Sustainable Hydroponics Project in Mafraq city, Jordan

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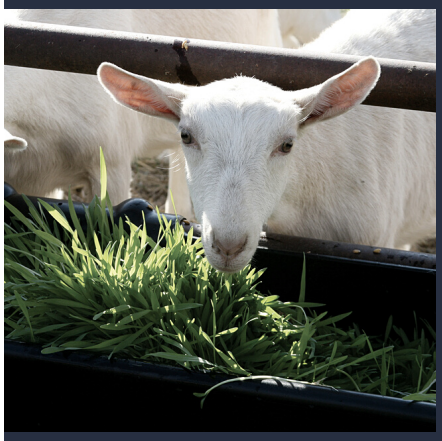
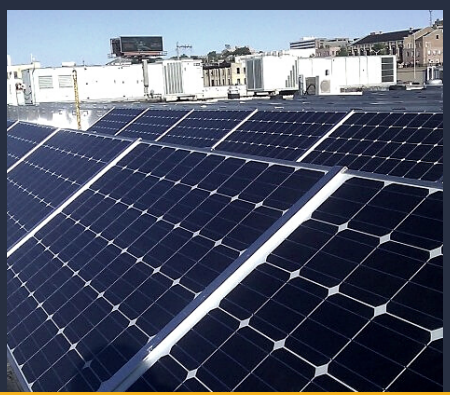
This report is submitted in fulfillment of the requirements of module T3190– Entrepreneurship





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1. Introduction

1.1. Background

The world is facing several serious crises; of which population rise, climate change, soil degradation, water scarcity, and food security are having the most negative impact (Capone, El Bilali, Debs, Cardone, & Driouech, 2014); (Raphael Slade, Renée van Diemen, and Jim Skea., 2017). In addition, disproportionate urban population increase and decreasing rural agricultural populations combine to create greater need not only for food but also alternative food production. Because of this growing demand, there is an expected global food crisis in the coming years (Simpson, 1993). The issues stated above underline the need for new and innovative methods of increasing food and fodder production. Inland, water, and resource-scarce countries such as Jordan, mitigation efforts that take into consideration available land resources, regional climate, and cultural/societal factors are vital for the future of the country.

1.2. Objective

To produce a certain amount of barley fodder to fulfill a share of the market in Mafraq city, a national production using renewable energy technology and modern farming technologies is essential to ensure food security and lower the prices for better accessibility. The project targets, directly and indirectly, several Sustainable Development Goals (SDGs) in the long run. Figure (1) shows the SDGs aimed at by the project.

Figure 1: targeted SDGs by the project

1.3. About Jordan & Mafraq

Located in the eastern Mediterranean region (Fig. 1), Jordan is subdivided into three ecological belts; the Jordan Valley, Western Highlands, and the Badia region. The Jordan Valley receives between 102 mm and 300 mm average rainfall per year, whereas the Western Highlands averages roughly 350 mm to 500 mm rainfall annually. The Badia region, an arid to the semi-arid area to the east, covers nearly 85% of the country and averages less than 200 mm annually (USAID, 2017). Beginning in summer, from April until November, Jordan cycles between warm, dry seasons while December through March brings winter rainfall (USAID, 2017).

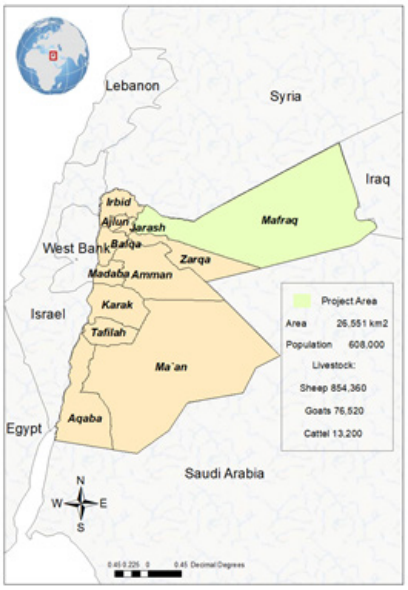


Figure 2: Jordan

Jordan's geographical location, limited agricultural opportunities, and severe water shortages challenge daily life in Jordan and hinder the country's ability to provide its inhabitant's food stability (WFP, 2019). Only 10 % of Jordan's lands are suitable for agricultural production and are mainly located in the Highlands and Jordan Valley. Conversely, the Badia region suffers from periodic drought and soil degradation. Due to the recent trend of decreasing rainfall and increasing temperatures, barley (an important fodder crop for the region) yields in the Yarmouk Basin are predicted to fall between 5% and 50% by 2050 (USAID, 2017). Mafraq has a very constrained agricultural and farming land area, which can be observed in Appendix (1), presenting a map showing the land use coverage as well as a table indicating the classifications of the land cover along with all its statistics.

1.4. The situation of Barley in Jordan

Based on (Mohamed Khraishy, Mariano J. Beillard, 2019) Jordan's barley production is negligible. It is mainly used for animal grazing and fodder. However, there is a big gap between production and consumption, the latest forecasts by FAS Amman is to have 750000 metric tons in MY 2019/2020 (July-June). The lion's share of this huge amount is used as sheep fodder. To a lesser extent, barley is included in dairy cattle and poultry feed rations.

Jordan fills this gap by importing, up to 25% of the imports are from the United States Department of Agriculture (USDA) at 150000 metric tons. However, bigger amounts used to be imported, around 600,000 metric tons are the estimates of MY 2018/2019. Jordan started to import barley from the Black Sea region, primarily Romania followed by Russia and Ukraine. The main importer is the government, then it sets the domestic sell price based on an average of different origins' prices and delivery dates, plus storage and handling costs, minus the subsidized discount (ranges $10 to $50 per metric ton).

The Ministry of Industry and Trade and Supply obtains bids from traders fulfilling specified standards. The barley purchased by the ministry is subsequently sold to shepherds at a subsidized price. Arbitrage is resorted to in order to minimize the potential for profit-seeking when significant price fluctuations occur. However, Traders will attempt to exploit fluctuations in price to exploit price fluctuations targetting undercut the price set by the government.

The Jordanian government set a clear policy that Only shepherd and goat farmers obtain subsidized barley. However, the subsidy program eliminates commercial dairy and commercial poultry farms, based on the new animal tagging/registration project.
The stocks of barely ending at 380000 million metric tons in MY 2019/2020. The official policy is concentrated on securing sufficient stocks; the government is scheduling its purchases aiming at obtaining superior prices. It is expected not to have any major changes in government policy; inventories are expected to remain stable (i.e., maintaining a ten-month stockpile at current consumption levels).

Number of Sheep, Goats and Cattle by Governorates as on 1/4/2019 and 1/11/2019 in Mafraq			
Type	**Sheep**	**Goats**	**Cattle**
Number on 1/4/2019	880,720	82,240	14,460
Number on 1/11/2019	846,380	69,780	12,640
average	863,550	76,010	13,550

2. Hydroponics Description

Hydroponics is a technique of growing plants in a water-based, nutrient-rich solution with or without the use of an inert medium to provide mechanical support. The term Hydroponics means water work since it is derived from the Greek words “hydro” which means water and “ponos” which means labor (Darwish, et al., 2019).

The main goal of hydroponics is to allow the plant’s roots to come in direct contact with water containing mineral nutrients which varies regarding the type of plant while having access to oxygen, which is an essential process for their proper growth. Therefore, almost any kind of plant can be grown hydroponically, including vegetables, herbs, fruits, and flowers (Sharma, et al., 2018).

Hydroponics used to be considered a system where there was no growing media at all, such as the Nutrient Film Technique in vegetables. But today it's accepted that a soilless growing medium is often used to support the plant root system physically and provide for a favorable buffer of solution around the root system. (Jones, 2014)

The rapid urbanization and industrialization worldwide are causing a decrease in the cultivable land extension and the lack of practice of traditional agriculture, which is the reason for some of the negative impacts on the environment. Therefore, it is important to find a sustainable way to feed the world's growing population and hydroponics seem to be an alternative for sustainable production and, water and land conservation (Sharma, et al., 2018).

2.1 Benefits of Hydroponics

- Is a clean and relatively easy agricultural method.
- There is no chance of soil-borne disease, insect, or pest infection to the crops there fore the use of pesticides is reduced.
- Plants require less growing time as compared to crops grown in the field.
- It is very useful for an area with environmental stress.
- Crops can be cultivated year-round and considered as offseason.
- Hydroponics saves a large amount of water as irrigation.
- Higher yields can be obtained since the number of plants per unit is higher compa red to conventional agriculture.

(Sharma, et al., 2018)

2.2. Limitations of Hydroponics

- Traditional agricultural practices can be reduced or eliminating
- Technical knowledge and the higher initial cost is a fundamental requirement for commercial-scale cultivation.
- Plant in a hydroponics system is sharing the same nutrient, and water-borne diseases can easily spread from one plant to another
- Hot weather and limited oxygenation may limit production and can result in the loss of crops.
- Maintenance of pH, EC, and proper concentration of the nutrient solution is of prime importance.
- Light and energy supply is required to run the system under a protected structure.

(Sharma, et al., 2018)

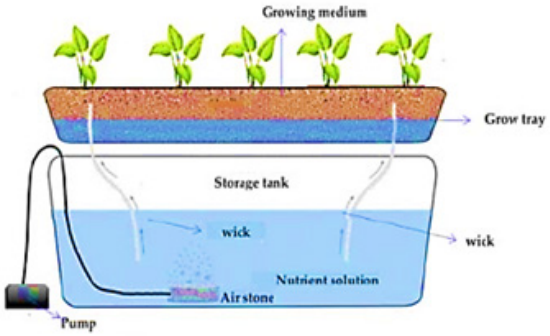


Figure 3: Wick System

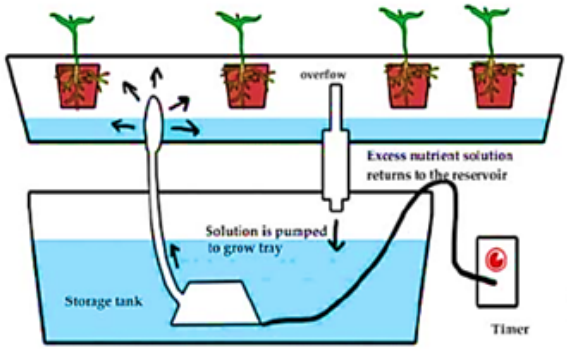


Figure 4: Ebb & Flow System

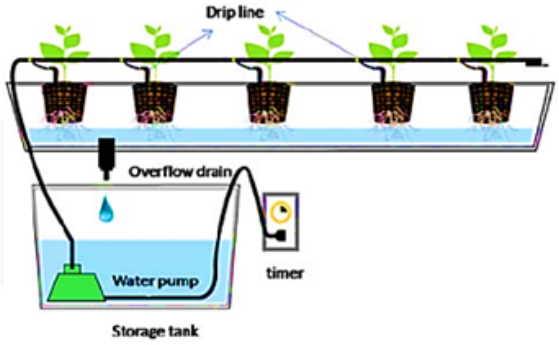


Figure 5: Drip System

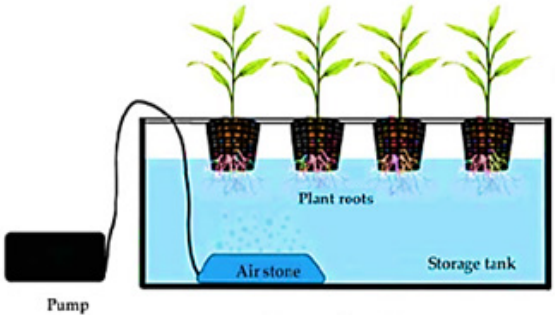


Figure 6: Deepwater culture

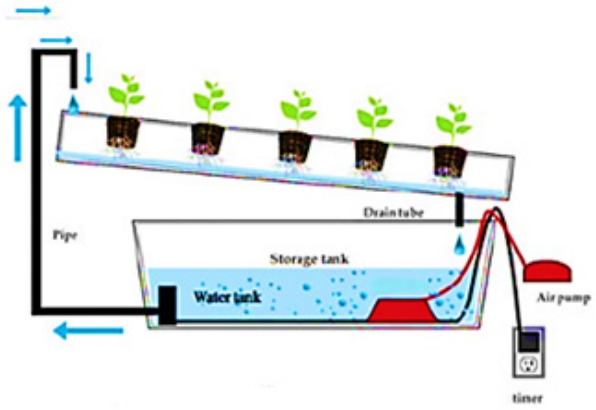
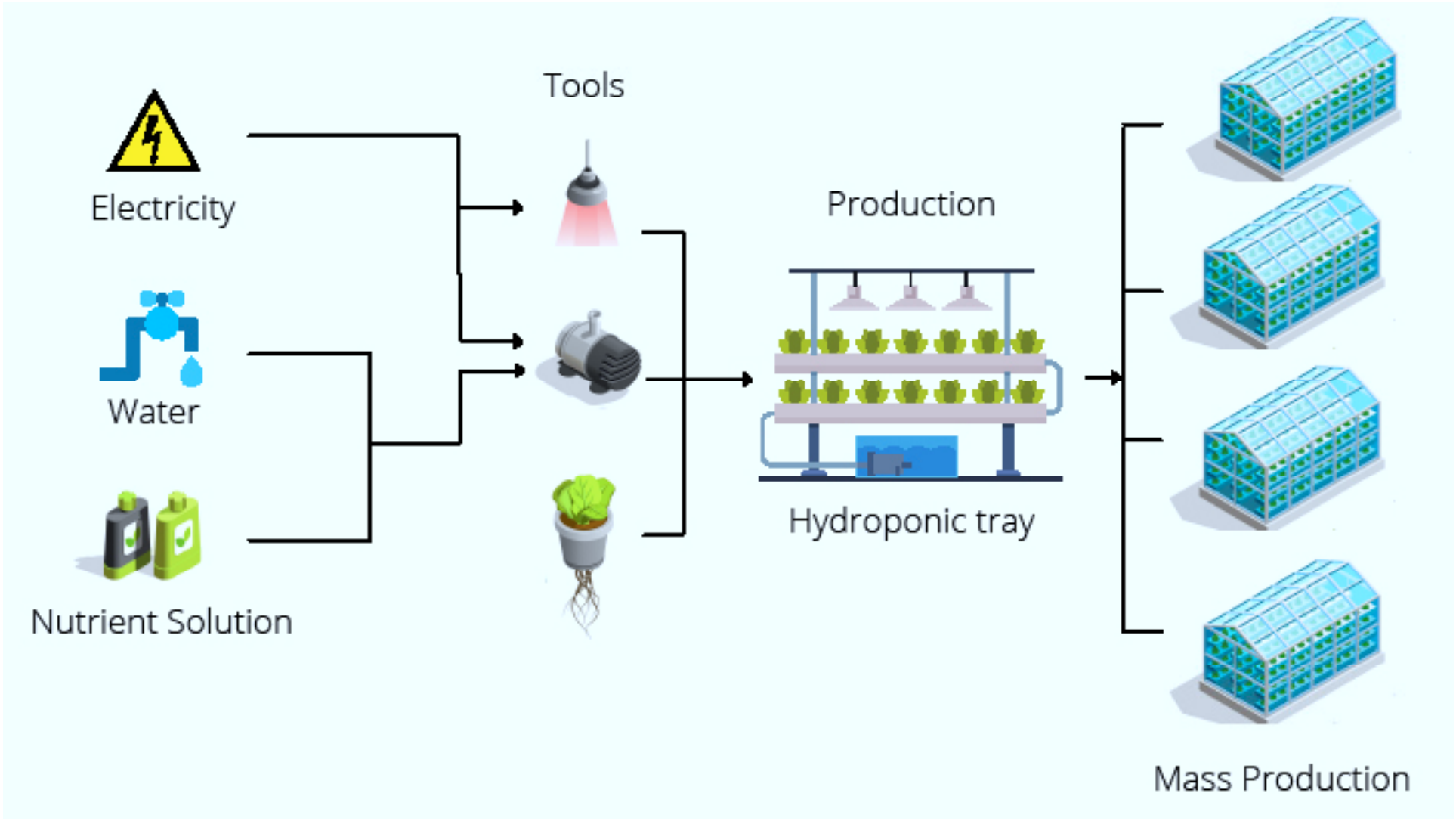


Figure 7: Nutrient Film Technique (NFT)


Tools
Electricity
Water
Nutrient Solution
Production
Hydroponic tray
Mass Production

3. Product Description: Barley Fodder

The term fodder describes food for livestock, such as sheep or calves. Barley fodder consists of fresh-grown, tender and young barley sprouts. These sprouts are grown with the previously explained hydroponics system. A study conducted by the Faculty of Agriculture of the Jordan University of Science and Technology shows that barley specifically performs well in terms of efficient water usage. Comparing the crop with alfalfa, cowpea or wheat, it results that barley gives the highest green dry yield, together with the most efficient water usage in comparison, making it the best available choice for green hydroponics fodder production and low water resources availability. Also in terms of nutrition, which must be the highest priority to ensure best life conditions for the herds, barley is proven to give the best outcomes. Analysing the fresh fodder weight, crude protein and ether extract content, barley shows the best results, as a study in the Journal of Agricultural Engineering and Food Technology concludes.

In Jordan, barley fodder is mainly fed to sheep. The effect of hydroponics barley fodder for sheep has already been monitored in Jordan, concluding that the fodder has a positive effect on feed intake, final body weight and average gain. Barley fodder is therefore especially useful for the fattening period.

As referred to in the first chapter, Jordan is dependent on the import of barley fodder in order to compensate its high need. Our product is capable of positively influencing this dependency by developing a self-sustaining system of required barley fodder production to ensure excellent sheep nutrition and highest water usage efficiency.

Figure 8: Hydroponic system-grown barley fooder ready for harvest

4. Detailed description of the Photovoltaic System

4.1. General Overview

Photovoltaics (PV) are devices that convert sunlight into electricity without the use of heat engine or rotating machine. Photovoltaics are semiconductor devices put together which can conduct electricity. Commonly used materials are silicon (Si) and compound of cadmium sulphide (CdS), cuprous sulphide (Cu2S) and gallium arsenide (GaAs). The cells of photovoltaics are designed into the module such that they produce a specific voltage and current when illuminated. PV modules can be connected in series or parallel to generate lager voltages or currents. The PV system depends on sunlight. They have no moving parts and are modeled to match power requirements on any scale. They are reliable and durable. Photovoltaic systems can be designed to operate independently or in association with other electrical power sources. PV systems can be applicable in remote power, remote monitoring, lighting, water pumping communication and battery charging. The PV system is composed of modules, inverter, energy storage, and electrical and mechanical equipment that generates AC and DC power.(Bright, 2008)

4.2. Types of PV Systems

There are generally three main classifications of PV system. They include grid connected PV systems, standalone PV systems and hybrid PV systems. The crucial stage of a PV project is the design and sizing of the PV system. Common failures that affect the PV system performance are the junction box failures, bypass diode failures, and broken glasses. It is important to monitor the PV system in other to ensure a steady performance of the system. This is done by the monitoring system of the PV collecting the required data in the PV system and transmitting it to the control center. This enables the user to evaluate and control the system. The PV system is controlled in other to decrease maintenance costs, evaluate the system performance (power generation), and keep track of fault in the system.(David Tan, 2011)

4.3. PV System Components

PV system are made up of different components. Each of the components have specific functions. The type of component used depends on the type of PV system and the purpose. The PV system components are: solar panels, an inverter, isolator switches, a PV generator meter, and cables (Franklin, 2018).

4.3.1. Solar Panel

Commonly used solar panels for residential and commercial solar systems are silicon crystalline. These modules are composed of multiple strings of solar cells wired in series (positive to negative), mounted in an aluminum frame. Each solar cell can produce 0.5 volt. Therefore a 36-cell module can produce 18 volts. Bigger modules usually have 62 or 72 cells in a frame. The higher the number of cells, the higher the amperage.

4.3.2. Inverter

The inverter is used to convert the direct current (DC) produced by the PV system to alternating current (AC). Generally, homes and most industries use AC current and the PV can only produce DC current. For this reason, the inverter is important for the current conversion.

4.3.3. Isolator Switch

Isolator switches are used to protect the system by cutting it off from the supply in case of a serious fault. It is usually placed after the inverter.

4.3.4. PV Generator Meter

The PV generator meter is used to display in real time the quantity of electricity the system generates. On standalone or off grid PV systems, the PV generator meter is used to measure the total energy entering and going out of the battery.

4.3.5. Charge Controller

The charge controller is used to regulate the quantity of charge going into the battery from the module to prevent it from over charging.

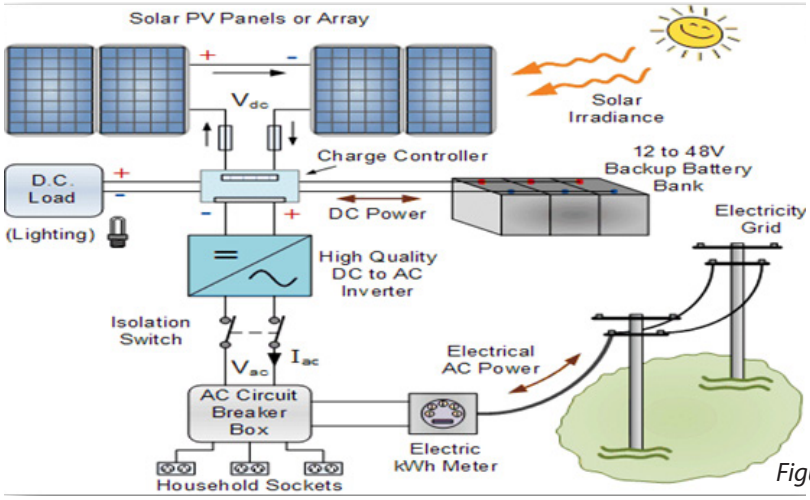


Figure 9: General structure of a PV system

4.4. Photovoltaic System Design

In this project, there is a plan to invest in a photovoltaic system, which could make the project independent from the shortage of electricity from the grid and improve the economic feasibility of the project. Therefore, all the electrical devices and their consumption were estimated. The table below shows the details of the monthly electrical consumption of the project:

Device	Number of Units	Power per unit (W)	Total Power (kW)	Operating hours per month (h)	Total electricity demand (kWh)
Ventilation fans	2800	28	78.4	120	9408
water pump	1400	3707	5189.8	4	20759.2
LED lights	168000	7.5	1260	360	453600
LED lights(neon)	9800	3	29.4	30	882
Farms total energy demand					484649.2

To determine the overall cost of that system, nevertheless, the analysis is done for each kWp. The rule of thumb is that every 1 kWp generates 130 kWh in Jordan. This means that this project would consist of 3728,07 kWp. Since the average price for large-scale projects in Jordan is €800 per kWp as the total cost, the total cost is €2982456,6.

For calculating the photovoltaic system feasibility study, it is necessary to determine the Net Present Value (NPV) as well as the payback period. Therefore, figure (x) demonstrates the summary of the system's profitability for a clear understanding of the system. Nevertheless, the NPV is calculated by the formula :

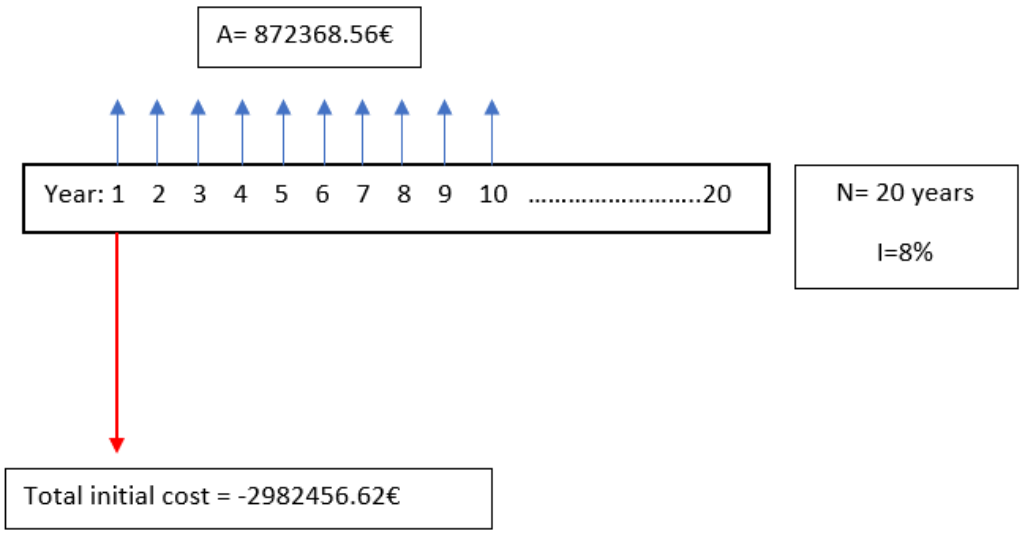


Figure 10: financial aspects of the PV system

$$NPV = P + A * \left(\frac{(1 + i)^N - 1)}{i * (1 + i)^N}\right.$$

Where:

- P: Total initial cost of the PV system
- A: revenue of the Normal monthly electricity bill (1 kWh= 0.15 for the industrial scheme)
- I: discount rate [%] [1]
- N: the lifetime of the PV project

Using the formula, NPV = 3533651

As the Net Present Value (NPV) is positive then this investment is profitable.
To calculate the simple payback period using the formula:

$$simple\ payback\ period = {Total\ initial\ cost\ of\ the\ PV\ system}/{annual\ revinue}$$

$$simple\ payback\ period = {2982456.62}/{872368.56}$$

= 3.42 years

Assumptions:

- • The tariff scale for electrical energy will be the same along the 20 years
- • MARR= Minimum Attractive Rate of Return= 8
- • The PV system will cover the whole electrical energy needed
- • The revenue every year results from saving the money that should be paid for electrical energy if the PV system is not installed.

1 Best Practice Guidelines for PV Cost Calculation, Accounting for Technical Risks and Assumptions in PV LCOE (tuv.com) the value of 8% is being considered as the medium senario

5. Type of Legal Form of Company

In Jordan, the best legal form of establishing a company like ours is the Limited liability company. Unlike other form of companies, the limited liability company can be easily set up by foreign investors and the business form can be registered by a single shareholder if the company's registrar commissioner grants the permission. Shareholders can be from any nationality. Setting a limited liability company in Jordan required a minimum capital of US&70,650 for a foreigner and will required to enter a joined partnership with a Jordanian citizen. (Www.Companyformationjordan.Com, n.d.)

The limited liability company in Jordan must have one director from any nationality before an agreement with the company's registrar commissioner can be met. Furthermore, our company annual financial statement will require auditing from a licensed audit firm. To successfully set up the company, the following points must be taken into consideration: (Kreston International, 2013)

- creating the limited liability company in Jordan takes at least 8 weeks to get it running.
- It will take a maximum of 4 weeks to set up the company bank account in Jordan.
- In the limited liability company in Jordan, there is annual tax return.
- The Jordan corporate tax rate in the limited liability is 14%
- In Jordan, we can issue invoices in the limited liability company.
- We can sign contract with Jordan entities.
- We can import and export our products.
- We can easily rent an office to start up the business.
- We can also buy Jordanian property to set up the business. (Client, 2018)

5.1. Forming of the Limited Liability Company

According to the Jordanian law art 53, the limited liability company must consist of at least two persons, but it also allows us to register the company under an individual name.

Requirements needed to form the limited liability company in Jordan

To set up the limited liability company, we need to meet up the following requirement:

- Company's name: SMARTYIELDS
- Object of activity: mass production of Fodders using hydroponic system controlled by a solar energy system.
- Headquarters:
- Names and nationality of shareholders:
- Minimum share capital:
- Share owned by each share holder:

6. Contracting and Personnel

Labor plays an important role when it comes to indoor farming. Based on the workload and the nature of the business, we have decided to employ 16 workers of different professions including practitioners. The list below shows the different positions open for employment:

Position	Quantity	Qualification	Worker/ employee	Type of contract
Engineers	2	Masters	Employee	Unlimited
Project managers	1	Masters	Employee	Unlimited
Assistant Managers	2	Bachelors	Employee	Unlimited
Site workers	3		worker	Limited
Practitioners	8	Masters/ Bachelor/others	worker	Limited

6.1. Employee

Those in this category like the engineers, project manager, and assistant manager will be employed on a full-time basis that is, they will be required to work 8 hours a day, six times a week under the normal Jordanian labor law. The engineers will constitute one electrical engineer to oversee the power supply to the farm and an agricultural engineer in charge of running the farm. The project manager will be the general overseer of the entire business. The assistant mangers will be there be to assist the project manager.

6.2. Workers

Here, workers in this category will be the site workers and the practitioners. The site workers will be required to work at specific period (part time) of the day depending on the job available at the time (during watering of the fodder mostly in the morning and evening) and during harvesting of the fodder. The practitioners will be volunteers from either engineering or agricultural background willing to learn and help in the field if need be. Both the site workers and the practitioners will be provided with a limited contract (part time) which can be renewed depending on their performance.

7. Costs & Depreciation

The tables represent in detail the project investment and the respective depreciation rates for the present year in Jordan.

Property, equipment, and computer software are recorded at their historical cost deducting accumulated depreciation or any valuation losses. Property and equipment (except land) are depreciated, once they are available for use, over their expected economic useful lives, using the straight-line method (CENTRAL BANK OF JORDAN, 2020).

Therefore, the very first investment will be of 3.182.659,92 and by the next years this amount will be depreciated in a rate of 11.98% per year, considering the specific values of building, equipment (including machinery and other inputs to develop the hydroponic system), vehicles (in this case a tractor will be needed) and other investments related to licenses, permissions, transportation and assembling as well.

It is important to note that two additional investments have been considered for the start-up of the project: the unexpected costs and the circulating capital; both items have no depreciation rates.

7.1. Equipment Costs & Depreciation

Description plant	Type of units	Number of units	Cost per unit	Investment expenditure	Depreciation rate (annual %)	Depreciation costs p.a
Equipment for 700 tons production						
Water pump	Piece	1400	48,72 €	68.208,00 €	15%	10.231,20 €
Polyethylene flexible pipe	meter	112000	0,07 €	7.795,20 €	15%	1.169,28 €
Polyethylene flexible pipe	meter	21000	0,28 €	5.846,40 €	15%	876,96 €
Reducing Tee Polyethylene pipe	Piece	23800	0,56 €	13.251,84 €	15%	1.987,78 €
Butterfly valve for poly pipe	Piece	4200	4,18 €	17.539,20 €	15%	2.630,88 €
Tee Poly-ethylene pipe	Piece	2800	0,28 €	779,52 €	15%	116,93 €
Adapt Tee from Polyethylene to PVC	Piece	1400	4,18 €	5.846,40 €	15%	876,96 €
PVC pipes	meter	7000	0,97 €	6.820,80 €	15%	1.023,12 €
Short radius bends	Piece	7000	0,56 €	3.897,60 €	15%	584,64 €
Coupling	Piece	4200	0,21 €	876,96 €	15%	131,54 €
Water sprayers	Piece	86800	0,70 €	60.412,80 €	15%	9.061,92 €
Water tank	Piece	42000	22,27 €	935.424,00 €	15%	140.313,60 €
LED strips	meter	168000	1,18 €	198.777,60 €	15%	29.816,64 €
LED Neon	Piece	9800	4,18 €	40.924,80 €	15%	6.138,72 €
Ventilation fans	Piece	2800	20,88 €	58.464,00 €	15%	8.769,60 €
Display Plas-tic Stands	Piece	42000	22,27 €	935.424,00 €	15%	140.313,60 €
Glue	Piece	1400	4,87 €	6.820,80 €	15%	1.023,12 €
Total			**136,35 €**	**2.367.109,92 €**		**355.066,49 €**

7.2. Labour Costs

The following table represents the number of employees for the project and the respective salaries per month and year.

The project will need:

- 1 Project Manager: who will be in charge of the whole team and is responsible to achieve the goals in the production
- 2 Assistants: who will help the Manager to handle the schedule in production as well as the different relationships with the suppliers and the sales points.
- 2 Engineers: who are able to design the hydroponic system and to control the quality in the production process.
- 1 Human resource management: who will be in charge of organizing personnel contracts and their functions within the company's operation.
- 3 Site workers: who will control the right functioning of the hydroponic system, as well as the growth and health of plants.
- 8 Practitioners: who will help in any activity related with the production, as they are students, they will not receive a payment, and their work will be for some hours per week.

For the gross income calculation, the personal income taxes (PIT) of Jordan were considered to deduct the corresponding duties per year according to the salary amount (PWC, 2021). In this case, PIT rates are applied progressively as follows:

- The first 5000 (5%)
- The second 5000 (10%)
- The third 5000 (15%)
- The fourth 5000 (20%)
- Over 20 000 and up to 1000 000 (25%)

Personnel	Number	Individual Salary per month	Cost per year	Individual salary per year
Engineer	2	2.319,00 €	55.656,00 €	27.828,00 €
Human Resources Manager	1	1.979,00 €	23.748,00 €	23.748,00 €
Project Manager	1	2.795,00 €	33.540,00 €	33.540,00 €
Assistants' Manager	2	931,00 €	22.344,00 €	11.172,00 €
Site workers	3	582,00 €	20.952,00 €	6.984,00 €
Practitioners	8	0,00 €	0,00 €	0,00 €
Total	**17**	**8.606,00 €**	**156.240,00 €**	**103.272,00 €**

Yearly taxable income	PIT at 5%	PIT at 10%	PIT at 15%	PIT at 20%	PIT at 25%	Salary brut per year
17.828,00 €	250,00 €	500,00 €	750,00 €	1.000,00 €	0,00 €	25.328,00 €
13.748,00 €	250,00 €	500,00 €	750,00 €	0,00 €	0,00 €	22.248,00 €
23.540,00 €	250,00 €	500,00 €	750,00 €	1.000,00 €	885,00 €	30.155,00 €
1.172,00 €	250,00 €	0,00 €	0,00 €	0,00 €	0,00 €	10.922,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	6.984,00 €
0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €	0,00 €
56.288,00 €	**1.000,00 €**	**1.500,00 €**	**2.250,00 €**	**2.000,00 €**	**885,00 €**	**95.637,00 €**

7.3. Raw Materials

In the following table can be seen the main raw materials that will be used for the project, the amount of production that was considered for the estimation of the values is 700 tons per week, thus, the tables are made based on the monthly costs of this production.
The information here represented was estimated from the current market prices of seeds, water, and electricity in Jordan (Global Petrol Prices, 2021).
The table of considerations explains in detail how much grain it is needed per week and how much water and electricity is needed per ton of grain. In this way, it was possible to make a more accurate estimation of the values presented.

Expendable material		**Price per unit**	**Consumption per month**	**Taxes per month**	**Total Cost per month**
Barely Grain	ton	185,90 €	280	0,00 €	52.052,00 €
Water	m3	0,85 €	8400	5,81 €	7.145,81 €
Total					**59197,81 €**

Considerations:	
Fodder production per tray	10Kg
Fodder production per week	700 tons
number of trays needed	70000 units
barley grain per tray	1 kg
barley grain needed per week	70 tons
water needed per ton of grain	30m3

7.4. Building Costs & Depreciation

Description plant	**Investment expenditure**	**Depreciation rate (%)**	**Depreciation costs p.a**
Building			
Administration offices	150.000,00 €	3%	4.500,00 €
Workshop	125.000,00 €	3%	3.750,00 €
Production hall	300,00 €	3%	9,00 €
Total	**275.300,00 €**		**8.259,00 €**

7.5. Off-Sites Investments

Description plant	Investment expenditure	Depreciation rate (%)	Depreciation costs p.a
Off-sites			
Transportation and assembly inclusive	10.000,00 €	10%	1.000,00 €
Furniture and fixture	5.000,00 €	10%	500,00 €
Total Off-sites	15.000,00 €		1.500,00 €
Engineering			
Planning	10.000,00 €	10%	1.000,00 €
Licenses	7.000,00 €	10%	700,00 €
Total Engineering	17.000,00 €		1.700,00 €
Vehicles			
1 Truck	100.000,00 €	15%	15.000,00 €
Total Vehicles	**100.000,00 €**		**15.000,00 €**

7.6. Total Investment & Depreciation

Investment	Investment expenditures	Depreciation rate (%)	Depreciation costs p.a.
Land	8.250,00 €	0%	0,00 €
Building	275.300,00 €	3%	8.259,00 €
Equipment	2.367.109,92 €	15%	355.066,49 €
Engineering	17.000,00 €	10%	1.700,00 €
Vehicles	100.000,00 €	15%	15.000,00 €
Offsites	15.000,00 €	10%	1.500,00 €
Unexpected	300.000,00 €	0%	0,00 €
Circulating Capital	100.000,00 €	0%	0,00 €
PV system	2.982.456,62 €	15%	447.368,49 €
TOTALS	**6.165.116,54 €**		**828.893,98 €**

7.7. Total of Investment & Financing

In this table we can see that the total investment for our project will be 6.165.116,54 €. 40% of this amount will be divided in equal amounts by the project partners' own funds. The remaining 60% will be financed through a loan to the bank, with an annual interest rate of 2.5%, which will be financed for a term of 10 years.

Total of investment and financing			
Total Investment		6.165.116,54 €	
40% own capital funds (equity)		2.466.046,616 €	
60% outside financing	2,5 % Interest	3.699.069,924 €	10-year loan

In the interest paid on debt table we can note that every year the interest cost amount and the refunding bank loan are calculated separetly in order to decrease the debt to the bank yearly which will be totally paid in 10 years.

Calculation of financing costs				
	Interest paid on debt			
Year	Balance of debt	Interest rate (%)	Interest costs p.a	Refunding Bank Loan
1st year	3.699.069,92 €	2,50%	92.476,75 €	369.906,99 €
2nd year	3.329.162,93 €	2,50%	83.229,07 €	369.906,99 €
3th year	2.959.255,94 €	2,50%	73.981,40 €	369.906,99 €
4th year	2.589.348,95 €	2,50%	64.733,72 €	369.906,99 €
5th year	2.219.441,95 €	2,50%	55.486,05 €	369.906,99 €
6th year	1.849.534,96 €	2,50%	46.238,37 €	369.906,99 €
7th year	1.479.627,97 €	2,50%	36.990,70 €	369.906,99 €
8th year	1.109.720,98 €	2,50%	27.743,02 €	369.906,99 €
9th year	739.813,98 €	2,50%	18.495,35 €	369.906,99 €
10th year	369.906,99 €	2,50%	9.247,67 €	369.906,99 €
Total of interest			**508.622,11 €**	
Total of Repayment				**3.699.069,92 €**

In this table we can note that the self cost for one ton of fodder in the first year is 52,21 €, taking into account the total costs of our company incluiding the raw materials. This total expenses are calculated for a production of 20160 tons of fodder a year, meaning the 60% of the total production that we aim to achieve from the third year of operations. As we can see in the table, the prices from year to year reduce significally due to the reduction of our financing costs.

	Self costs in years 1 - 4				
Capacity (in tons)		700			
		1st year	**2nd year**	**3th year**	**4th**
Utilization of capacity (%)		60%	80%	100%	100%
Fodder quantity (tons) per week		420	560	700	700
Fodder quantity (tons) per year		20160	26880	33600	33600
Costs		**Costs per year**	**Costs per year**	**Costs per year**	**Costs per year**
Depreciation costs		-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €
Financing costs		-92.476,75 €	-83.229,07 €	-73.981,40 €	-64.733,72 €
Labour costs		-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €
Consumption costs (raw materials)		-35.518,69 €	-47.358,25 €	-59.197,81 €	-59.197,81 €
Total of costs		**-1.052.526,41 €**	**-1.055.118,30 €**	**-1.057.710,19 €**	**-1.048.462,51 €**
Cost first years		**52,21 €**	**39,25 €**	**31,48 €**	**31,20 €**

7.8. Self costs per ton of fodder

Capacity installed: 700 tons

10 years period

	1st year	2nd year	3th year	4th year	5th year	6th year	7th year	8th year	9th year	10th year
Utilization of capacity (%)	60%	80%	100%	100%	100%	100%	100%	100%	100%	100%
Fodder quantity (tons) per week	420	560	700	700	700	700	700	700	700	700
Fodder quantity (tons) per year	20160	26880	33600	33600	33600	33600	33600	33600	33600	33600
Costs	Costs per year	Costs per year	Costs per year	Costs per year	Costs per year	Costs per year	Costs per year	Costs per year	Costs per year	Costs per year
Depreciation costs	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €
Financing costs	-92.476,75 €	-83.229,07 €	-73.981,40 €	-64.733,72 €	-55.486,05 €	-46.238,37 €	-36.990,70 €	-27.743,02 €	-18.495,35 €	-9.247,67 €
Labour costs	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €
Consumption costs (raw materials)	**-35.518,69 €**	**-47.358,25 €**	**-59.197,81 €**	**-59.197,81 €**	**-59.197,81 €**	**-59.197,81 €**	**-59.197,81 €**	**-59.197,81 €**	**-59.197,81 €**	**-59.197,81 €**
Total of costs	**-1.052.526,41 €**	**-1.055.118,30 €**	**-1.057.710,19 €**	**-1.048.462,51 €**	**-1.039.215,84 €**	**-1.029.968,16 €**	**-1.020.720,49 €**	**-1.011.472,81 €**	**-1.002.225,14 €**	**-992.977,46 €**

8. Cash Flow

8.1. Calculation of Turnover

Considering similar products available in the market, the estimation of final price was decided to be according to the minimum price offered in the market that is 60 Euros per ton. Therefore the calculation of turnover in the first 10 years are as follows.

Calculation of Turnover			
Year	Output	Price per ton	Turnover
1st year	20160	60,00 €	1.209.600,00 €
2nd year	26880	60,00 €	1.612.800,00 €
3th year	33600	60,00 €	2.016.000,00 €
4th year	33600	60,00 €	2.016.000,00 €
5th year	33600	60,00 €	2.016.000,00 €
6th year	33600	60,00 €	2.016.000,00 €
7th year	33600	60,00 €	2.016.000,00 €
8th year	33600	60,00 €	2.016.000,00 €
9th year	33600	60,00 €	2.016.000,00 €
10th year	33600	60,00 €	2.016.000,00 €

8.2. Cashflow Calculation

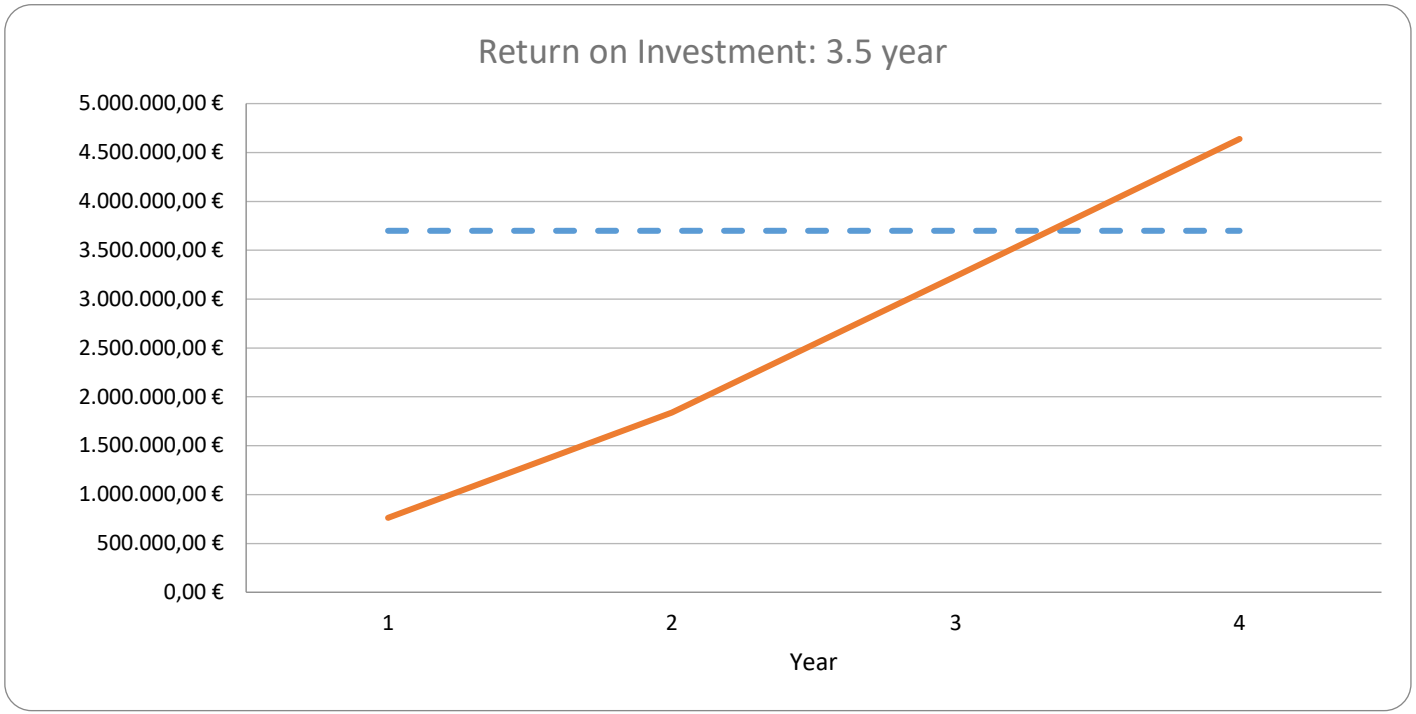
This table gives an overview of the company's turnover and the production self-cost. According to the latest update of Jordanian tax law all of the companies active in the industrial sector are chaged with a standard rate of 20% corporate income tax and 1% National contribution tax. As such, the total rate of 21% was selected for calculating the company's profit after tax. At the end, the cashflow that is the sum of profit after tax and depreciation costs is determined in a separate row.

	1st year	2nd year	3th year	4th year	5th year	6th year	7th year	8th year	9th year	10th year
Utilization of capacity (%)	60%	80%	100%	100%	100%	100%	100%	100%	100%	100%
Fodder quantity (tons) per year	20160	26880	33600	33600	33600	33600	33600	33600	33600	33600
Turnover	1.209.600,00 €	1.612.800,00 €	2.016.000,00 €	2.016.000,00 €	2.016.000,00 €	2.016.000,00 €	2.016.000,00 €	2.016.000,00 €	2.016.000,00 €	2.016.000,00 €
Costs	Costs per year	Costs per year	Costs per year	Costs per year	Costs per year	Costs per year	Costs per year	Costs per year	Costs per year	Costs per year
Depreciation costs	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €	-828.893,98 €
Financing costs	-92.476,75 €	-83.229,07 €	-73.981,40 €	-64.733,72 €	-55.486,05 €	-46.238,37 €	-36.990,70 €	-27.743,02 €	-18.495,35 €	-9.247,67 €
Labour costs	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €	-95.637,00 €
Consumption costs (raw materials)	-35.518,69 €	-47.358,25 €	-59.197,81 €	-59.197,81 €	-59.197,81 €	-59.197,81 €	-59.197,81 €	-59.197,81 €	-59.197,81 €	-59.197,81 €
Loss carried forward										
Profit before tax	157.073,59 €	557.681,70 €	958.289,81 €	967.537,49 €	976.785,16 €	986.032,84 €	995.280,51 €	1.004.528,19 €	1.013.775,86 €	1.023.023,54 €
Tax	32.985,45 €	117.113,16 €	201.240,86 €	203.182,87 €	205.124,88 €	207.066,90 €	209.008,91 €	210.950,92 €	212.892,93 €	214.834,94 €
Profit after tax	124.088,13 €	440.568,54 €	757.048,95 €	764.354,61 €	771.660,28 €	778.965,94 €	786.271,60 €	793.577,27 €	800.882,93 €	808.188,59 €
Cashflow	952.982,11 €	1.269.462,52 €	1.585.942,93 €	1.593.248,59 €	1.600.554,26 €	1.607.859,92 €	1.615.165,58 €	1.622.471,25 €	1.629.776,91 €	1.637.082,57 €
Repayment credit	190.959,60 €	190.959,60 €	190.959,60 €	190.959,60 €	190.959,60 €	190.959,60 €	190.959,60 €	190.959,60 €	190.959,60 €	190.959,60 €
Re-investment										
Dividend	762.022,51 €	1.078.502,92 €	1.394.983,33 €	1.402.288,99 €	1.409.594,66 €	1.416.900,32 €	1.424.205,98 €	1.431.511,65 €	1.438.817,31 €	1.446.122,97 €

assumptions	
Selling price per ton	60,00 €
Corporate Tax	21%

8.3. Return on Investment

			Return on Investment (ROI): 3.5 years							
	1st year	2nd year	3th year	4th year	5th year	6th year	7th year	8th year	9th year	10th year
	3.699.069,92 €	3.699.069,92 €	3.699.069,92 €	3.699.069,92 €	3.699.069,92 €	3.699.069,92 €	3.699.069,92 €	3.699.069,92 €	3.699.069,92 €	3.699.069,92 €
Dividend	762.022,51 €	1.078.502,92 €	1.394.983,33 €	1.402.288,99 €	1.409.594,66 €	1.416.900,32 €	1.424.205,98 €	1.431.511,65 €	1.438.817,31 €	1.446.122,97 €
Cumulative dividend	**762.022,51 €**	**1.840.525,43 €**	**3.235.508,77 €**	**4.637.797,76 €**	**6.047.392,42 €**	**7.464.292,74 €**	**8.888.498,72 €**	**10.320.010,37 €**	**11.758.827,68 €**	**13.204.950,65 €**



9. Appendix

9.1 CONTRACT OF EMPLOYMENT

MADE AND ENTERED INTO BY AND BETWEEN:

with address at:

herein represented by _____ duly authorized hereto
(hereinafter referred to as the "EMPLOYER")
AND

_____
_____
with address at:

_____
_____
(hereinafter referred to as the "EMPLOYEE")

WHEREBY THE PARTIES AGREE AS FOLLOWS:

1. Employment

The EMPLOYEE, who hereby accepts the appointment and is appointed as a _____ _____ for the EMPLOYER.

2. Duration

2.1 This agreement will become affective as from _____ (insert date) and it will continue for an indefinite period until it has been cancelled in terms hereof.

2.2 The EMPLOYEE's appointment (in the instance of new appointments) is subject to a 2 (two) month's probationary period during which period the EMPLOYER may terminate the services of the EMPLOYEE for any fair reason. One week's written notice of termination of service to the EMPLOYEE, prior to the end of the probationary period will be given.

2.3 Substantive and procedural fairness will entail that the EMPLOYEE will be given the opportunity to state his / her case in response to the allegations being raised and to a final decision from the EMPLOYER.

3. THE EMPLOYEE'S DUTIES

3.1 The core of the EMPLOYEE's duties towards the EMPLOYER is a duty to obey all lawful and reasonable order and to perform such work as she / he is directed to perform which falls within his / her vocational ability.

3.2 Without limiting the aforesaid duties, the EMPLOYEE is obliged to strictly comply with the provision of this agreement, may not misappropriate the EMPLOYER's property,

keep all information entrusted to him / her confidential and must adhere to the general Code of Conduct that governs all relations with co-employees, clients and patients.

3.3 The EMPLOYER undertakes to draft a duty sheet in accordance with the post description and it will be filed on the EMPLOYEE's personnel file.

4. WORKPLACE

The EMPLOYEE will execute his / her duties at the following offices:

_____provided that

The employer may require the EMPLOYEE to execute his/ her duties at such a place as may be Indicated by the EMPLOYER. Such an instruction will be given in writing to the EMPLOYEE.

5 SERVICE HOURS

1. Service hours will be from 08h00 until 17h00 on weekdays. It will be expected from the EMPLOYEE to work on Saturdays as from _____ up to _____. The EMPLOYER will however not expect of the employee to work more than 45 hours normal hours of work.

2. The EMPLOYEE will be entitled to a meal interval of thirty continuous minutes. Interruptions will normally not be permitted however operational circumstances may justify an interruption whereupon equivalent time off will be given.

6 REMUNERATION

The EMPLOYEE will be entitled to the following remuneration:

1. A monthly salary of R _____

2. The EMPLOYEE hereby gives permission to the EMPLOYER to deduct all obligatory deduction as authorized by statute from the above remuneration.

3. Overtime will be performed when so reasonably requested by the EMPLOYER and the EMPLOYER will remunerate the EMPLOYEE according to the Basic Conditions of Employment Act of 1997, as amended.

7 LEAVE

1. The EMPLOYEE is entitled to 14 (fourteen) consecutive days leave on full pay for every annual leave cycle. This leave is extended to twenty-one days where the worker has been in the employment of the same employer for five consecutive years. Official and religious holidays and weekly rest days shall not be counted as part of a worker's annual leave unless they fall in its course.

2. The said leave shall be granted by the EMPLOYER as from a date determined by him at any time during the 12 months cycle but not later than six months after the completion of a 12 month's period.
3. Upon termination of the EMPLOYEE's employment the EMPLOYER shall pay to the EMPLOYEE his / her full remuneration in respect of any leave which accrued, but not granted to him / her before the date of termination of the employment.

8 SICK LEAVE:

The EMPLOYER shall grant to the EMPLOYEE who is absent from work through incapacity during a sick leave cycle of 36 months employment with the EMPLOYER sick leave equal to the number of days the EMPLOYEE would normally work for six weeks.

During the first six months of continuous employment, the EMPLOYEE will be entitled to one days paid sick leave for every twenty-six days work.
The EMPLOYEE will provide the EMPLOYER with a medical certificate when applying for sick leave.

The medical certificate must be issued and signed by a medical practitioner or person who is certified to diagnose and treat patients and who is registered with a professional council.

9 MATERNITY LEAVE:

The EMPLOYEE is entitled to unpaid maternity leave for a maximum period of 2.5 consecutive months commencing at any time from 4 weeks before the expected date of birth unless otherwise agreed upon or on a date as certified by a medical practitioner.
The EMPLOYEE will inform the EMPLOYER at least 4 weeks before she intends taking maternity leave, of such dates.
The EMPLOYEE may not work for 6 weeks after the birth of her child unless a medical practitioner certifies that she is fit to do so.
The EMPLOYEE is entitled to commence employment after expiry of the maternity leave.
The EMPLOYEE will be entitled to maternity benefits in accordance with the provisions of the Unemployment Insurance and the EMPLOYER will assist the EMPLOYEE in processing her claim against the Unemployment Fund.

10 FAMILY RESPONSIBILITY LEAVE

The EMPLOYER will grant the EMPLOYEE during each annual leave cycle at the request of the EMPLOYEE, three days paid leave which the EMPLOYEE is entitled to take:

When the EMPLOYEE's child is born.

When the EMPLOYEE's child is sick.

In the event of death of the EMPLOYEE's spouse, parent, grant parent, child, adopted child or grandchild, brother or sister.
The EMPLOYEE may take family responsibility leave in respect of the whole or a part of a day and the EMPLOYER may require a reasonable proof of the reasons for which the leave is required.

11 ACCRUAL OF LEAVE

Leave may not be accrued by the EMPLOYEE and in the event of it not being taken, the EMPLOYEE will forfeit it.

12 PUBLIC HOLIDAYS

The EMPLOYEE is entitled to such public holidays on full pay as are determined by law.

13 TERMINATION

This agreement may be terminated by either party by giving a one month's written notice of termination of service the one to the other, provided that such notice must be given on the 1st day of the month.

The period of notice shall not be given during the EMPLOYEE's absence on leave as determined herein.

14 CERTIFICATE OF SERVICE

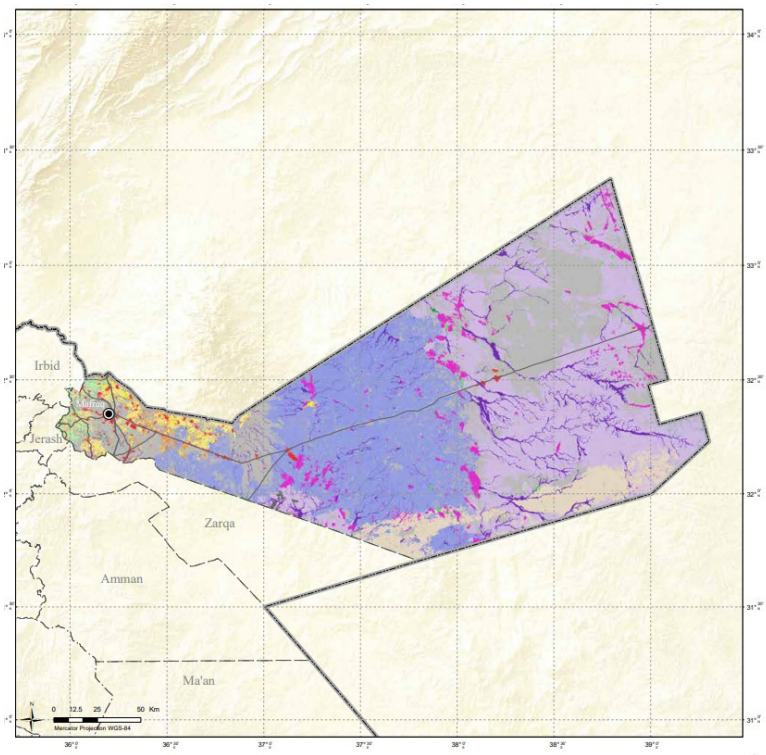
On termination of employment an EMPLOYEE is entitled to a Certificate of Service, the particulars whereof are detailed in the Basic Conditions of Employment Act.

THUS, DONE AND SIGNED at_____
_____ on
this _____ day of _____ 20_____

_____
EMPLOYER

_____
EMPLOYEE

9.2. Land Cover of Mafraq City



9.3. Land Cover Statistics

Aggregated land cover statistics of the Governorate by district

LAND COVER CLASSES		DISTRICTS				TOTAL km²	TOTAL %
		Al-Badiah Ash-Shamalieh Al-Gharbieh	Al-Badiah Ash-Shamaliyah	Ar-Rwaished	Qasabet Al-Mafraq		
Irrigated orchards		26.36	77.84	0.07	5.30	**109.57**	**0.4**
Irrig. herb. crop		36.56	47.40	6.96	7.54	**98.46**	**0.4**
Rainf. herb. crop		113.18	223.65	0.19	80.73	**417.76**	**1.6**
Rainfed orchards		1.59	0.16	0	46.99	**48.75**	**0.2**
Closed trees		0.01	0	0	2.90	**2.91**	**0**
Open trees		0.01	0	0	3.53	**3.54**	**0**
Woody vegetation		0.09	0.91	50.15	0.01	**51.15**	**0.2**
Grasslands		71.10	0.50	0.03	98.79	**170.42**	**0.6**
Build-up		60.88	73.99	17.03	51.65	**203.55**	**0.8**
Bare soil		345.87	1,319.61	5,156.91	292.39	**7,114.78**	**26.8**
Undif. bare rocks		0	0.61	0	0	**0.61**	**0**
Bare rock granite		0	6.67	0	0	**6.67**	**0**
Chert plain		0	227.67	7,393.12	0	**7,620.79**	**28.8**
Basaltic plain		0	1,442.09	5,666.20	0.02	**7,108.30**	**26.8**
Sandy areas		0	0	1,666.84	0	**1,666.84**	**6.3**
Saline soil		0	0	0	0	**0**	**0**
Extraction site		3.85	22.25	0.71	11.07	**37.88**	**0.1**
Saline waterb.		0	0	0	0	**0**	**0**
Natural waterb.		0.02	0.01	0.06	0.05	**0.15**	**0**
Artificial waterb.		0.89	1.10	3.83	0.06	**5.87**	**0**
Wetlands		1.49	0.32	14.14	0.05	**16**	**0.1**
Wadi		4.17	102.78	913.20	0	**1,020.16**	**3.8**
Mudflat		0	99.98	701.24	0	**801.22**	**3**
TOTAL LAND		**666.07**	**3,647.53**	**21,590.68**	**601.10**	**26,505.37**	**100**

9.4. Articles of Association

Articles of Association

Between:

- Hala Al Zubi
- Omar Mohamed

Following articles of association for the formation of a GmbH are contracted:

§ 1 Name, Registered Office and Financial Year

(1)The name of the company is SmartYield
(2)The company is located in Mafraq, Jordan.
(3)The financial year shall be the calendar year.

§ 2 Object of Business

The object of business is to produce a certain amount of barley fodder to fulfill a share of the market in Mafraq city, a national production using renewable energy technology and modern farming technologies is essential to ensure food security and lower the prices for better accessibility.

§ 3 Share Capital

(1)The share capital is 1.909.595,95 € Euro.
(2)The associates have a share of 50%
(3)The share shall be paid immediately on the bank account of SmartYield.

§ 4 Manager and Representation

(1)The manager of Nexus Farms is Hala Al Zubi.
(2)The manager can represent the whole association.
(3)The manager can be represented with a written consent by Omar Mohamed.
(4)TheCompany is to be represented legally by the manager or
an authorized person with a written power of attorney.

§ 5 Announcements

Announcements of the company shall be published on the official SmartYield webpage www.smartyieldjordan.de.

§ 6 Formation costs

Both associates shall bear the costs of incorporation.

§ 7 Final provisions

(1)This contract can only be changed in a written form.
(2)This article of association shall be governed by the laws of the Kingdom of Jordan.

_____
Hala Al Zubi

Cologne, March 13, 2021

_____
Omar Mohamed

10. References

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10.1. Figure References

Front Page: Retrieved From https://www.fodderworks.net/blogs/fodder-fridays/selling-barley-fodder-for-profit.

Figure 1: Targeted SDGs by the project (own graph based on SDGs)

Figure 2: Modified graph based on https://en.wikipedia.org/wiki/Mafraq_Governorate#/media/File:Mafraq_in_Jordan.svg)

Figure 3: Sharma, et al., 2018

Figure 4: Sharma, et al., 2018

Figure 5: Sharma, et al., 2018

Figure 6: Sharma, et al., 2018

Figure 7: Sharma, et al., 2018

Figure 8: Retrieved from http://foddertech.com/the-hidden-costs-of-a-fodder-system/.

Figure 9: Retrieved from www.electrical2z.com.

Figure 10: Own graph