydroponic method has succeeded in fulfilling its original goal of producing a high quality, low-cost source of fodder to increase the resilience of herders to the challenges they face in the West Bank. The practice leads to a decrease in the cost of feeding by approximately 30 percent, which allows herders to save capital, reallocate resources for other expenditures such as healthcare or education. Furthermore, improved animal health stemming from higher quality fodder also cuts down on veterinary costs.

The method has met the needs of the herders without compromising the ecosystem, due to its minimal environmental impact. Successful implementation in the specific context was achieved partly due to working in a participatory fashion with the livestock cooperatives. The beneficiaries' feedback and monitoring of post-project activities have shown the practice to be effective and relevant.

Alternative fodder production has replication potential – FAO's experience in the West Bank demonstrates that production unit design can be modified to conform to geographic and climatic variations, but the up-scaling of this practice depends on access to local seed varieties.

Mr. Saaed Bisharat, is the head of the Cooperative Association from the village 'Atuf in Tubas Governorate. Mr. Bisharat describes his experience of the hydroponic fodder production unit:

"It is clear that the herders in my cooperative benefit economically from the unit. We noted an increase in the milk production of our dairy cattle by up to 33 percent, compared to the amount the cows produced when fed the traditional feed.

It is well known to herders that sheep which are fed fresh feed (from grazing) are healthier. Their wool is shinier and in general their health is better. Now, with this hydroponic unit, fresh, green fodder can be available all year, and not just during the grazing season".

References

- A Final Report for project OSRO/GAZ/202/CAN has been produced and submitted to the donor (the Government of Canada).

Related technology on aquaponics available on TECA:

- Designing an aquaponic unit: <http://teca.fao.org/read/8350>
- Management of the Aquaponic Systems : <http://teca.fao.org/read/8398>
- Media Bed Aquaponic Unit – Step by Step Description: <http://teca.fao.org/read/8395>
- Nutrient Film Aquaponic Unit – Step by Step Description: <http://teca.fao.org/read/8396>
- Deep Water Culture Aquaponic Unit – Step by Step Description: <http://teca.fao.org/read/8397>

Maps: <http://mapsof.net/> and https://en.wikipedia.org/wiki/Governorates_of_Palestine

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