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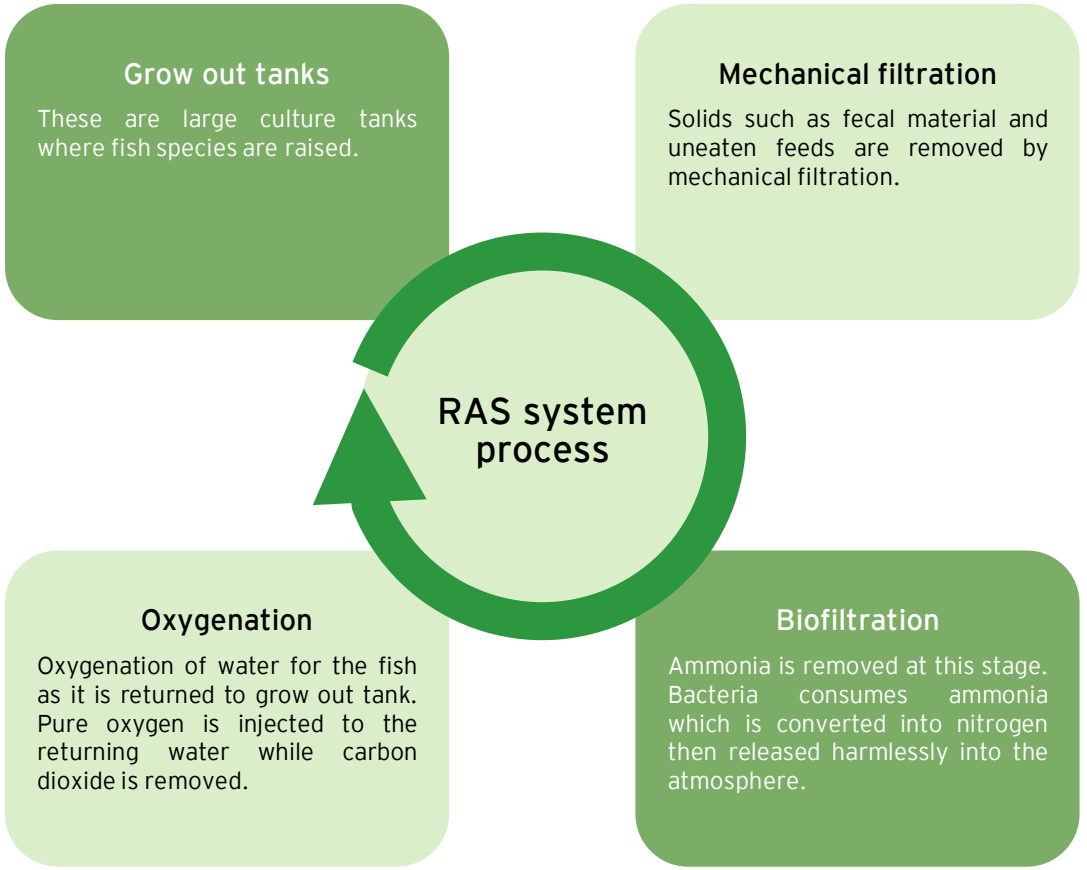
Technical Overview

Production technology

Technology description

- The project involves building salmon land-based aquaculture farm. Taking into consideration the building of the farm in the region with scarce water resources, the implementation of a Recirculating Aquaculture System (RAS) is necessary.
- The production process is based on purchasing juvenile fish (fingerlings) and feeding them into the RAS system where they are raised in high densities. The system enables the growth of fish in a separate compartment under controlled environment.
- RAS operates by passing water from the fish tanks through a mechanical filter and biological filter, before aerating and stripping carbon dioxide from that water and returning it to the fish tanks to be reused. Other facilities such as a pH regulator, heat exchange unit, and denitrification unit, are required to regulate the environment in which the fish are grown.
- The process involves **four** stages: grow out tanks, mechanical filtration, biofiltration, and oxygenation.
- **Grow out tanks:** There is constant water flow, which is controlled for speed, pressure, and direction.
- **Mechanical filter:** The filter is a micro screen that helps to facilitate the biofilter process by removing organic impurities. The waste is collected at a slow rate by a sump (clarifier) tank.
- **Biological filter:** Biofilters are used to remove fine pollutants such as ammonia nitrogen from the water, which can cause brown blood disease in the fish. Biofiltration requires that the temperature and pH level of the water be regulated properly.
- **Oxygenation:** Water circulation systems need to constantly supply oxygen in order for the fish to survive. Oxygen is supplied by blowing air through a submerged air stone, and a trickling filter system is used to strip out accumulated carbon dioxide.



Technical Overview

Aspect	Fish farm	Aquaponic farm
Land area	▸ The fish farm is expected to cover an area of **10,000 sqm**.	▸ The fish farm is expected to cover an area of **24,000 sqm**.
Investment required	▸ The investment required for the fish farm and aquaponic farm is around **SAR 30mn**. The amount is divided into: Machinery & Equipment **(79.9%)**, Civil work **(18.2%)**, vehicles **(1.0%)**, and tools and furniture **(0.9%)**.	
Period of construction	▸ The construction of the fish farm will start in the beginning of **2023**. The construction period will be from **6 to 12** months. The completion is planned for December **2023**.	▸ The construction of the aquaponic farm will start in the beginning of **2023**. The construction period will be from **6 to 12** months. The completion is planned for December **2023**.
Water consumption	▸ Both farms will consume approximately **24,650 m^3** per annum. The unit cost of water will be **SAR 7.2** per m^3 .	
Electricity consumption	▸ The annual electricity usage of both farm will be approximately **72,000 kWh**. The unit cost of electricity will be **SAR 0.2** per kWh.	
Staff required	▸ Based on our technical analysis, each **500 sqm** requires at least **1** worker. Accordingly, both farms will require a total of **68** workers. Please refer to the organization and HR section for more details.	

Production stages (1/3)

Salmon farming process	Parr (Fingerling)	On-growing	Harvest	Processing
General	▸ Under the farming process, fingerlings are inset the grow out tanks, fed, raised, and harvested once they have reached a suitable weight. The optimal temperatures to raise salmon is **8-14** degrees Celsius.			
Process description	▸ Fingerlings will be purchased from external suppliers and inset into grow-out tanks. ▸ Average initial weight of fingerlings will be **30g**.	▸ The salmon farming production cycle is about **2-3** years. ▸ Fish are grown until reaching smolt stage. ▸ The fish are then transported to seawater cages where they are grown to around **4-5 kg** over a period of **12-24** months.	▸ The harvest will be at **4.5 kg 2.5** years after first fingerling inset. ▸ The fish will be kept at lower temperatures and fed only for maintenance. ▸ The biomass in the farm will be around **300** metric tons throughout the production period.	▸ The processing for salmon will be mainly filleting and packaging. ▸ Raw salmon will be inserted into the processing line which includes bleeding, cutting and gutting. ▸ Based on our technical research, filleting yield for salmon is **65%**. This means only **65%** of the whole fish is recovered while the rest is considered waste. ▸ After processing, salmon fillet moves directly to inspection and grading. Thereafter, it goes to packing, weighting and labeling. The final processed product moved to the chiller for finished goods.
Feed conversion ratio	▸ Salmon's feed conversion ratio (FCR) is **1.2** ▸ Feed is composed of fish meal **(30%)**, insect meal **(10%)**, wheat meal **(15%)**, corn **(20%)**, soybean **(15%)**, and other meals **(10%)**.			
Mortality rate	▸ From parr (fingerling stage) to harvest stage, mortality rate is between **5 – 10%**.			

Production stages (2/3)

Nile Tilapia farming process	Fingerling	On-growing	Harvest
General	▸ Under the farming process, fingerlings are inset the grow out tanks, fed, raised, and harvested once they have reached a suitable weight. The Nile Tilapia is a hardy and tough fish that can survive temperatures from **1-30** degrees Celsius. However, the optimal temperatures to raise Nile Tilapia in an aquaponic system is **24-30** degrees Celsius.		
Process description	▸ Fingerlings will be purchased from external suppliers and inset into aquaponic tanks. ▸ Average initial weight of fingerlings will be **25g**.	▸ The Nile Tilapia farming production cycle is about **1** year. ▸ It takes **6** months to reach from egg hatching to fry. Another **6** months are required to reach from fry to harvested size of **450-500gm**.	▸ The harvest will be at **500g 1** year after first fingerling inset. ▸ The fish will be kept at lower temperatures and fed only for maintenance. ▸ The biomass in the farm will be around **214** metric tons throughout the production period.
Feed conversion ratio	▸ Tilapia's feed conversion ratio (FCR) is **1.1 – 1.3** ▸ Feed is composed of fish meal **(30%)**, insect meal **(10%)**, wheat meal **(15%)**, corn **(20%)**, soybean **(15%)**, and other meals **(10%)**.		
Mortality rate	▸ From fingerling stage to harvest stage, mortality rate is between **3 – 10%**.		

Production stages (3/3)

Leafy vegetables farming process	Seeding	Harvest	Processing
General	▸ Aquaponics is a farming system that combines aquaculture and hydroponics. It is environmentally friendly since it uses less land than traditional farming, reduces the need for pesticides and fertilizers, and has a smaller carbon footprint. In aquaponics, the nutrient-rich water from fish waste provides a natural fertilizer for the plants and the plants help to purify the water for the fish.		
Process description	▸ Seeds will be purchased from external suppliers and used in soilless cultivation in the aquaponics system. ▸ We will consider seeds for lettuce, kale, arugula, and microgreens.	▸ The expected total capacity of leafy vegetables is **1,130 tons** per annum. ▸ It takes lettuce **7-8** weeks from seeding to harvest to turn into **1** ton. ▸ It takes kale **6-7** weeks from seeding to harvest to turn into **1** ton. ▸ It takes arugula **7-8** weeks from seeding to harvest to turn into **1** ton. ▸ It takes microgreens **7-8** weeks from seeding to harvest to turn into **1** ton.	▸ The processing for leafy vegetables will be mainly rinsing and packaging. ▸ Leafy vegetables will be inserted into the processing line to be rinsed and packaged.
Seeds requirement	▸ About **6-8g** of lettuce seeds (app. **700-800** seeds per gram) can turn into **1** ton lettuce. ▸ About **20-25g** of kale seeds (app. **230-300** seeds per gram) can turn into **1** ton kale. ▸ About **6-8g** of arugula seeds (app. **700-800** seeds per gram) can turn into **1** ton arugula. ▸ About **20-25g** of microgreens seeds (app. **230-300** seeds per gram) can turn into **1** ton microgreens.		

Business cycle and value chain