

UOT 631.

**Fazil Tatarxan Jafarov**<sup>1</sup>, Dr., Senior Lecturer  
*e-mail*: faziljafarov@yahoo.com

**Mustafa Gilman Mustafayev**<sup>2</sup>, D. S. (Agrarian), Associate Professor  
ORCID ID 0000-0003-2071-3078 *e-mail*: meliorasiya58@mail.ru

<sup>1</sup> Agjabadi branch of Azerbaijan State Pedagogical University, Baku, Azerbaijan

<sup>2</sup> Institute of Soil Science and Agrochemistry of Azerbaijan National Academy of Science, Baku, Azerbaijan

## THE IMPACT OF CLIMATE CHANGE ON SOIL FERTILITY IN THE CENTRAL REGION OF AZERBAIJAN

**Abstract.** *Global warming also contributes to ongoing land degradation. Higher temperatures have become more frequent in recent years, which has led to desertification and land degradation due to reduced rainfall and increased evaporation. The problem of desertification is very important for Azerbaijan, located in dry climate. The deterioration of potential and effective indicators of land fertility inherent in the central part of Azerbaijan has become a consistent and irreversible process. In most natural areas, a decrease in humus, which is a very important indicator of fertility, is a serious warning and should be seen as an environmental crisis or soil degradation. To maintain soil fertility, a system of land reclamation and agroreclamation measures can be applied. Besides of these measures it is also possible through the use of new technologies (Conservation Agriculture) to maintain soil fertility.*

*Conservative (protected) systems are not just a technique, but simply a type of approach. Following list of technologies is using on conservative agriculture:*

- *Laser surface alignment;*
- *Preservation of plant residue in the area;*
- *Reduction of soil plowing (minimum cultivation) or lowering the plow to zero;*
- *Application of turn cultivation system.*

*This type of cultivation is also called a sow or a direct sow. Conservative agriculture based on reduction of plowing or reset plowing. Additionally, it is important to apply plant debris on soil surface and it should be combined with sequence cultivation.*

**Key words:** *soil fertility; Conservation agriculture; plant debris; salinization; land erosion; humus; soil surface alignment*

### Introduction

The rapid population growth in the country over the past hundred years, the excessive expansion of settlements, the intensive development of transport and other industries have led to increased impact on ecological and natural ecosystems. As a result, there was a decline of arable soil area, deterioration of fertility indicators and decline of biopotential of these lands. Plowing of lands with fertilizers for hundreds years led to decline of organic matter of the soil. Soil organic matter does not only provide soil with nutrients. First of all, it is the most important element for soil structure stabilization. Therefore, more soils degrade after long time intensive plowing.

Degradation process leads to erosion. Erosion process in Azerbaijan is widespread. The total area of eroded lands in our republic is 3144.7 hectares, which is 36.4% of territory of the country. As a result of this process, the soil is washing away and its fertility decreases. This leads to decline of productivity and has a negative impact on the quality [1, 2, 5].

To protect and increasing the fertility of the soil is possible with application of conservation agricultural technologies. Conservation Agriculture is not only a technical method, but also resistant method of approach. Conservation Agriculture is based on declining of the plowing or lowering the plow to zero. Besides of that, it is one of the important issues to apply plants residue on land surface. Here occurs constant biochemical processes, breakdown and synthesis of organic matters and enrichment of the soil with nutrients. In addition, plants residue protects cultivated agricultural lands from sunlight, wind, irrigation and wind erosion [3, 4, 6, 8].

Therefore, research and development of recommendations for the preservation of soil fertility and increasing of productivity in the Central region of Azerbaijan is very important and needs a great scientific and practical experience.

### **The purpose of the study**

The main purpose of the study is to improve the fertility of soils through less provided meadow gray soils residue in the Central Region of Azerbaijan.

Followings have been studied regarding the above-mentioned issue:

1. Preparation of soil surface.
2. Quantity of plant residues stored on soil.
3. Save on irrigation.
4. Study of humus content on experimental area soils.

### **Materials and Methods**

Experimental works have been carried out on the farm in Mil-Garabagh region of Agjabadi district between 2017 and 2019.

Experimental area was 1 ha area land.

The experiment was carried out using a traditional planting and storage scheme for plant residues that are used by farmers.

During the experiment, farmers were encouraged to apply the new technologies together and it will provide sustainability of the results applications on long term use.

To study the soil clarification soil samples have been taken from 5 different places of the area, dried in laboratory, crushed and sieved 1 mm sieve.

Local seed sorts have been used during the experiment. Also, Turkish made laser levelling aggregate and seed sower machine aggregate have been used.

### **Results and discussions**

The experiment was conducted to reduce soil erosion by applying conservation agricultural technologies in 1 ha land Beylagan-Agjabadi districts, the Central part of the Azerbaijan. For this purpose, *the surface of the soil is leveled by a laser beam*. In the land levelled by laser beam, Germination and growth of plants and water spreading is providing equally, which prevents soil washing.

Through laser levelling it is possible to make a surface level spirit or slope. In general, laser leveling of the soil surface very effectively prevents the loss of water and leaching of nutrients. Also, land erosion, secondary salinization and other negative impacts are declining [6, 9].

**Check-row planting.** Check-row planting is being carried out by planting machine after the land preparation for planting. During the check-row planting sowing norm declining by 30-40%. Besides the saving of irrigation, it doubles productivity of one, who carries irrigation. In check-row plantation process, the rowing machine makes row, as well as plants 3-4 rows seed with 8-14 cm interval [9, 10, 11].

**Application of crop rotation.** The following types of crop rotation is applying in uncultivated lands at the same place: Increasing the productivity of agricultural plants, protecting of soil fertility and disease and pests control measures.

**Application of plant residues.** In this process in order to increase the soil fertility the chopping plant residues applying to the soil surface after the harvest period. The aim of this activity is to increase the activity of the microorganisms through plant residues. The plant residues also increase decompositions in the content of soil and it leads to the increasing of soil fertility. During the experiment process of conservation agriculture program sowings of seeds of wheat, corn, sunflower, sorgo and cotton shifted regularly during the autumn, spring and summer at the same place.

The plants residue remained on land surface after the harvest period. These residues applied after the chopping procedure by special chopper machine. These residues also protect the soil from sun shine, wind and negative impacts of rain, as well as irrigation and wind erosions. Besides of protection, residues also prevent negative impact of weeds growth. During these works it is possible to get stable productivity, increasing soil fertility, as well as the recovering of micro and macro faunas in unplowed lands [8, 12, 13].

As the starting of the Conservation agriculture plants, the land levelled by laser, then wheat seed has been planted to this area in fall of 2016. As an interval planning, in the summer of 2017, Phaseolus has been planted to this land and again in the autumn of 2017 barley seed has been planted. After the harvest period, as an interval period corn seed has planted at summer of 2018, later, in autumn of the same year, again barley seed has been planted to this area.

During this period following seeds have been planted as above-mentioned sequence in 1 ha land: wheat, bean, barley, corn and again barley.

Soil samples have been taken from experimental lands between 2016 and 2018 and sent for laboratory testing. Results shown in table 1.

Table 1 – Agrochemical classifications of soils

| Per year      | Nitrogen % | Phosporus mq/kq | Potassium exchange mq/kq | Humus % | Organic carbon % |
|---------------|------------|-----------------|--------------------------|---------|------------------|
| 2016          | 0.135      | 25.9            | 191.0                    | 2.7     | 1.60             |
| 2017          | 0.140      | 32.6            | 209.0                    | 2.8     | 1.62             |
| 2018          | 0.155      | 34.3            | 211.0                    | 3.1     | 1.80             |
| Difference, % | 14.8       | 32.51           | 10.471                   | 15      | 12.5             |

As it described in figure, general nitrogen changed between 0.135-0.155%, phosphorus 25.9-34.3%, potassium exchange 191.0-211.0 mg/kg, humus 2.7-3.1%, organic carbon 1.60-1.80%.

During the same period, the same farmer has planted 1 ha land of wheat seed and barley seed by traditional way. In the traditionally area the farmed used only autumnal cereals and residues have been removed from site like recent years. Results of samples analysis from that site shown in table 2.

Table 2 – Agrochemical classification of soil

| By years      | Nitrogen, % | Phosphorus, mq/kg | Potassium exchange, mq/kg | Humus, % | Organic carbon, % |
|---------------|-------------|-------------------|---------------------------|----------|-------------------|
| 2016          | 0.150       | 20.61             | 218                       | 3        | 1.89              |
| 2017          | 0.145       | 18.32             | 217                       | 2.9      | 1.68              |
| 2018          | 0.140       | 17.50             | 216                       | 2.85     | 1.64              |
| Difference, % | -6.667      | -15.1             | -0.9174                   | -5       | -13               |

As it described in the table, between 2016 and 2018, general nitrogen changed between 0.150-0.140%, phosphorus 20.61-17.50%, potassium exchange 218.0-216.0 mg/kg, humus 3.0-2.85%, organic carbon 1.89-1.64%.

At the same time, the amount of the residues after the harvest period on conservative agricultural lands is constantly monitored per 1 sq m. The same procedure has been monitored during the same period in 1 ha land after the harvest period. Sowing different types of seeds with turn during the experimental period of 2016-2018 as following: autumnal wheat seed in 2016, planting of bean as an interval in summer 2017, then autumnal barley in 2017, then corn planting as an interval in summer 2018 and later autumnal barley in 2018. The volume of residues after the harvest period accordingly to above-mentioned years shown in table 3.

Table 3 – Residues volume during the experimental period (kg per ha)

| Volume of residues Kg per ha | 2016 autumnal | 2017 Interval summer planting | 2017 autumnal | 2018 Interval summer planting | 2018 autumnal |
|------------------------------|---------------|-------------------------------|---------------|-------------------------------|---------------|
|                              | wheat         | Bean                          | Barley        | Corn                          | Barley        |
|                              | 1300          | 1150                          | 1050          | 10500                         | 1200          |

As it shown in the table 3, plant residues applied 1300 kg/ha autumnal wheat area in 2016, 1150 kg/ha in summer interval bean area in 2017, 1050 kg/ha in autumnal barley area in 2017, 10500 kg/ha in summer interval in 2018 and 1200 kg/ha in autumnal barley in 2018.

Thus, it becomes apparent that the amount of humus in the experimental region increased compared to the traditional region in the period of 2016-2018. The amount of humus and organic carbon has been changed 2.17-3.1% (difference 15%) and 1.60-1.80% (difference 12.5%) respectively. The main reason for this is plant residue in experimental area and application of turn plantation and it leads also for preventing of land erosion and salinization, and improves recovering of land fertility.

Initially, it is possible to observe visually the increasing numbers of earthworm, due to remaining of plant residues on sites. Because these residues are breaking down gradually and at the same time the activities of small creatures are improving in soil contents. It will help us to focus on effects of new agricultural systems on land fertility.

Turn planting scheme is very important in the frame of increasing of the productivity and increasing of land fertility in agricultural lands. The scientifically based sequence of plants provides the correct prevention of land erosion, diseases and pests, weed growth, and also helps to increase the nutrient content in the soil. Through the plant residues some part of nutrients of plants are pushing aside, but another part is remaining for soil. By this way, 50% of phosphor and calcium, 60% of nitrogen returning to the soil [3, 2, 5].

Perennial bean plants and wheat seeds plants provides protection of soil from water and wind erosion, as well as improves the soil structure. Thus, it is possible to improve the agrophysical characterization of soil and to increase the land fertility through proper turn planting of ephemeral and perennial wheat plants.

The soil is living creature, which consists of various small creatures and microorganisms. The fertile soil is able to provide plants with air, heat and necessary nutrients for its development and normal growth. The content of the soil is changing constantly, because of interactions between soil and plants. The main locomotive for natural fertility is microorganisms, small creatures, plants and interaction of soil.

At the end of their lives, all small creatures that live in the soil contents gradually decompose and mix with the soil as a result of microbiological processes. At the result, the amount of humus in the content of soil is increasing. Organic and inorganic ingredients combine and shape a new form in the soil. It calls soil fertility. That's why we call soil living creature.

The porosity of the soil is also increasing due to microorganisms' process. This leads to provide soil with wetter. At the result the structure of the soil is increasing. The better structural soil and its fertility always leads to increasing of microorganisms and its diversity of sorts [5, 8, 13].

The plants residue remained on land surface after the harvest period in conservation agricultural system. These residues applied to the soil after the chopping procedure by special chopper machine. The aim for applying residues is only to strengthen activities of microorganisms. Through these microorganisms the compose materials in the content of soil is being increased.

These residues also protect the soil from sun shine, wind and negative impacts of rain, as well as irrigation and wind erosions. Besides of protection, residues also prevent negative impact of weeds growth. During these works it is possible to get stable productivity, increasing soil fertility, as well as the recovering of micro and macro faunas in unplowed lands [4, 5, 12].

## **Result**

This article is about the declining of land erosion and increasing of land fertility through the applying of conservation agricultural system in the central part of the Azerbaijan. As a result of study, it became a clear that, levelling of soil with laser also check-row planting leads to save a water use and prevent a loss of nutrients during the irrigation. At the same time, it also became a clear that the content of the humus also is being increased in the soil because of above-mentioned applying

methods. The amount of humus and organic carbon has been changed 2.17-3.1% (difference 15%) and 1.60-1.80% (difference 12.5%) respectively.

## REFERENCES

1. Mammadov, Q.S. (2007). *Fundamentals of Soil Science and Soil Geography*. Баки: "Elm".
2. Mammadova, S.Z., & Jafarov, A.B. (2005). *Fertility classification of soil*. Баку: "Elm".
3. Babayev, A.H. (2005). *Modeling and prediction of fertility of Azerbaijani lands*. Баку.
4. Mustafayev, M.G. (2012). Some problems of saline soil reclamation of Azerbaijan. *Nauchnye issledovaniya v melioracii i vodnom hozjajstve. Sb. nauch. trudov*, 49(1), 106-110.
5. Mammadov, Q.S. (2002). *Land resources of Azerbaijan*. Баку: "Elm".
6. Jafarov, M.I., Quliyev, R.M., & Safarov, N.A. (2000). *Technology of cultivation and harvesting of agricultural plants*. Баку: "Maarif".
7. Dovban, K.I. (1990). *Zelenoe udobrenie*. Moskva: VO «Agropromizdat». (in Russian)
8. Haruna, S.I., & Nkongolo, N.V. (2015). Effects of tillage, rotation and cover crop on the physical properties of a silt-loam soil. *Int. Agrophys.*, 29, 137-145.
9. Aliyev, C.A. (1964). *Organic matter and fertility of Azerbaijani lands*. Баки: "Azərneshr".
10. Retrieved from: [www.fao.org/ag/agp](http://www.fao.org/ag/agp)
11. Retrieved from: <https://www.agro.gov.az/az>
12. Retrieved from: <http://eco.gov.az/>
13. Retrieved from: <https://www.aqrar-elm-ve-innovasiya-merkezi>

*The article was received 11.12.2019 and was accepted after revision 13.03.2020*

**Ф.Т. Джафаров, М.Г. Мустафасв**

## **ВПЛИВ ПРОЦЕСІВ ЗМІНИ КЛІМАТУ НА РОДЮЧІСТЬ ҐРУНТІВ ЦЕНТРАЛЬНИХ РЕГІОНІВ АЗЕРБАЙДЖАНУ**

**Анотація.** Глобальне потепління чинить суттєвий негативний вплив на триваючу деградацію ґрунтів. Підвищення температури повітря, яке все частіше спостерігається останніми роками, разом зі зменшенням опадів і збільшенням випаровування призвели до опустелювання і деградації ґрунтів. Проблема опустелювання дуже актуальна для Азербайджану, для території якого взагалі характерний сухий клімат. Погіршення потенційних і ефективних показників родючості ґрунтів в центральних регіонах Азербайджану перетворилося в тривалий, практично незворотний процес. Спостережуване зниження кількості гумусу, який є вагомим показником родючості, являє собою дуже серйозне попередження, яке слід розцінювати як екологічну кризу або деградацію ґрунту.

З метою захисту родючості ґрунтів можливе застосування комплексу меліоративних і агроеліоративних заходів. Разом з тим збереження родючості ґрунтів також можливо шляхом використання нових технологій, а саме консервативного сільського господарства – КСГ. Система консервативного сільського господарства – це технологія, яка використовується при вирощуванні польових рослин з повною або частковою відсутністю оброблення ґрунту, за умови збереження на поверхні ґрунту мінімум 30% залишків попередніх культур.

Система консервативного сільського господарства є не тільки технічним методом, а й має декілька різновидів підходу. У консервативному сільському господарстві в основному використовуються такі технології:

- Вирівнювання поверхні ґрунту лазерною бороною.
- Збереження на ділянці рослинних залишків.
- Зниження до мінімуму розорювання земель (мінімальна культивация) або зведення розорювання до нуля.
- Застосування системи посіву рядами, що чергуються.

Такий посів також називають безпахотним або безпосереднім посівом. Крім того, в якості добрива ґрунту необхідно застосовувати рослинний перегній (мульчування) і особливо поєднувати його з посівом рядами, що чергуються.

**Ключові слова:** родючість ґрунтів; консервативне сільське господарство; рослинні залишки; засолення; ерозія ґрунту; гумус; вирівнювання поверхні ґрунту

**Джафаров Фазіль Татархан огли**

доктор, старший викладач, Азербайджанський Державний Педагогічний Університет, Баку, Азербайджан

*e-mail:* faziljafarov@yahoo.com

**Мустафасв Мустафа Гілман огли**

доктор аграрних наук, доцент Інституту ґрунтознавства та агрохімії Національної академії наук Азербайджану

**Адреса робоча:** AZ1073 Азербайджан, м. Баку, вул. М. Рагіма, 5

*e-mail:* meliorasiya58@mail.ru

ORCID ID 0000-0003-2071-3078