



Urban, industrial and technological risks. Synthesis of the elements of vulnerability of the city of Hassi-Messaoud

Riscos urbanos, industriais e tecnológicos. Síntese dos elementos de vulnerabilidade da cidade de Hassi-Messaoud

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Abstract

Today, Algeria is one of the developing countries that are engaging seriously into a new approach consisting of all kinds of combined risk assessments for better prevention them. Note that, this is a fairly important parameter, that is, the safety of people and property. However, the magnitude of the risk, of whatever nature, affects a variety of diversified aspects (Human, economic, technical and environmental). This study presented a case study, which is sometimes paradoxical, seeing that it is the result of the combination of all risk factors and specific factors related to them connected to a fragile urban environment: Hassi-Messaoud. It is well known that Hassi-Messaoud is one of the most important city for Algeria's economy; in which the demographic development is mainly known by incessant flows of immigrants, motivated essentially by job search. This arbitrary of population distribution exposes this city to a certain danger; especially as Hassi-Messaoud is in a zone subject to a probable risk expressed here by being characteristic of an oil zone. Thus, this article aimed to provide elements of risk assessment related to oil activity. This approach could conclude that, through a schematic scale, the different types and levels of exposure and vulnerability could be identified, that is, characteristics of the urban space in question.

Keywords: Risk. Hazard. Vulnerability. Stakes. Disorder. Impact. Assessment. Oil zone.

Resumo

Hoje, a Argélia está entre os países em desenvolvimento que estão tentando se engajar seriamente em uma nova abordagem, a de avaliações de risco de todos os tipos combinadas para uma melhor prevenção. Note que este é um parâmetro bastante importante, o da segurança de pessoas e bens. No entanto, a magnitude do risco representado pelo risco, de qualquer natureza, afeta dimensões variadas e diversas (humana, econômica e técnica). Este estudo apresenta um caso às vezes paradoxal, resultante da combinação de todos os fatores de risco e fatores específicos relacionados a eles em um ambiente urbano frágil: Hassi-Messaoud. É sabido que Hassi-Messaoud é um dos componentes mais importantes da economia da Argélia;

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e onde o desenvolvimento demográfico é conhecido principalmente por fluxos incessantes de imigrantes motivados essencialmente pela busca de emprego. Essa forma arbitrária de distribuição da população expõe a cidade em questão pelo mesmo a um certo perigo; especialmente quando se sabe que Hassi-Messaoud está em uma área sujeita a um risco bastante provável expresso aqui por seu caráter de zona petrolífera. Assim, tentaremos através deste artigo fornecer elementos de avaliação de risco relacionados à atividade de petróleo. Essa tentativa leva a uma conclusão que acaba por apresentar, através de uma escala esquemática, os diferentes tipos e níveis de exposição e vulnerabilidade característicos do espaço urbano em questão.

Palavras-chave: Risco. Perigo. Vulnerabilidade. Problemas. Desordem. Incidência. Avaliação. Zona de óleo.

Introduction

Although not much disturbing than destruction caused by humans, the so-called industrial disasters are no less dreaded.

When there is a catastrophe somewhere, at the beginning, the news are usually focused on loss of life and material goods; that is, the so-called “negative balance of damage “. Then, after a period called “relief”, one wonders about the secondary consequences of the disaster, such as its impact on the urban environment, economic activity, social life and so on.

Regarding it, there are few studies that emphasize the magnitude and impact of major risks. While some studies try to establish the links between the agents that generate disasters and the direct causes of vulnerability, others focus on the analysis of the impact of these phenomena, in the short and long term, both material and physical, social or human.

Evidently, through these specific studies, this study aimed to put a preventive system into action to collect data of such situations as soon as possible (Margosian, 2006), in order to mitigate, in the future, the risks of foreseeable disasters caused by the petrochemical installations in urban areas.

One of the fundamental singularities of industrial disasters is their instructive character. Experience shows that they bring lessons to life, which must be taken into account and last permanently, if not, the adverse effects of such incidents will be inevitable and certainly a total misfortune.

The extent of a disaster is intimately linked to human action after the disaster; in other words, it depends enormously on the way in which human being perceives and manages the “risk” (Leroy & Signoret, 1992) and may deal with this risk. Thus, among the undesirable effects that any form of “spatial anarchy” may be present in certain urban agglomerations, it is noteworthy that there is a potential risk regarding this growth, especially related to the city of Hassi-Messaoud that is located in a land disturbing activity of the country.

In the opposite sense, according to Dubois-Maury & Chaline (1994), the intervention on risks is important by preventing the background of design of cities and contributing enormously to the modification of the urban area.

Methodology

It is noted that the risk is a multidisciplinary field of study and therefore quite complex. For a long time, it was estimated, calculated and measured, regarding hazard and dangerous phenomenon, however, ignoring all the issues and especially the vulnerability of the elements exposed to risks. Thus, it is important to consider the risk in its overall context, integrating all probabilities of training effects or chain reactions which, in most times, are incalculable.

In this paper, the risk considering integrated risk information in urban areas was highlighted; especially for the city of Hassi-Messaoud in association with the risks related to the oil industry.

The method was based on an identification of the hazard and the evaluation of the risks while reserving a particular interest to the different scenarios of accidents, such as: estimation of the physical and functional vulnerability of property risk exposures; as constructions, regarding human populations and the potential interactions between risk and land use technique. According to Martinais & Galland (2010), the function of conducting a prior evaluation is perhaps more problematic concerning industrial risks.

Thus, a systemic approach was adopted, first of all, to understand the interactions that are related to the origin of the vulnerability; secondly, to evaluate risk management policies, the pillars of which are the Risk Prevention Plans (Mohamed-Chérif & Chacha, 2015). Admittedly, the public authorities have established a legal anchoring (Kherdoun, 2010), to manage the industrial sites by the introduction of these plans¹.

The methodology consisted of a cartographic representation showing with a certain precision the risk areas, being useful to highlight the meaning of the concepts and ideas that will be used in this article.

Concepts and semantics fields

The idea of risk highlights the probabilities of disaster response and consequent material damage. The risk may be defined by the proportionality constituted by threat, vulnerability and elements at risk (Thouret & Ercole, 1996). Thus, this subject is related to the confrontation, in the same geographical place, considering the associated uncertainties.

Then, it must be understood that the hazard is the probability that an accident, an event or a disaster reaches or exceeds on a certain moment, at a given site, a certain level of disorder.

The idea of vulnerability, on the other hand, refers to the ability of any construction, equipment or facility to suffer a proportional loss expressing the ratio of the cost of damages to the value of the property in question. .

The elements at risk or ongoing events refer to all the elements exposed to the risks of a possible accident and that may be affected by the consequences of this event, such as population, buildings, works, economic infrastructures and industrial installations, among other things. These benefits are measured in terms of vulnerability (Equation 1).

$$\text{So, Risk} = \text{Threat} \times \text{Vulnerability} \times \text{Issues} \quad (1)$$

This equation shows that a single risk can be considered the product of the combination of a hazard and a vulnerability of high, medium or low levels. In addition, a risk may be the result of a strong hazard and a low vulnerability, a random and average vulnerability, or a high risk and a strong vulnerability (Dauphiné, 2013).

Risk and acceptability

Risk is indeed a fuzzy concept (Brugnot & Dumolard, 2001), that is, a field of uncertainty but fundamental to characterize the confidence to allocate to a system. When the level of risk is tolerable for

¹ Risk Prevention Plans (in French Plans de Prévention des Risques (PPR)) reduces vulnerability through the regulation of land use. These plans are governed by the law 04-20 on December 25, 2004 regarding the prevention of major risks and disaster management in the context of sustainable development. They meet the following objectives: to contain and control accidents as well as minimizing the effects and limiting damage to people, the environment and property. The law was promulgated following the series of disasters that occurred in the country: technological incident in Skikda (2004) and natural disasters, Boumerdès earthquake (2003) and floods of Bab El-Oued in Algiers (2001).

one or more individuals or entity, the risk is considered acceptable. Note that acceptability concerns the risk and not the severity of the damage. In addition, it must be considered the risk of identifying a risk to which an individual is previously exposed.

The Farmer curve (Figure 1), is a good illustration of the fact that risk depends on both gravity and frequency (or probability of occurrence). These two parameters make it possible to define the three domains that are indicated below.

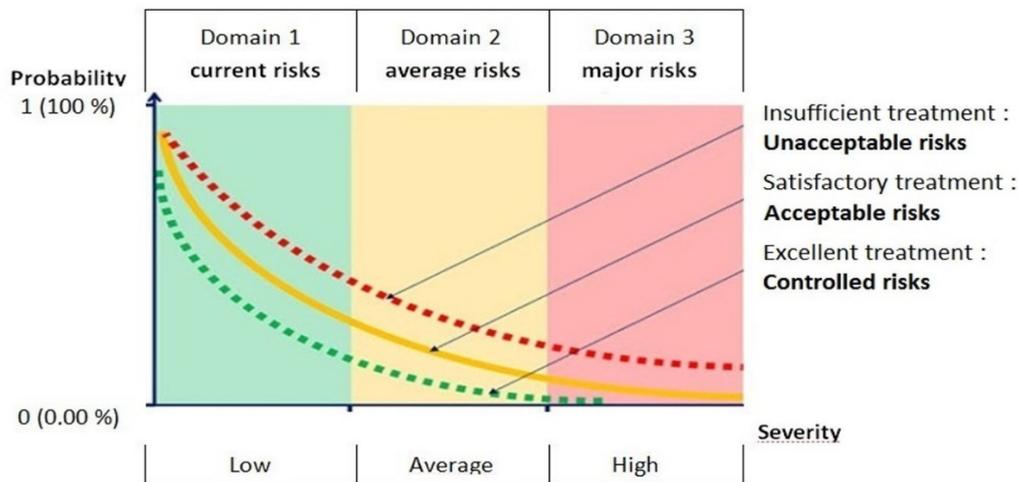


Figure 1 - Curve of FARMER - Severity, probability and risk treatment. Source: Qualité et Sécurité des Soins (2017).

The urban risk

Is considered as urban risk any possible danger that may have an effect on their inhabitants and their economic goods, probably or not to happen, in time and across the space of a district of one or more cities. When this risk is described as urban, it is defined in a generic way, such as the potential danger linked to the territory of a city. It is therefore the concentration of humans and their goods and activities in urban areas that generate a multitude of risks of varying importance, of different types and origins.

In this sense, the human being (living in society) is both a producer, a manager and a potential victim of risk (Denis, 1998). Thus, it is necessary to understand that the risk may be associated with a socio-technological or socio-natural dimension.

Furthermore, several essential criteria contribute to the determination of the risks to which we may be exposed; one is related to the probability or frequency of occurrence of risk, whereas the other is the severity or importance of it. If the first criterion, it could be characterized the natural hazard and therefore the fact that the risk has a low or high chance to happen; the second criterion represents the level of damage to residents, various facilities and the environment. In fact, it expresses the cost of human and material losses (Dauphiné, 2013).

Probability and severity classify urban risks into two distinct types:

The first type is associated with ordinary risks (usual); their interventions are daily and often episodic and have a characteristic of being acceptable by the population. Consequently, they are marked by high occurrence and low level of severity (e.g. urban violence, accidents at work or on the road).

The second types are extraordinary risks (exceptional), which are called the major ones; consisted of weak intervention and usually being forgotten by the population, but their gravity is noticeable. They require management to mitigate the effects.

By their natures, the risks are either caused by the man, the so-called problems such as pollution, road accidents, urban violence, ... or from natural sources such as earthquakes, volcanic eruptions, floods, ... or

finally caused by technological advances, called anthropic and which group industrial, nuclear, biological risks, ...

A major technological risk is intimately linked either to dangerous industrial installations or to the use of a certain number of technologies, in which the "side effects" may be disastrous (Dupont & Ferréol, 2004). In this case, if the losses are related to populations and/or the environment, the humans due to the technological advances may be responsible for causing the disaster.

The terms risk² and disaster refer to potentiality. If the risk is persistent and widespread in space, the disaster is often brief (Dauphiné, 2013). A major industrial risk is therefore an accidental event that may occur on an industrial area and which may have direct or indirect, immediate or successive effects, temporary or permanent events considered serious for human populations, economic goods and the environment.

Presentation of the case study

The city of Hassi-Messaoud is located about 80 kms from the capital of Ouargla wilaya, along the National Road No. 3, from Skikda to Ain Amenas (Illizi Province). Urban fabric covers an area of 880 hectares (1432 hectares including the industrial zone) with a population of about 75,000 inhabitants in 2016.

The housing stock rose from 250 housing units in 1966 to 7,700 in 1999 and to 8,086 housing units of all types in 2007, following a flat rate of approximately 5.70. The city was built in 1984; its previous status was CIS (Saharan Industrial Center).

Its overall population growth (natural and migratory combined) reflects a fairly rapid pace of population growth, reaching a rate of 10.15% compared to that of the national average estimated at 4.2%. This exceptional development is not surprising because it takes place in a context of the economic trend that plays an important role in attracting population for these regions of Algeria. It could be noted there was a demographic movement through incessant flows³ of immigration to Hassi-Messaoud. Generally speaking, large oil projects and new activities and services have been linked to considerable impact on the socio-economic field.

It is undeniable that the development of the city of Hassi-Messaoud, as a result of a surplus population, is and remains the most serious problem to solve. Given that the current population of the city is mostly consisted of a positive migration, it would be unrealistic to imagine that these new inhabitants of the city, brutally settled, will return to an area they had left for multiple reasons. Therefore, the cause of continued emigration is related to easier access to employment and housing opportunities.

It must be mentioned, moreover, the considerable impact of "centripetal" types of migration streams, taking into account the variety and size of the problems they may engender. To mention only the socio-spatial problems related to the functional mutations of space, it may not be easy to admit that these displacements, often arbitrary, contribute considerably in the present case to the risk's increase.

Risk assessment at Hassi-Messaoud

Geographically, the risk is omnipresent and spreading over a large area of the Algeria. It is therefore an essential parameter regarding urban planning and urbanization of a number of urban areas in Algeria. For instance, it can be mentioned the Algiers refinery, the Bab-Ezzouar power station or the gas pipeline

² The Littré dictionary defines it as "Danger in which the idea of chance coincides." According to Larousse, risk means "Danger, more or less likely disadvantage to which one is exposed". According to Robert, the risk is a "potential hazard more or less predictable."

³ Migration flow is the number of migrations or last migrations made during a given period from one area to another.

Thus, for two given zones (i) and (j), two currents can be defined: the flow $M_{i \rightarrow j}$ and the flow $M_{j \rightarrow i}$.

The sum of the two flows ($M_{i \rightarrow j} + M_{j \rightarrow i}$) is called the total current (traffic or migratory volume) of the zones (i), (j)

The difference ($M_{i \rightarrow j} - M_{j \rightarrow i}$) is called net current (balance or net migration) of zone (j) compared to (i).

that supplies the capital with energy and it represent relevant threats to the Algerian population. Arzew and Bejaia cities have also faced industrial accidents that have caused economic damage. Also mentioning Skikda, the risk is inherent to the presence of its industrial complex (Boukaibet, 2004) which was the center of one of the biggest industrial accidents in Algeria; in which an explosion was caused by half of the liquefaction infrastructures used to liquefy the natural gas in 2004 (Dubois-Maury & Chaline, 2004), 29 people have died, hundreds of injuries and substantial damages have been caused⁴. According to these dramatic examples, it could be measured the extent to which the populations of these urban centers are exposed to technological risks.

In this section, regarding the double security-economic plan, it was outlined some informations on the paradoxical case of Hassi-Messaoud, such as: industrial pole N° 1 and zone ranked high risk according to the Algerian law. The approach highlighted here was an attempt to answer the following two questions:

- Which facilities are responsible for this risk?
- What is the impact of the latter on the urban and natural environment?

The industry related to the exploration, extraction and exploitation of oil and gas in Algeria oscillates between 70 and 80% of major risks from all causes (explosions, fires, pollution etc.). The coastal strip alone, contains nearly 50% of highly hazardous industrial units. Hassi-Messaoud comprising its huge oilfield⁵, when exploited, may expose the city and its neighborhood to a risk likely to lead to serious consequences.

Apart from the consequences of such installations on town planning and the population, it must be noted that the petrochemical industry generates significant sources of pollution in the form of discharges of liquid effluents. The dumping of hydrocarbon substances poses a great threat to any human settlements. The biodegradability of these products is quite slow, their presence and infiltration and therefore the contamination of the water must last for years owing to the soil retention capacity.

In some studies, it is considered that regarding the detonation, 1 kg of hydrocarbons corresponds to 10 kg of TNT (Lagadec, 1981). In the same context, Hassi-Messaoud experienced, on the same day (on August 8, 2011), two serious accidents. One accident was due to an explosion of a gas distributor, and the population, who was in shock, should be deal with a disorder related to a possible emergency evacuation to leave the city and expect for an imminent disaster. This type of disaster could reveal an indicator of the ignorance, as well of the absence of local authorities to help the inhabitants, and to informer about the gravity of the situation when many residents tried to settle nearby of the exposed area.

The second accident, following a snubbing⁶ operation, was carried out on an oil well, the famous OM083 (University M'Hamed Bougara, 2011). This accident caused, among other things, the demolition of a drilling system estimated at billions of dinars.

Moreover, if the legislation in force has defined the norms and delimited a perimeter of safety, however, it seems that these obligations have not been applied (Heraut, 2004), since hospital and school facilities as well as living quarters and other social infrastructures and economic have been erected around and within this area.

More seriously, in order to meet the needs of the resident population mainly employed in the oil sector, housing programs have been carried out around the initial nucleus, in a ZHUN and on a prefabricated habitat site strictly reserved for SONATRACH personnel. . In descriptive terms, it is actually an urbanization constituted by a juxtaposition of living bases and areas of oil activity.

⁴ The destruction of the three LNG units represents a loss of nearly \$ 500 million, about \$ 400 million in revenue shortfalls for the complex and some 220 decommissioned vehicles. In terms of damage to homes, a report made "state of destruction on a radius of about 4 kms. According to the Directorate of Civil Protection Skikda.

⁵ The oil field of Hassi-Messaoud is among the largest deposits in the world.

⁶ Interventions essentially concentrated on eruptive wells thanks to their safety devices equipped with remote controls, interventions on wells with pressure without having used a neutralization fluid that could affect the productivity of the formations.

The different operations performed by Snubbing units are:

Bottom cleaning, scraping, milling, refoaming, acidification and repêchage or instrumentation.

Added to this fact, it will be hard to see a change in attitude towards sustainability and safety views for the city of Hassi-Messaoud; seeing that it is one migratory flows generated by various activities under multiple influences, that is, the prosperity of the labor market or the prospects of housing acquisition. A situation of this magnitude had systematically stimulated an accelerated urbanization which developed without taking into account the constraints of such a sensitive subject, thus favoring the emergence of spontaneous settlements and shantytowns (estimated at 560 in 2010) inside and outside the city, also in the oil field and the urban fabric.

Obviously, the urbanization of the city of Hassi-Messaoud generated problems and presented negative effects such as:

- The bursting of the urban fabric in the form of a discontinuous structure;
- Lack of rationality in the choice of urbanization sites;
- The juxtaposition to industrial sector without taking into account the risk of such a neighborhood;
- The spread of the city under the impact of immigration flows;
- Anarchy of the built up space, proliferation of shantytowns and illicit individual housing.

In the same order of practice, there is a need to emphasize the dramatic form of urbanization that has resulted in construction on pipelines⁷, that is, high voltage power lines. This situation has already caused some serious accidents, for example, the explosion of a gas pipeline that occurred on March 3, 1998, 12 people have died, about forty wounded, all of them situated nearly a dozen homes destroyed and fifty severely damaged.

Furthermore, this form of uncontrolled urbanization emerges a depreciated image of urbanity and a spontaneous appropriation of space that has been outside of the control of the authorities concerned. When the occupation of these areas becomes the symbol of arbitrariness, it most often causes irreversible damage to urbanism, the architectural landscape and the environment. The repercussions are of exceptional gravity when it is related to the assessment of sensitivity of the occupied soils. The idea of a dangerous area must, however, be associated with the way in which the « risk/safety » composition is organized (Remy & Voyé, 1981) for humans and their environment, both natural and artificial (Donze, 2001).

Thus, the inventory of the accidents⁸ experienced in the urban fabric of Hassi-Messaoud, in its current configuration, just show the inefficiency of the whole preventive system, since the threat is, at the same time, associated with security and economic order.

In fact, this urban agglomeration remains one of the territorial entities most exposed to oil and chemical industrial hazards; various types of major risks, out of the twenty listed at the national level, are located at the level of Hassi-Messaoud especially that it contains sectors of activity posing a certain threat: refining, chemical industries, power generation, storage extremely dangerous substances, the transport of hydrocarbons by pipelines, etc. see table below.

Since the risk is considered to be the probability that an accidental event will occur at a sensitive industry site, it is clear that there is a non-exhaustive series of direct impacts that may be caused by these kinds of major risks; among others:

- Explosions and/or fires in industrial and/or urban areas;
- Accidental or voluntary polluting discharges in the urban environment and contaminating the aquatic environment;

⁷ No less than 3880 high-risk industrial installations have been identified in Algeria, in urban areas and on a small surface. According to estimates by the Ministry of the Environment and Spatial Planning, more than 4,000 dwellings (a population of at least 28,000) are built on pipelines or pipelines.

⁸ The city records several industrial accidents each year related in particular to the hot welding of tanks storage or transport of hydrocarbons.

- Dangerous gas spills;
- Ionizing radiation etc.

Location of risks in Hassi-Messaoud

If the prediction of risk over time and its precise delimitation in space are difficult to perceive, given the complex nature of the hazard due to the diversity of its nature, it could be observed that sometimes the variation of the stakes associated with it and which amplify strongly that risk, regarding its location near Hassi-Messaoud city (Table 1).

The Figures 2 and 3, provide us with a physical support showing the situation of the zones exposed to possible cases of important disasters. The most plausible hypothesis, resulting from a simple morphological reading of the urban area, suggests that the areas are consisted of those in the vicinity of oil production wells, north and south power generation centers, gas pumping stations, all kind of pipelines and other petrochemical industrial facilities.



Figure 2 - Agglomeration of Hassi-Messaoud, Location of oil exploitation sites. Source: Land-SAT modified image, authors, 2018.

As indicated, the vulnerability of almost all of the urban space comes from the proximity of the industrial activities associated with the built environment of Hassi-Messaoud. For example, as indicated

in Figures 4 and 5, oil and gas pipelines with potable and wastewater pipelines and high and medium voltage power lines expose several neighborhoods to a fatal risk of mass destruction. These facts are related to pipelines Nos. 6, 8 and 12 of 350 bars each, located at a distance of between 40 and 80 meters from the neighborhoods of collective dwellings, individual habitats, life bases belonging to Sonatrach among others, as well as, a drilling company with 3,500 employees; while the easement zone required by the by-law is 250 meters.

Table 1 - Distribution of types of risk according to the area and type of land use

AREAS	OCCUPATION	TYPE OF RISK
ZONE/A (POS: 1, 2, 3, 4, 5, 8, 10, 12, 13, 14): 3000 m	Main Networks	Explosion - Fire - Pollution
	Electricity HT & MT	Explosion - Electrification
	Gas-Oil-HP-Water Pipes	Explosion - Fire - Pollution
	ZEA-ZET-AEP-Equipment	Electrification - Flood
ZONE/B (POS: 3, 13, 14): 1000 m	Distribution networks	Pollution - Contamination
	Sewerage networks	
ZONE/C (POS: 1, 2, 12): 500 m	Lines	Explosion - Fire - Pollution from Railway accident
	Tanks	
ZONE/D (POS: 4, 10): 500 m	Lines	Explosion - Fire - Pollution from Railway accident
	Center	
	Wells	
ZONE/E (POS: 4, 5, 10): 500 m	Station	Explosion - Fire - Pollution from Flood
	Facilities	
	Tanks	
ZONE/F (POS: 7, 8): 500 m	Pipes	Fire - Pollution - Flood
	Networks	
ZONE/G (POS: - -): 500 m	Wells	Explosion - Fire - Flood
	Lines	
ZONE/H (POS: 11): 500 m	Lines	Explosion - Electrification - Fire Railway accident
	Fuel storage	
ZONE/I (POS: 11): 500 m	Lines	Explosion - Electrification - Fire and Railway accidents
	Industry	
ZONE/J (POS: O): 500 m	AGIP	Fire Explosion
	Sonatrach	

Note: POS means Land use plan. Source: Authors observations, Hassi-Messaoud, 2018.

According to the Land-Sat image, it could be noted that the city is obviously surrounded by oil wells production, gas and water pumping stations in addition to the famous Manifold (a gas distributor). It is important to observe the presence of the MD46 well which it is located at a distance of barely 20 meters from the large urban area that comprises a city of 442 housing units, four primary schools, barracks gendarmerie, a mosque, two hotels and some private establishments.

By ignoring the Master Plan of Planning and Urban Planning (PDAU) safety guidelines, that specify an easement area between 500 and 3000 meters, the MD174 well (in the east of the city) meanwhile, it is around 60 meters distant from the 1850 city housing, a district of collective habitats and the headquarters of ENAFOR. Finally, to the west, the well MD184 is threatening both the area of human activities. See (Figure 6) and (Figure 7), as well as the following summary Table 2.

Other sources of probable industrial disasters also include six huge complexes of various activities, such as the oil refining and gas pumping center, geographically close to the largest electricity generating station. Obviously, the major risk here is both compound and combined when taking into account the

cumulative effect of accident scenarios that may occur within an already fragile urban core (Figure 8 and Figure 9).

The two other centers of production of electric energy, using gas turbines, and more particularly that of the south, one of the most important of Algeria, consist of worrying elements, that is, a major omnipresent risk for all inhabitants, while PDAU rules and guidelines set a safety zone to a radius of 3000 meters, separating it from the urban area (Figure 10).

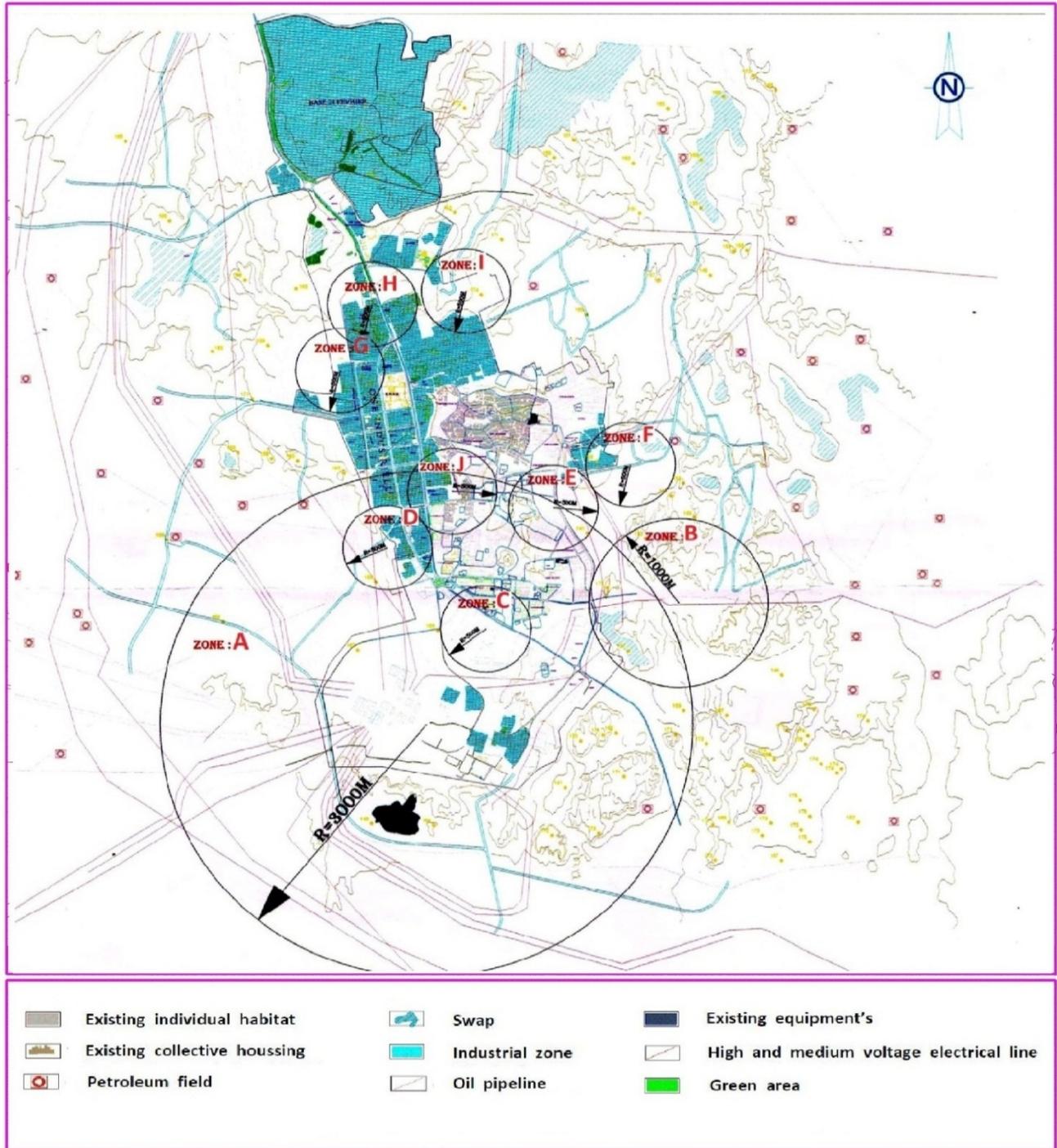


Figure 3 - Agglomeration of Hassi, Space concerned by the risk. Source: PDAU, First Phase, URBASE-Sétif, modified by authors, 2018.



Figure 4 - Pipelines of Oil and Gas. Source: Authors observations, Hassi-Messaoud., 2018.



Figure 5 - Pollution caused by the refinery. Source: Authors observations, Hassi-Messaoud, 2018.



Figure 6 - Wells near an area of human habitats. Source: Authors observation, Hassi-Messaoud, 2018.



Figure 7 - Well near human activity. Source: Authors observation, Hassi-Messaoud, 2018.

Table 2 - Spatial characteristics of risk-prone areas according to the type of occupation

AREAS	SURFACE (Ha)		NUMBER		EQUIPMENT
	Total	Built	Housing	Inhabitant	
ZONE/A	2826	367.38	3670	18350	<ul style="list-style-type: none"> • Activity Area • Complex • Base ZELACI • ECO • Nursery • Annex ADM • Defence Area • REBO • APC Center • Technicom • Hotel • SNTV • Daira SEAT • Area Games • Station
ZONE/B	340	1.5	42	366	<ul style="list-style-type: none"> • CTC Sud • Arab Bahir • School • SONEGGAZ
ZONE/C	78.5	21.98	732	3663	<ul style="list-style-type: none"> • Activity Area • High School • CFPA • Customs • SubHydrau
ZONE/D	78.5	14.13	235	1413	<ul style="list-style-type: none"> • SNTV • Technicom • NAFTAL • School • HESP
ZONE/E	78.5	40.82	833	4166	<ul style="list-style-type: none"> • NPHS • Sport Room • KANALGAZ • ENAFOR • Private Base
ZONE/F	78.5	29.83	586	4102	<ul style="list-style-type: none"> • Hotel • Camp • Station • Center
ZONE/G	78.5	5.79	115	805	<ul style="list-style-type: none"> • ENECO • SONELEC • Center • Ouarfissi • ENAGEO • Military • NAFTOGAZ • NAFTAL • Center • Fezz Souad • NAFTAL • Center • ENTP • Society • GTP • Ouarfissi • SAERB • SONELEC • GTP • Center • Industrial
ZONE/H	78.5	39.59	266	1333	<ul style="list-style-type: none"> • ENAGEO • Military • NAFTOGAZ • ENTP • Society • Center • Industrial
ZONE/I	78.5	40.79	375	1875	<ul style="list-style-type: none"> • Military • NAFTOGAZ • ENTP • Society • Center • Industrial
ZONE/J	78.5	10.03	166	833	<ul style="list-style-type: none"> • AGIP • SONATRACH • ENTP • Society

Source: Authors observations, Hassi-Messaoud, 2018.



Figure 8 - Gas pumping in the middle an area of human habitats. Source: Authors observations, Hassi-Messaoud, 2018.



Figure 9 - Production center in the south of urban area. Source: Authors observations, Hassi-Messaoud, 2018.

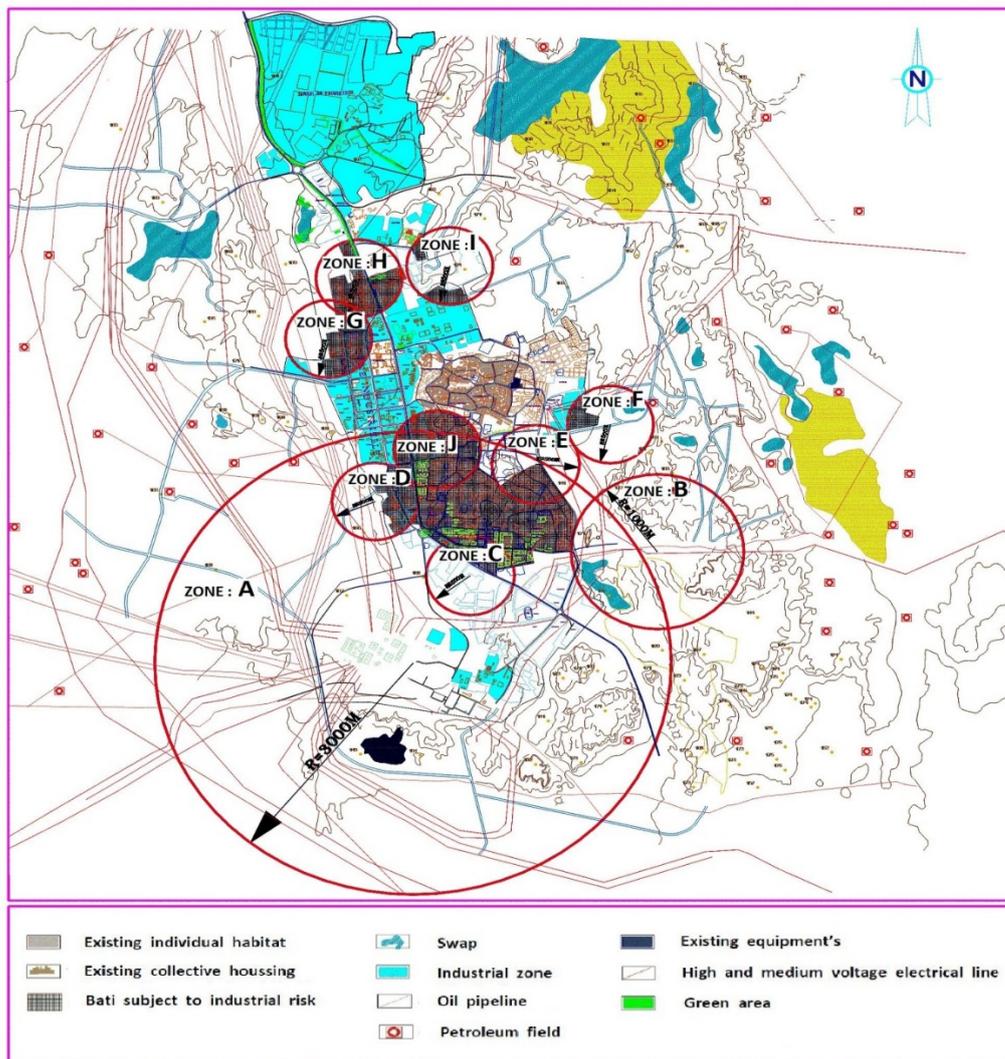


Figure 10 - Agglomeration of Hassi-Messaoud, showing buildings exposed to risk. Source: PDAU, First Phase, URBASE-Sétif, modified by authors, 2018.

Imagine the extent of the human and economic damage if an accident occurs within the area of this gigantic power-generating turbine, while it is located in the immediate vicinity of two neighborhoods respectively 1600 and 120 dwellings, 20 villas, two other neighborhoods of collective housing (Saadane Fadhila and Aissat Idir.), various administrations, a zone of equipment as well as several state and private companies, doing altogether work, from official source, more than 15000 employees.

Hazards scale in Hassi-Messaoud

After persisting in evaluating the impact of oil risks, it is also important to measure the dangerous environment, whereas that local authorities and major risk managers, in their policy of fighting against these dangers, may think over their schemas and plans for the prevention of technological risks (PPRT) (Larrouy-Castera & Ourliac, 2004). It is also essential for the population to develop a cognitive risk process (Beck, 2006) in order to make the population aware of the importance of the quality of their urban environment towards the security aspects by helping them acquire relatively reliable, independent and transparent information.

For this purpose, regarding the case of Hassi-Messaoud and at a basic stage of examination of the question proposed in this paper, the following representation could allow us to characterize this hazard of petrochemical origin as well as the levels of risks to which people and their institutions are permanently exposed.

The scale we proposed (Table 3), is only indicative. However, it indicates only a hierarchy and therefore the quantitative distribution of the phenomenon studied, which means that it does not pretend to be a 100% scientifically accurate result; since, we could accept it according to a constructed idea from an exercise based on our direct observation.

Table 3 - The risk scale related to the petrochemical industry in Hassi-Messaoud

LEVEL	NATURE	SYMBOLS
0	No	∅
1	Minor and therefore negligible	¥
2	Acceptable and therefore tolerable	α
3	Safety precautions are necessary	£
4	Interventions must be initiated	Δ
5	Demand extra care and attention	‡
6	Major - high risk - catastrophic	#

Legend: DEGREE OF RISK - ∅ No risk. ¥ Very weak. α Low. £ Serious. Δ Highly important. ‡ Very important. # Extremely serious.
Source: Authors observations, Hassi-Messaoud, 2018.

The relatively significant distribution of risk (Table 4), could show a composition of several parameters: first, the level or intensity of the risk as well as its nature or quality, then its location in relation to the exposed subjects and finally the material properties of the environment.

Table 4 - Distribution of risk levels depending on the area and coefficients

AREAS	LEVELS OF RISK							COEFFICIENTS	
	0	1	2	3	4	5	6	Footprint coefficient	Land use coefficient
ZONE/A							#	0.13	0.26
ZONE/B				£				0.004	0.012
ZONE/C					Δ			0.28	0.56
ZONE/D						‡		0.18	0.54
ZONE/E							#	0.52	1.04
ZONE/F					Δ			0.38	1.14
ZONE/G						‡		0.07	0.14
ZONE/H							#	0.50	1.00
ZONE/I						‡		0.51	1.02
ZONE/J					Δ			0.12	0.38

Legend: DEGREE OF RISK: £ Serious. Δ Highly important. ‡ Very important. # Extremely serious. Source: Authors observations, Hassi-Messaoud, 2018 .

Conclusion

Thus, major risks often consist of large-scale disasters for cities located in dynamic areas by a highly hostile industry. However, such disasters are due to poor human planning but not to the risk created by

the presence of such activity: an anarchic urbanization, insufficiently protected or badly located, is enough to create a disaster during the manifestation of an accident, even being not significant. And when the human populations and their urban environment are affected by this type of incident, the resulting disorders are enormous and very complex, affecting all levels and aspects of human existence.

The seriousness of this impact encourages more and more all the actors involved, technical, political, to guide the populations and their activities for settling in safe zones and studying the actions to be taken for the protection of the settlements in places considered dangerous.

It is imperative for space planners and developers to address industrial risks in a complex and practical way, on a multidisciplinary basis. In other words, there is an absolute need for efforts involving the scientist, the urban planner, the architect, the economist, the sociologist with respect to the development of management plans and for developing regions with risks associated with high-tech industry.

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