



RESEARCH ARTICLE

ANALYZING THE INTERTWINEMENT OF SUSTAINABILITY AND RESILIENCE THROUGH A REVIEW OF THEIR MULTIPLE DIMENSIONS

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ABSTRACT

Some recent studies suggested that resilience could put an end to sustainability. Sometimes resilience is considered as one of the indicators of sustainability. However, the correlation between these two is complicated and this vagueness may weaken both concepts. The objective of this study is to clarify the correspondence of sustainability and resilience by doing a comparative analysis, in order to demonstrate the importance of considering both concepts simultaneously. Resilience is considered as the ability to become strong, healthy or successful again, after an unpredicted turbulence occurs. Additionally, sustainable development includes three main pillars; environmental protection, social equality and economic development. The correlation of sustainability and resilience in this paper, is studied for each of these three pillars. At the end, the importance of assessing any project from both points of view to have a real sustainable and resilient community is demonstrated.

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INTRODUCTION

It is possible to have sustainable cities -which can reduce resource and energy consumption, optimize waste management and be economically efficient- but not necessarily operative in the case of shocks and major turbulences, so that they are not resilient. Such cities are not truly sustainable. It is also possible to have resilient cities that are not sustainable according to energy consumption, social equity, economic efficiency, and so on. They are not even resilient, but rather resistant, as they resist the hazardous situations. As an example, on September 2004, more than one century of deforestation and soil erosion provoked landslide and flood in Gonaives (a commune in northern Haiti) (Figure 1). Absence of a mitigation plan left the homeless people hungry and worsened the situation. In the city, people were living on roofs, as their homes have become uninhabitable. This catastrophic event showed how an unsustainable way of development might increase the vulnerability of communities. The purpose of this study is to clarify the correspondence of sustainability and resilience in order to have a balanced development. In order to understand the intertwinement of resilience and sustainability, it is necessary to clarify their definitions prior to any further analysis.

Comparative Analysis: In the built environment, sustainable design refers to the methods employed to conserve capital, most often ecological in nature (Hassler and Kohler, 2014).

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Sustainability is a goal put in place to achieve demonstrable outcomes (Anderies, 2014). Sustainability is often associated with defined performance metrics that show how decisions or analytical frameworks are translated into previously defined goals. The concept of sustainability may be applied to systems of varying scales (Redman, 2014). Resilience typically does not set standards, but is instead a measure of the capacity of a system to both persist and adapt (Longstaff *et al.*, 2010). "It is important to point out that resilience is a system-level concept and is distinct from sustainability in that it is not normative, i.e., it does not include specific choices about performance measures" (Anderies, 2014). Resilience in the built environment often refers to the innate ability of a system to retain and resume functionality in the face of the effects of both acute shocks and chronic stressors (Longstaff *et al.*, 2010). A system's measure of resilience is dependent on changes across both temporal and spatial scale, unlike sustainability, which may be a static measure of outcomes (Anderies, 2014). Resilience is mainly considered at the community scale, and applying the concept to individual buildings is challenging (Longstaff *et al.*, 2010). Resilience has been referred to as the capacity of a system to absorb and adapt to change, while retaining the same essential functions and relationships (Vale, 2014). Sustainable development includes three main pillars; environmental protection, which is strongly correlated with global warming and other impacts to ecosystem; social equality, which focuses on the social well-being of people and the growing gap between incomes of rich

and poor; economic development, which generates economic growth without hurting the environment (Brundtland, 1987).



Figure 1. The effect of deforestation on Haiti-Dominican Republic border

The study of the intertwinement and the conflict of sustainability and resilience is done through this triple bottom line.

Almost all of the environmental impacts of human activities including global warming can cause hazards, or at least increase their intensity. Global warming has two primary aspects: a rise in the temperature and a rise in the sea level. The outcomes include an increase in the risk of drought, in the intensity of storms, and having more intense mid-latitude storms, etc. There are also some other impacts of human interventions which amplify the damage. Deforestation can be an example of such consequences.

The approach of sustainable development is to minimize the number or the intensity of hazards while resilience minimizes their effect. Furthermore, sustainability always encourages communities to build green buildings and generate energy using renewable resources, such as sunlight, wind, rain, tides, waves, and geothermal heat. They are eco-friendly as they decrease the non-renewable resource consumption; Thus, they lower the environmental impacts, which can reduce the vulnerability of communities. They are also more resilient since, in the case of hazard, these resources compensate a large amount of loss that comes from the infrastructural damage. This is why improving the resilience of building units, as the smallest spatial scale, is essential. From this point of view, starting from the building scale may be beneficial to improve the resilience of larger systems.

Social sustainability measures equity as the fair access to livelihood, education, resources, and level of participation in the political and cultural life of the community. In both sustainable development and resilience concepts, the social equity and participation play a key role. More equity - as a sustainable approach - leads to less vulnerability and improves resilience. As an example, after hurricane Katrina hit New Orleans in 2005 (Figure 2), being alive or dead, having a habitable house or being homeless was determined on the basis of how high from the sea level people were living. The level of the housing units above the sea - in New Orleans - became a characteristic of class stratification (Barnes *et al.*, 2008). On the other hand, place attachment - which is the emotional bond

between person and place - is one of the important indicators of resilience. It makes the habitants of a community tend to manifest their sense of community and to bond with other members of the same group by providing social and cultural services.



Figure 2. Weakness of social-economic equity increased the number of houses constructed in vulnerable regions of New Orleans

Socially sustainable communities can provide place attachment to a more extent, since they improve participation of residents. For example, cohousing is a type of intentional community composed of private homes supplemented by shared facilities. Cohousing has been always considered as a good example of a sustainable way of life. It has different ecological, economic and social benefits including improvement of place attachment and participation. It is easy to imagine how these factors can help the community act in a more cooperative way. Therefore, sustainability - by improving community competence and place attachment- helps resilience, and the effect is sensible in case of hazardous situations.

Economic Sustainability: The third pillar of sustainable development as stated above is economic sustainability. Economic sustainability is the ability of an economy to support a defined level of economic production indefinitely in a manner that sustains natural resources and provides social welfare. An increase in production does not necessarily lead to an increase in welfare. Index of Sustainable Economic Welfare (ISEW) is an economic indicator intended to replace the Gross Domestic Product (GDP), which is the main macroeconomic indicator of System of National Accounts (SNA) (Schepelmann *et al.*, 2010).

On the other hand, economic resilience is the ability to bounce back from economic shocks and to reduce the vulnerability of economies to crises and strengthening their capacity to absorb and overcome severe shocks while supporting strong growth. "A community needs to have access to resources to grow and react to changes" (Radloff, 2006). The difference between resilient and non-resilient economy is that the resilient economy addresses local needs on often locally based sources of employment, skills, and finances. Indicators of economic resilience determine poverty rate, income distribution, economic gaps, life expectancy, diversity etc. Both sustainable and resilient economy need to provide a defined level of production considering the social welfare and the income distribution.

In addition, sustainable economy tries to control the environmental impacts of this production level and improves resilience by lowering hazards intensity. For example, after super storm Sandy hit New York City and the New Jersey coastline, there was much discussion about large technical infrastructure solutions for dealing with expected future storm and coastal flooding. One suggestion was closeable sea gates at the narrow section of the entrance to New York harbor (Bloomberg, 2013). Nevertheless, these gates could lock the city into long-term maintenance costs that also had serious environmental side effects. This is how a risk reduction plan can amplify the problem if both resilience and sustainability are not considered simultaneously.

Besides these three pillars, both resilience and sustainability are strongly dependent on durability of the projects. Durability is an important indicator of sustainability. Improving durability means less energy and resource consumption. The longer the structure lasts, the less resources are required to build replacements. Furthermore, the more resilient buildings and structures are, the less maintenance is needed, and thus the cost of it is reduced. Durability is also integrated with the first sustainability pillar. If the life of a building increases, no matter what the building is made of, the environmental impact of its construction -which contains the largest amount of impact over building life cycle- is reduced.

In order to explain the correlation between durability and resilience, let's consider the two projects shown in Fig. 3. Project 2 is more durable than project 1. After an extreme event, Project 2 reaches the desired level of functionality sooner than project 1, because less resources and time are required to go back to the initial conditions; thus, requires less maintenance, and recovers quicker. Therefore, durability has a positive effect on resilience.

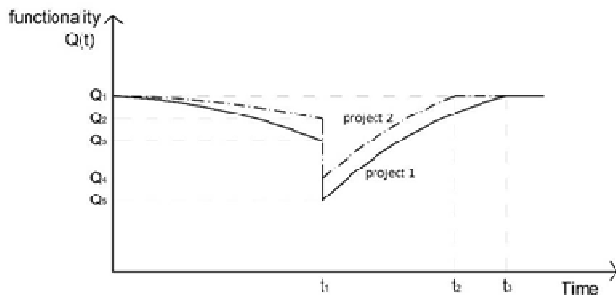


Fig. 3. Durability vs. Resilience

Conclusion

Resilience as a new approach in community development aims to reduce vulnerability and to adapt and recover from extreme events. This is different from resistance, which is the ability to prevent something from having an effect. However, the vagueness of its correlation with sustainability may weaken both concepts. Sustainability and resilience are essential for future cities, while they do not always approach the problem in the same way. Sometimes sustainability and resilience goals, if not examined carefully, can be completely against each other. This study presents this correlation in different dimensions, including environmental, social, and economic. However, to have a deep study of this correlation, the evaluation of both concepts must be developed.

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