



**Food and Agriculture Organization
of the United Nations**

LEBANON



**“Improving the nutrition of Syrian refugees and host communities
through garden walls”**

OSRO/LEB/503/CHA

FINAL REPORT

Emergency and Rehabilitation Division

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ABBREVIATIONS AND ACRONYMS

AUB	American University of Beirut
FAO	Food and Agriculture Organization of the United Nations
FS	Food Security
WFP	World Food Programme

EXECUTIVE SUMMARY

The ongoing crisis in Syria has put tremendous pressure on the coping capacity of both refugees and their host communities, impacting Lebanon's agricultural economy and food production capacity, particularly in the most affected areas of northern and eastern Lebanon. The Government of Lebanon does not allow refugees to cultivate land, which has led to increased food insecurity rates among Syrian refugees and a critical need to assess alternative methods of food production for refugees and vulnerable host communities.

In response, the United Nations Office for the Coordination of Humanitarian Affairs, through the Country-based pooled funds, contributed USD 148 698 for the Food and Agriculture Organization of the United Nations (FAO) project OSRO/LEB/503/CHA, entitled "Improving the nutrition of Syrian refugees and host communities through garden walls". The project was implemented from 15 September 2015 to 15 June 2016. The overall objective of the project was to promote diversified and quality food for vulnerable landless households through deployment of micro-gardens.

The project targeted poor and vulnerable households representing a total of 170 direct beneficiaries (76 vulnerable Lebanese and 94 displaced Syrians), living in Akkar, Tripoli, and the Bekaa. FAO was responsible for overall coordination and implementation and the American University of Beirut (AUB) was the sub-implementing partner.

A micro-garden wall structure designed by the AUB and five other structures were tested, as well as one method with no structure (plastic crates distributed for use as planter boxes). The success, partial success or failure of each method was recorded and analyzed. The results showed that vertical planting systems (AUB wall and Trolley) recorded the lowest success rates while the simplest structures yielded the best results. In the refugees' informal tented settlements, the plastic boxes supplied without any structure was by far the cheapest, easiest and most successful method.

A key finding, therefore, is that the simpler the structure, the better the success rate of the micro-garden. The availability of space, pest-resistant seed varieties, reliable water supply and protection from extreme weather were other key factors found to impact success rates.

With rare exceptions, women took the role of managing the micro-garden and the experience was well received by the 170 targeted beneficiaries. While the experience of micro-gardening was considered a fruitful addition to the family sites and improved the quality of life of the targeted beneficiaries in a very short period of time, the micro-garden technique should not be seen as a replacement of normal agriculture practices but only a substitution when the context prohibits the access of cultivable land.

1 INTRODUCTION

1.1 Project background

The economic repercussions of the Syrian refugee crisis and the unstable security situation over the past five years have seriously impacted the agricultural economy and food production capacities, especially in the most affected areas of northern and eastern Lebanon, and even more in the border areas of Hermel, Baalbek and Akkar.

The Food Security (FS) sector, led by the Ministry of Agriculture of the Government of Lebanon, the Food and Agriculture Organization of the United Nations (FAO) and the World Food Programme (WFP), has provided food assistance to more than 850 000 vulnerable individuals in Lebanon. Based on all vulnerability assessments of Syrian Refugees undertaken annually since 2013, it is evident that food insecurity is not only impacted by the quantity of food, but also the quality of food.

Food insecurity rates among Syrian refugees have been increasing, with the number of food-secure households dropping from 32 percent in 2013 to only 7 percent in 2016. The food consumption score dropped from 55 percent to 24 percent over the same period, while the expenditure share on food increased, from 54 percent in 2013 to 62 percent in 2016.

Dietary diversity is another major issue that Syrian refugees have been facing, and this is evident by the fact that the household dietary diversity keeps on decreasing year after year (from a score of 6.4 in 2015 to 5.6 in 2016), highlighting the low consumption of different food groups, which directly impacts their wellbeing. One of the least-consumed food groups is fresh produce, which includes fruits and vegetables that are the major source of vitamins and minerals. Due to legal restrictions and increased deterioration in Syrian refugee household dietary diversity, the FS sector in Lebanon developed an innovative approach to tackle an increasing concern on nutrition.

As such, this project falls under Outcome 3 of the Lebanon Crisis Response Plan – food security sector plan: promoting food utilization, by improving good nutritional practices.¹

1.1.1 Micro-gardens

In the absence of arable land, micro-gardening, using features such as garden walls, tower gardens, table gardens, etc., is a proven and cost-effective technique to grow vegetables and herbs. Micro-gardens use cheap, readily available materials, such as used or discarded plastic boxes, drums or walls made from recycled plastic, as receptacles that can be filled with soil and planted with seeds. Once the seeds germinate, boxes are stacked and fixed to walls making the best use of limited available space. Micro-gardens can be used to plant,

¹ Source: Food security sector plan, Lebanon Crisis Response Plan 2015-16. Accessed at <http://www.un.org.lb/library/assets/FoodSecurity-SectorPlan-065649.pdf> on 10 August 2016.

nurture and harvest consecutive crops several times per year. The soil can be re-used for several seasons, and the plastic boxes can remain in use for many years.

Micro-gardens can be very productive: 1 m² can yield up to:

- 36 lettuces every 60 days, or
- 10 kg of tomatoes two times per year, or
- 10 cabbages every 3-4 months, or
- 100 onions every four months.

Yields for leafy vegetables can reach up to 10 kg per m² per year, equivalent to 100 tonnes per hectare. Yields for fruit and root vegetables can reach up to 20 kg/m²/year, equivalent to 200 tonnes/ha.

In Lebanon, micro-garden activity is not very common but the American University of Beirut (AUB) had built a prototype structure – “the AUB wall” – in which plastic crates are fixed vertically on their side and vegetable growth occurs through the bottom of the boxes. For this pilot project, the implementing partners tested the “AUB wall” and five other micro-garden structures – and one method that has no structure, simple plastic crates for use as planter boxes.

1.2 Financial contribution of the Donor

In response, the United Nations Office for the Coordination of Humanitarian Affairs, through the country-based pooled funds, contributed USD 148 698 for the FAO project OSRO/LEB/503/CHA, entitled “Improving the Nutrition of Syrian refugees and host communities through garden walls”. The project was implemented from 15 September 2015 to 15 June 2016.

1.3 Project objectives

To promote utilization of diversified and quality food for vulnerable landless households through the promotion of micro-gardens.

1.4 Planned beneficiaries

Poor and vulnerable Lebanese and Syrian households representing a total of 170 direct beneficiaries residing in Akkar, Tripoli and the Bekaa.

2. PROJECT IMPLEMENTATION

2.1 Implementation arrangements

FAO is responsible for the overall coordination and implementation of the project. AUB is the sub-implementing partner under a letter of agreement, responsible for daily monitoring

of the project activities, collecting data and reporting to FAO of the activities implemented in Akkar and Tripoli. Activities in the Bekaa were implemented directly by FAO.

2.2 Main project activities

2.2.1 Design of micro-garden structures

AUB designed and tested a vertical wall system where plants are growing through the bottom of crate and gradually inclined to 90 degrees to fit in a shelf. FAO designed 4 different structures to be compared with the AUB wall described below. Each structure uses the same type of plastic boxes which are easy to find second-hand in Lebanon as they are used to transport vegetables and fruits. The standard dimensions of these boxes are 30 cm x 45 cm x 12.5 cm.

(i) AUB wall

AUB's structure is made out of a metal frame made from galvanized steel. With the following dimensions: 1.6 m x 1.4 m x 0.5 m.

Each wall unit occupies 0.7 m². Another 0.8 m² is needed to manage wall operations (planting, harvesting, etc.). The wall unit accommodates a total of 12 plastic boxes, three in each row providing a total planting area of 1.6 m². The total planting mix volume needed to fill the boxes is 162 litres. The planting mix was used as follows:

- 54 litres of peat moss,
- 54 litres of perlite,
- 54 litres of potting soil.



The AUB wall is prepared by taking the following steps:

1. Planting mix is prepared as above;
2. Boxes are filled with the planting mix and sealed with a polystyrene foam board fixed with metal wires;
3. Seeds are planted in the bottom of the perforated plastic boxes and irrigated;

4. Filled plastic boxes are laid down horizontally until the seedlings reach 3 cm, then are tilted at 45 degrees for 7 days;
5. Boxes are transferred to the AUB wall and fixed to the frame vertically with metal wire;
6. Irrigation system is installed and boxes are regularly irrigated.

(ii) **Trolly**

One limitation of the AUB wall is the small number of boxes it can accommodate. To increase the number of boxes, FAO designed a 3-dimensional wall in the form of a trolley, featuring a wall on each side. The Trolley is mounted on wheels to allow sun exposure to all sides, and is designed to be assembled on site. The structure consists of a galvanized steel frame on wheels, with the following dimensions: 1.2 m high x 1.1 m wide x 1.1 m deep.



The Trolley occupies an area of 4.4 m², allowing space to manage wall operations (planting, harvesting, etc.). It accommodates a maximum 32 boxes, eight boxes in each row and eight on top, providing a total planting area of 4.3 m². The total planting mix volume needed to fill the boxes is 432 litres. The following planting mix was used:

- 144 litres of peat moss,
- 144 litres of perlite,
- 144 litres of potting soil.

The planting methodology is identical as for the AUB wall described above.

(iii) *Agro-Trolly*

In addition to the two structures using vertical growing, FAO also designed structures using conventional horizontal plantation. The Agro-Trolly consists of a galvanized steel frame on wheels and is conceived to be assembled on site. Its dimensions are the following: 1.2 m high x 2 m wide x 2 m deep.

The Agro-Trolly occupies 9 m² to allow wall management operations (planting, harvesting, etc.). The Agro-Trolly accommodates up to 27 plastic boxes, eight boxes in each row and three on top providing a total planting area of 3.6 m². The total planting mix volume needed to fill the boxes is 364 litres. The following planting mix was used:

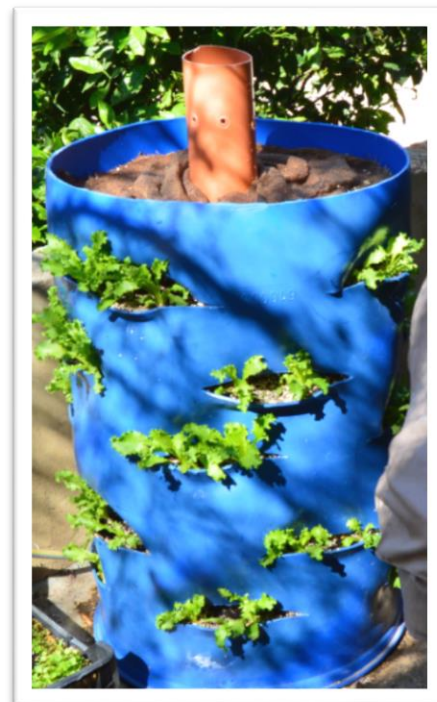
- 121 litres of peat moss,
- 121 litres of perlite,
- 121 litres of potting soil.



(iv) *Barrel*

The Barrel is a 200-litre plastic cylinder, cut and shaped to fit the plants. This structure is 1 m high and occupies a circular area of 0.2 m². The Barrel contains 25 holes (5 on each level), placed all around to provide a planting area of 0.375 m². In the center of the barrel a UPVC perforated pipe is inserted with the following dimensions: 125 mm diameter and 1.2m length to reduce the volume of planting mix by 7 percent. This unit needs 2.3 m² of available space for gardening. The total planting mix volume needed to fill it is 186 litres of planting mix using the following components:

- 62 litres of peat moss,
- 62 litres of perlite,
- 62 litres of potting soil.



(v) *Standing wall*²

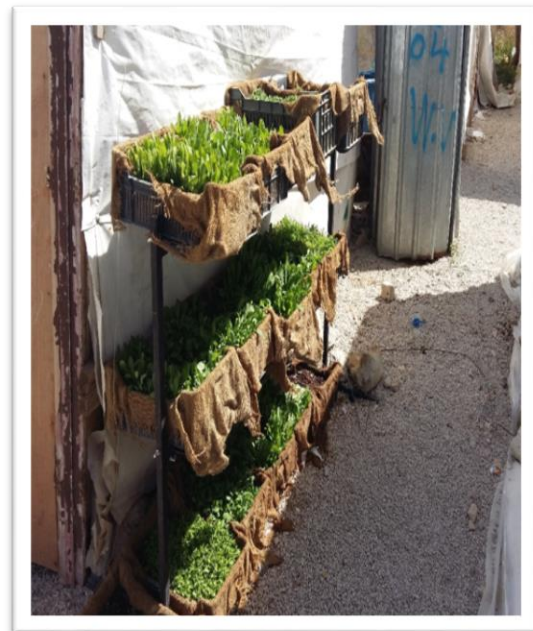
The Standing Wall remains stationary; it is not on wheels and cannot be moved. It is made of a parallel-piped galvanized steel frame (a 3-dimensional object formed by six parallelograms), covered with recycled plastic ECO 2 m² boards, each 1 m high x 2 m long. The width of the base is 0.5 m. The plastic ECO boards are pierced with 176 x 70 mm diameter holes: 72 holes on each long side and 16 on each short side. In total, this model has 1.27 m² of planting area and requires 800 litres total volume of planting mix using the following components:

- 266 litres of peat moss,
- 266 litres of perlite
- 266 litres of potting soil



(vi) *Agro-shelf*

The Agro-shelf is made from a galvanized steel frame and is conceived to be assembled on site, to the following dimensions: 1 m high, 1.5 m long, and 0.5 m wide. The Agro-shelf occupies 0.75 m² and needs another 0.8 m² of space to manage operations (planting, harvesting, etc.). The Agro-shelf accommodates horizontally a total of 15 plastic boxes, five in each row and five laid on the ground, providing a planting area of 2.025 m². The total planting mix volume needed to fill the boxes is 202 litres. In the Bekaa sites only, the planting mix was used in a proportion of 90 percent potting soil and 10 percent perlite.



² Manufactured by **Cedar Environmental Co.** Cedar Eco-Industrial Park Abou Mizane – Lebanon. Phone: +961-1-388339 Mobile: +961-3-293222 email : ziad@cedarenv.com

(vii) Plastic boxes with no structure

This simple design consists of twenty plastic crates laid down on the ground. The dimensions of each box are: 45 cm high, 30 cm wide, 15 cm deep. The design occupies an area of 2.7 m², entirely for planting. The total planting mix volume needed to fill the boxes is 405 litres. The planting mix used consisted of 90 percent potting soil and 10 percent perlite, only in the Bekaa sites.



Table 1 : Description of each unit specifications and cost (USD)

	Space needed (m ²)	Number of boxes	Planting area (m ²)	Volume of planting mix (l)	Unit Cost (USD)
AUB wall	1.5	12	1.6	162	140.5
Trolley	4.4	32	4.3	432	227.6
Agro-Trolley	9	27	3.6	364	229.0
Barrel	2.3	–	0.375	186	90.4
Standing wall	2.86	–	1.27	800	347.9
Agro-Shelf	1.55	15	2.025	202	174.3
No Structure	2.7	20	2.7	405	72.4

2.2.2 Identification of project sites and beneficiaries

(i) Identification of project sites

The project was implemented in two regions: The North (Akkar and Tripoli) and the Bekaa.

The project intended to work equally with Syrian refugees and host communities. FAO identified a total of eight sites in north Lebanon: four sites in Tripoli (two sites for displaced Syrians and two sites for host communities) and another four sites in Akkar (two sites for displaced Syrians and two sites for host communities) (Table 2).

Table 2: Selected sites in Akkar and Tripoli

Area	Akkar				Tripoli			
Residents	Syrian	Syrian	Lebanese	Lebanese	Syrian	Syrian	Lebanese	Lebanese
Location	Qobbet Shomra – Sea Side	Qobbet Choumra – Inland	Bebnine left to al iman	Bebnine right to al iman	Beddawi glass factory	Bhannin	Beddawi glass factory	Minieh
Beneficiaries	14	10	14	6	16	10	12	12
Total	94							

In addition, two Syrian displaced informal tented settlements sites and nine host community sites were identified in the Bekaa governorate (Table 3).

Table 3: Selected sites in the Bekaa governorate

Area	Bar Elias - Bekaa										
Residents	Syrian		Lebanese								
Location	Tali	Tal Sarhoun	Brita	mghasil	abu warshi 1	abu warshi 2	abu warshi 3	mazjoub	aisra seid	rahal	younis
Beneficiaries	23	20	8	3	3	3	9	2	1	3	1
Total	76										

(ii) *Description of sites*

Below is a detailed description of each location within each site in North Lebanon and Akkar Governorates.

- *Qobbet shomra* (sea side) site is a Syrian camp made up of nine tents. Eight tents are part of the project. Each tent has two families. They have cattle of goats, and one cow. A river passes next to the tents. Around them are agricultural lands. The project supported 112 household members residing in the camp.
- *Qobbet Choumra* (inland) site is a Syrian site in an unfinished building of two floors, with two apartments on each floor. Each apartment houses three families. Five families are part of the project. There were 80 indirect beneficiaries of the project.
- *Bebnine Al Iman* is a Lebanese site which consists of two parts; a building of one floor and a small house next to it. The building has five apartments. It is divided between two families. There is an open area with a cement floor.
- *Bebnine Al Ain* is a Lebanese site; a building of two floors and five apartments. They have access to a 15 x 15 m space next to the building.

- *Glass Factory* is a Lebanese site it is made up of 8 rooms. There is a small concrete space in front of the rooms. They have two small rooms. One for the goats and the other for the chicken. Their rooms are empty. No beds are available. Parents and children live in the same room. The floor is dirt. The family shares two restrooms next to the house. The kitchens are very small; they lack facilities and food.
- *Glass Factory* is a Syrian site made for nine families living each in a small unfinished room, one family per room. There is a muddy outdoor space in front. The rest room is shared with the three rooms. No beds are available and the floor is dirty.
- *Bhannine* site is a Syrian informal tented settlement made up of 10 tents, with one family per tent. Only 9 families participated in the project. Every tent is made up of a room and a small kitchen. Every 3-4 tents share one rest room. Floor in tents is made up of cement and the outside of gravel. Tents are made up of plastic and wood.
- *Minieh* is a Lebanese site having 3 houses; 1 is a building, another is a flat house, and one is on the first floor. They have everything they need.

Below is a detailed description of each location within each site in the governorate of Bekaa.

- *Tali Bar Elias* Syrian site is an informal tented settlement made up of 23 tents. Each tent has one family. A small water stream passes nearby into which all sewage from the latrines flows. Fresh water is delivered by water tanker every two days.
- *Tal Sarhoun* Syrian site is an informal tented settlement made up of 30 tents. The residents of 20 tents agreed to participate in the project. Fresh water is available to all the tents on daily basis.

(iii) Identification of beneficiaries

Overall, 170 households were identified consisting of 76 vulnerable Lebanese and 94 displaced Syrians. With rare exceptions, it was always a woman who was in charge of the micro-garden. Beneficiaries were selected according to the following criteria:

- Vulnerable Syrian or Lebanese in Tripoli, Akkar and Bekaa governorates;
- The family's income not coming from agricultural activities;
- Water availability;
- Availability of space for the micro-garden units;
- Willingness to join the project;
- Preferably not already benefiting from WFP vouchers.

2.2.3 Procurement and Distribution

FAO prepared the technical specifications of the micro-garden units, planting mix components and agricultural tools. After the completion of the procurement process the items were delivered to the beneficiaries on site (**Table 4**).

Table 4: Household distribution of micro-garden structures

Item	Akkar, Tripoli		Bekaa		Total
	Lebanese	Syrian	Lebanese	Syrian	
AUB wall unit	8	24	0	0	32
Trolley unit	12	11	0	0	23
Agro-Trolley unit	4	0	26	0	30
Barrel unit	4	0	0	0	4
Agro-shelf	0	0	0	43	43
Standing wall	6	2	0	0	8
No structure (20 plastic boxes each)	0	0	0	5	5
Total	34	37	26	48	145

Note that because the Agro-Trolley is a larger structure accommodating more plastic boxes, they were shared between 1.5 or 2 households. In all, 145 structures were distributed to 170 household beneficiaries.

In the Bekaa governorate sites, the Syrian displaced beneficiaries received only Agro-shelf micro-gardening units, and the Lebanese host communities only received Agro-Trolley units. The Tall Sarhoun Syrian displaced camp beneficiaries received an additional five sets of plastic boxes without structure.

As shown in Table 5, different planting mix components were delivered to beneficiaries in the three regions. In the Bekaa, only potting soil and perlite were delivered to both Lebanese and Syrian beneficiaries to test a cheaper planting mix, in conditions with almost the same soil properties.

Table 5: Soil mixture components delivered to the beneficiaries

Item	Volume per bag	Akkar, Tripoli		Bekaa	
		Lebanese (# bags)	Syrian (# bags)	Lebanese (# bags)	Syrian (# bags)
Peat moss	340 litres	16	13	0	0
Potting soil	80 litres	68	57	78	129
Perlite	100 litres	48	41	26	43
Fertilizer	1 kg	12	29	26	43

Each beneficiary received a box containing certified vegetables seeds and agricultural tools (see technical specifications in Annex 3). The seeds species were purslane, parsley, green thyme, spinach, lettuce, radish, rocca, dandelion, watercress and coriander. All the procured seeds were certified hybrid seeds to ensure high percentage of germination and productivity (Table 6).

Table 6: Agricultural tools delivered to beneficiaries in each region

Sites	Items delivered
Tripoli, Akkar	<ul style="list-style-type: none"> • agriculture water can • plastic boxes • hardware items (metal wire, pliers, bolts, nuts, rondelle) • bucket • irrigation items (pipes 20mm, plastic fittings, valves) • linen jute • polystyrene foam • small garden shovel • seeds
Bekaa	<ul style="list-style-type: none"> • agriculture water can • plastic boxes • hardware items (pliers, bolts, nuts, rondelle) • bucket • linen jute • small garden shovel • seeds • seedlings (tomatoes, eggplant, green pepper.)

2.2.4 Training

An introductory session was conducted to train participants on the following:

- preparing the plastic boxes for use on the AUB wall and trolley;
- preparing a mixture of one third perlite, peat moss, and potting mix;
- filling the boxes with the planting mix, then covering them with polystyrene foam board and fixed firmly with a wire;
- flipping the box to start planting seeds. Individuals pick the seeds they prefer; and
- planting the seeds and irrigating.

The plastic boxes were then prepared for the remaining units, including covering the inside of the box with linen jute before filling it with the planting mix.

2.2.5 Technical support and follow up

The national micro-garden expert, recruited by FAO, conducted weekly visits to each site. He monitored the work done by AUB, proposed correction measures and amendments, and provided technical advice to beneficiaries when needed.

3. RESULTS

3.1 Assessment of performance at each site

3.1.1 Sites in Akkar and Tripoli

An assessment of performance was made in each site for all micro-garden units planted in early spring (Table 7). At the social level, failed attempts were linked to the fact that in some cases women joined the project out of peer pressure, or lost interest in the project when daily follow up of irrigation and fertilization was required and/or when Ramadan started. The most significant technical challenge is water availability, which limited the survival rate of the plants and in many cases contributed a loss of interest in the project. Other problems included agricultural pests and in some cases domestic animals (chicken) feeding on accessible boxes.

Table 7: Assessment of performance based on site: Akkar and Tripoli

Intervention	Model Units, Boxes	Social		Technical	
		Positive	Negative	Positive	Negative
Successful	<ul style="list-style-type: none"> • AUB wall: 8 units 32 boxes • Trolly: 3 units 23 boxes • Agro-Trolly: 1 unit; 4 boxes • Barrel: 1 unit 4 boxes 	<ul style="list-style-type: none"> • Group Work • Full time attention • Regular observation of the plants 		<ul style="list-style-type: none"> • Regular irrigation & fertilization • Presence of shade 	<ul style="list-style-type: none"> • Leaf Miners
Partial Successful	<ul style="list-style-type: none"> • AUB wall: 11 units 32 boxes • Trolly: 3 units 23 boxes • Standing wall: 2 units; 8 boxes 	<ul style="list-style-type: none"> • Partial interest of the beneficiaries in such kind of agricultural techniques 	<ul style="list-style-type: none"> • Woman are not allowed to go outside to irrigate • Domestic conflict 	<ul style="list-style-type: none"> • Regular but limited irrigation 	<ul style="list-style-type: none"> • Leaf miners • White flies • Limitation of water consumption because of the owner • Chicken eating from the lower boxes
Failed	<ul style="list-style-type: none"> • AUB wall: 13 units, 32 boxes • Trolly: 17 units 23 boxes • Agro-Trolly: 3 units, 4 boxes • Barrel: 3 units, 4 boxes • Standing wall: 6 units, 8 boxes 		<ul style="list-style-type: none"> • No interest of the beneficiaries • Domestic conflict • Some beneficiaries joined because of peer pressure 		<ul style="list-style-type: none"> • Not enough water during the dry season • No shade the sun scorches the plants • Rats eating the plants

3.1.2 Sites in the Bekaa

Based on the assessment performed in all the sites for all the units in Bar Elias - Bekaa, (**Table 8**). Similarly, to Akkar and Tripoli, the same reasons for failure at the social and technical level were obtained. At the social level the reason for a failure was the lack of commitment of the beneficiaries in the project activities. At the technical level, the lack of irrigation during the vegetative phase (dry season).

Table 8: Assessment of performance based on site: Bekaa

Intervention	Model Units, Boxes	Social		Technical	
		Positive	Negative	Positive	Negative
Successful	<ul style="list-style-type: none"> • Agro-shelfs: 37 units 43 boxes • Agro-Trolley: 6 units 26 boxes • No structure: 5 units 5 boxes 	<ul style="list-style-type: none"> • No domestic conflicts • High interest of beneficiaries • Regular observation of the plants • Interested to have production 		<ul style="list-style-type: none"> • Regular irrigation & fertilization • Presence of shade 	<ul style="list-style-type: none"> • Leaf Miners • White flies
Partial Successful	<ul style="list-style-type: none"> • Agro-Trolley: 7 units 26 boxes 		<ul style="list-style-type: none"> • Domestic conflict 	<ul style="list-style-type: none"> • Limited irrigation 	<ul style="list-style-type: none"> • White flies • Limitation of water for irrigation
Failed	<ul style="list-style-type: none"> • Agro-shelfs: 6 units 43 boxes • Agro-Trolley: 13units 26 boxes 		<ul style="list-style-type: none"> • No interest of the beneficiaries • Domestic conflict 		<ul style="list-style-type: none"> • Not enough water during the dry season • No shade the sun scorches the plants

The units using the vertical planting systems (AUB and trolley) recorded the lowest success rates while the simplest structures (Agro-shelf and plastic boxes without structure) gave the best results (**Table 9**). Large structures, such as the trolley and Agro-Trolley, did not perform as well as smaller units or no structure.

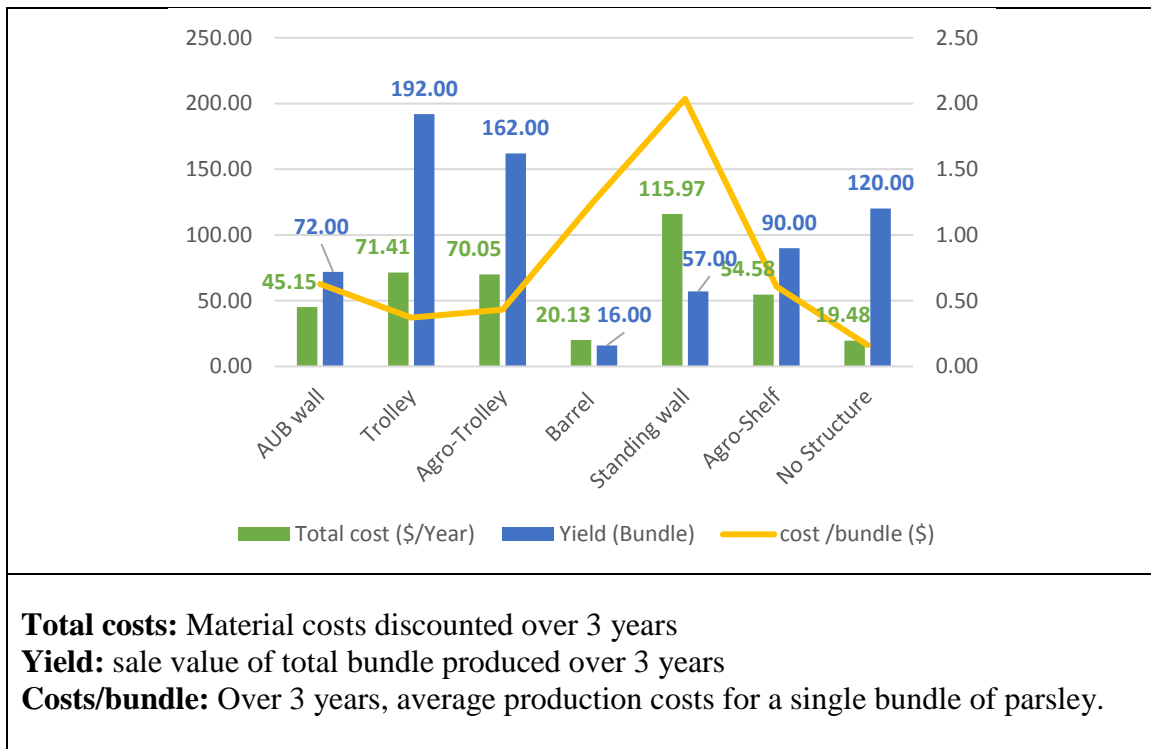
3.2 Analysis of the potential economic results per units

Since each group of beneficiaries planted different types of plants and harvested at different times, it was not possible to have a strict field data collection on production. The socio-economic analysis is therefore based on average potential production per box for a single plant which was most commonly planted: parsley. The potential yield of each box is estimated to be 2 bundles of parsley every 45 days which give three cuts per season. **Figure 1** shows that the maximum potential yield is given by the Trolley. The cost of production is the lowest in the set of boxes without structure.

Table 9: Performance rates of each one of the units in Akkar-Tripoli and Bekaa

Model (# units distributed)	Akkar-Tripoli			Bekaa			Success rate (%)	Failure rate (%)
	Successful	Partial Success	Failed	Successful	Partial Success	Failed		
AUB wall (32)	8	11	13				25	40
Trolly (23)	3	3	17				13	74
Agro-Trolly (4)	2		2	6	7	13	27	50
Barrel (4)	1		3				25	75
Standing wall (8)		2	6				0	75
Agro-Shelf (37)				37		6	86	14
No Structure (5)				5			100	0

Figure 1: Comparative economic return per units



4. CONCLUSIONS AND RECOMMENDATIONS

The project addressed the food security of a group of vulnerable Lebanese households and Syrian refugees by trialing methods to grow their own vegetables in micro-gardens. The experience of micro-gardening was considered a fruitful addition to the family sites and improved the quality of life of the 170 household beneficiaries.

In a very short period of time, the project managed to identify beneficiaries in two of the most deprived governorates in Lebanon, and selected appropriate crops that addressed their needs. This was possible because of the long term presence of FAO in Lebanon and the knowledge of the Lebanese context and production systems. The project benefited from the technical and operational expertise of both international and local FAO staff, and from other ongoing FAO projects, contributing to smooth implementation.

The preliminary testing of different micro-gardening units shed light on two important limiting factors: hot weather conditions and lack of water. Accordingly, the results suggest that micro-gardening activities should be restricted to the rainy season or spring (March-June), and possibly during autumn (September- December).

To avoid the need for pest control, the project promoted the production of leafy vegetables and herbs only, which are much more pest-resistant. Although beneficiaries would have been interested in the production of vegetables like tomatoes, onion or eggplants, it is important to acknowledge these vegetables take longer to grow and require more intensive protection against pests and disease. Organic pest control is not easy to implement nor is it always efficient, and there is increased risk that uncontrolled and inappropriate use of chemical pesticides could result in harmful impacts upon beneficiaries.

Space availability is also an important consideration. When comparing units, the **AUB wall** and **Agro-shelf** appeared to be most suitable when there was limited space available. The vertical planting approach did not give very good results. The planting system is cumbersome and was not well understood by the beneficiaries, who would often replant the boxes in the conventional horizontal manner. The vertical plants boxes also tend to dry up fast and soil is lost during irrigation. This was even more pronounced in the AUB wall with sun exposure on both sides. A single day without irrigation was enough to irreversibly damage the plants.

When space is not restricted then the **Agro-Trolley** and the **Trolley** designs can be considered as they can accommodate significant number of boxes. However, they are heavy and need a flat and smooth surface to be moved. Although the trolleys have potential, they did not perform very well in the trial because only part of the structure was used, or it was only partially watered.

The **Barrel** is a low-cost unit, needing little space and with a good productive potential. Unfortunately, safe second-hand barrels which did not contain dangerous chemicals are not easy to source and/or are difficult to clean of chemical residues. Furthermore, the thickness of the plastic makes it very hard and relatively dangerous to cut holes and bend the material to create pockets. Therefore, large scale barrel units would be cumbersome to create and quite difficult and risky to be made by the beneficiaries themselves.

The **Standing Wall** was bulky and cannot be moved and was not adopted by the beneficiaries. Some beneficiaries complained that the plastic used produced unpleasant odors in high humidity. It also requires a large volume of soil. The unit used in the project was manufactured commercially and was quite expensive, but could be reproduced at a cheaper cost.

The **Agro-shelf** was designed to reduce the cost of the structures and keep the familiar horizontal growing pattern. It can fit in small spaces and gives easy access to the produce.

Finally, in many situations and certainly in the refugee's informal tented settlements, the **plastic boxes** without any structure was by far the cheapest and the easiest. Small boxes can fit in small interstices, or in spaces that would go unused for anything else. They can be moved easily, to avoid direct sun exposure during the hot season for example, and are easy to water. Sometimes, the beneficiaries will build a shelf with a scrap of wood or place the boxes on a pile of bricks or lay them in line between 2 tents. Children can have their own boxes and become very interested by them. When production is over, the boxes are stacked in a corner, with no bulky metal structures in the way. Finally, the free boxes are more easily accepted by the beneficiaries who regard the metal structures a waste of money that could have been spent more usefully.

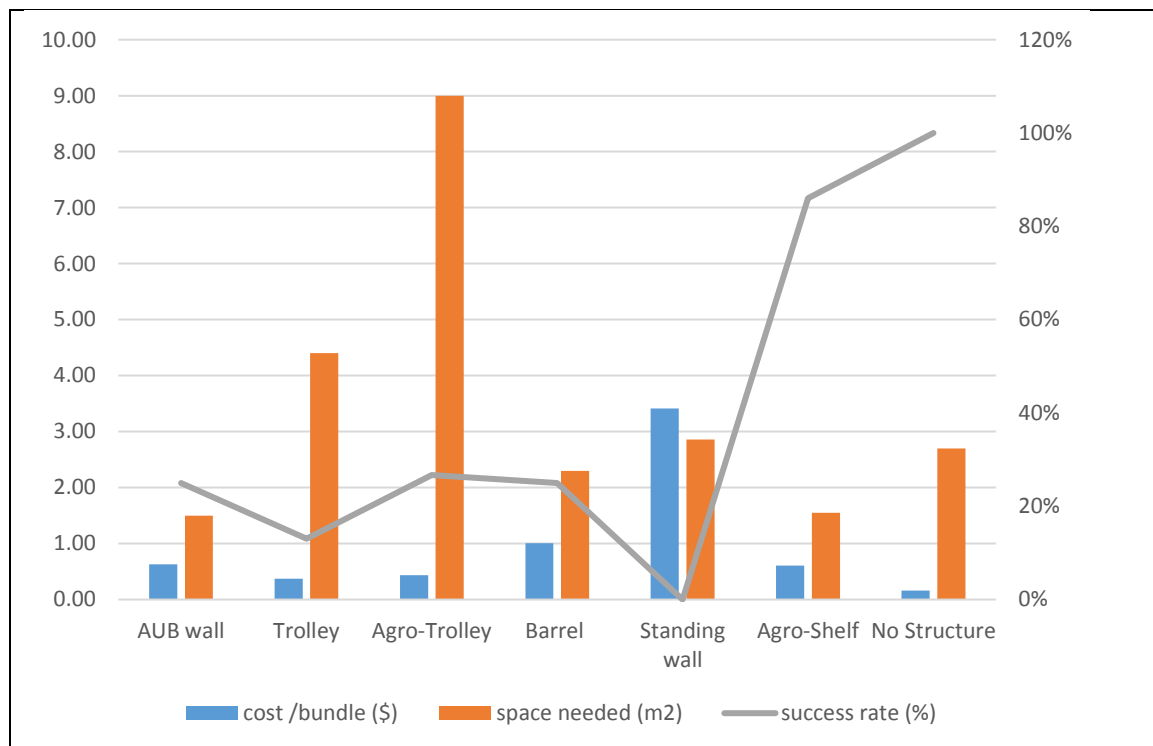
Deciding which structure to implement depends on three key factors: (1) space available, (2) costs of production and (3) the success rate which relies on several factors such as the adoption rate, water needs, ease of use, time of year, etc.

Figure 2 compares these three factors to support decision making in which type of unit would be more appropriate. In the case of Lebanon, we would recommend the Agro-shelf or just the set of plastic boxes without structure, or any similar system which can reduce the cost of production.

Micro-gardening is only an alternative for vegetable production when cultivable land is not available, or when legal decisions prevent affected populations from directly cultivating the soil. In Lebanon, very often, Syrian refugees could easily cultivate a small piece of land next to their house or settlement, if legislation would allow. The creation of small gardens can reduce the cost of production and allow different types of production like root vegetables which are more nutritious.

The micro-garden technique should therefore not be seen as a replacement of normal agriculture practices but only a substitution when the context prohibits the exploitation of cultivable land.

Figure 2: Comparison of 3 decisions criteria for the choice of type of micro-garden



Costs/bundle: Over 3 years, average production and fixed costs for a single bundle of parsley

Space needed: Total ground surface needed for the structure

Success rate: Percentage of structure which were fully adopted and well looked after resulting in production

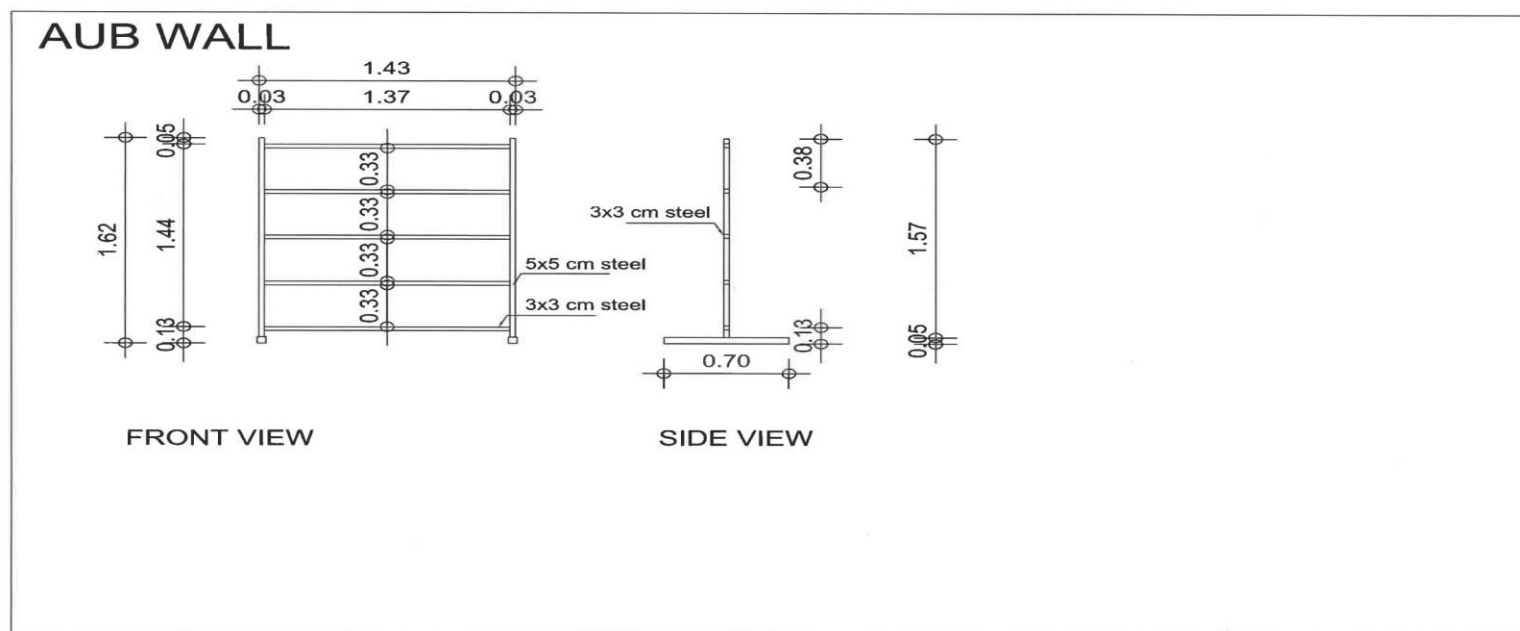
In conclusion, micro-gardening is a good activity to support vulnerable families who have no access to cultivable land but some key principles need to be kept in mind;

1. The beneficiaries need to express clearly their interest in gardening
2. Water need to be available free of charge without competing with any human need
3. Sufficient space and shade need to be available. In no circumstance the micro-garden units need to represent a hazard e.g. in obstructing emergency exit.
4. Although the choice of plants to grow should be done by the beneficiaries, it should be restricted to vegetables which can grow fast, with little soil and with no chemical pest and disease control measures
5. Since the benefit from micro-gardens is as much the occupational therapy side as the real production, it is recommended to include micro-garden activities within a social support program like establishment of educational school gardens, women's group support, etc.

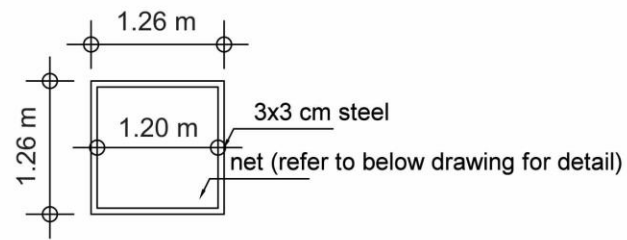
ANNEXES

Annex 1

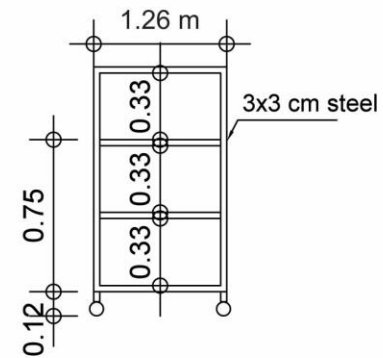
Technical specifications of the units made by galvanized iron



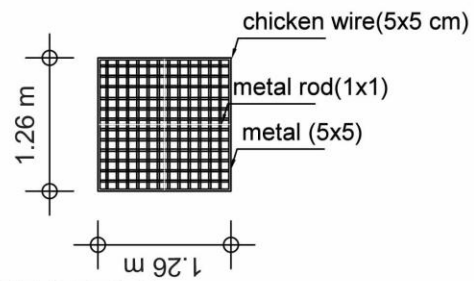
TROLLY



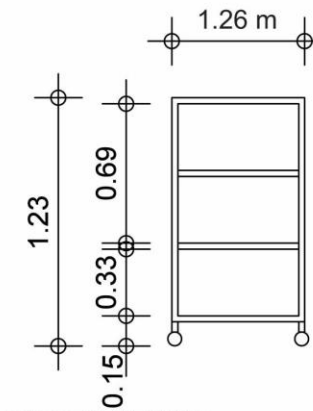
TOP VIEW



SIDE VIEW 1

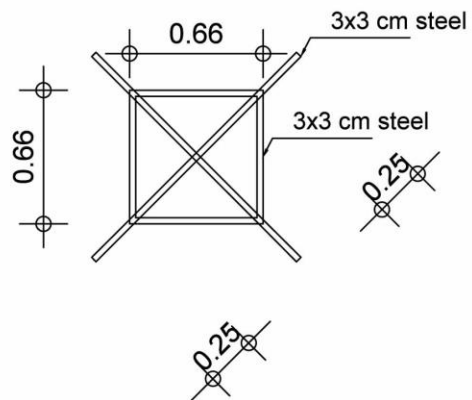


NET DETAIL

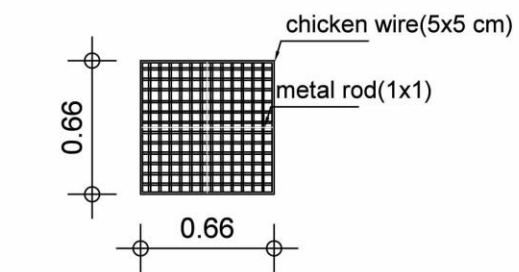


SIDE VIEW 2

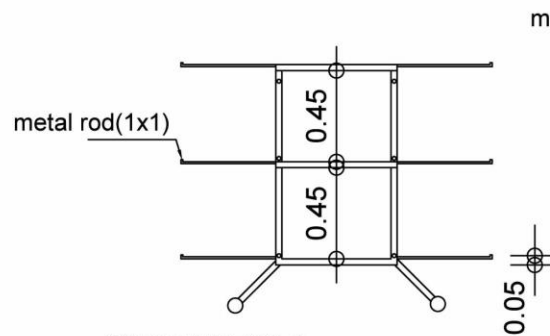
AGROTROLLY



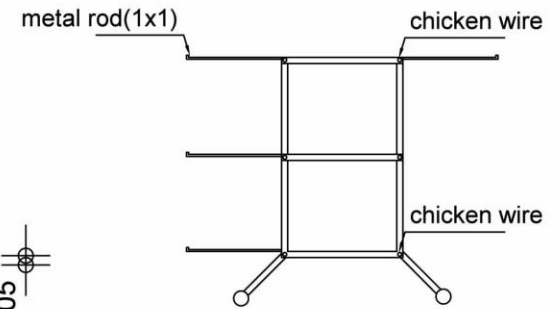
TOP VIEW



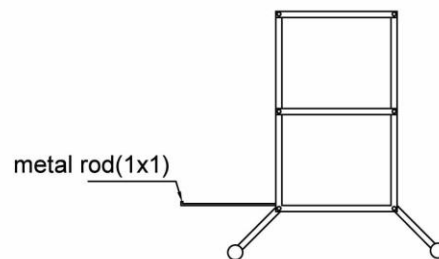
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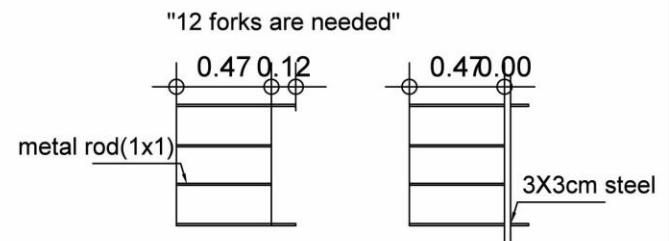
SIDE VIEW 1



SIDE VIEW 2



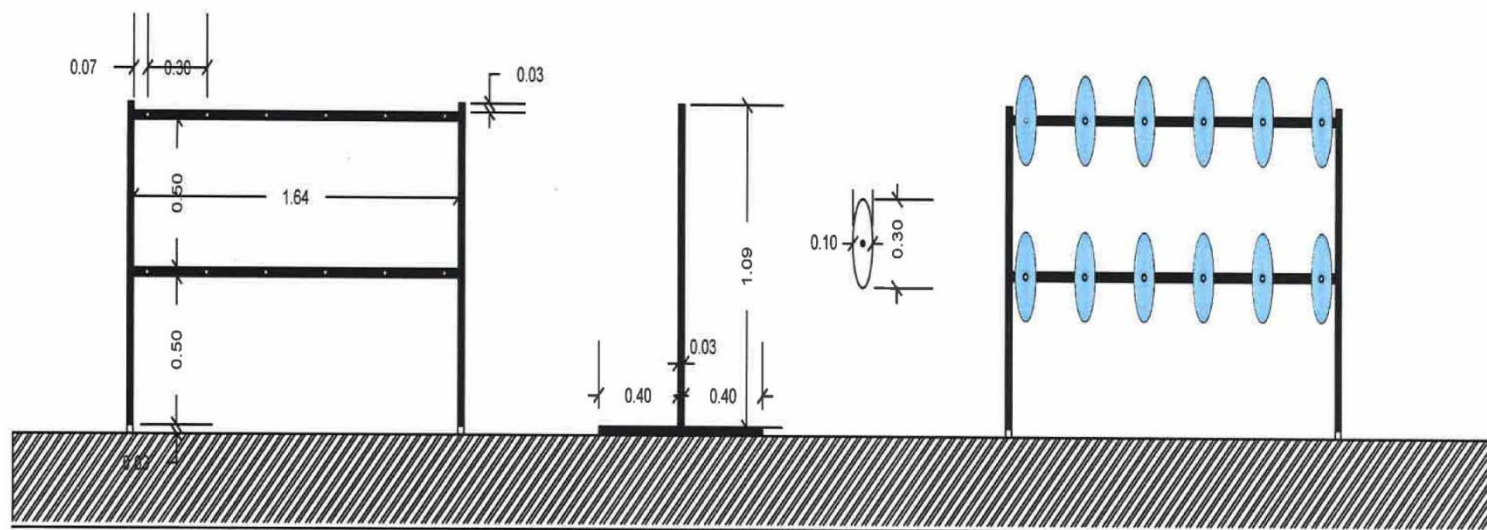
SIDE VIEW 3



FORK TOP VIEW



II- Agro shelf:



Notes:

- Structure to be assembled and dissembled
- Metal used for designs should be hollow 3x3 from inside
- Structure to be painted with rust roof paint.
- 12 plates

Annex 2

Technical specifications of the agricultural tools

Materials	Specification	
Rubber	20 mm	
Plastic Valve	20 mm valve	
Plastic Irrigation Puncher		
Jute	Cut into 70 to 100 cm pieces	
Polystyrene foam	Cut into 45 cm x 30 cm pieces	
Peat moss	Contain Macro & Micro Nutrients. Particle Size fine: " 0- 7mm" Bags of 340 litres	
Potting Soil	Contain Macro & Micro Nutrients and Mycorrhizae Bags of 80 litres	

Perlite	Horticulture Grade " 2 - 6" mm Bags of 100 litres	
Fertilizer	NPK, 20-20-20 + micronutrients Packaged in 1 kg sealed plastic bags	
Agricultural Water can	Plastic watering can 4 litres with handle Any color	
Plastic vegetable box	30 cm x 45 cm x 15 cm Black Color	
Plastic vegetable box	30 cm x 45 cm x 20 cm Black Color	
Metal Wire	2.5 kg rolls, 0.1 mm thick	
Pliers	Combination Pliers Length 15 to 20 cm	

Bucket	<p>Bucket commonly used for cement mixing.</p> <p>Plastic is semi-malleable.</p> <p>Upper diameter 30 cm, lower diameter 20 cm.</p>	
Bolts	<p>7 mm diameter, length 6 cm – 6.5 cm</p>	
Nuts	<p>Must fit the 7 mm diameter Bolt</p>	
Rondelle	<p>Must fit the 7 mm diameter Bolt</p>	

Annex 3

Technical specifications of the vegetable seeds

Materials	Specification	Quantity (g /bag)	
Seeds	• <i>Purslane</i>	50	Hybrid seeds, resistant to relevant diseases present in Lebanon Germination rate: 85% minimum All the seeds are suitable to be planted during (April and June) in-open fields in the Bekaa valley.
	• <i>Parsley</i>	50	
	• <i>Thyme</i>	25	
	• <i>Spinach</i>	25	
	• <i>Lettuce</i>	25	
	• <i>Radish</i>	25	
	• <i>Rocca</i>	50	
	• <i>Dandelion</i>	25	
	• <i>Garden cress</i>	50	
	• <i>Coriander</i>	25	