

ENVIRONMENTAL IMPACT ASSESSMENT OF URBANIZATION IN THE CITY OF ALGIERS (ALGERIA): THE NEED FOR AN INTEGRATED DISASTER MANAGEMENT STRATEGY TOWARDS VULNERABILITY REDUCTION

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ABSTRACT

The capital Algiers represents a gravitational pole which constitute a true economic center, recording a considerable migratory flow in addition to one important demographic growth, a rapid industrialization and an anarchistic urbanization, which make of it the receptacle of various sources of pollution, where ground, air and sea do not escape the consequences of these plagues. Furthermore, Algiers have also suffered from storms, floods, landslides and earthquakes. It is true that the advances of science and technology have facilitated in solving many complex issues regarding global, regional and national development. Regrettably, these advances have also had negative consequences particularly in the developing countries where technology is imported. This technology could be the cause of complex technological disasters if prevention, planning and preparedness are not taken into account during the design and exploitation of the project. This has generated a new type of vulnerability in Algeria which has been experienced by two third of the whole Algerian population during three hours last February. In fact, two third of the country was in the dark for three hours because the newly built electrical power plant of El-Hamma (Algiers) broken down and stopped the whole Algerian electrical network. As both the authorities and the civil protection were not used to this type of emergency, there were no intervention except by the national electrical society teams trying to restore the electrical current. Algiers in this research work, capital of Algeria, is taken as a case of study because it introduces most of the risks met in the other cities in the country. Algiers counts more than 3 million inhabitants for an area of 809.19 km². From the independence of Algeria in 1962, Algiers was found constituted of a dense urban fabric where various functional scales were overlapped. The city of Algiers experienced a significant development as well on the urban level as industrial and of this fact it is seen confronted with a degraded environment and a multiform pollution. The industrial sector and the factories established in urban fabric and its periphery, are at the origin of the existing or potential sources of technological disasters and of pollution in addition to the consumption of space. This research work presents most of

the types of environmental, technological and natural disasters the city of Algiers is confronted to. According the various cases experienced in Algeria and elsewhere, the disaster management system should start at the basic level which is the enterprise (Electricity, gas, etc.) and ends at the central government. The conclusion drawn from this work is to establish an integrated national disaster management system which should work permanently to reduce the vulnerability in all various sectors in order to make decisions and implement the plans with special consideration given to the severity of the disaster.

1. INTRODUCTION

For the North African countries, geological, environmental and technological hazards constitute a constant threat to human life and property, sometimes causing major economic losses and disruption. The rapid urbanization, development of critical engineering works such as dams, decaying building stock, implementation of various industries within and around the main cities, industrialization of cities with modern types of buildings and the large concentration of populations, with a heavy dependency on infrastructure and services, living in large cities and/or settling in hazardous areas are matters of growing concern, as they contribute to heavier loss of life and seriously increasing the economic losses in future disaster damage. The environment concerns and an increased official and public awareness of various hazards have, in the last decade, led to a rapid rise of interest in hazard and risk evaluations and thus in disaster risk management.

In fact, there are various reasons for investigating the Mediterranean Africa as a unit and for evaluating the various hazards of the entire zone under similar criteria: (1) In terms of geological process: the countries limiting the southern part of the Mediterranean Sea and its adjacent continuation in the Atlantic Ocean have had, since hundred million years ago, the same tectonic process marked by a relative motion alternating between left and right lateral along the border of the African and Eurasian plates, (2) Similar present level of development: the actual state of development in the whole zone is dominated by a rapid urbanization, high density of population in most important cities, degradation of the environment, (3) at the present pace and patterns of rural-to-urban migration and unplanned urbanization are causing increased population densities in urban centers, such areas are a prime reason for increasing vulnerability, (4) Similar historical development: the historical development of the countries in the region shows many common factors, such as cultural background. Similarities in population settlements, building stock characteristics and socio-economic and demographic conditions, various types of pollution, climate, etc., are very important parameters in the whole process of disaster risk studies in most cities in the zone under consideration. For all these reasons, this research work is concentrated on the city of Algiers which presents a general case of most of the geological, environmental and

technological threats found in all the main cities across the Mediterranean Africa.

Algiers, the Capital of Algeria, including its surroundings communities, has a population of approximately three millions, represents the most important concentration of investment, government institutions and population in the whole country. It is the intellectual, social, political and economic center of the country. In recent years the disaster risks have increased due to overcrowding, faulty land use planning and construction, inadequate infrastructure and services, and environmental degradation and technological plants within and surrounding the city. In the last two decades, the city of Algiers and its surroundings have known an important development in the urban domain as well as in the industrial one and thus it is actually confronted to rapid environmental degradation and to a multiform pollution. The industrial sector implemented within the city itself and its surroundings increases considerably the risk of disasters. Algiers is confronted seriously to all risks as earthquakes, floods, landslides, as well as the industrial pollution (4 Industrial zones), atmospheric pollution (road traffic, main industries, Public dump Oued Smar), Solid wastes pollution (Public dump Oued Smar, units for wastes treatment), Hydro pollution (superficial and underground water), marine pollution, soil pollution, forests and green spaces degradation, as well as to geological risks. The topography, the waterfront location and the ancient neighborhoods (Casbah) make it difficult to affect radical solutions to most of its problems. Decision-makers need adequate integrated information on the likely (probabilities) intensity of the disaster the city will face if they are to reduce disaster vulnerability. This research work shows the need of an integrated disaster risk management in megacities.

2. INDUSTRIAL POLLUTION

The industrial activity constitutes a most significant source of pollution and harmful effect in the city of Algiers. It is the origin of several forms of pollution as hydrous pollution and atmospheric; it is also generating dangerous and toxic wastes posing serious problems for the health of the people as well as their elimination.

Great Algiers represents one of the most significant areas of the country, from the point of view of the industrial activity. The total number of industrial units is approximately 735 public and private in the Wilaya of Algiers, that is to say 7.2% of the national total estimated at 10 200 units, of which 5 242 would be located on the coast.

The polluting industrial activity is localized with the periphery of Algiers, mainly in the East at the industrial zones of Gué de Constantine (8 km of the center town), of El Harrach (11 km of the center), Oued Smar (15 km) and Rouiba - Réghaia (27 Km).

The most polluting units on the level of Algiers are:

- paper mills,
- Manufacture of batteries,
- Oils and soaps,
- Yeasts, detergents, metals heavy,
- Pharmaceutical products
- fertilizers,
- Petroleum products: gas, gasoline, asphalt,
-

3. AIR POLLUTION

The principal sources of pollution in Algiers are:

- very intense road traffic,
- rejections of pollutants by the industrial units established in urban fabric and by the various industrial zones,
- the combustion of the wastes at the public dump of Oued Smar .

3.1. Road traffic

The automobile park of Algiers counts approximately 560 000 vehicles all categories mixed (with a daily traffic of 1500 to 2000 vehicles/hour), which represents the quarter of the national automobile park. This pollution consists approximately to CO₂ 15%, 60 à 70% of CO, 40 to 50% of NO, 30% of the hydrocarbon none burnt residues, SO₂ 5%, black fume, dust, lead, ...

A quantity of 180 tons lead/year is emitted in the streets of the capital at a rate of 0.5g of lead/liter of gasoline for the vehicles, that is to say an annual average of 3.8mg/m³ (average higher than that of the capitals of the other countries). The annual average recommended by WHO, as a standard of quality of the air not to be exceeded, ranges between 0.5 and 1 mg/m³. Whereas lead concentration in the agglomeration of Algiers east of 2.01 mg/m³ (Aoudia, 1996).

3.2. The main industries

The most polluting industries are:

- the cement factory of Rais Hamidou which emits cement dust charged with combustion gas NO, CO₂ and of CO, is 30 tons of dust/day (the standard ranges between 15 to 250 tons/Km²/year) (Service environment and forests, 1990). This cement factory, localized within the heart of an urban zone (to 10 km west of the center of Algiers), unquestionably constitutes a significant harmful effect for the populations resident and the whole environment in the vicinity. Producing 750 tons of cement per day, this cement factory emits fine particles, made up mainly by products limestone, which generate respiratory diseases. The most visible impact is certainly the deposit of cement dust on the roofs, the vegetation and on all the

zone close to the cement factory. The threshold of 1000g of dust/100m²/month, determined by a model of dispersion as a norm, is largely exceeded on a radius of 3 km (INGECO, 1997).

- The tobacco production units of Bab El Oued and El Hamma (both located within the center of Algiers) emit harmful fume due to the use of fuel.
- the unit of cable-making of Oued Smar emits dust charged with lead,
- the industrial unit of the greasy substances in the harbor of Algiers emits fume with nauseous odors,
- the manufacturing plant of batteries of Oued Smar emits lead oxide dust,
- the manufacturing plant of painting within Oued Smar emits gas dust charged with asbestos and lead,
- the refinery of Baraki (localized to 12 km of the center of Algiers) releases various hydrocarbon gases,

3.3. Public dump of Oued Smar

It releases nauseous fume, odors and gas emissions (CH₄, CO₂, NH₃) from the combustion of the household refuse of the city of Algiers, its surroundings and the industrial zones. This pollution is visible at Oued Smar, El Harrach, Bab Ezzouar, Hamiz, Dar El Beida and Eucalyptus.

4. POLLUTION BY SOLID WASTE

Solid urban wastes can be defined like the whole of the solid waste generated by the urban activity. In Algeria, in particular in Algiers, household refuses pose serious difficulties to the public services to collect them correctly, as they encumbers the streets of Algiers and its surroundings. Wild waste dumps on which the inhabitants come to deposit their waste without paying any attention to the impact on the environment. In fact, the lack of information and awareness, and the non respect of the law, made that the citizen pours his solid waste anywhere, more particularly in the isolated places and thus the creation of wild discharges. The estimate of the quantity of the waste generated by the agglomeration of Algiers is about 1 408 tons per day (ANAT, 1996). The quantity of 2 500 tons per day is produced on the whole of Wilaya of Algiers, that is to say 910 000 tons/year. This quantity will pass to 3 200 tons/day in 2005.

As for the industrial facilities, they pour daily more than 2 000 tons of not controlled wastes, particularly asbestos, acid, cyanide, phosphorus, etc. It should be also noted that waste of the slaughter-houses is rejected directly into the public dump of Oued Smar.

The nature of solid waste is:

- domestic Waste: 657 000 tons/year;
- industrial Waste: 930 000 tons/year;

- Waste of the administrations (paper, paperboards, etc.) : 90 000 tons/year;
 - Waste of the markets: 50 000 tons/year;
 - Waste of hospital (syringes, bandages, etc.) : 3 900 tons/year;
 - Waste of trade: 80 000 tons/year;
 - special Waste (toxic): 30 000 tons/year;
- (Service CPVA in Inspection of environment of Algiers).

4.1. Public dump of Oued Smar

Solid waste of the Wilaya of Algiers is forwarded to the single public dump of Oued Smar just as well as the waste of the industrial zones. The initial surface was 10 hectares and reached 37.5 hectares today. It is located at 13 km of the center of Algiers on a ground of a unit of clay. This public dump reached a very advanced degree of saturation where the mounds of stored waste exceed 6 meter high above the ground level. An investigation of a engineering and design department (Kaoula, 1996) estimated at 4 000 tons/day the quantity of waste which arrives on the discharge including 1 600 tons/day of domestic waste, that is to say approximately 1 000 000 tons/year coming from Wilayates of Algiers, Boumerdes and Tipaza.

4.2. Hydrous pollution

Hydrous pollution is related to the disposal of the liquid and solid wastes in the ground. Pollution reached today most of the hydrographic networks and poses serious problems, on the one hand by the insufficiency of the water resources, and on the other hand, because of the degradation of the living conditions in the aquatic environment.

4.3. Superficial waters

The superficial water pollution is caused mainly by the sewage systems deteriorated and not maintained where also pour the effluents in the rivers. Sewage water of the of the city of Algiers and that of all the other communes of the Wilaya is rejected to the sea, either directly, or by the means of Oued El Harrach . Oued El Harrach in which flow all the waste water of the regions of El Harrach, Baraki, Eucalyptus, Bab Ezzouar, Dar El Beida, Oued Smar, Gué of Constantine and even part of Wilaya de Blida. The total volume of the waste water poured in the Oued El Harrach is approximately 57 000m³/day (IEA, 1997).

4.4. Underground waters

The water table of the plain of Mitidja constitutes the main water tank of the area. It is prone to many contaminations:

- pesticides, nitrate fertilizers;
- the liquid infiltrations of the water table;
- nitrates of the catchments basin of Oued El Harrach.

The pollution of the water tables by hydrocarbons is a serious problem since it can expand to surrounding collecting fields. Indeed, drillings of the water table of Algiers were subjected of a pollution by hydrocarbons. Most of drillings analyzed present a very high degree of pollution, showing a largely higher index than the maximum permissible concentration (10mg/litre) for the water intended for human consumption (Bruchet, 1985).

The discharge of domestic and industrial waste water without treatment in the receiving medium constituted by a hydrographic network which is characterized by nonpermanent rivers and relatively low flow not allowing a process of self - purification, dangerously threatens the water table, the beaches, the dams as well as the public health.

4.5. Marine pollution

The bay of Algiers covers a water area of 184 ha, characterized by a pollution of urban and industrial origin. Most of the cities in the Wilaya and industrial facilities established on the of Algiers littoral pour their waste water either directly to the sea, or by the means of the Oueds, without preliminary processing which causes the deterioration the sea water quality. At the Algiers harbor, 25 outlets of urban and industrial waste water were listed, with presence of oils and greases coming from the harbor maintenance workshops, the sewage waters of Hamma, the hospital Mustapha Bacha, the factories of the fatty corps, the pasta production unit, oil company and electricity production unit in addition to the draining operated by the tankers and other ships either within the harbor or at large (Urbanis, 1998).

4.6. Soils Pollution

The pollution of the soil may have its origin from the industrial activities. The massive use of the artificial fertilizers, the use of certain organic soil conditioners and the systematic use to the pesticides result in a very significant increase in the agricultural outputs; unfortunately this rise of the productivity of the grounds is often accompanied by the increase in the contents of heavy metals in these grounds. Indeed, the contamination of the grounds by heavy metals constitutes a phenomenon which results mainly from the various human activities as the agricultural use of fertilizers (phosphates, fertilizers, organic soil conditioners,...), the industrial wastes, etc. The analysis carried out in various places of the Mitidja plain shows a content of nitrates between 50 and 250 mg/l, whereas the standard set by WHO is 45 mg/l (ANAT, 1996).

4.7. Deterioration of the forests (Deforestation)

The forests of Wilaya of Algiers know actually a very advanced deterioration covering a surface of 633 ha for a total surface of 5 338 ha, including 37 forests whose majority were arranged as entertaining forests.

The principal causes of deterioration of the forests are:

- Attack of insects;
- Fires;
- Atmospheric pollution of origin generated by the industrial activity; case of the cement factory of Rais Hamidou which devastated the forest of Bainem;
- Neglect of the sector of the forests in the land use decisions;
- anarchistic urbanization;
- Proliferations of the cities.

5. FLOODS

Rapid urbanization is a major factor in the increase of floods. Flash floods is a growing concern due to concrete which absorbs little water, the decline of open spaces, engineering works that divert river flows and weak city drainage systems (neglect, lack of maintenance). inappropriate housing on river banks or near delta is a major concern.

The last Algiers flood and mudflow of 10 November 2001 which caused the loss of 712 human lives, injured 350, 116 are missing, and 1800 housing units suffered damage, 56 schools, scores of bridges, roads, public works were damaged. 1000000 m³ (up to 10 m thick) of mud in the street of Bab el Oued, more than 350 vehicles (cars, trucks and buses) with passengers buried under mud.

• preliminary cost u.s.\$ 250 000 000.

6. LANDSLIDES

- Rocks and soil sliding rapidly downhill. Mudflows and rock falls triggered by earthquakes, storms, water logged soil and heavy constructions.
- growing amounts of badly built housing on/below steep slopes, on cliffs, or at river mouths of mountain valley. Landslides have occurred with or without the help of earthquakes. During the last Algiers flood and mudflow of 10 November 2001, several landslide cases were recorded within Algiers and its surroundings.

7. EARTHQUAKES

- Algiers, densely built, densely populated city located on seismic zone. The city suffered several damaging earthquakes in the past, occurring within the city or in adjacent zones. The earthquake catalogue for the Wilaya of Algiers goes back to 1365. Algiers has experienced on 21 May 2003 a magnitude 6.8 earthquake which caused the loss of 2,300 lives and extended damage.
- The building stock of the capital Algiers presents a high vulnerability to earthquake loads and thus seismic risk management is really needed if the government wants to avoid surprises.

8. CONCLUSIONS AND RECOMMENDATIONS

Decision-makers need adequate integrated information on the likely (probabilities) intensity of the disaster the city will face if they are to reduce disaster vulnerability. This research shows the need of an integrated disaster risk management in megacities.

In a country which, regrettably is a disaster-prone as Algeria or in other country, it is of crucial importance, at the macro-level, for the country to have a well established and well regulated disaster management plan. This will enable the government to avoid undue crisis management when future emergencies occur. It is also of crucial importance, again at the macro-level, to integrate disaster management in all its facets with government's mainstream policies and plans for national development.

Disaster management and economic development are not two separate disciplines that conflicts for resourcing. They are synonymous and their resourcing should be a combined administrative process.

To fulfill these goals, the proposal of the establishment of a national disaster research and management agency in Algeria has two objectives (1) to prepare the national disaster management plan and (2) to create a sustainable cadre of disaster management staff at all levels, and to promote institutional and public awareness of disasters, their effects and likely relief activities. The permanently established national disaster management organization is presented in what follows. The organization chart describes the structure, the chain of control and reporting, and the main working relationships. It allows to have a permanently established and functioning integrated data collection system to gather information relevant to disaster management in all its aspects. However, it has a wider application and provides an important step forwards an effective national data collection system, and this will require extensive research work. Several partial data bases are already available and these will be drawn upon in the creation of the agency which will attempt to provide a more general view within a single framework. The structure of the agency will then incorporate existing government, non-government and community information/data sources in order to provide an overall picture of potential danger zones, multi- sectoral early warning indicators and available resources. This enables particular attention to be paid to problem geographic sectors or problem functions, and the consequent mobilization and allocation of resources in advance of disasters. A permanent structure for disaster management integrated in the Algerian government is presented in Figure 1.

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