ENVIRONMENTAL PLANNING FOR DISASTER MANGEMENT BY USING GIS (A CASE STUDY ABOUT FLOOD IN MAZANDARAN)

A. R. Gharagozlou [a], A. R. Azmoudeh Ardalan [b], M. Hejrani Diarjan [c]

[a] Geomatics College of NCC, Iran, agharagozlu@yahoo.com
[b] Geamatics Department of Tehran University, ardalan@ut.ac.ir
[c] National Cartographic Center of Iran (NCC), mojhej@hotmail.com

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ABSTRACT:

Geo-information technology offers an opportunity to support disaster management: industrial accidents, road collisions, complex emergencies, earthquakes, fires and floods as the natural disaster management in national and international level. The Tsunami in Asia and some natural disaster accidents demonstrated that human beings are at risk at any time, anywhere. Adequate geo-spatial information is a prerequisite for sustainable development, but many parts of the world lack adequate information on environmental resources. By providing such information, which serves as an important tool for decision-making in land use planning, national mapping agencies can help provide effective information to natural disaster management. Their role in sustainability and development planning is thus unique and essential. Organizations with normally distinctive mandates today design, store and manage geo-information. Accurate information on land and environmental resources is essential to provide disaster management plan. Key sources of information include topographic maps, aerial photos, satellite images, and data derived from geographic information systems (GIS). At the national level, this information can be used to identify environmental resources to use in proper planning as a tool for disaster management and help promote effective ecological and environmental situation and sound land use planning to reduce disaster risk. In this article begins with some general comments on the importance of land use planning, and outlines some current environmental issues and then presenting environmental models to use in disaster management plan by using GIS. The article also discusses the role that geo-information and environmental planning play in disaster management to reduce negative impacts of flood and present proper alternatives for developing of Mazandaran. Finally, offers proposed environmental models that illustrate how geo-information can be used in land use planning programs that take a sustainable development plan for disaster management in Mazandaran

1. INTRODUCTION

This article begins with some general comments on the importance of land use planning, and outlines some current environmental issues. It also highlights the connection between land use planning and sustainable development and the discussion describes several key methods of resource identification, with particular emphasis on existing potential of geo-information technology that offers an opportunity to support disaster management: floods and environmental impacts, and natural disaster in national level.

The article also discusses the role of geo-information in promoting geographic information system use. By attention to natural disasters in Iran especially flood in Mazandaran in the North of Iran proper assessment of flood by using environmental development models and GIS and with attention to Sustainable development approach and disaster management are presented. The article offers proposed models that illustrate how GIS and remote sensing data can be used in land use planning programs that take a sustainable development approach [9] and disaster management (flood). Excessive land use and increased human impacts have imposed significant pressures on the environment worldwide. These effects are increasingly noticeable from a scientific and technical viewpoint. In an era when human economic activity affects all areas of the environment, there is no doubt that governments and organizations should plan their land use wisely. Future development should proceed on the basis of proper land use planning, with minimum destruction of the environment because impacts of human activities results natural disasters in some area. Planning assessments must therefore consider environmental issues and natural disaster (flood) and use environmental and geo-referenced information to refine decisions. Gathering information reveals the available potential of the environment; development planning at the nationwide level can help decision-makers identify resources and target their future scientific studies to reach sustainable development.

2. ENVIRONMENTAL ISSUES

Since the late 1970s, statistics show that the number of cities with populations of more than eight million have increased from two to 28. In addition, water consumption has been increased from 1300 billion to 4200 billion cubic meters annually, gas production has increased from five billion to 25 billion tons per year, and rain forests have decreased by 30 percent. Metal resources also are being used up rapidly: It has been estimated that nickel will be depleted within approximately 55 years, copper within 36 years, zinc within 25 years, and lead within 21 years.

Moreover, ***each minute, 5.6 hectares of forest are being destroyed*** and some other human activities cause disaster such as flood in some parts of the world.

In this study by using geo-spatial information and environmental impact assessment approach proper environmental models to reach sustainable development plan

for Mazandaran in the north of Iran for flood management are presented. To achieve sustainable development, land use must be tailored to the land's capacity. Sustainable development sees the economy within a comprehensive context, and recognizes that economic growth is inseparable from environmental and social issues. Effective land use planning considers the sustainable capacity of land, based on qualitative and quantitative potential, and prevents squandering of resources and misuse of land.

2.1 Flood

Floods are one of the most common hazards in the world also in the north of Iran and some parts of Mazandaran. Flood effects can be local, impacting a neighborhood or community, or very large, affecting entire river basins and multiple states [1]. However, all floods are not alike. Some floods develop slowly, sometimes over a period of days. But flash floods can develop quickly, sometimes in just a few minutes and without any visible signs of rain. Flash floods often have a dangerous wall of roaring water that carries rocks, mud, and other debris and can sweep away most things in its path. Overland flooding occurs outside a defined river or stream, such as when a levee is breached, but still can be destructive. Some general reasons of flood include: weather related reasons: heavy rainfall, duration of precipitation, sudden snow melting and physical conditions: soil variety, slop of lands, land degradation and human activities: deforestation, misusing of land and transforming to grasslands or agricultural area, misconstruction of roads, bridges, dams. Flooding can also occur when a dam breaks, producing effects similar to flash floods. Be aware of flood hazards no matter where you live, but especially if you live in a low-lying area, near water or downstream from a dam. Even very small streams, gullies, creeks, culverts, dry streambeds, or low-lying ground that appear harmless in dry weather can flood every state is at risk from this hazard [7]. Some scientists think the major problem about natural disaster and flood is in the improper exploitation of land [5]. By using process of plan compilation with a land use planning approach some important negative impacts that cause flood is under our control. Now process of plan compilation without a land use planning approach and with a land use planning approach are presented: Process of plan compilation without attention to natural disaster and land use planning approach is include (a) reassigned objectives for land use planning without attention to natural disaster, (b) identification of resources for exclusive objective (c) planning (d) plan compilation with extra emphasis on identification of resources related to objectives. Process of plan compilation with attention to natural disaster management and land use planning approach is include (a) identification of environmental resources (b) analysis of resources (c) assessment of economic and social capabilities of the land and human made human made construction (d) assessment of economic and social capabilities of the land and human made construction (e) assigning of objectives for land use planning (f) planning (g) compilation and conclusion.

3. METHODS OF IDENTIFICATION OF LAND RESOURCES

Statistics and sampling, conversion of the aerial photos, satellite images and topographic maps, automatic conversion of aerial photos and satellite images and data of remote sensing, geographic information systems (GIS) are different methods of identification of resources. One of the objectives of this study is to utilize Geographic Information System (GIS) data to construct a set of GIS data, a flood hazard map, and land development priority map to help the responsible authorities develop, design and operate flood control infrastructure and prepared aid and relief operations for high-risk areas during future floods. In recent years the combination of 3D-laser scanning and side-scan can be very beneficial for mapping complicated water side areas; the two systems are complementary [11]. To geo-reference the relative location, GPS positioning required.

4. ASPECTS OF THE ENVIRONMENTAL MODELS FOR NATURAL DISASTER MANAGEMENT (FLOOD)

It should be clear that presenting an environmental development model to be used in a GIS for natural disaster management has a lot of restrictions and limitations [8] whose description would lead too far here. Some factors that have been considered in presenting the model include; industrial sites, transportation networks, weather and climate data, landform, elevation, slop, geology, bedrock, soil, water resources, vegetation, installations and buildings[2], energy transmission stations, natural resources, gardens, forests[3], parks, etc. the priority of the mentioned parameters are different in the model[10]. It is clear that north of Iran and Mazandaran has an environmental development context and is under the interactive effects of the large region. Also it is thus impossible to correctly analyze the environmental conditions of Mazandaran for natural disaster management without considering the social and economic activities in this district.

5. LINEAR MODELS

Set out below are mathematical linear models for flood management in Mazandaran. N refer to specific model with environmental planning approach for flood management and control of destroying by attention proper land use planning in the region that present location of improper area for development: \

M=

S(5,6)+H(5,6)+QA(2,3,4)+MA(1,2,3)+WS(4,5,6)+SO(1,2,4,5,6)+SW(1,2,3)+NI(1,2,3)+HP(1,2,3)+HBU(1,2,3)+HBR(1,2) (1)

Where:

S is slope, H is height or altitude, A is aspect, QA is fault line, MA is distance from ravine areas, WS is wind speed, SO is soil components, SW is distance from subterranean water resources, NI is distance from industrial sites and HP is historical landmark, HBU is Distance from urban habitat and HBR is distance from rural habitat. For purposes of the linear models, the terms used have the following definitions:

"Slope" (S) includes six classes: 0 to 2% (class 1), 2 to 5% (class 2), 5 to 8% (class 3), 8 to 12% (class 4), 12 to 15% (class 5), and more than 15% (class 6). "Height" (H) includes six altitude classes: less than 1000 meters (class 1), 1000-1200 meters (class 2), 1200-1400 meters (class 3), 1400-1600 meters (class 4), 1600-1800 meters (class 5), and more than 1800 meters (class 6). "Distance from ravine areas" (MA) includes four classes: less than 50 meters (class 1), 50-300 meters (class 2), 300-500 meters (class 3), and more than 500 meters (class

4). "Subterranean water resources" (SW) divides resources into four classes, based on distance to the water resource: less than 100 meters (class 1), 100-500 meters (class 2), 500-1000 meters (class 3), and more than one kilometer (class 4). "Distance from industrial sites" (NI) includes three classes: less than 5 kilometers (class 1), 5-10 kilometers (class 2), and 10-20 kilometers (class 3). "Distance from Urban Habitat" (HBU) divides 4 four classes: less than 5 kilometers (class 1), between 5 to 10 kilometers (class 2), between 10-20 kilometers (class 3) and more than 20 kilometers (class 4),"Historical landmark" (HP) divides historical places into four classes, based on how far away they are located: less than 5 kilometers (class 1), 5-10 kilometers (class 2), 10-20 kilometers (class 3), and more than 20 kilometers (class 4), Distance from rural habitat "HBR" divides rural area and around this to 4 classes: less than 2 kilometers (class 1), 2-4 kilometers (class 2), 4-8 kilometers (class 3) and more than 8 kilometers class 4.

In 1999 flood in northern Iran left 34 dead and 15 missing after more than a week and presumed dead. More than 100 people were injured and damages caused to various areas was estimated at 15 million dollars. The flood in Neka in the northern Caspian Sea province of Mazandaran was unprecedented. Neka, Sari, Behshahr and 59 villages of the Mazandaran province were hit. Greatest daily of precipitation of Mazandarn between 1995 to 2005 based on meteorological data center of Iran to monitor are presented. To analyses by using GIS and digital map of Sari and based on past on the region about flood some analysis are presented

Figure 1: Overall view of Mazandaran and it's districts

TEHRAN 2006, MAY M.S & A)
STATION RAMSAR (40732) I.R OF IRAN METEOROLOGICAL ORGANIZATION (IRIMO) FORM 26
LATITUDE 36 54 N
LONGITUDE 50 40 E DATA PROCESSING CENTER
ELEVATION -20.0 M

GREATEST DAILY OF PRECIPITATION IN mm.

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	ANNUAL
1955	****	*****	*****	*****	*****	*****	*****	30.0	33.0	3.0	70.0	9.0	******
DAY	**	**	**	**	**	**	**	17	11	25	12	4	
1959	27.0	26.0	33.0	14.0	9.0	18.0	4.0	16.0	62.0	80.3	48.0	40.0	80.3
DAY	20	2	16	6	25	18	23	11	21	17	11	23	
1996	29.0	41.0	10.0	18.0	12.0	44.2	4.0	21.0	100.0	51.0	44.0	41.0	100.0
DAY	9	2	19	3	26	30	26	29	19	1	11	18	
1997	25.0	40.0	18.0	22.0	8.0	35.0	35.0	5.0	55.0	27.0	73.0	32.0	73.0
DAY	27	19	7	11	19	3	4	6	23	31	6	16	
1998	28.4	43.0	22.0	16.0	5.0	7.0	19.0	11.0	29.0	209.0	59.4	71.0	209.0
DAY	16	19	31	5	13	25	8	14	11	8	9	2	
1999	48.0	8.8	32.0	49.0	50.1	0.2	38.0	32.0	46.0	32.0	37.0	34.6	50.1
DAY	1	4	17	6	20	25	12	31	27	24	20	24	
2000	19.0	17.0	22.0	3.0	14.3	21.0	5.0	26.2	47.9	40.7	63.0	11.8	63.0
DAY	15	25	8	21	4	12	13	29	11	13	6	9	
2001	62.0	5.0	43.0	3.1	52.0	13.0	11.0	30.0	219.2	273.0	40.0	39.0	273.0
DAY	24	21	10	26	25	30	18	17	1	2	19	16	
2002	27.0	47.0	52.0	26.0	30.0	3.8	7.0	18.0	14.0	18.0	107.0	60.0	107.0
DAY	5	16	18	22	13	20	21	11	20	15	25	2	
2003	17.7	23.2	21.0	19.6	10.8	46.4	4.0	29.0	117.0	155.0	149.8	100.0	55.0
DAY	15	28	8	28	7	5	21	24	7	20	3	29	
2004	22.0	6.4	35.0	33.6	13.0	41.4	24.0	13.0	39.0	191.0	45.0	97.0	191.0
DAY	26	17	31	4	23	12	2	13	12	14	4	26	
2005	33.5	24.0	25.0	18.0	12.0	126.0	6.0	29.0	13.0	49.0	10.9	17.9	126.0
DAY	11	2	5	2	6	4	12	21	4	21	6	27	
1955-2005	72.0	86.0	70.0	49.0	66.0	126.0	103.0	126.0	260.0	340.2	195.0	114.0	340.2
YEAR-DAY	69- 3	67-14	90-16	99- 6	56-26	5- 4	74- 6	87-16	60-17	90-14	62- 9	70- 8	90

With attention to linear model of flood management and digital map of Mazandaran and by using GIS the result of analysis are presented. Comparing between road ways and flood ways and risk assessment for railway lines and oil and gas stations and also improper area for development are presented:

Figure 2: Statistics related to land use changes (per Km2) 1990 to 2001, North of Iran

Analyzing the satellite images reveal reduction of forestlands in north of Iran due to the expansion of the urban limits misuse from these area. The other fixed natural resources of the region too have been overused resulting in environmental destruction of the area. The amount of residential areas during 1999 and 2001 show a 10% growth while there is no increase in the number of forestlands. The amount of forestlands and gardens declined and open areas have been reduced thus leading to the conclusion that most of the construction activity took place in forestlands.

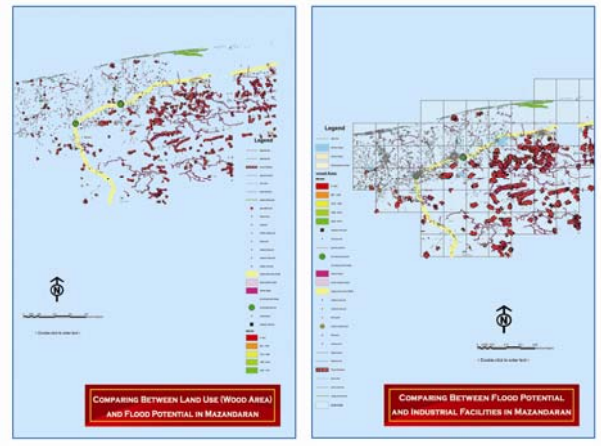

Figure 3: Comparing Between Flood Potential and Industrial Facilities and Land Uses

6. CONCLUSION AND RECOMMODATIONS

In the discussion and conclusion, first some innovations are introduced: Innovations in the filed of presenting environmental development models for planning which are based on natural disaster management for flood in Iran and are proper models for analysis in GIS. Geo-information technology offers an opportunity to support disaster management: industrial accidents, road collisions, complex emergencies, earthquakes, fires and floods as the natural disaster management in national and international level.

The tsunami in Asia has once again demonstrated that human beings are at risk any time, anywhere. Considering the presented outstanding characteristics in the models, one of the obvious and prominent aspects of innovations in this paper, are the patterns and models that can integrate between Geo-information technology and natural disaster management. Positioning of improper models and places by using GIS analysis for development of Mazandaran based on the environmental and ecological capacities with a land use planning approach are presented. At the same time, by using GIS necessary analysis to find flood risk in the region and impacts of flood on natural and human facilities are presented. Choosing proper linear models based on environmental capacity with a flood management emphasize determining the natural and ecological potential of the area and using GIS is the important point of this paper. The joint application of GIS and environmental planning can help land use planners apply optimal development planning guidelines. The other key idea we suggest here is the need to compare the results of these analyses with future development plans. Comparing the natural potential of the territory with predicted development plans can result in better decision making to reduce the cost of flood in rural and urban area. The use of GIS technique during the last decade are increasing being applied for identification of natural resources but the practice of analyzing the development models with the use of GIS in development planning for flood management is a new experience.

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