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The potential market for sustainable housing under the contingent valuation method. City of Palmira

El mercado potencial de la vivienda sostenible bajo el método de valoración contingente. Ciudad de Palmira

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Abstract

Sustainable housing is the constructive alternative under discussion in recent decades due to the multiple environmental impacts produced by the construction sector and its state of permanence and acceleration. Policies and standards at the international and national levels quickly encourage the implementation of actions in its favor. The lack of a market and the need to know it justify the research objective hereof of exploring the willingness to pay for sustainable housing through the Contingent Valuation Method applied to the city of Palmira, Colombia. A case of interest, as it is an emerging intermediate city regarding urban growth in the last decade in Colombia. The method designed a survey through the identification and valuation of significant variables for sustainable housing and the parameters of the analysis model and the method, which allow it to identify the potential market for sustainable housing. It is observed that the main variables of analysis in the literature consulted refer to topics such as location in relation to nearby equipment, materials' properties, technological innovation and reduction in consumption of home public services. The survey shows that the willingness to pay in the city of Palmira is high for the lowest housing prices, and that the people with the highest income are the ones who would invest the most in sustainable housing and that the level of knowledge on the subject is scarce in general.

Keywords: Sustainable housing, Environmental impact, Potential market, Contingent valuation.

Resumen

La vivienda sostenible es la alternativa constructiva en discusión en las últimas décadas debido a los múltiples

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impactos ambientales que produce el sector de la construcción y su estado de permanencia y aceleración. Las políticas y normas a nivel internacional y nacional incentivan rápidamente la implementación de acciones a su favor. La inexistencia de un mercado y la necesidad de conocerlo justifican el objetivo de la investigación por explorar la disposición a pagar por una vivienda sostenible a través del Método de Valoración Contingente con aplicación a la ciudad de Palmira, Colombia. Un caso de interés, al ser una ciudad intermedia emergente referente del crecimiento urbano en la última década en Colombia. El método diseña una encuesta a través de la identificación y valoración de variables significativas para la vivienda sostenible y de parámetros propios del modelo de análisis y del método, que le permiten identificar el mercado potencial de la vivienda sostenible. Se observa como las variables principales de análisis en la literatura consultada hacen referencia a temas como la localización en relación a los equipamientos cercanos, las propiedades de los materiales, la innovación tecnológica y la reducción en consumo de los servicios públicos domiciliarios. La encuesta muestra que la disposición a pagar en la ciudad de Palmira es alta para los precios más bajos de la vivienda; que las personas con mayor ingreso son las que más invertirían en una vivienda sostenible y que el nivel de conocimiento del tema en general es muy bajo.

Palabras clave: Vivienda sostenible, Impacto ambiental, Mercado potencial, Valoración contingente.

1. Introduction

In recent decades, population growth has increased rapidly and, with this, urban expansion and housing construction. A combination of new and traditional homes, which, under the parameters of supply and demand, occupy large areas of the territory generating impacts both from the obtaining of raw materials for construction and occupation, and from their functioning after occupation.

The constructive practice of housing is one of the main processes contributing to environmental degradation. The consumption of natural resources affects the ecosystem balance mainly by the extraction of soil for the manufacture of cement, bricks and blocks. Other impacts are generated by the use of water, and metals such as iron, steel and aluminum that are mainly necessary to start up the technological process for transformation and transportation.

In recent years, the impact of housing construction has permeated the concern of policies and regulatory framework in different countries including Colombia, producing as a result a set of parameters to be met wherein, little by little, progress is made towards more sustainable constructions.

The main objective of the research was to establish the potential market for sustainable housing through the MVC contingent valuation method, formulating a survey applied in the city of Palmira, based on the most representative variables associated with the design, construction and functioning of housing.

Different statistical methods are known to diagnose through quantitative and qualitative information environmental and housing issues, for instance, direct methods such as hedonic, travel cost method and avoided or induced costs, among others. However, for this research, as a tool, the method that enables the valuation of the sustainable housing market potential is the contingent valuation method, since there is no established market for sustainable housing in the country and it is necessary to create a hypothetical one.

2. Context

2.1. The influence of housing on environmental sustainability

From the ecological, economic and social standspoints, sustainability refers to the ability of any process to maintain the balance in the parties involved, achieving a profound relationship between the three areas that ensure the development of humanity in the future. “Sustainability has emerged as an increasingly important principle in the area of construction due to the considerable industrial effects on both the environment and society” (Myers, 2005). The notion of sustainability in construction has focused mainly on restricted resources, particularly on energy and reducing the impact on nature and on technical concerns such as building materials and technologies (Amran, Zainuddin, and Zailani, 2013). The recognition of non-technical concerns such as the use of solar energy, water and air has become popular in terms of economic sustainability in the 21st century (Lawanson and Fadare, 2013).

Sustainable housing improves practices throughout the life cycle of housing from design, construction and functioning to demolition. Practices that have effectively contributed to minimizing the effect on climate change, the reduction of greenhouse gas emissions, the consumption of natural resources and the loss of biodiversity Consejo Colombiano de Construcción Sostenible-Colombian (Council for Sustainable Construction) (CCCS) (2016). While conventional design and construction initiatives focus on costs, performance and quality elements in sustainable construction offer challenges in reducing resource consumption and environmental degradation along with establishing a healthier built environment, ensuring health, comfort individual and social (Sev, 2009).

Putting a house into functioning generates other impacts such as demands for water (16.4 m^3/user/month), energy (252 kW/user/h) and soil (95-110 m^2 net area/housing) and the generation of solid waste (230 kg/user/day) and wastewater (21 m^3/user/day) permanently, undermining the natural heritage nearest and farthest to its location (SUI, 2015)

In many cases, sustainable construction is present in parts of the design of large buildings such as the Handmade School in Bangladesh, the HSBC Building in Mexico, the ACROS Garden Building in Japan and R4HOUSE Housing in Spain. In Colombia, projects such as the Orchidnorama and the adaptation of the Pilot Public Library in Medellín, the La Aldea urbanization in La Estrella, the ecological citadel Nashira in Valle del Cauca, the project to recover the historic center of Barranquilla and the Pueblito Acuarela in Santander are examples of the application of the concept of sustainable construction (Acevedo, Hernández, and Ramírez, 2012). In Colombia, currently there are few initiatives to build sustainable housing and the vast majority are focused on concrete actions to save water and energy. Bogotá, Medellín, Cali and Barranquilla in the years 2010 and 2011 led green buildings in the country.

2.2. Key parameters to design more sustainable housing

Housing associates with its construction, accessibility and durability a series of biophysical, social and economic variables that allow estimating its price and valuation. This is why clarifying the main environmental variables that influence the value of housing enables accurate decision-making regarding its impact and possible contribution to environmental sustainability. Georgiadou, Hacking, and Guthrie, (2012) state that eco-innovation does not necessarily mean intervention of costly solutions, but rather technically robust, socially responsible and financially viable solutions (Abdul-Rahman, Wang, Wood, and Ebrahimi, 2012).

The social, economic and environmental fields include variables of interest to sustainable housing Abdul-Rahman *et al.* (2012). Particularly important are variables that consider the site, the efficiency of water, energy and atmosphere, the type of materials and resources, the interior environmental quality and finally the considerations of innovation and design processes. Closing material cycles and providing habitability are also two keys to sustainable building (CMMAD) (Abidin, 2009). Rodríguez, Will, Bidegaray and Botero (2006) promote the planting of bamboo on the riverbank to protect ecosystems and for its future use as a building material that also helps the region's economy, as well as other passive strategies such as hot air extraction, ventilation and sunlight ingress. Other authors also present references thereto such as Landázuri and Mercado (2004), Romero, Irarrázaval, and Opazo (2010), Bedoya (2011), Mitchell and Arena (2005) and the Centro Nacional de Consultoría Bogotá (Bogotá National Consulting Center) (2012).

In Colombia, most initiatives develop environmental and economic benefits such as managing more comfortable temperatures and saving water.

2.3. Public policies on sustainable housing

In Colombia, according to CONPES 3919 (2018), the National Policy on Sustainable Buildings, the construction sector is one of the growth-driving engines of the Colombian economy (it reached 4.9% of GDP 2017 compared to 1.8% in 2001, (DANE, 2015). With significant environmental impacts on the part of construction and in the face of the expected scenario for urban growth, the challenges of including regularized parameters of environmental sustainability in construction are an increasing challenge.

With a 2030 horizon, the proposal seeks to promote sustainability criteria within the life cycle of the construction of buildings through standards, culture, monitoring and financing. This initiative is the result of commitments made under the Sustainable Development Goals (especially 11th and 12th), the United Nations Conference on Housing and Sustainable Urban Development Habitat III and the National Development Plan 2014-2018 under the strategic view of green growth and cooperation of other institutions.

In the same vein, Resolution 549 (Ministerio de Vivienda, Ciudad y Territorio. 2015), referring to sustainable housing, refers to a set of passive and active measures in the design and construction of buildings that allow achieving the minimum water an energy saving percentages aimed at improving the quality of life of its inhabitants, and the implementation of actions with environmental and social responsibility.

Other regulations that aim to regulate the environmental impact of construction are Decree 1460 (2017) on rediscount lines (FINDETER), Colombian Technical Standard NTC 6112 (2016) by the Ministry of Environment and Sustainable Development on environmental criteria for the design and construction of buildings for uses other than housing through the environmental seal, the National Development Plan 2014-2018, All for a New Country, and its National Green Growth Strategy and the Sector Action Plan for Mitigation for Housing and Territorial Development 2014 within the framework of the Low-Carbon Strategy. Also, Decree 1285 (2015) by the Ministry of Housing with the setting of guidelines for sustainable construction (water and energy saving), and many others that promote water and energy saving such as Resolution Resolution No. 030 (Ministerio de Minas y Energía, 2018a), Decree 0570 (Ministerio de Minas y Energía, 2018b), Resolution 143 (Congreso de la República de Colombia, 2016), Act 1715 (Congreso de la República de Colombia, 2014), Resolution 631 (Ministerio de Ambiente y Desarrollo Sostenible, 2015) and others for construction waste such as Resolution 472 (Ministerio de Ambiente y Desarrollo Sostenible, 2017).

Finally, in to the 1 annexes of the Resolution 549 (Ministerio de Vivienda, Ciudad y Territorio, 2015) about the code of sustainable construction is the practical guidelines that encourage the sector to produce a lower environmental impact.

2.4. The potential market for sustainable housing

The potential market is understood as the maximum amount that could be sold in a market within a given period. This is a concept somewhat vague as it would imply that all possible customers are buying. In practice, this concept is used in the form of indexes that link potential submarkets to the general market, i.e. the relative value of purchasing capacity of each pre-established geographical area (Rivera and de Garcillan, 2007).

Any commercial initiative must have a formulation and evaluation plan that highlights its functionality and benefit possibilities for a community, which must adapt to a market opportunity known as a potential market (Sánchez, 2015). There are purchasing decisions influenced by savings, social status, affinity to style, design etc. in each market. As the experience in several markets has shown, the ideal thing for a potential market to be realized is that in its products, goods, or services to be offered are incorporated a criteria of functionality, safety and security, technology and variation in design (Feichtinger, 1992).

For the case of sustainable housing, the potential market for the good to offer is a latent business opportunity, that is, people who do not have sustainable housing as part of their properties will see therein the incorporation of functionality, technology, design, and innovation, and their purchase decision will respond to different reasons and needs that will bring on greater status and advantages over the rest of buyers.

Emerging intermediate cities such as Palmira present outstanding growth in their urban area and are, within the framework of the national and regional territorial model of Valle del Cauca, strategic spaces for intervention and strengthening. Sustainable housing becomes an opportunity for these cities to grow more harmoniously with the internationally proposed goals for environmental sustainability.

2.5. The contingent valuation method

The MVC contingent valuation method is a direct method for economic valuation. It is described as one of the "techniques often the only one we have to estimate the value of environmental goods (products or services) for which there is no market" (Riera, 1994, p. 12). It is a matter of simulating a market by surveying potential consumers. They are asked about the maximum amount of money they would pay for good if they had to compare it, as they do with other goods. Hence the value of the asset in question for the average consumer (Riera, 1994).

The MVC conducts individual surveys in order to assign a value to the environmental good or service (Azqueta, 2002). The method is based on two types of direct analysis: willingness to pay (DAP per its acronym in Spanish), which was applied in this research, and the willingness to waive or willingness to be compensated (DAC per its acronym in Spanish); both referring to the use related to said good or service by the respondent. Individual responses are aggregated to generate or simulate a hypothetical market, the methods included under the name of contingent valuation intend to ask directly and find out the valuation that people assign to a given system or environmental good, in this case sustainable housing.

In the case of goods which do not entail a direct monetary cost to the consumer, this willingness to pay for the goods is equivalent to the benefit that the consumer obtains. Alternatively, the MVC also makes it possible to find the maximum willingness to be compensated for the loss of an asset. This approach includes the following phases (Riera, 1994): 1. Defining precisely what is to be valued in monetary units. 2. Defining the relevant population. 3. Defining the simulation elements of the market. 4. Deciding on the interview mode. 5. Selecting the sample. 6. Drafting the questionnaire. 7.Conducting the interviews. 8. Exploding the answers statistically. And 9. Presenting and interpreting the results.

This method became popular in the second half of the 1980s in the United States, with works by Cummings, Brookshire, and Schulze (1986) and Mitchell and Carson (1989). In Europe, its application was relatively low until the 1990s, where there was an explosion in the number of applications carried out. Both books, and especially the second, tried to place this valuation technique in a broader context than that of environmental economics and welfare. The richness in the challenge of correctly valuing a good in a hypothetical market requires the collaboration of statistics, psychology, sociology, market research and, in general, branches of economic sciences that do not necessarily fit into the tradition of welfare economics (Riera, 1994)

3. Methodology

The proposed concept of sustainable housing addresses the analysis of the theories by other authors and institutions, and manages to highlight the most relevant aspects for their understanding in the context of the potential market for sustainable housing.

The proposed "triquetrus' methodology that includes biophysical, economic and social aspects manages to select from the large number of variables found in different theoretical sources (Sustainable Social Interest and Priority Housing in Colombia -VISS and VIPS (Bedoya, 2011), comparative environmental evaluation of masonry applied in walls of dwellings in arid Andean regions (Mitchell, 2005), some physical and psychological factors related to internal habitability of housing (Landázuri and Mercado (2004), among others associated with housing, sustainability, construction and sustainable housing in some cases), those with greater impact on their potential market. Subsequently, with this set of variables, the selection of a lower one with greater impact is made according to four established criteria. This set of variables defined as the most representative, become the basic parameters for the preparation of the survey questions. Furthermore, other variables are included by requirements of the analysis model and the MVC.

The method used a minimum number of surveys, based on simple random sampling, to find out the price the respondent would pay for the environmental good or service to be valued, to wit, sustainable housing. The results obtained by the surveys enabled the construction of a hypothetical market that represents the social demand for the good.

The population surveyed in this research was initially 300 easily accessible households with an approximate of 20,385 people. On the other hand, the representative sample was 280 households, all of which were used to calculate the willingness to pay -DAP- through the Probit Model without explicit utility function. From this number were excluded protest votes or those that failed to respond to the questionnaire.

At last, the survey had 25 questions separated by sections (Introductory, A, B and C) according to the method and using the selected variables qualified as having the greatest impact on the potential market of sustainable housing. The Introductory section explains to the interviewee that it mainly characterizes sustainable housing in order to understand the difference with traditional housing. Section A contains relevant information about the subject matter of valuation. Section B aims at trying to find out the respondent's willingness to pay for the environmental good or service, sustainable housing in this case, with previous data taken from virtual construction prices in the country. Initial prices are different for each question as multiple and varied answers were required. Finally, section C inquired about some of the socioeconomic characteristics of the respondent (income, age, sex, marital status, educational level) and other questions on environmental behavior (water and energy saving, thermal comfort) selected from those variables with the highest assessment according to the proposed criteria.

In this method, the questionnaires (surveys) play the role of a hypothetical market, where the supply is represented by the interviewer and the demand by the interviewee, and within these papers the interviewers asked about the maximum willingness to pay the interviewees. The answer can be equal, greater, or less than the value offered; if it is lower, the question is repeated with a lower value; if the answer is greater, the question is repeated with a higher value. Each answer at the end was different and subjected to statistical analysis.

Survey responses are statistically analyzed using estimates in the package state® version 14. The probit models (*Double* and *Single Bounded*) were estimated using maximum likelihood routines (MV). The DAP values for a representative household were estimated by means of the mean, median and integral of the positive, taking the average of the estimated DAP for each of the 300 households. For the interpretation of the results, the questions were linked to determine if there are positive correlations among them.

Finally, we build from expansion factors, one for households to be surveyed and the other for the total population, the possible scenarios for the potential market for sustainable housing in the city of Palmira. The generalization for the total population is considered to be less accurate since the sample corresponds only to households surveyed.

4. Results and discussion

The research defined sustainable housing as residential building in which practices are improved comprehensively throughout its life cycle, from its design, design, construction and operation to its demolition. It integrates active and passive measures to make its building materials and products healthy, durable and innovative, optimizing its efficiency and reducing the negative environmental impact. In this way, sustainable housing can be characterized with a green seal for its biophysical, social and economic sustainability.

4.1. Key variables of sustainable housing

From the initial set of 60 variables related to constructive practice, according to the revised bibliography, 28 variables related

<table>
<tr><th colspan="5">Table 1. Criteria and parameters for evaluating variables*</th></tr>
<tr><th colspan="2">Criterion</th><th>Evaluation parameter</th><th>Value</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Level of influence on the cost to be paid for sustainable housing (cost of production) (NIC): power exercised by the variable on the final cost of housing.</td><td>Equivalent to a range between 0% -30%. Does not increase or show influence.</td><td>0</td></tr>
<tr><td>Equivalent to a range between 40% -60%. It increases fairky*</td><td>2</td></tr>
<tr><td>2</td><td>Level of influence on the valuation of sustainable housing at the time of purchase (NIV): influence of the variable when choosing housing for purchase (it is striking, interesting, welcoming, strategic).</td><td>Equivalent to a range between 70% -100%. High increase compared to the evaluated criterion, this being the one that contributes the most thereto.</td><td>3</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Housing functionality for environmental sustainability (CBF): contribution of the variable versus functionality (recycled materials, energy saving, water saving, internal temperature control, waste management, good practices of its users and technology, among others).</td><td>Equivalent to 0%. Does not contribute.</td><td>0</td></tr>
<tr><td>Equivalent to 50%. Contributes indirectly.</td><td>2</td></tr>
<tr><td>4</td><td>¿}The variable makes it possible to introduce housing in the green seal category (SV): influence level of the variable to obtain a green seal due to its contribution to the environment, which generates differentiating characteristics for potential buyers.</td><td>Equivalent to 100%. Contributes directly.</td><td>3</td></tr>
<tr><td colspan="4">* If the criterion remains in the limit range, the lowest percentage will be chosen; for instance; if the result falls between 30 -40% it will be evaluated as low increase and not as medium and so on.</td></tr>
<tr><td colspan="4">Source: Author's own elaboration.</td></tr>
</table>

to sustainable housing and its potential market were selected that added onto and/ or subtracted from the price of housing. This set of variables (28) were evaluated under 4 criteria with values of 0, 2 or 3 establishing total percentages for each of them (from 0 to 100%), where 100 signals the optimal value variance (Table 1).

The application of the criteria to the 28 variables allows to highlight those with the greatest possibility of influencing a potential purchase by the respondent as follows (Table 2).

At the end of the 28 variables, 14 are the highest qualified (12, 11 and 10) and the most relevant for the potential market of sustainable housing, which show a great interest in efficient use and low waste (water, energy and waste). Likewise, user comfort generated by innovation in design, the properties of the materials and their location in relation to the nearby equipment. Much of these variables (10) depend on the capacity for innovation in design and research that provides the formula for maximum use in design, building materials and technology for the provision of public services. All these variables mostly in the hands of private construction companies lack a particular interest in research, which leads to the continuity of traditional procedures with little innovation.

For each of these 14 variables, their degree of effectiveness in sustainable housing depends mainly on factors such as:

1. Reducing drinking water consumption depends on efficient use (technological accessories) and recycling (GBI, 2010; LEED, 2002).

4. Energy performance is dependent on efficient lighting, improving ambient temperature, and adaptating designs to solar orientation and materials (GBI, 2010; LEED, 2002).

9. Thermal comfort depends on the design (forms and materials) of the building and its immediate environment and the presence of nearby vegetation (Lai, Mui, Wong, and Law, 2009; Nicol and Humphreys, 2002).

7. Materials' properties (structure, enclosures, roof and floors) are subject to the type and degree of processing, maintenance requirements, service life, resistance to potential damage or deterioration and technical performance (LEED, 2002; Pearce, Hastak, and Vanegas, 2012).

13. Innovation in design seeks performance

Table 2. Valuation of variables for the design of the Contingent Valuation Method survey*

	Variable	Evaluation Score				
		NIC	NIV	CBF	SV	Total
1	Reduction in drinking water consumption	3	3	3	3	12
2	Water losses and residue	2	3	3	3	10
3	Alternative resources	2	2	3	3	10
4	Energy efficiency	3	3	3	3	12
5	Reduction in non-renewable energy	2	3	3	3	11
6	Waste management	2	2	3	3	10
7	Materials' Properties (in structure, enclosures, roof, floors)	3	3	3	3	12
8	Implementation of regional materials	0	2	2	2	6
9	Thermal comfort	3	3	3	3	12
10	Indoor Air Quality	0	2	3	3	8
11	Visual comfort	0	2	2	2	6
12	Hearing comfort	0	2	2	2	6
13	Innovation in design	2	3	3	3	11
14	Environmental design	2	2	2	2	8
15	Contamination	2	3	3	3	11
16	Environmental culture	0	2	3	3	8
17	Urban equipment	3	3	2	2	10
18	Sensitivity	2	2	2	3	9
19	Quality of infrastructure (road, leisure, spaces...)	3	3	2	2	10
20	Site security (design and management)	3	3	0	2	8
21	Land use	2	2	2	0	6
22	Daylight and sunlight exposure	2	3	3	3	11
23	Capital cost	3	3	0	2	8
24	Cost Lifecycle	3	2	0	3	8
25	Environmental cost	2	2	0	3	7
26	Local materials	2	2	0	2	6
27	Improvement on local work	0	2	0	3	5
28	Localization	3	3	2	3	11

*The shaded variables correspond to the 14 with the highest rating.

Source: Author's Own elaboration.

above the minimum requirements without the need for costly solutions, but rather those that are technically robust, socially responsible and financially viable (Holden and Scerri, 2013 and Georgiadou *et al.,* 2012).

28. The location observes the type of soil and its ability to support the dwelling, climatic conditions, topography and orientation.

22. Daylight and exposure to sunlight depend on the building's design; proper use of sunlight improves productivity, reduces disease and minimizes the use of electrical appliances to improve climate comfort and electrical lighting (Maria and Stella, 2006).

5. The reduction of non-renewable energy is subject to the use of alternative energy

rather than fossil fuels (Shen, Hao, Tam, and Yao, 2007).

15. Pollution reduction depends on the efficient use of measures taken to prevent land, air, water, light and noise pollution, and the effects on local climate (Kim, Yang, Yeo, and Kim, 2005; LEED, 2002; Shen *et al.,* 2007).

3. Alternative resources are dependent on the availability of rainwater harvesting, direct recirculation and the switch to efficient technologies that enable saving and harvesting (LEED, 2002).

2. Water loss and residue require the application of innovative technologies with gray water management (Green Homes Rating System IGBC, 2009).

6. Waste management depends on reduction programs throughout the construction life cycle, on increasing the amount of recycling, reuse and waste reduction (Asif, Muneer, and Kelley 2007; IGBC, 2009; LEED, 2002).

17. Urban equipment must be of quantity and quality, and must be predominantly for public use, with activities complementary to those of the room and work, and also provide social welfare services and support for economic, social, cultural and recreational activities (Secretaría de Desarrollo Social, 2010).

19. The quality of the infrastructure must show how easy access is to different modes of transport, the existence of streets, the identification of land use, demand for water, roads, energy, services and spaces needed to improve the construction of housing (Cerón-Palma, Sanyé-Mengal, Oliver-Solà, Montero, Ponce- Knight, and Rieradevall, 2013).

4.2. Application of the contingent valuation method

The execution of the first phase of the Method obtained, for the valuation in monetary units, that the range of entry prices for the model is between 120 and 300 million Colombian pesos, varying greatly according to the design, location and area. The optimal sample for the DAP as a continuous variable was n=280 observations, however, n= *300* were made to take into account the percentage of null responses.

In terms of the preparation of the survey, the 14 variables with the highest rating according to the evaluation criteria are taken into account. Other variables included in the survey by requirements of the MVC and the Probit Model were: Variables associated with expenditure or financial obligations of the family (PERHOGAR), Variables associated with income and wealth of the family (NIVELESCOLAR AND PERINGRE), Variables associated with the complementarity of housing (OTRAVIV), variables related to the environmental attitude towards the housing project (IMPORTANCE, VARIABLE WATERSAVING, COMFORTHERMAL VARIABLE, VARIABLE SAVINGENERGY) and other socioeconomic variables of the head of the household (SEX, ANONACIO, POSIRSE AND ANOSVIVE). The survey is as follows (Table 3).

When analyzing the variables of the Probit Model, it was observed that the values of the significant parameters, in absolute value, tend to be slightly higher in *Double Bounded* (DB) models compared to Single Bounded (SB) models. Double Bounded models are more efficient in statistical terms, in the sense that they incorporate more information within the model and allow us to clearly discern the significance of certain variables that in the SB model do not reach a significant value.

In the Introductory Section people have a high interest in sustainable housing, but little knowledge on the subject, thus limiting the success of new housing projects. Topics such as innovation in design, water recirculation and savings that could be attained in home services are of greatest interest, as is health caring through the use of materials other than traditional ones. Finally, 98% of respondents admit the importance and need to build this type of housing.

In Section A, the responses were positive (beta positive) that is, people who are more aware of the environmental problems in traditional housing would have a greater willingness to pay. The correlation is high and significant, meaning that this variable may explain a greater or lesser willingness to pay. For 139 people (49.64%) the level of importance is high and for 22.50% of the highest importance, which means that of the total number of people surveyed, 72.14% of the population considered that the

<table>
<tr><th colspan="3">Table 3. Implemented Survey</th></tr>
<tr><td colspan="3">Introductory section: explains to the interviewee that it mainly characterizes sustainable housing in order to understand the difference with traditional housing.</td></tr>
<tr><td colspan="3">In sustainable housing, alternative resources such as rainwater harvesting, gray water separation, solar or wind energy harvesting, and others with more efficient technologies that allow saving on the payment for home utilities can be used.</td></tr>
<tr><td colspan="3">Sustainable housing includes the reduction of non-renewable energy, mainly due to its adequate exposure to sunlight and thereby reducing traditional energy consumption rates and contributing to its best sale in the market.</td></tr>
<tr><td colspan="3">Sustainable housing efficiently manages waste using building materials of longer duration that do not affect health and carrying out recycling processes both in its construction and in its operation.</td></tr>
<tr><td colspan="3">Sustainable housing takes into account the properties of the materials in its construction (structure, enclosures, roof and floors) seeking the greatest respect for natural resources.</td></tr>
<tr><td colspan="3">Sustainable housing continuously pursues greater innovation in design, which allows it to obtain great benefits such as saving water and energy with separate facilities for discharge and reuse (separating water from showers for washing clothes, bathrooms, carts and garden), with energy-saving light bulbs and large windows and transparent walls that capture more light and others that adapt to greater thermal comfort with lower energy consumption.</td></tr>
<tr><td colspan="3">Sustainable housing reduces pollution by consuming less water and energy by applying recycling strategies and using materials with a longer life cycle.</td></tr>
<tr><td colspan="3">Sustainable housing takes into account the close availability of different basic facilities (education, health, recreation and sport, security and administration) for a better quality of life for its inhabitants.</td></tr>
<tr><td colspan="3">Sustainable housing offers a better-quality road infrastructure with access to different modes of transport such as bus, taxi, motorcycle, bicycle and all home public services.</td></tr>
<tr><td colspan="3">Sustainable housing offers greater possibilities to capture daylight with solar exposure to produce energy, obtain hot water, naturally improve climate comfort and reduce energy consumption.</td></tr>
<tr><td colspan="3">Sustainable housing establishes its location and location taking into account winds, sun exposure, vulnerability to natural risk, topography and availability and quality of equipment to ensure better living conditions.</td></tr>
<tr><td colspan="3">Section A: relevant information on the subject of valuation, sustainable housing:</td></tr>
<tr><td colspan="3">A.1: How important is this problem to you?</td></tr>
<tr><td colspan="3">A.2: Do you agree to a sustainable housing construction project that will reduce these negative environmental and social impacts?</td></tr>
<tr><td colspan="3">A.3: Do you or any of your family members think to buy a new home in the coming years?</td></tr>
<tr><td colspan="3">Section B: respondent’s willingness to pay for sustainable housing:</td></tr>
<tr><td colspan="3">B.1: Would you pay for $174985000 sustainable housing in Palmira? Yes__No__</td></tr>
<tr><td colspan="2">B.2: Would you pay $122489500 for sustainable housing in Palmira? Yes__No__</td><td>B.2.1 What would be the maximum amount your household would pay for sustainable housing? $______ Move to C.1</td></tr>
<tr><td colspan="2">B.2: Would you pay $ 227480500 for sustainable housing in Palmira? Yes__No__</td><td>B.3.1 What would be the maximum amount your household would pay for sustainable housing? $______ Move to C.1</td></tr>
<tr><td colspan="3">B.4: Why do you think you would not pay or do not answer about your willingness to pay?</td></tr>
<tr><td colspan="3">Section C: Socioeconomic characteristics and environmental performance:</td></tr>
<tr><td>C.1: Sex?</td><td colspan="2" rowspan="2">C.9: Would you like to go and live somewhere else?
C.9.1: According to your conditions and capacity, how likely are you going to live elsewhere?</td></tr>
<tr><td>C.2: Year of birth?</td></tr>
<tr><td>C.3: Neighborhood you live in?</td><td colspan="2">C.10: Would you like to buy (another) house in the coming years?</td></tr>
<tr><td>C.4: Marital status?</td><td colspan="2">C.11: Did you already know or hear about sustainable housing before this survey?</td></tr>
<tr><td>C.5: How many people contribute to the family income?</td><td colspan="2">C.12: Is it important for you to save water?</td></tr>
<tr><td>C.6: Occupation?</td><td colspan="2">C.13: Is it important for you to have a comfortable temperature in your home?</td></tr>
<tr><td>C.7: Level of schooling?</td><td colspan="2">C.14: Is it important for you to save electricity?</td></tr>
<tr><td rowspan="2">C.8: How long have you lived in this house?</td><td colspan="2">C.15: How many people live in your current home?</td></tr>
<tr><td colspan="2">C.16: How much is the monthly income of the family?</td></tr>
<tr><td colspan="3">Source: author’s own elaboration.</td></tr>
</table>

problem explained is of high relevance and needs to be addressed. This coincides with Departamento Administrativo Nacional de Estadística (DANE) (2015), which indicates that environmental concerns are increasingly important. In 2008, environmental affairs were ranked 5th in the capital city and for cities such as Medellín, Cali, Pereira and Palmira it was 4th. In 2015-2016, the new report showed that Palmira rose 1 level in terms of the degree of importance, that is to say that although the progress is not accelerated, if there is a positive change. Among the concerns highlighted in the report, the main one (58%) is the problem of waste, followed by water resource management (54%), and air pollution (38%) (IDEAM, INVEMAR, SINCHI, IIAP, IAvH, 2016).

In Section B, a higher level of schooling, where several people are the economic support of the household and who want to buy another home within a year, will be those who are willing to pay a higher sum for sustainable housing. On the other hand, people who have been living in their current home for a long time, people with lower levels of education and people who underscore savings, would not pay the sums offered for sustainable housing.

In Section C, the water saving and water caring variables have positive responses, that is, the correlation of the beta is positive, and the importance that people bestow to water saving in their current home is highlighted; the variables show an increase in DAP, a low but significant percentage. This fact is consistent with the efforts made by environmental bodies and organizations that are constantly working to preserve the resource. In both qualitative and quantitative terms, a reduction in available water in quantity, quality, or both causes serious negative effects on people and the environment (UNESCO, 2003).

The thermal comfort variable has a positive beta compared to the willingness to pay and its correlation is positive, even greater than the variable water and energy, most certainly influenced by the temperature of the city. The attitude of people towards a comfortable temperature in their homes shows a high importance (93.21%) compared to 6.79% who do not consider it important. Many say that not being in their homes reduces the value of this variable.

The energy saving variable also has a positive beta and a direct correlation against willingness to pay. The results show in frequency and percentages acceptance versus variable. 95% of the people surveyed are interested and consider the issue of energy saving important, mainly because of the need to save on the payment of their bill.

Finally, when applying the expansion factors it was obtained that for the case of the households interviewed, their DAP would represent the decision of 1,071 households, in other words, this maximum DAP would require 1,071 homes. To determine the number of dwellings variable, the willingness to pay obtained through the Probit Model without explicit utility function were ordered from higher to lower, and then numbered from 1 to 280 in descending order. Thus, for the maximum estimated DAP corresponding to a given household, it was obtained that it would require 1 dwelling, and in that order the next highest estimated DAP corresponds to a 2, which indicates a demand for 2 dwellings, and so on for the lowest estimated DAP we have that280 dwellings would be required. However, since the total population was not 280 households, we must multiply by 1,071 each of the corresponding values to the assigned numbers from 1 to 280; so for the maximum estimated DAP the data indicated that not 1 but 1,071 homes would be required, and for the minimum estimated DAP we would not have a demand for 280 but 299.84 housing. The foregoing was the way to construct from the estimated data the horizontal sum of individual demands for the aggregate population as defined by the basic macroeconomics manuals (Varian, 1994).

The possible market scenarios for sustainable housing in the city of Palmira that resulted from the expansion are presented below (Table 4).

For the city of Palmira, the DAP shows that the lower the price, the greater the demand of the population. Likewise, as the increase is more proportional in the first prices (up to 6) and for higher prices it presents changes with greater differences.

Table 4. Possible market scenarios for sustainable housing in the city of Palmira

Scenarios	Price Offered (millions of pesos)	Number of dwellings demanded for a population of 300 households	Number of dwellings demanded for a population of 20385 households	Percentage of heads participating in the market
1	120 180 000	299,84	20 212	99
2	130 424 000	271,280	20 100	92
3	141 007 000	235,58	19 975	68.5
4	150 295 000	217,01	18 870	54.2
5	161 158 000	188,45	17 170	53.8
6	171 835 000	174,17	16 320	47.1
7	193 326 000	117,05	12 920	22.1
8	204 433 000	88.49	11 220	20.2
9	253 474 000	8.536	5 270	15.3
10	278 707 000	4.69	2 720	11.42
11	298 884 000	2.56	170	7.14

Source: Author's own elaboration.

It is observed that for the offered price of 171835000 Colombian pesos and lower prices, the demand for housing by households is high; however, with higher prices the demand decreases significantly from 47.1% to 22.1%.

Quite surely, the socioeconomic conditions of Palmira, in a higher proportion low and medium low socioeconomic strata (92% of the population is in strata 1, 2 and 3 according to the Municipal Planning (Fundación Progresamos, 2015), can respond to this behavior that shows the low economic availability to pay for the highest offered housing.

The prices offered to explore the DAP leave out the maximum roof for social housing in Colombia (105 467 670) that most likely requires greater innovation strategies or greater subsidies to become sustainable housing.

The MVC allows a wide and varied valuation of goods, which is one of its main advantages. From an administration that needs to evaluate the initiatives it puts forward, to organizations that wish to know the social value of natural heritage or courts that must impose economic sanctions on those who cause damage to collective property.

The main limitation of the MVC is the absence of an established market, which implies generating a hypothetical market that could be mistrusted. The limitation of the method also falls on the complexity in the design, development and analysis of the survey and the people's preparedness to answer it. The drafting of the Contingent Valuation Survey is complex and requires many hours of preparation.

5. Conclusions

Sustainable housing is an integral building that involves a rational and conscious process, which can easily implement new technologies and habits with a little innovation, some of which are low-cost and have great positive impacts on the environment.

The variables evaluated according to the studies reviewed correspond mainly to the design, construction and putting into functioning process. The variables with the greatest impact according to the survey are related to water, energy and climate comfort. It is desirable to integrate other environmental analysis variables such as the origin of building materials, air quality and maintenance costs.

The research could be replicated for other cities in the country and incorporate methods for the mass knowledge of the subject and the implementation of new sustainable housing and the adaptation of existing ones.

The DAP of Palmira, shows that there is a high demand for sustainable housing for lower value offers, however, investment in them, even with the lowest value, is high. The most interested population in this type of housing corresponds to the that with the highest income, while the level of knowledge on the subject is very low in general.

The contributions of sustainable housing have a significant impact mainly on environmental protection, manufacturing costs, people's health and the optimization of urban infrastructures and municipal resources. Further potentiating these impacts depends on the degree of application and the chains associated with other impacts less attractive to the population, but equally significant to the environment.

6. Conflict of interest

The authors declare no conflict of interest.

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9. References

Abidin, N. Z. (2009). Construcción Sostenible en Malasia: Conciencia de los Desarrolladores. *World Academy of Science, Engineering and Technology, 29,* 801-808.

Abdul-Rahman, H., Wang, C., Wood, L. C., y Ebrahimi, M. (2012). Integración y clasificación de criterios de sostenibilidad para la vivienda. *Engineering Sustainability, 38*(SP–126-134), *1-10.*

Acevedo, H., Hernández, A., y Ramírez, D. (2012). Sostenibilidad: Actualidad y necesidad en el sector de la construcción en Colombia. *Gestión y Ambiente*, *15*(1), 105-118.

Amran, A., Zainuddin, Z,. y Zailani, S. (2013). Comercio de carbono en Malasia: revisión de políticas y prácticas. *Sustainable Development*, *21*(3), 183–192.

Asif, M., Muneer, T., & Kelley, R. (2007). Life cycle assessment: A case study of a dwelling home in Scotland. *Building and Environment, 42*(3), 1391-1394.

Azqueta, D. (2002). *Introducción a la economía ambiental* (2° ed.). Madrid, España: Editorial McGraw Hill.

Bedoya, C. (2011). *Viviendas de Interés Social y Prioritario Sostenibles en Colombia – VISS y VIPS*. Medellín, Colombia: Ed. DIKÉ, MARES, Cátedra UNESCO de Sostenibilidad UPC.

Centro Nacional de Consultoría. (2012). *Encuesta de empleo y calidad de vida para el Municipio de Cali.* Recuperado de https://repository.icesi.edu.co/biblioteca_digital/bitstream/10906/78005/1/TG00850.pdf

Cerón-Palma, I., Sanyé-Mengual, E., Oliver-Solà, J., Montero, J., Ponce-Caballero, C., y Rieradevall, J. (2013). Hacia una estrategia sostenible verde para los barrios sociales en América Latina: el caso de la vivienda social en Mérida, Yucatán, México. *Habitat International, 38,* 47-56.

Congreso de la República de Colombia. (2014). *Ley 1715.* Recuperado de http://www.secretariasenado.gov.co/senado/basedoc/ley_1715_2014.html

Congreso de la República de Colombia. (2016). *Resolución 143.* Recuperado de http://es.presidencia.gov.co/normativa/normativa/RESOLUCION%20143%20DEL%2008%20DE%20JUNIO%20DE%202016.pdf

Congreso República de Colombia. (2017). *Decreto 1460.* Recuperado de https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=83402

Consejo Colombiano de Construcción Sostenible (CCCS). (2016). *Referencial Casa Colombia. Para el diseño y construcción de soluciones habitacionales sostenibles.* Recuperado de https://www.cccs.org.co/wp/referencial-casa-colombia/

Consejo Nacional Política Económica y Social (CONPES). (2018). *Política Nacional de Edificaciones Sostenibles* (Documento 3919).

Recuperado de https://colaboracion.dnp.gov.co/CDT/Conpes/Econ%C3%B3micos/3919.pdf

Cummings, R. G., Brookshire, D. S., & Schulze, W. (1986). *Valuing Environmental Goods: An Assessment of the Contingent Valuation Method.* Totowa, USA: Rowman and Allanheld.

Departamento Administrativo Nacional de Estadística (DANE). Archivo Nacional de Datos. (2015). *Encuesta ambiental industrial EAI. Dirección de Metodología y Producción Estadística – DIMPE marzo 31 de 2017, catálogo de datos.* Recuperado de http://microdatos.dane.gov.co/index.php/catalog/460

Feichtinger, G. (1992). Hopf Bifurcation in an Advertising Diffusion Model. *Journal of Economic Behavior and Organization*, *17*, 401-411.

Fundación Progresamos. (2015). *Anuario Estadístico de Palmira.* Recuperado de https://fundacionprogresamos.org.co/anuarios_estadisticos/palmira/anuario_2015/indice.html

GBI, Residential New Construction (RNC). (2010). Design reference guide &submission format. Retrieved from https://new.greenbuildingindex.org/Files/Resources/GBI%20Tools/GBI%20Design%20Reference%20Guide%20-%20Residential%20New%20Construction%20(RNC)%20V1.02.pdf

Georgiadou, M. C., Hacking, T., & Guthrie, P. (2012). A conceptual framework for future-proofing the energy performance of buildings. *Energy Policy*, *47*, 145-155.

Green Homes, Rating System IGBC Ver 1.0. (2009). *Abridged Reference Guide.* Retrieved from https://2cl4223.files.wordpress.com/2013/06/igbcgreenhomesver-1-0-apr09.pdf

Holden, M., & Scerri, A. (2013). More than this: Liveable Melbourne meets liveable Vancouver. *Cities 31,* 444-453.

IDEAM, INVEMAR, SINCHI, IIAP, IAvH. (2016). *Informe del Estado del Ambiente y de los Recursos Naturales renovables.* Recuperado de http://documentacion.ideam.gov.co/openbiblio/bvirtual/023834/INFORME_E.A_2016.pdf

Kim, S. S., Yang, I. H., Yeo, M. S., & Kim, K. W. (2005). Development of a housing performance evaluation model for multi-family residential buildings in Korea. *Building and Environment, 40*(8), 1103-1116.

Lai, A., Mui, K., Wong, L., & Law, L. (2009). An evaluation model for indoor environmental quality (IEQ) acceptance in residential buildings. *Energy and Buildings*, *41*(9), 930-936.

Landázuri, A., y Mercado, S. (2004). Algunos factores físicos y psicológicos relacionados con la habitabilidad interna de la vivienda*. Medio Ambiente y Comportamiento Humano, 5*(1-2), 89-113.

Lawanson, O., y Fadare, S. (2013). Diferencias de vecindad e interfaz de salud ambiental en la metrópoli de Lagos, Nigeria. *Habitat International*, *39,* 240-245

Leadership in Energy & Environmental Design(LEED). (2002). *Green Building Rating System for New Construction & Major Renovations.* Retrieved from www.usgbc.org/Docs/LEEDdocs/LEED_RS_v2-1.pdf

Maria, S., & Stella, K. (2006). Present and future of building performance assessment tools. *Management of Environmental Quality*, *17*(5), 570-586. https://doi.org/10.1108/14777830610684530

Ministerio de Ambiente y Desarrollo Sostenible. (2015). *Resolución 631.* Recuperado de http://fenavi.org/wp-content/uploads/2018/05/Resolucion-631-2015.pdf

Ministerio de Ambiente y Desarrollo Sostenible. (2016). *Norma Técnica Colombiana NTC 6112.* Recuperado de http://www.minambiente.gov.co/images/AsuntosambientalesySectorialyUrbana/pdf/Sello_ambiental_colombiano/redise%C3%B1o_/NTC_6112._Construccion.xlsx

Ministerio de Ambiente y Desarrollo Sostenible. (2017). *Resolución 472.* Recuperado de http://www.minambiente.gov.co/images/normativa/app/resoluciones/3a-RESOLUCION-472-DE-2017.pdf

Ministerio de Defensa Nacional. (2015). *Decreto 1285.* Recuperado de https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=62885

Ministerio de Minas y Energía. (2018a). Resolución 030. Recuperado de http://apolo.creg.gov.co/f/1c09d18d2d5ffb5b05256eee00709c02/83b41035c2c4474f05258243005a1191?OpenDocument

Ministerio de Minas y Energía. (2018b). *Decreto 0570.* Recuperado de http://es.presidencia.gov.co/normativa/normativa/DECRETO%200570%20DEL%2023%20DE%20MARZO%20DE%202018.pdf

Ministerio de Vivienda, Ciudad y Territorio. (2015). *Resolución 549.* Recuperado de:http://www.minvivienda.gov.co/ResolucionesVivienda/0549%20-%202015.pdf

Mitchell, J. A (2005). *Evaluación ambiental comparativa de materiales mampuestos aplicados en muros de viviendas en regiones áridas andinas.* Actas XIX Reunión de ASADES, Mar del Plata, Argentina. Recuperado de https://docplayer.es/31096770-Evaluacion-ambiental-comparativa-de-materiales-mampuestos-aplicados-en-muros-de-viviendas-en-regiones-aridas-andinas.html

Mitchell, R., & Carson, R. (1989). *Using Surveys to Value Public Goods: The Contingent Valuation Method.* Washington DC, USA: Resources for the Future.

Myers, D. (2005). Una revisión de las actitudes de las empresas de construcción hacia la sostenibilidad. *Construction Management and Economics*, *23*(8), 781-785.

Nicol, J., & Humphreys, M. (2002). Adaptive thermal comfort and sustainable thermal standards for buildings. *Energy and Buildings, 34*(6), 563-572.

Pearce, A. R., Hastak, M., & Vanegas, J. A. (2012, March). *A Decision Support System for Construction Materials Selection using Sustainability as a Criterion*. SimAUD '12 Proceedings of the 2012 Symposium on Simulation for Architecture and Urban Design. Society for Computer Simulation International, San Diego, USA. Georgia Institute of Technology.

Riera, P. (1994). *Manual de valoración contingente*. Madrid, España: Ministerio de Economía y Hacienda, Instituto de Estudios Fiscales.

Rivera, J., y de Garcillan, M., (2010). D*irección de ventas: organización del departamento de ventas y gestión de vendedores*. Madrid, España: ESIC Editorial.

Romero, H., Irarrázaval, F., y Opazo, D. (2010). Climas urbanos y contaminación atmosférica en Santiago de Chile. *EURE*, *36*(109), 35-62.

Rodríguez, N., Will, W., Bidegaray, P., y Botero, R. (2006). *Utilización del Bambú (Guadua angustifolia Kunth) (Bambusoideae: Gramineae), como una alternativa sostenible de construcción de viviendas en la zona atlántica de Costa Rica.* Recuperado de https://www.academia.edu/22066184/UTILIZACI%C3%93N_DEL_BAMB%C3%9A_Guadua_angustifolia_Kunth._BAMBUSOIDEAE_GRAMINEAE_COMO_UNA_ALTERNATIVA_SOSTENIBLE_DE_CONSTRUCCI%C3%93N_DE_VIVIENDAS_EN_LA_ZONA_ATL%C3%81NTICA_DE_COSTA_RICA

Sánchez, E. (2015). *Formulación y Evaluación de proyectos agrarios* (Vol. 12). Bogotá Colombia: Universidad Nacional de Colombia.

Secretaría de Desarrollo Social. (2010). *Diagnóstico nacional de los asentamientos humanos ante el riesgo de desastres.* Recuperado de http://www.sedesol.gob.mx/work/models/SEDESOL/Sedesol/sppe/dgap/diagnostico/Diagnostico_PRAH.pdf

Sev, A. (2009). How can the construction industry contribute to sustainable development? A conceptual framework. *Sustainable Development, 17*(3), 161-173.

Shen, L., Hao, J., Tam, V., & Yao, H. (2007). A checklist for assessing sustainability performance of construction projects. *Journal of civil engineering and management, 13*(4), 273-281.

Sistema Único de Información de Servicios Públicos Domiciliarios (SUI) (2015). Reportes sobre consumo de energia por empresa. Recuperado de http://www.sui.gov.co/web/energia/reportes/comerciales/consumo-no-residencial-promedio-kwh

UNESCO. (2003). *Water for people, water for life executive summary of the un world water development report first published by the united nations educational, scientific and cultural organization.* Paris, France: Ed. UNESCO/Division of Water Sciences.

Varian, H. (1994). Contribuciones secuenciales a los bienes públicos. *Journal of publics Economics*, *53*(2), 165-186.

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