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# Environmental Quality in Rural Dwellings: Case of Tébessa's Region

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#### Abstract

This research paper aims to find the main causesthat led to the creation of countryside dwellingsin the Region of Tébessa that are not reflecting an image of a houses build according to sustainability standards, unlike rural contemporary French countryside dwellings, the research was based on-site investigations: General and specific observations, assessments of building construction technics, design criteria, and architectural configuration, field visits, and interviews with various building actors, also bycomparing with some existing Frenchcountryside dwellingsand also through the comparison of the Algerian construction regulations with the French Environmental Regulations for New Buildings 2020, A critical interpretation was performed, and it has been discovered that the designing of the rural dwellings built in the region of Tébessa excluded the eco phase depending on the decree 15-19 which controls the modalities of obtaining a construction permit and the same time rule out the application of the regulations and policieson energy regulation, indoor environmental quality, and thermal guidelines which have already been released. The objectives of building's sustainability were overcome trough the eco-design concepts, the reduced impact on the surrounding environment and life quality of indoor spaces, The French legislator injected and confirmed the eco parameters directly through the environmental regulation of 2020 however in the Algerian case this step was not taken into consideration where the decree defining the construction permit did not call upon the existing environmental texts and regulations.

**Key words:** Rural houses – sustainability-- environmental quality –building regulations–eco design.

# INTRODUCTION

Building in the 21<sup>st</sup> century has never been like before where architectural and building designing nowadays introduced the environmental / ecological parameter as a centerpiece and fundamental component to the designing processto face the fallouts and consequences of pollution and global warming, this initiative was even included and imposed throughout legislative texts and laws in many countries, and it evolved with time.

Rural dwellings provide a nice example of exploiting the eco-concept, those houses should be planned and built-in accordance with eco building standards to meet the demands of their residents and provide them with a suitable place to live and have a low ecological impact on its environment in the same time.

The building design in France is subjected to laws and regulations, most importantly the environmental regulations, many policies were taken, starting with The Environmental Forum in 2007the thermal regulation in 2012, and the most recent one : The Environmental Regulations For New Buildings was published in 2020 which is a French guide explaining and detailing the environmentalsettings and sustainable development criteria which should be included and used in order to create ecofriendly and sustainable buildings.

For the Algerian case designing and building rural dwellings follows law texts and regulations in order to obtain a construction permit, with the presence of laws defining eco criteria to be taken into consideration (Largat, Farid et Chettah, 2022), however most of the resulting houses in the region of Tébessa from a preliminary sight do not reflect an image of a house build according to sustainability standards, they testify to some poor craftsmanship, the interior do not meet the technical, environmental, or sanitary criteria.

The previous discussion pushes us forward to ask the following questions: why rural dwellings in the region of Tébessa built within a legislative framework are made in such form?



Figure 1. Rural dwelling in countryside of Cheria, Region of Tébessa. Source : Author, 2021





**Figure 2.** Orientation of requirements for the different certifications, Source: International environmental certifications for the design and construction of non-residential buildings, France GBC 2015

The environmental quality of buildings is a management approach applied to the construction or rehabilitation of buildings, through an evaluation system that promotes sustainability approaches, there are various tools and regulations for diagnosis and environmental evaluation of buildings varying from a country to another following the regulations and standards set by

governmentswhere the labeling method is most common because it encourages interaction among various building actors. using both quantitative and qualitative information to provide an in-depth picture of a building's environmental performance.(Collectif\_d'auteurs 2012).

# **MATERIALS AND METHODS**

This study is a qualitative study, it aims to explain anoccurring phenomenon through the collected data (Claude 2020), in our case the collected findings include: Algerian regulations and laws, plans and written documents, field surveys, notes and discussions with different building actors; Since the gathered data cannot be quantitatively measured, it must be interpreted subjectively.

Given the growth and effectiveness of sustainable construction standards in France, comparative study examples were chosen to be used as a benchmark for comparison. A logical analysis of the information gathered from the locations visited as well as the content of the official texts been introduced and integrated in favor of the goals set by the regulations of the current trend of sustainability, in order to compare the case of Tébessa's Region using references to a French experience; Participants in this research included the key players and actors in the building phase of rural dwellings:

#### Dwelling's occupants

Engineers from the technical department handlingrural dwelling's building permits.

Engineers and attorneys from both housing and environmental departments.

## Environmental Regulations for New Buildings (Re2020) in France

It is a French regulation published in 2020 which pursues objectives of improving the environmental quality of new buildings: reducing their impact on the climate(taking into account greenhouse gas emissions over the course of a building's lifetime) and their adaptation to environmental conditions such as future climatic conditions (reinforcement of summer comfort); Thus, it will lead to an improvement in the bioclimatic design of buildings, strengthening the performance of the building envelope promoting the use of renewable and low-carbon energies and materials with a low carbon footprint, in particular those which store carbon.(Nicolas 2020).

Energy	<b>Bbio</b> [points]	<b>Bioclimatic needs</b>	Assessment of <b>heating</b> and <b>cooling needs</b> (whether the building is air-conditioned or not) and <b>lighting</b> .
	Cep [kWhep/(m².an)]	Total primary energy consumption	Evaluation of renewable and non-renewable energy consumption for the 5 RT 2012 uses: heating, cooling, domestic hot water, lighting, ventilation and auxiliaries + 1. lighting and/or ventilation of car parks 2. lighting of collective circulations 3. Elevators and/or escalators
	<b>Cep,nr</b> [kWhep/(m².an)]	Non-renewable primary energy consumption	
Carbon	<b>Ic<sup>énergie</sup></b> [kg eq. CO <sup>2</sup> /m <sup>2</sup> ]	Impact on climate change associated with primary energy consumption	Introduction of the life cycle analysis method for the evaluation of greenhouse gas emissions from the energies consumed during the operation of the building, i.e. 50 years.
	Ic <sup>constrution</sup> [kg eq. CO <sup>2</sup> /m <sup>2</sup> ]	Impact on climate change associated with "components" + "construction site"	Generalization of the life cycle analysis method for the assessment of greenhouse gas emissions from construction products and equipment and their implementation: the impact of "Components" and "Construction site" contributions.
Summer Comfort	<b>DH</b> [°C.h]	Degree-hour of discomfort: level of discomfort perceived by the occupants throughout the hot season	Evaluation of the differences between building temperature and comfort temperature (temperature adapted according to the temperatures of the previous days, it varies between 26 and 28°C).

**Figure 3**. Indicators meeting the minimum requirements of RE 2020. Source :Réglementation Environnementale Des Bâtiments Neufs (Re2020), Ministère de la Transition écologique, 2020

## **Regulations in Algeria**

Possession of the building permit is required for any new construction or transformation, including changing the form, size, façadeor use, the structure, and various networks and grids crossing the property, this permit is an affirmative answer to an architectural and engineering file consisting of graphic (Floor plans, sections, elevations, structural detailing, perspectives...) and also Paperwork (applicationsforms, descriptive reports, bill of quantities etc...)The Executive Decree 15-19 of January 25 2015 establishing processes for the supervision and issuing of town planning acts, is a reform of the Executive Decree 85-211 of August 13 1985, the content is almost the same, with minor changes considering applications forms, both decrees give major importance and require the presence of the deed of ownership, respect for the surface of the land, as well as the town planning regulations concerning the built percentage of the plot, the height of the construction and the number of floors built while the eco component was not mentioned in both decrees.

However various laws and decrees with regard to the environmental aspect of buildings and energy use exists in the Algerian legislation, the following table provides a summary:

Law No. 99-09 of July 28, 1999 about energy management

Concepts, generalizations, and determinations of approaches: Energy control implementation process and stages; regulations criteria and recommendations for thermal insulation and energy efficiency of new facilities and home furnishings (vague and nonspecific articles missing in precision); assessment and supervision of energy efficiency, the governmental initiative to raise public awareness about energy saving and to provide financing, incentives, and penalties.

Executive decree No. 2000-90 of April 24, 2000 on the thermal guidelines for new construction.

Identifying the buildings affected by this text; establishing rules and standards for the use of heating systems, air renewal, thermal insulation, heat loss and indoor air conditioning systems.

Law No. 04-09 of August 14, 2004 regarding the support of renewable energy sources within the context of sustainability.

Concepts refinement and definition, references, and content development of the Methods of Deployment and Concretization of the Development of Renewable Energies.

Executive Decree No. 05-495 of December 26, 2005 corresponding to energy audits of facilities with high energy consumption.

Concepts and classifications of the approaches, techniques, and circumstances under which the energy audit will be conducted, large consumer establishments' requirements for energy audits and their surveillance and assessment.

Figure 4. Algerian laws and decrees corresponding to building and environmental regulations. Author: 2022

# **Study Cases**

The Investigated dwellings exists in the region of Tébessa which is located in the east of Algeria near the Tunisian borders, the region is known mainly for its historical landmarks and richness with agricultural and especially pastoral nature of its rural sectors and countryside's the picked dwellings are located within the countryside of two municipalities: Ain Zerga and Cheria, known by their specific climate (highlands): cold and dry in winter and hot in summer, the sites of both cases are similar: clear and open far from other houses in a fully natural environment with no urban structures.



Figure 5. The geographic location of Tébessa region. Source: Google Earth 2023

## **Rural Dwelling of Cheria's Countryside**

It's a one-bedroomunfinished house with a cubic form the structure is made of reinforced concrete with a hollow body slab as a cover, the walls are made of cement blocs and some are made with hollow bricks, The walls from the exterior are not coated at all, and from the interior they are covered only cement coating while the floor is covered with paving slab, both restroom and the kitchen are uncompleted.



Figure 6. Aerial view of the visited rural dwelling in Cheria's Countryside. Source: Google Earth 2023



Figure 7. Exterior view of the visited rural dwelling in Cheria's Countryside. Source: Author 2021

Through the interview with the owner, we proceeded the following findings: the financial aid from the housing fund did not help much because of the high cost of labor and transportation of building materials to the isolated construction site, and in order the be able to finish most of the construction phases the owner made it only a one-bedroom house which did not satisfy his needs in terms of indoor spaces for his family of four.



Figure 8. Floor plan and surface chart of visited rural dwelling in Cheria's Countryside. Source: Author 2021

For indoor installations and various networks, electricity exists in both sites however heating in winter could be a real issue because of the absence of city gas where the house is fully exposed to the outside with 4 façades alongside with the roof which makes heating it a real problem, septic tanks are used to ditch sewage and waste water; Reaching out to the designing architect and housing department engineer both confirmed that the house was built according to the construction permit regulations where the eco concepts have not been introduced.



Figure 9. Indoor picutres of the visited rural dwelling in Cheria's Countryside. Source: Author 2021

# Rural Dwelling of Ain Zarga's Countryside

This dwelling istwo-bedroom unfinished house with a cubic form same as the previous one the structure is made of reinforced concrete with a hollow body slab as a cover, the walls are made of cement blocks, The walls from the exterior are not coated with paint coating and a layer of acrylic paint, while the floor is covered with floor tiles and the kitchen isunfinished and it lacks arrangements.



Figure 10. Exterior view of the visited rural dwelling in Cheria's Countryside. Source: Author 2021.



Figure 11. Aerial view of the visited rural dwelling in Ain Zarga's Countryside. Source: Google Earth 2023.

After interviewing the owner, we moved forward to the following findings: high cost of construction fees and building materials transportation delayed the finalization of the project, and because of that the owner could not use high end materials and contemporary interior installations to obtain a comfortable home, were the cold weather in winter, the exposed house to weathering and the absence of city gas; sewage and waste water are evacuated directly on site due to the absence of sewage network and the non-fulfillment of the spetik tank, Same as the previous example, both designing architect and housing department engineer confirmed that the house was designed and built according to regulations, while the eco concepts have not been.



Figure 12. Indoor picutres of the visited rural dwelling in Ain Zarga's Countryside. Source: Author 2021



Figure 13. Floor plan and surface chart of visited rural dwelling in Ain Zarga's Countryside. Source: Author 2021

#### **Cordwood House in Beruges (86)**

This house is an ecofriendly construction in perfect harmony with its surrounding environment throughout its design, construction materials, the eco-concepts used, the respect to the French environmental regulations and its energy efficiency.(Arnault 2005)



Figure 14. Floor plan and exterior view of Cordwood house, Source: L'architectureEcologique, LEROY Arnault, 2005.

The house was built respecting eco critera starting with the Bioclimaticconcept:South-facing house with large bay windows, roof overhang to protect from the summer sun. Buffer spaces formed to the west (dominant winds) by the garage and a hedge, and for the structure and building materials there is a concrete slab on top of a sanitary void, high end wooden structure,exterior walls are made of local wood, placed across, assembled by a mixture of sand, natural lime, cement and sawdust, the interior wall in raw earth brick (taken on site) and terracotta tiles giving the house good thermal inertia in order to store the energy provided by the sun; and for the energy a solar panel is placed facing the south side covering  $15m^2$ , a water tank is placed a holding 1000 l for 2 days usage with and solar heating system holding 170 l, there is also a system for rainwater recovery and purification of wastewater.



Figure 15. Various details of construction materials of the Cordwood house, Source: L'architectureEcologique, LEROY Arnault, 2005.

# **RESULTS AND DISCUSSION**

#### **Environmental Quality and Regulations**

Sustainability has been the dominant paradigm in the planet for the past 30 years for a variety of reasons especially energy usage, pollution control, and natural resource management, architects, from the other side, have embraced this notion and built numerous eco-friendly constructions and designs; therefor to integrate a building within the context of sustainability, it must respond properly to numerous criteria focusing on the performance and effectiveness in designs and executionby examining the user's requirements and the way they will changethrough time and also take socio-cultural scales into considerationand encourage the use of pragmatic and sustainable solutionthrough the process, as well as promoting the public health and economy by practicing prudent and rational management over time.

Sustainability in the buildings design and construction involves extremely open communication with stakeholders since it is based on the life cycle analyses approaches, carbon footprint methodologies, and consideration of the project's combined short- and medium-term implications, and it makes the best possible adjustments for variables like energy and transportation (public transport, solar advantages, the presence of heating infrastructure, etc.), which might have an impact on site choosing and upcoming projects localizations. and in order to achieve these goals and stay within sustainable development objectives, evaluation tools, assessment procedures, and certificating methods were developed across the world, were the French government fused summarized and structured these steps by creating the Environmental Regulations for New Buildings (Re2020) which is the 1<sup>st</sup> ever energetic and environmentalregulationcomplementary to the construction permit regulation. (Nicolas 2020)



**Figure 16.** Included and excluded elements bye the Re2020 on the construction permit premises. Source : Réglementation Environnementale Des Bâtiments Neufs (Re2020), Ministère de la Transition écologique, 2020

Furthermore The Algerian government did not outline the sustainability goals nor the eco-design requirements, the regulation setting the guidelines and specification to obtain building permits are put under the Executive Decree 15-19 of January 25 2015 establishing processes for the supervision and issuing of town planning act which only deals and clarifies the needed plans, sections and details, applications forms, reports and paperwork... and even though laws and decrees concerning construction and building with environmental and sustainable criteria exists in theory ( Law No. 99-09 of July 28, 1999 about energy management, Executive decree No. 2000-90 of April 24, 2000 on the thermal guidelines for new construction, Law No. 04-09 of August 14, 2004 regarding the support of renewable energy sources within the context of sustainability , Executive Decree No. 05-495 of December 26, 2005 corresponding to energy audits of facilities with high energy consumption) we cannot find a link between the building permit decree and these regulations, in practice where architects, designers and administration's engineer and supervisors dismissed the environmental quality of buildings and the eco component because their main objective is building houses in order to meet housing demand on the countryside where they should've given the aspirations of sustainable development and ecological construction an importance given the sensitivity of the rural sites and the importance of eco-building standards.

# **Countryside Dwellings and their Environmental Qualities**

A rural home is both a physical and a social entity inhabited and exploited by rural communities' and countryside occupants, which are distinctive for their own qualities, customs, habits, and practices. These factors contributed to the development of several rural settlement types found all over the world, each of which shows distinct characteristic, features and patterns; therefor in order to keep the rural population deeply invested in their communities and prevent overcrowding in the cities, modern rural homes should provide the same feeling of convenience and technology as urban homes. They should also be harmoniously merged into their surroundings so as to help maintain the rural landscape while meeting sustainability objectives and environmental quality targets.

In France rural dwellings took a new form, a fully upgraded version of the traditional rural houses, where the designers integrated eco concepts and provided contemporary accommodation to the inhabitants in terms of indoor and outdoor quality of life, the designs were made according to various eco building regulations which evolved through time.



Figure 17. High end rural dwellings from the French countryside. Source :L'architecture Ecologique, LEROY Arnault, 2005.

Thesehouses should adapt to several characteristics in order to accomplish sustainability goals and due to the delicate characteristics of the natural sites these homes are placed in, their creation should not negatively influence the biodiversity and preserve the surrounding ecosystemwhile their daily usage must have the least negative environmental impact; To maintain a low carbon footprint project and a sustainable project, the selection of construction materials, techniques, and procedures should promote the use of recyclable resources found on site and reduce transportation throughout construction phase; The management of the dwellings and their use over time should be sustainable and thrifty: the use of green passive renewable energy with a rational water usage with some effective waste-water management and natural resource recycling policies are preferable with the employment of the best available technologies available such as Canadian wells for ventilation and air conditioning, rain water catchment techniques, Solar, wind power and geothermal sources for power supply and wastewater settling treatments to reduce the impact of sewage water on the environment.

The various indoor spaces have to be comfortable on a variety of levels, beginning with hygrothermal, acoustic visual comfort, and olfactory comfort, and last but not least the indoor spaces should meet high standards for hygienic conditions, particularly in terms of the water and air quality.



Figure 18. Various techniques and construction details and materials used for rural dwellings in the French countryside Source :L'architectureEcologique, LEROY Arnault, 2005.

In Algeria, Rural housing nowadays took a new design not similar to the traditional vernacular designs of the various regions, not similar by spatial design nor by the building materials or the construction techniques, concrete cubic houses of approximatively 100 m<sup>2</sup>, 2-bedroom house with a living room, distribution hall or corridor and a bathroom, these houses are supposed to host 5 person familiesand satisfy their needs in terms of required spaces and comforts on different levels. In Algeria rural dwellings should provide modern, pleasant homes with all the conveniences of modern lifewith a harmonious connection with its surroundings environment otherwise it should keep the traditional aspect of the rural dwellings and update it to keep the site integration and the local architectural identity.



Figure 19. Contemporary rural dwelling in the region of Tébessa. Source: Author 2022



Figure 20. Vernacular rural dwelling in the region of Tébessa. Source: Author 2021

We evaluated two distinct dwellings in two different municipalities using on site discoveries and interviews with technical departments engineers and other city actors, architects and residents where we found that the dwellings made are not built according to environmental quality standards and building eco-criteria, the operation was led by the construction permit regulation which neglected sustainability standards.

The visiteddwellingsare almost identical and equivalent with minorreadjustmentsin terms of:

**Size, form and bulk of construction**: Withalmost similar size and shape they are parallelepipedal with an area of varying around  $100 \text{ m}^2$  and a height of 3 m.

Space	Cheria Dwelling	Ain Zarga dwelling
Living room	25,80 m <sup>2</sup>	16,00 m <sup>2</sup>
Kitchen	9,05 m <sup>2</sup>	9,05 m <sup>2</sup>
Hall or corridor	15,00 m <sup>2</sup>	21,15 m <sup>2</sup>
Bathroom	3,60 m <sup>2</sup>	$4,10 \text{ m}^2$
WC	1,65 m <sup>2</sup>	$1,80 \text{ m}^2$
Porch	8,90 m <sup>2</sup>	8,90 m <sup>2</sup>
Bedroom 01	11,90 m <sup>2</sup>	10,90 m <sup>2</sup>
Bedroom 02	-	9,70 m <sup>2</sup>

**Indoor spaces**: The houses are composed of the following spaces:

Figure 21. Indoor spaces and their areas of the visited rural dwellings. Source: Author 2021

The indoor spaces don't meet the needs of families in term of area and quantity, rural families typically consist of five people or more; bedrooms are not sufficient, and the spaces are too small to offer sufficient intimacy where intimacy is a crucial component of rural authenticity.

**Construction technology and materials**: The dwellings are made using the same method: reinforced concrete insulated footings, reinforced concrete columns of 30 by 30cm with, beams and chaining are also made with reinforced concretecarrying a hollow body slab; The outer walls are made from two layers of 30 cm thick cinderblocks that are 5 cm apart, The indoor spaces are divided by a straightforward 15 cm thick wall of cinderblocks coated with cement plaster and some are coated also with paint coating and acrylic paint, And for the flooring floor tiles are used, The environmental quality and sustainability objectives were not served by any of the construction materials indicated because they are all industrial products, not recyclable, a set of the s



Figure 22. Exposed building materials used in rural dwellings in Tebessa's region. Source : Author 2021



Figure 23. Exposed building materials used in rural dwellings in Tebessa's region. Source : Author 2021



Figure 24. Use of propane gas cylinder in cookin and heating water, Source: Author 2021

**Energy sources and interior equipment and installations**: The public grid provides energy to residents who use it for domestic appliances, lights, and air conditioning, the users depend on butane gas cylinders to supply their kitchens and heaters, given the nature of the residences and their natural surroundings, it was recommended to choose renewable energies like solar and wind energy for sustainability purposes, the wastewater management system isarchaic; there are no recycling procedures nor wastewater grids, so users must simply discharge their waste into the surrounding environment.



Figure 25. Use electricity from the public power grid, Source: Author 2021

# CONCLUSION

Environmental assessment methods and regulations action makes an excellent tool for evaluating the environmental quality and sustainability of the building where the French legislators have introduced this step in the design phases of buildings through the Environmental Regulations for New Buildings (Re2020) which aims to improve the environmental quality buildings, enhance the quality of life and reduce their impact on the natural environment, Environmental regulations been imposed because of their important role which works in favor of challenges and aspirations of sustainability which will enhance the performance of buildings' envelopes and improve their bioclimatic design, boost the use of low-carbon, renewable energy sources and materials, particularly those that store carbon(Nicolas 2020).

The law No. 99-09, the executive decree No. 2000-90, the law No. 04-09, and the executive decree No. 05-495 in terms of guidelines for energy promotion and efficiency;eco design performance and theendorsement of sanitary conditions and indoorquality of life are just a few of the laws the Algerian legislature has passed in response to the challenges of sustainable development; however the introduction of these regulations in the study, design, and construction phases-contrary to French case was not been made properly because of the building permit regulation which exclude the eco regulations indirectly from the designing and approval phases.

Because of the regulations that are unconnected where some exclude others, The lack of the eco awareness among the various actos and stakeholders (designers, housing department's engineers and inhabitants) rural dwellings developed under the building permit regulations in Tébessa's region suffer from a lack of environmental quality because they were never created using solid eco-based approaches, they appear to be foreign to their surroundings, unintegrated with the natural environment, and fall short of the aims and goals of sustainability and environmental quality of buildings. Therefore, the right initiative was to set a solid link between permit construction regulation and the regulations that have already been published in terms of energy management, indoor environmental quality, thermal guidelines and renewable energy sources management or to simply create a new regulation which fuses all the previously mentioned parameters in order to be able to fully control the design and approval of sustainable and environmentally efficient buildings.

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