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Research Paper

Eco-Entrepreneurship Based On Hemp Concrete: What Challenges In Morocco?

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SUMMARY: *Building with a reduced ecological footprint has become a hot topic in the environmental and economic debate in academia as well as in industry. This is due to Morocco's heavy energy bill as well as to the great potential of the building sector to reduce energy consumption, decrease environmental impacts.*
This article aims at analyzing the institutional challenges facing the integration and diffusion of green solutions and eco-entrepreneurial initiatives in the building sector in Morocco.
The concepts of environmental innovation and eco-entrepreneurship are taken as a conceptual framework for our analysis. We present a case study of the integration of green technical solutions: it concerns the use of a biosourced material and an innovative system for the construction and the energy production.
The results show that these alternative solutions allow for the reduction of the carbon impact on the environment and encourage the development of local population. However several barriers can hamper the generalization of these solutions in Morocco even with the existence of a fairly developed regulatory and legislative framework.
KEYWORDS: *Green solutions, Eco-entrepreneurship – Building materials – Morocco - Institutional challenges.*

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I. INTRODUCTION

Even though it contributes to the economic growth by 1 million jobs and almost 7% of the GDP (HCP, 2018), construction in Morocco remains an industry with strong negative externalities and is responsible for around 25% of greenhouse gas emissions. Indeed, it is an energy-intensive sector throughout the whole value chain: from extraction, to demolition, passing by construction, operation, maintenance, repair, renovation / rehabilitation.

In this context, in order to overcome these negative externalities and reduce energy consumption, Morocco has initiated the energy transition process with a very high potential of renewable energies (especially solar) and the integration of eco-innovations, however, the use of these resources and the integration of these innovations are still very limited: the production of renewable energies does not exceed 8.8% of primary energy consumption and the budget allocated to R&D does not exceed 0.6% of GDP. In fact, although the Moroccan population is becoming more and more demanding, it is however constrained by a limited investment to integrate highly efficient technical solutions or innovative (Erbach, 2015).

In this sense, several questions arise: Can the use of innovative/biobased building materials, new processes and high-performance systems be beneficial in terms of reducing the ecological footprint on the environment? Are these innovations affordable? Is the generalization of the integration of innovative technical solutions possible? And what are the challenges that might hinder this generalization? In order to answer these questions, we start in a first section by a brief review of the link between eco-entrepreneurship and the environment. The second section is devoted to explaining the methodological aspects. The third section will be dedicated to the presentation of our case study of an eco-entrepreneurial prototype project. Finally in the fourth section, we discuss some of the challenges that face the development of innovative eco-entrepreneurial ideas and green projects in Morocco.

II. ECO-ENTREPRENEURSHIP AND THE INNOVATIVE APPROACH TO THE ENVIRONMENT

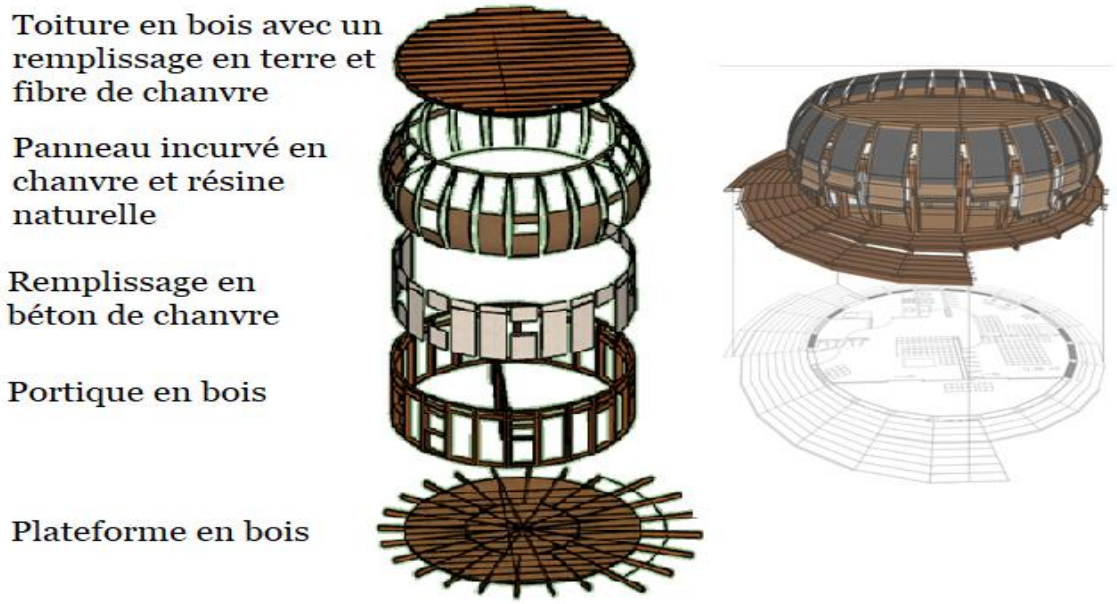
In recent years, there has been the emergence of new subjects linked to eco-entrepreneurship, green entrepreneurship and sustainable development; all refer to the same idea that the entrepreneur must be aware of his environmental role and responsibility towards the environment. In this sense, responsible entrepreneurship has been defined by the European Commission as a "way of management that increases the company's positive contribution to society while minimizing its negative impact on citizens and their environment". According to Likaneen (2004) (cited by Filali, 2019), it is about the relationships that leaders adopt with their stakeholders: customers and business partners, staff in the workplace, the community and IT is therefore a matter of applying to the company the principles of sustainable development by combining economic development and the preservation of the environment. As a distinct field of research, Eco-entrepreneurship emerged in the late 1980s. In this context, Quinn (1971) in his pioneering research mentioned that "The ecology movement can provide profitable new markets for business expansion instead of simply being a drain on economic activity". Few years later, Bennett (1991) used the terms environmental entrepreneur, green entrepreneur or eco-entrepreneur, and therefore marked the emergence of more structured research subfields. In the early 2000s many scholars such as Taylor and Walley (2004) presented a typology of eco-entrepreneurs.

These two authors put the emphasis on the dynamic nature of their typology: the type of eco-entrepreneur is not frozen in time. On the contrary, it can evolve over the course of events. It is recognized that engaging in the field of eco-entrepreneurship requires the eco-entrepreneur to adopt ecological innovations (environmental innovations, green innovative solutions). The Eco-Entrepreneur is characterized in many ways and regards: first, his sensitivity and awareness of the importance of to Fair Trade. Second, his attention to environmental regulations: While for the traditional entrepreneur, the new laws imposed by the States in favor of the environment, would be constraints with which they should comply. Fourth, the relationship he has with technology: Indeed, the eco-entrepreneur would choose the technologies only according to their mission and among those that do not harm the environment not like the normal conventional entrepreneur who continually seek new technologies whatever their negative externalities are. In the Moroccan context, there have been numerous great efforts to overcome current social, environmental and economic problems.

Indeed, the country has been adopting numerous policies aligned with the global strategy of a sustainable development: the launch of the INDH (the national initiative for human development) in 2005, the creation of the CSR label by the CGEM in 2006, the signature of the environment and development charter sustainable development, the organization of COP 22 in 2016, the national sustainable development strategy 2016/2030. However, despite these efforts, sustainability and eco-entrepreneurship are still at a very early stage and the ecosystem is still not developed. More particularly, with regard to the construction sector, during the last decade, there has been the introduction of several environmental innovations, especially those relating to construction materials. Indeed, several green materials have seen the day and whose objective is, among other things, to rationalize the use of resources and preserve the environment by allowing the manufacture of buildings with a low ecological footprint[1].

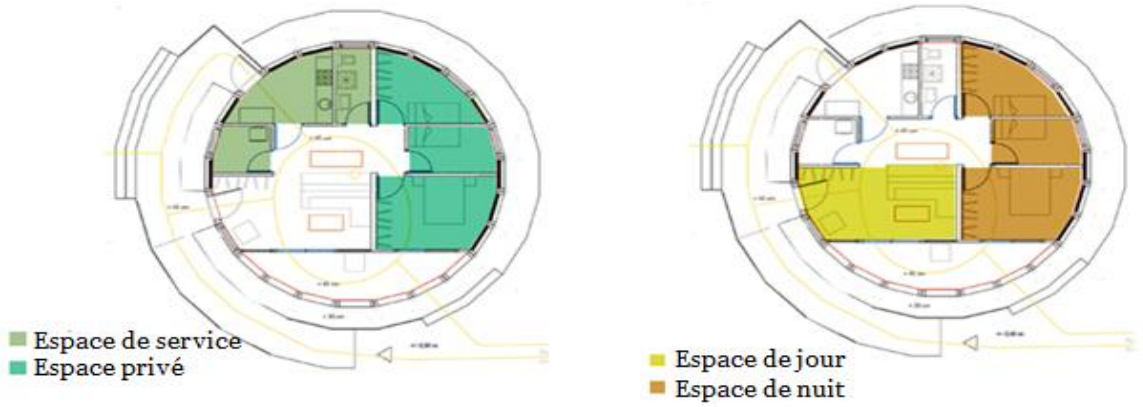
[1] For example, the Smart Construction Laboratory (SCL) manufactures recycled aggregates and mineral foam solutions revolutionary for insulation that achieves performance levels first class. The Lab also develops innovative concrete products thermally efficient (Ultra High Performance Concrete) (UHPC), building systems that combine cement solutions, aggregate and concrete with other insulating components to create energy-efficient building elements (walls, floors, roofs, etc.) .These advances are not only the result of the private sector, but also the result of state efforts: Indeed, the public sector is committed to improving the quality of the building and reducing the footprint carbon through in particular the launch of several green projects, research programs, international competitions and entities and establishments whose objective is the development and promotion of new innovative building processes, systems and materials.

III. METHODOLOGICAL ASPECTS OF THE ECO-ENTREPRENEURIAL PROTOTYPE HOUSE AND KEY TECHNICAL FEATURES



In this section, a case study is presented, it relates to the conceptualization / construction of a zero-energy building as part of the international competition Solar Decathlon, Africa 2019. The building is designed with a circular shape that is inspired by the architectural model of traditional houses found in various African countries.

The construction of this building is based on the use of an innovative material from the Moroccan hemp plant. It was developed by the cooperative Adrar Nouh from the mixture of water, lime and the stalk of hemp. This material was used for the construction of the walls of the building. The exterior envelope of this building (double skin facade) was made of hemp panels with a natural resin.



In addition to this innovative building material, there is a highly innovative photovoltaic panel system for the production of energy. This system adapts to the shape of the building (partially spherical shape).

Thus, during the usage phase, energy production covered the entire energy consumption of the building (TV, dishwasher, fan coil, electrical oven, computer, and lighting). For the production of domestic hot water, a solar thermal panel was more than sufficient. This building is considered to be a zero-energy building. In addition, hempcrete has several advantages with respect to environmental impacts compared to usual materials (conventional such as reinforced concrete and bricks.

This prototype project is based on the concept of saving the environment and heritage culture of the Haut Rif region Moroccan. Our approach was based on traditional architectural concepts while adding to these construction concepts bioclimatic technologies environmentally friendly adapted to current efficiency standards energy and comfort.

IV. BENEFITS AND ECONOMIC POTENTIAL OF HEMP CONCRETE

Bio-sourced plant fiber materials are in vogue and the 2015 energy transition law aims to promote their development because of their ability to store carbon. According to a definition of the Ministry of Territorial Cohesion: "bio-sourced materials come from renewable organic matter (biomass), of plant or animal origin. The nature of these materials is multiple: wood, hemp, straw, cellulose wadding, recycled textiles, cereal husks, miscanthus, cork, flax, thatch, etc. Their applications are just as applicable in the building and construction field: structure, insulation, mortars and concrete, plastic composite materials or even in building chemistry (paint, adhesives, etc.). ". These materials are the basis of many experiments which are inspired by both ancestral knowledge and modern engineering. They also invite us to reconsider a more local approach to resources, due to their diversity, which requires locally anchored know-how. Thus, straw, for example, promotes a circular approach by also allowing certain farmers to recover their waste.

More particularly, the benefits are numerous, both for the quality of the soil and for the diversity of possible industrial uses (construction, textiles, packaging, food, dermatological products, paper). The water needs are less important. Herbicides and pesticides are unnecessary. For example, the British Hemp Alliance and the EIHA, which is based in Brussels, are trying to get the legal bans on the cultivation of this plant lifted. They argue in particular that the level of THC (Tetrahydrocannabinol) in hemp is too low to have psychoactive power.

The hemp plant has been wrongly considered as a cannabis flower (marijuana), that is to say as a narcotic substance in the United Nations Single Convention", continues Victoria Troyano. “Over the years this has caused a lot of confusion, as the cultivation of cannabis plants for industrial purposes is clearly excluded from the scope of international control. Industrial hemp has been severely restricted by onerous licensing procedures and European regulations. and complex nationalities. Three years after the adoption of the Farm Bill in the United States, which defined "industrial hemp" as a plant with no more than 0.3% THC by dry weight, the European Parliament announced in turn raised the minimum level of THC allowed in the cultivation of hemp, from 0.2 to 0.3%, which was seen as a first step in the right direction by the EIHA.

More specifically, the characteristics of hemp fibers make it a very good natural thermal and acoustic insulator. Hemp wool is used in the form of bulk, rolls or semi-rigid panels. In the latter two cases, the addition of approximately 20% polyester fibers is necessary to ensure the cohesion of the product. Hemp wool is suitable for wall insulation as well as for roofs and floors.

Hemp is also used as a building material. The “hemp brick” covers a sort of concrete block made up mainly of chènevotte, designating the stalk of the hemp. Excellent thermal insulator, hemp brick is often used to line existing walls by internal thermal insulation (ITI), or by external thermal insulation (ITE). However, it is strong enough to be used in its own right with a wooden or steel frame.

More surprisingly, hemp is also used in an evolved form of hemp brick, as "shot hemp concrete". It is a mixture of hemp and lime, placed in a special machine that projects the product into a pneumatic hose. On leaving, the mixture receives a spray of water and is thus projected into a construction formwork, or onto an existing wall.

V. CHALLENGES OF THE ECO-ENTREPRENEURIAL INITIATIVES IN THE BUILDING SECTOR IN MOROCCO

Despite the existence of a descent regulatory framework[2], the integration and dissemination of green solutions and Eco- entrepreneurial initiatives comes up against panoply of institutional challenges that we can classify into two main categories: specific/conjectural constraints specific to the building sector and structural constraints relative to the Moroccan context in a more global way. The role of institutions is of a great importance in the success of every innovative project.

[2] In this perspective, several public establishments have been created: The Moroccan Agency for Energy Efficiency (AMEE-Ex ADEREE), the solar energy and new energies research institute (IRESEN), the Construction21 platform, the Moroccan Alliance for climate and sustainable development (AMCDD), the EMC cluster, the Mediterranean Center for Environment and Development (CMED), and the Moroccan Green Building Council. Still in relation to the legislative and regulatory framework, a legal arsenal has been put in place. Indeed, the RTCM (Technical Regulations for Construction in Morocco) set up by the AMEE. IMANOR (Moroccan Institute for Standardization) has developed several standards relating to construction materials: standard 10.1.008 on technical specifications for durable concrete. Also, a national charter for the environment and sustainable development was adopted in 2012 and a framework law 99-12 in 2014 was implemented. In addition, there was the adoption of Law No. 58-15 relating to renewable energies as well as the integration of the energy dimension into some sectoral development programs (Ministry of Energy and Mines of Morocco, 2017).

Concerning the first category of challenges, and more specifically with regard to construction materials, it is still difficult nowadays to integrate or use several biobased materials due to the absence of a regulatory framework that defines the technical specifications to be observed for construction with these materials, particularly in urban areas. In fact, at the contrary to the precise predefined technical structure calculations that exist for construction with conventional materials (steel, concrete, brick, etc.), there are no technical specification for the case of unconventional materials (hemp, straw, earth, etc.).

This makes it impossible to have well-defined and pre-established structural calculation standards, which creates a lack of confidence among all stakeholders in the act of building as well as with the end customer. Indeed, the absence of a standardization process translates into the absence of technical references which would normally allow specifying the characteristics of materials / products, and systems, to define methods of tests and analysis necessary for the assessment of their conformity. In addition, the still problematic, or even "illegal", nature of certain unconventional materials limits their use: for example, in the case of hemp (hemp stalks / hemp wool), it has so far been prohibited for this material to be incorporated in the construction process in Morocco.

Again, in relation to the institutional constraints and more specifically this time, on the integration of innovative systems and processes, as such, the future inhabitants (end customer) are very reluctant to opt for this kind of technical solutions due in particular to the absence of incentive measures: in fact, the law has still not authorized residents to sell their own energy that they would generate from their own means of production. Thus, there is reluctance on their part to opt for this type of technical solutions even when the latter prove to be more economical in the long term than conventional solutions (cement, concrete, steel, metal, concrete blocks, etc.).

This reluctance also finds its origin in cultural factors. As for the second category of institutional constraints, namely the so-called "structural" ones, this category is more disabling. In fact, these are institutional weaknesses and rigidities that could slow down the development of any potential innovation in Morocco: Indeed, the share of research and development expenditure in the GDP is less than 1%, it is far from the 3% objective set by EU countries to claim to build a knowledge economy; moreover, as underlined, the production of knowledge is limited by numerous obstacles: the overwhelming majority of universities are still largely limited to the role of conservation of knowledge through its transmission via basic educational activities.

As for the links that universities maintain with businesses, they are very limited, episodic, and therefore do not allow the formation of a viable "critical mass", materialized by sustained, dynamic and lasting interactions. Innovation thrives in societies whose social ties revolve around law, trust, empathy (Casadella, Uzunidis, 2017) and which, therefore, institutionalize change. While in Morocco, bureaucracy, privileges, lack of civic education do not promote a spirit of entrepreneurship focused on innovation and creation. (Affaya, Guerraoui, 2009), Mesbahi, (2017). Moreover, the multiplication of sectoral plans with different time horizons blurs the tracks in that it seriously undermines the visibility of actors, testifies to the lack of global coherence, makes coordination mechanisms between public policies (economic , fiscal, learning, sectoral, etc.) inefficient. (El Aoufi, 2012, Akesbi, 2017), this slows down the construction of favorable conditions to a real dynamic of innovation supported by strong and sustainable institutional coordination linked to economic development. (Ben Slimane, Ramdan, 2017, Casadella et al., 2017).

VI. CONCLUSION

Finally, in this article, we have tried to discuss the institutional barriers facing the integration of environmental innovations and eco-entrepreneurial projects in buildings in Morocco by focusing mainly on the case of a zero net energy house. The literature on the subject distinguishes between two categories of environmental innovations: "environmental innovations that are not purely technological" (sustainable management, routines, practices, modes of organization of the company) and a second category "purely technological innovations". At the empirical level, to enrich our analysis, we were particularly interested in one example that concerns a purely technological environmental innovations, more specifically studying the use of an innovative/green material (hemp concrete) and an innovative system (the solar photovoltaic panels).

The results show that these alternative solutions allow for the reduction of the carbon impact on the environment and encourage the development of local population. However several institutional challenges might hamper the generalization of these solutions in Morocco even with the existence of a fairly developed regulatory and legislative framework.

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