EXECUTIVE SUMMARY

"Regional Level Market Analysis of the Construction Sector and Pilot Project based on a Public Policy Portfolio in order to reduce SLCP of Traditional Brickyards in México"

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Executive summary

Brick production in Mexico is generated by approximately 17,000 artisanal units that operate informally, with rudimentary technology in or near urban areas, generate air pollution problems and emit greenhouse gases, including short-lived climate pollutants (CCVC), mainly black carbon, that affect producers and those living nearby.

The construction industry also uses bricks, concrete blocks and hollow bricks produced on an industrial scale by extrusion, with cooking; then, what is the future of artisanal production of clay brick in Mexico? What alternative products are competing with it in the market? What is the best strategy to boost the modernization of the sector? The National Institute of Ecology and Climate Change (INECC) seeks to respond to these questions through the execution of the project called "Market analysis of the construction sector and pilot project at the region level based on a portfolio of public policies with the objective To reduce the CCVC of artisanal brick in Mexico ", developed by CIATEC through the agreement INECC/RPA1-001/2015.

Background

In Mexico in 1994, the Secretariat of Social Development prepared a study of financial engineering of the technological reconversion or relocation of the brick kilns of the northern border of Mexico. In 2012, the Energy Efficiency Project in Artisanal Brickyards (EELA as in Spanish) published a diagnosis of the situation of brick-makers nationwide in Mexico, based on a market study, which describes the marketing mechanisms and identifies the regulations Applicable to the sector. However, this study does not address the issues of product demand, substitutability for alternative products, and market trends and characteristics.

Since 2012, under the Black Carbon Mitigation and Other Brick Pollution Initiative, the Climate and Clean Air Coalition (CCAC) has sought to identify and promote emissions mitigation measures in Artisanal brickwork from an inter-sectorial perspective. As part of these efforts, CCAC promoted the creation of the Public Policy Network for Clean Brick Production (PAN LAC) and published in May 2016 the document "Beyond Bricks" as an attempt to change the way governments Understand and design their public policies to prevent the negative social and environmental effects of artisanal brick production.

Objectives and methodology

The objective of this study was to raise the level of knowledge about the construction sector in Mexico through a market analysis (supply and demand) specifically oriented to constructive elements such as block, extruded brick and handcrafted ”ladrillo”, as well as providing a portfolio of public policy instruments to meet the needs of each type of producer, particularly artisanal brick, and help lay the groundwork for designing a pilot project. The scope of the study is national and the analysis of artisanal brick production is focused on seven states that together account for 58% of the country's brickyards: Hidalgo, Tlaxcala, Puebla, Morelos State of Mexico, Mexico City, Jalisco and Guanajuato.

Three types of instruments were used for the analysis of the supply of both brick and industrial partition, block and partition of concrete, which were applied to representative samples:

- 1,043 surveys to artisanal brick makers,
- 107 in-depth interviews to industrial producers, and
- Three focus groups.
- For the analysis of the demand, 119 in-depth interviews were conducted and six regional or municipal workshops were held.

The inputs to set up a pilot project and the portfolio of public policies were enriched in a national meeting and four workshops (in Chalco, Cholula, Leon and Zapopan) carried out in selected municipalities through the application of 17 criteria. The works and contributions were documented photographically, with audio files and lists of attendance.

The demand for bricks by the self-construction sector was assessed using a CIATEC methodology based on the qualitative appreciation of the use of brick in priority areas (polygons of poverty) in 72 cities of the 32 states of the Republic of Mexico. The economic analysis included the application of the Cobb-Douglas production function to the factors of production, the approach to factors controlling supply and demand using Logit models, and the analysis of price-supply, price-demand and cross-price elasticity's of the demand.

Results

According to the data collected, we can conclude that the producers are almost permanently engaged in this activity (92%), since only 8% have a complementary activity that can be agriculture, construction or commercial activities. It can also be said that this is an activity mainly supported by people who have been engaged in it for a long time: 52% of them have more than 20 years of activity, 29% are between 10 and 20 years old, and only 19% have 10 years or less producing bricks, which points to a low incorporation of new permanent producers.

Among the producers, the educational level is very low and even lower among women. 7.6% of the producers did not receive education or only had a pre-school education, 4.5% of the people involved in brick production did not complete primary education, 28.0% if they completed it, 25.3% have basic secondary education, 4.5 % higher secondary education (high school) and only 0.5% have higher education.

The artisanal brick production activity is predominantly performed as a family and informal activity, with a gender ratio of one woman for every six or seven men; 85% of the women who participate in the production come from the family nucleus of the "main producer". 50% of the producers have between 2 and 3 economic dependents and 30% between 4 and 10. The work of direct relatives generally has no remuneration and is considered as part of their obligations as a member of the "Main producer".

In most cases, there is irregularity in land tenure; 18% of the producers rent or have as loan the property in which they carry out their activity and, on the other hand, 48% have the kiln in the same place where they live. Typically, the cost of the property or rent of the property is not considered within the costs of production, which favors the producer's perception of apparent higher economic benefits than the real ones.

The activity is usually carried out informally and with difficulties to regularize before municipal and fiscal authorities, which affects their eligibility to obtain financing or support with public resources: they do not have the capacity to issue invoices because only 20% of the producers have RFC and 63% of them do not have municipal land use permit.

We can state categorically that those who engage in this activity earn less than the national average because 92% receive less than $ 6,240 pesos per month (equivalent to 4 or less minimum wages) and 30% receive less than $ 1,500 pesos per month (equivalent to a salary minimum). Given the poverty conditions of artisanal brick producers, a careful evaluation of the deterioration of the social fabric is required, where there is a significant presence of problems such as domestic violence, addictions, gender problems and child labor.

Production units are classified as "micro-enterprises" and suffer from a major stagnation in capital accumulation; they lack financial or entrepreneurial education (including a weak or inadequate perception of profitability) and difficulties in finding workforce. The number of average employees involved in production is between two and four. 84% of producers work from 5 to 6 days a week without fixed hours and the culture of the use of personal protective equipment and social security is absent.

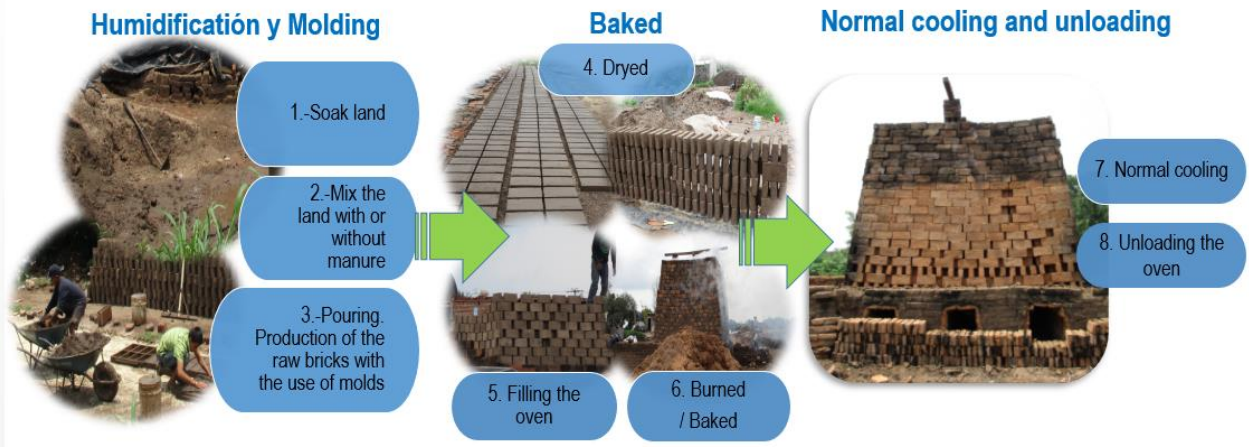
Artisanal brick production in Mexico is done with fixed (75%), traditional (22%) or MK2 (less than 0.5%) type "traditional" kilns. The construction and operation of only one horizontal multi-chamber kiln was detected. More than 65% of producers use metering machines, 22% use turbines, 19% have burners and 8% fans, and only 32% of them have their own cargo vehicles used to transport their product.

The experiences of changes in the way of production are scarce since only 10% of the producers have tried other ways of producing, 7% by means of the use of mixers for the preparation of the earth or by means of the substitution of fuel, whereas 2% of them have tried to produce different parts to the ones that they use, such as tiles, petatillo, or, to change the dimensions of the brick and less than 1.0% has made changes in the kilns. Of these, 38% said they had faced barriers due to cost, lack of financing or difficulties in using the new form. 61% of those who tried to change did not continue because they said they did not work, they did not like the operation or cost reasons.

The production process of clay brick consists of materials acquisition activities (carried out by suppliers or by 32% of the producers with trucks), humidification and molding, baking of parts, cooling and unloading of the kiln, and finally enlisted of the product for its commercialization. The cooking process is controlled by supplying fuels in the order and quantity that the experience of each producer indicates, and can last from less than ten hours to more than two days, depending on variables such as land type, type Of fuel, the number of pieces and the prevailing climate (rainy climates demand more cooking time).

Finally, once the producer determines that his product is sufficiently cooked, the cooling period begins to the point where the temperature of the kiln itself allows its discharge and delivery to who will take charge of the commercialization, without generating storage of finished product

Artisanal brick making process



Source: CIATEC.

The production capacity is small, ranging from 5,000 pieces / burning up to 40,000 or more pieces / burning although 60% of them have capacities ranging from 5,000 to 20,000 pieces. The number of burns per month depends on factors such as the space available for raw brick laying, the ability to pay wages to employees, the availability of employees, the time required to use the kiln in a complete work cycle, and The seasonal change from dry season to rainy season.

Under such conditions, approximately 50% of brick makers produce from 5,000 pieces / month to 20,000 pieces / month and less than 15% produce more than 35,000 pieces / month (data for dry season). To get an idea of the level of production that this means we can mention that the productive capacity in industrial plants of extruded partition reaches from 50,000 to one million pieces per day.

Biomass is the most widely used fuel (in the beginning of a burning process, liquid fuels are preferred), but in some areas the use of hazardous and highly polluting materials such as spent oils, textiles, tires and plastics persists: 33% of Producers in Tlaxcala, 15% in Guanajuato and the State of Mexico, 6% in Jalisco and 5% in Puebla. Regarding the purchase of firewood, 28% of the producers do not verify that they have an operating permit and 34% do not know the legality of the provenance. The materials used as fuels are acquired mainly through purchase, as, for example, the collection of waste by means of collection occurs in less than 2% of the producers.

The diversity of types of handicraft products is limited, but without standardization of dimensions (although tending to size 7x14x28 cm), the vast majority of producers only make bricks, although there are alternative products for floors, ceilings and apparent finishes. The dimensions of the bricks vary from one producer to another, even in the same state.

The percentage of defects due to major critical defects (broken, cast or raw bricks) ranges from 4% of the baked pieces per month in Morelos, to 10% in Tlaxcala, Puebla or Hidalgo. According to the Mexican Standard NMX-Z-12-2-1987, the decrease is acceptable in the case of Morelos producers, but between 12 and 33% of the producers in the other states have higher levels of decline.

The profitability of the activity is affected by the distances between the banks of materials that provide the land, the kilns and the urban areas that constitute its market. The same happens with the need of access routes that allow the transfer of the raw material and of the finished product, whose value is associated with the lowest possible loss of the raw material. The proximity of production areas to urban areas gives advantages over consumption sites, which in turn

increase the annoyance and complaints of the neighbors against the activity and the reactive response of the municipal environmental authorities.

Three cases of interventions were found to install ovens with technology superior to that traditionally used (less than 2% of producers knew or used other forms of production):

- a tunnel kiln based on infrared lamps in San Diego Cuachayotla in Puebla,
- an kiln with ceramic coated chamber and gas use in León, Guanajuato, and
- a coupled kiln (type MK2) in Metepec, State of Mexico.

In the first two cases, the kilns are in disuse because of the lack of profitability or deficiencies of their operation, and in the third case, the kiln is not functioning regularly to produce, nor has it replicated in other municipalities. In contrast, a group of Irapuato producers, Guanajuato, built a bi-chamber fixed-arch kiln with a capacity of 15,000 pieces (design for 17 hours of burning) that is in operation and waiting for municipal support to have a land that allows Expand the number of cameras.

The MK2 kiln has been promoted as an alternative to traditional kilns, although without the expected success in adopting the technology by the producers. Its construction was financed with public resources its construction in several states: Querétaro, San Luis Potosí, Guanajuato, Durango and Chihuahua. In Tequisquiapan, Queretaro, a training school was founded for its use and in San Miguel de Allende and Leon, Guanajuato, there are kilns that can be used for demonstrative purposes.

In what appears to be the only case of intervention that continues and has good business prospects, the state government of Zacatecas, promoted and supported 10 artisanal producers to form the cooperative "Ladrilleros Ecologistas de Loreto, Zacatecas" since 2013 More than 60 regional clients. They produce bricks with holes and pieces customized to the customer's needs, although the price of the brick produced is higher compared to the prices that each piece of traditional producers reach.

Regarding the development of productive and entrepreneurial capacities, 96.5% of artisanal producers have not benefited from training programs and only 3.5% have benefited from some program; In terms of credit support only 1.2% have had access to credit support.

Experiences of successful interventions in artisanal brickwork include the following:

- 200 small modernized bricklayers in Colombia, are what reduced emissions by more than 52,000 tons of CO_{2eq} and income improvements for $ 1,439,215,
- design of public policies in Brazil that generated programs to support innovation in brickyards, and
- construction and monitoring of Hoffman Hybrid Kiln in Bangladesh, and promotion of south-south experience exchanges.

The main lessons learned were that the initial investment for technological change is very high and the efforts are faced with unfair competition from traditional technologies, and there is resistance to change and difficulty to meet environmental standards.

In terms of organization, 33 associations of brick producers were detected in Mexico, of which half are in Guanajuato, another 25% in Hidalgo and the remaining 25% in Puebla, Tlaxcala, Morelos, the State of Mexico and Jalisco. Its operation is not without difficulties and one of the main motivations of the producers is to cope with the demands of the authorities. A scheme of maquila of the burning occurs in which the owners of kilns rent them to producers of crude brick: 6% of the producers use this.

The artisan producer is price-accepting in an environment of high competition between producers and oligopolistic control of the marketing by some intermediaries who usually buy the production at the bottom of the kiln, and they are precisely those who have contact with both brick and final consumers. This marketing mechanism allows these intermediaries to offer financing to the artisan producer by paying the product in cash or even financing the production by paying in advance, albeit in exchange for a lower price of the product.

The product that competes directly with artisanal bricks, are the concrete block and “tabicón” (opinion of 78% of the artisan producers). The extruded partitions are not direct competition for the brick and have a market share of 10% in the opinion of the largest company installed in Mexico; compacted earth blocks are also not direct competitors and their penetration in the market is minimal.

The low-income areas of the Mexican cities demand economic construction materials, which is why they represent a market for bricks, although it is preferable in the central-north and western states of the country, emphasizing that in the Mexico City preference is toward concrete blocks and walls.

Sixty five per cent of builders prefer concrete blocks and walls to build walls, compared to 26% preferred brick. In construction, the brick is used by specifications established by the client, as it happens for the construction of schools according to the guidelines of the National Institute of Physical Educational Infrastructure (INIFED) and for the average dwelling.

Currently, several innovative products are being developed for the construction sector: compacted earth blocks, lime blocks, earth blocks with cement. Walls with PET bottles ("biomimetics"), bricks made with uncooked synthetic cement (polybrick), blocks made from compacted waste with the addition of binding agents, recycled paper blocks for interiors, expanded concrete blocks with "bubbles" Of other material and prefabricated modular perforated (MUROMOL).

In Puebla, artisan substitute bricks are produced, hollowed and heated at high temperatures with gas, whose characteristics are lightness, strength and efficiency per square meter of wall. This replacement product is used in Chiapas, Tabasco, Puebla, Tlaxcala and Oaxaca, its price is $ 3,900.00 per thousand, unlike traditional brick, whose price ranges from $ 800.00 pesos to more than $ 2,500.00 pesos per thousand.

From the results of the probabilistic analysis of the supply, it can be indicated that the intervention of the labor force in the production process is vital in the artisan production. At the same time, the increase in the same does not contribute to an improvement in the competitiveness of the unit Producing brick if it is not complemented by an increase in conjunction with capital and all this translates into a low capacity to offer more product before increases in its price.

The artisan brick producer is in a market of perfect competition characterized by being price accepting to end consumers characterized by inelastic demand. The intermediary obtains the economic benefit in the purchase and sale of the good; on the one hand benefits from the competitive market for the possibility of obtaining the lowest price and on the other hand benefits from the inelasticity of the final consumer.

The specific environmental normative instruments for the bricklayers are scarce and are summarized in three environmental technical norms referring to the bricklayers, a state regulation with a specific chapter, four municipal regulations, six management programs to improve air quality (states of Puebla, Jalisco, 2 areas of Guanajuato and 2 areas of the State of Mexico.

In relation to construction, 19 municipalities in the country have regulations that specify the use of bricks and two have complementary technical standards. The Mexican Chamber of Construction Industry promoted the creation of NMX-AA-164-SCFI-2013, "Sustainable Building - Criteria and Minimum Environmental Requirements. Technical specifications for materials. It indicates the thermal properties of materials ", but it does not refer to the use of the brick. The NMX-R-021-SCFI-2013, "Quality of Physical Educational Infrastructure - Requirements", nor does it establish specifications in this regard

A total of 13 federal programs were identified that affect construction, although none of them specifically mention the use of artisanal brick or other alternative materials: 7 focus on infrastructure works, 2 specifically on housing (targeting low-income segments of the population) and 4 in both areas.

Public policies and pilot project

The attention of bricklayers in Mexico has not been coordinated from the federal level, which has resulted in a variety of strategies implemented by some state municipalities and government, which have given heterogeneous and dispersed results. The configuration of a pilot project to modernize the brickyards requires public policies other than the assistance options; auxiliary equipment endowments have not been shown to have the necessary scope or desired depth. The following are proposed under five initial considerations of policy Public: commitment of the three orders of government, transversal and multidisciplinary approach, equality and equity in the treatment of producers, promotion as an area with economic potential and productive alternatives:

- environmental sustainability (promotion) policies: better quality of life thanks to a healthier environment,
- social policies (extension): the right to access social development to improve the quality of life,
- normative policies (strengthening): recognition of artisanal activity in the environmental, territorial and construction regulatory framework,
- technological development policy (guidance): growth of technological capabilities transferred to the sector, and
- economic policies (extension): full insertion of artisanal activity in the construction sector.

Based on them, five axes of a modernization project are proposed: 1) collaborative entrepreneurial culture, 2) regulatory framework, 3) technological access, 4) product quality and diversification, and 5) market mechanisms. Each of them is described below.

Axis of collaborative entrepreneurial culture

The premise of this axis is that endowing all the country's producers, individually, with the financial, material and knowledge resources for the modernization of their activities is not a viable solution, due to the limited resources, the scale Micro-enterprises, economies of scale and the great diversity of individual views among producers. Individually treated, it is possible that in some cases, they may access government support for the purchase of auxiliary equipment or even new kilns, but they would be isolated cases that would not correspond to the expected efficiency of a national public policy. One of the most important problems identified in the study is the fact that, in the marketing process, competition between producers is predominantly dominated by lack of liquidity, poverty and direct competition, which tends to reduce Selling prices on a permanent basis, at the expense of the quality of life of producers and their families. The promotion of a collaborative entrepreneurial culture is oriented towards ending these practices and replacing them with others that allow them to improve their processes and their quality of life.

Axis of strengthening of the regulatory framework

Public policies of command and control are not sufficient, but they are necessary to create a baseline reference for producers and avoid practices that continue to harm the environment; this implies the clarification of the responsibility of the local authorities in the regulation, surveillance and control of the activity. Although the brick factories do not contribute the highest amount of pollutants to the atmosphere, compared to other fixed and mobile sources, they constitute focus of attention due to health effects and the emission of short-lived climatic pollutants. Monitoring attention from local broadcasting sources can give better results by focusing on informal sectors compared to the performance observed in formal economic sectors.

Other relevant regulatory areas refer to land use for the legal location of the activity and the legal solution of the mechanisms for granting the necessary environmental permits under the appropriate environmental performance rules.

An important consideration in this area is the need to design and implement sound environmental and social regulations (human rights, child labor and intrafamily violence, among others) and business (formalization, tenure and land use).) In a gradual manner and related to the incentives and supports necessary to reduce negative impacts on the population and the producers themselves.

Axis of technological access

Linked to the two previous axes, it is necessary to improve the possibilities currently available to producers to access new production technologies, adequate to improve product quality and reduce environmental impacts. This axis is key to implementing a modernization project, since it must take into account the gradual access given the current low level of technology of the producers, the effective control of the polluting emissions, and the organizational changes and infrastructure requirements demanded by technologies of greater productive capacity.

Technological change in Mexico should be closely associated with the management of dry biomass from different sources, taking care of forest sustainability, and the use of liquid fuels that have been technically validated by environmental authorities.

Axis and product quality and diversification

This axis responds to the fact that the quality of the products is one of the subjects of greater more lag in the artisan production. In all the workshops, this was identified as one of the central problems to be addressed. The improvement in the quality of the base product, which is the brick, is a priority, while product diversification, which may bring additional commercial advantages, is considered as a priority in a medium term.

Axis of market mechanisms

This axis and the previous one allow to "close the clamp" in a pilot project, thanks to the direct link of the production with the demand. Throughout this study, it was documented the structural weaknesses that producers have in marketing their product. It is not enough to organize them, to adapt the framework that regulates them, to give them access to technology and produce with quality, if the project does not is capable of improving the margins of profit of the producers themselves and of expanding the market served.

The execution of a pilot project demands the establishment of a permanent dialogue and work table in which the three levels of government of the economic, social and environmental sectors, the organized sector of the construction, the agents involved in the processes of adaptation Normative and producers, and even the academy. The ideal scenario is one in which the organized producers are managed through associations that allow them to have a common and integrating voice.

A pilot project should be based on the careful design of the public policy portfolio that integrates the actions of authorities, builders, intermediaries and marketers around producers. Technical support in this project is essential, and it is critical that it be based on a correct social approach that overcomes the natural resistance of producers and generates a motivation for change and continuous improvement. Another factor that emerges clearly and conclusively from this study is the need for affordable financing mechanisms for production, an aspect that, in the absence of applicable institutional support, is today covered by intermediaries with a high cost of producer profit.

In view of the above, the main recommendation of this study is to develop a National Program for the improvement of the artisanal brick industry, which feels the basis of the process governance with scope throughout the territory, but taking into account the regional strengths and weaknesses, which ideally should integrate elements:

- regulations (regulation of emissions, product quality, land use, protocols for validation of technologies and fuels authorized and regulation of exploitation of clay),
- social awareness (environmental, valuation of artisanal activity, gender equity and quality of life),
- training (in productive and business aspects, including marketing, certification of labor competencies, technology transfer in training centers based on "seeing to believe"),
- organizational (economies of scale, formation of cooperatives, platforms for information exchange and sharing of experiences),
- innovation (promotion of technology-based companies and financing for the assimilation of successful technology),

And • promotion (such as incentives, direct supports and buoyancy among buyers, such as large housing developers, "green" product labeling with their respective "marketing").

Based on the success stories identified in other countries, and particularly in Colombia, the gradual nature of policies to promote the required changes in environmental, territorial and product standards, production processes and marketing is an important factor for the success of a program like the one proposed.

The implementation of the policies and pilot cases derived from the National Improvement Program must address regional differences based on a range of solutions that allow the execution, from simple measures of equipment and access to technologies of better environmental performance, to organizational processes of the producers linked to economies of scale favored by kilns of more efficient technology.

The variety of possible solutions generated by the National Program should be framed in a comprehensive management of social, economic, environmental and innovation policies. At the same time, those policies must be executed at a speed controlled by two fundamental factors: the social appropriation of the changes by the producers and the success of the process of assimilation of technology (sound operating practices in production, equipment and kilns)