GOLSHNAS
- SMART FARM -

Scientific webinar

In collaboration with Zanjan University

Increasing productivity efficiency using new technologies in new generation greenhouses

Conductor :Mietco International Engineering Company

Introduction :

- The center of economic development of any country is agriculture
- The largest share of industrial development in countries are related to industries related to agriculture.
- The first industries that emerged and developed in the world were related to agriculture or transformation industries
- Among 177 countries in the world, Iran ranks 69th in terms of water resource poverty
- In Iran, water consumption in the agricultural sector is about 90%, drinking 8% and industry and mining 2%
- In developed countries, the share of water in the agricultural sector is 30%, drinking and sanitation is 11%, and the share of the industry and mining sector is 59%.
- The share of Iran's agricultural economy in the gross national product is 8%
- According to the report of the World Bank and according to the existing experiences to reduce poverty, investment in the agricultural sector has been 2.5 to 3

times more effective than investment in non-agricultural sectors.

- In India, since its first development program in 1951, 25% of its net investments have been allocated to the agricultural sector, which has led to a 50% reduction in the poverty rate.
- In China, the impact of the agricultural economy in reducing the poverty rate is four times that of non-agricultural sectors. In 1981, more than 50% of the Chinese people lived below the poverty line, and in 2005, this amount reached less than 5%.

Modern and controlled water-oriented gardening (Horticulture)

A)Hydroponic
B)Aeroponic
C)Aquaponic

A)Hydroponic farming

(NFT)Nutrient Film Technique

(DWC)Deep Water Circulation

Creating a humid environment and suitable ventilation in the greenhouse environment and creating all the equipments and facilities needed by the plant, fertilizing and pest control in the greenhouse's climate are essential for this type of greenhouse.

B)Aeroponic greenhouse

Creating a humid environment and suitable ventilation in the greenhouse environment and creating all the equipments and facilities needed by the plant, fertilizing and pest control in the greenhouse's climate are essential for this type of greenhouse

C)Aquaponic greenhouses

- Aquaponics is a combination of aquaculture and hydroponics in a circulating system
- In an aquaponics unit, the water moves from the water source to the filters and the plant culture bed and returns to the aquatic breeding pond.
- In the filtration process, the residues of the aquaculture pond are separated from the water.
- The first step in filtration is passing the water through mechanical filters that separate solid particles from the circulating water, then the water enters the biological filters, where the ammonia solution in the water, which is a toxic substance for the aquatic breeding environment, is converted into nitrate by bacteria and then it becomes absorbable for plants.
- This process is called nitrification.
- The water containing nutrients and nitrates moves to the growing bed of the plants and returns to the breeding ponds after the nutrients are absorbed by the plants.
- This process is called nitrification.

- The water containing nutrients and nitrates moves to the growing bed of the plants and returns to the breeding ponds after the nutrients are absorbed by the plants.

Characteristics of aquaponic agriculture

- Controlled agriculture
- horticulture
- sustainable agriculture

Aquaponics World Slogan
NO FERTILIZERS, No PESTISIZERS

Advantages of aquaponics system

1-Sustainable food production.
2-Production of several products from a single food source, aquatic food and vegetables.
3-High water efficiency.
4-No need for soil.
5-No need for fertilizer or chemical pesticides and a healthy and organic product.
6-Managing organic matter and production leads to reduced waste.
7-A higher level of biological security and lower risks than external pollutants.
8-Cultivation on barren lands such as deserts,salt marsh and etc.

9-No aquaculture waste output and reducing environmental pollution.
10-Increased performance per unit area.
11-Increasing employment rates.
12-Plants feed on elements that are filtered in the aquaculture system.
13-No need to mix the food elements.
10-Increased performance per unit area.
11-Increasing employment rates.
12-Plants feed on elements that are filtered in the aquaculture system.
13-No need to mix the food elements.
14-Aquaponics are organic plant nutrition.
15-By removing soil, soil-borne diseases are removed as well.
16-water consumption is very low and there is no weed to absorb water.
17-In aquaponics, the plant can be cultivated compactly.
18-With high compression the aquatic and the plants can grow and develop quickly.
19-insecticides and herbicides are not used in the acuaponic system.
20-There is the possibility of producing in the acuaponic system all year round.
21-dense production of aquatic protein is possible.
14-Aquaponics are organic plant nutrition.
15-By removing soil, soil-borne diseases are removed as well.
16-water consumption is very low and there is no weed to absorb water.
17-In aquaponics, the plant can be cultivated compactly.
18-With high compression the aquatic and the plants can grow and develop quickly.
19-insecticides and herbicides are not used in the acuaponic system.
20-There is the possibility of producing in the acuaponic system all year round.
21-dense production of aquatic protein is possible.
22-Reduction of investment for each plant production and aquaculture separately.
23-In the aquaponic system,only one percent of the water consumed by normal methods is consumed.
24-Very low water requirement applicable in arid and semi-arid areas.
25-Free from pesticides and the fresh aquatics can be sold at a good price in urban areas.
26-Hydroponic beds can act as a biological filter.

Balance in the aqua ponic system

The main variables for balancing an aquaponic unit

- Production capacity of the system
- The production methods include DWC,NFT or Vertical Farm, A Farm, MEDIA BED
- Aquatic type.
- Aquatic feed's protein level
- Type of plant (leafy vegetable or fruit vegetable)
- Environmental and water quality conditions
- Purification methods

Water quality is very important in aquaponic system. The six main indicators of water quality include the following.

1-Dissolved Oxygen (DO)
2-Acidity(PH)
3-Temperature
4-Total Ammonia Nitrogen (TAN)
5-The alkalinity of the water
6-Other elements soluble in water

The aquaponic system is based on the natural cycle of three main elements:
1- Nitrogen (Nitrification)
2-Carbon (Fermentation)
3-Oxygen (Oxidizing)

There are three main methods for growing plants in an aquaponic system:

1-Media Bed Cultivation using neutral solids in the plant production bed
2-Nutrition Film Techniques (NFT)
3-Deep Water Circulation (DWC)

Aquaponic systems mainly have seven main elements

1-Water ponds
2-Plant bed
3-Sediment filter for solid waste
4-Biological filters or nitrification
5-Pumps, for water circulation
6-The final supplementary system of water purification(SUMP SYSTEM)
7-Control systems,monitoring and detectors

Filtration

- Mechanical filtration
- Biological Filtration
- The bacteria that perform the ammonia production process are: ADB (Ammonia Oxidizing Bacteria)
- The bacteria that perform the nitrite process are: NOB (Nitrate Oxidizing Bacteria)

Types of biofilters:

1-Filter using Media Bed
2-Rotary Drum Filter
3-Filter with content of non-woven products
4-Filter with solids content
5-Filter with clonal components

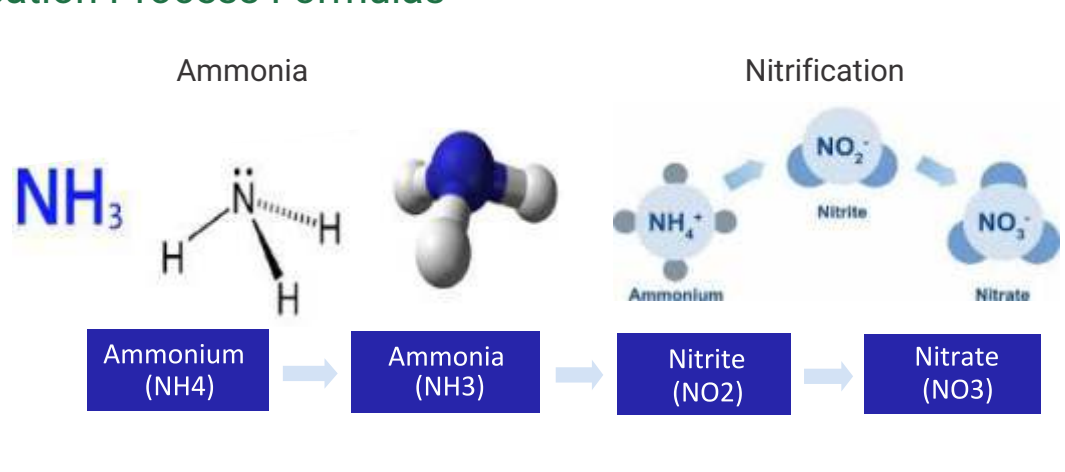
Equilibrium of environmental conditions

1-Nitrate's balance between plant and aquatic
2-Ratio of feeding rate (which depends on three factors)
A:Amount of daily food
B:type of plant (vegetable or fruit)
C:Cultivation area

3-Plant and aquatic's health
4-Control of oxygen cycle in nitrification and carbon cycle in fermentation

Nitrification process in nature and in aquaponic system

Nitrification Process Formulas



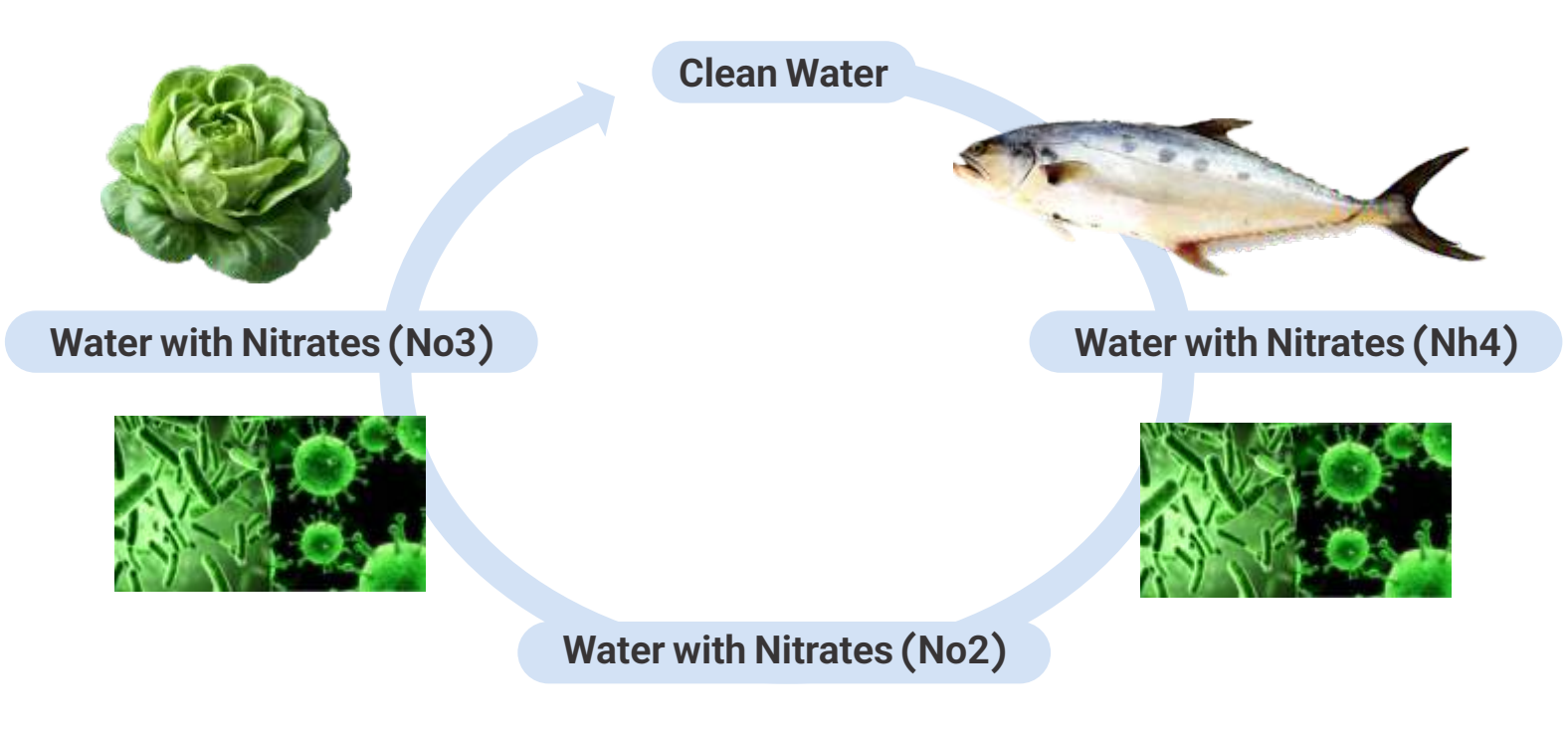
The design of an aquaponic unit is based on the following:

1-Fish tank
2-Mechanical filter
3-Bio filter
4-Hydroponic Grow Bed

Tables and vital signs of aquaponics system

Organism	Temperature	Acidity (PH)	Ammonia (Nh3) Mg/1	Nitrite (No2) MG/1	Nitrate (No3)	Dissolved oxygen (DO) Mg/1
warm water fish	22 to 32	6 to 8.5	<2	<1	<150	4 to 6
cold water fish	10 to 18	6 to 8.5	<0.5	<0.5	<100	6 to 8
plants	16 to 30	5.5 to 7.5	<30	<1	-	>3
bacterias	14 to 34	6 to 8.5	<3	<1	-	4 to 8

the life cycle process of a complete aquaponic system



Supplying, cultivating and multiplying microscopic organisms of bacteria (AOB, NOB, DNB)

In order to complete the nitrification operation in the first stage, these organisms are supplied from accredited laboratories and then they can be cultivated and duplicated in the aquaponic greenhouse laboratory which is located in a completely sterile environment.

Changes in the vital elements of water, including:
- 1-PH
- 2-EC
- 3-TDS
- 4-DO

In the aquaponic system, everything can be controlled and traced using advanced systems

The role, effects, lack and performance of various chemical elements such as:

- Sodium
- potassium
- iron
- phosphorus
- calcium
- copper
- magnesium
- Nickel and others

In case of shortage of any element, it will be announced by warning systems and it will be supplied automatically or manually.
For example, in case of phosphorus deficiency, phosphoric acid is used and in case of potassium deficiency, potassium hydroxide is used.
duplicated in the aquaponic greenhouse laboratory which is located in a completely sterile environment.

Aquatic growth in the aquaponic system:

- Aquatic animals grow quickly as soon as they adapt to their environment.
- Aquatic animals grow at a favorable speed due to the mechanized reception of food that is given to them in sufficient quantity.
- Aquatic animals grow free of any disease due to the use of optimal, clean and controlled water daily.

Growing plants in the aquaponic system:

Due to the access of plant roots to completely natural and compatible nutrients, compared to planting in the soil, plants grow about 50% faster, due to the high density of cultivation and receiving the necessary nutrients required in an environment free from any type of pesticides and toxins.
Harvesting in aquaponic system will increase up to six times compared to soil cultivation, and water consumption is one tenth of soil cultivation.
Aquatic animals also grow quickly as soon as they adapt to their surroundings.

Types of aquatic animals that can be cultivated in the aquaponic system:

1-Tilapia
2- Salmon
3-common carp
4- Catfish
5- Big lip fish
6- Ornamental fish
7- Invertebrates

Ideal plants for growing with an aquaponic system include:

- Types of beans (protein and normal)
- Zucchini, cabbage, pepper, cucumber
- Peas, spinach
- All kinds of vegetables
- Salvia
- Lemongrass (some medicinal plants).
- Wheat
- Strawberry
- Watermelon, cantaloupe
- Tomato
- All kinds of garden flowers

Cultivation of plants in specific geographical areas:

- In order to grow plants of specific regions, the necessary conditions and suitable structure should be provided in the environment
- Fruits of tropical regions and other valuable agricultural products can also be cultivated by creating the necessary conditions

The system of aquapotronic greenhouses and its difference with aquaponic greenhouses

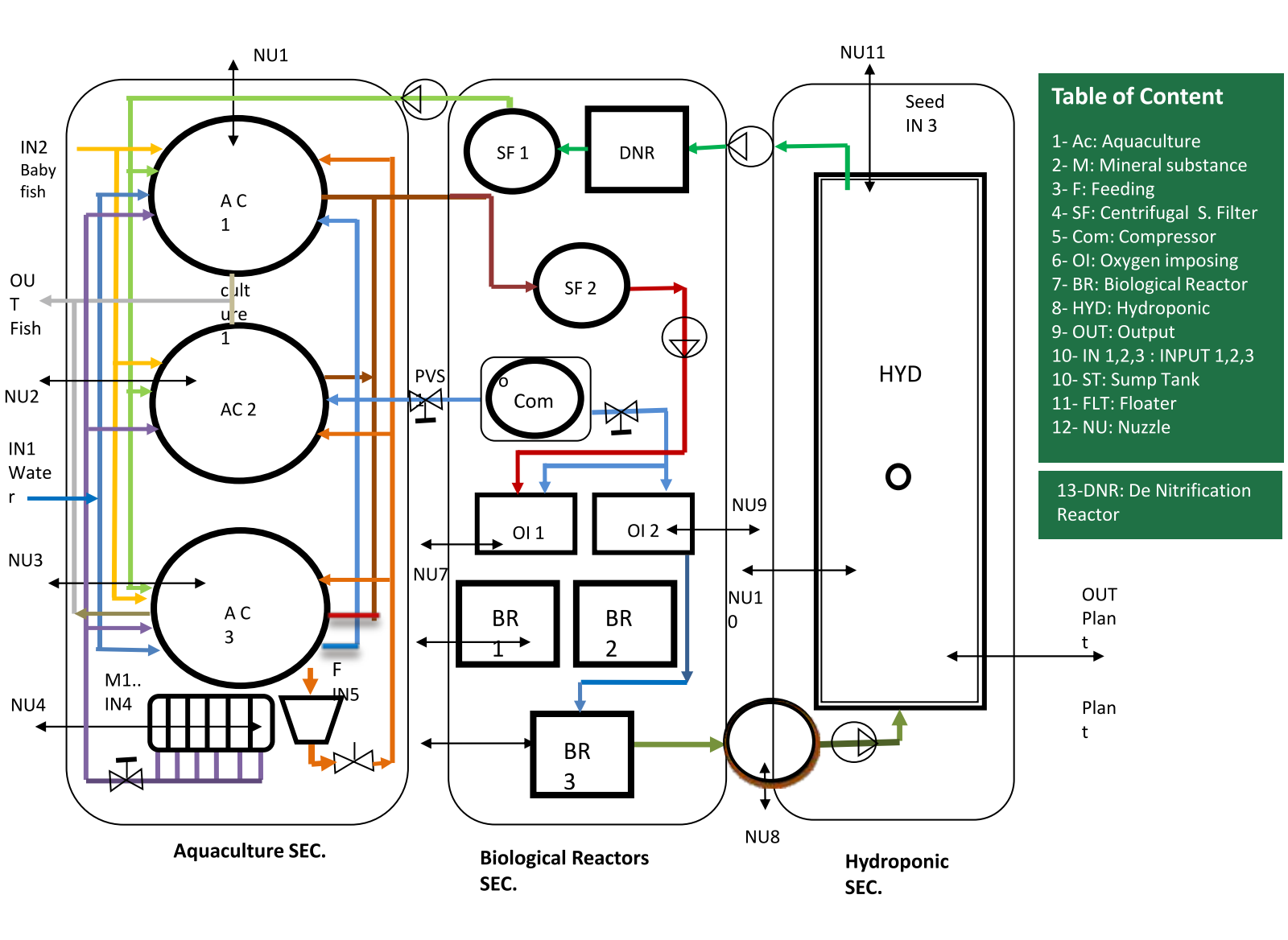
The aquapotronic greenhouse system has the following parts:

1-Aquaculture ponds are available in aquaponics
2-Intelligent self-cleaning filtration device for separating substances suspended in water
3-Intelligent ammonium to ammonia bioreactor device
4-Intelligent ammonia to nitrite bioreactor device
5-Intelligent nitrite to nitrate bioreactor device
6-Hydroponic bed (VERTICAL FARM), (A FARM), (DWC), (MEDIA BED), (NFT) (available in aquaponics)
7-SUM Process Tank (is available in aquaponics)
8-Intelligent denitrification bioreactor system
9-Intelligent self-cleaning filtration system for separating substances suspended in water
10-Complete tissue culture machine
11-Clean room system
12-Spark system
(To produce natural fertilizers "weak carbonic acid" and natural sterilants "hydrogen peroxide" and to complete the nitrogen cycle of "converting nitrogen into nitrate")

The aquapotronic greenhouse system has the following parts:

13-Fog production system to produce sufficient plant moisture
14-Air circulation system in the space and in the necessary equipments(is available in aquaponics)
15-Shading system
16-A variety of online detectors
17-A variety of diagnostic kits(is available in aquaponics)
18-A variety of probes(is available in aquaponics)
19-A variety of stepping pumps
20-A variety of floaters(is available in aquaponics)
21-Using electric and pneumatic valves
22-Continuous non-chemical disinfection systems
23-Common pollination systems
24-A variety of monitors
25-Data accumulation and monitoring system
26-Data processing and management system
27-Internet of things(IOT) system and use of artificial intelligence

SCHEMATIC of System DIAGRAM FOR AQUAPOTRONICNIC GREEN HOUSE



Summary of the economic and technical justification report of the 5-hectare aquapotronic greenhouse

row	description	information	considerations
1	site	60000	m2
2	water	5	L/s
3	electricity	200	Kw/h
4	gas	120	m2/h
5	building area and landscaping	54000	m2
6	cost of building and landscaping	448800	million rial
7	public and private facilities	75870	million rial
8	equipment and machinery	28500	million rial
9	plants production capacity	3000	ton
10	aquatic production capacity	400	ton
11	manpower	45	person
12	fixed capital	739122	million rial
13	total capital	1032660	million rial
14	annual net income	806400	million rial
15	amount of available facilities	373395	million rial
16	break even point	826128	million rial
17	value added	18	percent
18	capital per capital	574167	million rial
19	duration per capita	27177	million rial
20	duration of project implentation	18	month
21	rate of return on capital	40	percent
22	payback time	2.6	years

Problems in traditional and amateur units implemented in the country:

1-Lack of appropriate feasibility studies, and insufficient knowledge of the necessary facilities and equipments
2-Lack of awareness about technical knowledge related to the project
3-Failure to comply with the standards and principles of implementation
4-Failure to comply with system design standards and principles
5-Failure to comply with the standards and principles of balance in the system
6-Incomplete procedure and nitrification process
7- Lack of adequate knowledge of living organisms in the system
8-Failure to recognize and meet the requirements of every living being in the system
9-Failure to comply with the minimum requirements of space, facilities and equipment
10-Shortage of required facilities, equipment and machinery
11-Failure to implement the characteristics of the environment required for the cultivation of living organisms in the system

The mission of the Aquapotronic Research Institute

1-Providing the technical knowledge of locating and the feasibility of building an aquapotronic greenhouse unit
2-Providing technical knowledge of construction based on the principles of aquapotronics engineering
3-Providing technical knowledge of equipping the facilities, including equipment and machinery installations
4-Providing technical knowledge and process design of nitrification process
5-Providing technical knowledge of balance in the system in compliance with all principles
6-Providing technical knowledge to produce organic products based on the principles of 100% productivity
7-Providing technical knowledge of changing production elements, both aquatic and plant
8-Providing technical knowledge to produce plants and special products
9-Construction design of structures required for specific products and plants
10-Marketing and providing advice regarding the export of organic products abroad
11-Providing advice regarding the maximum efficiency of the units established by this research institute
12-Providing suitable solutions to solve the problems of existing amateur units
13-Training of the personnel of the units under the supervision of this research institute
14-Export of technical engineering services, design and construction of aquapotronic sets abroad
15-Providing technical and engineering services and consulting to aquaponic units inside and outside the country

MIETCO

Mobile processing plant are the most economical investment

1- Saving money for land , building and utilities, reduction of labour expenses
2- Reduction of investment up to 60 percent
3- Using B and C grade of raw material
4- Saving transportation cost
5- Expansion of production time
6-Reduction of labour expenses
7- Reduction of total cost of the production
8- Using high technology
9- No strange and its expenses
10- The production is reliable & compatible in market

Technical inforamation of mobile processing plant
Capacity: up to 1000 kg/h Raw material
Production area: 90 m_2
Electricity: 50 KVA (55hp)
Heat generating: 200 $\frac{kg}{h}$ in bar
Water: 8 $\frac{m^2}{h}$ in 2/5 bar
Compressed air: 270 $\frac{1}{min}$