

CALCULATING THE PERMISSIBLE EXTENT TO THE SOIL LEACHING IN IRRIGATION EROSION OF THE ARID SUBTROPIC

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A method being based practically and scientifically for the definition of the permissible extent to the soil leaching has been offered in guarding measures preparation against irrigation erosion. It is possible to calculate the permissible extent to the soil leaching in the grey, meadow-grey, bright grey-brown, ordinary grey-brown and mountain grey-brown soils by this method.

Keywords: irrigation erosion, a permissible extent, soil loss, humus, washing rate

An intensity and development evaluation of the general irrigation erosion and erosion change depending on physic-geographical condition. As is known, a human's economical activity effects on this change very much. Therefore a human- water-soil system must be taken into account in a mutual connected form for the rational irrigation technology preparation against erosion during an organization of the irrigation works in the erosion-risky soils. That's why a main aim is the definition of the basic factors in the fight measures choice and estimation.

A development rate of the irrigation erosion is extremely great, 18-20 tons of soil are washed out from a hectare in the areas higher than 0,005-0,01 for a year. Mostly leaching occurs by the furrows, strips and torrential irrigation. The soil intensive leaching mainly occurs on the upper part of the irrigative area. As a result the soils expose to degradation and productivity reduces. That's why it is important to prepare the fight measures against erosion in these soils.

A basic factor in preparation of the measures against erosion is to pay attention to the permissible extent for the soil leaching. A soil loss of the permissible extent to the leaching mustn't be more than the soil mass restoring during soil-formation. As additionally, humus and nutrient in soil are assimilated by the agricultural plants and fertility reduces at a vegetation period. This dependence should be expected while the measures are preparing at this moment.

$$T \leq Q_{\text{permissible}}, \quad (1)$$

here: Q- a quantity of the soil being leached as a result of the irrigation erosion: T- the soil mass quantity permissible to leaching.

The main factors in measures preparation for the irrigation erosion are permissible soil mass extent for leaching, a rate of soil-formation and erosion-risky degrees of the zone. The researches show that an exact definition of these factors is very difficult for the concrete zones. The soil profile, thickness, its genetic type and a thickness of the fine layer must be assumed as a basis to protect fertility and substantiate a quantity of the soil mass permissible to the leaching. The changes in the soil physical and chemical characters, a latter state of the erosion development should be taken into account. While a soil mass permissible to leaching is determining, the soil formation rate should be defined. The biogen elements and humus quantity being assimilated by the growing plants must be taken into consideration with the spreading soil. Some researches in the world have recommended to prepare the measures by using of these factors [1, 2, 3, 4, 7, 13]. Last fifty years in some countries of the world different methods have been prepared to determine a quantity of the soil mass permissible to leaching. By these methods its quantity was defined in the different soil types and zones.

The soil leaching extent is accepted being from a ton to 11 (eleven) tons per hectare in a

year depending on soil types, eroding degree and soil formation rate in the USA [14, 15]. But in Germany the washable soil limit is taken as 4,5-11,2 tons of hectare [5]. In England this number is accepted very little 0,2-20 tons of hectare.

Surmach [12] shows that the soil permissible extent to leaching must be defined depending on soil type and its eroding degree while preparing the measures against erosion. The Belgium researches have defined that the soil mass permissible extent to leaching should be determined depending on its chemical structure state and a quantity mustn't be more than 11(eleven) tons of hectare in a year [5]. In Hungary the yearly soil loss permissible extent was determined by 10-15 tons of hectare in the different types of the natural economical areas [5]. The soil formation is a weak process, learning it in definition of the washable soil mass quantity is very important. The researches show that the soil formation rate must be equivalent to the leaching permissible extent [3]. Belgibayev and Dolgilevich [3] have defined a soil formation rate in chestnut and grey soils and come to such a conclusion that its velocity in chestnut soils is 0,36 mm/year, but 0,277 mm/year in grey soils. Shykula, Rojkov, Tregubov [13] have calculated a soil formation velocity for the different soil types by paying attention to a real situation. According to these researches a quantity of the soil mass permissible to leaching has been accepted 3 tons/hectare in chestnut soils.

While some researches recommend the water expenditure that is possible by a furrow in irrigation, they have taken the washable soil quantity in a different limit. In Uzbekistan B.F. Gambarov [6] and in Kazakhstan K.B. Balkabekov [2] show that a soil quantity permissible for leaching by a furrow in irrigation change 7-25 t/hectare/year depending on its thickness and structure. According to some researches a quantity of the soil permissible for leaching shouldn't be less than soilforming rate (velocity), Zaslavsky [5] recommended to be taken the soil quantity permissible for leaching two times less than a mass in soil formation. R.P. Morgan [15] has come to a conclusion that the leaching soil quantity during an irrigation shouldn't be more

than one ton from hectare in a year in order to prevent from the environment pollution and to protect soil fertility. V.S. Tatarova, Kristeva [10] consider that on Bulgaria condition the leaching soil mustn't be more than 0,2 t/hectare as a result of the surface flow in an irrigation.

Some researchers offered strong reducing the water expenditure quantity for minimizing of the leaching soil quantity on the upper part of the area.

S.E. Mirtskhlova [8] with her theoretical researches and M.S. Kuznetsov [7] with his practical researches showed that the flow velocity must be equal to the sum of the leaching rate number with 0,8 on the furrow top part for not being more of the soil quantity leaching as a result of irrigation erosion than the permissible extent (*Vor* $0,8=V_y$).

They called this velocity not possessing a limit for leaching. If this velocity limit is applied the water expenditure quantity mustn't form a leaching process on the furrows top part. Though this method is grounded on the exact calculations, some factors shouldn't be taken into account here. These debris accelerate the soilformation. It is possible to express the process as the following dependence form:

$$O+P \geq Q+B \quad (2)$$

here: O- soilformatin velocity, soil occurred in a year by ton/hectare ;

P- a fertile soil mass entering with the irrigation water, ton/hectare;

Q- a soil quantity lost as a result of erosion;

B- a fertile soil mass lost as a result of the plant assimilation, ton/hectare, sult of the plant assimilation, ton/hectare.

During the cultivation the mineral and organic fertilizers are applied in the soil, these positively influence on soil fertility, different soils enter the soil with the irrigation water by dependent flow and accelerate its chemical degradation. At present soilformation are separated into natural and cultural soilformation. The researches show that the cultural soilformation. The researchers show that the cultural soilformation

process occurs in the cultivated soils. A different idea is available about its velocity [5]. Though the soilformation velocity is fast in the cultivation with a high agrotechnical level, the contrary processes occur in a little level-cultivation.

It is obvious from the abovementioned analysis that the soilformation velocity in any soil is different under the various hydrothermic condition and a long scientific-research work is required for its exact definition and studying. Though the soil cover degrades as a result of the erosion process on the other hand it is restored by a natural and antropogenic soilformation. In spite of complexity and difficulty of learning the natural and antropogen soilformation, its comparativeness with the soil quantity permissible to leaching it creates a great scientific-practical interest.

We have used from the following formula to define permissible extent for leaching as a result of the soil irrigative erosion:

$$T = \frac{100 \times H}{C} \quad (3)$$

here: T- a soil permissible extent for leaching by t/h; H- a humus quantity lost from hectare in a year; by a ton. C- a humus quantity in soil at a present situation by %.

This formula can define the humus quantity lost from a hectare in a tear.

$$H = H_1 + (H_2 - H_1) \left[\frac{Z - Z_1}{Z_2 - Z_1} \right] \quad (4)$$

Here: H₁- the humus low extent permissible for loss in a year; by t/hectare, this limit must be equal to the humus collecting in the soil for a year.

H₂- the humus high limit permissible for loss in a year, ton/hectare;

Z- the humus supply on the soil layer being used in the current year, by ton/hectare;

Z₁- a last crisis supply of humus on the using soil layer, ton/hectare;

Z₂- an optimal convenient supply of humus on the using soil layer, ton/hectare.

A yearly lost humus average value is 0,0858 ton/hectare by calculating with this formula in the grey, meadow-grey and bright-grey soils. A quantity of the soil permissible to leaching is 3,04 ton/hectare (table). During the investigation 36 samples of bright grey-brown, 25 samples of ordinary grey-brown and 22 samples of mountain-grey-brown soils have been used. The given humus indications have been calculated on the basis of the mean statistical information.

The humus average quantity lost in the ordinary grey-brown and mountain-grey-brown soils in the year is 0,132 ton/hectare. A quantity of soil permissible to leaching in these soils is 3,82 ton/hectare. These indications are near to M. Belgibayev and I. Dolgiyev's conclusions. Including the offered washing limit corresponds to the obtained consequences in the USA, Germany and Belgium.

Table

Indications of the humus and soil limit quantity permissible to leaching

Soil name	Humus leaching low limit ton/hectare	Humus high limit permissible to leaching t/h	Humus supply			Humus lost in a year ton/hectare	Soil extent permissible to washing t/h
			In a current year	Crisis limit	Optimal limit		
Grey, meadow and bright grey-brown	0,062	0,132	48	20	88	0,054	3,03
Ordinary, dark grey-brown, mountaingrey	0,093	0,236	58	31	116	0,034	3,82

The soil loss permissible to grey, meadow grey and bright grey brown, ordinary grey-brown and mountain grey-brown has been calculated for preparation of the measure against irrigation erosion. It was known that a soil mass lost from a hectare for a year in the grey, meadow grey and bright grey brown soils shouldn't more than 3,03 tons, but in the ordinary, dark grey-brown and mountain-grey brown soils it shouldn't be more than 3,82 tons. In all the measures against erosion these numbers must be certainly taken into account. If the given water expenditure increase is taken into account, the measures can be additionally fulfilled to increase durability against erosion.

REFERENCES

1. Babayev M.P., Gurbanov E.A., Hasanov V.H. Soils degradation and protection in Azerbaijan, Baki.: Elm, 2010, p. 212.
2. Balgabekov K.B. Prevention methods of the irrigative soils erosion// News of the agricultural-science in Kazakhstan. Almaty, 1985, №3, p. 36-38.
3. Belgibayev M.E., Dolgilevich M.I. Definition of the soil erosion permissible quantity. Works VNIA. pub. 1(161) Volgograd, 1970, p.45.

4. Zaslavsky M.N. Soil erosion. M.: Misl, 1979, p. 245.
5. Zaslavsky M.N. Erosion implementation. M.: Vishaya shkola (High school), 1983, p. 320
6. Kambarov B.F. Antierosion and water preservation mechanics and technology of the land irrigation at a foothill zone of Uzbekistan. Synopsis of thesis. doc. of tech science. Tashkent, 1994, p. 38.
7. Kuznetsov M.S. Soil erosion and protection. Pub. MSU. 2006. p. 345.
8. Mirikhulova T.E. Water erosion of soils (mechanism, prognosis) Tbilisi: Mertsieniereba, 2009, p. 412.
9. Polyektov E.B. Soil erosion on Don and fight measures with it. Rostov-on-Don. Pub. Rostov University, 1984. p.164.
10. Tatarova- Kristeva V.S. Irrigative erosion under gravity irrigation of some soils in Bulgaria// Soil Science. 1971. №12. p. 107-115.
11. Sobolev S.S. Soil protection from erosion. Moscow, p. 31-98.
12. Sumrach G.P. Reliefforming and erosion processes in period// Soil science, 1978, №6. p. 31-98
13. Shikula N.K., Rojkov A.G., Tregubov P.S. To the problem of territorial mapping on erosion process intensity and "Evaluation and mapping of erosion-dangerous and deflation-dangerous soils". M., 1973, p. 30-34.
14. Soil erosion. Under pub. M.I. Kirkby, R.P.K. Morgan. M.: Kolos, 1984, p. 523.
15. Morgan R.P.S. Soil erosion and conservation, 2008, p. 293. 2-nd Longman.

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QURU SUBTROPİKDƏ İRRİQASIYA EROZİYASINDA TORPAĞIN YUYULMASINA YOL VERİLƏN HƏDDİNİN HESABLANMASI

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İrriqasiya eroziyasına qarşı mühafizə tədbirlərinin hazırlanmasında yuyulmasına yol verilən torpağın həddinin müəyyənləşdirilməsi üçün təcrübə və elmi cəhətdən əsaslandırılmış üsul təklif edilmişdir. Bu üsulla boz, çəmən-boz, açıq boz-qəhvəyi, adi boz-qəhvəyi və dağ boz-qəhvəyi torpaqlarda yuyulmasına yol verilən torpağın həddini hesablamaq mümkündür.

Açar sözlər: irriqasiya eroziyası, yol verilən hədd, torpaq itkisi, humus, yuma sürəti

РАСЧЕТ ДОПУСТИМОГО СМЫВА ПОЧВЫ ПРИ ИРРИГАЦИОННОЙ ЭРОЗИИ В СУХИХ СУБТРОПИКАХ

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Предложен научно и практически обоснованный метод расчета допустимого смыва почвы в процессе ирригационной эрозии для использования при разработке противоэрозионных мероприятий.

Этот метод может быть использован для расчета допустимого смыва на сероземных, лугово-сероземных, светлых серо-коричневых, обычных серо-коричневых, и горно серо-коричневых почвах.

Ключевые слова: ирригационная эрозия, гумус, деградация, плодородие, потери почв, морфогенетические показатели