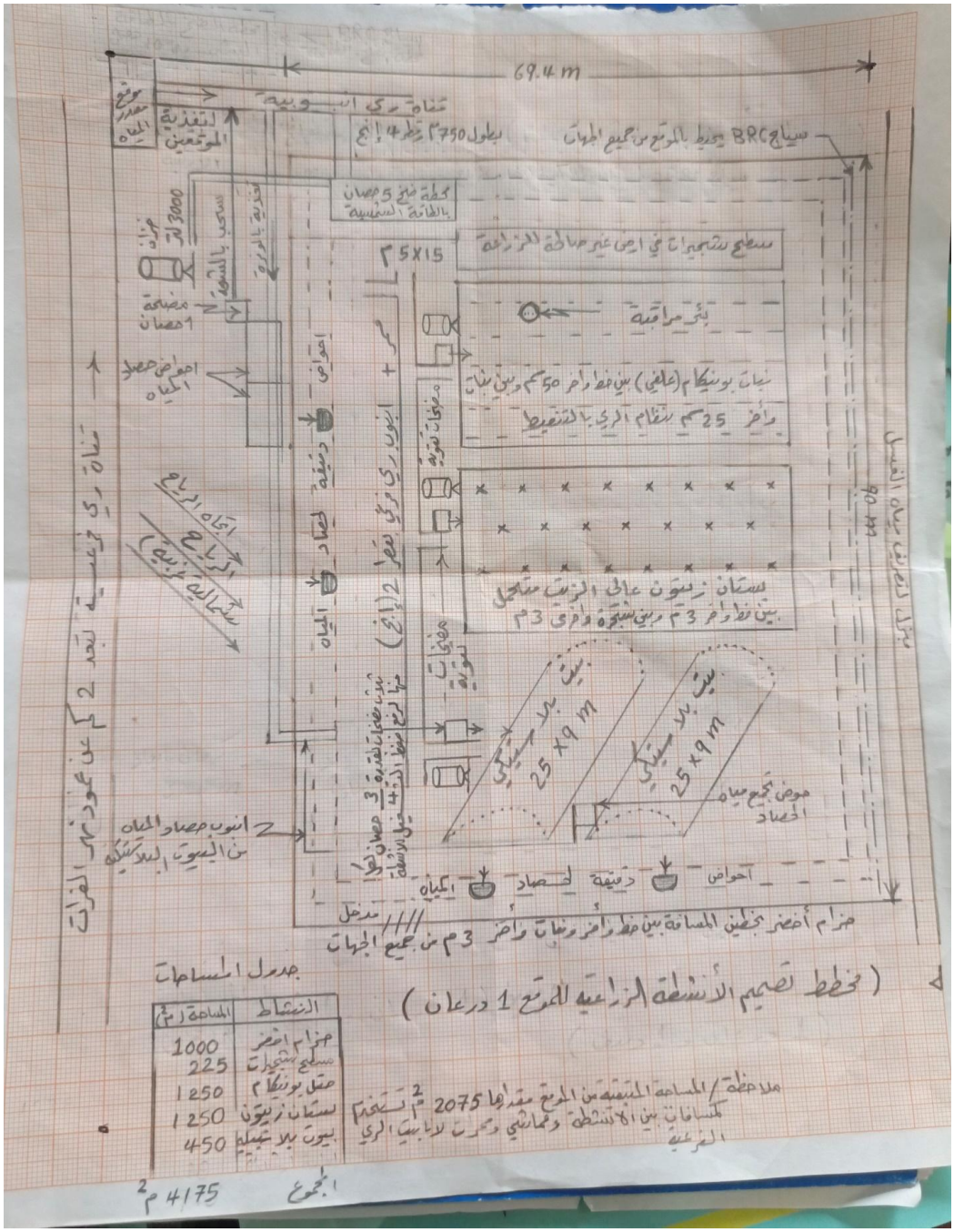
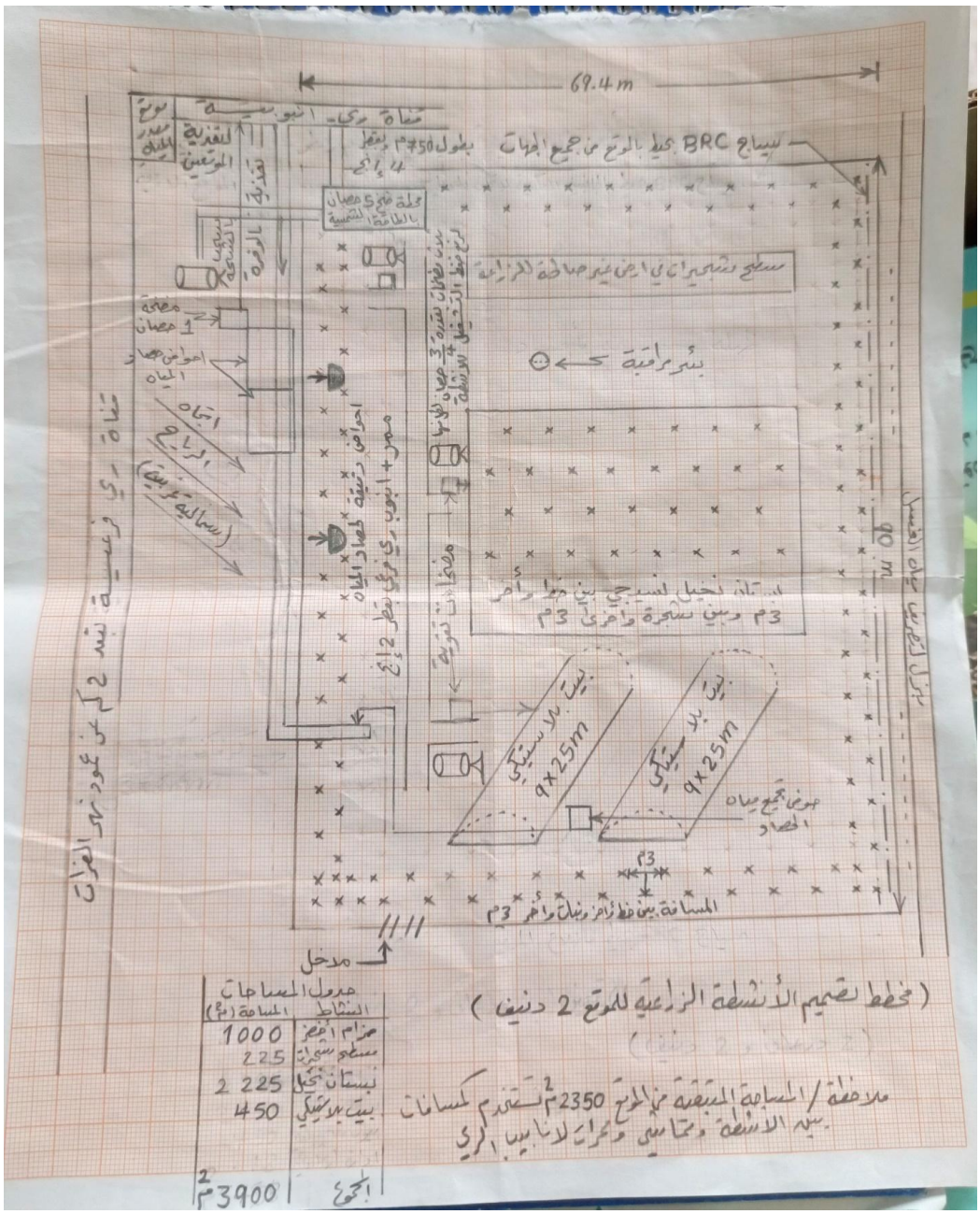
Design Details



The layout above is for Site No. 1 (Al Dur'an).



The layout above is for Site No. 2 (Al Dunaif).

Based on the layout drawings above, which include the agricultural activities under the (Wiqaya) programme and are to be installed as indicated in them, for the sites of the two villages of Al Dur'an and Al Dunaif:

The total area of each site has been set at 2.5 dunams, comprising the design details below:

Agricultural activities within each site:

1. Greenhouses (450 m²)

Two greenhouses, each measuring 25 m in length and 9 m in width, planted on four raised beds, each bed 1 m wide. Each bed has two drip lines irrigating two rows of plants planted alternately on the bed, with 1 m between one bed and the next. The spacing between plants depends on the crop type, namely okra, cucumber, eggplant and pepper.

The greenhouses must be fully equipped in every detail: galvanised posts fixed in the soil to a depth of 40 cm with concrete poured around them, and well wired and secured horizontally and vertically to hold the clear plastic cover, which shall be 180 to 200 microns thick to withstand dust storms. A metal fertiliser injector shall be installed for each greenhouse. The greenhouse soil shall be replaced over an area of 225 m² to a depth of not less than 30 cm with loam and peat moss, or improved with organic matter and peat moss, after testing and analysis.

The company undertakes to equip each greenhouse with front and back doors and two side vents, and to connect the greenhouse irrigation system to a sand or screen filter, a water tank and a booster pump. Gutters shall be added on both sides of the two greenhouses to collect water into an underground tank measuring 2 m long × 2 m wide × 1.5 m deep, which can be reused when water is scarce in the area, noting that well drilling has not been successful in the area.

The company also undertakes, after analysing the greenhouse field soil, to treat it to improve its properties and make it suitable for growing vegetable crops, and to purchase and supply hybrid seeds for eggplant, pepper, cucumber and okra (3,000 seeds), together with growth regulators for the vegetable crops to resist water salinity and improve water use. The emitters in the greenhouses shall be of the click-lock type, which are cleaned periodically of salt build-up and clogging. The company's offer shall include training on the integrated management of activities and pests. The company undertakes to provide insect-proof netting for the greenhouse doors and the plantings, and shade netting to reduce the effect of solar radiation in the very hot summer.

2. Green belt

Green belt: A green belt of two plant rows, with 3 m between plants and 3 m between rows, using drought- and salinity-tolerant species such as tamarisk (athel) for the first row and ghaf (*Prosopis cineraria*) for the second row, with drip lines laid along each plant row. The belt surrounds the two sides of the site that face the direction of the dust storms and winds, for a site length of 90 m and width of 69.4 m, per site only. This gives 320 m for one row, i.e. 640 m for the two rows of one site; multiplied by two sites, the total is 1,280 m for both sites.
BRC fence: The company undertakes to install a BRC fence around the four sites (treatment and control), 90 m long and 69.4 m wide, on all four sides, for a total of 1,280 m, at 320 m per site for each of the four treatment and control sites.

Before implementation, the company undertakes to carry out a soil analysis, scrape the surface layer, laser-level the land, carry out deep cross-ploughing with leaching, mark out the row lines, and dig an individual pit for each seedling, 40 to 50 cm deep and 1 × 1 m in size. These serve as micro-basins and are formed as half-moons with a bank 20–30 cm high, mulched with plant residues or palm fronds to a depth of 7–10 cm. They help conserve soil moisture and improve fertility around the trees in the belt rows (as shown in the design). Peat moss, organic matter, rooting stimulant and loam soil shall be added as a good bed for the seedlings, which shall be planted and staked on both sides with 1.5 m wooden stakes.

The belt irrigation system shall be connected to its own screen or sand filter from the main system, a water tank on a supporting stand, and a booster pump. There is no water conveyance canal; instead, a 750 m pipe delivers water from the branch irrigation canal to each site. It is buried at a depth of 2 m as the main feeder

pipe for all sites and is connected to each site's pump, which is solar-powered (5 HP, 15 solar panels with a reflector and inverter) and housed in a small, ventilated caravan.

3. Fruit trees: high-oil olive (1,250 m² per site) and date palm (2,225 m² per site)

A tissue-culture date palm orchard of trees aged 3 to 4 years, covering 2,225 m², comprising 20 palms of the Medjool or Barhi variety and 20 palms of the red or yellow Shuwaithi variety, plus 15 Ghannami offshoots as male pollinators for the female varieties. High-oil olive trees shall be planted as allocated to the site, at 3 × 3 m spacing to intensify planting in the two sites, with drip pipes laid between the trees along the rows.

Before implementation, the company undertakes to level the soil, carry out deep cross-ploughing, mark out the spacings, and dig pits 50 cm deep and 1 × 1 m in size. Peat moss, organic matter, rooting fertilisers and fine loamy soil shall be added to each pit before placing the offshoots, which shall be well secured and watered. The irrigation system shall be connected to a small fertiliser injector and a sand filter before being connected to the main irrigation system, and to a water tank raised on an iron stand and connected to a booster pump.

The proposed spacings were chosen for their economic return, and the high-oil olive varieties are suited to the southern region. The company undertakes to provide a certificate of accreditation and varietal conformity for the tissue-culture offshoots, to protect the offshoots during the first summer by wrapping and shading them, and to supply Ghannami male offshoots suited to the southern region, planted between the rows and the female offshoots to ensure pollination. The 1 × 1 m area around each tree serves as a micro-basin, which is mulched with crop residues to conserve moisture and can be used for water harvesting by raising its edges with soil.

4. American Panicum fodder crop (1,250 m²)

Planting the fodder grass Panicum (Panicum antidotale) at 25 cm between plants and 50 cm between rows in the designated area. It is planted as seedlings after raising them in trays, with drip pipes installed for each row. The plant is shrubby and grown for fodder; it relies on drip irrigation, which gives better production, and surface irrigation offers no benefit. Flood irrigation could be used if the land were not saline and the purpose were grazing, but this was not adopted at our site.

The land must be deep cross-ploughed, finely tilled and laser-levelled, and planting holes 10 cm deep prepared after raising the transplants or buying them from Basra nurseries, or raising them on site and transplanting them directly to the field after 20 to 30 days. Limiting the fodder crop to Panicum is ideal for an area affected by desertification; it is grown under drip irrigation in rows as shrubs and gives several cuttings. Surface irrigation cannot be adopted in the area, and sensors cannot be installed because farmers in the area are not familiar with how to operate them. Farmers may also grow barley as a fodder crop on their other land surrounding the site.

5. Irrigation water pump (solar power)

Installation of two solar-powered irrigation pumps, one per site, each including 15 solar panels to run a 5 HP pump, with a small caravan for the inverter. Filters shall be installed for each activity, together with a 3,000-litre water tank per activity on an iron stand raised 2 m. A 1 HP pump shall be installed to draw water from the collection basins to the main tank for reuse, and from the main canal to the collection tanks to store water in times of abundance to cope with water shortages, at 2 pumps per site. A ¾ HP booster pump shall also be installed, at 3 pumps per site according to the activities and their tanks.

The company undertakes to dig a 750 m piped irrigation channel with a 4-inch main pipe, connected to the main pumps of each site and to each site's main tank, distributing water to the activities and their three tanks at each site, including the stands raising them 2 m, and all connection requirements such as pipes, valves and fittings.

6. Modern irrigation system (drip)

A complete drip network including main conveyance pipes for each activity from the main system to each activity area, with a total length of 120 m (Saudi-made, lined), serving as 2-inch sub-mains, from which the drip lines branch off with a total length of 5,000 m (2,500 m per site). One click-lock emitter shall be fitted for each Panicum plant and two emitters for each palm or high-oil olive tree basin, while the system for the two greenhouses shall use round emitters that can be cleaned by hand, with a total length of 500 m for the two greenhouses per site.

Note that the main canal is a piped channel delivering water from the branch irrigation canal to four sites, buried 2 m deep and 750 m long. The company undertakes to dig an open ground channel 1 m wide in the form of a trench 2 m deep, as a drain to remove surplus water from leaching, irrigation or heavy rainfall at the site, and to drill an auger hole 6 m deep and 5 cm in diameter, away from the drain, which can be used as an observation well to monitor the groundwater level and its fluctuation.

The company also undertakes to carry out all analyses of water from the source, including pH, SAR, EC, chloride and boron, together with soil analysis, and to add control valves, complete fittings, flush valves at the ends of the lines and water meters, as well as to prepare an irrigation schedule for each sector and a maintenance plan for the filters and emitters based on the type of activity, irrigation frequency and maintenance dates.

7. Water harvesting

Rainwater shall be collected in two earthen basins per site, each 2 m wide, 3 m long and 1.5 m deep, lined with polyethylene and connected with 3-inch polyethylene pipes to the 1 HP pump so that the water can be reused for irrigation in times of water scarcity; they can also be filled from the main pump in times of abundance. A pipe collecting harvested water from between the greenhouses, and the collection basin between them, shall also be connected to them.