The role of flood anticipation and warming systems in flood risk management

ALI SHAKOOR[1], GHOLAMREZA ROSHAN[2] & MOHAMMAD REZA REZAEI[3]

1 *Assistant Professor of Geography- Department of Geography- Islamic Azad University – Marvdasht Branch-Iran*
shakoor@miau.ac.ir

2 *Department of Geography- University of Tehran-Iran*

3 *Assistant Professor of Geography- Department of Geography- Islamic Azad University – Marvdasht Branch-Iran*

Abstract Facing the problems of urban environment is one the issues that most cities face it. In this field, flood water is a danger that the people of many countries face it and is one of the most destroying disasters among 15 known natural calamities all over 90 countries are exposed to danger of flood water. The increase in the population and the shortage of agricultural lands led to human population movement to the flood water plains and this intensifies the danger of flood water and its effects. But nowadays, considering the destroying effects of flood water on the human societies, structural methods of protection against flood water such as flood water bands and other methods of controlling and directing flood water, can be efficient only when the design capacity of these structures is high. But when these structures break, always a remaining risk exists. In most cases, such structures may be improper or their execution may be impossible because of environmental reasons and therefore nonstructural methods are needed. The flood water warning for directing of the remaining risk is necessary is one of the most efficient methods of non-structural methods of flood water management.

Keywords hazard; disaster; risk management; flood perdition

INTRODUCTION AND BACKGROUND INFORMATION

Confronting urban crisis is one of the subjects most cities are facing.

Peculiarities and conditions governing urban areas and density of environmental investments, has made attention to proper planning for cities' immunity necessary. The flood is one of the disasters that about 196 million people in more than 90 countries are at the risk of it annually. About 170 people have been died in the floods occurred during the years 1970 to 2000 in the whole word (NDUP.2004).

Flood is a disaster that people of most countries has confronted with it and it has been known as one of the most serious disasters among 15 different types of disasters in the whole world (Zhou *et al.*, 2002). Economic loss and damages related to floods is rapidly increasing with economic development, population increase, capital accumulation, and improper use of lands in flood plains of great rivers (Hangnon, 1985).

Population pressure and the lack of agricultural lands have ever caused the movement of human population to flood plains. The Chinese first tried to protect themselves and their farming lands against floods by making dams and embankments (Wang, 2000). For some environmental reasons, such structures may be improper or their construction may be impossible, and as the result other non-structural flood-warning methods are necessary for the remaining risks management and are considered as one of the most effective nonstructural methods for floor management.

1-Nature of Urban Risk

Depending on the levels of environmental mechanisms, an urban issue may differ from other issues. Yet, in a more abstract level, urban issues have similar characteristics. In general, all the risks have nine characteristics in common: ignorance from the related mechanism, existence of a potential factor for imposing heavy costs, relatively low advantages, low probability of having miserable consequences, internal transfer of the advantages related to risk, costs external transfer, collective risk, reaction period, and irreversibility (Applegate, 2004, P.6).
Environmental risks cab classified according to the above nine characteristics. For this purpose, it is better to mention something about the advantages, costs, and the considered phenomena first. In the figure No.1, a sample has been drawn in this regard. The distance between zero and B indicates the value of advantages, and the distance from zero to B-C indicates the net costs of the three phenomena.

2- Recognition of the Different Types of the Risks of the Urban Environment

Generally, to recognize the risks existing in an urban environment it is better to mention the factors important in definition of the urban risk. Paul Slovich considers two factors to be important in definition of risk:
First, dreadfulness, and the second, being unknown (Applegate, 2004, P.10). These two major factors relate specific characteristics to risks which cause them to be considered as a risk when they occur.

Factor 2: unknown ness

• Being distributable	not being distributable
• without fear or dread	fear or dread
• without calamitous global contingencies	calamitous global contingencies
• not being destructive	being destructive
• being consequence	not being consequence
• the lowness of the problem seriousness	the highness of the problem seriousness
• having low risk for the next generation	having high risk for the next generation
• decreasing easily	not decreasing easily
• decreasing other risks	decreasing other risks
• being volitional	being compulsory and self-acting

not being observable
being unknown for the effects observed on the new delayed risks
unkownness of the risks for sciences

being observable
being known for the effects observed on the old risks
known ness of the risks for sciences

factor 1: dreadfulness factor 2: being known factor 3: dreadfulness

Typology of Urban Risks (source: Applegate, 2004, P.369)

3- Concepts of Crisis, Disaster, and Risk Management in Urban Management & Planning

From the very moment that the crisis occurs, important and major decisions are ought to be made. In confronting any types of crisis, the first vital and necessary thing to do is to classify the truths and realities; the fact that what has happened, what actions are to be made to control it, and how the future will be. But, no two crises are exactly the same. Furthermore, a crisis, in regard to definition, would be never exactly the thing that you have forecasted. One of the similarities simply occurs in crisis management is to think that there is a single way for all crises, while there are different ways and strategies to control different crises since they are originated from different sources, and different factors play role in their occurrence (Abdollahi, 2001, P.60).
Charles Fritz defines disaster as: an event, related to space and time, in which a society or a subgroup of a society sustains several dangers and damages; for instance, losing the limbs and physical belongings, which disorganizes the society's structure and reality of all or a part of its fundamental operations (Fritz, 1961).
This article has defined a risk as a deviation in events which may occur during a specific period in a specific situation. If only one event is likely to happen, deviation, and as a result the risk are zero, and if several risks are probable, the risk is not zero even if the deviation is more, the risk is higher, too (Arture Williams, et al., 2006, 27).

4- Responding Approaches to Risk, Crisis, and Disasters

In this regard, Brook and Lindblom have classified the management and planning approaches in relation with the mentioned issues into four groups according to the understanding level of the urban administrators, trustees, and managers, as well as the changes made by those conditions in the city (Braybrook & Lindblom, 1963, P.51).

High Understanding
(I) some technical or administrative decision-making
Method of Analysis: General and concise
Multiple changes
(III) Polices
Method of analysis: tending to increase
(II) Fundamental and idealistic decision-makings
Method of analysis: none
(IV) Big change
Wars, revolutions …
Method of analysis: not codified or not explained well

5- Urbanization and Flood

In general, floods can be divided into four groups: sudden, river, urban, coastal. But, urbanization also decreases the consecution time nowadays and increases the maximum flooding, therefore, the flood is intensified. With urban development, the plant coverage is displaced and changed (figure 4). In other words, the volume of water decreases and the flood risk increases. If the time of consequential change is very short, sudden and dangerous floods may occur periodically (Mohammadi &

Rowshan, 2006).
The level line diagrams in figure No.5 indicate a similar rain. In this figure, the curves indicate the increase and decrease of the spate. The lower curve (A) is related to the river water current in a bed with plant coverage (Pre-Urbanization). The higher curve (B) shows the same river after urbanization.

A) Before urbanization
Time of change before urbanization
Pre-urbanization river discharge
Rainfall/discharge
B) After urbanization
Time of change after urbanization
Post-urbanization river discharge
Rainfall/discharge

6- Objectives and Principles of Flood Plains Management

Quick and immediate actions before flood include emptying the region from population and valuable things, fortifying the buildings with sand sacks, making local ramparts, trying to establish peace, cleansing the streets, supplying food, water, and proper clothing, requesting for immediate help, all of which are from among the advantages of a correct flood management and establishment of an immediate and accurate flood alarm system.

Furthermore, the principles and foundation of flood management can be summarized as follows: (www.friendsoftheriver.org)

- The rivers' return to their broad capacity through withdrawal of supporting walls
- Increasing the plant coverage in flood plains
- Using the flood for different purposes in the upstream
- Fortifying the buildings and the existing supporting walls
- Continuous assessment of water tanks and penstocks
- Dredging and draining the rivers, water tanks, and penstocks
- Amending the flood risk maps related to flood plains
- Giving information to people in regard to the potential hazards of the regions
- Encouraging the people to abandon the hazardous regions
- Establishing a flood management organization
- Expanding the insurance culture

7- Flood Management Process & the Position of Flood Risk Assessment in it

Flood risk management is a compound of durability and decrease operations of flood risks and may include the activities before, during, and after flood (Helen Udale, Clarke, 2005).
In short, flood risk management includes a process of management of a place in which there is flood risk. But, in a broader meaning, it includes a system planning every components of which seeks to decrease the flood risk. These two facets of flood risk management have been considered separately and indicated by an existing system management including the mentioned processes.

Crisis assessment – primary warning
Vulnerability assessment
Risk assessment
Risk effects decrease
Risk prevention
Space planning
Economical planning
Social development –observation and watch-preparation

As we see in figure 6, the primary warning is a subset of the preparation part. Therefore, a main part of a management process includes the preparation phase the purpose of which is to offer an essential decision reinforcing system for the cases where the flood management system is deficient. Then, it should be borne in mind that there is always another non-forecasted risk (Bronstert et al., 1999).

8- Different Flood Management Methods

- Structural Methods
They include those methods performed with the purpose of decreasing flood and on the basis of physical protection by the use of structures (Stephan Lees, 200). The structural approaches in flood management include establishment of physical obstacles such as dams, embankments, improving the river route, deviating the current, flood control channels, etc. which try to control the floods by limiting, deviating, and leveling the flood current.
- Non-Structural Methods
These are the methods, the purpose of which is to decrease the vulnerability and damages against flood and preparation to sustain damages (Duncan Mckukie, 2002). Drainage area management, flood alarm and forecast systems, board holding, bed demarcation, reinforcement of structures, and residential areas, lands usage, emptying the inhabitants are some of the non-structural methods. Using non-structural methods increases reinforces the effectiveness of the structural methods and is generally of lower costs.

9- Flood Alarm System

Flood alarm is the announcement of the result of studying the region and flood forecast to the people and the authorities of a society.
Flood alarm systems are the ones designed for the purpose of informing the people before the occurrence of a probable flood to save their lives and properties.

10- Flood Forecast Methods

There are three forecasting methods in general:
the method based on meteorology which is to forecast heavy rains in flood-prone zones
the method based on hydrology devised to observe the rainfall or the rivers heading-up and making people aware of water increment of the rivers which may lead to flood
A hybrid method comprising the hydrology and the meteorology methods. This

method has been used more than the other two ones and has been more efficient. Its advantage, other than the time of warning based on rain forecast, is especially forecasting flood on the basis of previous notice and rainfall observations which is usually dependent on observationand the rivers' heading-up (Mohammadi & Rowshan, 2006).

11- The Purpose of Flood Alarm and Forecast Systems

Any flood alarm and forecast system has two objectives in common with other similar methods as follows: (www.emagov.au)

A- the purpose of warning is to empower the people and the societies exposed to hazards, in order for them to have enough time to take proper action and react for decreasing the individuals' injuries, losses, and damages to the environment

B- Taking proper reactions by the people and the related organizations during the flood period is the purpose of any flood alarm system. Effective warnings increase the organizations' chance to maximize the fulfillment of their duties and roles during the phenomenon.

12- Factors effective in forecasting flood and warning for decreasing the loss

The effective factors in forecasting flood and warning for decreasing the loss are of great significance, so that for instance, the effective time of flood alarm should be enough to let the people perform the instructions to protect their lives and properties or to abandon the zone.

From among other factors, reliability of the warning in regard to precision and probability should have been approved and not forgotten (Behbahani, 2006).

Table (2): common activities for every flood alert system (adopted from Mark Crance, 2002)

1	Gathering data
2	Transferring data
3	Forecasting the atmospheric conditions
4	Weather forecast models
5	Providing alert
6	Sending alert
7	Receiving alert and the authorities' reactions
8	Feedback of the responses to alerts

Conclusions

An accurate and successful alarm system include the following specifications: (www.na.unep.net)

- On-time warning for emptying the population
- Saving the people's, the animals', and the livestock lives as well as the belongings and personal property
- Decreasing the major executive costs
- Unity and closer relations between the public and the private sectors
- Positive changes in lands usage

- Societies take the responsibility of more important duties
- Starting up and establishing other projects for supporting flood risk decrease
- Access to hydrologic data
- Topography and geology
- Sediment load
- Urban flood
- Distance communication systems, etc.

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