

By ravines and gullies forest belts influence on the erosion and accumulation process on hollow slopes

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The purpose. To develop the theory of allocation of melkozem on hollow downslopes under the influence of gullen- and balk-adjacent woodland belts and to attract more attention to restoring wood-melioration operations in terrains of agricultural land-use. **Methods.** Geomorphological analysis of map material and space pictures, selection of typical for conditions of Northern Steppe hollows on downslopes of different exposure with various combination of agricultural lands. Geodesic methods of soil-erosive surveys which determine developmental character and moving direction of soil on different elements of land forms and as a result — formation of head loops of ablation — accumulation on hollows. **Results.** Influence of gullen- and balk-adjacent woodland belts is fixed on erosive-accumulative process on hollows which upper part from below is limited by woodland belt and is under intensive agricultural land-use, and lower one — is under forage grasslands. During field and cameral surveys catchment areas of woodland belts are specified. Character of formation of head loops of ablation and accumulation proves that soil as a result of ablation or plowings was tolerated from drainage area and secondary downslopes and deposited on thalweg in catchment area of woodland belt. **Conclusions.** Gullen- and balk-adjacent woodland belts are the organizing beginning of soil-protective land-use on slope lands. They promote levelling procedure of surface of soil on field part of hollows, reduce erosion processes on drainage areas and form head loops of accumulation in working area of the influence. Besides they promote activity of natural gears of protection of soils on hydrographic network. With termination of active erosion processes on the balk part of hollows the powerful soil-covering is formed, and on thalweg — dumetums. It as a whole confirms necessity of restoration of wood-melioration operations on lands of the agricultural factories.

Key words: *gullen, hollow, scour, woodland belt, erosion, accumulation.*

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Forest plantations in the steppe zone frequently of all are distributed as gully forests on a hydrographical network. By ravines and gullies forest belts are located alongside of ravines and gullies edges. Technology of the forest belts creation and looking after them was designed by many scientific institutions and famous scientists [1, 2, 3, 4]. In seventies of the last century development and implementation of soil conservation complexes with the system of forest shelterbelts was carried out the most intensively [5, 6]. From that time the work gradually finished and an attention to the soil conservation value of forest plantations on the lands of modern agricultural formations decreased but that is not deserved. However despite of that, the most favorable conditions for agricultural production growing are observed on the fields under the protection of forest plantations exactly [7, 8, 9]. By the data of Thomas Scholten [10] afforestation is used in Europe as a soil control measure, as far as soil lost only from rainfalls amount 2.46 t/ha in a year.

Investigations purpose – update a theory of the soil fine particles distribution on hollows slopes under the influence of forest shelterbelts along gullies banks and attract more attention to the restoration of forest amelioration works on territories of an agricultural use.

Materials and methods of investigations. Investigations were fulfilled in conditions of the North step of Ukraine on a territory of gully watershed “Archipiv yar” with the area 11.28 km². The object is situated on the territory of the agricultural enterprise “Rzovten”, Sotenne village, Stanichno-Lugansk district of Lugansk region. Directly gully part of the watershed is confined by a forest belt. Height of the belt is 8.5 m, width – 20 m. Field part of the watershed is used for field crops rotation, gully part is occupied by grasslands. Laboratory

surveying included cartographical material and cosmic prints study, field surveying – reconnaissance observation of different elements of hydrographical network and selection of more typical hollows for investigations in detail (table). Topographical land survey was performed on the watersheds [12]. After cameral processing of the survey, received plans with horizontals mixed in the same scale with a topographical map on the moment of it correction in 1989. It makes possible to define relief changes during 28 years [13] and contours of the soil movement, as a result of erosion and accumulative process with the help of a vertical chart-mapping [14]. Main point of this is to define a depth of the soil profile along selected transects. So on the hollow 1 four transects were selected. The first one was laid along a thalweg – main runoff line, others – crosswise to the hollow on the up and down forest belts margin and in a middle part of the gully. On the hollow 2 it were laid three transects: along the thalweg, parallel to up and down margins

Short characteristic of investigative hollows

Object	Slope exposition	Agrolandscape element	Area, ha	Runoff line length, m	Thalweg steepness grade	Agricultural background
Hollow 1	North-East	field	12.6	700	3.2	Ячмінь, соняшник
		gully	0.71	110	4.2	Кормові угіддя
Total		-	13.31	810	3.4	-
Hollow 2	South-west	field	4.52	378	2.4	Соняшник
		gully	1.43	147	5.0	Кормові угіддя
Total		-	5.95	525	3.1	-

Result of investigations. Field survey results analysis allowed to define soil lost and accumulation contours on hollows (fig. 1, 3).

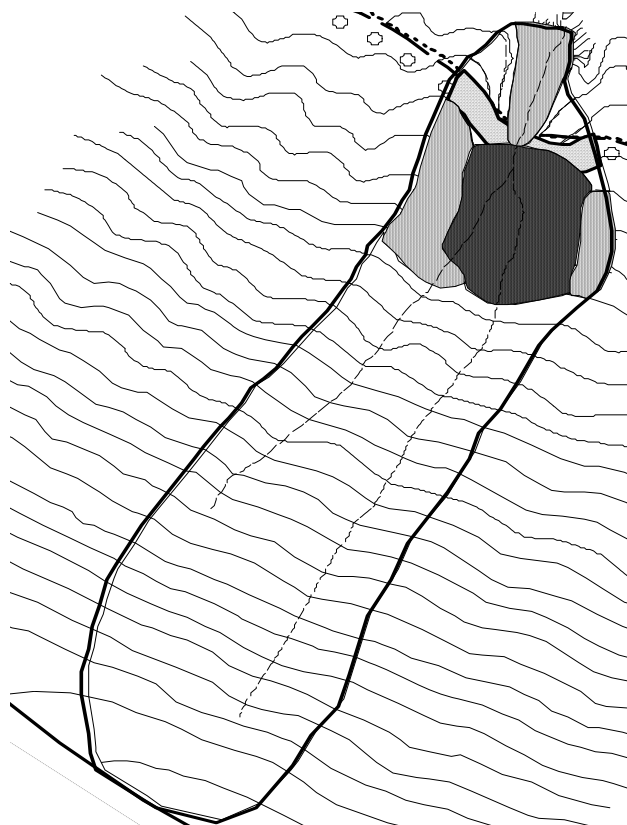
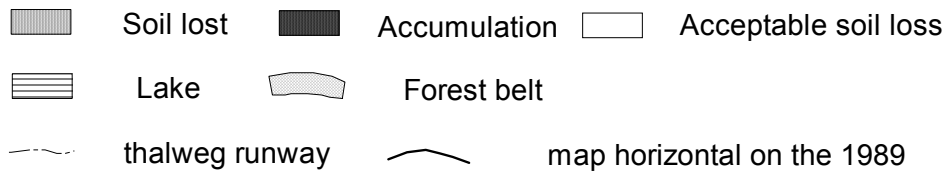


Fig.1. Chart-mapping of erosion and accumulative process on the hollows 1



The contours disposition indicates changes for the 28 years. So, on the hollow 1 erosion and accumulative process is more actively observed in it's down third part (fig.1). In the time of the forest belt planting (about 40 years ago) a ravine in down part of the hollows was active and grew up to the slope. After forest belt creation the ravine crown progressed to the middle of it. After that a damping process of the ravine became. Soil profile chart-mapping along the thalweg (Fig.2) shows soil fine particles deposit on the field part of the hollows on the distance 140 m up to the slope. On the up forest margin gradually a little shaft is ploughed. Soil from the hollow water divide was carried to thalweg.

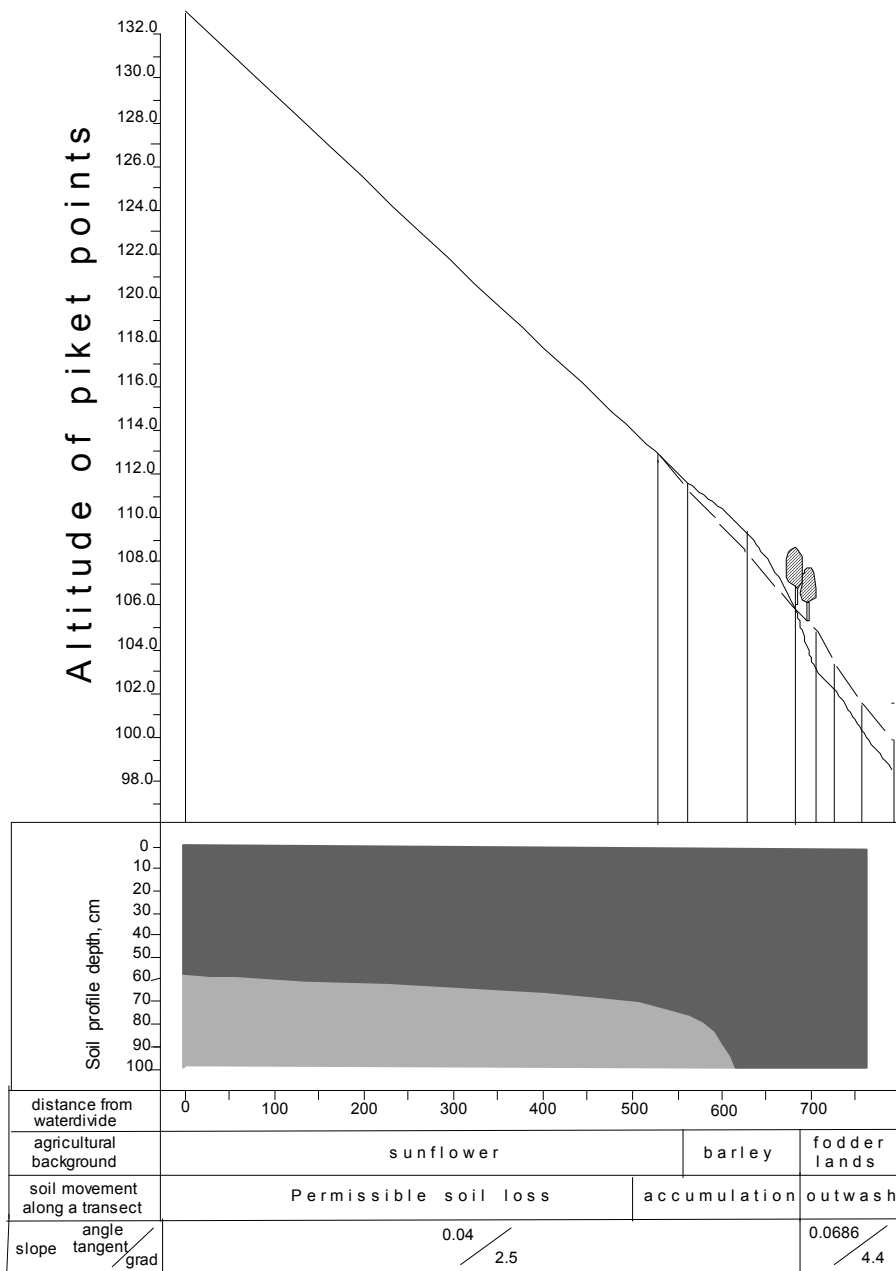
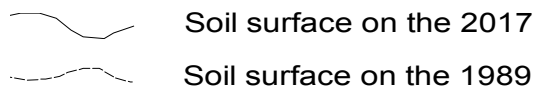


Fig.2. Chart-mapping of the soil profile along the hollow 1 thalweg



On the down gully part the soil fine particles carrying out observed on the surface, but a vertical profile shows more depth lay of a humus horizon. It gives evidence of the soil deposit. It is possible to suppose, that soil along the thalweg is alluvial, an accumulation process is being continued and ancient ravine is not filled yet by carried from upper slopes soil material. On the hollow 2 erosion and accumulative processes more intensively developed on the down half of it (fig. 3). So, the chart-mapping of the soil profile along the thalweg (fig. 4) shows that on the distance of 100 m above the upper forest margin, in a very forest belt and in a lower gully part of it stable process of accumulation is observed. In a gully boundary the ravine with the 662 m² area was flattened.

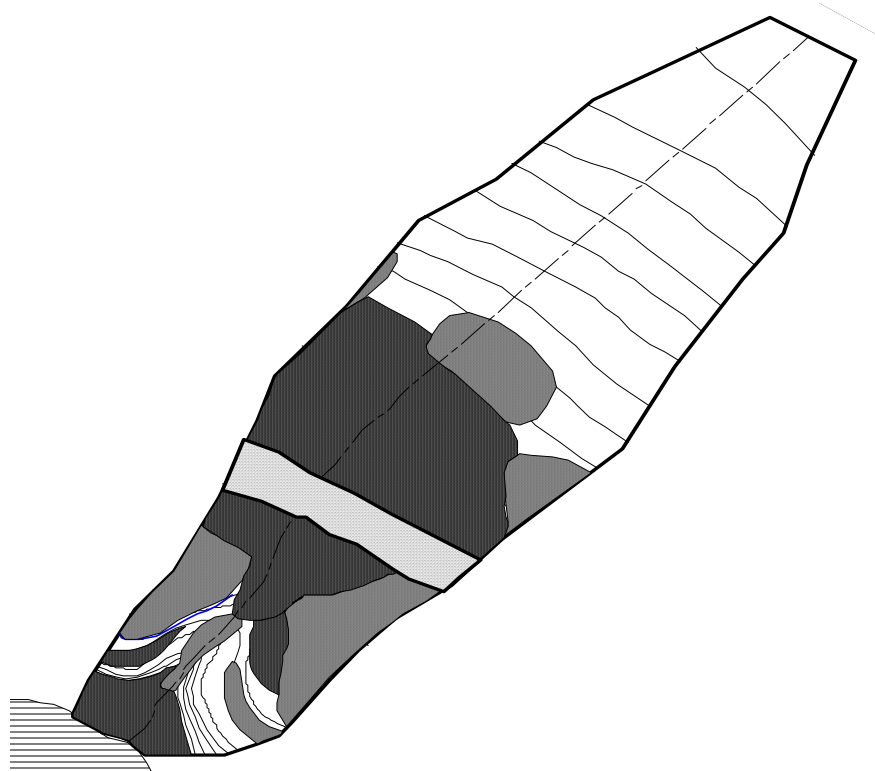









Fig.3 Chart-mapping of erosion and accumulative process on the hollows 2

	Soil lost		Accumulation		Acceptable soil loss
	Lake		Forest belt		
	thalweg runway		map horizontal on the 1989		

Forest belt in a process of her growing have played a role of organizing origin for mechanical cultivation of the soil. Gradually the soil surface on the field before forest belt has being flattened, soil fine particles thanks to plowing was carried from the hollow water divides to its thalweg. At the same time with a runoff intensity decrease in a big activity, natural mechanisms of the soil control, such as grass cover and bushes, especially in a thalweg part of gully had displayed. Therefore the soil fine particles were being carried by brooks from the less fixed surfaces of water divides to thalweg.

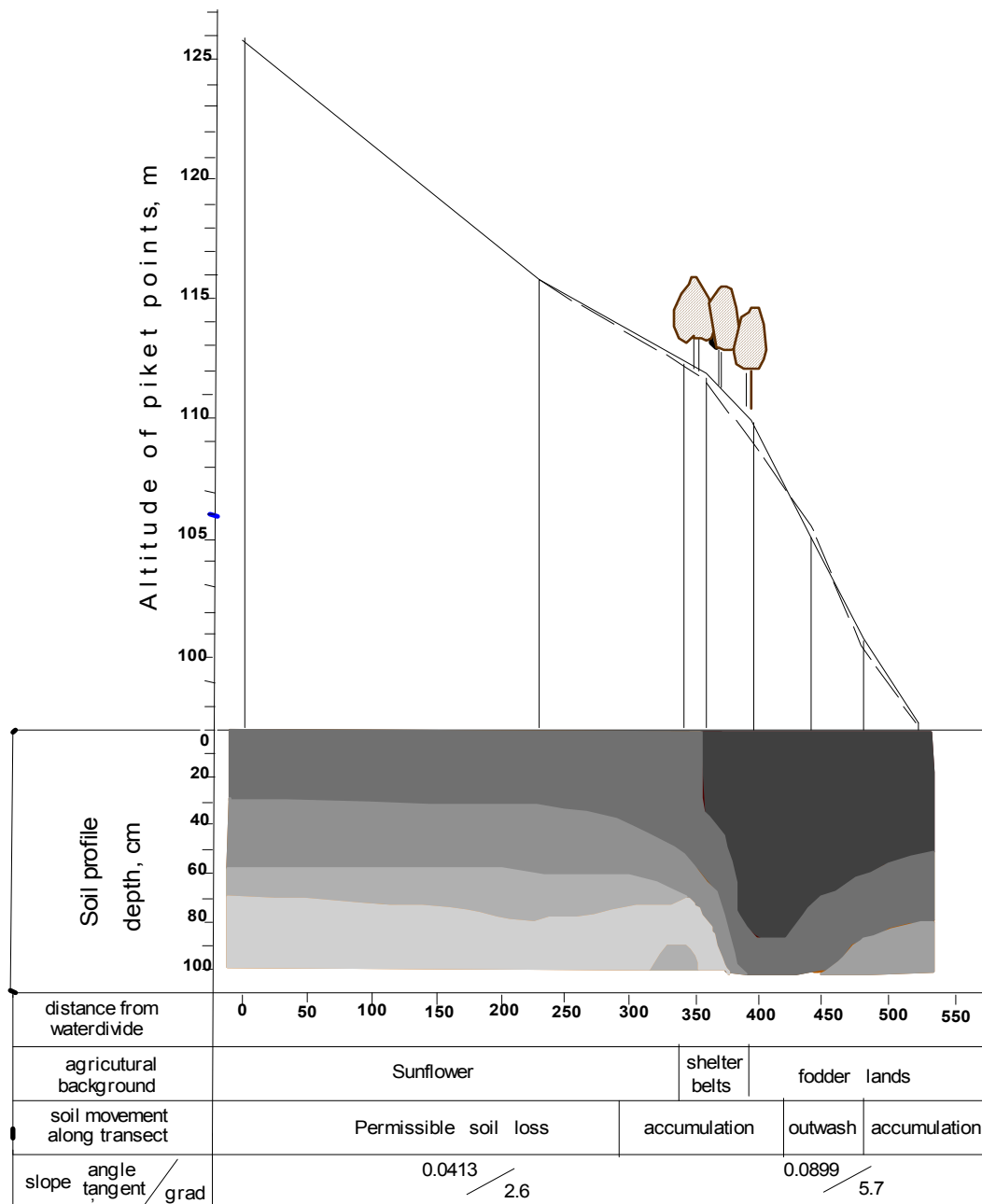

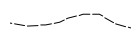


Fig.4. Chart-mapping of the soil profile along the hollow 2 thalweg

 Soil surface on the 2017
 Soil surface on the 1989

Summary

By ravines and gullies forest belts are an organizing origin for a cultivation direction, promote the soil surface flattening on a field part of the gully. On the upper forest margin a little shaft is plowed, which promotes runoff absorption and the soil accumulation. Forest belt decreases the destructive runoff energy, thereby prevents the soil wash out and reinforces natural mechanisms of the soil control on a gully part of a hollow, wherewith prevents ravine creation process.

Bibliography

1. Instruktivnye ukazaniya po proektirovaniyu i vyrashchivaniyu zashchitnykh lesnykh nasazhdeniy na zemlyakh sel'skokhozyaystvennykh predpriyatiy [Guidelines for the design and cultivation of protective forest plantations on the lands of agricultural enterprises]. Moskva: Kolos. 1973. 40 p. [In Russian].

2. Instruktsiya po proektirovaniyu i vyrashchivaniyu zashchitnykh lesnykh nasazhdeniy na zemlyakh sel'skokhozyaystvennykh predpriyatiy Ukrainskoy SSR [Instructions for the design and cultivation of protective forest plantations on land agricultural enterprises of the Ukrainian SSR. Kiev: Urozhay. 1979. 39 c. [In Russian].

3. *Pasternak P.S., Koptiev V.I., Nedashkovskiy O.M. et al.* (Pasternak P.S. et al.) (1988). Dovidnyk z ahrolisomelioratsii. 2-he vyd., pererob. i dop. [Guide for agroforestry. 2nd edition, revised and supplemented]. Kyiv: Urozhai. 288 p. [In Ukrainian].

4. *Hladun H.B., Stadnyk A.P., Bipura L.M. et al.* (2010). Rekomendatsii shchodo pokrashchennia melioratyvnoi efektyvnosti zakhysnykh lisovykh nasadzhen riznoho tsilovoho pryznachennia. Kharkiv [Recommendations for improvement of meliorative efficiency of protective forest plantations of various purpose]. 120 p. [In Ukrainian].

5. *Dzhamal' V.A., Shelyakin N.M., Golovko M.I., Golovchenko I.N.* (1982). Metodicheskie rekomendatsii po proektirovaniyu kompleksa protivoerozionnykh meropriyatiy dlya territorii USSR. Voroshilovgrad [Guidelines for the design of anti-erosion measures for the territory of Ukraine]. 55 p. [In Russian].

6. *Tarariko A.G.* (1990). Agroekologicheskie osnovy pochvozashchitnogo zemledeliya [Agri-environmental bases of soil protection]. Kiev: Urozhay. 184 c. [In Russian].

7. *Zubov A.R.* (2016). Vliyanie lesnykh polos na produktivnost' agrolandshaftov Donbassa [The influence of forest belts on the productivity of agrolandscapes of Donbass]. Zashchitnoe lesorazvedenie, melioratsiya zemel', problemy agroekologii i zemledeliya v Rossiyskoy federatsii. Volgograd: VNIALMI. P. 113–117. [In Russian].

8. *Ruleva O.V., Ovechko N.N.* (2016). Vliyanie lesnykh polos na izmenenie produktivnosti sel'skokhozyaystvennykh kul'tur v khozyaystvakh Volgogradskoy oblasti [The influence of forest belts on the change in crop productivity in farms of the Volgograd region]. Zashchitnoe lesorazvedenie, melioratsiya zemel', problemy agroekologii i zemledeliya v Rossiyskoy federatsii. Volgograd: VNIALMI. P. 506–511. [In Russian].

9. *Sarychev A.N.* (2016). Issledovanie vliyaniya zashchitnykh lesnykh nasazhdeniy i tekhnologiy obrabotki pochvy na produktivnost' ozimoy pshenitsy [Investigation of the effect of protective forest plantations and tillage technologies on the productivity of winter wheat]. Volgograd: VNIALMI. P. 511–515. [In Russian].

10. *Sholten T.* (2015). Soil Erosion under forests. *European Society for Soil Conservation*. Newsletter. № 2. P. 3–13.

11. *Levitskiy I.Yu., Krokhamal' E.M., Reminskiy A.A.* (1977). Geodeziya s osnovami zemleustroystva [Surveying with the basics of land management]. Moskva: Nedra. 256 p. [In Russian].

12. *Berlyant A.M.* (1986). Obraz prostranstva: karta i informatsiya [Space Image: Map and Information]. Moskva: Mysl'. 240 p. [In Russian].

13. *Tarasov V.I., Khromiak V.M., Nalyvaiko V.V. (Tarasov V.I. Ed.)* (2018). Metody vertykalnoho kartohrafuvannia erodovanykh gruntiv i rekonstruktsii gruntovoho profilu (naukovo-metodychni rekomendatsii) [Methods of vertical mapping of eroded soils and the reconstruction of soil profile (scientific and methodological recommendations)]. Kharkiv. 23 p.