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Informal urban development in urban cities. Spatial assessment in the city of Batna, Algeria.

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Abstract. The development of the urban space of Algerian cities over the last thirty years has been characterized by an urban evolution that has been at odds with the various regulatory instruments of the state for shaping the urban space of cities, in particular, the land use plan (LUP), whose main objective was to guide, plan and control the urban development of urban space. However, the result today is the emergence of new fragmentary spaces that have informal forms and structures that break with the existing space. This type of informal trend is well-illustrated in the city of Batna and the region covered by land use plan No. 6. Therefore, the objective of this study is the evaluation of the urban development process of the area covered by the land use plan No. 06 by measuring the level of formality of that process from 2001 to 2018. The obtained results demonstrate that following the indicators selected, urban informality in the research region develops through time and space in a gradual and evolutionary form. The results obtained can be used as support for the development of a land use plan, if needed, but also for the implementation of a strategy to monitor the urban development of the city.

Keywords. Urban evolution; urban policy; spatial assessment; informality; land use plan; Batna.

1. Introduction

Over the last thirty years, the study of informality and its evolution at the level of urban space has occupied a prominent place in academic literature and scientific research [1], [2]. This interest has been reinforced by the fact that it is part of the vision of the Sustainable Development Project initiated by the United Nations Program to find durable solutions to the proliferation of informal settlements. According to recent estimates, 20% of the global population lives in informal settlements and/or cities, with the majority of this population concentrated in developing countries in Africa, South Asia, and Latin America [3], [4].

Thus, the development of informality was endemic and eventually reached the most developed countries, such as European countries [5], to establish itself as the main form of access to housing and urban spaces in many countries and cities around the world [6].

Informality has come to be considered as a formative embodiment of the North-South divide rather than an object of study and academic inquiry, and its definition has become even more ambiguous, inconsistent, and ideologically charged.

However, the renewal of the epistemological base initiated by contemporary urban studies has enlarged the perspective and understanding of the phenomenon. It has effectively contributed to reshaping and enriching the concept of informality, freeing it from the burden of geography [5], [8] formality [9], and the dichotomy between formal and informal [10]. Such as the occupation strategies, practices of the population, the power games, the resilience, and the conflict between the local political power and the local population [11].

Through these developments, urban informality emerges according to different tendencies and logics that unfold, formalize, and build according to different levels, forms, and structures, as the terminology allows.

This form of reorientation has made it possible to ask new, more relevant, and concrete questions regarding the contribution of scientific production to contemporary urban informality [12], [13]. In this sense, it is still necessary, even imperative, to conduct this research based on reliable quantitative data to guide urban action, also to enable the implementation of new, more inclusive urban policies that are better adapted to existing urban contexts, and adapt them to the situation of the different urban actors [2].

Like all developing countries, Algeria has since experienced rapid population growth, accompanied by a significant rural exodus, which has led to a very intense urban development at the spatial level. While in 1945 only 19.4% of the Algerian population was considered urban. The urbanization rate has increased from 22.2% in 1950 to 71.9% in 2020 and 83.5% in 2050 [14].

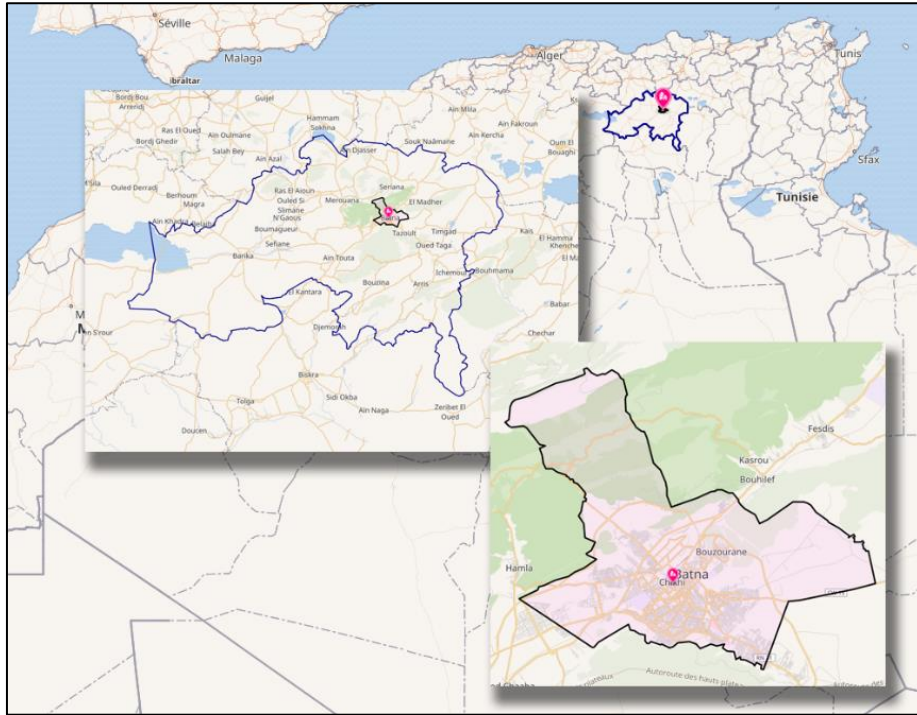
This urban development is characterized, in the case of Algeria, by the emergence of new fragmentary spaces, with forms and informal structures that break with the existing space[[15], [16]and by an uncontrolled urban sprawl from the pre-independence period to the present day [17]. In some cases, it replaces the regulatory measures of the state, implemented through the main instruments of action, orientation, and control of urban space, and reorients its urban policies and planning instruments [18].

2. The city of Batna, a contrasting urban development

2.1. Review of the situation

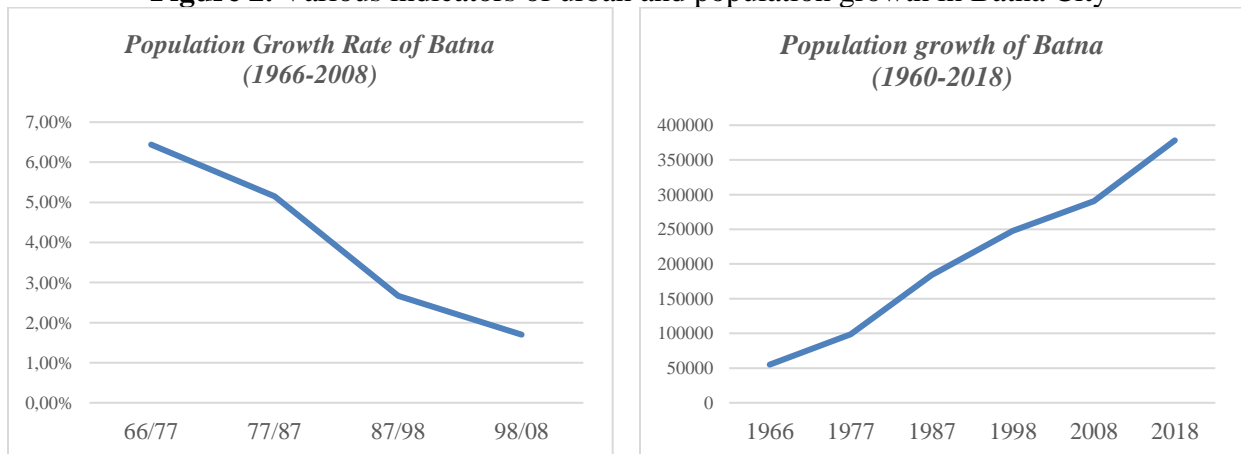
Batna is one of Algeria's most important cities, it is located in the country's east. Founded by the colonial government in 1848, after Algeria's independence, it went through significant urban dynamics, rising from 28th place in 1950 to 5th place in 2005 [19]. This dynamic has been articulated in different scales at the level of urban expansion. It increased from 483 hectares of urban area in 1972 to more than 2,880 hectares in 2018 [20] and at the level of very significant population growth, which increased from 55,017 inhabitants in 1966 to 378,136 inhabitants in 2018 [21], [22].

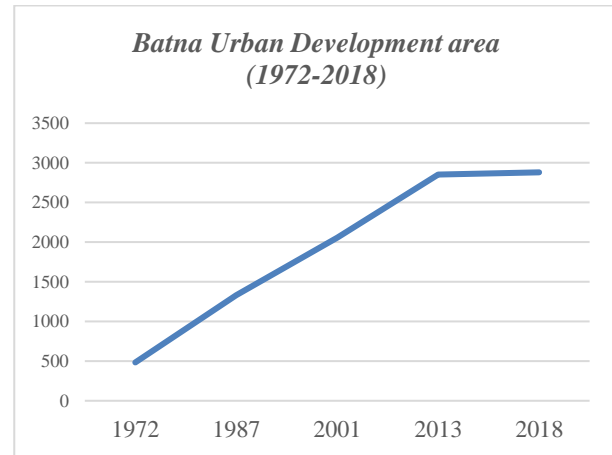
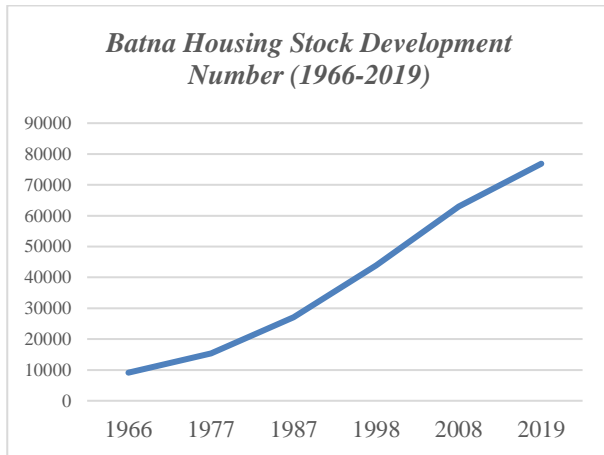
Figure 1. The city of Batna1



The city's housing stock has also increased significantly, from 27,082 housing units in 1987 to more than 76,862 in 2019 [21]. Even assuming that the Spatio-temporal development of the city of Batna is based on a diversification of land use between residential (individual, collective, and semi-collective) and facilities. There is a significant disparity between allocation and occupancy ratios areas and allocation, which, combined with the rapid population growth, can largely explain the urban saturation of the fabric of urban space of Batna city.

Figure 2. Various indicators of urban and population growth in Batna City



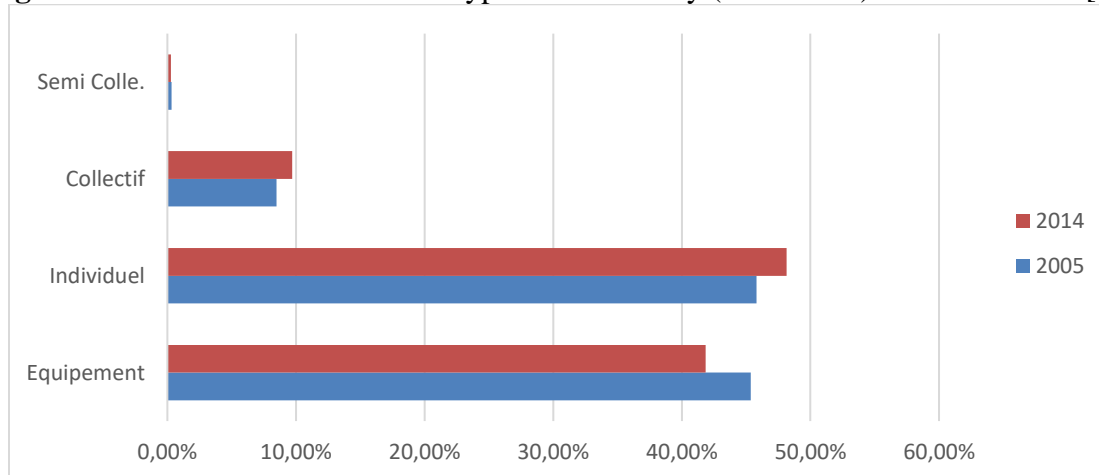


The data of the last census of 2008 show the predominance of the building type “individual residential buildings” compared to other existing typologies (collective and semi-collective). Thus, of the 46,433 structures with residential use, no less than 32,171 structures, i.e., more than 69%, can be considered “individual residential buildings” type.

Parallel to this form of dual development (between demography and the number of a building), the urban space of the city of Batna experienced an accelerated urban expansion of considerable scale in the period from 1972 to 2013, which led to the erosion of the mainland reserves and the saturation of the urban space of the city. According to Bendib's [23] analysis based on satellite images of the city of Batna from 2005 to 2014, the built-up area of the city has increased to almost 280 hectares, the latter mainly consisting of individual houses, whose area increased. Almost 63%. Bendib believes that this morphological typology occupies a much larger urban area, estimated at over 970 hectares or 48.15% of the total area, compared to his two other typologies, making it more economical are considered more suitable for urban conditions.

With the location of an industrial zone in the north of the city and the university and military camp in the southwest, we can see a preponderance of the equipment sector in the distribution of building typologies that define the urban space of the city of Batna. On the other hand, we observe a scattered arrangement of residential buildings articulated in the towers of the main mechanical axes that connect the city of Batna with neighboring cities.

Figure 3. Distribution of Land Use Types in Batna City (2005-2014) Source: Bendib [23]



2.2. *The informality of the urban space of Batna, a chronological evolution:*

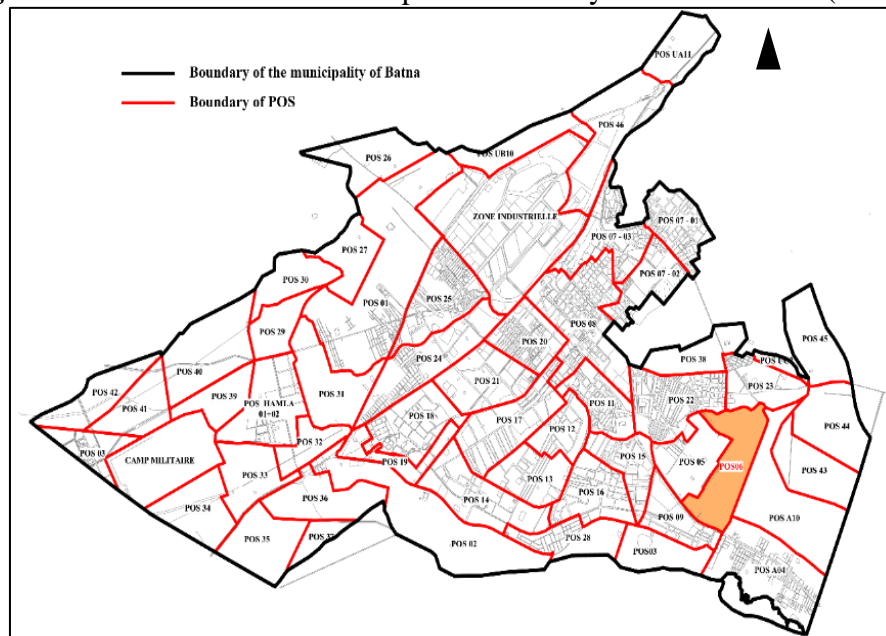
Throughout the development of the city of Batna, the urban space of the city has experienced a highly variable development dynamic, distributed mainly in two forms of typology. The first is the result of a planned production process, and the second is the result of an informal production process. For Belguidoum and Mouaziz [24], this form of duality existed in Algerian cities long before independence. In the case of the city of Batna, it is between 1923 and 1962 that the first neighborhoods, called informal neighborhoods, were gradually pushed to the outskirts of the planned city, which are the neighborhoods of “Z’MALA”, “BOUAKAL”, “KECHIDA” and “PARC À FOURRAGE” [25]. After independence and in the period between 1985 and 1990, other informal neighborhoods emerged on the main roads linking Batna city with other neighboring agglomerations, these are the “ROUTE DE TAZOULT” neighborhood (Batna / Tazoult axis), the “OULED BECHINA”, “HAMLA”, “BOUKHRIS” and “KARIET EL HOMOS” neighborhoods (distributed on the Batna/Merouana, Batna/Hamla axes) and finally the “ARAR” neighborhood (Batna/Constantine axis) [26].

In 2005, under the influence of the changes that have marked the urban development of the city and the informal character that characterized this development, the local authorities started to revise the Master Plan of Urban Development of the city of Batna, approved in 1998, integrating the six municipalities adjacent to the city of Batna, to solve the problem of saturation of the urban fabric of the city. However, the approval of the Master Plan of Urban Development is only approved by the ministerial authorities in 2012 and will not come into effect globally until 2018.

The Master Plan of Urban Development, in its new version, proposes to divide Batna town into 44 land use plan regulatory plans, with the need to revise 10 plans identified in the Master Plan of Urban Development 1998 SADP where there are significant discrepancies between what was prescribed by these instruments and what has been constructed on the ground.

2.3. *The study area*

Figure 4. Distribution of land use plans in the city of Batna PDAU (2012)



The classification established by the Master Plan of Urban Development, in its approved version of 1998, indicates that the area covered by land use plan No. 06 is an area of short-term urbanization. In this context, the relevant studies were launched at the end of 1999 and a local multidisciplinary planning office was commissioned to prepare them. After the elaboration of the different phases under the guidelines of Law 170-90, the land use plan received the approval of the local authorities and was implemented on 09.06.2001.

The area covered by land use plan No. 06 is an area with a total area of almost 42 hectares, including an area where existing buildings are grouped at the level of the land use plan with an area of 15.5%, which has not been included in this study. The various reports of the land use plan, in particular the inventory report, highlight the existence of buildings for individual residential use, which have been considered in the preparation of the land use plan, in particular about the development of the site, the rest of the land is described as empty ground.

Table 1. Consistency of the provisional program of land use plan 06 (2001)

Type of construction	Number	Area (hectare)	Ratio
Individual housing	335	7,67	25,2 %
Semi-collective housing	155	4,26	14,0 %
Collective housing	1.396	13,53	44,3 %
Green space	/	1,90	6,2 %
Accompanying equipment	10	3,14	10,3 %

The study land use plan No. 06 started with the implementation of a rich program (see Table 1) both in terms of diversification of building typologies for residential use (collective, semi-collective, individual) with more than 1880 dwellings, and in terms of a wide range of very different local facilities (planning of 10 local facilities). According to the data of the study land use plan, the study area could therefore contain a population estimated at more than 12,000 people in the long term [14, p [27, p. 428].

Figure 5. Planning projection of the land use plan area N° 06 (2001)



The terrain study of the land use plan points to two main constraints, namely the crossing of the medium voltage power line, whose right of way was estimated to be 18 m wide on either side of the line (36 m wide), and the presence of a drinking water line, whose right of way is 6 m wide on either side of the line. Apart from these two constraints, no other site constraints are found in the various documents of the land use plan.

3. Research methodology:

3.1. Research objective:

This study attempts to provide a model for analyzing the development process and evolution of the city's urban space, based on the evaluation of a set of quantitative indicators drawn from the main guidance and technical regulatory instruments of Algerian urban policy introduced by the promulgation of Law 29-90. These include the land use plan and the Urban Development Master Plan.

Based on a real inventory of an urban area under consideration (extracted from satellite imagery in this study) and taking the proposals for targeting the regulatory instruments as the main reference point, a comparative analysis is carried out to assess the level of correspondence between what exists at the urban level and what is prescribed by the same instruments. The study and analysis of the different data of the assessment model will therefore allow us to measure the level of deviation and/or conformity of the urban development of a given urban area, but above all to define the level of urban informality of the area in question.

In this way, this process can contribute in an effective, evolutionary, and adaptive way to the understanding of the characteristics of the development and change of the built environment of cities. In this way, it is possible to locate urban areas and their typologies very precisely, especially informal areas, which helps to facilitate the tasks and interventions of urban and institutional actors, especially in monitoring and controlling the process of building the urban space of the city. It allows, among other things, the adaptation of interventions to the different contexts reinforced, such as the operations of regulation, renovation, provision of funds, and implementation and/or upgrading of the various infrastructures necessary for improving the living conditions of the inhabitants of the city.

3.2. Data sources:

It should be noted that this study is part of a larger study currently underway, covering several areas of the urban space of the city of Batna (Algeria), which have been the subject of revision directives of the bodies responsible for the control and monitoring of the urban situation of the city, in particular, the "Popular Communal Assembly" and the "Directorate of Urban Planning, Architecture, and Construction". In this sense, we have chosen to present in this study the case of the land use plan No. 06, responsible for part of the sector "Parc-à-Fourrage" at the level of the city of Batna, for the period from 2001, the date of its approval and implementation, to 2018, the date of the beginning of its revision, which, for information, has not yet been approved to date.

Thus, the choice to present in our research, the case of the land use plan No. 06 is rejected according to several criteria, the most important of which are:

- A legal coverage of the study area, which was adopted from put into operation by authorities on 09/06/2001.
- The availability of quantifiable data about the area of our study, in particular, about:

- Data that we were able to extract from the execution file land use plan as approved and implemented in 2001.
- Primary data we were able to extract from the revision of land use plan No. 06 initiated in 2018.
- Survey data of planning permissions granted by local authorities.
- Data from satellite imagery covering the period and area of our study is accessible through the Google Earth platform (<https://earth.google.com>).

3.3. *The construction of the analysis model*

Given our interest, we have chosen to assess the development of land use in the area under consideration by contrasting and overlaying the real state of the urban area with the development proposals of the land use plan for the period and 2018. Our analysis model is thus based on the following evaluation criteria:

- The level of compliance with legal requirements, in particular the footprint, buildable area, and height of buildings.
- The level of compliance with the building typologies.
- The level of compliance with the building orders at the level of the study area.

4. **Data extraction:**

Based on the data we were able to extract from the 2018 satellite imagery and the baseline data established by reviewing the land use plan (2018), we compared and overlaid it with the regulatory and urban design projections established at the 2001 land use plan level. We were able to extract a range of data, the processing of which enabled us to identify the following elements:

4.1. *At the level of the exploitation of the islands and parcels of land:*

Table 2. State of urban activity at the level of the land use plan (2001-2018)

Number of land use plan Plots	Plots existing before 2001	Plots added between 2001-2018	Total Plots in Use in 2018
95	9	56	65
100%	9.5%	59.0%	68.5%

By compiling and examining the various data we collected on the area of our study, we were able to establish that the area of the land use plan has undergone significant changes that have led to substantial consumption of the area of urban space, between 2001 and 2018. As we can observe, of the 95 islands that make up the area of our study, only 9 islands were already in operation before 2001, which is 9.5% of the total islands. In 2018, this number has increased from 9 islands to 56 islands, representing a total use of almost 68.5% of all the islands that make up land use plans.

4.2. *In terms of the number of buildings*

As for the number of buildings, based on the 2001 and 2018 inventory (Google Earth), we were able to establish the existence of 671 structures, distributed according to the following typology:

Table 3. Range of Parcel Area Deviation

Type of buildings	Number
Pre-2001 building	60
building in 2018 (not in operation or progress)	120
building in 2018 (in operation)	491
Total	671

As for the number of buildings in our study, in addition to the 60 buildings identified before the implementation of the land use plan, we have been able to establish the existence of 611 new structures in the 2018 census by cross-referencing data from the primary revision study of the land use plan as well as through the analysis of satellite imagery, bringing the total number of structures to 671.

4.2.1. The state of the typology of buildings. As far as the typology of new buildings is concerned, we note a very interesting diversity, especially in terms of form and state of use. Thus, we observe the appearance of the typology of the collective model with a very minimal representation of 2.1% (18 blocks), while the individual building house model remains the most frequently addressed model with no less than 97.1% (593 blocks). Most noticeable is the absence of the semi-collective model, as well as the absence of public facilities, despite the many buildings used in the area.

4.2.2. The condition of the template. The analysis of the physical condition of the buildings, which we were able to identify clearly, shows us that the model of the gauge of the building that received the most responses is the gauge on the ground floor and in ground floor + one level with 27.5% and 33.2% respectively. The size form of the ground floor + two levels comes next with a rate of 13.7%, the blocks in buildings come in the third position with a rate of 10.8%, comes at the bottom of the ranking, the buildings in ground floor + three levels and ground floor + four levels with 4.7% and 3.3% respectively. Unused buildings remain at 17.5%, of which 10.5% are in the state of the foundation, 1.1% in the state of the platform, and 5.9% in the unfinished state of the ground floor.

4.2.3. The state of use. The state of use shows that the building process at the zonal level is an evolutionary process both in time and space, as the collected data clearly show. In this sense, we were able to establish the existence of at least 107 buildings that are under construction and/or being completed but have no effective use, while the rest of the buildings have been used, especially in the residential sector. It should be noted, however, that most of the buildings in use (97%) show signs of possible future extension and/or addition level, with structural elements not yet completed, especially on the last floor (presence of steel reinforcement for the extension).

4.3. At the level of the distribution of buildings

We note that at the level of the 2018 inventory (Map 2), the urbanization process initiated by the citizens has been spatially implemented at the level of the territory in a process that has a form of marked heterogeneity and irregularity compared to the proposed development projections and urban regulations elaborated in the land use plan, both in the form of buildings and in the

distribution (location) both at the level of islands, plots, and streets. Moreover, it appears that the actions carried out by the inhabitants were spatially defined in an irregular and informal way, which calls into question the viability of the urban rules indicated in the land use plan.

Figure 6. State of implementation of plots at the land use plan level (2018)



4.4. *At the level of building permits (building permits):*

The analysis of the data published by the technical services of the Municipal People's Assembly on construction permits shows that, given the irregularities of the provisions of the land use plan No. 06 identified by the residents, no permit was issued at the level of buildings until 2018, except for the eighteen collective blocks present at the level of the collective zone, and this after an exemption by the APC.

5. **The typology of informalities:**

The study of the urbanization process of the land use plan area shows that of the 611 housing units constructed between 2001 and 2018, more than 93.45% of the structures have at least one violation of the provisions of the land use plan, while almost 6.55% of these structures fully comply with the same provisions.

Moreover, the analysis of the results shows that the irregularities found are on a scale from total conformity to complete irregularity. In this sense, we have adopted a classification system for the levels of irregularities, which includes a classification of informality according to a rating scale based on three reference criteria:

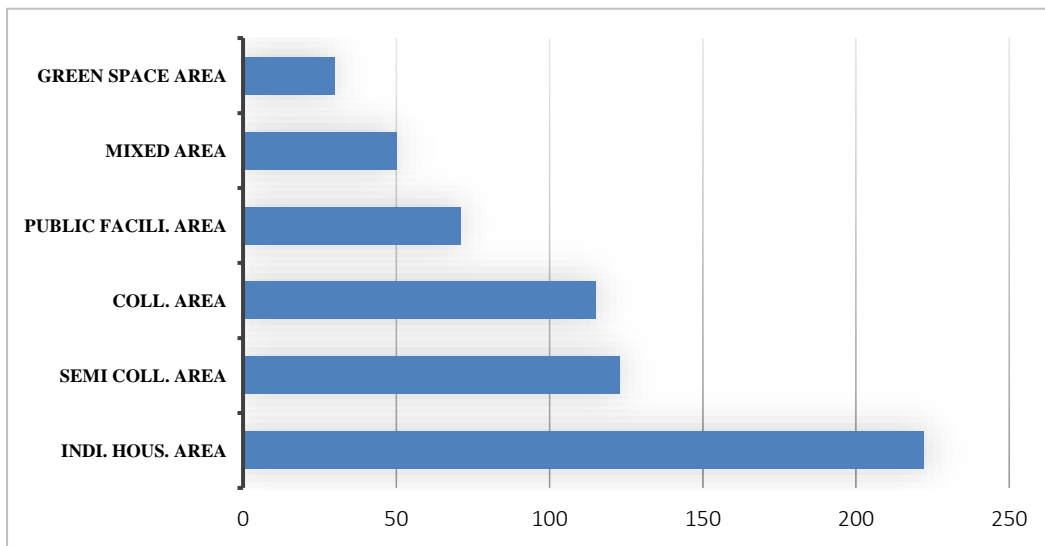
- The first level concerns the irregularities related to the type of zoning allocation; in this category, we are interested in the level of correspondence with the allocation of the building typology indicated on the website land use plan for each area of the territory in question.

- The second level: concerns the irregularities related to the encroachment on the public road, here we are interested in identifying the transgression related to the public road, ranging from total compliance with the road morphology to total blocking of the public road.
- The third level, irregularity, refers to the level of compliance with the typology of plot division proposed in the development plans, which is determined according to certain criteria such as compliance with plot morphology and plot area, etc.

5.1. *Informality related to zone assignment:*

Of the 611 existing buildings until 2018, we found that only 36.3% of the buildings comply with the guidelines of the land use plan, while the rest, i.e., 63.7% of the buildings, have irregularities. In this sense, we note that (123) of the buildings are located at the level of the areas reserved for semi-collective housing, (115) buildings are located at the level of the collective housing zone, while (71) other buildings are located at areas reserved for public facilities. (30) buildings are in green areas, mainly in areas where the medium voltage power line runs, and (50) buildings are in mixed areas (where at least two zones are combined).

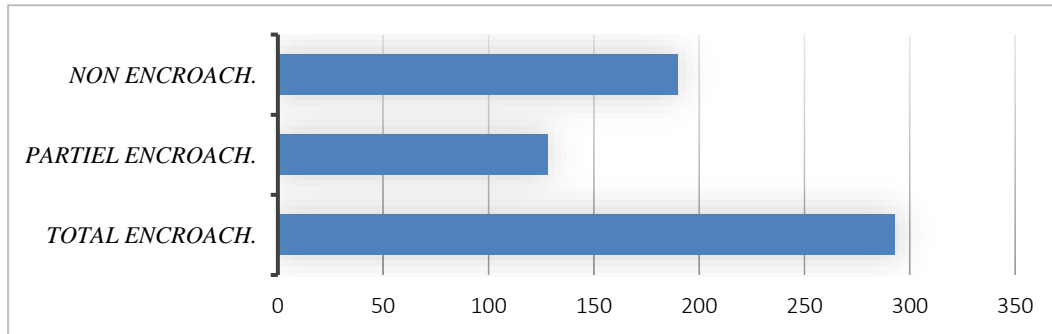
Figure 7. Distribution of irregularities about the 2001 land use plan areas of assignment



5.2. *Informality related to encroachment on public roads:*

Regarding the intrusion of buildings in public roads, we found that there are (421) buildings that have this form of violation. In this sense, we found that this type of violation is divided into two categories: the first category refers to the presence of structures that exceed the construction zones and intrude on the public road, which systematically leads to the blocking and/or closing of the lane to mechanical traffic; this category is represented by (293) structures. The second subcategory relates to the presence of an encroachment on the public road, but not resulting in the closure and/or blockage of the road; this subcategory is represented only by (128) structures.

Figure 8. State of offense encroachment on the public highway (2018)



5.3. *Informality related to subdivision and parcel area.* s indicated in the description of the urban planning orientations of the land use plan No. 06, the development of the study area was developed according to certain urban planning regulations for the harmonization of the development. In this sense, according to the typology of land use, a plot subdivision has been made, considering the area of the plot, its footprint, and its height. All these parameters are introduced by applying two criteria, namely the Coefficient of Land Use and the Coefficient of Land Area.

5.3.1. *The area of the plots.* In terms of areas and considering that the data collected a very wide variety in the areas of land built between 2001 and 2018, and this compared to the basic reference area of 150 m² adopted in the guidelines of land use plan for housing construction could determine. For this reason, for all the units identified, we have categorized the areas of the plots according to areas of deviation in intervals of $\pm 10\%$ from the reference area established in the land use plan, obtaining the following table.

Table 4. Range of deviation of parcel surfaces

Lower range	Range of deviation	Upper range	Total construction
56	$\pm [0 \sim 10\%]$	73	129
57	$\pm]10 \sim 20\%]$	107	164
82	$\pm]20 \sim 30\%]$	19	101
74	$\pm]30 \sim 40\%]$	35	109
56	$\pm]40 \sim 50\%]$	4	60
21	$\pm]50 \sim 60\%]$	4	25
3	$\pm]60 \sim 70\%]$	7	10
0	$\pm]70 \% \sim \infty [$	13	13
349	Full name	262	611

Based on the area ratios we determined, we found that most of the areas of the investigated plots showed very significant disparities in terms of area compared to the reference area. In that sense, a

certain balance can be seen in the building distribution of high-rise buildings (42.9%) and low-rise buildings (57.1%). However, only 21.1% of the buildings seem to comply with the guidelines of the land use plan, which at the same time raises the problem of compliance with the two basic indicators, namely the coefficient of land use and the coefficient of Land Area and coefficient of land area.

As we have already explained, to achieve a homogeneous urban form in the study area, two coefficients were applied: the coefficient of land area, which, as a reminder, is a reference indicator for determining the building area of a plot, was adjusted, in the land use plan No.9, to the coefficient of land area=0.6 to avoid a crowded and compact urban form. The coefficient of Land Area adjusted to 1.2, in the land use plan No.6, is applied to adjust the height gauge of the buildings (the number of floors) to the gauge of the road and obtain, among other things, a homogenization of the buildings, but even more, to ensure the sunshine of the interior spaces of the houses.

According to the results obtained in Table 1 and taking into account the data on the built-up area, we can already see that the application of the coefficient of the land area shows the existence of more or less great unsuitability for plots located at the level of the area " $]-30\%-\infty]$ " and whose number is estimated at almost 36% of the total number of units built, i.e., 49 units, highlighting the problem of the possibility of applying this type of coefficients in practice.

5.3.2. Compliance with the footprint coefficient. Apart from collective buildings, for which the land use plan provides for a prescribed height of grand floor + 4, buildings for residential purposes are limited by the coefficient of land area to a maximum authority of 2 levels (i.e. grand floor + 1 level). In this context, we found that of the 593 residential buildings surveyed, more than 19.4% of the buildings have a violation of the coefficient of land area, while more than 80.6% of the buildings appear to have positive compliance with this coefficient. However, as we have already mentioned, more than 97% of the buildings show signs of possible future expansion, which may significantly affect this indicator.

6. Measuring informality

Thus analyzed, the different results selected from the study of the various indicators allow us to note the presence of informality at the level of urban development of the area land use plan N° 6, and this is both spatially and temporally.

The cross-reference and compilation of the results of the analysis obtained through the measurement of the different indicators selected allowed us to make an initial inventory of the presence of informality at the level of the buildings at the level of the land use plan N° 6. However, the impact of this informality on collective urban action is not uniform, as the irregularities observed do not overlap at the level of the same buildings, so informality occurs at varying levels and at different levels.

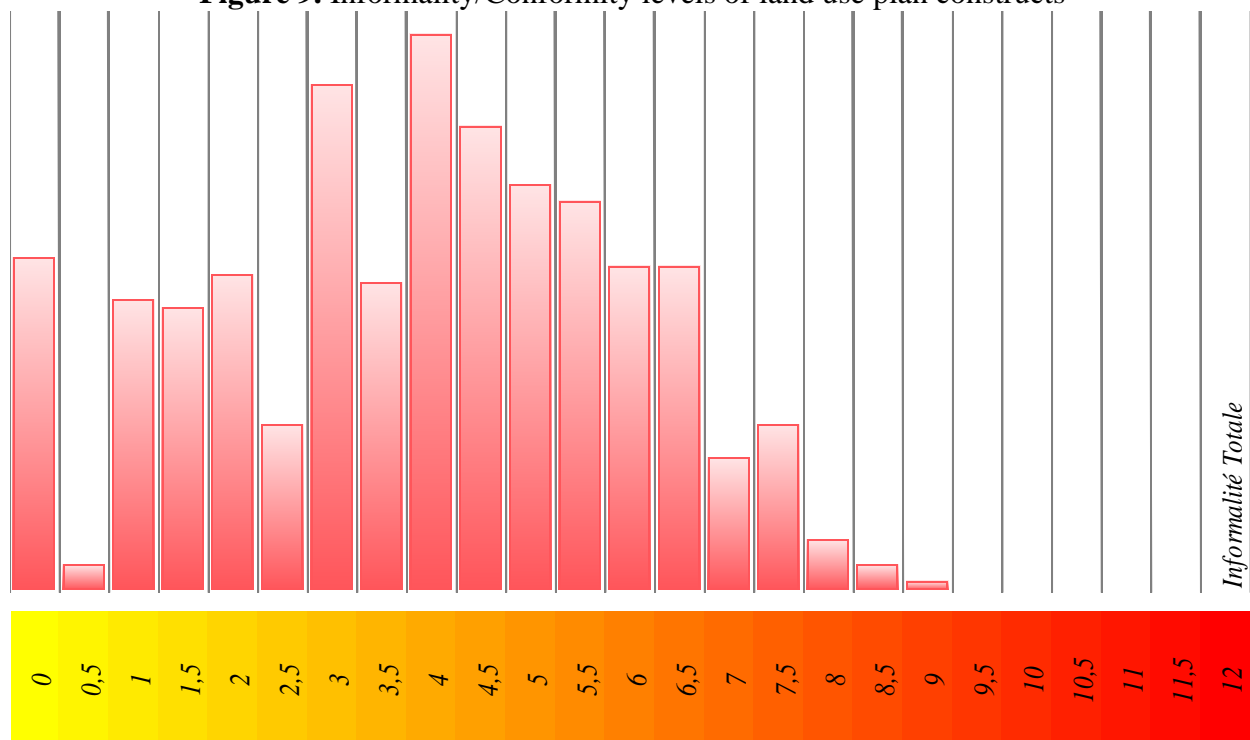
In light of this, we used an analytical model based on a scoring grid for each of the chosen indicators to determine the level of urban informality. In doing so, we used an adaptive technique that changed depending on how significant or severe the infraction revealed by our study was. Thus, the informality levels for each of the indicators (coefficient of Land Area, zoning allocation, lot area, and encroachment on public roads) were set according to a range of variation between 0 and 3, so that a value of 0 corresponds to positive compliance with the rules of the land use plan and a value of 3 represents the maximum informality level. This results in an overall informality value scale ranging from 0 to 12.

Applying the different value scales of informality to the selected indicators allowed us to determine the following results:

6.1. Levels of informality

According to various levels, starting on a scale between 0 and 9 on a total scale that is between 0 and 12, as illustrated in Figure 9, the analysis of the various data obtained substantially supports the existence of informality in the study area. In this regard, we note that there are at least 40 buildings that are distinguished by complete compliance with the regulatory provisions of the land use plan, even though the technical services did not issue any building permits for individual constructions between 2001 and 2018 for residential use.

Figure 9. Informality/Conformity levels of land use plan constructs



In another register, we can see that there are only a few buildings that exhibit extremely high levels of informality, which rapidly declines once this level is reached and evaluated at 4. We record 8.06% for the highest rates (between 7.5 and 9), while we record a representativeness rate of more than 43.08% for the categories of informality located between 4.5 and 7. It can be observed that the rate of representativeness is lower and sits at 32.40% for buildings with a lower rate of informality, which is between 4 and 2.5. For the category of building, which reports informality rates between 2 and 0.5, this rate declines to less than 19.26%.

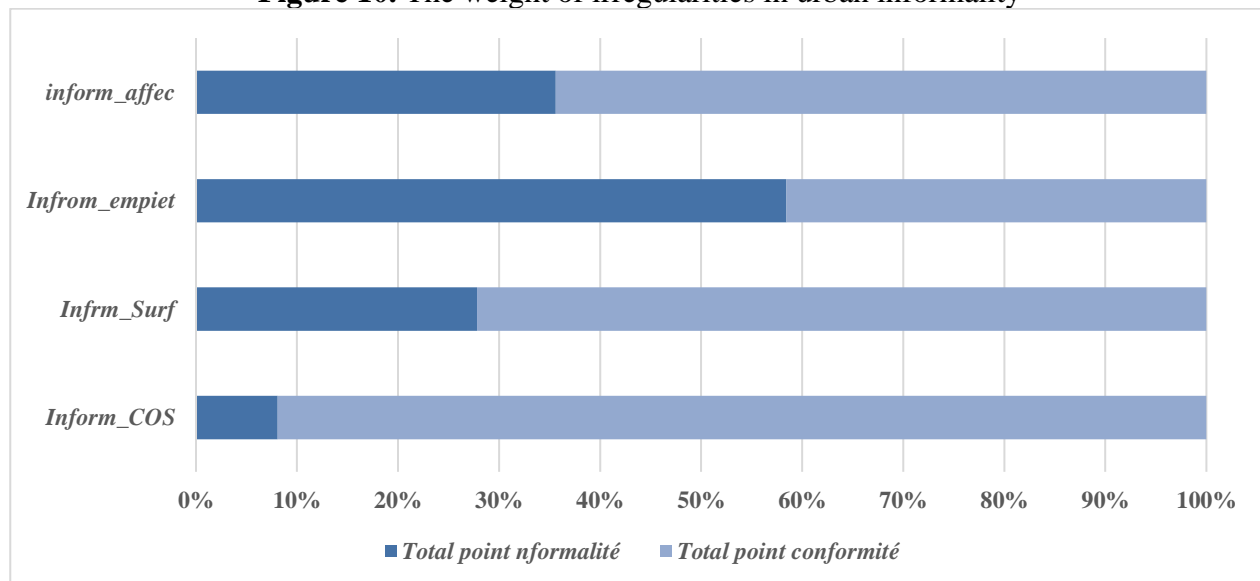
As a result, the majority of individual constructions performed without a building permit are unable to comply with the Land use plan orientation requirements. Accordingly, the Law 29/90 instrument is still a useful tool that, in the ideal scenario, can result in some form of regulatory compliance.

6.2. *The weight of irregularities in urban informality*

In terms of the weight of irregularities, we can conclude that the informalities highlighted in our study make it clear that regulatory irregularities are not similarly involved in the development of the urban informality level in the land use plan area No. 6. Moreover, we note that there is a very interesting variation in the participation of irregularities in each of the indicators in the phenomenon of informality in general.

In this context, we note that the indicator coefficient of Land Area, which refers to the level of non-compliance with the building dimensions imposed by the provisions of the land use plan, should be considered a low-impact indicator, as it represents only 2.02% of the urban informality of the land use plan No. 6 area. This is all truer if we consider that the coefficient of Land Area does not affect the urban morphology as a whole, except for the total height of the buildings.

Figure 10. The weight of irregularities in urban informality



As for the three remaining indicators, we note that the participation rate of the latter seems to increase significantly since they have a direct influence on the urban morphology of the land use plan area, especially the zoning indicator, which participates at a rate of 8.90%, and the public road encroachment indicator, which ranks first with 14.61%.

However, given the unfinished nature of the buildings present in the area of our study, it is necessary to address the evolutionary nature of these deployments, both in time and space, which can significantly alter the level of urban informality instantly. This is even more important considering that the rate of construction in the area appears to be very low relative to the total area, suggesting that the rate of informality over time needs to be evaluated about the evolution of the consumption of the urban space of the area.

7. **Conclusion:**

In this article, we have proposed a quantitative analytical model based on the assessment of the level of applicability of the main urban indicators to measure the level of the informality of buildings for an urban area that has a regulatory framework that governs the construction process (land use plan). In this sense, by collecting, combining, and analyzing data from different and

evolving sources, we were able to measure the level of urban informality in the area covered by the land use plan 6 at the Batna city level.

In this sense, we have found that more than 93% of the structures constructed at the land use plan zone level have at least one violation of the provisions of the urban regulations applicable to the area of our study. Furthermore, based on the indicators, we found that the different irregularities observed do not have the same weight and are not similarly involved in urban informality, so some irregularities may directly affect the actual functioning of the land use plan, while others do not.

Moreover, and even if it has been observed that the level of the informality of the buildings remains more or less important, it should be noted that the development of informal action has significantly challenged the planning and the planning orientation of the main regulatory tool provided by the Algerian urban legislation for the governance of the urban space of these cities, namely the land use plan, which has also led to the start of work on its revision in 2018.

According to this vision, our model for the analysis and evaluation of the urban construction process is proposed as a powerful tool that can be included and integrated into the monitoring and control process of both the applicability of the land use plan orientations and citizen actions. However, more extensive research is needed to cover a wider area so that comparative analyses can be carried out to give us insight into the causes of the occurrence of these irregularities.

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