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## Biological Features Of Hydroponic Production: Costs, Planning, Investment And Management.

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### ABSTRACT

Biological features of hydroponic production are that plants are grown using a special solution. Land and other soil fillers are not used in hydroponic production, the roots of plants are in solution, from where plants receive the necessary nutrition for full development, thereby achieving ecological healthy fruits and achieving high yields. Problems of planning, investment and improving the efficiency of hydroponic production, improving its quality and cost reduction can be solved using the principles and tools that are reflected in the management system.

**Keywords:** hydroponics, productivity, hydroculture, ecology, investment planning, profitability, management, costs.

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**INTRODUCTION**

In modern conditions, the state has a policy of import substitution, depletion of land suitable for growing plants, environmental pollution and abrupt changes in temperature conditions, so agriculture faces the challenge of developing new approaches to growing environmentally friendly and competitive products. Hydroponic farm can be one of these methods.

Hydroponics is a groundless method of growing plants in water, which contains dissolved nutrients [1].

In Russia, hydroponics began to develop as a result of increasing interest in small farms, where large areas are not required for growing greens, vegetables, and flower and berry crops on a scale of industrial production [13].

The principles of this method of growing plants are that it is necessary to maintain the desired temperature of the solution and the proportions of nutrients in the solution. In addition, an important factor is the constant saturation of water with oxygen [14].

Hydroponics, like any other method of growing plants, has its advantages and disadvantages [7].

**Table 1: Advantages and disadvantages of the hydroponic method of growing**

<b>N</b>	<b>Advantages</b>	<b>Disadvantages</b>
1	The possibility of using unfavorable land	The need for more thorough care
2	The ability to grow healthy plants that are not susceptible to common diseases	Risk of overheating. Constant monitoring of the temperature in the root zone every 1.5 - 2 hours
3	High planting density allows efficient use of space	Non-universality Not all plants can be grown hydroponically.
4	Direct access to the roots provides the possibility of monitoring the development of plants, the level of Ph, the sufficiency of nutrients	An excess of nutrients and an increased Ph level can lead to plant death.
5	Increased yield	Initial high cost
6	Full control over the nutrition of plants	-
7	Environmentally friendly, efficient use of water and nutrients	-
8	No need for weeding and hilling	-
9	No problem of abrupt changes in climatic conditions	-
10	When using hydroponics in closed rooms, it becomes possible to regulate the concentration of carbon dioxide in the air, favorable for photosynthesis, humidity and air temperature, duration and intensity of illumination	-

Problems of hydroponic production, crop production, planning, management, organization, accounting and analysis are highlighted in the works of Russian scientists, economists [1,2,3,4,5,7, 12] and others. Significant experience has been gained; however, hydroponic production has its own features that should be considered.

Management of hydroponic production is the introduction of approaches and methods aimed at reducing all sorts of costs and increasing the productivity of production. These tools are aimed primarily at production [6].

If the entire production system changes according to the proposed principles of hydroponic production management, not only costs but also internal losses will be reduced, while free labor and other resources will be obtained.

Before deciding to open a hydroponic farm, it is necessary to carefully examine all the pros and cons of this method of growing plants.

Efforts to manage hydroponic production are based on the type of business processes that do not increase the cost of products and, accordingly, do not increase the value added for an economic entity. The concept of introducing hydroponic production is presented in Figure 1.

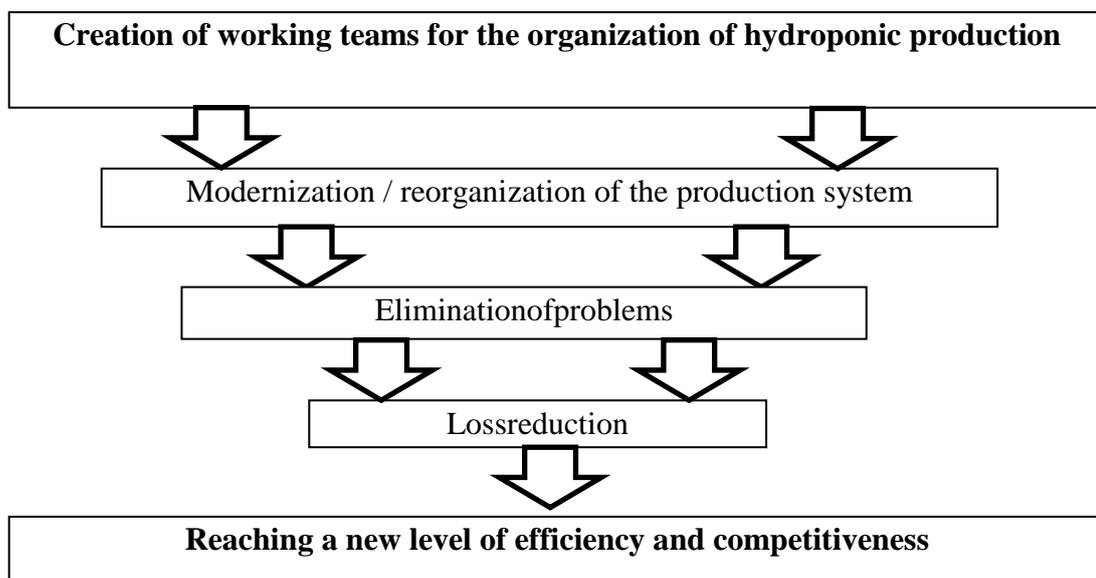
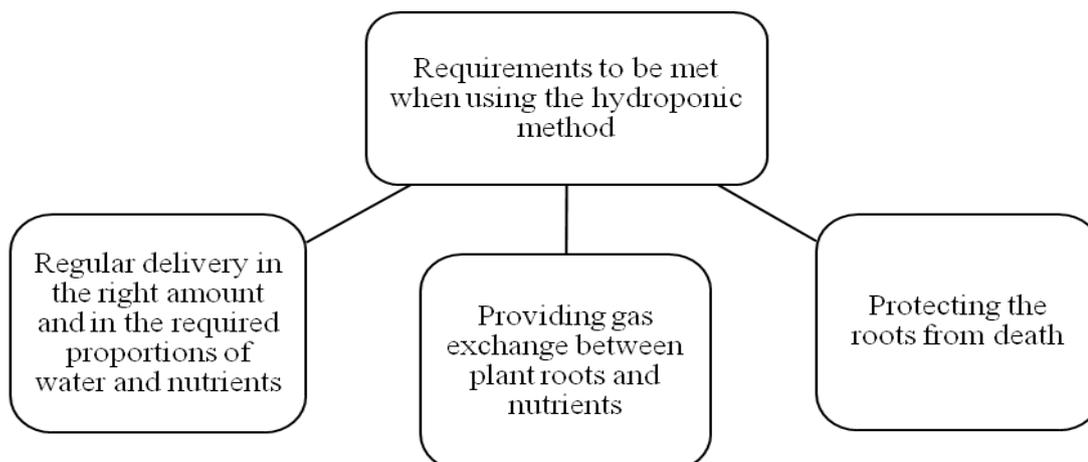


Figure 1: The concept of introduction of hydroponic production

When calculating the savings from cost reduction as a result of introducing the main tools of hydroponic production and improving the operation of the applied machinery and technology, the savings on the main and auxiliary materials, energy resources and other costs are taken into account [8,9,10,11].

The introduction of the concept of hydroponic production provides an additional effect both for the enterprise and for the state budget [9].

Creating ideal conditions for plant growth ensures maximum yields, better quality in a shorter time.



**Figure 2: Basic requirements for hydroponic cultivation**

There are several methods of growing plants using hydroponics (table 2).

**Table 2: Biological features and methods of growing plants using hydroponics**

N	Method	Essence
1	Hydroponics (aquatic culture)	<p>This method of cultivation assumes that the plant is rooted in a thin layer of an organic substrate (peat, morph, etc.) laid on a mesh base and dipped in a pan with a nutrient solution.</p> <p>The disadvantage of this method is in the complexity of root aeration, since the oxygen contained in the nutrient solution is not enough, therefore the root system of the plant cannot be completely immersed in the solution. A small air space is left for oxygen. At the same time, it is necessary to ensure increased humidity of air in space, so that the roots do not dry out quickly. The nutrient solution changes once a month.</p>
2	Hydro culture (substrate culture)	<p>This method consists in the necessity of placing the plant root system in a thick layer of substrate. The substrate can be gravel, expanded clay, etc. The plant is powered according to the principles of backwater, periodic moistening or watering from above.</p>
3	Aeroponics (air culture)	<p>Method of growing plants without the use of substrates. Plants are fixed with clips on the lid of the vessel, which are filled with nutrient solutions. In this case, part of the roots should be in solution, the other in the airspace. The roots between the vessel lid and the solution must be moistened periodically.</p>
4	Chemo culture (culture of dry salts)	<p>With this method, an organic substrate is used in which the plants are hardened. As a substrate can be used moss, brick crumb, stones. Most often, cacti are grown by this method.</p>
5	Ionoponics	<p>Method of growing plants on ion exchange materials. Substrate is ionite resins, fibrous materials, blocks and granules of polyurethane foam. Rich nutrient solutions with vitamins and hormones are used. Algae agar can be used as a mechanical substrate.</p>
6	Aquaponics (joint cultivation of aquatic animals and plants)	<p>This is an artificial ecosystem in which following three types of living organisms are key: aquatic animals (usually fish), plants and bacteria. Environmentally safe method. Fish provide food for plants, plants purify water. The main essence is the use of waste of marine animals - fish and shrimp.</p>

Properly chosen method of growing plants with hydroponic method can increase the volume of the crop in a shorter time.

**Table 3: Factors that influence the cultivation of plants in hydroponic conditions**

N	Factor	Meaning
1	Substrate	<p>Coconut chips are one of the most popular substrates. It is able to hold water well, like vermiculite, but retaining air like perlite.</p> <p>Perlite is the most popular substrate for hydroponics. It retains oxygen well, but is quickly washed off with water.</p> <p>Claydite-concrete retains moisture due to the crushed expanded clay granules. It has a neutral pH, can be reused.</p> <p>Special cast sponges (starter sponge) is the latest invention among substrates. It is made from a bio-grade polymer. Due to its softness, it does not damage the roots. Well hold water.</p> <p>Basalt (stone) wool easily absorbs water. The main plus is sterility from pathogenic microflora.</p>
2	Nutrients	<p>To ensure optimal growth, it is necessary to observe the concentration of nutrients and the acidity of the pH required by plants. The easiest way to maintain nutrient solution status is to measure PPM and TDS (Concentration of parts per million and Number of Dissolved Salts). Relative acidity or pH determines the ability of a plant to take food. When the pH of the nutrient solution deviates from the optimum, a number of nutrients may become unavailable for plants.</p>
3	Light	<p>Due to the energy of the sun, the process of photosynthesis occurs, which plays a large role in the development of plants. With a lack or absence of sunlight, phyto light is used.</p> <p>The advantages of LED lighting fixtures are the “right” spectrum of light, long service life (10-15 years), low power consumption and eye safety.</p>
4	Seed preparation for cultivation	<p>To ensure a comfortable temperature for seeds, electric warm mats are used, which are able to maintain the required temperature in the root zone.</p>

**Characteristics of object** Type of activity: Agriculture, growing crops in a greenhouse for commercial purposes.

OKVED: 01.13 Growing vegetables, root and tuber crops, mushrooms and truffles;  
 Taxation: simple taxation system (income minus expenses \* 5%)

Location of the object: Hydroponics greenhouses will be placed in a heated room with water supply to the operating organization. On the territory, there are buildings that can be used as a storage room for seeds, fertilizers, equipment. One building can be converted into a cold warehouse for storing and packaging products before being sent to stores.

Types of services:

- growing onions, lettuce, dill, parsley;
- growing vegetables (cucumbers, tomatoes, peppers, radishes);
- sales of small and large wholesale products;
- retail sale of products.

Grown products will be sold in stores and processed in the organization. In the future, it is planned to expand the sales market, so product sales will be made throughout Udmurtia and the Republic of North Ossetia Alania and beyond.

Algorithm of investment planning and cost management Special equipment and containers needed for the greenhouse. Containers are selected according to the culture that will grow in the greenhouse. A special substrate (crushed stone, gravel, grass) is placed in the greenhouse and liquid is poured in, which is replenished as needed through hoses.

The climatic conditions in Udmurtia are a shortage of sun and cold, in the Republic of North Ossetia Alania are constant winds and rains and therefore, additional heating, insulation, ventilation and lighting will be required to provide the necessary harvest volumes.

**Table 4: The cost of hydroponic production**

N	Item of expenditure	Amount, rub.
1	Document collection, registration	30 000
2	Purchase of industrial greenhouses	180 000
3	Industrial hydroponic system (cultivated area of 60 sq. M.)	1 500 000
4	Purchase of industrial refrigerators	100 000
5	Pots, seeds	100 000
6	Packaging, labels, containers for transporting products	30 000
7	Arrangement of storage space racks for storage of products prior to shipment	100 000
8	Unexpected expenses	100 000
9	Total	2 140 000

An agro chemist, agronomist and engineer are needed to grow plants using hydroponics.

The duties of the agro chemist include the preparation of a nutrient solution for plants that can replace the soil, the selection of diet, corresponding to the characteristics of the plant, the control of plant nutrition.

Hydroponomic agronomist selects the level of lighting, temperature, humidity and time feeding plants. He must know the conditions necessary for the growth and development of plants. Agronomist monitors the time of harvest. The main task is to fulfill the plan for yield and to obtain high-quality plants suitable for storage and sale.

The engineer must ensure the operation of all systems (irrigation, microclimate) and know how to do this as efficiently as possible, saving energy, and without harming the plant.

When growing plants using the hydroponic method, it is necessary to know all the features of the plants: structures, cultivation, possible diseases, and pests

**Table 5: Expenses for hydroponic production personnel**

N	Position	Number	Salary, rub.	Total, rub.
1	Head of the household	1	30 000	30 000
2	Agrochemist	1	16 000	17 000
3	Agronomist	1	16 000	15 000
4	Engineer	1	15 000	15 000
5	Handyman	2	12 000	24 000
6	Total	6	-	101 000
7	Deductions	-	-	30 000
8	Monthly expenses	-	-	131 000

Administrative work, product sales and accounting is entrusted to the manager of the structural unit. More highly specialized specialists in crops or cultivation technologies will appear in the development process, possibly expanding the staff. For example, an expert in growing tomatoes using hydroponics in a light culture, a sales manager and suppliers

When recruiting employees, attention should be paid to specialists with specialized education in the agricultural or biological field.

**Performance planning** During the year, there will be expenses for the remuneration of employees, utility bills, the purchase of seeds, fertilizers, maintenance work, taxes and much more.

**Table 6: The cost of hydroponic production for the first year**

N	Item of expenditure	Amount, rub.
1	Purchase of seeds, mineral complexes, substrates	120 000 (10 000 / month)
2	Utility bills	120 000 (10 000 / month)
3	Salary and deductions	1 572 000 (131 000 / month)
4	Tax	98 000
5	Total expenses	1 910 000

To assess the profitability of a business, we calculate revenues in the first year of production. It is necessary to grow crops that coexist well on the same area.

During the year, a greenhouse in hydroponics allows growing some crops in several stages:

- Greens to 12 parties - revenue about 1,080,000 rubles.
- Cucumbers in 3 stages - revenue from 600,000 rubles.
- Tomatoes in 3 stages - revenue from 720,000 rubles.
- Bulgarian pepper in 3 stages - revenue up to 900,000 rubles.
- Radishes in 4 stages - revenue up to 400,000 rubles.

Approximate revenue is 3 700 000 rubles.

**Table 7: Economic performance of hydroponic production**

N	Indicator	Value
1	Annual revenue	3 700 000 rub. (308 000 rubles per month)
2	Payback period	1 year 2 months
3	Return on sales	0.48
4	Profitability of activity	0.94
5	Net profit	1 790 000 rub. (149 000 rubles per month)
6	Annual revenue	3 700 000 rub. (308 000 rubles per month)

2 million 140 thousand rubles were invested at the opening stage of the greenhouse. If the greenhouse makes a profit of about 150 thousand rubles per month, production will be self-sufficient in 1 year and 2 months. To speed up the process, the product range needs to be thought out. In the first years, it is possible to focus activities on crops that do not require long periods of cultivation and large investments in maintenance.

The hydroponic system is now becoming increasingly important. Due to hydroponics, it is possible to compactly grow plants, thereby saving working space, and, therefore, it is possible to increase the yield of finished products.



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