

令和 4 年 9 月 2 日現在

機関番号：14301

研究種目：若手研究

研究期間：2019～2021

課題番号：19K14020

研究課題名（和文）Comparative studies of culturally-based characterisation of energy services

研究課題名（英文）Comparative studies of culturally-based characterisation of energy services

研究代表者

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交付決定額（研究期間全体）：（直接経費） 3,200,000円

研究成果の概要（和文）：この研究では、さまざまな地理的、気候的、社会文化的状況でエネルギー、電化製品、住宅の特性を使用した新しいエネルギーサービス（ES）の特性評価方法を開発しました。ES提供の選好に関連する地域のエネルギー文化を解明し、国連SDGsフレームワークによる普遍的な電力アクセスのビジョンを補完する代替エネルギー貧困とエネルギーアクセス指標の基礎を築きました。最後に、本研究では、インタラクティブな地図を通じて、社会的不平等と貧困撲滅に取り組むことを目的とする政策の設計に価値のあるエネルギーサービスの有用な分解されたビジョンを作成しました。

研究成果の学術的意義や社会的意義

この研究は、地域のエネルギー文化とエネルギーアクセスの脆弱性に関する知識の向上に貢献しました。まず、ES特性評価法の開発により、関連する学術文献の方法論的なギャップが埋められました。この研究は、ES提供の選好に関連する地域のエネルギー文化を解明し、国連SDGsフレームワークによるユニバーサル電力アクセスのビジョンを補完する、エネルギーアクセスと脆弱性に関する代替の視点を示しました。最後に、調査は、不平等と貧困を削減するための政策介入に価値のあるインタラクティブな地図を通じて、エネルギーサービスの有用な細分化されたビジョンを作成しました。

研究成果の概要（英文）：The research developed a novel energy services (ES) characterisation method using energy, appliances and home characteristics in diverse geographic, climatic and socio-cultural contexts. It elucidated local energy cultures associated to the preferences for ES provision, and laid the foundations for an alternative energy poverty and energy access metric, complementing the vision of universal electricity access by the UN SDGs framework. Finally, the investigation created a useful disaggregated vision of residential energy services privation through interactive maps valuable in the design of policies aimed to address social inequalities and poverty eradication.

研究分野：Social energy science

キーワード：energy services residential energy households vulnerability deprivation sustainability SDGs

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1. 背景

The residential sector is one crucial segment in sustainability debates. On the one hand, through energy services homes aggregate the direct and embodied energy from industrial output, services and transportation. On the other hand, households also characterise more meaningfully the context of consumption, because their structure and social setting reveal preferences. Thus, a large part of sustainability discussions are concerned with developing methods to better visualise factors and implications related to residential energy use.

Studies over the past 30 years have also noticed the potential of the household perspective. There has been substantial investigation on energy efficiency and sustainable consumer behaviour. Yet, most of the research has primarily targeted the overall material and energy consumption instead of a disaggregated focus on measures, particularly when it comes to elements more directly connected to human well-being. Social studies and particularly human well-being related literature have been less concerned with the implications of material consumption specifically energy. In recent investigations, however, the connection appears more important because higher levels of well-being with lower energy use is a vision of the sustainable. Therefore, it is increasingly important to find concepts bridging both ends.

Energy services (ES), which first appeared in energy literature of the 1980s, is becoming one useful notion to connect energy consumption and well-being. ES comprise energy consumption, household equipment and technology in use, and act as energy-related well-being surrogates (Cravioto et al, 2014). However, in the light of specific socio-cultural contexts there is limited information on how ES are structured. For example, the diversity of fuels in use for ES in the global south is one among many aspects neglected in sustainability discussions, and characterising ES could improve the design of strategies for more efficient energy use in harmony with local preferences and culture.

At the same time, ES are also essential in energy vulnerability analyses. Traditionally the measurement of energy access has focused on electrification and availability of energy resources, but the analysis of energy services access could show a different depiction of poverty and deprivation. ES can elucidate through their measurement an alternative representation of vulnerable groups.

On a greater scale, ES can also contribute in conceiving sustainability goals beyond universal energy access (SDG7). ES could assist to outline new localised energy policies that feature social inclusiveness, spatial differentiation, government roles and stimuli. New sustainability frameworks could potentially benefit from the study of ES characterisation, because ES are a more truthful portrayal of real residential energy access, which might commence a discussion on how to design future post-SDGs frameworks.

2. 研究の目的

The objective of this research is to characterise ES using energy, appliances and home characteristics in the socio-cultural context of Mexico. The study will elucidate local energy cultures associated to the preferences for ES provision and will elucidate a different lens of energy access vulnerability complementing the vision of universal energy access by the UN SDGs framework.

3. 方法

This research is comprised of three parts:

- (1) First, an investigation exploring the connexion between local culture and the selection of wall and roof material in a middle-sized ethnically diverse context: the Metropolitan Area of Oaxaca City (ZMVO in Spanish), which is comprised by Oaxaca City and 22 surrounding municipalities. With a brief review of the retrofitting initiatives at related governmental levels, the basis to analyse the choices and reasons for selecting specific materials for walls and roofs in the ZMVO is set. Then with primary data obtained through a survey, the analysis unveils to what extent cultural practises and preferences have been considered or left behind in the strategies and ensuing challenges.

- (2) Next, an analysis on a greater scale takes place. Seven energy services (household features, cooking and water heating, thermal comfort, cleaning, lighting, communications and entertainment) in three climates among five ethnic groups in Oaxaca State (Mexico) serves to complement the ES characterisation in diverse geographic, climatic and socio-cultural contexts.
- (3) Finally, at an even greater scale, the research identifies ES access patterns nationally. In this section, data for nine ES sub-domains (lighting, television, internet, refrigeration, cooking, washing machine, hot water, housing, and air conditioning) is used to estimate the ES access. The 2015 Intercensal Survey (IS) published by the National Institute of Statistics and Geography of Mexico provides the data for the analysis, which also distinguishes climate, geography and socio-economic condition. In addition, an interactive map based on the results is developed, useful to reveal graphically the differences on the access at municipal level.

4. 成果

The analyses found particularities in the provision of ES in Mexico. At the most local scale, the analysis of ZMVO homes reveals that homes have a traditional nature of more open space as well as firewood kitchens used for cooking and often for thermal comfort (Cravioto & Mosqueda, 2022a). This is typical of the region but different to other urban settings in the country. The selection of roof and wall materials did not relate to concerns on traditions, local culture or energy efficiency. Instead, more importance was placed on protection against environmental disasters and crime, particularly among households with precarious materials (fig. 1).

Another revealing fact was that energy efficient materials in use were experiencing a reduction. Despite the use of adobe on walls was once commonplace, now the more natural choice seems to be concrete blocks. However, concrete incorporated in traditional houses diminished thermal comfort and the aesthetic value among householders.

On the other hand, inadequate materials in this context intersect with other vulnerable conditions, such as deficiencies in water supply or sewage, and poverty. Preferences evolving into less energy efficient outcomes and the connexion between deprivation and less efficient use of resources are important issues of the household features' characterisation.

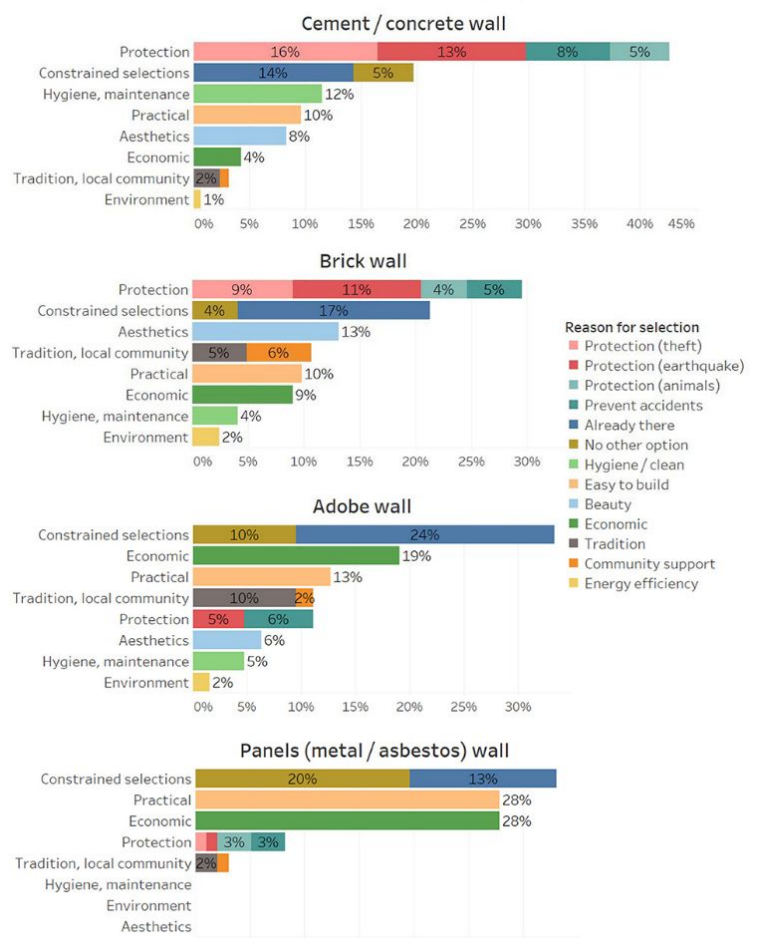


Figure 1 Wall material selection reasons (percentage of frequency)

At a greater scale, the second analysis stage found that preferences for some specific ES do vary among local cultures, but climate is the most determinant. For example, the use of air conditioners is only restricted to specific regions in Oaxaca State and nationally -the north and Yucatan Peninsula-, while the use of firewood for cooking is more commonplace in temperate climates dictated by a cultural choice. In Oaxaca State the use of residual heat from cooking is used for space heating and to heat water for drinking and bathing (Cravioto & Mosqueda, 2022b).

Moreover, in this context it not unusual to see agricultural residues such as corn stubble firing water heaters to provide hot water for bathing and cleaning. The results support that socio-cultural preferences determine the way ES are characterised.

At a national scale, another perspective surfaced. Regardless of climate differences, unequal access to ES exists in Mexico. In the first place, the differences between access to electricity and energy services is notable, and a significant proportion of households in the municipalities lacked basic ES necessary to satisfy human needs. Through interactive maps, it was revealed how the access level to electricity differs from any other of the nine ES sub-domains illustrated (fig. 2).

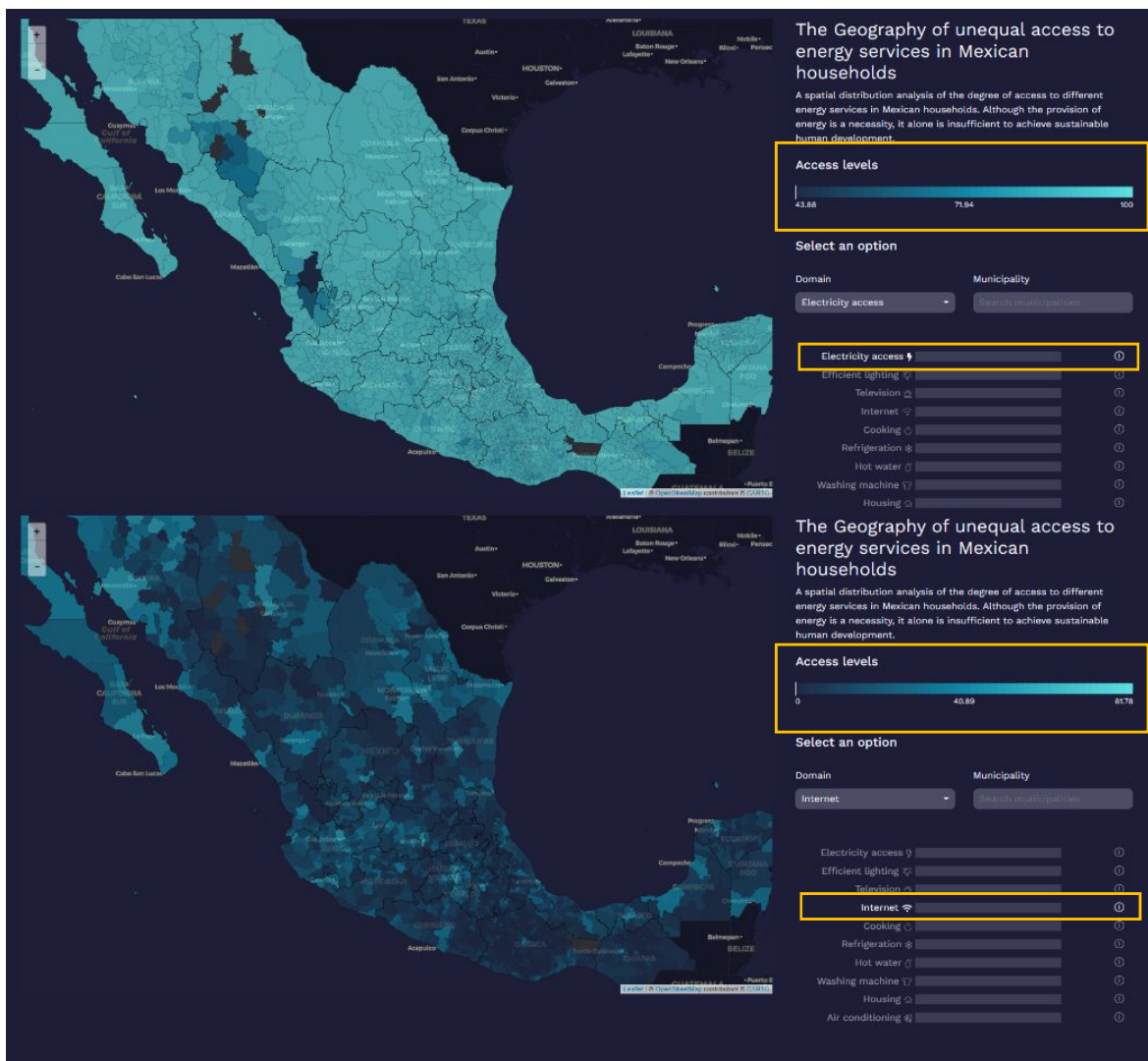


Figure 2 Comparison of ES access differences (electricity vs internet)

On the other hand, a strong correlation existed between overall ES access and other social conditions of vulnerability. Lower ES access linked with higher economic restraints, food vulnerability and predominantly the rural context. All these findings suggest the necessity to redesign energy policy and consider ES access to address social inequalities. More details about the outcomes briefly outlined above are discussed in Ochoa et al. (2022) and Ochoa et al. (2021).

In sum, the research developed insightful outcomes on the role of ES in sustainability measures and clarified the importance of ES in creating a more disaggregated vision of residential energy consumption. It also provided useful tools to identify vulnerability through novel lenses different to electrification and energy access. This could help to design strategies to improve sustainability in the sector. Finally, several directions stem for further research from these outcomes. In the first place, the application of the ES characterisation methods here

developed in more diverse contexts and scales. The limited time and budget did not allow for further replication of the methods in Japan and other contexts of interest. However, the potential to obtain insightful outcomes is clear. Continuity for the refinement and establishment of these methods is one important avenue to incorporate ES in more universal household energy vulnerability and sustainability metrics.

[参考]

Cravioto et al. (2014). *Energy Policy*, 73, 110-126.

Cravioto & Mosqueda (2022a). *Frontiers in Sustainable Cities* 3, 63.

Cravioto & Mosqueda (2022b). Energy services characterization: a study on cooking, temperature control and water heating practices in Oaxaca, Mexico
エネルギー・資源学会研究発表会 研究発表募集, Aug 08, 2022.

Ochoa, Avila-Ortega, & Cravioto (2022). *Energy Policy*, 164, 112822.

Ochoa, Avila-Ortega, & Cravioto (2021). *Terra Digitalis* Vol 5 No 1.

5. 主な発表論文等

〔雑誌論文〕 計3件（うち査読付論文 1件/うち国際共著 1件/うちオープンアクセス 1件）

1. 著者名 Jordi Cravioto; Rigoberto Garcia Ochoa; Daniel Itzamna Avila-Ortega	4. 巻 5-1
2. 論文標題 The Geography of unequal access to energy services in Mexican households	5. 発行年 2021年
3. 雑誌名 Terra Digitalis	6. 最初と最後の頁 1-7
掲載論文のDOI（デジタルオブジェクト識別子） 10.22201/igg.25940694e.2021.1.86	査読の有無 有
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1. 著者名 Ochoa Rigoberto Garcia, Avila-Ortega Daniel Itzamna, Cravioto Jordi	4. 巻 164
2. 論文標題 Energy services' access deprivation in Mexico: A geographic, climatic and social perspective	5. 発行年 2022年
3. 雑誌名 Energy Policy	6. 最初と最後の頁 112822 ~ 112822
掲載論文のDOI（デジタルオブジェクト識別子） 10.1016/j.enpol.2022.112822	査読の有無 無
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1. 著者名 Cravioto Jordi, Mosqueda Augusto	4. 巻 3
2. 論文標題 Local Culture and Urban Retrofit: Reflections on Policy and Preferences for Wall and Roof Materials	5. 発行年 2021年
3. 雑誌名 Frontiers in Sustainable Cities	6. 最初と最後の頁 638966
掲載論文のDOI（デジタルオブジェクト識別子） 10.3389/frsc.2021.638966	査読の有無 無
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 -

〔学会発表〕 計2件（うち招待講演 0件/うち国際学会 2件）

1. 発表者名 Jordi Cravioto
2. 発表標題 Energy services characterization: a study on cooking, temperature control and water heating practices in Oaxaca, Mexico
3. 学会等名 エネルギー・資源学会研究発表会（国際学会）
4. 発表年 2022年

1. 発表者名 Jordi Cravioto
2. 発表標題 Energy services and household energy access policy design [Los servicios de energia en el diseno de politicas de acceso a la energia]
3. 学会等名 International Colloquium on Energy Porverty in Latin America [Coloquio Internacional de Pobreza Energetica en America Latina] (国際学会)
4. 発表年 2020年

〔図書〕 計0件

〔産業財産権〕

〔その他〕

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6. 研究組織

氏名 (ローマ字氏名) (研究者番号)	所属研究機関・部局・職 (機関番号)	備考

7. 科研費を使用して開催した国際研究集会

〔国際研究集会〕 計0件

8. 本研究に関連して実施した国際共同研究の実施状況

共同研究相手国	相手方研究機関