

PREVENTIVE MEASURES FOR GRASS FIRE RISK REDUCTION

Gunārs Mašins¹, Dipl.ing.; **Valentīna Urbāne**¹, Dr.chem.,prof.; **Jānis Ieviņš**¹, Dr.oec.,prof.
and **Jelena Malahova**¹, Dr.oec., asoc.prof.⁺

¹ Riga Technical university

Abstract. One of the problems within ecosystems is fire, which is a commonly recognized component of ecosystem disturbance regime. In the grassland ecosystem, such disturbances as fire and grazing or range management to some extent positively influence the productivity and plant diversity of the grassland ecosystem. But every year, as a result of last year's grass burning, people die; residential and household buildings are burnt down causing several tens or even hundreds of thousands of euros material loss. The problem of grass burning requires intense work for several years. The main aim of the paper is to create medium term solution for grass fire prevention and propose an action plan to reduce possible fire-extinguishing costs. Research is based on traditional economic science methods, such as analysis and synthesis, monograph method and practical experience of Latvian fire protection services. As main result of the paper, the authors elaborated proposals for plan of action for reducing the number of grass fires. Implementation of prepared recommendations gives a premise to ensure reduction of fire protection costs and ensure effective natural resource management.

Key words: grass fire, damage prevention, economics of fire- extinguishing.

JEL code: Q50, R19, H59

Introduction

Fire protection and fire prevention problems are not only technical and technological issues; they could also be evaluated as an economic problem, since fires are an important source of economic losses for municipalities and also a part of state budget costs. As a result of last year's grass burning, people die; residential and household buildings are burnt down causing several tens or even hundreds of thousands of euros material loss. In 2013 (State Fire and Rescue Service (2013)) there were registered 2,430 grass fires (including the fires possibly caused by grass fire) in Latvia. In comparison with 2012, when, according to the State Fire and Rescue Service (2012), there were registered 1,824 fires, their number increased by 25%. In

⁺ Corresponding author. Tel.: + 371 67089099; fax: +371 67089097
E-mail address: jelena.rtu@inbox.lv.

2012 overall 8,536 fires were registered in Latvia. 21.3% out of these 8,536 fires are exactly grass fires. The number of grass fires tends to increase during last four years. In 2013 the State Fire-Fighting and Rescue Service spent for fighting grass fires the amount of LVL 20100.33 for petrol (the sum was calculated, taking into account the prices for petrol for summer, 2013). 6 vehicles were damaged in fighting such fires. The repair works cost LVL 560.99. (the State Fire and Rescue Service (2013)). The problem of grass burning requires intense work for several years. The main aim of the paper is to create medium term solution for grass fire prevention and propose an action plan to reduce possible fire-extinguishing costs. Research is based on traditional economic science methods, such as analysis and synthesis, monograph method and on practical experience of Latvia's fire protection services. As main result of the paper, proposals for the plan of action for reducing the number of grass fires have been worked out. Implementation of prepared recommendations gives a premise to ensure reduction of fire protection costs and ensure effective natural resource management.

Landscape fire problems

Fire is a commonly recognized component of ecosystem disturbance regime (see Cheney P., Sullivan A.(2008) as an example). In the grassland ecosystem, disturbances such as fire and grazing, or range management (haymaking) can positively influence the productivity and plant diversity of the grassland ecosystem (Li, M. and Guo, X.L. (2014), Anderson, R.C. (1990)). Also, grazing and burning behaviours are studied in scientific literature (Bond, W.J. and Keeley, J.E. (2005), Moreira F. *et.al.* (2011)). Because both of them not only have contributed to the evolution history in the past, but also are both forms employed in grassland management practice (cattle grazing and/or prescribed burning). Burning grass is not an ancient Latvian tradition. In ancient beliefs and reports there are no statements that it would be an ancient Latvian domestic tradition. It was even mentioned, that there was often lack of grass. For Latvians their land was sacred and they made maximal use of it and maintained it carefully, so there was no dry grass on the fields in spring. In Latvia burning grass started in Soviet times; it was introduced by immigrants from Russia and the Ukraine. In these countries, where there were large and non-maintained lands, grass was burned (TVNET (2013)). Mainly in the ecological literature, scientific researches are devoted to agricultural aspects of grass fire problems. As an example, Cruz M., Alexander M.E. (2013) and Alexander M.E., Cruz M. (2012) are examining flame length and fire line intensity modelling aspects. As shown in Sullivan A.L. (2010), thorough understanding of the behaviour of fire in grasslands is critical to the minimization of the impact of fires on agricultural and pastoral land as well as the successful management of the health, robustness, and species diversity of native grasslands. Some authors are exploring fire spread consequences (Carmel Y. *Et al* (2009), Velez R. (2010)). Only few papers are devoted to fire protection and fire prevention issues as a regional problem (Peattie S. *et.al* (2012), Pezzatti, G.B. *et al.* (2013)).

Unfortunately, nowadays burning last year's grass has become a kind of entertainment (BNN (2013)). Fire starters excuse their actions with the necessity to free the land from old grass and its fertilisation with ashes. But every year, as a result of burning last year's grass, people die; residential and household buildings are burnt down causing several tens or even hundreds of thousands of euros material loss.

Last year's grass fire starters often emphasize that they "control" burning process and are sure they are really able to control fire. Burning last year's grass cannot be controlled. Under the influence of wind and other factors the direction of burning can change, flames can rapidly expand and spread to buildings and other objects. Authors agree with Mourao P., Martinho V (2014) conclusion that the amount of municipal burnt area per forest fire depends on the economic dynamism of each locality, the population density of a municipality, the availability of trained teams of forest firefighters, and the presence of relatively high municipal expenditures on environment outlays and exactly the same is applicable for other types of landscape fires. Grass fires may appear only in the places where the land is not well-managed, the grass is not mown down in autumn. Additionally, not only countryside is not well-managed, but also urban territories are not well-managed in many places. Although, as compared to countryside regions, smaller areas burn down in towns, these fires are very dangerous, as there is denser building and grass fires endanger residential buildings, household buildings, historical monuments and other urban objects. As a result of fire urban territory gets smoked and polluted. In peaty soils there is lasting smouldering which creates fire hazard during longer period of time. Burning last year's grass can cause and also causes forest fires. The level of society awareness is often insufficient to understand that economically the most profitable method of maintaining weedy meadows – burning – cannot be joined to the modern person understanding of natural processes. Unfortunately, the unwillingness of land owners to invest financial means or their little financial possibilities sometimes force them to act imprudently and irresponsibly. One should emphasize that last year's grass is not burned only by private owners in their territories. According to the State Fire-Fighting and Rescue Service data (State Fire and Rescue service (2013)), 70% of grass fires occur exactly in the territories owned by local authorities. Burning last year's grass causes damage to nature and its biodiversity, destroys valuable plants, insects and small animals, bird nests. The greatest harm can be done when burning grass in late spring or even in summer when almost all animals have woken up, nests have been built and eggs have been laid. Additionally, wet meadows and river flood-lands, that are important for birds, are burnt. Authors agree with Malcolm Gill A. (2005) that 'landscape' fire problem is exemplified by the destruction of homes and human lives by landscape fires raging out of control. The 'problem' involves a series of landscapes (e.g. wild land and suburb), a series of systems (e.g. biophysical system and environmental-effects system), and a series of time phases (e.g. planning phase). It is a multi-stakeholder, multi-variable, multi-scale problem. Land uses, like 'farmland', imply a set of specific assets and, thus, particular perception of losses. In all land-use designations, at any one point, fire-

proneness may be seen as a function of exposure to ignition sources (members, burning brands or flame radiation and flame contact) and the ease of ignition. The landscape-fire problem has multiple partial 'solutions', not just one overall solution, and these involve social governance, land management (public and private), suppression capacity and personal preparedness. The problem needs to be addressed at multiple temporal and spatial scales in an integrated fashion for the outcome to be of maximal benefit. There will always be a residual risk of severe fire occurrence. Minimisation of residual risk requires effective land management, recurrent funding and the perpetual vigilance of all parties. Such kind of problems are common in many countries (see also Brown A., Davis K. (1973), Pyne S., Andrews P., Laven R. (1996)). Extinguishing grass fires is physically hard and even dangerous for fire-fighters work – there is no water and driveways, fire-fighters are forced to damage their vehicles driving over plough lands and ditches, to work long hours directly next to fire and in strong smoke, using dry fire-extinguishing method (with brooms, lashes). During the periods of intensive grass burning, the number of calls to the State Fire-fighting and Rescue Service reaches 300 times a day. It seriously endangers effective receiving of fire-fighters' help in other accidents.

Statistic analysis of grass fires

In 2013 2,430 grass fires were registered in Latvia (including the fires possibly caused by last year's grass burning). As compared to 2012, when 1,824 grass fires were registered, the number of fires increased by 25%. In 2012 there were in general registered 8,536 fires. 21.3% out of these 8,536 fires are exactly grass fires. The number of grass fires during last four years has tended to increase (see Table 1).

Table 1

The number of fires from 2000 to 2013

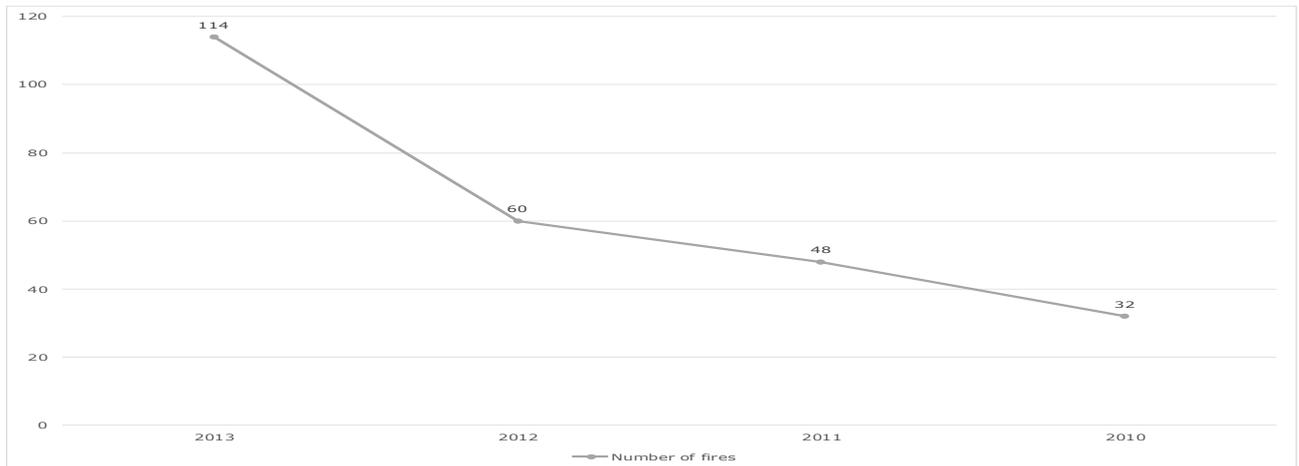
Year	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
Number of grass fires	430	824	760	695	054	092	651	083	594	446	594	328	410	024
Total number of fires	-	8536	8120	8087	8997	8967	10179	16295	8853	9525	10574	11620	7479	7554

Source: author's calculations based on the State Fire and Rescue Service (2013)

Of course, the number of grass fires in each definite year depends on the totality of various conditions. The most essential aspects are: meteorology and the time of spring coming. Let us take spring of 2013 as an example. Spring came comparatively late, snow cover remained long, but, as soon as snow melted, it became warm very rapidly and the weather mostly remained sunny. Such weather conditions were a prerequisite for grass fires. Further follow

economic, social, society education level and other compulsory conditions, that can directly or indirectly influence the number of grass fires.

If total number of grass fires increases, the number of fires possibly caused by grass burning also increases. If in 2010 there were 32 fires of such kind, then in 2013 there already were 114 fires. It draws attention to dangerousness and non-predictable consequences that appear while burning last year's grass. The increase in the number of these fires during last four years we can see in Fig.1.



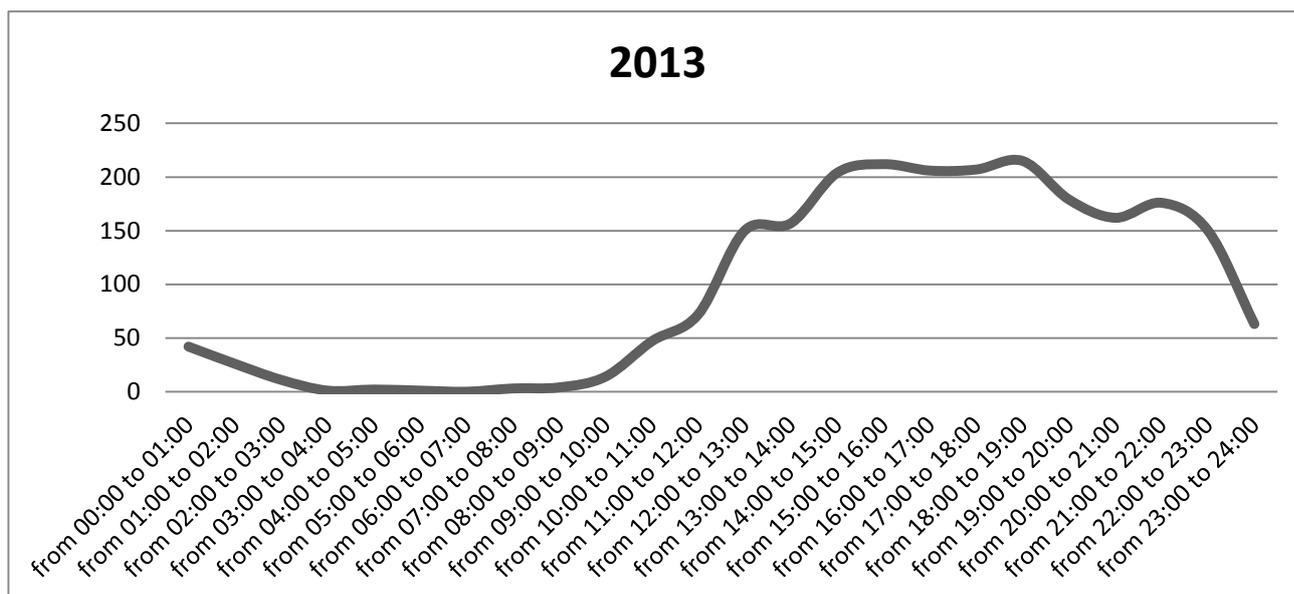
Source: author's calculations based on the State Fire and Rescue Service (2013)

Fig. 1. Number of grass fires possibly caused by grass burning, 2010-2013

The next figure (see Fig.2) shows the summary of the statistic data about grass fire according to the time of their starting. It is clearly seen that the most rapid increase in the number of grass fires can be observed from 11:00 till 16:00. This is the time when the children of school age return back home from school, but the people of working age are at work. It allows concluding, that during this period of time exactly schoolchildren are the ones that burn grass after returning from education institutions. After communicating with teachers, it was concluded, that educational institutions do not dedicate time to a separate lesson about grass fires, their threats and possible consequences. At several lessons children were briefly told about grass burning and its consequences. At the beginning of a school year, schoolchildren are instructed in fire security issues, as well as in actions in case of fire. To improve the situation, it would be necessary to introduce at least one lesson in the beginning of grass burning „season“ about issues of grass burning threats in education institutions.

It is clearly seen that the situation is very similar in all parts and positions every year. Special attention should be paid to the situation in the territories of those parts or positions, where most grass fires occur. There should be special control, if fields and other territories are in order, irresponsible owners should be punished: first, for not maintaining the territory and, secondly, for a grass fire, if it occurs. With the help of mass media, land owners should be recommended to manage their territories, stating that in the opposite case penalty will be inflicted. People also should be educated in grass fire dangerousness and its non-predictable consequences, its effect on nature and penalties applied. In that way, people would

understand real damage from burning grass. While people perceive grass burning as a matter of course, nothing will change.



Source: author's calculations based on the State Fire and Rescue Service (2013)

Fig. 2. Dynamics of grass fires depending on the time of announcement, 2013.

In regions, the number of grass fires depends not only on the number of inhabitants, but also on other essential factors: area of the territory, existence or non-existence of farmers in the region (if agricultural land is managed). But, examining last year statistics, one can find that every year there are such regions in Latvia, where the number of such fires is measured in tens and there are regions where there are no or little grass fires. Every year remarkably great number of grass fires is registered in Daugavpils, Dobele, Gulbene, Jelgava, Ogre, Olaine, Rezekne, Salaspils and Tukums districts. Special attention should be paid to these regions. Firstly, local authorities should be requested to manage their territories and, if it is not done, administrative penalty should be inflicted. Secondly, private properties should be inspected and owners should be informed about the consequences if the territories are not put in order. Thirdly, information campaigns about dangerousness, damage and consequences caused should be conducted. Not all grass fires can be quickly and easily reached by fire automobiles. As, for example, grass fires, that start spreading in remote territories which can be reached by several, in the worst case, by no stable road. As a result flames can spread for a distance of several kilometres already before fire-fighting brigades arrive. April is the most active grass burning period when the threat and danger for the society and environment are the highest. Grass burning starts in March and it ends in May, when new grass outgrows last year's grass. During last four years in grass fires 3 people have died and 7 have been injured. 144 buildings and 2 vehicles have been destroyed (State Fire and Rescue (2013)). Riga is the place where the most grass fires occur. It indicates that the greater possibility of fire occurs in the place where the greater number of inhabitants is concentrated. Comparing to rural regions, a lot smaller areas burn out in towns. But in towns the dangerousness of grass fires is much higher because of dense building and grass fires endanger dwelling houses, historical

monuments and other urban objects. As a result of fires urban territory gets fumed and polluted. Many non-maintained territories are the property of municipalities and the number of administrative violation reports is very little or they are not drawn up at all. To solve this problem situation, it would be necessary to involve municipal supervising institutions – the Ministry of Environmental Protection and Regional Development. As one of possible solutions of the problem, local authorities can organise grass mowing and sawing out bushes in their territories. After that they can be processed into granules and woodchips and used for heating, as in many municipalities there is heating equipment suitable for woodchips.

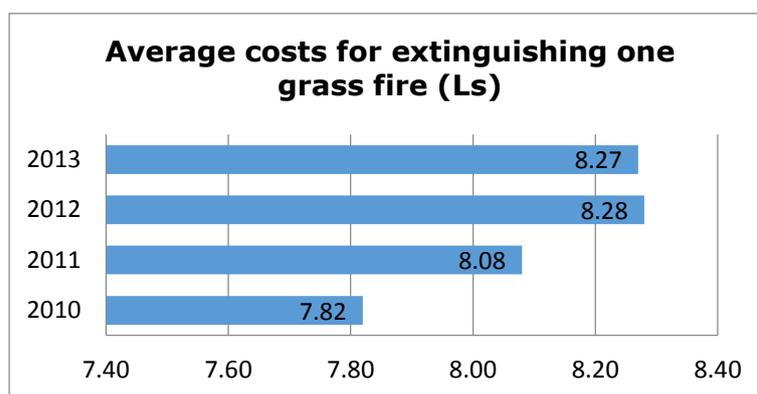
Table 2

Number of buildings, vehicles destroyed, injured, dead in 2010-2013

Year	Dead	Injured	Destroyed buildings	Destroyed vehicles
2013	1	1	44	2
2012	1	1	20	0
2011	1	2	48	0
2010	0	3	32	0

Source: the State Fire and Rescue Service (2013)

As analysed in Goldish M. (2012) and the International Association of Fire Chiefs (2009) extinguishing of grass fire leads to additional costs and is associated with additional requirements, competencies and needs for rescue services. In 2013 the State Fire-Fighting and Rescue Service spent for fighting grass fires the amount of LVL 20100.33 for petrol (the sum was calculated, taking into account prices for petrol in summer, 2013). In fighting such fires 6 vehicles were damaged. The repair works cost LVL 560.99. 2,430 grass fires were registered. In 2012 the sum spent on petrol for extinguishing grass fires was LVL 15099.10 (the sum was calculated, taking into account prices for petrol in spring, 2012). In fighting such fires 7 vehicles were damaged. The repair works cost LVL 481. 1,824 grass fires were registered. In 2011 the sum spent on petrol for extinguishing grass fires was LVL 14221.51 (the sum was calculated taking into account prices for petrol in spring, 2011). In fighting grass fires 4 vehicles were damaged. The repair works cost LVL 1035. 1,760 grass fires were registered. Every year considerable sums are spent on extinguishing grass fires, every year this sum differs, depending on the number of grass fires, petrol price, as well as area of fire. Several SFRS technical units are damaged, their repair works require financial means. On the background of total costs the costs for repair works are not really great, but one should take into account that, fighting grass fires, vehicles go along meadows, bad roads and even cross countries. In long term perspective such use of technical means can cause serious damage, the prevention of which will require large amounts of money. Comparing the costs for extinguishing grass fires with the number of these fires, there appeared an interesting tendency. Dividing the costs for petrol by the number of fires, one can see that every year for extinguishing one grass fire a very similar sum – about LVL 8 – is spent (see Fig.3).



Source: author's calculations based on the State Fire and Rescue Service (2013)

Fig.3. Average costs for extinguishing one grass fire (LVL), 2010-2013

In last years this sum is slightly higher than LVL 8, which, most certainly, is connected with growth in prices. Of course, it is only a number gained by dividing two statistic data, but it shows the tendency, which can be used for predicting costs for extinguishing grass fires depending on their number. One must not, in no case, rely this number to all grass fires, as in some fire there burn out only 1 square meter of grass, and in the other – several tens of hectares.

Plan of action for reducing the number of grass fires

When burning grass, essential damage is done to plants, insects and other invertebrates die, especially those whose evolution starts in early spring. These animals play an essential role in the ecosystem as food for bigger animals. Among them there are rare and protected species. The problem of grass burning cannot be solved in few years; it requires intense work for several years. To solve the problems stated, the authors propose an action plan for reducing the number of grass fires.

1. The Ministry of Environmental Protection and Regional Development should define in normative regulations minimum requirements for land maintenance and management to prevent the growth of last year's grass. The requirements should be equal for all local authorities.

2. Every year, without interruption, more actively in spring and autumn, there should be enhanced monitoring of the observation of requirements defined in normative regulations.

3. Every year in autumn the Ministry of Environmental Protection and Regional Development should gather information about non-maintained and non-mown lands and put this information into the information system of the State Real Estate Service. Municipalities, calculating the land tax, should raise the land tax, if the facts, testifying that the land is not maintained or there has been grass fire in it, are found.

4. Every year in summer and autumn the Ministry of Environmental Protection and Regional Development, the Ministry of the Interior should require from local authorities to maintain their territories already in autumn not to develop the possibility of fire starting in spring. They should send a letter to the Ministry of Environmental Protection and Regional Development,

which will send the letter to all local authorities. They should also control the maintenance of territories. Municipalities that have not maintained their territories should be punished administratively. The State Police, the Municipal Police should be involved in monitoring process.

5. Interdepartmental agreement between the State Land Service and the Information Centre of the Ministry of the Interior about co-operation and providing the data from the State Real Estate Service information system and State Address Register should be signed. Every year co-operation within interdepartmental agreement between the rural Support Service and the State Fire-Fighting and Rescue Service should be continued and information on grass fires should be given.

6. Every year the Ministry of the Interior, the Ministry of Agriculture, the Ministry of Environmental Protection and Regional Development should conduct timely information campaigns on the necessity to maintain territories already in autumn, stating the penalty for not doing it. It can be achieved by spreading the materials, prepared by institutions. In early spring they should conduct propaganda on dangerousness of grass burning as well as on the penalty inflicted (for example, placing the information in shops, at bus stops, etc.). They also should ensure the information for mass media according to institution competence and plans of action.

7. Every year the Ministry of Environmental Protection and Regional Development, the institutions stated in the Law on Protection Zones and the persons in charge of maintenance of protected zones should reduce areas, where last year's grass grows, by sustaining in fire safe condition the protection zones defined in the Law on Protection Zones along roads, railways and woods (land owner or legal possessor has to ensure maintaining road and railway zones, establishing and managing mineralized zones).

8. Every year the Ministry of Education and Science should raise the level of schoolchildren's education by including the issues of fighting grass burning into education program and extracurricular activities. It should include the issues of fighting grass burning in the contents of primary, compulsory and secondary education programs. It also should educate teachers in the issues of fighting grass burning.

9. Every year, on the basis of existing experience, the Ministry of the Interior should at regional level improve co-operation model of the State Fire-Fighting and Rescue Service with the State Police and the Municipal Police departments in the sphere of fighting grass burning, including practicing joint raids, monitoring. Complex of activities should be performed according to institution's annual plans of action.

Conclusions, proposals, recommendations

1. The number of grass fires during last four years has increased. In 2013, 2,430 grass fires were registered in Latvia (including the fires possibly caused by grass burning). As compared to 2012, when 1,824 grass fires were registered, the number of fires increased by 25%.

2. Having analysed the dynamics of the number of grass fires depending on the time of announcement, the most rapid increase in the number of grass fires can be observed from 11:00 till 16:00. This is the time when the children of school age return back home from school, but people of working age are at work. It allows concluding that, during this period of time, exactly schoolchildren are the ones that burn grass after returning from educational institutions. To improve the situation, it would be necessary to introduce at least one lesson in the beginning of grass burning „season“ about issues of grass burning threats in educational institutions.

3. Special attention should be paid to the situation in the territories of those parts or positions, where most grass fires occur. There should be special control, if fields and other territories are in order, irresponsible owners should be punished: first, for not maintaining the territory and, secondly, for a grass fire, if it occurs. In that way, people would understand real damage from burning grass. To improve the situation in land management, it would be necessary to ask for involving the police and the State Environmental Service resources in inspecting non-managed land already in autumn to motivate land owners to put their property in order by administrative penalties and prevent grass fire threat.

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