DEVELOPING AND USING SUSTAINABLE MANAGEMENT SYSTEMS FOR MONITORING AND EVALUATING AIR ENVIRONMENTAL RISKS IN INDUSTRIAL AND URBAN AREA

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Abstract: In the frame of sustainable management of resources and environment, there is an increasing interest to elaborate and implement sustainable management systems used for monitoring and evaluating environmental risks, system that can be efficiently used in prevention of some negative situations and in the management of crises situations induced by accidentally pollutions. The implementation of such systems will become operative in the sustainable backyard management, being very important for life quality and environment development at local, regional and national level. In this frame the main goal of many research activities is the conception, development, testing and implementation of advanced systems of rehabilitation and spatial planning of territory that have to assure the evaluation of environmental risks in order to manage crises situation, in accordance with the demands of sustainable development on rural, urban, regional and national levels.

INTRODUCTION

Having in view the present backyard situation in Dâmbovița County, the existence of industrial plants (Târgoviște, Doicești, Titu, Fieni, Moreni) with a high atmosphere pollution (induced by different agents: dusts, gases, noises) and the legislative demands in environmental area – according to the UE legislation, there is necessary to solve some problems in relation to the creation of easy and viable instruments that can be used for sustainable environmental management through management of spatial databases offered by climatic and environment indicators, monitoring system, instruments provided with the capacity to forecast eventually crises and to offer solutions in order to their prevention and management.

Such systems will offer methods and technologies for spatial databases achievement in monitoring environmental risk factors area in order to evaluate them (prevention and reduction) and to improve environmental management quality to assure the environment security in crisis. A sustainable management system of resources used for monitoring and evaluating the environmental risks in order to prevent the negative effects and to manage crises situations represents an advanced informational system for e-service in particular for risk management.
Conceived to manage atmosphere pollution with dusts, pollution gases and noises, we propose a management system that can be adapted for the management of all types of pollution and natural disasters. The topic is actual, framing to European and national policy for sustainable environment management, which came as a necessity not only for improving life quality in Dambovita County, but also as a present request of European Community - life and environment quality, being a governmental and non-governmental priority of contemporary civilization. The sustainable development involves the introduction of environmental policies and high level management in order to provide, at first the prevention and than the retrieval of environment quality [3, 5].

At present, the trend in research is offered by the development of some efficient management systems which can manage a large database, obtained through on-line monitoring, capable to offer solutions and operative decisions in malfunctioning situations and crisis and which can provide the prevention of a series of disasters [6]. In this respect, there were launched a series of studies [1], the usage of spatial databases being one of the directions most approached [4]. There are also many unsolved problems related to the applicability of the theories in concrete conditions [2].

At European level act the European Environment Agency that aims to monitor the environment state and identify the trends of evolution to global level. On the other hand, every European state is liable to make environment examinations based by necessary minimum criterions and to publish the results. The central financial instrument for environment policies implementation is the LIFE program. Among technical instruments of application of environment policies are Eco-Management and Audit Scheme (EMAS), eco-profit, eco-efficiency, eco-label, ISO 14000 standards. The Environment European policies include the “liability principle” that enforce the growing of concernment of economic agents for environment protection investments and “caution principle” that assume measures of environment pollution prevention including the stopping of some actions that have no risks evaluation [7].

At national level, in the frame of environment policies, the responsibilities concerning the sustainable management belongs to local administration (prefectures, cities) and to governmental agencies that monitor and manage the environment quality (National Environment Agency) [8, 9, 10]. These are responsible for European legislation implementation that demands high performance instruments. The creation to the local level of these instruments to respond to requests, decrease a lot the costs of implementation, so that the researches on this field are very important. Industrial areas in Dambovita County, even they are not serious pollution areas, they are included in potential risk areas category.

In this context, the partnership realized in the frame of MEMDUR project [11] proposes a solid IT support, as following: the usage of information systems for databases management, data came from the monitoring of different environment parameters, is a present-day international research field. By its complexity, the development of the system contributes to the knowledge development offering a sustainable management system of environment pollution which allows managing the malfunctioning situations and crisis.

GENERAL GOALS OF THE MANAGEMENT SYSTEM

The general goals of the management system are:

1. Increasing the technical and informational level for acknowledgement of the specified conditions in Dâmboviţa County where environmental risks factors are present (pollution
source, specified pollutant, dispersion proceedings, impact) – in this frame, the selection of the environmental factors and atmosphere pollution sources will allow the estimation of a series of risk situations and the selection of the best monitoring points. Beside, the effectuation of pollutants analyses (dusts, pollution gases, noises), both with classical methods and online methods, will allow the determination of the efficiency of data utilization from online monitoring on evaluation and forecast activities.

2. Spatial development through an efficient resources management system definition and the existent systems adaptation to knowledge-based information society demands (knowledge management).

3. Systemic and detailed conception of information tools needed for territory spatial planning to provide the environmental risks evaluation in order to anticipate and prevent the negative effects.

4. The development of the sustainable management system and demonstration of its utility from the point of view of providing the reduction of costs to remove the risk generating causes and the effects on the environment and population.

5. The development of applications with information support which provides the technical content necessary for increasing the level of certitude in elaboration of technical and technological non-generating ecological risks solutions.

6. The generalization of good practices of sustainable resources management through large-scale research results dissemination and increasing the prestige of the consortium created in the frame of the project.

THE DEVELOPMENT OF THE MANAGEMENT SYSTEM

The development of the proposed management systems involves the following steps:

1. Identification of the most important pollution sources and the pollutants generated by these sources. The monitoring will be made based on spatial and temporal diagrams. The collected data will be saved in a database which will be compared with the existing one to the partners and to the beneficiary unit. There will be monitored environment atmospheric parameters (wind speed and direction, air temperature and humidity), atmosphere pollutants (atmospheric dusts and PM10 dusts), polluting gases (CO, NO, NO\(_2\), SO\(_2\), NH\(_3\), H\(_2\)), all along the dispersion area.

2. The data will be saved in a database and compared, using mathematical models, with existing standard data offered by the Environmental Protection Agency, and after the analyses there will be established the input elements of the system. Dispersion analyze will be made using specific programs for data processing. The software methodology implies, first, the usage of the spatial database for increasing the efficiency of the management of the environment pollutant factors evolution. In this sense, it becomes very important the identification in the field of the spatial position, the geometry and the details of the inhabited zones, hydrographic elements that can be affected by ecological accidents through possible pollutant sources. The analysis will be made in relation with climatic and atmospheric factors: air drafts, atmosphere humidity, air temperature.

The principals entities of geospatial database are: parcels of land, constructions, green spaces, city limit, administrative territories limits, hydrography, high voltage networks, gases or oil main, secondary products of industrial processing (ash, industrial water, residues, used industrial water, etc.), level curves to 1 meter equidistance in city and 5 meters outside the city, using different primary sources: satellite image, ortophotogrammes, topologic plans on paper support. The current working scale will be 1:5000. The transcription of these elements
will be made in geospatial database in the national protection system Stereo 1970 and Black Sea altimetric quota. It will be generated the digital model of the 3D area on interest zones.

The interest zones in Dâmbovița County are: a) Fieni area and neighboring localities; b) Doicești area and neighboring localities; c) Târgoviște area and neighboring localities; d) Titu area and neighboring localities.

The interest zones will be integrated on digital map of the Dâmbovița County, which will have the scale precision as 1:25:000.

The graphical data will be organized on distinct layers. From the work flow point of view, there will be followed the next steps:

a) Primary spatial data sources determination and their geo-referencing into the projection system Stereo 70;

b) Graphic processing (vectorization and mapping) - using standardized graphic elements in accordance with conventional signs atlas used in cartography - and realization of spatial database;

c) Waters and sol characteristics in interest zones and definition of sol, water, air entities attributes - attributes which determine the fundamental impact of pollution factors with environment;

d) Topology of spatial entities implementation;

e) Textual database design;

f) Database population with values determined in the field, collected from technical file or from Environmental Protection Agency database. Their validation will be made by study beneficiary technical compartments;

g) Databases interconnection and spatial queries realization;

h) Spatial and textual database utilization for pollution monitoring and crises situation management, and software application design in accordance with actual localization and actualization demands.

i) The interconnection with databases which contain the technical parameters of environment state monitoring, the parameters acquired by an acquisition system and automated centralized on a server;

The finalized management system will have at least two minimal components:

a. Spatial databases: contain the vectorial representation of the real world attached to a coordinates system and the alphanumerical representation, which contain technical attributes values of the objects and also the events appeared in industrial plants exploitation. There will be implemented these three elements typical to spatial database: position – usually in terms of spatial coordinates and postal address; attributes – characteristics of geographic entities (pollution factors names, admitted limit values, current values and alarming thresholds); spatial relations – relative position from the entities, important characteristic in analysis that introduce the notion known as topology;

b. The applicative software for the creation, the maintaining and the exploitation of databases and the realization of communication with the system database. The applicative technology will be the type client-server using the procedures saved on database management server.

In order to make the graphical entities, it will be used technologies specific to geographical data processing: geo referencing, vectorization and mapping. The data collected in the field will be digitized in order to realize the digital plan and to populate the spatial database. The vectorial model will store the graphical information in shape of points sequence and linking segments, in order to represent points, lines and polygons boundary.

In order to represent the spatial entities, the lines of segment are pointers (vectors) and there are connecting relations between them. The point entity in vectorial model can be a
point (defined by a coordinates set), a node (the beginning or the ending of a segment) or vertices (were a polygonal path change its direction). The line entity includes segments, curves or arc connected in nodes, chains (complex lines or arcs, with more then one segment) and rings (closed entities where the starting point coincide with the ending point, so they have at least three non-linear points). The surface type entities can be distributed on interior surfaces (delimited by rings, lesser their outlines) and polygons (surfaces that include their outlines). Unlike the raster model, the coordinate’s space is continuous. Each point entity has a precise and unique position.

In vectorial system, these five types of entities (point, line, surface, S3D and network) will be definite by their coordinates. The points are represented through the coordinate’s pair, lines through the segments or arcs that unify the points, surfaces through the polygons that border them, networks through connected lines etc. In order to develop a data structure belonged to spatial entities in vectorial system, there are necessary additional information about the geographical relation between the entities - that’s the way of implementation of the topology. The specialized software routines are used to make the automated calculus of the pollution factor value in term of the distance from the place of pollution generation and taking into account: the wind direction and speed, air temperature and air humidity.

The processing will be staged and will be delivered in shape of plates. In case of graphical representation imprecision, the stage of identification in the field will be remade with beneficiary help. The database structure for the network will be designed on spatial and logical level. There will be created also the software applications needed to loading an updating the textual database: data introduction forms, updating and data validation modules. These will be made with object oriented software tools. Beside the geospatial queries realization, the spatial and textual databases will be structured by the appeared events evidence modeling, associated with the production causes. Beside, it will be analyzed the interconnection of the spatial database with the automated acquisition database, it will be defined the functioning parameters of the network and the technical solution will be proposed.

THE USING OF THE MANAGEMENT SYSTEM

The management system will provide the improvement of atmosphere pollutants monitoring methods and registering of data to the relational databases. There is envisaged the proving of automated online monitoring methods, in point of reliability (systems which can function automated for a long period of time) and their sensibility (to the detection level), being known the quickness of data providing (real-time measurements).

On regional level, for sustainable area development there will be identified the major pollution sources, their risk level and the impact on environment of pollutant dispersion. In this way, it will be possible to elaborate an emplacement plan scientifically of automated monitoring stations which will be acquired and administrated by beneficiary.

The management system will provide - through the definite models - the simulation of spatial effects of technical accidents which can cause pollution, graphical plotting of risk areas, production system reliability tracing and revisions planning starting from the associated events evidence, the advice of industrial plants functioning, optimal scenarios of intervention for reducing the technical accidents effects over the environment, growing the operating safety in normal and crises conditions in industrial area with high technological risk, the possibility of fast and proper intervention in case of ecological disasters.

The product will contain: topographical plans (digital file form and tables of pictures
at 1:5000 scale and integrated on city map at 1:25,000 and 1:100,000 scale), databases (vector for spatial and textual data appropriate to graphical entities), vectorial, textual and raster data sources integration, software application necessary for textual database update (the functioning on multi-user network using Windows 2000 server, the administration of access rights for the users), backup application for databases, installation kit for software application, installation and using documentation.

CONCLUSIONS

Being an information system easy to use, the system will provide the possibility to an efficient citizen’s information, through the implementation of the concept “Science - Society”, in accordance with the prior directions given by European Commission related to research areas structuring and Government Decision nr. 878/2005 (public access to environmental information).

The aim of the system is oriented to a sustainable management of environment polluting, in order to manage crisis and malfunctioning situations. It will be an open-system to allow the integration of automated systems for monitoring functioning technological parameters. By implementing the system it will be realized a functional model needed to decisions-making, especially related to negative effects of pollution on environment minimization actions and also the support for managers in decision-making and - as consequence - the growing of operation security in normal condition and crisis, on the field.

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