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QUESTIONS TO PREDICTING SOIL EROSION

Matveev P.M., *researcher*
Kharkov National Agrarian University named after V.V. Dokychaeva

The analysis and comparison of mathematical model and the equation of soil loss from water erosion. Suggestions on improvement WEPP model in terms of detail block "Terrain" by using software Arc / Info / Map / Scene.
Keywords: *erosion process, erosion Weep model, land degradation, steepness of slopes, terrain model .*

Statement of the problem

Today predicting quantification of soil erosion is the most urgent task, as a result of the crushing of large farms change ownership of the land , the violation of technological processes in agricultural production, failure of crop rotation, acceleration observed intensity of erosive destruction of the soil [1-6]. To this end, in the last days of the world's developed and used many mathematical models [7-9], which allow a sufficient degree of probability to observe and predict soil erosion . However, almost all models have a number of drawbacks:

1) model developed by analyzing statistical observations under artificial irrigation on experimental sites (landfills);

2) have a different degree of theoretical study and performance conditions which simulated erosion;

3) All models can only be used for specific natural and economic conditions of a particular region so they aren't universal in application;

4) require a lot of information indicators are either missing or require special studies to their reception , large costs both time and money;

5) dependence, which are incorporated in the model can not be directly extrapolated to real conditions , even in regions where they are received;

6) models do not describe a number of components of soil erosion, which in nature can and usually operate simultaneously in different combinations, making it impossible to foresee with a sufficient accuracy the effects of the destruction of the soil.

Proceeding from the above question in more detail to investigate this problem and identify some areas to address it.

Analysis of recent research and publications

The issue of determining the manifestation of erosion processes and their qualitative and quantitative evaluation are devoted S. Bulygina, E.V. Butenko, G. Dobrovolsky, D.S. Good-natured, V. Biotechnology, A.P. Canas, V. Krivov, S.A. Osipchuk, A.M. Tretyak, M.A. Hvesyka, M.K.

Shykuly and others who have developed mathematical models that make it possible with reasonable probability to observe and predict soil erosion and improve sustainable agricultural landscapes and land resources in general.

However, along with the already illuminated face new aspects that require thorough research and observations. In particular there is a need in more detail explore of the problem of erosion in sloping practical application of mathematical models describing the process.

The aim of the article - to justify the theoretical and methodological approaches to determining the sloping soil erosion based on our research and analysis are developed and consumed by the most practical mathematical models that enable different degrees of probability to determine soil erosion.

The main material

Virtually all methods of calculating sloping erosion based on the dependence

$$A = f(R, K, L, S, C, P)$$

where A - the average annual soil loss under the influence of rainfall per unit area per year (t / ha);

R, K, L, and S - indices that take into account the impact of energy intensity rains;

R - index, which will account for the energy and intensity of rainfall (rainfall erosion index).

Determined by statistical analysis udometer graphics of all stoke creating rains as average values of the energy of rain over a 30 minute intensity or erosion index map of precipitation for Ukraine.

K - index of type and condition of the soil is a factor pliability soil erosion. Defined as the ratio of the average soil flushing of the drip area of 1 m^2 to the value of R depending on the steepness of the slope and the percentage of size fractions of soil organic matter in its structure and permeability. However pliability factor of soil erosion mainly takes into account only the differences in texture, the soil at the same time the resistance of soils is highly dependent on soil erosion and neglect that influences the underestimation of the potential erosion of arable land security.

L - length of the slope (m) and S - slope steepness (%) - terrain factor - determined on a standard waste box, which is often not the actual conditions because of the neglect of the features of the flow and flushing hill slopes complex shape.

C - index, which reflects the impact of land - crop rotation conditions is dependent on vegetation for erosion conditions. Determination of this factor is quite a challenge because of the wide variety of cultures.

P - the index that measures the impact of antierosion efficiency. Defined as the ratio of soil loss from areas occupied by various crops with specific erosion control measures to control soil loss from land that is fallow without erosion control measures.

Analyzing and comparing model and equation of soil loss from water erosion, those that are often used for prediction (table 1) can be drawn:

Honors following models are in:

1) simplifying or complicating the basic system of equations;

2) the choice of different boundary conditions;

3) The choice of different numerical schemes in implementation;

4) the presence or absence of a standard technology for output and degree of detail.

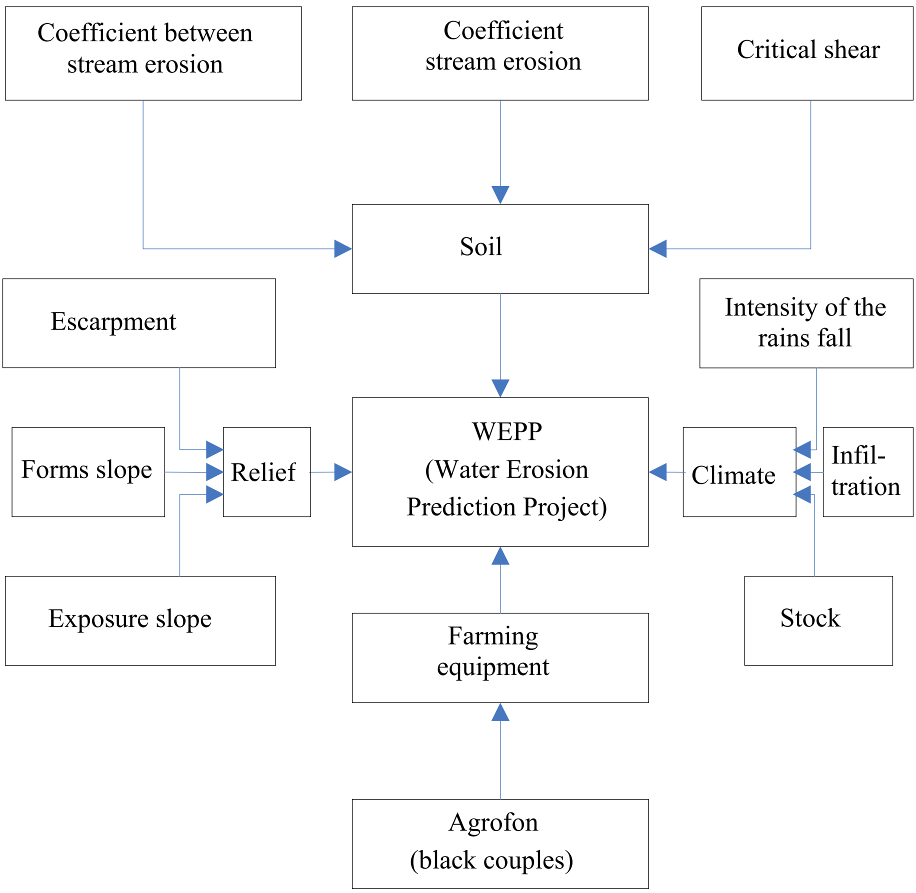
1. Analysis of the models in terms of soil loss from water erosion

№ in order	Models and equations of soil loss from water erosion	Characteristic	Features and values of the coefficients
	Methods for water erosion calculations		
1.	USLE A=RKLSCP	Used to calculate between stream and stream erosion factors as a function of climate, soil, topography and land use	A - soil loss; R - coefficient of soil erosion sediments; K - coefficient of soil erosion (soil loss from rain under standard conditions); L - coefficient of length (soil loss from the catchment); C - coefficient of land use; S - the catchment of bow; R - coefficient of erosion control measures.
	Analysis: difficulty determining of growing crops factor in view of a large number of ways of cultivation is C multiplied by the average annual precipitation coefficient R for each period		
2.	RUSLE	Saved all factors USLE formula but tweaked	R - calculated on the basis of statistical analysis of hourly data layer of rain in the United States; K - calculated by the program to determine soil erosion.
	Analysis: The model can not be considered universal, but the technology can be used		
3.	EPIC A=RKCPLS	Simulates water erosion caused by rain and brief rainfall. Based on the universal equation USLE	A - value erosion, t/ha; R-product precipitate, t/ha; K - coefficient of soil erosion; C - coefficient yields during all days when there is precipitation, t/ha; R - coefficient of erosion control measures; L, S - slope coefficient and slope.
	Analysis: require rather complex calculations of additional coefficient K, C, L, S, R (P exclusion coefficient - defined as the model USLE)		
4.	WEPP continuity equation for the flow of sediment that established dG / dx = D1 + Dr	Simulates prior to erosion processes with a time step of one day and is based on the concept between stream and stream erosion	G - unit costs of sediment along the length of the slope, kg/s/m; x - distance down the slope, m; D1 - intensity side bringing the flow of particles kh/s/m2; Dr - intensity separation or postponement of particles in streams, kg/s/m
	Analysis: The model prediction is limited only superficial, stream and ravine erosion		

Addressing soil degradation and, above all, as a result of erosion on a particular plot of land in an integrated account of the maximum number of parameters which contribute most effectively to present a model of water erosion Water Erosion Prediction Project (WEPP). The model is based on objective natural laws of physics erosion- accumulative processes, so it can be used to simulate erosion regulation of agricultural landscapes.

When modeling erosion WEPP model works with several blocks of data (Figure) "Soil", "Climate", "Farming equipment" (data can be collected for the region by the average or typical values), "Terrain" (data unique to this specific land).

To create a block "Terrain", namely simplification and greater specificity database of any land, we have proposed to use software Arc / Info / Map / Scene.



Pic. Algorithm WEPP mode l

The program is intended for simulation and analysis of topographically related objects in a spatial network, display continuous geographic phenomena. Arc / Info supports coordinate geometry (input as a primary surveying data and coordinate) and conversion of raster images into vector, which allows to calculate the steepness of the slopes, create terrain model in three - dimensional image.

Using the software to analyze the data object of scientific study (PDP "Molniya-1" Vovchansky area Kharkov region) obtained the following results. Total agricultural land, being on a slope area to three degrees to almost 80% with more than 16 % of arable land (approximately 1561 ha) is at risk of water erosion is a bias relief of 3 to 7 degrees to 11,4 %, and more than 7 degrees more than 5 % (table 2).

2. Distribution of agricultural land on a slope terrain PDP "Molniya - 1" Vovchansky area Kharkov region

Slope topography, degrees	Arable		Pastures		Hay		Total	
	га	%	га	%	га	%	га	%
To 3	7704,9	83,2	151,0	25,2	19,2	28,2	7875,1	79,3
From 3 to 7	1056,9	11,4	107,4	17,9	21,7	31,8	1186,0	11,9
More than 7	504,1	5,4	341,5	56,9	27,3	40,0	872,9	8,8
Total	9265,9	100	599,9	100	68,2	100	9934,0	100

Applying this technique far more accurately reflects the actual danger of erosion of soils in comparison with the general characteristics of the Kharkov region (table 3).

3. Soil Erosion hazard of Kharkiv region

Regions	Average length of the slope, m	Average slope, degrees	Soil erosion, t/ha			Average humus horizon H, cm	Index of soil conservation, years
			When shower	When snowmelt	Total		
In Kharkiv Region	492	1,8	4,7	19,4	24,1	42,1	234,5
Administrative district forest - steppe zone	462,5	1,9	5,0	25,1	30,1	40,0	149,6
Volchanskiy area	430,0	1,7	3,8	21,0	24,8	41,0	182,0
Administrative area of the steppe zone	535,0	1,7	4,4	11,1	15,5	45,1	347,5

Conclusions

1. Existing models predict soil erosion processes characterized by different degrees of generalization, and selective use of information.

2. In the study, a higher level of information base and filling it with new data models used today, it is necessary to update and refine, leaving their essence.

3. Creating universal soil loss prediction model of erosion by the use of other areas of software will allow more likely to anticipate a situation in the future .

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Проведено аналіз і співставлення математичної моделі та рівняння втрат ґрунту від водної ерозії. Подано пропозиції щодо удосконалення моделі WEPP в плані конкретизації блоку «Рельєф» шляхом використання програмного забезпечення Arc / Info / Map / Scene.

***Ключові слова**: ерозійні процеси, модель Weep, деградація ґрунтів, крутість схилів, модель рельєфу.*

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Проведён анализ и сопоставление математической модели и уравнения потерь почвы от водной эрозии. Предоставляются предложения по совершенствованию модели WEPP в плане конкретизации блока «Рельеф» путем использования программного обеспечения Arc / Info / Map / Scene.

***Ключевые слова:** эрозионные процессы, модель WEPP, деградация почв, крутизна склонов, модель рельефа.*