

Article

## Some Considerations on the Seismic Event of 23 November 1980 (Southern Italy)

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**Abstract:** More than forty years after the 23 November 1980 earthquake, which devastated the Campania and Basilicata regions, causing the destruction of a large number of towns and the death of around three thousand people, we have tried, through a large survey, to understand how and to what extent the urban fabric and the most affected communities have been rebuilt. Our main objective was to show, on one side, the commitment of the scientific community, and on the other the transitions that have led from the emergency to reconstruction. Of the Apenninic towns Conza della Campania, Laviano, Lioni, Santomena, and others, where the devastation was almost total, we have tried to give an iconographic vision of the post-earthquake phase through the change in the urban layout. The partial or total reconstruction of the towns has taken place most of the time in situ, only in some cases by relocating buildings to neighboring areas, as happened in Conza della Campania, Bisaccia and Romagnano al Monte. Reconstruction was carried out mainly of anti-seismic buildings and only in some cases recovering pre-existing buildings in historic centres; reconstruction was completed after a very long period, in some cases lasting over thirty years, inevitably passing through a dramatic experience of the population in temporary settlements of various kinds, from tents, caravans, railway carriages, to containers, and finally to thermo-igloos and to prefabricated wooden chalet-type. A very complex and detailed reconstruction was linked to factors not only territorial, economic and political but also conditioned unfortunately by the non-negligible intervention of organized crime.

**Keywords:** 1980 Irpinia-Basilicata earthquake; Southern Italy; reconstruction; resilience; environmental effects

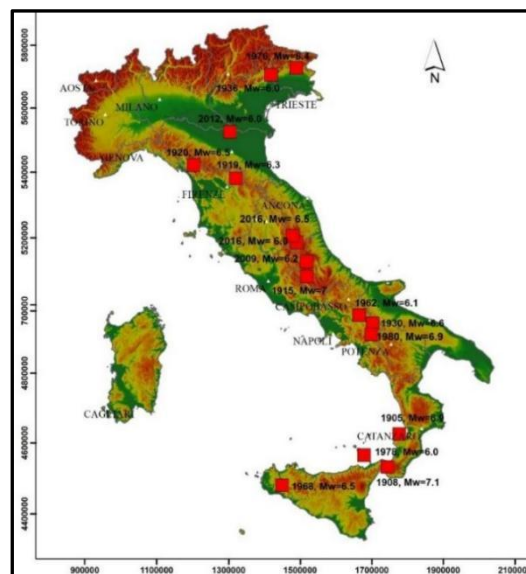
### 1. Introduction

Over more than forty years after the earthquake which dramatically shocked southern Italy in the evening of 23 November 1980, causing the destruction of a large number of towns and the death of around three thousand people, we have tried to understand how and to what extent the urban fabric and the damaged, devastated, erased communities have been rebuilt through a brief overview survey. The underlying theme of our path has been the reconstruction in that seismic zone with a brief introduction on the seismic and geological characteristics of the area of the event: the seismological parameters, the level of damage, the evaluation of the macroseismic intensity, the seismo-induced geological effects, to finally deal with the post-earthquake reconstruction. Starting from some cases of the almost totally devastated localities, we have attempted to give an overview of the earthquake through the new conditions and subsequent changes in the structure of the villages

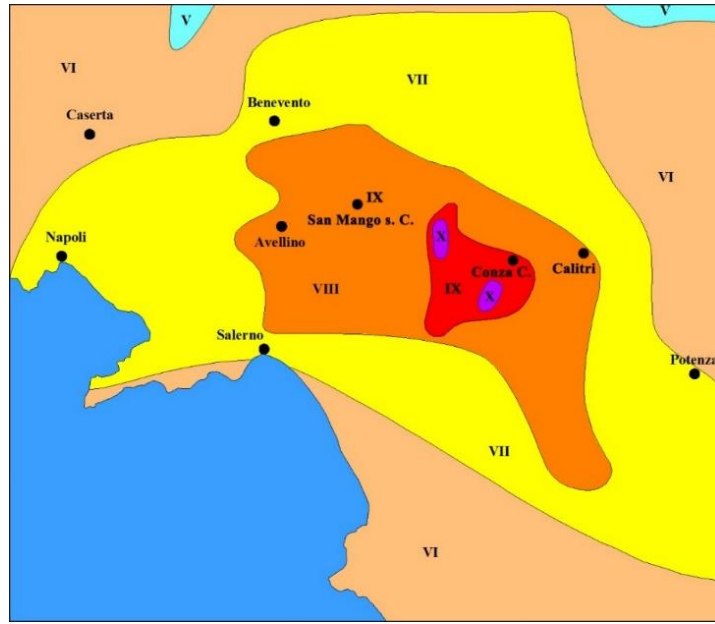
located in the Apennine hinterland. We will describe the phases of the partial or total reconstruction of entire towns which occurred, most of the time, in the same places, and only in some cases in neighboring areas, through a process of delocalisation.

## 2. The Irpinia-Basilicata Earthquake of 23 November 1980

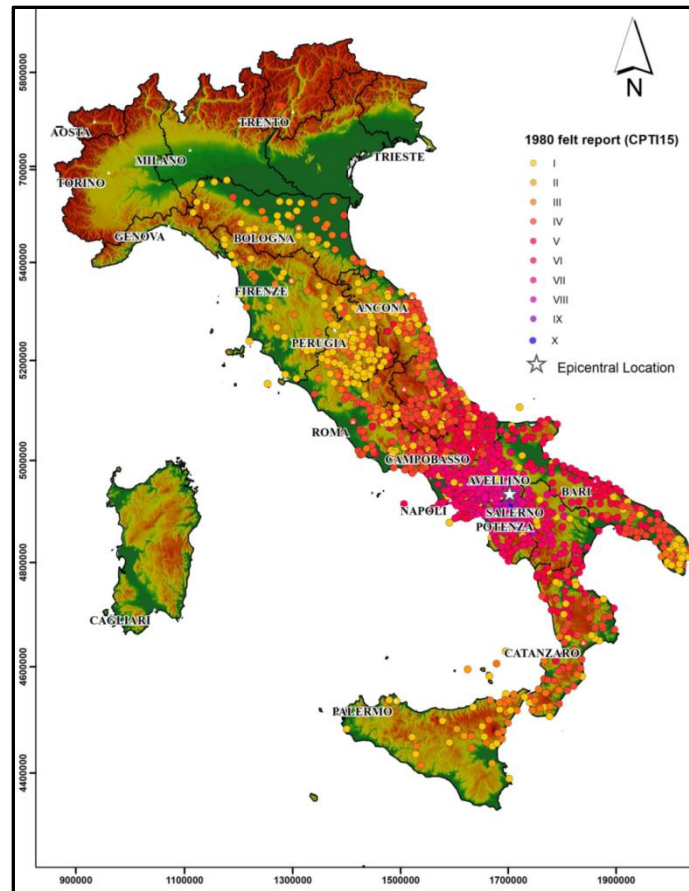
The Irpinia-Basilicata earthquake of 23 November 1980, has been considered the highest energy seismic event that occurred in the southern Apennines (Italy), in the last hundreds of years (Figure 1). It was felt all over the Italian peninsula from Sicily in the south, to Emilia Romagna and Liguria in the north, and caused serious damage in many places of the Campania and Basilicata regions, marginally also in Puglia region (Figure 2a,b [1]). The victims were around 3000, 10,000 injured. A total of 75,000 homes were destroyed and 775,000 were damaged. The magnitude reached the value of 6.9 Mw [2-4], the epicentral intensity was 10 = X MCS and X in the ESI-07 scale [1,5,6]. In the provinces of Avellino, Salerno and Potenza, several municipalities were almost destroyed, reaching a level of damage equal to or greater than IX degree MCS: Castelnuovo di Conza, Conza della Campania, Laviano, Lioni, Santomenna, Sant'Angelo dei Lombardi, Balvano, Calabritto, Caposele, Guardia dei Lombardi, Pescopagano, Romagnano al Monte, S. Andrea di Conza, S. Mango sul Calore, S. Michele di Serino, Senerchia, Teora (Figure 2a). In Campania 542 localities were declared damaged, of which 28 were classified as destroyed, 250 seriously damaged, 264 damaged; in the Basilicata region the damage affected 131 municipalities of which 9 were declared destroyed, 63 seriously damaged and 59 damaged [4,7]. Some towns were also significantly damaged, among these the city of Avellino suffered the highest damage I = VIII MCS [8], followed by Potenza, Salerno and Naples which recorded minor damage I = VII MCS [9,10]. In Avellino 72 people died, with a large part of the historic center affected (Figures 3 and 4), most of the historic ecclesiastical buildings were seriously compromised, and serious damage even to the newer reinforced concrete buildings [11]. Even in Potenza the historic center was seriously damaged [12] as well as in Salerno and Naples. In the latter city, in addition to widespread damage to the historic center [10,13], a residential tower collapsed in the zone of Poggioreale, in which 52 people died [10]. Among the most important monumental buildings, seriously damaged by the earthquake, there was also one of the largest buildings in Europe, dating back to eighteenth-century, the Royal Albergo dei Poveri (Figure 5), also known as Palazzo Fuga or Serraglio, where the infirmary, part of the refectory and some of the rooms on the first and second floors collapsed [10]. Over forty years after the earthquake, a large investment of millions of euros has finally been decided for its restoration as part of Italy's Recovery Plan (PNRR).



**Figure 1.** The strongest earthquakes occurred in Italy in XX and XXI centuries (Data INGV [2,3]).



(a)



(b)

**Figure 2.** Intensity distribution of the 1980 earthquake in the near and far field. (a) Macroseismic field of 23 November 1980 earthquake (Modified from [1]); (b) The 1980 earthquake was felt all over the Italian peninsula, from Sicily in the south, to Emilia Romagna and Liguria in the north (Data INGV [2,3]).



**Figure 3.** The city of Avellino just after the earthquake of 23 November 1980 (cortesy of F. Capossela).



**Figure 4.** Detail of the city of Avellino under reconstruction a few years later.



**Figure 5.** Naples: Real Albergo dei Poveri or Palazzo Fuga, current view. The building suffered severe damage in the infirmary, part of the refectory and some of the rooms on the first and second floors.

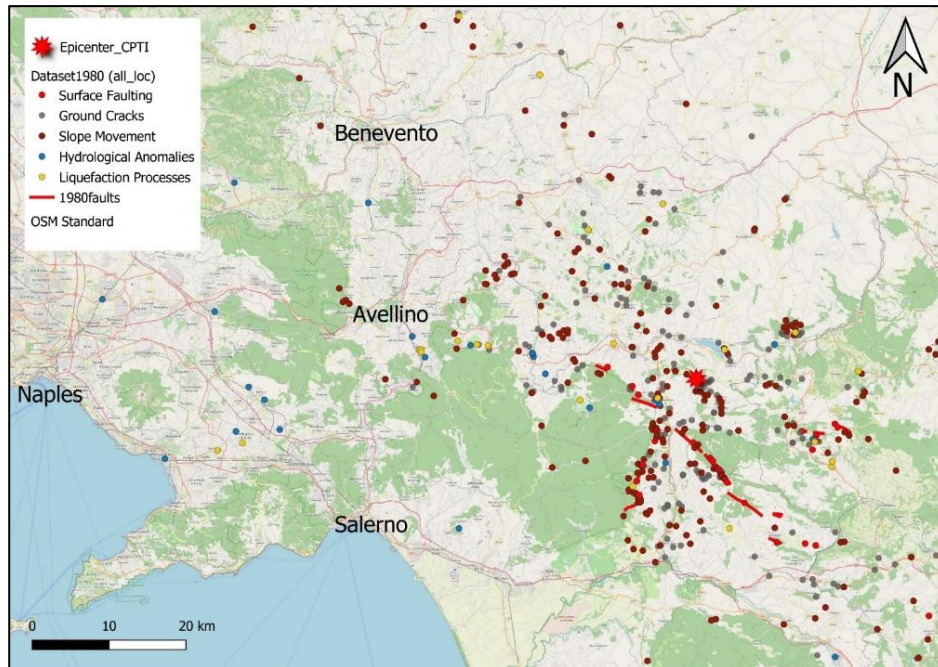
### Focal Parameters of the Earthquake and Environmental Effects

The seismic event occurred on the evening of 23 November 1980 at 7:34:52 pm, and was characterized by Mw 6.9 with a complex failure mechanism [14,15], made up of three sub-events which occurred at 20 and 40 seconds compared to the first arrival of the main shock; three distinct normal fault segments were sequentially activated, whose total end to end length turned out to be approximately at 40 km [5,14–17].

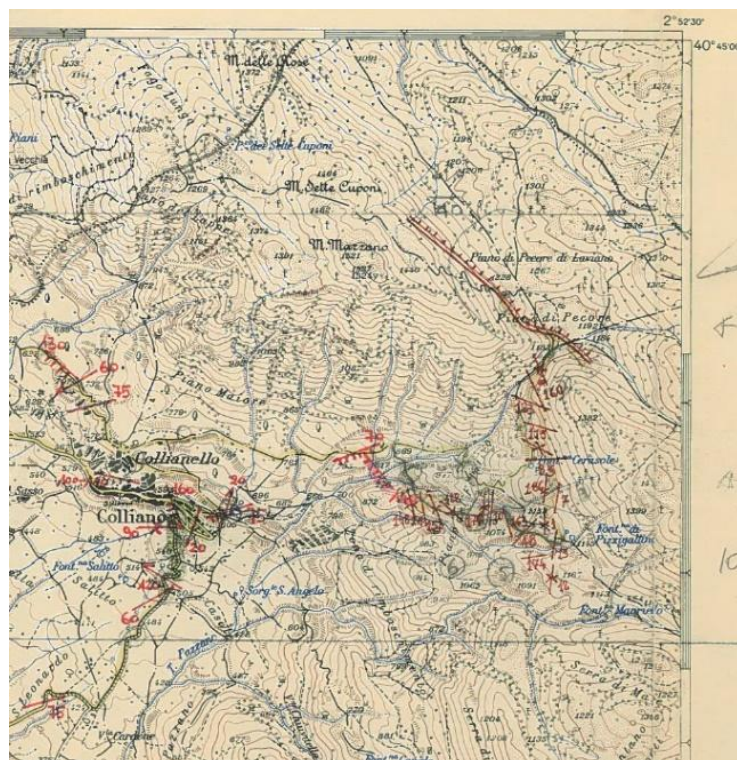
Apart from the destruction of the building heritage, which we mentioned above, we must consider the several effects that the earthquake induced on the natural environment [18] (Figure 6), which in some cases permanently affected the layout of the places, such as phenomena of surface faulting, but also and above all landslide phenomena, fractures in the soil, hydrological variations and liquefaction phenomena, contributing significantly to modifying the territorial structure of some municipalities [18,19]. A displacement up to one meter was observed along the surface fault [14,20,21] found in the Marzano and Ognia Mountains (Figure 7a,b,c), in the territories of San Gregorio Magno [22] Colliano, Calabritto, Caposele, Muro Lucano [18,22]. Several literature papers relating to the primary and secondary effects induced by the 1980 earthquake have been published recently [18,23–28]. Among the secondary effects induced by the earthquake, the most devastating ones were certainly the landslides that affected both inhabited centers and rural areas [18,23,28], 200 landslides were surveyed; most of them were rock falls and rotational slides, followed by slump-earth-flows and earth-flows. The large rock falls were mainly located in the epicentral area, with rock volumes of up to 10,000 m<sup>3</sup>. The rock falls that occurred on the western slope of Monte Valva were significant, where the blocks rolled 500 m from the detachment sector. The landslide that partially devastated homes in the historic center of Calitri (Avellino province) was dramatically spectacular, mobilizing 23 million m<sup>3</sup> of material [28–31]; as well as the gravitational movements that affected large portions of rural territory, 30 million m<sup>3</sup>, in Caposele (Avellino province) in the Boninventre area and in Senerchia (Avellino province), in the Serra d'Acquara area (28 million m<sup>3</sup>) [32].

Widespread ground fracturing phenomena were observed not only in the geomorphological context, but also along the main road structures of the epicentral area, up to VIII MCS isoseismal line (Figures 2 and 6) [33] blocking traffic, in some cases making the rescue work even more difficult, due to the heavy snowfalls that occurred immediately after 23 November 1980. Modest soil liquefaction phenomena were observed in 21 locations, including Lioni, Calitri, Caposele, Volturara Irpina and San Michele di Serino etc [18,34,35]. The hydrological effects triggered by the earthquake were also notable, especially variations in the flow of springs, rivers and wells. The most important changes in flow were recorded in the springs of Caposele (Avellino province) and Cassano Irpino (Avellino province) [29,36,37] where a very notable increase in flow of water was observed equal to a few thousand liters per second, a phenomenon that lasted a total of 6–12 months. Particularly

important is a complete database, published recently, with an updated dataset of environmental seismic effects, which collects 564 environmental effects: slope movements 46.3%, hydrological changes 7.7%, liquefactions 4.4%, surface faulting 9.4%, ground cracks 32.1% (Figure 8). Each environmentally triggered effect is described and catalogued by specific census forms. The majority of the effects are located in the epicentral area: 56.9% of the total effects classified were located within 20 km of the macroseismic epicentre, and 84.4% within 40 km. However, some effects were located nearly 200 km from the epicentre [18].



**Figure 6.** The distribution of the ground effects triggered by the 1980 earthquake (from [18]).



(a)

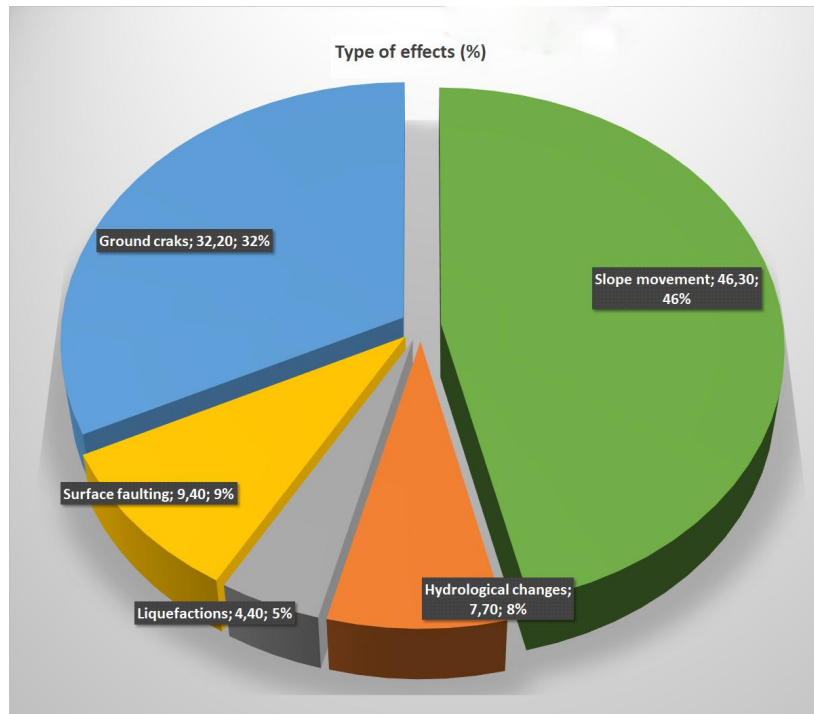


(b)



(c)

**Figure 7.** Primary and secondary effects triggered by the 1980 earthquake. (a) The original survey of primary and secondary effects triggered by the 1980 earthquake (Courtesy PFG-CNR). The top right is the trace of the surface fault segment at Piano di Pecora; (b) 1980 Piano di Pecora surface fault 24 years later; (c) 1980 Piano di Pecora surface fault 40 years later.



**Figure 8.** Percentage distribution of seismoinduced effects of the 1980 earthquake on the environment (Modified after [18]).

### 3. Reconstruction: Emergencies and Transitions

The topic of post-seismic reconstruction is a very complex subject of debate [38–43] and is still open, due to multiple factors, primarily the geographical location, the socio-economic situations of the affected involved populations, the lack of effective and permanent interventions for economic development and local employment. The history of post-earthquake reconstruction is always a very long path with several steps, which can be summarized in the emergency phase, transition and reconstruction in the strict sense [4,23,40,42,43]. Fortification of buildings, infrastructures and historic center for reconstruction should be introduced.

On this last point, it is worth emphasizing that in the years following the event, several laws and ordinances were issued using which the Basilicata, Campania and Apulia were declared seismic regions, through the relative seismic classification of the territory based on a CNR study. Successively, numerous ministerial decrees have not only updated the seismic classification of the national territory but have also given indications on the rules for repair and reinforcement of buildings damaged by the earthquake, with technical standards for design, execution and consolidation of masonry buildings as well as for construction of new reinforced concrete buildings and infrastructure (D. M.7 /3/ 1981; D. L. n. 75 19 / 1981 ; D. M. n. 515 -3 /6/1981; D. M. n. 2 July 1981; D. M. 12 /2/ 1982; D. M.- 19 /6/ 1984; Circolare Ministero LL.PP. 25882 -5 /3/ 1985; D. M. LL.PP. 24 /1/ 1986; Circolare Ministero BB.CC.AA n. 1032- 18/ 7/1986; etc in <https://www.ingegneriasismicaitaliana.com/it/normative/24> [44]).

In several websites, particularly touching testimonials explaining the drama of the 1980 earthquake arrival time and the associated ‘noise’ are collected, including “terribile boato—A terrible roar” [45]. As regards the Irpinia-Lucania earthquake, in the emergency phase, because of the high level of destruction, a large population of homeless people occurred, therefore many temporary settlements of various kinds were tentatively installed, depending on whatever the State could provide at that time, first with the installation of tents, caravans, railway wagons, containers, ending with the thermo-igloos [46,47] and the more complete prefabricated buildings, in chalet-type wood. Particularly, the settlements formed by thermo-igloos (Figure 9a,b), a gift from the Sicilian Region to some towns in Irpinia, including the small municipality of S. Potito Ultra, have been used for many years; they were abandoned, and eliminated only about ten years ago [46,47], while the prefabricated wooden houses, real little houses, have suffered a different end, in fact in some municipalities they have been abandoned



through time, in others they persist today although mostly in a state of decay, or in the best case, still partially used as in Conza della Campania or with touristic functions, as happened before the Covid-19 pandemic in San Mango sul Calore (Figures 10 and 11), and Romagnano al Monte [48–50].



**Figure 9.** San Potito Ultra (Avellino province) temporary housing consisting of thermo-igloos, which were dismantled only a few years ago (Photo by Sabina Porfido, [47]). (a) Examples of temporary accommodations; (b) Detail of the thermo-igloo of San Potito Ultra (Avellino).



**Figure 10.** Conza della Campania (Avellino province). Temporary housing consisting of prefabricated wooden houses are still visible today ([48,49]).



**Figure 11.** San Mango sul Calore (Avellino province). Complex prefabricated wooden housing used for post-earthquake, successively used for tourism functions, and after the Covid-19 pandemic completely abandoned[48,49].

During the dramatic emergency phase, a massive intervention of volunteers from all over Italy took place, directly involved in the field with development of great national and international solidarity, and a generous collection of funds for the reconstruction. An example among all is the “Campo Bergamo-Bergamo Camp” in Lioni (Figure 12a,b), a town strongly hit by the earthquake with loss of 228 people. The city of Bergamo located in Northern Italy, immediately twinned with the destroyed Irpinia town of Lioni ( $I = X$  MCS), firstly has built a village of prefabricated houses and then, very rapidly, built a futuristic condominium of three reinforced concrete buildings delivered to 60 families in 1985 and still inhabited. On the fortieth anniversary of the earthquake (1980–2020), one side of the building was enriched with an artistic mural, which shows two outstretched hands approaching each other and aims to symbolically represent once again the solidarity, closeness and brotherhood of the two communities. Reciprocally, from Lioni towards Bergamo, the epicenter of the dramatic Covid-19 pandemic which caused an impressive number of deaths, a chain of solidarity took place [45,48,49] (Figure 12b [51]). Examples of international solidarity are also found in the current toponymy of some countries, which highlight the interventions carried out for reconstruction, such as the Italian-Canadian village in San Mango sul Calore (Figure 13) or the Swiss village in Teora [45,48,49].



(a)



(b)

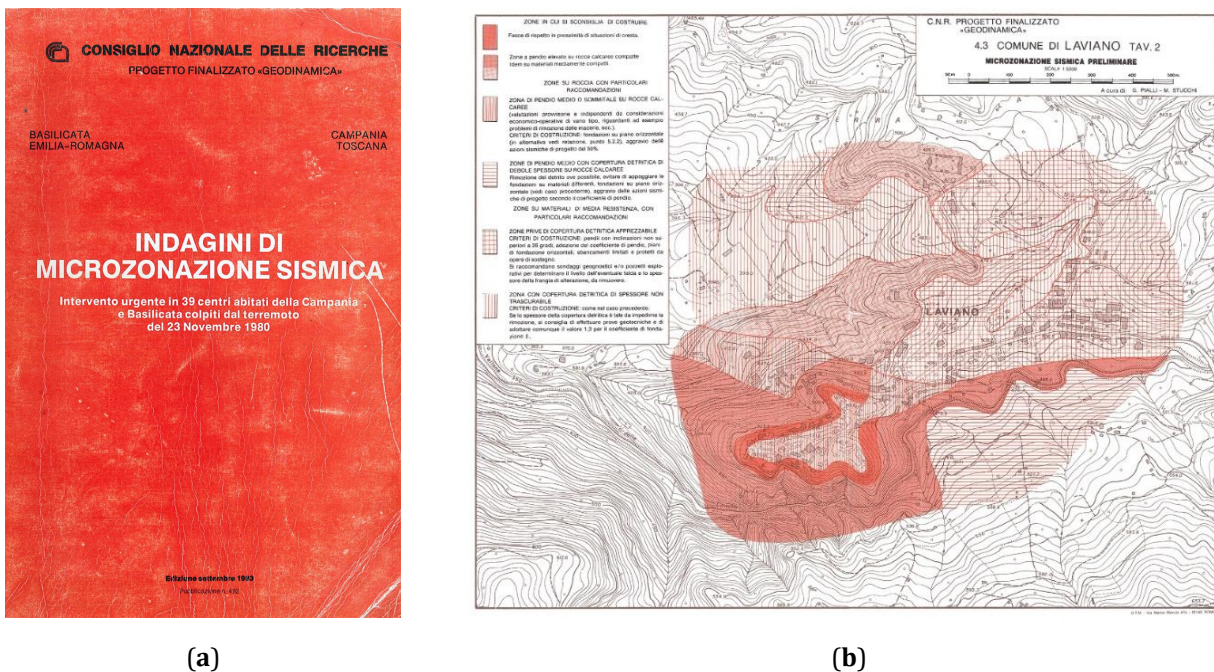
**Figure 12.** Lioni (Avellino province) “*Campo Bergamo-Bergamo Camp*”. (a) Concrete apartment block built with funds raised by citizens of Bergamo and province, donated to the people of Lioni after the 1980 earthquake; (b) the mural in the same condominium depicting in 2020 the solidarity of the people of Lioni to Bergamo, epicenter of the Covid-19 pandemic [48,49].



**Figure 13.** San Mango sul Calore (Avellino province) “*Italian-Canadian village*”, example of housing built thanks to the international solidarity of Italians abroad [48,49].

### 3.1. Reconstruction: The role of the National Scientific Community

The dominant imperative of the time was “rebuild, rebuild”: But where and how? These are the most important questions that followed the destruction of a very large territory, which wanted and needed to be reconstructed. The Italian scientific communities also contributed to finding answers to these dramatic needs [50–53]. In the field of applied sciences, an important role was played by the national scientific society of the time, which through the *Progetto Finalizzato Geodinamica-Geodynamics Finalised Project* (PFG) of the National Research Council (PFG-CNR), contributed with a strong commitment directly in the field. In fact, targeted studies of preliminary seismic microzonation were carried out in collaboration with the regions of Tuscany and Emilia-Romagna in 39 inhabited centers of the epicentral area of Campania and Basilicata [54] (Figure 14a,b) to provide technical maps, on a scale of 1:5000, with indications of the areas with different geological characteristics and the identification of the most suitable areas for reconstruction. It was a notable effort deployed by over a hundred researchers from universities and research centers throughout Italy, who logistically and scientifically were headed by the historical Vesuvian Observatory of Naples.



**Figure 14.** The book of preliminary seismic microzonation in 39 inhabited centers of the epicentral area of Campania and Basilicata [53]; Detailed mapping of municipal areas with different geological characteristics [54]. (a) Preliminary seismic microzonation; (b) Laviano (Salerno)-map of seismic microzonation.

This big effort was deployed with direct interventions in the seismological, geological and engineering fields with the production of numerous scientific publications among which it is useful mentioning, in addition to seismic microzonations edited in 1983 [54], two other fundamental contributions for the understanding of seismicity of Italy, consisting of the “*Catalog of Italian earthquakes starting from the year 1000*” and the “*Atlas of Isoseismal Maps of Italian Earthquakes*”, both edited by D. Postpischl [55,56] in 1985. In fact, the 1980 earthquake constituted a milestone in the study of modern seismology and earthquake geology in Italy, giving rise to lively discussions and passionate debates on the subject [1,14–17,21]. Forty years later, many innovative techniques have contributed to making the mechanisms that affect earthquakes clearer, allowing a better assessment of the seismic hazard and therefore of the associated risk [23–27].

### 3.2. Reconstruction

First of all, it must be said that the historic centers of all the Apenninic villages affected by the earthquake were mostly made up of extremely poor buildings: houses leaning against each other, in natural stone, sometimes in gray or yellow tuff, or in bricks bonded with poor quality and/or little cement mortar, construction

typologies characterized by mostly superficial, or even missing, foundations, thrusting roofs with wooden beams, without horizontal curbs, of which some striking examples were San Mango sul Calore, San Michele di Serino, Laviano, Balvano, Castelnuovo di Conza, Conza della Campania (Figure 15), Calabritto, etc.



**Figure 15.** Conza della Campania (Avellino province). Examples of very poor constructions consisting of rubble stone with little mortar were very common at the time of the 1980 earthquake throughout the historic centers of the Campano-Lucano Apennines (Photo by Porfido & Spiga 2021).

Overall, that very singular landscape that constitutes the so-called “*crib villages*”, is still characteristic of the Apennines hinterland today [40,43,45,57]. In some more economically developed countries, the presence of reinforced concrete buildings was not lacking, such as in Sant’Angelo dei Lombardi (I = X MCS) [54,58], an important municipality in Irpinia, headquarters of notable administrative and judicial apparatus. Some of these new buildings, such as the hospital and the Japicca Palace, were destroyed or seriously damaged by the earthquake, probably due to poor construction quality and failure to comply with seismic regulations, causing the death of hundreds of people. Even the church of Balvano, whose roof had been rebuilt in reinforced concrete shortly before the earthquake, collapsed causing the death of 77 people of which 66 were children and similar cases, with a high level of damage, unfortunately also occurred in many other towns such as Lioni, Teora, Valva, Solofra etc. Currently it can finally be said that all the towns placed within the epicentral area have completed the reconstruction [40,41,45,46,48,49] generally on the same site or in localities in the immediate vicinity with the exception of some municipalities: Conza della Campania, Romagnano al Monte and Bisaccia, they have chosen to move elsewhere from the original location.

### 3.3. In situ reconstruction

The newly inhabited centers were almost generally rebuilt *in situ* with prevalent building typologies in reinforced concrete; only in a few cases it was possible to recover the pre-existing buildings [40–42,57] through long interventions of recovery, first conservation, and then restoration: some examples are the historic center of Sant’Angelo dei Lombardi (Figure 16a,b), in which the community’s attachment to the original town prevailed and therefore the desire to rebuild in any case “*as it was, where it was*”, as also demonstrated by the recovery of the Goleto Abbey (Figure 16b); moreover, also in the town of Quaglietta, a hamlet of Calabritto, the ancient medieval village was completely recovered and enhanced, in order to finally be used in 2016 as “*Albergo Diffuso-diffuse hotel*” for tourism purposes.



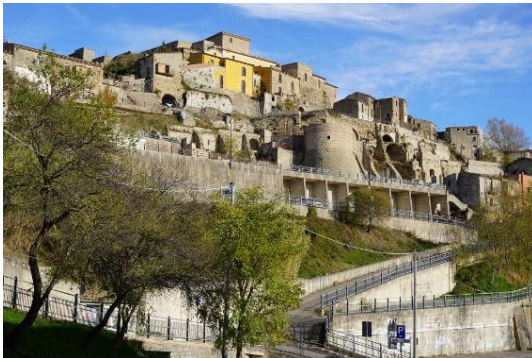
(a)



(b)

**Figure 16.** Sant'Angelo dei Lombardi (Avellino province): reconstruction of a severely damaged village by trying to recover pre-existing building types. Right, the Goletto Abbey, recovered and restored [48,49]. (a) Examples of reconstructions in historic centres; (b) Restoration work at Goletto Abbey.

The new urban centers, after reconstruction, are today generally characterized by wider road systems, the narrow streets with the characteristic alleys are preserved and appropriately valorised only in some cases, such as Guardia dei Lombardi or Calitri, where part of the historic center is recovered, although it had been affected by a landslide of considerable size [54] maintaining however the appearance of the pre-earthquake town, at least in its original nucleus while the expansion zone is rather chaotic, without a real architectural structure (Figure 17a,b).



(a)



(b)

**Figure 17.** Calitri (Avellino province). (a) Reconstruction of the historic center with the preservation of the original urban heritage [48,49]; (b) Building expansion zone.

Rebuilding *in situ*, despite everything, even after a huge tragedy, is the case of the municipality of San Mango sul Calore, almost totally destroyed by the earthquake (I = IX MCS and VIII ESI-07) with 84 fatalities. The seismic microzonation investigations of the PFG highlighted that the causes of the destruction of the town were due both to the poor quality of the houses and to the unfavorable position of the ridge, together with the hydrogeological structure of the territory, characterized by widespread phenomena of more or less accentuated instability along the slopes [54,59–61]. San Mango sul Calore was rebuilt from scratch *ex-novo* on the original site after important soil consolidation works on the hill on which it was built, effectively modifying its original profile, lowering and leveling the top, but maintaining the overall structure of the destroyed town (Figure 18).



**Figure 18.** San Mango sul Calore (Avellino). Overview of the village completely rebuilt after a substantial foundation soil remediation. (Photo by Porfido & Spiga, 2020 [48,49]).

In other cases, the old and new construction typologies try to coexist, managing to blend perfectly as in the case of Guardia dei Lombardi, Torella dei Lombardi or Caposele (Figures 19 and 20).



**Figure 19.** Guardia dei Lombardi (Avellino province). Reconstruction of the village keeping in mind the old architectural plan [48,49].



**Figure 20.** Caposele (Avellino province) New construction integration into the old structure of the village [48,49].

In other municipalities, such as Lioni, Teora, Balvano, the choices to modernize and make buildings functional, especially public ones, prevail, thanks to the innovative intervention of some architects (Figures 21–23) [48,49]; in other cases, such as Laviano, Calabritto and Santomena (Figures 23–26) although modern construction in reinforced concrete prevails, towns without a real identity can be found, with public and private buildings lacking real connection with the original landscape, sometimes representing an isolated nucleus, perennial testimony of the moment of tragedy, as in the case of Romagnano al Monte or Senerchia, as regards the upper part of the town.



**Figure 21.** Lioni (Avellino province). The new historic centre, reconstructions with innovative architectural interventions [48,49].



**Figure 22.** Teora (Avellino province) Rebuild the village according to construction criteria that favor the use of reinforced concrete (Photo by Porfido & Spiga 2022).



**Figure 23.** Balvano (Potenza province)—The village was completely rebuilt mostly in reinforced concrete with architectural structures designed by artists Boffo and Eibl [48,49].



**Figure 24.** Laviano (Salerno province).



**Figure 25.** Calabritto (Avellino province) Reinforced concrete buildings without a well-defined architectural identity to reproduce the historic village prevail ([48,49]).





**Figure 26.** Santomenna (Salerno province)—View of part of the historical center completely reconstructed in reinforced concrete, the large gray building, top right, in the photo is the town hall (Photo by Porfido & Spiga 2022).

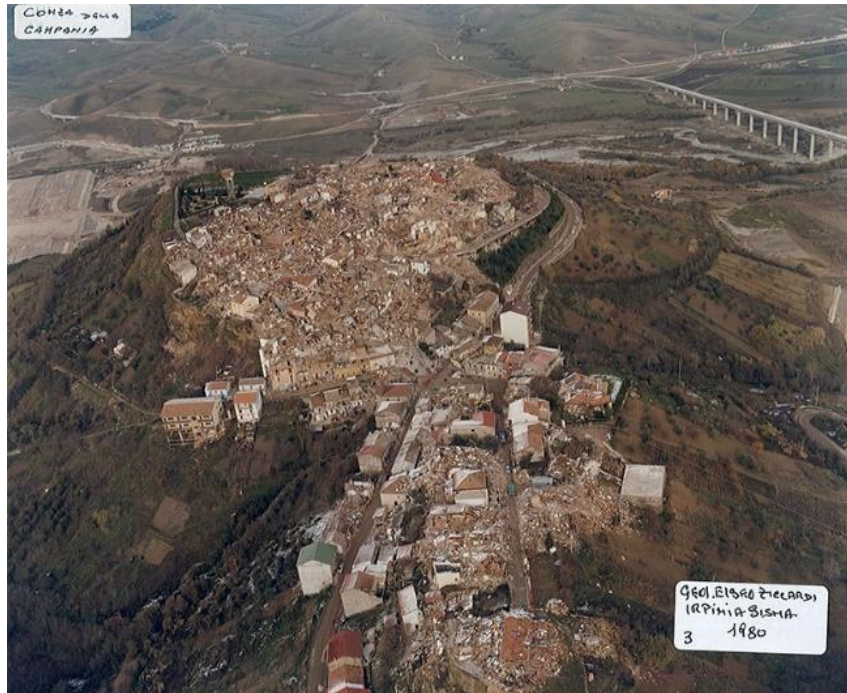
#### 4. Relocation

Even the choice of relocating new buildings to another site was a very complex process with the concurrence of many factors, among which the political pressure of the administrators certainly prevailed [4,40,42,59]. A better socio-economic development was forecasted, as can also be seen from the documents of the 1991 Senate Commission of Inquiry [4]. On the other hand, the geological and geotechnical characteristics of some of the involved villages, as well as their seismicity level, have in fact influenced the reconstruction in situ according to the investigations carried out by the technicians, playing an important role in the choice of reconstruction.

Three different cases of relocation are presented below: Conza della Campania, Romagnao al Monte and Bisaccia, towns with high seismic risk, currently classified in the first seismic category [60]. The town of Conza was characterised by almost total destruction of the built heritage, caused by (a) the type of building and the terraced position of the dwellings themselves, (b) morphological and geotechnical conditions of the subsoil on which it was built. For Romagnano al Monte, the predominant causes were the morphology of the ridge, which produced effects of damage amplification, together with geotechnical factors with declared uninhabitable of 446 residential units after the earthquake and a clear political will to relocate the town elsewhere. The delocalization of Bisaccia town, despite the lesser damage to the built heritage, was conditioned not only by high seismic risk, with the strong historical earthquake (1694, 1732, 1930 and 1980) that recurrently severely damaged it, but also to hydrogeological risk due to slope instability, well known even in the past, having been classified since 1917 among the towns eligible for consolidation, because it was affected by continuous and extensive landslide phenomena. Moreover, a very pronounced political will led to the use of public funding to carry out reconstruction elsewhere.

##### 4.1. Conza Della Campania

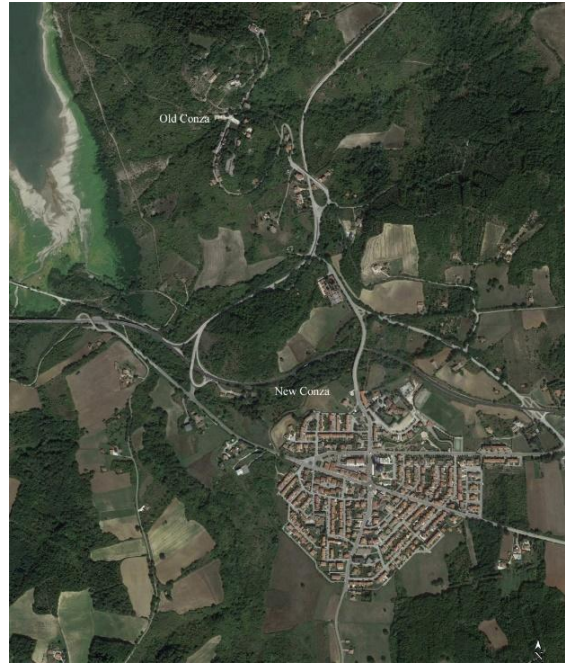
The small town of Conza della Campania (Avellino province), at a distance of a few kilometers from the macroseismic epicentre, suffered enormous damage assessable as I = X MCS [1] and VIII ESI-07 [5]. About 90% of the buildings collapsed and the remaining were seriously damaged, with 186 deaths (Figure 27).



**Figure 27.** Conza della Campania (Avellino province) Aerial photo taken immediately after the 1980 earthquake in which you can see the destruction of the village (Courtesy of Dr. E. Ziccardi).

The damages were conditioned by the poor construction quality, mostly houses without foundations, leaning against each other, and by the peculiar morphological conditions on which the town was built: two hills made up of alternations of extremely heterogeneous and poor soil made up of clay and sandy clays in the lower part, conglomerates with sand and sandstone in the central part, and conglomerates of medium-low resistance in the upper part, as highlighted by Guelfi in the report of the preliminary microzonation survey carried out for the PFG-CNR project [54,61,62].

In Conza, the 1980 earthquake also produced various effects on the environment such as modest-sized landslides, cracks and settlement of the ground. The problems connected to the possible geological effects of local amplification, identified by the technicians in charge of the subsequent seismic microzonations [6,53,60], together with the memory of the victims linked not only to the 1980 event but also to the old memory of the dramatic destruction suffered by the town after the historical earthquakes occurred in 1466, 1517, 1694, 1732 and 1930, led the community to choose a different site to rebuild the town. Two villages of Conza currently coexist: the village of the recent past with its ruins, recovered and enhanced through the creation of an archaeological park which also preserves the remains of the ancient Roman and pre-Roman “*Compsa*”, discovered just after the event of 1980 [26,40] and the new Conza, built in Piano delle Briglie, 4 km far from the original nucleus where the flat topography guarantees, according to the designers, safer conditions. The town of Conza Nuova, designed by Professor C. Beguinot of the University of Naples and completed with the variations carried out by Professor V. Bordini of the University of Rome with F. Dinelli (Figure 28), is a town with a modern layout characterized by earthquake-proof low-rise houses and wide streets with a central nucleus containing the cathedral. It is useful to underline that the new town, according to Beguinot’s architectural design, had to be connected to the old town with a series of connecting structures, in fact never built due to abandonment, the subsequent depopulation due to the emigration of residents for the lack of economic development of the area. Currently, the town is also a destination for environmental tourism linked to the naturalistic oasis of Conza, thanks to the presence of the artificial lake of the dam on the Ofanto River (Site of Community Importance SIC IT8040007)(Figure 29).



**Figure 28.** Map of the old and new village of Conza(Avellino province): the remains of the old Conza are located on two hills and on the left the artificial lake of Conza. On the lower right, the new Conza with its very regular architectural layout is visible-(Image from Google, 2024).



**Figure 29.** New Conza (Avellino province) panoramic view of the new town as it appears today. In the background on the right at the top of the hill the characteristic village of Cairano, and on the left the remains of old Conza (Photo by Porfido & Spiga, 2022).

#### 4.2. Romagnano al Monte

In the mountain range of Campania Apennines there is no town better than Romagnano al Monte (province of Salerno) and perhaps a few others, for example, Senerchia (Figure 30a,b), can transfer into today's reality the exact image of the urban cultural heritage of the inland towns before the 1980 earthquake [46,63].



**Figure 30.** Senerchia. (Avellino province) Remains of the original structure of the old village of Senerchia, which is currently being recovered, the new village was rebuilt not far away [48,49]. (a) The old village dwellings; (b) Detail of the old town.

In fact, this earthquake was the one that most left its mark on urban planning, following which, however, the town has not undergone any significant changes. Even for Romagnano al Monte, a small village in the province of Salerno with only 370 inhabitants, located at 650 m above sea level, on a spectacular limestone ridge, a few steps from the gorges of the Platano River and a few kilometers from the epicentral area, a political decision prevailed of moving to another area. The main reason was linked to the overall level of damage to the town characterized by the collapse of the churches, the serious damage to the town hall and above all by declared unusability of 446 housing units [7], reaching the I = VIII-IX MCS degree. The particular geomorphological and geological structure also contributed to the choice of relocation, in fact the position on the crest made worse the effects of the seismic shaking. Furthermore, along the slopes of the ridge, numerous rock fall phenomena were also frequent due to the high degree of fracturing of the rocky substrate. The little town was evacuated and abandoned, effectively becoming a “ghost town” [46,63,64], not without controversy due to the lack of recovery despite the large funding received, becoming a town that sometimes opens to tourists for some sporadic summer events (Figure 31).

The new town was rebuilt in the locality called Ariola, 2 km away from the historic centre, in a less spectacular position, but certainly with easier access for inhabitants and tourists. The new urban structure, also in this case, is mainly made up of anti-seismic houses, in reinforced concrete, without, however, a particular identifying design in the overall architectural system (Figures 31–33).



**Figure 31.** Romagnano al Monte (Salerno Province)—Panoramic view of the old village frozen at the time of the 1980 earthquake. The village was completely abandoned and rebuilt a few kilometres away, in a geologically less hazardous location [48,49].



**Figure 32.** The New Church of Romagnano al Monte (Salerno Province)—was rebuilt after the 1980 earthquake in the new village [48,49].



**Figure 33.** New and old Romagnano al Monte (Salerno province)—On the left is the new village of Romagnano, while on the right is the old small town located on a steep ridge (Image from Google, April 2024).

#### 4.3. Bisaccia

The relocation history of the municipality of Bisaccia is more complex and longer. The town, located at 860 m a.s.l., has always been affected by notable phenomena of hydrogeological instability, and has been hit by seismic events with epicenters in the surrounding areas, such as those that occurred in 1694, 1732, 1930 and finally in 1980 [23,48,49,64,65].

Without neglecting the authoritative intervention of politics (the mayor of Bisaccia in 1980 was a senator of the Italian Republic), it must be added that the geological and seismic conditions also influenced the decision to rebuild in another place. The 1980 earthquake, despite the limited damage to the housing stock ( $I = VIII$  MCS), once again highlighted the conditions of extreme instability of the external edges of the conglomerate slab, weakly cemented, resting on varicolored clays on which much of the historic center of the town is located. Such an unstable situation was ascertained and documented by numerous technical reports by several geologists and engineers, including those drawn up by academics from the University of Ancona and the University of Naples, the result of which was that a part of the town had to be relocated.

“A choice other than transferring part of the historic center of Bisaccia to another area means, in the opinion of the writers, postponing the serious problem of Bisaccia which has been dragging on for many decades to a later date. It would be illogical not to take into account the serious risks to which the population is subject, both from the point of view of landslides and seismicity, unless we want to wait for a catastrophe of the size of those that recently hit, for example, the towns of Conza, Lioni, Pescopagano etc. in the next few decades, closing definitively and tragically the topic. (U. Crescenti, T. Nanni, A. Praturlon, D. Tomassoni of the Institute of Applied Geology of Ancona 30/12/1980)”.

The municipal administrations therefore opted for the reconstruction of the town on another site, more stable from a geological point of view, called the “*Piano di Zona-Zone Plan*”, which had already been identified in a previous urban planning, following the 1930 earthquake [65–68]. In fact, there are currently two towns: Bisaccia Vecchia, an ancient village recovered around the ducal castle, and Bisaccia Nuova of the Area Plan, the latter almost completely rebuilt according to the urban plan drawn up by the architect Aldo Loris Rossi of the University of Naples [69], who was born in Bisaccia (Figure 34). A particular “*visionary*” architectural system [66–68] that brings us back to a utopian, futuristic city (Figure 35a,b), which has not received the unanimous consent of the population, but which is the clear, decisive testimony of post-disaster change (it could be compared to a modern Cerreto Sannita, destroyed by the earthquake of 1688 and rebuilt downstream with a regular architectural layout, still functional today due to its anti-seismic characteristics [70]).



**Figure 34.** New and old Bisaccia (Avellino Province): on the left, the new town centre of Bisaccia, with its regular architectural structure, designed by architect Aldo Loris Rossi, while on the right is visible the old town centre with an elongated layout towards the N to retrace the basic morphology on which it rests (Image from Google, April 2024).



(a)



(b)

**Figure 35.** New Bisaccia town (Avellino Province): examples of new reinforced concrete buildings designed by architect Aldo Loris Rossi (Photo Porfido & Spiga, 2022). (a) Bisaccia reconstruction; (b) Detail reconstruction of Bisaccia.

## 5. Final Remarks

In Italy, the earthquakes affect not only the number of victims but also the economic costs which weigh both on the economy of the affected territories and mainly on public finances. Destructive earthquakes, such as the 1980 Irpinia-Basilicata earthquake in particular, apart from damage to public, and private buildings and infrastructures, have made a strong impact on the social and economic fabric of the hit territories, with heavy and widespread negative economic consequences lasted for several decades [23,42,50]. By “*Reconstruction*” we do not mean only the phase which saw the rebuilding of houses collapsed or seriously damaged by the earthquake, but also the phase of social “*restoration*” we do not mean only the phase which saw the rebuilding of houses that collapsed or were seriously damaged by the earthquake, but also the phase of social “*restoration*” of the damaged towns and “*reconstitution*” of the communities that lived locally, through a process of resilience. After the dramatic condition generated by the earthquake, the involved communities managed to recover the sense of belonging to the places and to face the reconstruction, including the delays in obtaining public funding. The reconstruction process was punctuated by numerous laws concerning the distribution of public funds and their use, starting from Ordinance no. 80 of 6.1.1981, of the Extraordinary Commissioner of the Government, which allowed for the first restoration work on buildings that were not seriously damaged (expenditure had to be within 10,000,000 Italian lire). Subsequently, the Law no. 219 of 14.5.1981 was issued, which became the reference law for the entire reconstruction and support activity in the areas hit by the earthquake. The financing of the entire reconstruction process of the areas affected by the earthquake has been estimated in 2008 nominal values, equal to approximately 47.5 billion euros (Camera dei deputati-Chamber of Deputies, 2009 [4,40–43,57,65,71]).

In the reconstruction process after the 1980 Irpinia-Lucania earthquake, the policy of reconstruction at any cost has often prevailed, even with buildings unsuitable for the context of the internal Apennines areas, and often oversized compared to the real needs of the resident population, such as the example of some sports facilities (Figure 36), with considerable management costs (Castelnuovo di Conza, Caposele, Santomenna, Cassano Irpino etc), or the case of the *Area Plans-Piani di Zona* (Figure 37), built almost everywhere, with housing units not always used, or made often with incorrect forecasts of demographic expansion.



**Figure 36.** Castelnuovo di Conza (Salerno province): sports complex built after the 1980 earthquake [48,49].

One example among many is the Caposele swimming pool, built with funds made available by the municipality of Milan and completed in 1987, for which the evaluation team of the Guardia di Finanza (financial police) already highlighted in 1991 that “...for this plant there are very significant management costs (198 million lire per year), which constitute approximately 8% of the municipality's annual current expenses. Consequently, the municipality tried for about 3 months to manage the system directly, but considering the scarcity of users (30–40 frequencies per day with entrance ticket equal to 5000 lire per person) in 1988 it made free the facility to be managed by a local sports association which was also granted a contribution of approximately 30 million at the end of the year (upon presentation of the final balance sheet) to cover the constant liabilities that characterize the operation of the sports facility in question” (Commission Parliamentary inquiry 1991 [4]).

In Bisaccia, the houses of the IACP (Autonomous Institute for Social Housing) also constitute an example of an inappropriate intervention with respect to the real needs of the population, which, contrary to the most optimistic forecasts of demographic increase (13,000 inhabitants were expected in the post-earthquake decade) suffered a notable contraction, in fact from the 4781 inhabitants registered in 1981, they became 3811 in 2017. Originally, 83 IACP appartements were planned, subsequently reduced to 75, again based on the architectural layout of A. Loris Rossi. After various events linked to construction companies, a redevelopment and completion process has finally started for 18 homes, the rest of the homes have been demolished (Figure 37), not without a waste of public resources [40,42,43,72].



**Figure 37.** The social housing of Bisaccia.

From the brief overview contained in this study it was possible to highlight some common factors that characterized the process for reconstruction of these towns:

- (a) the reconstruction was very complex, articulated, different town by town, in the process of which, unfortunately, organized crime also intervened, not without consequences [4,42,43,69,71,73,74];
- (b) it lasted more than thirty years, a time definitely too long for the rebirth of communities. A time during which bureaucratic, administrative, political, economic, but also technical delays had a predominant role, with a strong impact on the social development of several communities;
- (c) despite the 40 years that have now passed since the earthquake, unfortunately, once again there is a lack of a real policy of socio-economic redevelopment of the entire territory which suffers, like the whole of Southern Italy, from high unemployment and depopulation, despite the establishment of some important factories, such as the famous confectionery factory Ferrero in Sant'Angelo dei Lombardi and Balvano (with the state contribution [42,73,74].

The overview depicted by us certainly cannot be considered exhaustive, there are in fact still many other realities, in addition to those mentioned, which have undergone notable transformations during the reconstruction process, but through some photographic images proposed, deliberately of the reconstruction and not of the damage, we want to guide the reader to glimpse the urban development of the villages, with a view to safeguarding the territory and cultural heritage. A final reflection brings us back to today's reality, how much and how this experience has taught us in dealing with the consequences of an earthquake: but the answer is not positive, just thinking of the earthquakes that hit central Italy in 2009, and in 2016-17, the failed or incomplete reconstruction course of the small Apennine centers. It is evident the absence, even today, of a real policy of prevention and protection of the historical-architectural heritage, of cities as well as of small centres, a "cultural heritage", is unique in the world, and still the lack of intervention for reducing the hydrogeological instability that characterize the entire country. The opportunity to improve the situation could be offered to us by the National Recovery Plan (PNRR), considered as a prevention policy for the protection of the territory. Everyone's and our hope is that this actually will happen!



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## Author Contributions

Conceptualization, S.P. and E.S.; methodology, S.P., G.A., R.N; software, R.N.; validation, G.G., E.S. and G.A.; formal analysis, R.N.; investigation, S.P.; resources, E.S.; data curation, S.P.; G.A; R.N.; writing—original draft preparation, S.P.; G.A.; R.N.; writing—review and editing, S.P.; G.A.; R.N.; visualization, E.S.; supervision, S.P.; G.G.; project administration, S.P.; All authors have read and agreed to the published version of the manuscript.

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