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SHELTER-BELTS – THE SOLUTION FOR PROTECTING CROPS AND INCREASING PRODUCTIONS IN THE LANDS AFFECTED BY THE DESERTIFICATION PHENOMENON IN OLTENIA

ANCUȚA MARIN¹

Summary: *Because of the climate changes and the massive clearings, some of the most critical problems that Romania and especially the S-W part of Oltenia are confronted with are: the desertification and the earth flows. The purpose of the shelter –belts in preventing the effects of the wind and in protecting the agrarian crops and the agrarian production implicitly, can be evaluated by keeping in mind a series of specific determination: soil, climate, wind rate, the quantity of driven sand, wind erosion, soil erosion, agrarian production, density of crop. In this paper it is proven that the best results were obtained when the protection of the agrarian fields was made with the help of the shelter-belts arrays, made so that two shelter-belts encased and directed perpendicular to the dominant wind direction in order to confine an agrarian crop in rotation and, with their accumulated effect, to reduce the wind rate at soil level up to almost zero.*

Key words: *shelter-belts, desertification, protection, climate changes, wind rate, clearing*

INTRODUCTION

The shelter-belts can be defined as silvan vegetation formations, with different lengths and relatively narrow widths, encased at a certain distance from one another, with an environment protection and climate improvement, economical and aesthetical-sanitary function of the fields.

The purpose of the shelter-belts is found in the advantages brought to agriculture, in protecting establishments and communication and transport ways and last but not least in the advantages brought to the environment. In agriculture creating shelter-belts led to the reduction of soil erosion and to the increasing of the agrarian production, because they reduce the plant evaporation and exudation, so the agrarian production in the field grows up to 20%. The shelter-belts encased on sandy solis have the task of limiting deflation, ensuring an even wattering, protecting the crops against mechanical harms made by sandstorms and protecting the hydrotechnical equipments against sanding. The shelter-belts have the purpose of protecting the communication and transport ways against snowdrift, of protecting dikes and banks against currents, floods and ice, of protecting localities and different economical and social location from certain areas. Regarding the environment advantage, the shelter-belts have a purpose of storing carbon, of reducing air temperature, of increasing aerial humidity, of biological drainage, of reducing direct and reflected light.

The climate changes that happened in the last 50 years, the changes that happened in the structure and the formation ways of the agrarian exploitation, the crop technologies that were used, made serious agro-ecological alterations.

In our country, the first silvan plantations for sand protection occurred in Băilești starting with 1852, on the Știrbei Prince property. For 30-40 years, in the sands from the south of Oltenia 25.000 hectares of acacia were seeded. The silvan plantations for fixing desert soils in the SW of Oltenia were made after 1895 (Gheorghiu E., 1903; Crăciunescu G., 1904; Ionescu Șișești and Staicu I., 1958).

In our country, the soil and agrarian crops protection method by using shelter-belts was initiated since 1861 and developed in the years with big calamities, excessive droughts, sandstorms, (1890, 1935, 1946), materialised by 1961 in planting over 6.000 ha of shelter-belts, and in 1970-1975 of another 1.700 ha in the South Oltenia sands (Popescu, 1993).

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The purpose of this paper is to underline the long term implications of the desertification phenomenon that the S-W of Oltenia is dealing with, brings back to present time possible solutions to stop it.

MATERIAL AND METHODS

In order to blunt the harmful effects of the wind, man took a series of typical measures to reduce the speed of the air currents in horizontal movement and to abate their kinetic energy that were grouped in literature in three categories: *mechanical* (snow fences, interlaced wire net, fences made out of sunflower and corn strains), *biological* (shelter-belts, herbal plants bands, hedges, fruit tree plantations, vine plantations), *chemical* (glue and şî mygram).

The function of the shelter-belts in preventing the wind effects and in protecting agrarian crops and implicitly agrarian production, can be evaluated taking under consideration a series of specific determinations. A peculiar importance for an agrarian area consists in knowing the climate conditions. Given the fact that the type of climate of an area can favour or fade certain specific phenomena that influence the agrarian and silvan production, for that area, a study had been conducted in order to assess the type of climate for the studied area. In order to define the type of climate the average annual rainfall, the temperature values, the evapo-exudation potential value, were taken under consideration depending on the latitude. With the help from these elements were calculated 3 climate indexes for every month of the vegetation period, from april until september. According to these calculations, the SW area of the country is defined by a *semi-arid* towards *arid* climate *excessively dry* and *defective*.

The measurements regarding the wind rate were made in the Sadova-Corabia area and were made for the shelter-belts chosen foremost to display the typical traits of the majority of shelter-belts. They were carried out on a lineal direction, at half distance of the longitudinal axis of the shelter-belts, and in crop in rotation field delimited by the two shelter-belts, there where agrarian crops. In the analysed area there were set up in 3 consecutive years, (2011-2013) wheat, melons and tobacco crops, in both protected and unprotected lots.

In all cases, the soil is sandy, of the protosoil typical anthropical type, and the climate conditions and crop technologies were identical.

The most efficient measures, throughout time, were proven to be the biological ones, and among them the first place is occupied by the acacia shelter-belts arranged as a net or an array. The function of the shelter-belts in preventing the wind effects and in protecting agrarian crops and implicitly agrarian production, can be evaluated taking under consideration a series of specific determinations

The placing of the shelter-belts is assessed by the silvic research, based on foundation studies. These shelter-belts can be placed on both state-owned areas and private property areas, depending on necessity and on the results of the overwrought studies.

RESULTS AND DISCUSSIONS

The desertification is defined as being "a risk phenomenon of ecological nature, strongly depending on the other natural risks and on anthropic ones" (Bogdan Niculescu, 1999). It has multiple causes, from which the most known are high temperatures and the rise of the rainfall shortage in some areas. The prolonging of the drought sets most of the time the starting point in the occurrence of the desertification phenomena. În Romania, the drought phenomenon that has strong accents in some periods has been signaled and described a long time ago. The statistics show that the drought phenomenon, without having a very strict cyclic character, generally happens every 10-15 years, the alternation of extremely drought years with abundant years under the aspect of rainfalls (1-3 ani) being more and more obvious.

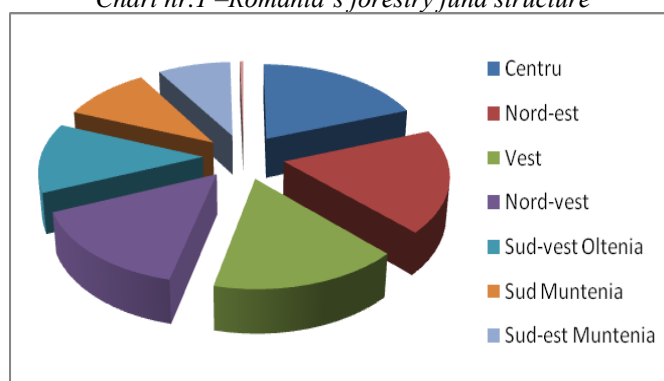
According to the data posted by The National Statistics Institute, from a total of 6.540 thousands ha forestry fund, 12,4% is in the SW of Oltenia, the area where we made the research (Table nr.1 și Chart nr.1).

Tabelul nr.1

ROMANIA'S FORESTRY FUND		
Geographic area	Thousands ha	%
Center	1.262,22	19,3
North-East	1.196,82	18,3
West	1.046,40	16,0
Noth-West	987,54	15,1
South-West Oltenia	810,96	12,4
South Muntenia	660,54	10,1
South-East Muntenia	549,36	8,4
Bucuresti-Ilfov	26,16	0,4
TOTAL	6.540,00	100

Source: data processing TNSI

Chart nr.1 –Romania's forestry fund structure



În Romania the area located between Calafat–Poiana Mare–Sadova–Bechet– Dăbuleni and the Danube river, a surface of 104.600 ha became arid, the sandy soils having an inclination toards desertification.

Table nr. 2

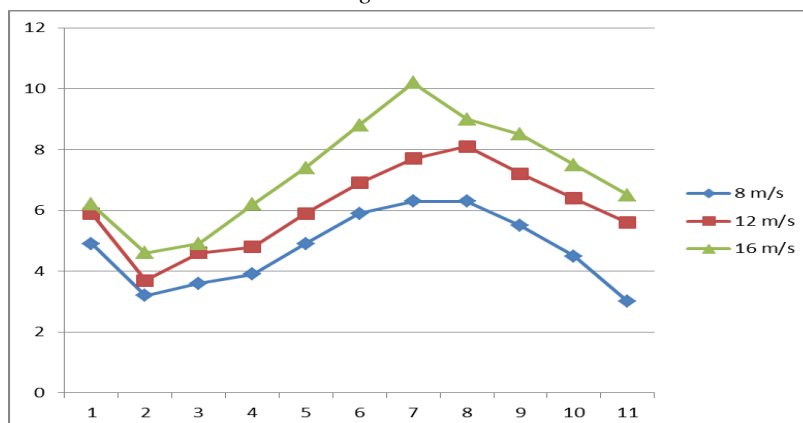
THE CASE OF DOLJ COUNTY AFTER 2011		
INDICATORS	HA	%
Dolj County surface	556.200	100,00
Forest surface	60.626	10,90
Desertified surface	104.600	18,81
Afforestation works	5.000	0,90

In our country, in order to attenuate and to refute the desertification phenomenon, until now, the only measure taken is the one related to afforestation, but it is done on very small areas. For example in Dolj County 5.000 ha (4%) of the 104.600 ha affected by the desertification phenomenon were afforested (Table nr.2). This fact, assesses the identification and analysis of all the factors that led to the desertification phenomenon and applies immediately and with strictness of the measures regarding the ceasing forest cutting, afforestation of the deforested areas, planting shelter-belts.

Reducing the wind rate at ground level by the shelter-belts placed across the agrarian fields against the direction of the dominant wind, generated by the acacia shelter-belts, representative for the area and the effects on reducing the wind rate between two shelter-belts, compared to the wind rate in open field, has been studied in three versions of wind rates: 8m/sec, 12m/sec and 16

m/sec, mentioning that they were read at a 2 minutes interval, in natural measuring conditions, at a distance of 1 m and 2 m from the soil, and the dominant direction of the wind was from west-east, perpendicular to the direction of the shelter-belts. The measurements have been made on a lineal direction, at the half distance of the longitudinal axis of the shelter-belts. Knowing the fact that the positive or negative terrain defines considerable influences upon the wind rate, it was taken under consideration the area to be on the lineal direction on which the measurements have been made, so that the general statement of the measurements in all of the versions to be able to be compared and analysed as accurately as possible. The wind rate reduction to the open field rate, which is of 8 m/sec, is obvious for all of the three hights: at ground level, at 1 m and at 2m. The wind rate reduction ranges with the hight, the smallest rate being registered at ground level.

Chart nr. 2- Wind rate reduction between two acacia shelter-belts,
at ground level



The strongest effects of wind rates reductions happen when the acacia trees reach maturity after 25-30 years and when their hight reaches approximately 18-20 m as well as the other characteristics of the shelter-belts that favour and involves different variation curves of wind rates in agrarian crop in rotation, but they are obviously superior to those with smaller hights. For sandy soils the sole existence of the shelter-belts doesn't block completely, up to annihilation, the aeolian erosion phenomenon.

This is also conditioned by the wind rate for the studied area, which is very aggressive and with high degree of turbulences and by the type of climate that favours this aggressiveness of the wind through pronounced aridity during the spring and autumn seedings or of underdeveloped crops. The knowledge of the variation curves characteristics is particularly important for the agriculture exercised in sands and sandy soils.

The study regarding the influences exercised by the acacia shelter-belts upon the agrarian productions has been made on a three calendar years period, in two standard facility agrarian crop in rotation Sadova – Corabia of dimension (300 x 280 m) and facing (north – south). The two agrarian crop in rotations where chosen, close to one-another: the one protected by the acacia shelter-belts (on west and east) on south following the unprotected one, identically faced, but without the shelter-belts on west and east. Also, in order to compare, in identical conditions was founded within the years of study, the same type of agrarian crop (tobacco, wheat, melons) in both cases, the sandy soil being the type of protosoil typical anthropic, establishment illustrative resulted from the leveling-moulding works. The climate, aerial and soil conditions for each agrarian crop in every year of study were similar, the differences made upon the crops happened exclusively because of protecting the cultures with acacia shelter-belts instead of unprotecting them. It must be shown that the technological conditions applied on crops, for the founding and the green period have been identical.

The state of the agrarian crops has been intended, applying the specific crop technologies, and for this comparison there have been harvested across the two crop in rotation agrarian production. Their harvesting was made on a 100m² surface, in three repetitions, and the productions where expressed in quintals per hectar (q/ha) for tobacco and wheat and tons per hectar (t/ha) for

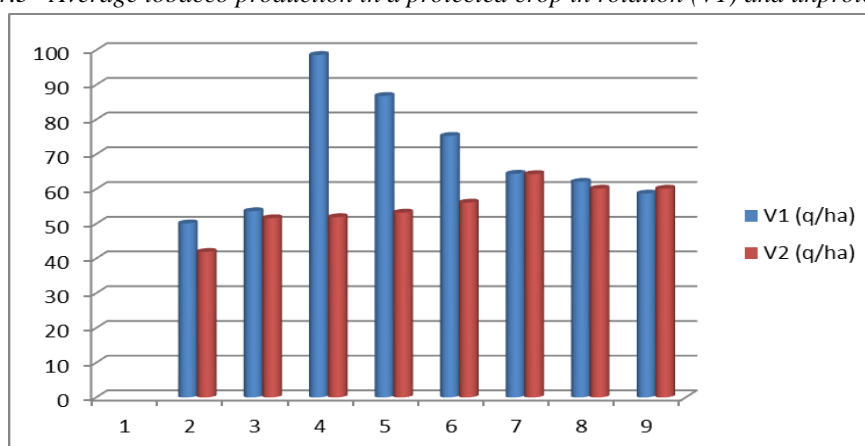
the melons. It was taken under consideration that the two crops in rotation in which the crops have been encased, are the object of a study regarding the influence of the acacia shelter-belts upon the agrarian productions and that is why the the conditions and technological measurements regarding their founding, maintenance and development have been applied identically regarding the time and the period.

The tobacco crop was made in two versions: version 1 – a crop in rotation protected by acacia shelter-belts and version 2 – a crop in rotation that is not protected by shelter-belts. In both of the chosen versions the tobacco was sprayed upon planting in order for the plants to develop roots in the soil where they have been unpoted and they were given 2 maintenance sprayings with norms of 400 mc/ha each. The productions that were obtained from the tobacco crop in the two studied versions were transfered in Table nr.3 and in Chart nr.3. No matter the way in which the size of the obtained production of tobacco crop is analysed, it shows that the smallest productions were obtained in the proximity of the shelter-belts, in the west front and also in the east front, and we believe it's because of the influence of the acacia roots, but especially because of the shading, and the largest tobacco production has been obtained at 50 m from the shelter-belt.

Table nr.3

NR. CRT.	DISTANCE FROM THE SHELTER-BELT (m)	TOBACCO AVERAGE PRODUCTIONS		
		V1 – protected crop in rotation (q/ha)	V2 – unprotected crop in rotation (q/ha)	Difference (V1-V2)
1	6	50,1	41,9	8,20
2	20	53,6	51,6	2,00
3	50	98,6	51,9	46,70
4	100	86,8	53,2	33,60
5	150	75,3	56,1	19,20
6	200	64,4	64,3	0,10
7	250	62,1	60,1	2,00
8	280	58,7	60,1	-1,40
TOTAL		549,6	439,2	110,40
AVERAGE		68,7	54,9	13,80

Chart nr.3– Average tobacco production in a protected crop in rotation (V1) and unprotected (V2)



Overall, the difference is not big, being of only 110,40 q/ha. We can explain this result with the fact that the wind effect is less obvious upon the tobacco crop, because it's planted in the field pretty late, when the wind doesn't have violent outbursts. Tobacco is seeded in especially installed and protected against the wind hotbeds and then they are shifted in the field.

The wheat crop has been also analysed in two versions: V1- a crop in rotation protected by shelter-belts and V2 – a crop in rotation that is unprotected by shelter-belts. The crop has been

supervised since the founding date, the 20th of October until harvest day, the 10th of July. According to the technological card the founding date of the culture has been kept the optimal period of founding the crop and 4 maintenance sprayings with 400 mc/ha each have been made, both experimental crops in rotation have been sprayed. The obtained productions for the wheat crop in the two versions have been transferred in Tabel nr.4 and in Chart nr.4. Just like tobacco, the smallest productions were in the proximity of the shelter-belt. The biggest wheat production has been at 50 m from the shelter-belt in V1 and at 150 m for V2. It's obvious that in V1 version the productions are bigger than in V2 version, this leading to considerable differences of production. In the unprotected crop in rotation version the production is of 30% from the total production obtained in the protected crop in rotation.

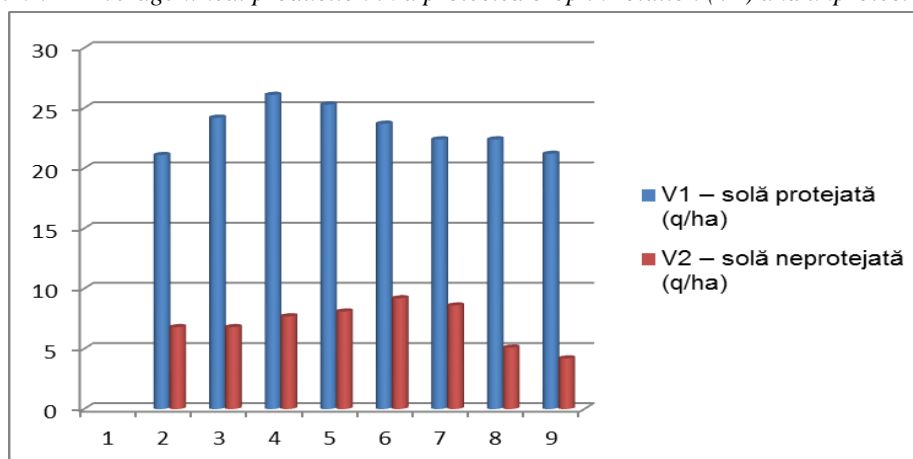
Increasing production in the protected version had an exponential trajectory, followed by a slower decrease. The small productions obtained at the ends of the chart interval are explained by the fact that in the west side of the crop in rotation there were uprooting phenomena, and in the east side the covering of the plants with the wind driven sand.

Just like in the cases above, for the melon crops we have in mind two versions: V1 – a crop in rotation protected by shelter-belts and V2 – a crop in rotation unprotected by shelter-belts. According to the technological card, on both crops in rotation the soil preparing works began on the 11th of March and were administered the same treatments and the same number of sprayings (3) with norms of 400 mc/ha each.

Table nr. 4

NR CRT	DISTANCE FROM THE SHELTER-BELT (m)	WHEAT AVERAGE PRODUCTIONS		
		V1 – protected crop in rotation (q/ha)	V2 – unprotected crop in rotation (q/ha)	Difference (V1-V2)
1	6	21,1	6,8	14,3
2	20	24,2	6,8	17,4
3	50	26,1	7,7	18,4
4	100	25,3	8,1	17,2
5	150	23,7	9,2	14,5
6	200	22,4	8,6	13,8
7	250	22,4	5,1	17,3
8	280	21,2	4,2	17,0
TOTAL		186,4	56,5	129,9
AVERAGE		23,3	7,06	16,24

Chart nr.4 – Average wheat production in a protected crop in rotation (V1) and unprotected (V2)



In both Table nr.5 and Chart nr.5 it can be seen that the smallest productions happened in the proximity of the shelter-belt. The biggest production of melons was at 50 m from the shelter-belt for V1 version and at 100 m for V2 version. The accession curve, respective the decresion one with exponential aspect can be attributed solely on the wind effect by the aeolian erosion phenomena, during the spring-summer period, existing more moments with violent sandstorms.

To all that, it adds the drying processes of the soil and the water loss from the soil at the depth where the roots are developing, especially in the first stages of development of the plants when the foliar system is undeveloped and doesn't allow protection from the evaporation. In these conditions, there were partial uprooting phenomena and wind driven sand.

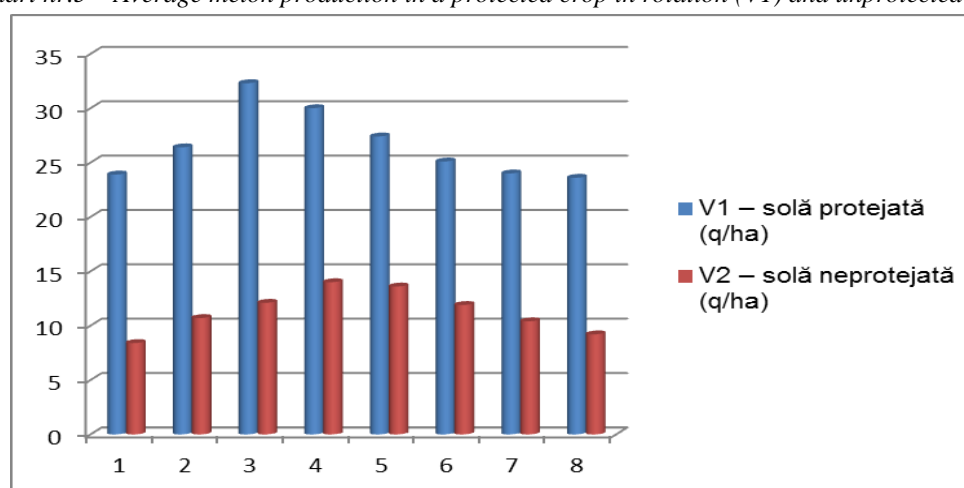
Just like in the cases of the tobacco and wheat crops, the biggest production was registered at 50 m from the shelter-belt. The central part of the crop in rotation had to suffer less, which is obvious given the obtained melon quantity. The obtained melon quantity from the unprotected version represents only 42% from the production obtained in the protected version.

The research made on the sands and the sandy lands from the SW of Oltenia, strongly affected by the deflation and the desertification phenomena evidentiate the purpose of the forests and of the shelter-belts for speed reduction as well as wind intensity, and also their role in protecting the agrarian crops and in increasing productions.

Table nr.5

NR CRT	DISTANCE FROM THE SHELTER-BELT (m)	MELON PRODUCTIONS		
		V1 – protected crop in rotation (q/ha)	V2 – unprotected crop in rotation (q/ha)	Difference (V1-V2)
1	6	23,9	8,4	15,5
2	20	26,4	10,7	15,7
3	50	32,3	12,1	20,2
4	100	30,0	14,0	16,0
5	150	27,4	13,6	13,8
6	200	25,1	11,9	13,2
7	250	24,0	10,4	13,6
8	280	23,6	9,2	14,4
TOTAL		212,7	90,3	122,4
AVERAGE		26,6	11,2	15,4

Chart nr.5 – Average melon production in a protected crop in rotation (V1) and unprotected (V2)



In the present paper it is shown that the best results in this regard, have been made when the protection of the agrarian fields has been made with the help of the shelter-belt nets, made so that two shelter-belts encased and oriented perpendicular to the dominant wind direction in order to bound a crop in rotation and, by their accumulated effect, to reduce the wind rate on soil level up to almost zero.

CONCLUSIONS

The effects of the wind rates reduction on ground level, exercised by the acacia shelter-belts, are more than obvious and very meaningful, but at rates bigger than 8m/sec. and especially more than 12m/sec., are not enough, they should be completed with afforestation actions of the areas that were cleared.

The wind, the main responsible with aeolian erosion, causes the driven of the sands and of the sandy soils along the year. As it was shown, the acacia shelter-belts reduces the rate and intensity of the wind on ground level. By that, the aeolian erosion and the aeolian transport of the resulted particles decreases considerably.

On both protected areas, but mostly on the unprotected by the acacia shelter-belts areas displacements of the broken ground soil happens. The size and weight of the displaced particles varying from fine to bigger dimensions. With them, there are also displaced from the ground the nutrients: nitrogen, potassium, phosphorus.

The climate type, the clearing, the soil types assert the founding of the shelter-belts directed perpendicularly to the wind direction, respectively N-S. The type of the climate existing in the S-W of the country, the fact that in March-April the wind blows strongly, it favours the aeolian erosion phenomena and drought implicitly. This fact leads us to the only logical conclusion, which is the necessity in founding the shelter-belts.

The acacia shelter-belts, by the wind rate reduction effect on ground level, it reduces the risk of triggering and decreases the intensity of the aeolian erosion processes by prolonging the initial time of dissipation and by the quantity of the aeolian capacity and of the aeolian transport quantum during a calendar year with up to two and a half times.

Given the conducted analysis and the conclusions we can make some recommendations, such as: improving the forest law, by implementing the provisions of the Forest Code, which matches to the present needs by prohibiting clearing and forcing those who are exploiting wood to plant seedling in the cleared areas; the development of the administration models and forest management in drought affected areas and with aridity risk; the ecological reconstruction by afforestation of the weather-beaten areas due to the desertification phenomena, aeolian deflation, landslides; making a national system of shelter-belts for the field and agricultural land, antierosional, of whose efficiency has been verified in time by reducing the loss of water from the soil on the lands between them and the general increases from the agricultural production. The measure has to contain both installing new shelter-belts and also repairing the old ones.

In conclusion, in order to protect them, people and the companies have to understand the vital importance that forests have on our life and the life of our planet, on the whole ecosystem.

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