# Climate Refugees, Housing in Risk Areas, and Vulnerability of the Built Environment in the Fez Urban Area of Morocco (Case of the Medina and Outlying Districts)

Abdellatif Tribak, Maria Paradiso and Kawtar Azagouagh

**Abstract**

The environmental crises linked to the recurrent droughts that have characterized the Moroccan countryside from the 1980s onward have been disastrous for the stability of rural populations in Morocco. Recurring droughts have resulted in an absolute scarcity of water resources in rural areas. This has had dramatic consequences, not only on the herding/farming system, but also on the whole physical and human environment. The scarcity of water is thus a fundamental factor in the crisis that has characterized the rural world at all levels during this period, leaving as a direct consequence the massive migration of people toward cities. This article attempts to delve into the nature of the exceptionally recurrent droughts that have affected the hinterland of the city of Fez since the beginning of the 1980s, and to assess the consequences on the stability of rural populations or its mobility, and, as a result, on the major expansion of the of the urban area of Fez, especially in the outlying areas that are periodically exposed to natural disasters.

**Keywords**

Climate refugees · Migration · Risks
Vulnerability · Substandard · Fez · Morocco

## 1 Introduction

The recurring droughts that have affected Morocco since the 1980s have driven people in rural areas to massively migrate to nearby cities. In the last three decades, the urban area of Fez has expanded extensively, mainly as a result of the inflow of large numbers of migrants from the surrounding rural countryside (Rif, pre-Rif, and Middle Atlas). This drought-driven movement of rural people has significantly contributed to disrupting the traditional urban fabric of Fez and its surrounding area. The medina and some outlying districts are presently taking the full negative impact of overcrowding and of urban sprawl in risk areas unsuitable for housing. As a result, wide stretches of substandard housing units have mushroomed in the outskirts of the city in response to the massive inflows of rural migrants and the shortage of suitable housing. In these districts, the lack of basic facilities and infrastructure, such as liquid waste disposal, and construction on terrain highly exposed to natural

A. Tribak (✉) · K. Azagouagh
University of Fès, Fes, Morocco
e-mail: tribakabdellatif@yahoo.fr

M. Paradiso · K. Azagouagh
University of Sannio, Benevento, Italy



M. Paradiso (ed.), *Mediterranean Mobilities*,
https://doi.org/10.1007/978-3-319-89632-8_12

hazards, as well as the non-compliance with current building standards are some of the factors that expose the urban environment to ever-mounting risks. These districts, in total disarray, have completely marred the citywide urban landscape and have profoundly destabilized the core of a civilization going back over twelve centuries. This state of affairs is so calamitous that corrective actions currently in place have been woefully inadequate to solve these problems. In spite of the State's numerous interventions, non-standard housing built in neighborhoods stricken by poverty and urban blight represents a major hurdle to be overcome, so that the city and its outlying areas can be properly rehabilitated. Persistent, unhealthy living conditions and an unsuitable urban environment call for a profound review of the dimensions of this issue and of the mechanisms that have set it in motion and caused it to develop. The root causes of the failures that have been inflicted on these cities and beyond to their outlying areas and of the problems they face must be urgently attended to as a matter of priority. The rehabilitation of the impoverished and desolate rural areas around Fez is more than ever essential.

Droughts triggering severe shortages of water in rural areas have prompted the implementation of measures that have disrupted territorial continuity. These have had disastrous consequences, not only on herding and farming systems, but also on the whole physical and human environment. The scarcity of water is thus considered to have been a fundamental factor in the crisis that has affected rural areas at all levels of society during periods of droughts, and its direct consequences have led to massive flows of people toward the nearest cities.

This article seeks to understand the nature of the exceptionally recurrent droughts that have devastated the countryside around the city of Fez since the early 1980s, and to examine their impact on the stability/mobility of rural populations, and, their correlation with the great urban sprawl of Fez and, more especially, of its outlying areas that are periodically subject to natural disasters.

## 2 The Setting: A Description of the Urban Area

The urban area of Fez is located in the Fes-Meknes region of northern Morocco (per the administrative divisions of 2015). At an average altitude of 450 m, it extends toward a depression in the NNE corner of the plain of Sais, and it is bordered on the north by the pre-Rif foothills, the highest point of which is Jbel Zalagh at 903 m, and on the south by the Tabular Middle Atlas culminating at 1400 m. To the east, it is bounded by the Sebou river basin, whereas to the West, the Sais of Fez extends up to the plateau of Meknes. The city of Fez thus is situated in a geographically central location at the crossroads of trade routes that have made it become an economic hub and an attractive regional center for business.

In the region, there are several distinct geological structural units. North of the Fez urban area, the pre-Rif foothills, basically composed of marl dating back to the Cretaceous and Tertiary periods, predominate. The plain of Fez is a subsiding region filled with Plio-Quaternary soils composed of lacustrine limestone, clay-limestone tuffs and conglomerates, overlying neogeneous deposits and their substratum (SDAU 1991; Amraoui 2005). Toward the south, outcroppings of limestone and Jurassic dolomites of the Tabular Middle Atlas are exposed.

The local climate is of a Mediterranean type influenced by continental features. It is marked by strong seasonal variations and very irregular precipitation. The average annual rainfall is 500 mm/year (from 1971 to 2010 at the Fez meteorological station). Despite this, rains are generally very heavy and fall during a limited period of a few days in the wet season. Exceptional bouts of rainfall in close succession during

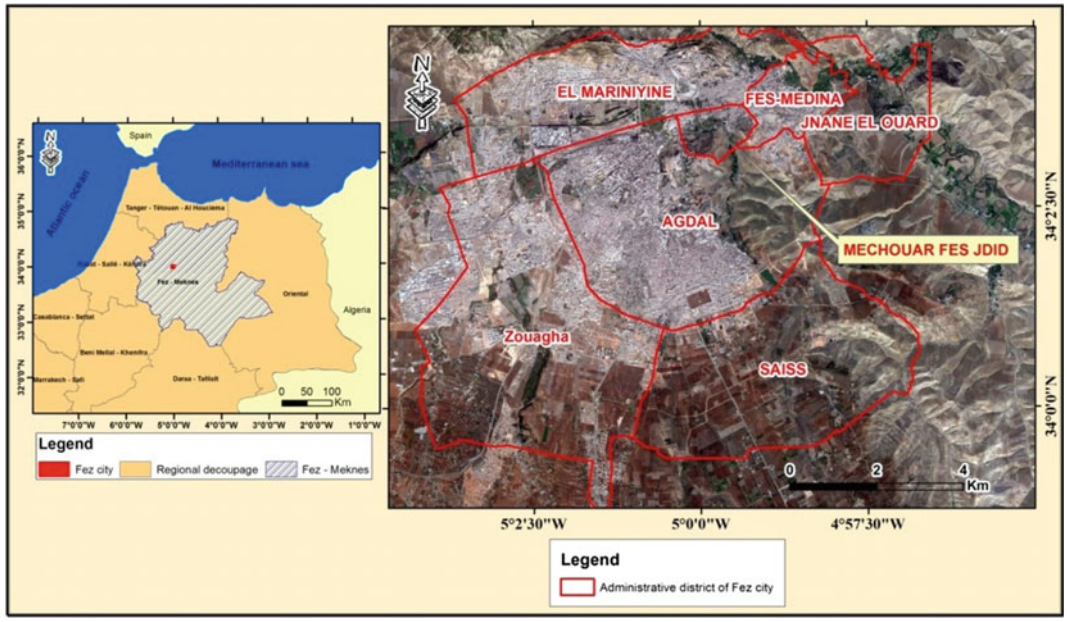


**Fig. 1** Diagram of the Fez-Meknes region and aerial photograph of the Fez urban area

wet years are considered to be an environmental hazard. The annual average temperature is 17.8° as measured over this same period of time. However, maximum temperatures in the summer can reach above 45 °C (Fig. 1).

In terms of hydrogeological features, the water table of the plain of Sais is characterized by the existence of two distinctly separate aquifers. The water table beneath the superficial Plio-Quaternary soils is easily exploitable by wells. Aside from this, Liassic soils reaching great depth contain a confined aquifer that can be tapped by artesian wells (Taltasse 1953; Margat 1960; Amraoui 2005). Moreover, the Fez urban area benefits from a dense hydrographic network of surface channels, one of which, Wadi Fez, being the main river dissecting the city in a SW–NE direction. At times, these channels unleash torrential amounts of water that may cause flooding during exceptionally wet seasons.

Historically, the early medina of Fez, set in a basin cut by the Wadi Fez, was founded at the end of the eighth century by the Idrisid Dynasty. It became the first kingdom of Islamic Morocco. In the years around 808, the city began to grow. Two settlements, the first built on the western bank, and the second on the opposite eastern bank of Wadi Fez, developed over the centuries (Agoumy and Benchrifa 1987). In the first half of the twentieth century, a new adjoining city was built during the French protectorate. After the country's independence, Fez started to expand to outlying districts at the edge of the city, and, in 1970, as it grew, it spread beyond manageable limits and spilled over its confines. Fez currently covers an area of about 11,000 ha. Its population rose from 325,000 inhabitants in 1960 to 796,000 inhabitants in 1994, and in 2014 reached 1,150,000 inhabitants (HCP-RGPH 2014).

## 3 Methodology

Our approach in this study is based on annual meteorological data taken from a series of measurements at the Taza weather stations (1935–2010) located in the pre-Rif foothills and in Fez (1971–2010). Other meteorological data has been obtained from bibliographic references cited in

previous studies (Tribak 2000, 2002; Tribak 2007; Nejjari 2005). Weather maps from the Wetter3 Web site were consulted to describe weather conditions (Wetter3–January 1992 and October 1995).

The data collected at different stations was used to examine rainfall patterns, to focus on the variations that would indicate a distinct tendency for droughts since the 1970s, and especially to study in greater detail the extreme rainfall events that are the determining factors in the onset of flooding. The results of prior studies reporting on the hazards and on the urban dynamics of the Fez urban area, cited here in the bibliography, have been immensely important for us to compare them with our own study and to provide our commentary. The use of aerial photography during our exploratory missions enabled us to map out and capture the development of built-up areas during the last few decades (1962–1990). The archives and administrative reports from the Urban Agency for the Safeguarding of Fez, the offices of the Ministry of Housing, the High Commissioner for Planning (HCP), and the Agency for the De-Densification and Rehabilitation of the Fez Medina, have been valuable resources for us to back up our findings gathered in the field. Field surveys are essential to determine the origin of population groups, to evaluate the impact of recurrent droughts on the movement of people, to identify the factors that affect the settlement of migrants in hazardous outlying areas, and to assess the degree of pressure on the built environment.

## 4 Recurring Droughts and the Movement of Population Groups

The prolonged droughts of the 1980s and 1990s accelerated the migration process that had already been underway in the preceding decades in the greater part of the Moroccan countryside. Data on population shifts in the rural countryside from 1982 onward reveal downward trends in many of the country's municipalities. At that time, rural populations displaced themselves within the country's borders. Urban areas and administrative centers attracted flows of rural people coming from surrounding districts (Rif Mountains and the Atlas). In this context, the urban area of Fez has undergone a very significant demographic transition, resulting concurrently from natural growth, and from the arrival of large numbers of migrants from the back-country. As a corollary to this, the outcome has been an extension of built-up housing districts in hazardous areas on the outskirts of the city and overcrowding in the old urban quarters.

### 4.1 Recurring Droughts and the Scarcity of Water

Figure 2, derived from reduced variations of annual cumulative rainfall measured over a sixty-year period at the Taza station in the pre-Rif foothills, shows the trend of extreme rainfall events, and clearly alternating dry and wet periods.

Early in the series of measurements taken between 1936 and 1942, annual rainfalls were markedly wet, with an index level fluctuating between 1.41 in 1936 and 0.74 in 1942. Only the years 1935 and 1938 stand out with negative indices that represent a deficit in total rainfall. The subsequent period between 1943 and 1950 is characterized by a succession of dry years. The reduced centered indices are all negative and even exceed −0.50 over a five-year period.

Beginning in 1951, the return of more favorable climatic conditions in the region was noted, despite clear evidence of high interannual variability. This new period lasted until 1979. There were no fewer than 17 years with a positive index, of which four exceeded +1: 1960, 1963, 1977, and 1978, the last one reaching a record-breaking index of +2.44. Dry years intervened between the wetter periods and thus interrupted this trend. We thus noted two very dry years, 1961 and 1966, with indices of −1.20 and −1.16, respectively.

A very significant downward trend began in 1980, announcing an exceptional drought that lasted until 1995. Reduced centered deviations

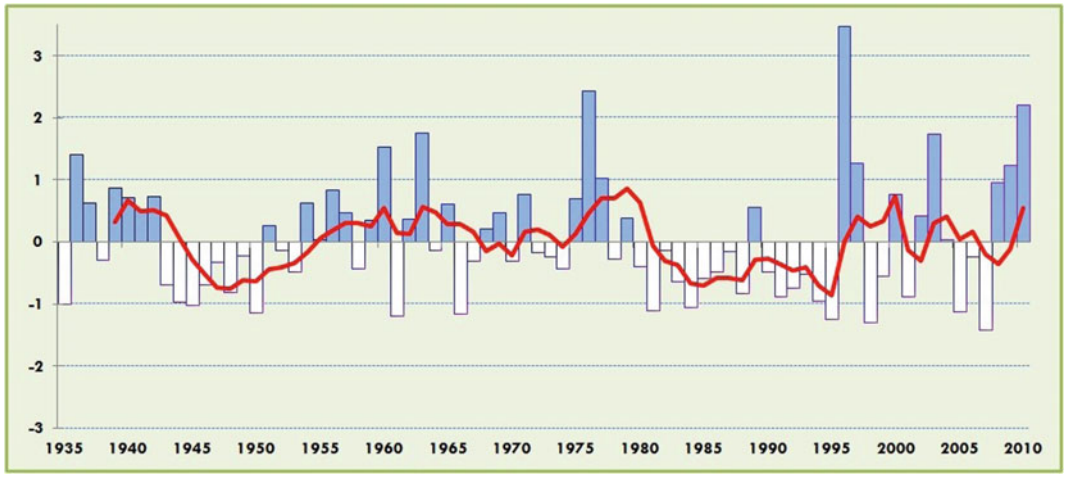


**Fig. 2** Variations in the reduced annual rainfall recorded at the Taza Station (1935–2010). *Source* Tribak et al. (2012)

showed negative values greater than −0.50 over a ten-year period and greater than −1 in 1981 and 1985. During this long drought, only two years showed a positive index (1978 and 1989, with +0.39 and +0.56, respectively). The last phase (1996–2010) is a break from the dry conditions observed between 1980 and 1995. Wet climatic conditions prevailed again as early as 1996 with indices exceeding +1 in five years (1996, 1997, 2003, 2009, and 2010). It is also notable that the year 1996 broke the measurement record with an index of +3.47 (Tribak et al. 2012).

The study of annual rainfall since 1935 has revealed the very irregular patterns of rainfall in the pre-Rif foothill region that are typical of Mediterranean climates (Fig. 2). Wet periods often occur between dry years, some of which may be extremely dry, as in 1961, 1998, and 2007 with negative indices of −1.3, −1.2 and −1.5, respectively. The periods of drought are more consistent and are marked by a quasi-uninterrupted succession of years of rain deficit (dry periods from 1943 to 1950 and from 1980 to 1995). The meteorological station of Fez reported the same trend, as evidenced by a great drop in the amount of rainfall during the period between 1980 and 1995.

In terms of the analysis of dry periods that have very negatively impacted the physical and human environment, it seems quite clear that the recent drought (1980−1995), having been especially severe, was indicative of the cumulative and recurring effect of the lack of rainfall in the years of serious shortage. Studies on the climate of the Atlas hinterland around Fez, for the period between 1971 and 1995, show that extreme droughts were recurrent, but yet had no cyclical patterns (Nejjari 2005). All the weather stations of the upper Sebou were thus closer to arid lands as a consequence of the very dry weather conditions during this period. The rain deficit was at approximately 25% compared to the reference period (Nejjari 2005). The drought from 1981 to 1985 was exceptionally severe. According to the 30 weather stations located in northern Morocco, the deficit between 1980 and 1985 varied from 20 to 45% and reached 85% in some regions (Belkhiri et al. 1987; Nejjari 2005). Likewise, the 1994–1995 season was also unusual: The climatic situation was especially harsh, as recorded by all weather stations in the country. The rainfall deficit as compared to normal levels exceeded the threshold of 40%, with 42% reported at the weather stations of Fez, Sefrou, and Ifrane, and 46.6% at the Taza station. Recorded annual amounts were among the lowest, with 190 mm in Fez and 241 mm at Taza.

Meteorologically, this pattern of recurrent and extensive droughts is linked to summer anticyclonic conditions that can appear as early as

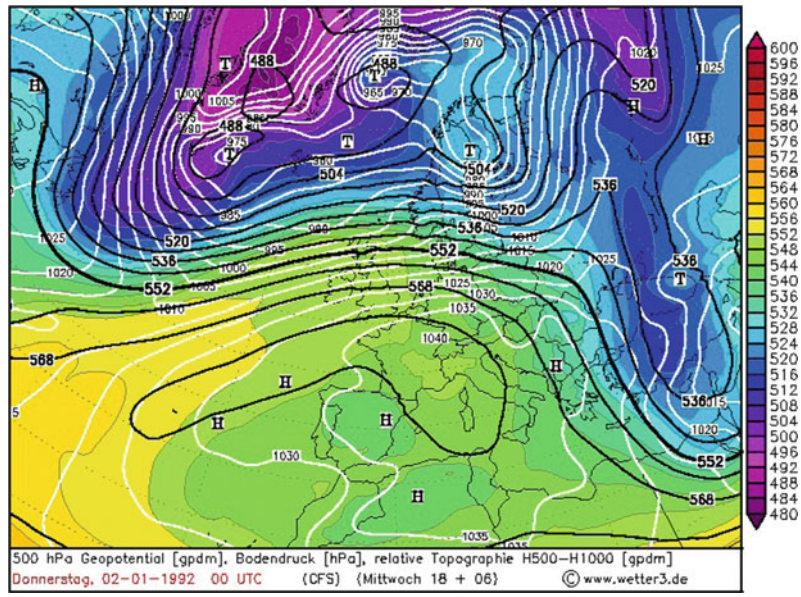


**Fig. 3** Anticyclonic weather condition (02-01-1992 at 00 UTC). *Source* Wetter3

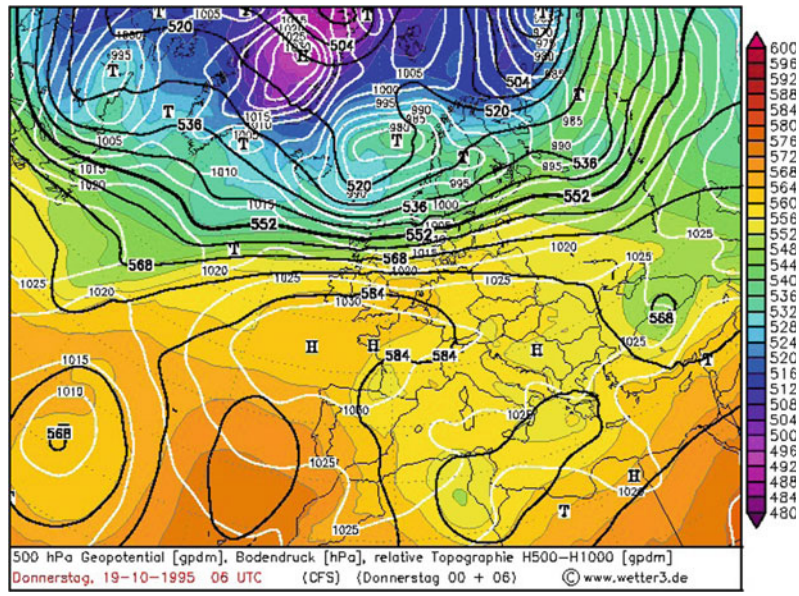


**Fig. 4** Anticyclonic conditions in summer extending to autumn (19-10-1995 à 06 UTC) *Source* Wetter3

spring and extend into autumn. Such is the case of the Azores anticyclone that is centered on or near Morocco (Figs. 3 and 4). However, in winter, a continental polar flux from the northeast can also provoke dry and cold weather conditions that increase the likelihood of having a dry-year deficit (Nejjari 2005).

This period of successive, severe droughts has devastatingly impacted the rural areas of Morocco. The pre-Rif foothills, which shape the countryside north of Fes, experienced such a sizable water deficit that the amounts of stored water were extremely low and practically nil, even in areas where aquifers are fairly prevalent. Absolute droughts intervening during the agricultural season, and occurring rather frequently, are indicative of disturbed seasonal patterns during this overall period. They have had serious

environmental consequences, resulting in a total lack of water during the wet season and in markedly reduced farming and herding activities. The example of 1992 is a good illustration. An absolute drought lasting 63 days occurred from December 18, 1991 to February 18, 1992 in the pre-Rif area north of Taza. The depletion of water supplies then reached a peak in the summer of 1995 due to the shortage of rainfall that year when a total 143-day drought occurred from June 21, 1995 to November 10, 1995. This depletion resulted in the total disappearance of a large number of water sampling points. Many other instances that reflect the extent of water supply shortages throughout the region during this drought period have recurred, especially around the marl basin of Wadi Larbâa near Taza, where the people living in the many douars (tent settlements) have had little access to water, mainly from very low-running springs (less than 1 L/s) or from wells drawing mediocre quality or briny water near the river banks. Similarly, field surveys during this period confirm that villages in the region were delivered with water on several occasions by truck from the town of Taza.

This exceptional drought caused the land to turn arid, consequently leading to an inevitable economic and social crisis. The sheer scarcity of water throughout the region, aggravated by droughts, has had negative repercussions on the physical and human environment. This outcome, combined with socioeconomic factors, helps explain the reasons for the deep economic and social crisis that was triggered when the rural countryside was abandoned and migrant flows began to swell in the early 1980s.

## 4.2 Migrants Moving and Settling in High-Risk Zones

In the wake of these hardship situations caused by the shortcomings of the herding/farming system and by people's precarious living conditions, peasants were forced to seek solutions outside of their milieu. This led to migratory flows that varied from one period to another in their form and in their scope. Large numbers of people left their forbidding mountain environment in the hope of finding ways to live more securely elsewhere. Thus, the mass departures toward the neighboring cities that began in the aftermath of independence have continued to increase up to the present day. The prolonged drought from 1980 to 1995 stepped up the migratory process that had already been underway in the rural areas of Morocco in the prior decades.

Nationwide, between 1982 and 1994, the urban population grew by nearly 5 million people, i.e., an annual increase of nearly 390,000 souls, as compared to just over 265,000 between 1971 and 1982 (HCP 2005). As for migratory movements responsible for nearly 40% of this increase, an estimated 1.9 million rural people left the countryside for the city, equivalent to an annual net inflow of some 156,000 rural inhabitants (HCP 2005). The urbanization of Morocco is typified by very powerful modern-day dynamics. Between 1982 and 1994, the country's annual growth rate was 3.6%, and the percentage of the urban population now exceeds that of the rural population: 51% in 1994, whereas it was only 43% in 1982, and 35% in 1971 (Joumady 1999).

On a regional scale, data on population growth between 1982 and 1994 indicates that the abandonment and the neglect of the rural countryside have affected a vast number of districts, which can no longer provide a sufficient quantity of resources to sustain its inhabitants. In the province of Taza, for example, the most stricken municipalities are Taïfa and Traïba, which have had negative growth rates of −12.1 and −5.3%, respectively. As for people living in douar tent communities, these figures reveal an even more distressing situation. Two douars, El Kochna and Ouled Abdeslam in the town of Taïfa, show negative population growth rates of −62.8 and −53.1%, respectively. A real demographic decline is in process (Tribak 2002).

Also in Hyayna (Taounate province), several rural towns had negative annual growth rates between 1994 and 2004: Aïn Guedah (−0.2%), Outa Bouaban (−0.3%), Ras el Ouad (−0.2%). In the pre-Rif region, 30% of Hyayna's douars also

had negative rates, of which 5.4% had rates below 5, and 10.8% had rates between −5 and −2%. At the same time, between 1994 and 2004, the rural communities of the Taounate subdivision, where rural depopulation is still ongoing, experienced low or negative annual growth rates. Among the 11 rural towns, five recorded negative growth rates varying between −0.1 and −1.4%, while others had rates that varied between 0.2 and 1.7% (ONDH 2010). These rates, albeit slight, can be explained by the massive departure of the rural population from the pre-Rif foothills.

In this context, during the last three decades, the city of Fez, the main regional economic hub, has undergone a major demographic transition, resulting concurrently from natural growth and from the inflow of large numbers of migrants from the countryside. Its population has grown considerably from 584,000 inhabitants in 1982 to 772,000 in 1994, and to 1,150,000 in 2014, with an annual growth rate ranging from 3.94% in 1994 to 1.63% in 2004 (Table 1). Likewise, at the town level, there has been very significant growth, especially in towns in outlying areas. The municipality of Jnan El Ward grew from 83,142 inhabitants in 1982 to 154,691 inhabitants in 1994, and the municipality of Mérinides from 113,213 inhabitants in 1982 to 177,400 inhabitants in 1994 (AUSF 2004).

Surrounded by an extensive area of migratory routes that extends from the Fez-Boulemane region to other nearby provinces, Fez acts a magnet that attracts settlers (HCP 2005). Its geographical proximity to the provinces of Taounate and Taza, and the strong presence of a migrant population having arrived from these same provinces are all factors that explain its great attractiveness (HCP 2005). Compared to Kenitra, for example, it draws three times the number of migrants, nearly half of whom come from neighboring localities: 31% from Taounate, 8% from Zouagha Moulay Yacoub, 5.5% from Taza. Beyond its own regional area, Fez attracts a relatively large proportion of migrants from the Wilaya of Rabat-Salé (10%), Berkane-Taourirt (10%), Casablanca (4%), and Errachidia (3.4%) (HCP 2005).

Surveys carried out in the Quettanine district of the old quarter show that 75% of the migrants come from the backcountry of the pre-Rif foothills, mainly from Taounate and Taza, and this accounts for 61.5% of the number of migrants (Ennasry 2011). Similarly, surveys conducted in the outlying neighborhoods of north and northeast Fez confirm that 80% of the migrants originate from these provinces, compared with 63% of those in the outskirts that lie southeast of the urban area, and 35% of those in the medina (Errafik 2012). Recent studies also confirm that the countryside of the province of Taounate alone accounted for about 50% of the city's population shifts between 1994 and 2004 (El Malki 2004).

Previous studies on the urban dynamics of Fez report that most migrant flows arrived in Fez during the 1980s and 1990s following the severe drought mentioned earlier (Hazoui 2006; El Bouaichi 2004a, b; Gartet 2007; Hnia 2009; Errafik 2012). Hnia (2009), in his study on interventional approaches to the management of housing located in hazardous areas, concludes that, "construction began in the Jnanate quarter in the 1950s. It reached its peak in the 1980s, at a time when the climate was very dry and when the rate of rural migration to the city was recorded at its highest." The ANHI (2000) report illustrates this point as well, i.e., 75% of the construction between 1981 and 1985 in the Hay Hassani quarter of the northern zone was unauthorized at

**Table 1** Population growth in the city of Fez (1960–2014)

| Years | 1960 | 1971 | 1982 | 1994 | 2004 | 2014 |
|---|---|---|---|---|---|---|
| No. of inhabitants | 325,327 | 335,050 | 484,654 | 772,184 | 946,815 | 1,150,131 |
| Annual growth rate (%) | 2.4 | 3.7 | 3.6 | 3.94 | 1.84 | 1.63 |

*Source* RGPH (2014) and AUSF (2004)

a time, just at the time when all of Morocco was in the grips of a severe drought. The field observations and surveys that we carried out in 1985 and 1995 indicate that the feeble supply of water arising in the marshy pre-Rif area north of Taza had almost totally dried up. These surveys also show that these milieus were being severely depopulated during the summer of 1985 and the summer of 1995. Population data between 1982 and 1994 confirm these findings. The douar, El Khochna, located in the pre-Rif rural town of Taïfa, recorded a negative population shift of −62.8% (Tribak 2002). Even in the town of Taza, there was no supply of water. From 1980 to 1985, in the medina of Taza, water was very frequently cut for 2–3 days. Also, during the summer of 1995, records show that water was cut in some of the poorer neighborhoods of the upper Taza medina for three weeks. This problem persisted until the Bab Louta dam was built. The dam is located in the Middle Atlas and, since 2002, has been supplying water to the outlying districts of Taza.

These migrant flows were composed mainly of poor people who were seeking housing in outlying areas or in the medina's old dwellings that could be shared with other households (Sawab 2001; SDAU 1991). During this drought, 63% of migrant families settled in the outskirts of the city, compared with 26% in the old quarter of the medina, and 11% in scattered pockets of slums lying outside the city limits (Fejjal 1995). The negative growth rates of the rural towns in the pre-Rif foothills, contrasting with the sharp population increase in the metropolitan area of Fez (especially in the outlying areas) between 1982 and 1994, confirm these findings. The gradual urban consolidation of the city of Fez, a reflection of the impact of its urban dynamics in recent decades, has been detrimental to surrounding rural areas that have been experiencing a steadily declining growth rate dating back to as far as the 1980s. According to the High Commission for Planning, the city of Fez took in, during this period, 22% of the total number of migrants, i.e., an annual average of more than 13,000 people choosing to relocate to a big city. The inflow of migrants accounted for more than 55% of the growth of the city. The remainder of the city's population growth came from a natural increase at a rate close to 44% (HCP 2005).

This demographic shift that has prevailed in the last few decades has been tied to a wild, chaotic, and mostly uncontrollable expansion of built-up areas. This explains the considerable number of interventions that have been adopted to recover the areas exposed to risk. Substandard housing generally sits on poorly valued land or on parcels that have an ambiguous legal status, such as old quarries, wadi beds, land with steep inclines, and terrain adjacent to steep cliffs (IRHUAE 2009; Gartet 2007). Indeed, in the last few decades, the city of Fez has entered into a process of rapid growth. It currently covers a land area of about 11,000 ha (Fig. 5). In 1991, according to the SDAU in 1991 (the urban planning authority), the metropolitan surface area of Fez grew from 3878 ha in 1960 to 6550 ha in the 1980s, during which time non-regulatory neighborhoods were built or were expanded in the northern outskirts, such as Hay El Hassani, Hay Al Wifak, and Jnanate (SDAU 1991). Likewise, in the northeastern part of Fez, which had a high number of migrants, 80% of the buildings were built in the 1980s and early 1990s in response to the large flows of migrants during that time. In addition, a great number of property speculators took advantage of the migrants' critical housing problem (Errafik 2012). In the same vein, Tlemçani points out that, besides rural migration, other socioeconomic factors came into play. "These factors have to do directly with the huge impact of urban growth, the severity of the housing shortage, the inadequate supply of available land for housing, and the demand characteristics of low-income households in particular". Hazoui 2010 also shows that the construction of illegal housing dates back to the fifties just after independence, and that the northern outlying areas were experiencing at that time a dizzying growth rate that started in the seventies mainly due to rural migration, a natural population increase, and intra-urban migration. According to the ANHI report (2000), the period between 1981 and 1985 was conducive to the construction of housing in two districts in the

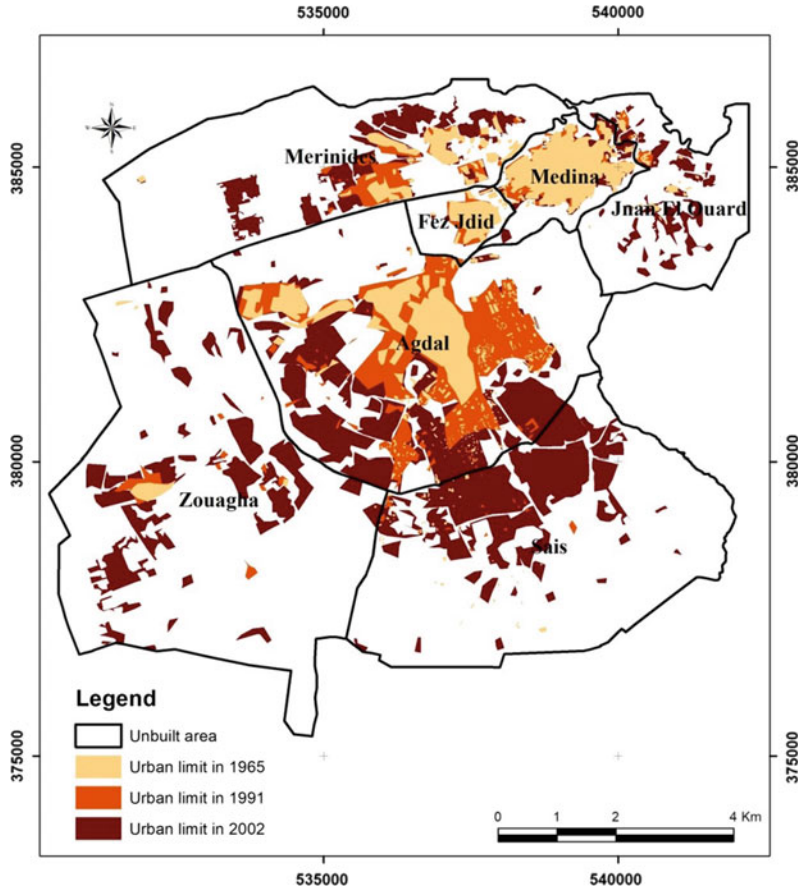


**Fig. 5** Diachronic development of the Fez urban area between 1965 and 2002 as seen from aerial photographs. *Source* Benriah (2016)

**Table 2** Dates construction began (Northern zone)

| Start of construction | Quarter | |
|---|---|---|
| | Hay Wifaq (%) | Hay Hassani (%) |
| 1977–1980 | 23 | 3 |
| 1981–1985 | 69 | 73 |
| 1986–1992 | 8 | 23 |

*Source* ANHI (2000) and Gartet (2007)

northern zone: 73% in Hay El Hassani and 69% in Hay Al Wifaq. Only four years were needed to construct three quarters of Hay Hassani's buildings (Table. 2).

Rural migrant flows, of greater magnitude during droughts, contributed greatly to expose the vulnerability of outlying areas, as most of the new construction was built on non-regulated land and was generally open to multiple hazards. The result of this illegal construction was the proliferation of anarchic and uncontrolled spatial expansions within the urban area. New urban structures arose as the result of misguided urban planning policies, and they were built outside of

a regulatory framework to compensate for the shortage of housing that prevailed during the urban crisis (Hazoui 2006; El Bouaichi 2004a, b; Gartet 2007). In this way too, this disorderly construction responded to the needs of one part of the population that was unable to afford a preexisting home, and it provided a means of shelter for the most disadvantaged. The attractive prices for land on the outskirts of the city encouraged new arrivals to seek an opportunity to settle in the greater urban area, even when areas were severely exposed to natural hazards. Surveys conducted in the northeastern zone (Jnanate) in 2011 show that 15% of families had chosen to settle in that zone, because the low price of land to purchase housing was affordable, and 22% because rents were cheap. In addition, 25% of the residents said that they had opted for less expensive neighborhoods, and finally 19% because of family ties with migrants who had already arrived, a factor that made it easier for them to settle there (Ennasry 2011). It is also worth pointing out the risk of having property values increase due to land and real estate speculation, one of the fundamental mechanisms for creating spatial segregation, a disjointed urban fabric, and an expansion of the non-regulated housing sector in the Fez urban area. Illegal housing districts provided fertile ground for up-and-coming speculators and real estate contractors during this period, and for the structuring of the housing construction market that would match the socioeconomic status of new arrivals (Ameur 1993; Gartet 2007).

## 5 Vulnerability and Substandard Construction in Non-regulated Districts

In Morocco, substandard housing, a major share of the country's available lodging, comes in many forms: slums, illegal housing, non-regulated housing, and unlawful accommodation in the old medinas lacking proper facilities. These types of housing take on the typical characteristics of those found other cities in the countries of the South, i.e., an indeterminate legal status, unstable construction, lack of basic infrastructure. In addition to this, it is the social pathology of the people involved who feel marginalized or excluded. There are multiple interrelated factors that explain the reasons for the construction and development of these forms of habitat that are exposed to risk, due to interweaving physical factors and human settlement issues.

### 5.1 Risk Factors

The outlying districts constructed with non-regulated housing were mostly developed during the 1980s on geographically exposed land, on no-construction zones, on geotechnically unstable terrain, or near cliffs or streams where there is a risk of frequent flooding and landslides (Hnia 2009). Moreover, this intrinsically fragile environment has been buffeted by substantial human development following the chaotic and uncontrolled urbanization of the outlying districts. The lack of basic infrastructure, overcrowding, the excessive height of buildings on very small surface areas, the failure to comply with building standards, and the lack of maintenance are all factors that have contributed to exposing these sites to ever greater risks. Such is the case of the Jnanate district situated in northeast Fez and the Hay el Hassani district in the north.

On the geotechnological level, neighborhoods in the outlying areas of the city that were built up with non-regulated housing stand on vulnerable ground. This physical instability is primarily due to the presence of unconsolidated formations that, once having been impregnated with water, have altered mechanical properties. These formations are prone to cause ground disturbances that are even more likely to occur by the presence of overhanging cliffs. In the case of the Jnanate district in the northeastern sector of Fez, for example, the report of the study carried out by the Public Laboratory for Testing and Studies (LPEE 1991), showed the presence of soil primarily composed of sandy marls with shifting channels. This predominating layer runs over all

the cliffs and even underneath building substructures and carries on its surface the runoff from rainfall or sanitary sewers. This contributes to weighing down geological formations to thus cause ground shifting that can disturb the rocky cliffs (Photograph 1). Moreover, the risk of hazards in these neighborhoods is also due to the fact that these buildup areas are directly adjacent to cliffs that are cut into marly or travertine formations a few meters in height, thus producing cliff overhangs. Such is the case in the Jnanate and the Hay Hassani districts in the northern zone of Fez (Photograph 2).


**Photograph 1** Constructions in the form of staircases, backed up and raised in height, built on marly lands on steep slopes, near the stream (Oued Fès). They are threatened with collapse due to landslides on these cliffs (Northeast zone of Fez)

**Photograph 2** Chaotic landscape of high-rise constructions that directly joins travertine cliffs a few meters deep. They remain susceptible to collapse (North zone of Fès)

Apart from these intrinsically unstable features, the accelerated and uncontrolled influx of people into these hazardous areas is another aspect of the problem. Indeed, this instability is progressively worsened by urbanization over inherently unstable terrain. A tight housing situation forced new arrivals, driven by harsh living conditions in the countryside, to build on land where risks are potentially high. Neighborhoods built in these settings are generally characterized as high-density environments with high-rise constructions. In fact, due to the large inflows of migrants during the 1980s and 1990s, and due to the difficulty of expanding horizontally (scarcity of available land, rugged topography), buildings that were constructed in the late 80s were generally extended vertically without taking into any account the amount of weight that the supporting frame could withstand. Our field surveys, conducted in April 2016, indicate that foundations initially designed for one ground floor currently bear an additional five to six floors and are built near the cliff of Hafat Moulay Idriss, which formerly served as a quarry. Most of the buildings in the north and northeast outlying districts are predominantly constructions with a ground floor plus 3 floors, or plus 4 floors, or even sometimes plus 5 and 6 floors. Buildings with a ground floor plus one floor represent only a small fraction, that is, not more than 15% of the total housing inventory (IRHUAE 2009).

These high-rise constructions are built on small surface areas offering a poor foothold to the ground, 85% of the area being less than or equal to 100 $m^2$; 66% are less than 60 $m^2$ in the northern zone. On the other hand, in the northeast zone, 50% of these buildings have a surface area of between 60 and 80 $m^2$, and 41% cover surfaces that measure less than 60 $m^2$ (Errafik 2012). These constructions create a jumbled landscape, where buildings generally lean against each other over rugged terrain or directly against the cliffs (Photographs 1 and 2). They thus bear significant weight on the underground geological formations (marly), where over-densification of buildings can translate to as many as 22 households on a ground surface area of 40 $m^2$ (IRHUAE 2009).

These population densities are therefore alarming. Based on the R.G.P.H. (general census) of 1994, the Jnanate sector covers approximately 95 ha and includes 1120 buildings. The most extreme densities are estimated at 1600 dwellings per ha (Alomrane 2010). Surveys conducted in these outlying districts indicate that families with more than 6 members represent 60% of the families in the northern zone, 33% of families in Jnanate (Errafik 2012), and 52% in the old quarter of the medina (Tribak et al. 2013). The upshot is strong demographic pressure on these types of construction that, in turn, hastens their dilapidation. It is also important to emphasize that inadequate basic infrastructure and the failure to comply with technical building standards augment the vulnerability of buildings and weaken their resistance to degradation or even collapse. Before being integrated within the urban limits, these urban districts remained under-equipped for a considerable period of time, notably in terms of roads, in liquid and solid sanitation networks, and in social infrastructures. Prior studies on the urban dynamics in these districts (ANHI 2000; Alomrane 2010; El Bouaichi 2004a, b; Gartet 2007; Errafik 2012) agree that the majority of these dwellings were built without having complied with current standards, namely those that deal with the pace of construction, the height of buildings on small surface areas, the poor quality of construction, and the malfunction of the sewer network. From this angle, it can be seen that this type of urban planning, generally unsuited to address the issues relative to this type of terrain, exacerbates the fragility of the terrain and of the housing that has been erected on it without having applied the current building standards. This causes these dwellings to gradually deteriorate, and even collapse to the point of causing significant human and material damage.

## 5.2 Risk Aspects

Studies carried out in the outskirts of the urban area point to the magnitude of risk generated from ever accelerating human settlement of these areas and, consequently, from the natural hazards that threaten these overcrowded spaces (Errafik 2012; Gartet 2007; Hnia 2009; El Bouaichi 2004a, b). Indeed, these impoverished neighborhoods, the end products of chaotic urbanization, are the most vulnerable to the impact of natural disasters and are the least equipped to cope with these events. Landslides and subsidence, travertine cliff collapse, and flooding are examples of natural hazards that can have a significant impact on the built-up areas and on the people who live in there.

Thus, in these neighborhoods, due to the weak supporting substrate under the foundations of most of the buildings that generally tend to lean one against one another, vertical and crisscrossing cracks appear both on the facade and on the inside walls of the buildings. The survey carried out by the AREA-TESCO Study Group (ANHI 2000; Gartet 2007; Errafik 2012) revealed the existence of cracks in the various parts of the building structure (floors, load-bearing beams, posts, floors coverings). Surveys and field observations report that 57% of the buildings in the northern zone are affected by cracks and dampness, compared to 46% in the northeast zone (Errafik 2012). Similarly, at Hay Hassani, 25% of buildings are affected by cracks in the floor covering and 24% are affected by cracks in the floor (Gartet 2007).

The magnitude of the network of cracks affecting many of the buildings in these districts predominantly reflects the interplay between the soft and unstable substrate and the mediocre quality of construction. These characteristics increase the risk of building collapse in the short and medium term. Buildings on the verge of crumbling are a constant headache for the city's authorities and are a threat to the lives of thousands of residents. In the Jnanate district (northeast zone), with its very high population density, the mid-term expertise carried out by the LPEE laboratory mapped out, at hierarchical degrees of severity, the built-up areas near the cliffs that threaten to disintegrate, including one zone that was declared as high risk for two reasons: the unstableness of the cliff and the specific faults in the construction of the buildings themselves.

According to estimates by this same laboratory, this threat of collapse, for geotechnical reasons, now affects 1200 households in the non-regulated neighborhoods of Jnanate, one-third of whom live near the cliffs and two-thirds against the cliffs (IRHUAE 2009).

In these neighborhoods, the recent spectacular collapse of buildings has been documented. The magazine, *L'Economiste* (Issue No. 4015 dated April 22, 2013) reports that "on April 19, 2013, the residents of Jnane El Araqui, in the Sidi Boujida neighborhood, were violently awakened by the collapse of three 3-floor buildings (25, 26, and 27) that successively crumbled down like castles of cards." It is apparent that the collapse of cliffs that support 5-story buildings housing more than 10 households—not counting their individual guests—is a hazard that translates into a form of social construction of risk, whereby it becomes one of the fatal consequences of human settlement on geographically unstable terrain.

Moreover, in the medina, the extent to which the built-up areas are threatened to collapse no longer needs to be demonstrated. The situation is of such magnitude that it is, by a long shot, the most spectacular indicator of the degree to which built-up areas are falling into ruin. Referring to the work carried out by the ADER, it appears that this situation affects 4000 of the 11,000 buildings in the medina, including 1850 in a state of advanced decay (ADER 2004). The qualitative field results in the Qalqliyne district (Karaouyin river bank) report that 66% of the buildings that were surveyed threatened to fall into ruin. They are affected by dampness, high occupancy density, degraded indoor facilities, cracking, and sloping walls (Ennasry 2011).

The above examples show that the complex blend of intrinsic factors contributing to instable conditions in these physically preordained vulnerable environments, and urban planning policies rendered inadequate by the high anthropic pressure are at the root of the utter disarray that affects buildings and the people of some of the outlying districts of the urban area. In addition to the total absence of sanitary conditions due to dampness, cracked walls, cramped quarters, and the lack of ventilation affecting a high proportion of dwellings, local people are threatened by a potentially looming natural disaster that can cause the collapse of the building that provides them shelter.

## 6 Discussion and Conclusions

From this analysis, it appears certain that the prolonged drought during the decades of the 80s and 90s throughout Morocco reinforced the migratory process that had already been underway in the previous decades in most of the Moroccan countryside. From the early 1980s onward, the habitat in the mountains of the eastern Rif changed from overcrowded conditions with pressure on the environment to a situation, in which the countryside was depopulated in the context of an economic crisis and social malaise (Gauché 2005). The demographic abandonment of the countryside in certain mountain environments and the tendency to concentrate people in urban centers thus responded to the failure of the herding and farming system to withstand the effects of recurrent and persistent droughts in a context of a generalized economic crisis. Our field surveys, in certain rural areas of the pre-Rif, confirm this well. The extremely high degree of mobility of rural populations is related to the availability of water in the desolate countryside of the pre-Rif hinterland. Water is a limiting factor that forges the relationship between population groups and their environment.

The absolute lack of this precious resource, caused by recurrent droughts throughout the region, has had a negative impact on the physical and human environment. It was at the root of the disconnection between the existing links that tied the environment and its inhabitants, who found, by migrating to neighboring cities, their chance for salvation. In this context, the urban area of Fez has undergone a very significant demographic transition, resulting, at the same time, not

only from natural growth and intra-urban mobility, but especially from the flows of migrants from the hinterland. This situation has led to an expansion of the illegal and chaotic habitable zones toward hazardous areas in the outskirts, and to the over-densification of the old quarters. In fact, recently arrived households from the rural countryside were forced either to cohabit with other households in the old quarter of the medina, or to relocate to the outlying districts where the purchase of housing was then still affordable (Fejjal 1995). Under these conditions, unsanitary non-regulated housing took shape therefore as an outlet to relieve the regulated housing market. Unhealthy living conditions were evidenced as much by the disastrous physical setting of the housing units as by the scarcity and even the lack of infrastructures and city services (Benlahcen Tlemçani and Missamou 2000). In fact, due to an acute housing crisis and the inability of the State to cope with it, chaotic housing units, generally with unhealthy living conditions, make up for a large part of the existing housing deficit. This situation explains the reasons for the apathy that housing services had in the 1980s and 1990s with regard to the considerable expansion of substandard housing toward potentially hazardous areas heavily threatened by various natural disasters (Hazoui 2006).

The unhealthy housing conditions and the shortage of social and community facilities and basic infrastructure in these neighborhoods have fueled feelings of exclusion and marginalization among local people. Physical risks tied to natural hazards and their consequences on the built environment are unfortunately linked to other social problems such as poverty, delinquency, extremism, and urban crime. These problems represent yet another category of urban risk, which requires all-encompassing and prioritized interventions equivalent to those needed to fight against unsanitary living conditions and the threat of buildings to collapse. So, we are faced with an urban situation in a state of disorder and of socioeconomic dysfunction that adds to the vulnerability of the environment. This disorder has completely fragmented and disfigured the urban landscape at the city's level and has profoundly destabilized the core of a civilization going back over twelve centuries.

After numerous disasters in these neighborhoods, the attitude of the public authorities toward the growth of the chaotic neighborhoods and substandard housing has evolved into a choice between, first, political action based on the acceptance of the actual situation and on policy measures designed at restructuring and rehabilitating poor neighborhoods so that they can better integrate into the official urban fabric, and, second, a technical approach aimed at redefining legal and regulatory tools to diminish the surface areas of non-regulated sectors (El Bouaaichi 2004a, b).

Since 1988, emergency measures have been indeed taken and actions on the ground have been carried out in all the neighborhoods at risk. Likewise, an urban program has been set up to survey urban planning policies and to manage malfunctions caused by the blatant expansion of uncontrolled construction of the habitat (Gartet 2007). This is particularly true of the 1991 SDAU and many of the sectoral development plans. New administrative bodies were created (e.g., the Urban Agency for the Safeguarding of Fez, the Agency for De-Densification and Rehabilitation) in order to coordinate the city's urban planning and solve the problems linked to population explosion and resulting chaotic urbanization. Despite these measures, urban disruptions, linked to natural disasters, to the multiple failures of the built environment, and to the dysfunction of the socioeconomic base of the outlying areas of the urban, continue to March on relentlessly.

Persistent, unhealthy living conditions and an unsuitable urban environment call for a profound review on the dimensions of this issue, and of the mechanisms that have set it in motion and caused it to develop. An innovative approach must be found and adopted that can address the city's social and legal concerns, not only from a technical, regulatory, and procedural point of view, but one that broadens the scope of intervention (Benlahcen Tlemçani and Missamou 2000). The causes of the shortcomings and the problems of

the cities—and more urgently, of the outlying areas—must also be determined. The rehabilitation of the impoverished and deserted countryside that makes up the hinterland of Fez is more than ever necessary. This fragile landscape needs improved access to basic infrastructure in the areas of transport, health, education, and agriculture. By the same token, water management, which is a determining factor for stabilizing the countryside, remains a national priority. A rural development policy must take it into account in order to ward off the severe consequences of any potential recurring droughts. Watershed management and conservation management of natural resources can also contribute to the sustainable local redevelopment of these areas. These measures may well rehabilitate the rural countryside and meet the expectations of local people, thus reducing the flows of migrants toward the cities.

**Acknowledgements** The research leading to these results has received funding from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme FP7/2007-2013/under REA grant agreement no. [612639] MEDCHANGe.

## References

ADER-Fès Agence pour le Développement et la Réhabilitation de la ville de Fès. (2004). Rapport sur le bâti menaçant ruine dans la Médina de Fès.

Agoumy, T., & Benchrifa, A. (1987). La Médina de Fès el-Bali, modèle de ville musulmane traditionnelle, La grande encyclopédie du Maroc. *Géographie Humaine, 9*, 168–177.

Alomrane. (2010). Rapport de projet de redressement urbain du secteur nord (Fès), Inédit.

Ameur, M. (1993). Fès ou l'obsession du foncier. Fascicule de Recherche n° 25, URBAMA, Université de Tours, 428 p.

Amraoui, F. (2005). Contribution a la connaissance des aquifères karstiques: cas du lias de la plaine du sais et du causse moyen atlasique tabulaire (Maroc); Thèse Doctorat d'Etat, Hydro-géologie 249 p.

ANHI. (2000). Problématique des constructions menaçant ruine sise au secteur Hay El Hassani et Hay Al Wifaq à Fès: étude de diagnostic, de consolidation et de gestion du risque. Rapport inédit, établit par AREA-TESCO, 62 p. +annexes, Rabat.

AUSF. (2004) Projet urbain du Grand Fès, Rapport diagnostic préliminaire. 148 p, Fès.

Belkhiri, B., Compte, J. P., El Khabouti, A., El Hamouri, A., & Meryouh, D. (1987). Bilan de cinq années de Sécheresse au Maroc. *Revue eau et développement N., 3,* 13–33.

Benlahcen Tlemçani, M., & Missamou, R. (2000). Habitat clandestin et insalubre au Maroc: vers une stratégie d'intervention plurielle. Les annales de la recherche urbaine N° 86, pp. 111–118.

Benriah, N. (2016). Occupations des zones à risques dans les quartiers périphériques de Fès causes et conséquences (cas du Quartier Jnanate), mémoire Master Géographie - LAGEA-DD, USMBA -Fès 76 p.

EL Bouaaichi, A. (2004). Le péri-urbain en qualification à Fès: recomposition de la ville, pratique urbaines et alternatives d'aménagement, Thèse de doctorat d'état, Université de Fès 709 p (Texte en Arabe).

EL Bouaaichi, A. (2004). Projet de réhabilitation d'habitat à risque: cas de Hay hassani à Fès, éléments pour un engagement dans le processus de MOS. pp. 101–109, in AL Maouil, les cahiers d'Al omrane n° 19/20 " La maitrise d'ouvrage sociale au Maroc: un état des lieux ", Rabat.

El Malki, A. (2004). Sociologie d'urbanisation au Maroc, étude des relations entre les cadres écologiques et les systèmes culturaux (cas des immigrants ruraux dans la ville de Fès) Thèse Doctorat d'Etat en sociologie; USMBA – Fès 264 p (texte en Arabe).

Ennasry, H. (2011). *Les dimensions socio- Anthropiques des risques dans l'agglomération de fès cas de la mèdina et les quartiers périurbains* (p. 137 p). Géographie, Faculté des Lettres et des Sciences Humaines Fès Saïs: Mémoire du Master.

Errafik, M. (2012). Problématique de l'habitat menaçant ruine liée aux risques naturels et aux pratiques urbaines dans la ville de Fès, thèse Doctorat Géographie, FLSH – Sais Fès 175 p.

Fejjal, A. (1995). Évaluation sociale du projet de sauvegarde de la médina de Fès, composante «Activités économiques» , Préfecture de Fès - Banque mondiale, 205 p.

Gartet, A. (2007). Risques naturelles, anthropiques et technologiques dans l'agglomération de Fès et son arrière pays. Aménagement, gestion et prévention. Thèse doctorat, géographie, Université sidi Mohamed ben Abdallah.

Gauché, E. (2005). La crise environnementale des bassins versants des Beni Saïd (Rif oriental, Maroc). *Revue Géomorphologie: Relief processus environment, 12* (2), 141–156.

Haut Commissariat au Plan. (2005). Dynamique urbaine et développement rural au Maroc: Chapitre 1. Transition démographique - Transition urbaine.

Haut Commissariat au Plan 1982–1994–2004. Recensement général des populations et de l'habitat.

Hazoui, M. (2006). La prolifération de l'habitat anarchique, acteurs et enjeux: cas de la périphérie Nord de Fès. In "La ville marocaine entre la planification et l'anarchie". Publication de FLSH. Saïs-Fès, Série Colloque n° 5, pp. 63–81, Fès.

HCP. (2014). Recensement général de la population et de l'habitat.

Hnia, H. (2009). *Aménagement de l'habitat à risques, Approches d'intervention et enjeux des acteurs, cas de figure représentatifs de la ville de fès*. Faculté des Lettres et des Sciences Humaines Fès Saïs: Mémoire du Master en Géographie.

IRHUAE/Fès-Boulemane. (2009). Rapport sur le secteur Jnanates, scénarios d'interventions, inspection régionale de l'habitat, de l'urbanisme et de l'aménagement de l'espace/Fès – Boulemane.

Joumady, K. (1999). Urbanisation et disparités spatiales au Maroc méditerranée 1–2. pp. 93–100.

LPEE. (1991). Étude géotechnique de stabilité de Jnane Alami à Jnanates. Rapport inédit, 63 p, Fès.

Margat, J. (1960). Carte hydrogéologique au 1/100.000 du bassin de Meknès Fès. Edition de l'office national des irrigations.

Nejjari, A. (2005). La sécheresse, l'eau et l'homme dans le bassin versant du Haut Sebou (Moyen Atlas septentrional), PhD dissertation – CEGUM- Metz 317 p.

ONDH. (2010). La diversité socio-spatiale de la pauvreté dans le pays Hyayna (Pré-rif central): caractérisation, perception et cartographie du phénomène; Rapport final, Projet d'étude USMBA-LAGEA/ONDH Rabat.

Royaume du Maroc, SDAU. (1991). «Schéma Directeur d'Aménagement et d'Urbanisme de Fès, Rapport justificatif» , Ministère de l'Intérieur, Fès, Maroc.

Sawab, M. (2001). la restructuration de l'habitat non réglementaire dans la ville de Fès: bilans et perspectives, Thèse de Doctorat FLSH DM Fès (Texte en Arabe).

Taltasse, P. (1953). Recherche géologique et hydrologique sur le bassin de la castre Fès- méknes. Notes et Mém. Serv. Géol. Maroc, no. 115, 300 p.

Tribak, A. (2000). L'érosion hydrique en moyenne montagne du Prérif oriental: étude des agents et des processus d'érosion dans une zone de marnes tertiaires. Thèse Doc d'État, 351 p.

Tribak, A. (2002). Contraintes du milieu et fragilité d'un espace montagnard marocain: les montagnes du Pr2-rif oriental. annales de géographie, no. 625, pp. 227–245 Armand colin, paris 2002.

Tribak, A. (2007). facteurs climatiques de l'érosion hydrique dans quelques bassins du Rif marocain: cas de la province de Taza actes du XXème colloque de l'AIC ' Climat, tourisme environnement' Carthage. *Tunis Septembre, 2007,* 550–555.

Tribak, A., Lopez Lara, E., Miranda, J., & Carrido Cumbrera, M. (2013). *El patrimonio construido en la medina de Fez: Degradacion salvaguardia y valorisacion in Ressources patrimoniales et développement local au Maroc et en Andalousie*. FLSH Sais-Fès: Pub.

Tribak, A., Nouaceur, Z., Amyay, M., & Abahrour, M. (2012). Genèses et impacts des pluies intenses sur les milieux Pré-rifains Marocains (Etude du cas de la région de Taza, Maroc). *Revue Géomaghreb numéro, 7,* 2011.