Soil fertility in agriculture: main tasks

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Abstract. Today, the problem of soil degradation is developing in the Fergana region of Uzbekistan. Improving the quality and productivity of the soil is an urgent task for specialists in the field. In the article, the necessary information for increasing soil fertility and working with the soil of farmers and peasant farms operating in the region was provided. Experimental studies were conducted in field conditions. They consisted of 8 options and were implemented according to the 4 return system. Various aspects of soil fertility related to the amount of soil and humus in it were considered. Soil is fertile only when there is enough humus, soils with low humus are biologically dead and have low fertility. In our conditions, scientific studies have shown that the amount of humus in the soil is at least 1.5-2%. Analyses were conducted to determine the mechanical composition of the soils of the experimental area. It was found that there is 27.6 mg/kg of nitrate nitrogen in the arable layer (0-30 cm) and 23.4 mg/kg in the bottom (30-50 cm). The lower soil layers of 70-150 cm are poorly supplied with humus and nutrients. Depending on the state of reclamation, the amount of soluble salts in the water is moderately sulfate-saline, the content is 0.46-0.78%, and the level of underground water is 1.6-2.0 meters. Experiments on replenishment of nutrients from crops in cultivated fields, mainly due to organic fertilizers, at least 10-15 tons of organic fertilizers per year in the amount of 50-70%, soilless waste, composts, phosphorus and potash fertilizers showed the need to use gites. Strict observance of regional ploughing and fertilization according to agrochemical cartograms depending on the type of soil crops. However, as a result of non-compliance with crop rotation, unscientific use of organic mineral fertilizers and resource-saving technologies, the amount of humus on irrigated lands decreased by 50%. To improve soil productivity, the article gives recommendations for improving soil quality.

1 Introduction

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of the activity of billions of microorganisms (the smallest living beings) in the soil, substances pass from one state to another, for example, humus, nitrogen, phosphorus, iron, sulfur, etc.

The most important feature of the soil is that the soil is just as necessary for life as the sun, air and water, and is a source of inexhaustible wealth and essential food and raw materials for humanity and the universe.

The soil has two different meanings in human society, on the one hand, it is the physical environment, human habitat, and function, and on the other hand, it is the economic and main means of production. Therefore, she demands to take care of him and take care of him all the time.

The soil covering the globe, like the world's oceans, is the main purifier of the world. The decomposition of most organomineral compounds is completed in the soil. In global agriculture, it is the main means of production and a non-renewable natural resource.

The word "earth" is used differently in different languages. Let's say the Russians say "Earth". The term in Turkish is close to the verb "Emoq". The earth eats itself and feeds the creatures. Coming out of the ground, returned, then again falls into the ground, being a means of nutrition for various living beings and insects.

For example, how much energy does the earth spend to germinate a seed that has fallen into its womb? How can the Earth germinate these seeds? She gives life to them, from the same point of view one marvels at the generosity of mother earth.

Restoration and improvement of soil fertility, ensuring its biological activity, and transition of advanced plant care technologies are necessary to achieve optimal development of plants, animals and microorganisms.

Soil fertility largely depends on the amount of humus (humus) contained in it. The soil will be fertile only if there is enough humus, soils with a low content of humus are biologically dead and have low fertility.

Under our conditions, scientific studies have shown that the amount of humus in the soil is at least 1.5-2%.

However, as a result of non-compliance with crop rotation, unscientific use of organic mineral fertilizers and resource-saving technologies, the amount of humus on irrigated lands decreased by 50%.

Established in 1926 at the Research Institute of Cotton Growing, Seed Growing and Agricultural Technology of Plant Growing, a unique experience is being carried out in analyzing the yield of cotton under the influence of permanent cotton, i.e., monoculture, crop rotation, organic, mineral fertilizers.

According to experimental data, the yield of cotton was 10.8 c/ha when planted without fertilizers and 33.0 c/ha when planted with permanent fertilizers. The same amount of fertilizers + mineral fertilizers + 30 tons/manure was applied at a yield of 40.2 centners/ha, or 7.2 centners/ha due to manure, this will be our study.

2 Methods

Field experiments (research) were carried out in the field on the farm "Altyaryk Dehkon Zamini" of the Altyaryk district of the Fergana region. The field experiment consisted of 8 options and was carried out according to the system of 4 returns.

Field experiments were carried out based on the "Methodology for conducting field experiments" (2007), developed by scientists from the Uzbek Scientific Research Institute of Cotton Growing and Internal Agrotechnologies of the farm "Altyaryk Dehkan Zamini".

Cotton varieties C-8290, alfalfa Tashkent-1, and wheat Zamin (Jeyhun) were cultivated in the experimental field.
3 Experimental part

In particular, the Earth is a living organism. She breathes, gaining strength to grow the planted crops, trees, and flowers. The earth also needs to be fed. No wonder our ancestors said that if you feed the earth, the earth will feed the people.

The farmer's dictionary contains terms such as "poor land" and "rich land". Plants that are planted regularly lose weight. The problem of crop failure arose especially after the development of technology and the unprecedented expansion of irrigated land. While our ancestors in ancient times saturated the soil with local fertilizers, this no longer satisfied the extremely poor land.

At the same time, the practice of the ancestors was reformed—chemistry entered the sphere of agriculture. Nowadays, it is difficult to imagine agriculture without chemical and synthetic fertilizers.

With fertile high-yielding lands, favorable climate, large natural resources and a sufficient number of domestic labor, our republic will become one of the richest countries in the world, providing food for a population of 100 million people, it can also export a large amount of products to foreign countries. This can be seen from the following diagram of the volume of crops grown (Fig. 1).

**Fig. 1.** Graphs of the volume of crops grown

Currently, the rating of the country's export potential is as follows: for the export of dried apricots—2nd place, apricots—4th place, plums—6th place, cabbage—8th, raisins—9th, peaches and grapes—10th place.

It is known that China ranks first in terms of population. There are 0.07 ha of arable land and 0.05 ha of irrigated land per capita in the country. Chinese farmers feed more than 1.7 billion people and are among the leading countries in selling surplus agricultural products to other countries [10-11].
Japan, the most populous country in the world, has very little arable land, only 0.03 hectares per capita. However, the peoples of the world recognize that Japan is the richest and fastest-growing country. This is achieved through the use of 0.03 hectares of arable land by Japanese farmers without reducing soil fertility.

Another example is the state of Kerallo in southern India, which covers only 38,000 square kilometres. About 40 million people in the region use land sustainably and live in abundance. Regularly enrich the soil composition.

An example is the Netherlands, which is developing significantly by improving soil fertility. The Netherlands is a small country in the world in the technology of cheese production, meat, dairy and vegetable products, occupying a leading position. In fact, this European country is home to 16.0 million people. The sown area per capita is 0.04 ha. However, the country annually produces more than 180 kg of meat per capita, as well as 1150 kg of milk per year. There are 1.038 million hectares of arable land for 16 million inhabitants—these are agricultural lands (60% of which are taken from the sea). Moreover, they produce agricultural products worth 131 billion dollars. In Uzbekistan, the population is 34 million and there are 4.4 million hectares of arable land, this figure is only 13.2 billion dollars.

In our country, the internal potential in this area is huge. In particular, in Uzbekistan per capita, there are 0.25 hectares of arable land and 0.15 hectares of irrigated land. With irrigated land alone, we can get 2.0 times more than in the state of Kerallo, 2.7 times more than in China, and 5.5 times more than in Japan, only by improving soil fertility.

In recent years, the average yield of cotton in the country is 24-25 centners/ha, alfalfa - 80-100 centners/ha, corn - 35 centners/ha, rice - 45-47.2 centners/ha, corn stalks - 60 centners/ha, the yield of vegetables and gourds decreased by - 60 c/ha. All this is as the result of violations of land use rules at the previous time. The taste and quality of the grown field products did not meet the requirements of the standards. The earth, which is the endless breadwinner of the human world, has become impoverished. The endless possibilities of the so-called “cash cows” of the earth have been depreciated, trampled down and blindly used for the last 80 years. Today there is a shortage of food, meat, milk and fat.

The negative aspects of the land did not go unnoticed by the President of the Republic of Uzbekistan Shavkat Mirziyoyev at a meeting on December 21, 2021 on the formation of land records and state cadastres, the introduction of digital technologies in the industry, there was a remark that our national wealth—the Earth, which is the basis of a prosperous life, was left without attention. He said that we do not have clear information about how much land is available and that the land has not been occupied for 30 years. He noted that work has now begun in our country on the conservation and rational use of land.

In Uzbekistan, for the first time in history, agricultural land is being formalized. To date, electronic maps of 23 million hectares of agricultural land have been created and a geoportal has been launched. We are talking about placing food on agricultural land, ensuring food security, its balance, which crops to which lands, how many crops to plan, and that every farmer should treat the sacred land, our breadwinner, with respect and kindness.

4 Results and discussion

The Fergana region is located in the east of the republic, in the western and southern parts of the Fergana Valley, including the plains of the valley, and the foothills of the Alai and Turkestan ranges. Its total area is 7.9 thousand square km and is distinguished by a variety of soil cover.
The soils of the Fergana region have been studied in depth and detail, as a result of which schematic hydrogeological, agrochemical, and reclamation maps of the soils of the region have been developed, and scientific farming systems have been created. The soil map of the Fergana region is shown in Fig. 2.

Fig. 2. Soil map of the Fergana region

The researchers divided the region into the following main soil zones:

- mountain slopes and foothills with dark, typical and light gray soils, burozems;
- gray and reddish-brown soils at the foot of the mountains;
- typical and light serozems of the Adyr region, burozems;
- typical soils from the Adyr Ridge;
- a smooth meadow that irrigates the plains and lowlands.
- meadows with meadow, bog, meadow-dough, gray and meadow-grassy soils, which are irrigated on the plains and lowlands;
- steppe meadow-marsh, meadow-marsh, saline soils and sands of the desert zone.

Among the above-allotted soils, meadow-loamy soils occupy one of the leading places and are the main agricultural territory of the Fergana region [7].

In this region, a short 1:2 rotation system has been introduced with a grain weight of 33.3% and a cotton yield of 66.7%, mainly with a crop rotation "cotton: grain" of 0 percent. For this reason, our research was carried out on a farm in the village of Altyaryk, Altyaryk district of the Fergana region, in sandy soil conditions with a heavy water supply. The soil of the experimental field is light in texture, the amount of physical turbidity in the arable land and under the arable land is 21 and 22.0%. Before setting up the experiment on June 20, 2019, a cross-section of the field was opened and the morphological characteristics of the soil were studied by genetic layers. The results of the analysis to determine the mechanical composition of the soil of the experimental field fully confirmed the indications of the mechanical composition of the soil in the morphological structure (Table 1).
In particular, in terms of turbidity (22.00 and 21.3%), the mechanical composition of the upper (0–30 and 30–50 cm), the soil layer is slightly sandy, the amount of physical turbidity decreases with penetration into the lower layer, and the layer 100–150 cm turned out to be sticky sand.

Table 1. Mechanical composition of the soil of the experimental field

<table>
<thead>
<tr>
<th>Soil layer, cm</th>
<th>Physical clay, %</th>
<th>Light sand, %</th>
<th>Sand, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–30</td>
<td>22.94</td>
<td>26.37</td>
<td>4.70</td>
</tr>
<tr>
<td>30–50</td>
<td>25.47</td>
<td>28.11</td>
<td>4.01</td>
</tr>
<tr>
<td>50–70</td>
<td>27.59</td>
<td>49.16</td>
<td>4.6</td>
</tr>
<tr>
<td>70–100</td>
<td>32.59</td>
<td>48.46</td>
<td>4.17</td>
</tr>
<tr>
<td>100–150</td>
<td>25.07</td>
<td>47.21</td>
<td>2.26</td>
</tr>
<tr>
<td>130–150</td>
<td>25.09</td>
<td>45.47</td>
<td>3.15</td>
</tr>
</tbody>
</table>

The soil of the experimental field is very poorly provided with humus, total nitrogen and total phosphorus 0.165 and 0.081%, respectively (Table 2).

Table 2. Initial agrochemical characteristics of the soil (“Altyaryk village”, Altyaryk district, Fergana region Farm - 2021)

<table>
<thead>
<tr>
<th>Soil layer, cm</th>
<th>Humus, %</th>
<th>NO3, mg/kg</th>
<th>P2O5, mg/kg</th>
<th>N - NO3, %</th>
<th>P2O5, %</th>
<th>K, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–30</td>
<td>0.969</td>
<td>0.069</td>
<td>0.165</td>
<td>27.6</td>
<td>34.5</td>
<td>230.0</td>
</tr>
<tr>
<td>30–50</td>
<td>0.803</td>
<td>0.080</td>
<td>0.081</td>
<td>23.4</td>
<td>26.8</td>
<td>220.0</td>
</tr>
<tr>
<td>50–70</td>
<td>0.533</td>
<td>0.065</td>
<td>0.075</td>
<td>17.5</td>
<td>16.3</td>
<td>170.0</td>
</tr>
<tr>
<td>70–100</td>
<td>0.496</td>
<td>0.060</td>
<td>0.070</td>
<td>13.2</td>
<td>12.6</td>
<td>140.0</td>
</tr>
<tr>
<td>100–150</td>
<td>0.474</td>
<td>0.055</td>
<td>0.080</td>
<td>10.7</td>
<td>17.8</td>
<td>90.0</td>
</tr>
</tbody>
</table>

In the lower, 50–70 and 70–100 cm soil layers, further reducing their amount, humus consists of 0.533 and 0.496 total nitrogen 0.065 and 0.060 total phosphorus 0.075 and 0.070%. From the analysis of the data in the table, it can be said that the indicators in the 70–100 cm layer are slightly higher, which is explained by the presence of a clay soil mixture in this layer.

It has also been established that the plant is poorly supplied with nitrate nitrogen, mobile phosphorus and exchangeable potassium, which are easily absorbed. In particular, nitrate nitrogen is 27.6 mg/kg in the topsoil (0–30 cm) and 23.4 mg/kg at the bottom (30–50 cm). The table shows that the lower soil layers of 70–150 cm are poorly provided with humus and nutrients. Depending on the reclamative state, the content of water-soluble salts is moderately sulfate-salt with a content of 0.46–0.78%. The groundwater level is 1.6–2.0 meters.
From the above analysis, it can be concluded that the agrophysical and agrochemical properties and characteristics of meadow soils with a light sandy mechanical composition require regular improvement.

To improve soil fertility, the following experiments were carried out:

Experiments on the replenishment of nutrients from crops on arable land, mainly through organic fertilizers (as in the experiments of farmers in the Altiaryk, Rishtan, Kuva, and Tashlak districts of the Fergana region), through crop rotation.

Apply at least 10-15 tons of organic fertilizers, soilless waste, compost, phosphate and potash fertilizers at the rate of 50-70% per annum.

Strict observance of district ploughing, ploughing and fertilizing according to agrochemical cartograms, depending on the type of soil crops.

Along with this, one of the main ways to overcome the shortcomings of soil health in the country is to carry out agricultural work on irrigated lands with resource-saving technologies, increase soil fertility, regular replenishment of organic matter, including from cotton 45-50 centners, from alfalfa hay 220-240 c, from corn grain 70-80 c, from corn stalks 700-750 c, from wheat 64.70 c, from rice 65-80 c, from grapes 200-250 c, from fruits 250-200 c, from vegetables and melons 650-700 c, out of 400-500 c. However, because we do not use these opportunities to the full, some farmers grow 3-7 times less than is possible.

Not less than 60 per cent of the lands freed from the sowing of spring grain crops remain unoccupied. As mentioned above, in recent years, 21.5 kg of meat per capita has been produced in our country annually. However, according to medical standards, a healthy person who can work regularly should consume at least 60-65 kg of meat per year. In recent years, this amount in Uzbekistan has averaged 25-26 kg.

Another important task to meet the needs of the country's 34 million people in the short term is the planting of legumes such as soybeans, lupins, rye, peas, and mung beans. For example, legumes equivalent to meat contain up to 50% legumes and lupine and 21 to 29% legumes and soy. To compensate for the lack of protein in the human body, a person should consume an average of 60-80 grams of legumes per day. This issue is currently being addressed.

It is impossible to grow any crops planted on the soils of the experimental plot without irrigation. This was due to low rainfall this year, severe drought, strong winds and rapid evaporation of soil moisture during the summer months.

5 Conclusions

1. To teach farmers the science of land use and love for the land-following modern requirements.
2. A step-by-step study of the current level of soil fertility, and regular monitoring of which crop to place.
3. Experiments on the replenishment of nutrients from crops on arable land, mainly through organic fertilizers (as in the experiments of farmers in the Altiaryk, Rishtan, Kuva, and Tashlak districts of the Fergana region).
4. Apply at least 10-15 tons of organic fertilizers, soilless waste, compost, phosphate and potash fertilizers at the rate of 50-70% per annum.
5. Strict observance of district ploughing, ploughing and fertilizing according to agrochemical cartograms, depending on the type of soil crops.
6. Harvest damage by weeds from 11% to 43% by crop type is unacceptable. Weeds are controlled by mechanical, chemical and biological methods.
7. Pests and diseases cause serious damage to crops and negatively affect yields by 13%.
to 40%.

8. Ploughed land should be levelled with long base laser levels to allow water to run off smoothly.

9. Rinse saline soils by removing sweet flooring.

10. Provide winter watering for the destruction of diseases and pests by plant species.

11. Clean all ditches for efficient use of water, and ensure unhindered runoff of rain and sewage.

12. Compliance with market principles for the placement of crops and varieties.

13. The use of technical, organic, organo-mineral fertilizers, as well as alfalfa, legumes by region based on strict recommendations deficiencies in soil health due to the implementation of the above recommendations.

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