Integrated Management System for Forest Fire Prevention: Its Application in the Valencia Region (Spain)[1]

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Summary

Forest fire prevention requires the ability to answer a number of questions such as: Where could a fire occur? When could it occur? What form will it take? In order to obtain answers, we need correct knowledge of hazardous situations in terms of time and space. We need to be aware of these situations in order to "mobilize" prevention suppression resources to avoid a fire breaking out or, if this occurs, to limit its effects to the minimum

The characteristics of the environment in which these fires can occur are very varied, particularly in a Mediterranean setting such as the Valencia region (Autonomous Community of Valencia) where risk factors are changeable and, in many cases, are due to a complex interrelation of multiple, and diverse factors. Managers, when taking decisions, must have at their disposal support tools which must be reliable and adequate to suit the social and climatic features of the physical environment in the area they are to be used.

The Integrated Management System, set up in the Valencia region, has been designed as a dynamic tool, backed by a Geographical Information System but rather more broad-based, as it is equipped to manage and produce a wide range of information, providing a service to and obtaining feedback from the forest fire prevention programmes implemented by the Valencia region.

Introduction

Forest fire prevention demands knowledge of both available resources and possible hazardous situations. The Valencia region is a region with markedly Mediterranean conditions, where weather conditions change constantly, conditions which are moreover particularly relevant to daily levels of forest fire risk. These considerations, linked to other factors concerning the surroundings, provide us with a very high number of variables which affect the decision-making process, and make it necessary to have support tools at our disposal.

Knowing the scenario where a possible fire may break out is essential in order to programme all necessary action to avoid this occurring (Vélez 2002). This knowledge of the many different risk factors and their evolution in time and space enables prevention resources to be "mobilized". These resources, although perhaps insufficient to prevent fires breaking out, will indeed be able to minimize their number and intensity.

The system described was designed from 2002 onwards, following guidelines and directions fixed by the Valencian government's environment department and implemented by the forestry department of the publicly owned company, VAERSA. It has never been considered as a closed system and is therefore continually adapted to suit the real needs of its

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users who, in principle, are those responsible for prevention. In a second phase it will be extended to other organizations and agencies also involved in fire fighting.

General characteristics of the system

At the time of approaching the guidelines for design of the system, it was considered, firstly, that this should be a dynamic tool, supported by a Geographical Information System able to manage and produce wide ranging information, either cartographic, documentary or statistical. The use of maps in emergency situations makes it necessary that these should be easy to understand, comparable, significant and quickly accessible (Nicolás, J.M, 2001). One of the basic requisites was therefore that it should be user-friendly for any type of user with a basic computing knowledge.

The need for the system to function by a module system was also considered, so that even though it is a joint tool, each one of the modules may work independently. Lastly, the whole application was developed in order that it be accessible and operational through Internet. Although this condition was not initially envisaged, its adoption brings a number of associated advantages which increase the operating capacity of the system. However, the system has a hierarchical access protocol with different degrees and capabilities in the sphere of both queries and updating capacity.

The previous guidelines laid down the basic principles to be followed in its design. The contents were stipulated in a first phase by the Surveillance Plan on forest fire hazards in the Valencia region. The second phase introduced other general applications for forest fire prevention, depending on the real demands of users. The first modules developed were those of weather and risk analysis, a map server, the support module for locating fire hotspots and a lightning early warning system. Other implementations have been added to these modules, such as data base managers or the analysis of individual anthropic hazards.

Hazard module and meteorological analysis

Introduction

The objective of this module is to supply a zoning plan of the area which meets the priorities of forest fire defence. To achieve this, the different variables which come into play in the probability of a fires braking out, the potential danger level of the fire, and the forestry type in the area have all been incorporated within simple maps. The application was developed on a geographical information system, applying a grid of 95,000 polygons in the Valencia region. Each variable calculated is interpolated in this grid. The result is a series of maps giving probability rates and danger indexes for forest fire prevention. The information they provide, using ecological and climatic parameters, enable us to view the level of fire hazard and danger, as well as the causes of the outbreak; distinguishing whether this was physical or due to continuing pressure which has been exerted upon a specific area over time.

To sum up, the Priorities Map for defence indicates the areas with greatest forest fire protection requirements; i.e. it is assessed which areas have the most unfavourable combinations of factors and greatest forest quality, these being the top priorities for surveillance. As a general rule, Protected Natural Areas and forestland with an fcc>25 % will always be within the highest defence priority thresholds. The information the map supplies is a support tool for daily decisions in planning surveillance and prevention resources. In the final decision in order to prioritise available resources it is fundamental to superimpose this information with the information from the early warning modules in the case of lightning and anthropic risks.

Methodology

The methodology is based on a multi-criterion analysis of different variables used, according to the weightings and formulations used in the Autonomous Community of Valencia Prevention Plan on Forestry (Generalitat Valenciana 1995) *(fig 1)*, the final result being a zoning of the area by fire risk, potential danger level, and forest quality or priority for defence.

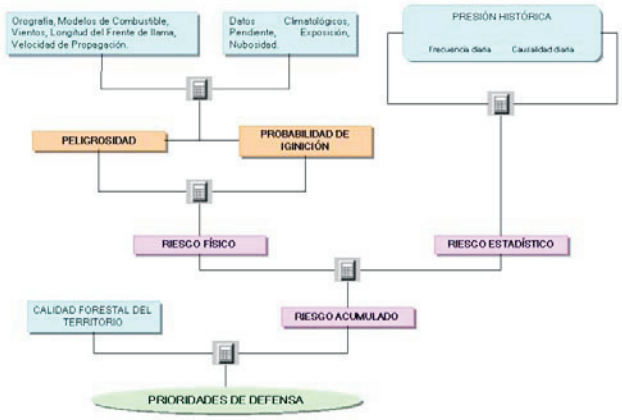

Figure 1—General methodology applied in the calculation process

This methodology was designed for a static application, so that in order to use it in a dynamic system in which the different formulations are calculated on a daily basis, it has been necessary to vary the weighting and thresholds to a certain extent.

Cartographic server

For daily calculation of the different indices, a significant amount of cartographic information has been required on digital support. The system has not been designed as a substitute to the decision-making process which must be undertaken by the Manager. For this reason it combines complex indexes, along with the basic information, in this case cartographic, which enables individual decisions to be taken. The server has also proved to be especially useful in solving another problem: the difficulty of introducing the use of the GISs generally to technical personnel with forest fire prevention responsibilities and forest management in general, apart from facilitating the use of a unified mapping system by the surveillance, prevention and fire-fighting services. The system has a cartographic server developed on ArcIms ®, which covers the basic needs in a user friendly environment. Amongst the operations which may be undertaken is included the production of individualised subject-based cartography, location of infrastructures, access to individualised alphanumeric information, and surface area planning, etc..

Prevention resources manager

The Valencia region has a major number of resources whose key and almost exclusive function is to undertake surveillance work and provide information on forest fire prevention. It is a dual purpose system: firstly the resources themselves have to be managed i.e. location, operability, routes, etc., and secondly the information they produce: meteorological data, operating incidents, individual hazards, etc..

As regards mobile resources, the system includes an area-based database which lists available resources for each municipality in the Valencia region, their characteristics, route and period available. The permanent resources (forestry observatories) are itemised in an area-based data base which includes complete information on the characteristics of the facility, along with an interface which enables meteorological data to be entered in real time.

Fire-fighting support infrastructure

The System is accessible to a wide number of organisations with a role in both fire prevention and extinction, as well as, in line with the current set up for public resources in the Valencia region, the bodies responsible for maintaining the firewall areas network, water tanks and forest road network, and the fire-fighting authorities. These are based in different departments of the Valencian regional government. For this reason it has been considered a priority to have a permanent inventory of all these infrastructures. In the case of the firewall area networks and forest road network, this is only accessible as cartographic information through the server, however in the case of the water tanks and other water supplies, there is a fiche with periodic updates which include the complete characteristics of this infrastructure, including their water levels in the summer season.

Fire Location Support Module

One function of the permanent surveillance network is the detection of any sign of possible fire and immediate transmission of this by radio or mobile telephone to the Emergency Call Centre for verification and, if applicable, immediate mobilisation of fire-fighting systems. The objective of this module is to facilitate this task. The module obtains a panoramic photo from each observatory, simulating the observer's vantage point. The photo is corrected, georeferencing the film produced, so that each pixel of the photograph has a number of coordinates on the plan.

Results

During the course of 2003 the system received 13,000 queries, an average of 35 per day, with 209 users registered. Within these users there is a broad range of professionals, shared between the different local government departments in the Valencia area. In spite of their different computing knowledge, these professionals have adapted very well to the System, getting actively involved right from the start in the maintenance of information and in its structure, through suggestions, e-mails, or personally at the different briefing meetings which have taken place to date.

It is early days to present conclusions which could be extrapolated to other situations. We consider that having a multidisciplinary team made up of forestry and computing professionals, in close contact with the real users, and the fact that from the start they have been able to use the system as easily as they make a query in the network, has been the key to this acceptance.

Thanks

The work undertaken by the VAERSA Forestry Dept. should be underlined, and particularly that of Javier De Vicente, whose work has been fundamental in the results obtained to date.

References

Nicolas, J.M. 2001. **Mapa de demanda de defensa territorial frente a los incendios forestales.** Dept. of the Environment. Autonomous Community of Madrid. Madrid (Spain)

Vélez, Ricardo. 2002. **Nuevas tecnologías para un viejo enemigo, el fuego forestal.** I Jornada técnica sobre prevención de incendios forestales. El desarrollo tecnológico y la prevención de incendios forestales, Valencia (Spain)

Generalitat Valenciana. 1995. **Plan de Selvicultura Preventiva de la Comunidad Valenciana.** Valencia (Spain).

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