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CARBON STOCK IN SOILS OF KAZAKH HUMMOCK CENTRAL PART AND ITS DYNAMICS IN DIFFERENT TILLAGE CONDITIONS

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Abstract. According to the results of soil studies within the Shetsky district of the Karaganda region, the organic carbon stocks in soils are determined. Based on a 1: 200 000 scale soil map, a map of soil carbon stocks in absolute (t) and relative (t / ha) values was compiled. For 20 monitoring sites, carbon stocks in soil and plants for 2004, 2006 and 2008 were calculated, and a comparative analysis of carbon stock changes was carried out depending on the cultivation technologies used.

Key words: carbon stock, soil map, carbon stock map, tillage conditions.

INTRODUCTION

Researches on studying of carbon content in soils of the Kazakh Hummock central part were conducted within implementation of the Drylands Management Project of the World Bank and the Government of RK.

Among the most urgent environmental problems having global value, not the last role belongs to a question of maintaining balance of carbon in the atmosphere. Increase in amount of the carbon dioxide coming to the atmosphere surface layers is connected not only with industrial emissions, but also is substantially caused by irrational environmental management.

Carbon stocks in the soil are the indicator reflecting an equilibrium condition and result of continuous course of two multidirectional and interconnected processes: hymification of the plant residues and their full mineralization. The vegetation cover is one of the major factors defining quantity and composition of the fossils coming to the soil which are the main source of carbon stocks in the soil.

In natural ecosystems carbon content of soil, the amount of organic matter produced by biomass, and the mineralization of plant residues, the carbon outgo to the atmosphere remains stable with the continuity of organic production processes. At the same time, each taxonomic unit of soil is characterized by the equilibrium of organic matter, which is determined by the whole complex of soil-forming conditions to each species.

The involving of soils in agricultural production is the main factor of changes in the balance of carbon in the soil. When plowing the ecological regime of the soil changes abruptly. The rhythm of the productive process of agrophytocenosis is settled artificially, while the interaction of plants with the soil is limited in time, and the agro-system organic substances is irreversibly removed, the biochemical balance is disturbed, leading to the loss of carbon in the soil. In arable soils there is an accelerated decomposition of organic substances caused by increased microbiological activity. The study showed that the roots of cultivated plants in the soil layer of 0-50 cm decompose 1.4-1.6 times faster than in virgin soils [1, 2].

Losses of humus of plowed soil in quantitative terms vary significantly depending on the genetic properties of the soil, topography, type of variable turnover, soil treatment system, the use of fertilizers and can reach 30 % on the plowed layer. On average, over the 50 years of plowing the chestnut soils have lost about 28-30 %. humus. The average annual carbon losses are 4,6-5,8 t/ha [3-5].

Overgrazing is also an important factor in reducing soil carbon stocks. Overgrazing is manifested primarily in disturbance of the natural vegetation cover, accompanied by the formation of secondary weed phytocenoses, and in some places down its complete destruction. The reduction of biomass entering the soil is inevitably leads to carbon losses. Within the central part of the Kazakh Hummock, the area of arable land is small, and pastures, respectively, occupy large areas. Studies show that owergrazing causes a loss of up to 15-18 % of carbon in the 0-10 cm layer [6, 7].

"Management of arid lands". 2004 – 2009. Component 3 "Determination of carbon sequestrations".

The main purpose of soil research in the central part of the Kazakh Hummock was to determine the carbon stocks in soils, above-ground and underground parts of plants and their change during the observation period.

To do this, it was necessary to solve the following tasks: identification of the main chemical, physical and physical-chemical soil characteristics of the territory; compile electronic kind of soil map on the basis of materials of remote sensing and field observation, create soil data base; conduct monitoring studies on selected sites with different types of land use; calculate carbon stock in soils, plant roots; compile a map of carbon stock, analyze carbon stock changes depending on used technologies.

OBJECTS AND METHODS

The object of the research is Shet district of Karaganda region. Geographically its territory is situated in the central part of Kazakh Hummock and is characterized by complex surface structure. Hill and low mountain massifs are divided by large flat-bottomed alluvial plains and interhill valleys which are complicated by different depressions, dry river-beds, depressions with subterranean waters outcrops. That is why the soil cover of the territory is characterized by heterogeneity and complex structure with wide development of soil combinations.

The soil cover of the territory is formed in the conditions of arid (hydrothermal index is 0,6- 0,8) and sharp continental climate of southern part of steppe and northern part of desert-steppe zones, in soil-geographic zonal system that corresponds to subzones of dark-chestnut, chestnut and light-chestnut soils.

Actual material was collected by field research with further analysis and summarizing of the results.

Field soil research include making profiles, their description and soil samples collection. The site of soil profile for background soil characteristics is chosen taking into consideration natural conditions, typical for the given contour. Depth of soil profiles is defined by depth of soil-forming processes.

Taxonomic definition of soil is conducted based on soil profile description in accordance with established classification and systematic list of soils, elaborated for this territory [8-11].

During soil map compilation along with traditional route research [12] distant research methods were used, which mean using medium-scale multi-zonal space images [13-14] besides topographic and soil maps.

All graphic works (scaling of cartographic materials and space images, interpretation of space images, compilation of colored map models) are carried out using Mapinfo Professional computer program.

To evaluate carbon stock in soil in t/ha it is important to know the content of organic carbon (%) and volume weight of soil (g/cm^3). Estimated depth of the layer is equal to 50 cm.

For carbon determination soil profiles were made, the samples were collected from them according to the genetic horizons. From the same profile soil samples of definite volume with undisturbed structure were collected three times repeatedly to evaluate volume weight of soil.

Organic carbon of the soil was calculated in the Laboratory of Institute of Soil Science by traditional and approved in Russia and Kazakhstan Tyurin method [15]. Simultaneously those analyses were conducted in the Laboratory of Hydrology and Remote Sensing of Agricultural Research Center of Agricluture Department of the USA for evaluation of data reliability. The results showed good level of convergence [16-17]. Carbon stock was identified for all soils recorded on the territory and included in the soil map, and also for soils of 20 monitoring sites. Besides, 5 samples were additionally collected from different parts of the each of site from the layer of 0 – 20 cm.

Root volume of the plants was determined on the same fields. To collect the samples a column of soil 25*40 cm in size and 50 cm in depth was dug. The samples were collected according to their genetic horizons. After cleaning the roots were dried and weighted. Later carbon content was determined in laboratory conditions.

Analysis of underground part of vegetation was carried out by the specialists of Institute of Botany and Phytointrodutcion of Ministry of Education and Science of the Republic of Kazakhstan. To evaluate the underground part of the vegetation 3 characteristic for the area sites with size of 1 m2 were chosen, all the vegetation was cut from them at the soil surface. Cut vegetation from each site was dried out to air-dry condition, and then average productivity in 1 m2 was determined. Then the collected samples were analyzed for carbon content.

RESULTS AND DISCUSSION

Soil map. Soil map is the most important document, the organic carbon stocks in soils for the whole Shet district territory can be estimated on its basis.

To compile the map more than 150 soil profiles and descriptions were made.

Soil map is compiled with scale 1:200 000. The legend to the soil map was developed in accordance with the systematic list of soils for the territory of the Shet district and consists of 44 numbers. Mountain soils are distinguished at the level of types and subtypes, and flat soils - inclusively genuses, in addition [11].

Each contour has its own base and contains up to 3 components taking into consideration their quantitive ratio in contour. Besides, the soil base contains data on soil cover structure, its distribution in relief and composition of soil-forming strata: soil complexes – soil combinations of one kind of moisture in microrelief (*), soil conjunctions – soil combinations of different kinds of moisture in mesorelief (+), spottiness – soil combinations of one type, but different genus, formed on strata with different composition, power, salination level (-).

Carbon stock. Carbon stocks were determined for all soils distingwished on the territory of the Shet district and presented in the legend to the soil map taking into account their mechanical composition. The results of calculations are given in Table 1.

Table 1– Carbon stocks in the soils in the layer 0-50 cm

Soil name	Stock, t/ha
Dark-chestnut normal heavy-loamy	113,19
Dark-chestnut normal loamy	93,57
Dark-chestnut carbonate gypsiferous loamy	93,50
Dark-chestnut noncalcareous loamy	88,90
Dark-chestnut solonetzic heavy loamy	102,17
Dark-chestnut solonetzic loamy	88,40

The rest of the table 1

Dark-chestnut xeromorphous heavy-loamy	103,35
Dark-chestnut xeromorphous loamy	117,57
Dark-chestnut xeromorphous light-loamy	77,81
Dark-chestnut underdeveloped heavy-loamy	85,95
Dark-chestnut underdeveloped loamy	85,59
Dark-chestnut underdeveloped light-loamy	64,01
Dark-chestnut eroded heavy-loamy	68,54
Dark-chestnut eroded loamy	65,50
Dark-chestnut eroded light-loamy	50,40
Dark-chestnut mountain loamy	89,62
Chestnut normal heavy-loamy	109,90
Chestnut normal loamy	81,03
Chestnut normal light-loamy	72,77
Chestnut carbonate loamy	70,84
Chestnut noncalcareous loamy	64,48
Chestnut noncalcareous light-loamy	60,82
Chestnut noncalcareous sand-loamy	39,67
Chestnut solonetzic heavy-loamy	53,24
Chestnut solonetzic loamy	55,05
Chestnut solonetzic light-loamy	42,56
Chestnut solonetzic sand-loamy	32,70
Chestnut gypsiferous loamy	79,98
Chestnut xeromorphous loamy	82,49
Chestnut xeromorphous light-loamy	44,97
Chestnut xeromorphous sand-loamy	32,09
Chestnut underdeveloped loamy	30,86
Chestnut underdeveloped light-loamy	35,53
Chestnut eroded loamy	63,84
Chestnut eroded light-loamy	66,79
Chestnut mountain loamy	59,06
Light-chestnut carbonate heavy-loamy	68,03
Light-chestnut carbonate loamy	89,13
Light-chestnut noncalcareous loamy	46,02
Light-chestnut noncalcareous light-loamy	38,25
Light-chestnut noncalcareous sand-loamy	41,83
Light-chestnut solonetzic heavy-loamy	58,20
Light-chestnut solonetzic loamy	62,94
Light-chestnut solonetzic light-loamy	30,93
Light-chestnut xeromorphous loamy	45,43
Light-chestnut xeromorphous light-loamy	76,19
Light-chestnut underdeveloped loamy	64,27
Light-chestnut underdeveloped light-loamy	60,85
Light-chestnut eroded loamy light-loamy	46,02
Light-chestnut solonchakous loamy	28,94
Light-chestnut mountain loamy	56,68

The rest of the table 1

Meadow- chestnut normal heavy-loamy	90,99
Meadow- chestnut normal loamy	101,54
Meadow- chestnut normal light-loamy	111,81
Meadow- chestnut carbonate solonchakous heavy-loamy	101,90
Meadow- chestnut carbonate solonchakous loamy	76,95
Meadow- chestnut carbonate solonchakous light-loamy	107,12
Meadow- chestnut carbonate solonchakous sand-loamy	92,20
Meadow- chestnut solonetz-solonchakous heavy-loamy	101,63
Meadow- chestnut solonetz-solonchakous loamy	60,57
Meadow- chestnut solonetz-solonchakous light-loamy	83,44
Meadow light not salinated loamy	100,02
Meadow light salinated heavy-loamy	39,05
Meadow light salinated loamy	83,48
Meadow light salinated light-loamy	75,92
Meadow light solonetz-solonchakous heavy-loamy	96,32
Meadow dark not salinated heavy-loamy	303,16
Meadow dark not salinated clay	223,09
Meadow dark not salinated light-loamy	224,41
Meadow dark salinated heavy-loamy	63,53
Meadow dark salinated loamy	181,36
Meadow-marsh heavy-loamy	75,56
Marsh heavy-loamy	72,95
Flood-lands meadow sand-loamy	96,53
Flood-lands forest-meadow sand-loamy	140,74
Forest-meadow loamy	61,11
Steppe solonetz heavy-loamy	40,67
Steppe solonetz loamy	32,34
Steppe solonetz light-loamy	66,19
Desert-steppe solonetz heavy-loamy	37,89
Desert-steppe solonetz loamy	34,44
Desert-steppe solonetz light-loamy	37,70
Desert-steppe solonetz sand-loamy	35,73
Meadow-steppe solonetz heavy-loamy	65,90
Meadow-steppe solonetz loamy	40,55
Meadow solonetz heavy-loamy	50,44
Meadow solonetz loamy	57,42
Common solonchak clay	11,17
Common solonchak heavy-loamy	33,82
Meadow solonchak clay	32,50
Meadow solonchak heavy-loamy	47,49

Average numbers of carbon stock in 50-cm layer of the soil for whole territory were calculated based on collected data and soil map for carbon stock map compilation. Map of carbon stock in given in Figure 1.

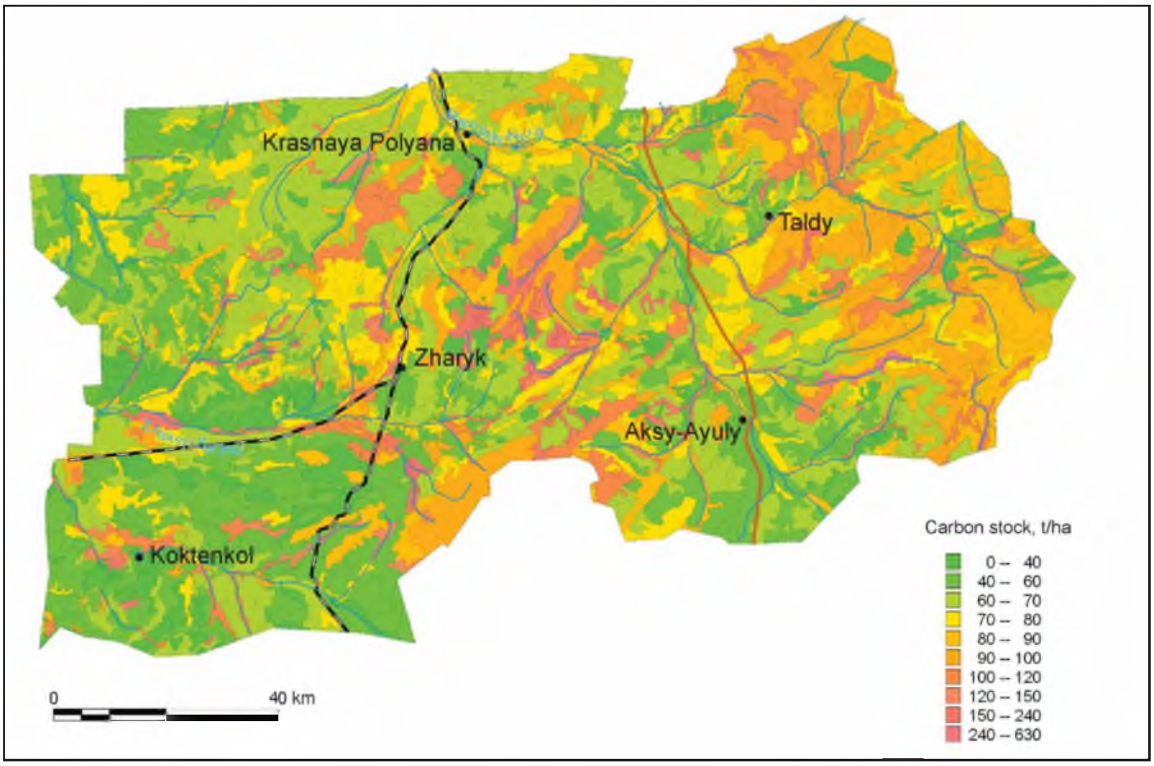

Figure 1- Carbon stock map in the soils

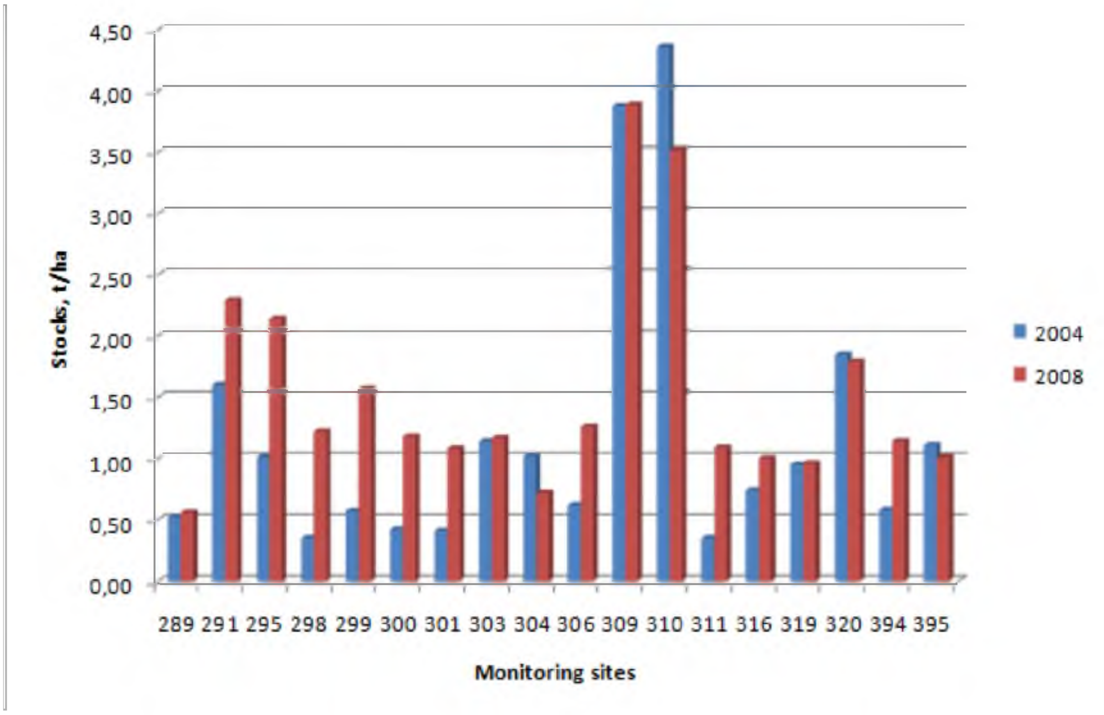

Figure 2 - Carbon stock change in 0-50 cm layer of the soil

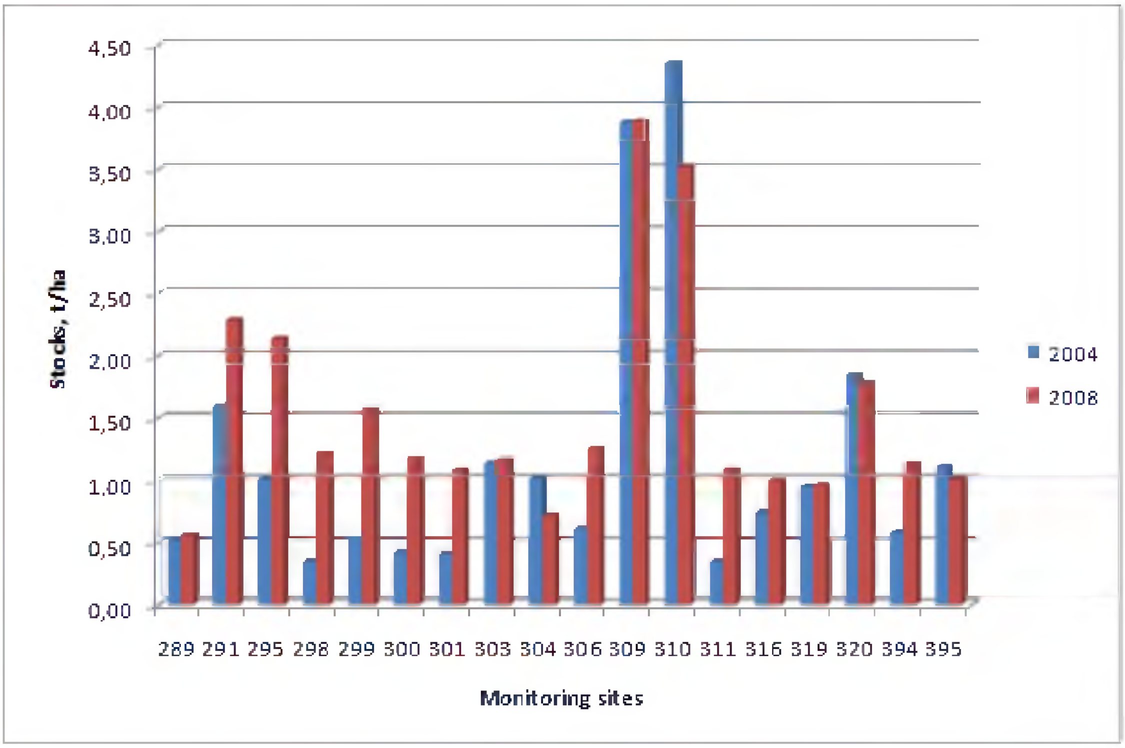

Figure 3 – Carbon stock change in roots in 0-50 cm layer

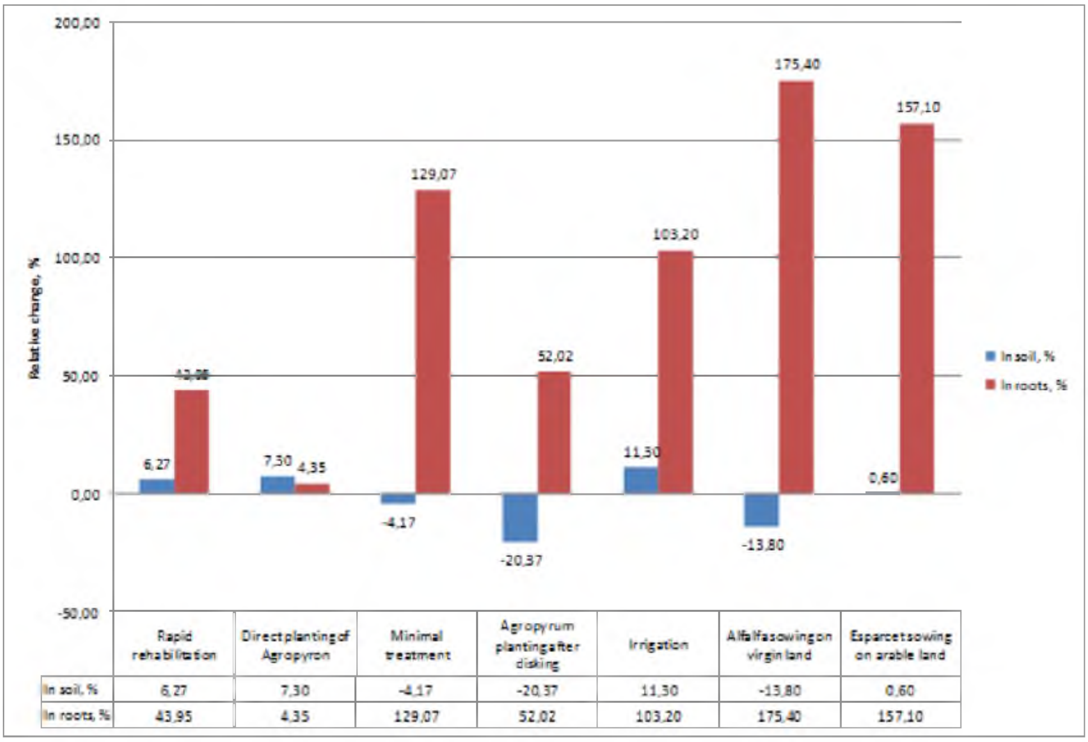

Figure 4 – Relative change of carbon stock in soil and roots
depending on the agrotechnical activity

Changes of carbon stock in soil and plant roots in dıfferent tillage conditions. Studies on the dynamics of carbon stocks in the soil and plants with different methods of tillage were carried out at 20 monitoring sites in 2004–2008. Carbon stock in soil and plants was calculated for these test (monitoring) sites for 2004, 2006 and 2008, as well as analytical definition the main chemical, physical-chemical characteristics of soils was carried out.

Above-ground and root plant residues serve as a source of humus creation and their content in the soil may considered as an index of its potential productivity. At the same time the root mass plays crucial role in carbon accumulation in the soil, especially in arid conditions of the territory, where average ratio of underground biomass to above-ground biomass is 16-17 [18].

The dynamics of absolute indices of carbon stocks in 50-cm layer of soils and roots on monitoring sites may be clearly evaluated after looking at the diagrams (Figure 2, 3).

Besides identification of carbon stocks at each fixed monitoring site, objective included elucidation of the patterns of carbon accumulation processes in the conditions of different agrotechnical activities conduction to find the most optimal ones. In this respect the most significant are relative and average change values in carbon stock, because they level the differences of sites' soils at the grade of genuses and varieties. The results of the summarizing of actual data are given in Table 2.

When the activities on *rapid rehabilitation* of old plantations of *Agropyron* take place, the humus condition of the soils is totally improved, resulting in the increase of carbon stock (average increase of 6.2 %) in 0-50 cm layer with stable indices for sites 295 and 310 and quite clear tendency to increase for sites 303 and 309.

Table 2 – Changes in carbon stock in roots and soils in different tillage conditions

№ of the site	Activity	Carbon stocks in soil, t/ha (0-50 cm)			Carbon stocks in roots, t/ha (0-50 cm)		
		2004	2008	%	2004	2008	%
Rapid rehabilitation							
295	Old *Agropyron* plantation	80,40	78,97	-1,8	1,01	2,14	111,9
301		64,48	70,71	9,7	0,41	1,08	163,4
303		60,60	67,71	11,8	1,14	1,17	2,6
309		101,50	112,31	10,6	3,88	3,89	0,2
310		77,3	78,55	1,6	4,36	3,52	-19,2
320		111,8	118,24	5,7	1,85	1,79	-3,2
Average				6,27			43,95
Direct *Agropyron* sowing							
289	In old fallow land	55,9	60,11	7,5	0,52	0,56	7,7
319		36,0	38,56	7,1	0,95	0,96	1,0
Average				7,3			4,35
Minimal treatment							
291	In old *Agropyron* plantation	55,0	60,50	10,0	1,60	2,29	43,1
394		70,08	62,77	-11,4	0,58	1,14	96,5
298	In littered fallow	66,8	59,39	-11,1	0,35	1,22	248,6
Average				-4,17			129,07

The rest of the table 2

Agropyron sowing after disking							
In old *Agropyron* plantation	55,0	47,11	-14,4	1,02	0,72	-29,4	
In fallow land	48,7	47,87	-1,7	0,35	1,09	211,4	
	49,2	37,74	-23,3	0,74	1,00	35,1	
	63,6	40,65	-36,1	1,11	1,01	-9,0	
			-20,37			52,02	
Agropyron sowing with irrigation							
In *Agropyron* and *Hordeum* plantation	81,0	91,8	11,3	0,62	1,26	103,2	
Alfalfa sowing							
In virgin land	72,8	62,79	-13,8	0,57	1,57	175,4	
Onobrychis sowing							
In tillage	63,8	64,14	0,6	0,42	1,08	157,1	

Significant difference in the values of organic carbon stock in soil of site 320 (111,8 t/ha in 2004, 180,2 t/ha in 2006 and 118,24 t/ha in 2008) are explained by the heterogeneity of soil cover in the limits of the field, connected to the differences in micro relief deposits of original virgin soils. Soil cover is represented here by combination of meadow-chestnut and meadow soils with insignificant participation of the latter (less than 5 %), which are located in limited in area but often spots among the dominating soils.

Comparative data on carbon stock in plant roots is characterized by positive as well as negative values, caused by high spacious and time variability of this index. But average data show increase of carbon content in plant roots in 43.95 % in comparison with 2004. The biggest growth increase of root biomass was registered at sites 295 and 301, which in the first case is explained by additional fertilizing with ammophos, and in the other case – by transformation of agrocoenosis with weed grasses domination into cereal agrocoenosis (*Agropyron*).

In case of *direct sowing of Agropyron*, carried out in old fallow land, when the surface soil horizons are almost undestroyed, organic carbon stock in soils stay almost stable. Some increase of this index (7.3 %) in comparison with 2004 does not reflect real increase of carbon stock; it rather reflects the peculiarities of morphogenetic soil characteristics. Chestnut solonetzic soils are widely distributed at monitoring site 289.

Depending on solonetz level the humus stock (and organic carbon stock, correspondingly) may considerably change. The data on carbon stock for 2004, 2006 and 2008 in surface 10-cm layer stay the same (13,22, 13,68, and 13,10 t/ha correspondingly).

The data for site 319, soil cover of which is represented by chestnut normal soils, is 12,24, 12,77 and 12, 52 t/ha. Variability of carbon stock in lower part of 50-cm layer in three test years is caused by different depth of soil-forming strata and, correspondingly, the carbonate horizon.

The increase in carbon stocks (in average in 4,35 %) in plant roots at the research sites is registered only as a tendency, which is probably caused by low seed germination in arid conditions of the observation years.

According to the data of the research, in case *of minimal treatment* the average values of organic carbon stocks in soil decrease in 11,2 %, in case of *disking* of the field the losses reach up to 20,4 %. The data on the stock of organic carbon at site 291 show its increase from 55,05 to 60,50 t/ha, but it is connected to the heterogeneity of the soil cover, caused by different depth of clay deposits, which serve as water confining layer and considerably influence the soil moistening regime. According to the data of analytical research of the samples, collected in five field sites by envelope technique, humus content in the horizon 0-20 varies in the limits of 1,5-2,3 %.

When the surface horizon is loosened, soil aggregates break up, rapid decomposition of organic substances takes place, caused by better water, air and caloric regimes and in accordance with this - better microbiological activity. Non-mobile humus is engaged in biological cycle, and nutritious elements transform into form available for the plants. But the treatment of surface horizons helps improve the conditions for *Agropyron* seed germination and rootage increase, which correspondingly leads to increase of carbon stock in plant roots. In case of the given agrotechnical activities this increase is 97,0 % and 52, 2 %.

Sowing of perennial legume fodder crops (Alfalfa, Onobrychis), the root system of which is developed faster in comparison with *Agropyron*, futhers to considerably increase carbon stock in roots for comparatively short period. In this case the increase was 175,4 % for Alfalfa and 151,7 % for *Onobrychis*. On both field with 3-years old plantations of perennial grasses, soil cover of which is represented by chestnut normal medium loam soils, the carbon stocks are the same according to the data of 2006 (61,3 and 60,1 t/ha), but the fields with *Onobrychis* (№ 300) stayed the same in comparison with 2004, as in the fields with *Alfalfa* (№ 299) decreased in 13,8 %. This is explained by the fact that *Onobrychis* sowing took place at the ploughed field, and *Alfalfa* sowing – after ploughing of the virgin land.

The most visible positive dynamics of carbon balance is found at the *irrigated field* with *Agropyron* (№ 306). The increase of organic carbon stock for the period of observations was 11,3 %, and carbon stock in plant roots - 103,2 % with quite high original values of these indexes (81,0 and 0,62 t/ha according to the data of 2004).

Thus, the carried out research allowed to reveal the most effective agrotechnical activities for the increase of carbon stock in plant roots and soil (Figure 4).

From their complex the most unfavorable are those that cause carbon loss, dealing with making worse the humus condition of the oils, because its rehabilitation goes very slowly in contrast with underground plant biomass.

It must be taken into consideration that collected data are not absolute, they reflect just the tendencies of carbon balance in case of different tillage conditions. It is caused by the fact that carbon content in soils is not constant throughout the year. In the beginning of summer it decreases, because this time is most favorable for organic substance mineralization. Besides, during the period of intensive biomass growth vegetation uses elements of mineral nutrition for vegetation and carbon losses in root layer increase. In the end of summer when plant growth almost stops and microbiological activity of the soils decrease, carbon content of the soil stabilizes. At that time newly formed humus substances are not involved in new biological processes, they are connecting to mineral part of the soil forming stable organic-mineral associations. Carbon stock in plant roots is even more dynamic, which is caused by seasonal changes connected to phoenological phases of plant development, as well as annual changes, caused by precipitation quantity and their distribution in months.

On the other hand, the observation period of 2004-2008 is not long enough to predict further changes. Organic carbon stock decrease observed in some field connected with the disturbance of surface horizons usually occurs only in first years after ploughing. It is well-known that carbon losses in agrocoenoses decrease with time primarily because of humus content decrease. Besides, humus that is left after long plough changes in its group and fractional composition and is characterized by better resistance to mineralization caused by its stable chemical couplings with mineral part of the soil. If the soils are used for planting of perennial grass, they transform into new stationary state quite quickly. But the intensiveness of this process (when the same agrotechnical measures are used) depends on lithologic-geomorphologic conditions of soil structure and water regime. In case of additional subterranean or surface moisture the conditions are more favorable for organic substance accumulation in soils. Rehabilitation of carbon stock in zonal soils of one subzone with different mechanical composition decrease from the soils of more heavy mechanical composition (clay, hard loamy) to light soils, which is explained by weak fixing of newly formed substances by their mineral part.

CONCLUSION

As a result of the research, a method was developed for determining carbon stocks in soils and plants not only at individual points, but also in an area ratio, as well as an extrapolation technique and calculation of stocks based on modeling, available data and space information. In addition, a carbon stock monitoring system was organized.

For the period from 2004 to 2008 research sites are characterized by different dynamics of carbon balance depending on applied agrotechnical activities and original condition of soil cover, which, in its turn, is defined by both factors of previous anthropogenic influence and morphogenetic features of the soils.

Nevertheless, on the basis of the conducted research basic tendencies in the dynamics of carbon balance of the observed sites can be elucidated, but also the necessity of additional measures to increase carbon stock in soils may be identified. All hayfields need additional mineral fertilizers to compensate losses of nutrition substances used by plants during vegetation. Arable soils, besides the measure named above, need additional organic fertilizers. The best effect in the conditions of arid climate is achieved with irrigation. The development of specific agrotechnical measures to keep carbon balance should be done taking into consideration all the factors of soil forming and soil morphogenetic features.

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ТҮЙІН

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ҚАЗАҚТЫҢ ҰСАҚ ШОҚЫЛАРЫ ОРТАЛЫҚ БӨЛІГІНДЕ ТОПЫРАҚТА КӨМІРТЕГІНІҢ ҚОРЛАРЫ ЖӘНЕ ОНЫҢ ДИНАМИКАСЫ МЕН ӘР ТҮРЛІ ӨҢДЕУ ТӘСІЛДЕРІ

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Қарағанды облысының Шет ауданында топырақты зерттеу нәтижелері бойынша топырақта органикалық көміртегінің қоры анықталды. 1:200000 масштаб топырақ картасы негізінде абсолютті (т) және салыстырмалы (т/га) мәндердегі топырақтың көміртекті қорлары картасы құрастырылды. 20 мониторинг учаскелері үшін 2004, 2006 және 2008 жылдардағы топырақ пен өсімдіктердегі көміртекті қорлар есептелді және пайдаланылған өсіру технологиясына байланысты көміртекті қорларының өзгеруіне салыстырмалы талдау жүргізілді..

Түйінді сөздер: көміртек қорлары, топырақ картасы, көміртегі қорлар картасы, топырақты өңдеу шарттары.

РЕЗЮМЕ

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ЗАПАСЫ УГЛЕРОДА В ПОЧВАХ ЦЕНТРАЛЬНОЙ ЧАСТИ КАЗАХСКОГО МЕЛКОСОПОЧНИКА И ЕГО ДИНАМИКА ПРИ РАЗЛИЧНЫХ СПОСОБАХ ОБРАБОТКИ

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По результатам почвенных исследований в пределах Шетского района Карагандинской области определены запасы органического углерода в почвах. На основе почвенной карты масштаба 1: 200 000 составлена карта запасов углерода в почвах в абсолютных (т) и относительных (т/га) значениях. Для 20 мониторинговых участков были рассчитаны запасы углерода в почве и растениях за 2004, 2006 и 2008 год, проведен сравнительный анализ изменения запасов углерода в зависимости от применяемых технологий возделывания.

Ключевые слова: запасы углерода, почвенная карта, карта запасов углерода, условия обработки почвы.