

# THE PROBLEM AND POTENTIAL OF SUSTAINABLE DESIGN IN RESOURCE POOR SETTINGS: CASES FROM RWANDA

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## Abstract

The concept of sustainable architecture in the developing world needs to be holistically rethought. In the context of constraint based design, a sustainable movement should adhere to contextual and adaptive systems that are characterized by appropriate, available, and climactic specificity. However, these conditions often evade international development projects in the tourism industry, in which there are examples of "greenwashing" and failure to have a sustainable local impact. Such problems require us to rethink the meaning of "sustainability," expose an inherent ambiguity in the overuse of the term, and suggest the need for better metrics. Architectural projects have the potential to address sustainability in the context of development by employing innovative low-tech solutions that can have reverberant and systemic change on economic, social, and environmental levels. As an example, a naturally ventilated hospital in Rwanda shows how an architectural project can impact public health by mitigating the transmission of airborne disease, reduce energy consumption, energize a local economy, and build a local skilled labor force. In order for this design revolution to truly impact development, it needs to embrace an expanded definition of sustainable design practices that includes a more multifaceted approach to the built environment.

**Key words:** sustainability, public health, natural ventilation, ecotourism, design metrics, Rwanda

## 1. Introduction

### 1.1 Rethinking sustainability

Discussion of the sustainability of buildings has traditionally considered how maintenance systems directly impact the natural environment. This discussion is particularly relevant in resource rich countries, where going "off-grid" has become as much a financial goal as it has become an environmental one. In resource poor settings, however, where the majority of people begin "off-grid," the goals for a sustainable building are more fraught. In this context, sustainable architecture forces its practitioners to rethink the responsibility of architecture to address the links between infrastructure, the environment, and the social conditions that effect poverty. Sustainable design often begins with locally

sourced materials because they are low cost, but case studies show that such strategies can have a broader impact by advancing local building practice to be more sustainable in social ways. This is one of several strategies that is central to sustainability in resource limited settings and reveals both the current limitations and potential for expanded impact of the sustainability movement in resource rich settings.

The aim of this paper is to discuss the problems of sustainability when it is deployed in resource limited settings, which in and of themselves often embody the tenets of what the green movement aims to simulate, such as lack of dependency on electrical grids, use of locally sourced materials, recycling of industrial land detritus for construction, and access to communal and public transportation systems. In this context, this paper highlights a naturally ventilated hospital and an eco-lodge in Rwanda that address sustainability by striving to use architecture as a means to reduce poverty and build social value through design. This paper then discusses the problem of "green" design – better known as "greenwashing" – that undermines such goals. "Greenwashing" has come to define the problem of sustainable design and the opportunity to disguise it behind the facade of green innovation. When deployed in poor settings, the result is especially nefarious and reveals what is a cultural tension between an idealized image of energy independence and the realities of resource poverty.

Taken together, these projects demonstrate the need for new metrics to evaluate sustainable design; one that would apply to both resource poor and resource rich settings. The two most applicable metric systems relative to this discussion are the Social Economic Environmental Design (SEED) Certification developed by Bryan Bell, as well as the rating system for ecotourism developed by Martha Honey to reframe the larger social impact that sustainable design has the potential to engender. Such recent metrics were developed response to the United States Green Building Council's rating system for green architecture, Leadership in Energy and Environmental Design (LEED), which has been criticized as failing to take into account the social impacts of a sustainable project [1]. These newer criteria are the first steps towards an effective design revolution in which architects embrace a holistic approach of empowerment, economic potential, and envi-

ronmental change in order to address global inequities of poverty and health.

## 2. Butaro district hospital Case study

### 2.1 Need for an effective medical facility in Butaro, Rwanda

Located on the eastern and northern edges of Lake Burera and home to more than 400,000 people, the Burera District is one of two large Rwandan regions without a central medical facility. Those in need of care are forced to seek services in other parts of the country, often traveling for days on foot before reaching help. The Government of Rwanda, along with Partners In Health (PIH) and the Clinton Foundation, proposed a strengthening of the district health services including retrofits to the current health center infrastructure and a new district hospital in the town of Butaro at the northern edge of Lake Burera.

PIH, a leading NGO in public health, contacted MASS Design Group to assist on the design and construction of the Butaro District Hospital in November of 2007. Collaborating with PIH, the Clinton Foundation, and the Rwandan Government, the MASS design team endeavored to develop a hospital that would have a high impact and be committed to sustainable design strategies revolving around local materials, passive systems of ventilation for increased airflow, and the reduction of cost through the commitment to these strategies.

### 2.2 Benefits of using local materials and local labor

Locally farmed and manufactured materials were an essential strategy for generating local economies through the use of design. Pumice stone is abundant in this volcanic region and is used as foundations for structures, stone walls for security, and outcroppings in fields. This pumice, which is dark grey when mined and cobalt blue when sliced, was chosen as a cheaper and more sustainable alternative to the red cobblestones typically used for construction in the region. Beginning with the deep excavation of the site itself, the design process began by rethinking not only how to use this stone as one of the main construction materials of the project, but also how to showcase its natural texture and beauty through atypical wall constructions. Local materials and labor were intended as a means to create an environmental advantage to be complemented by the financial benefits of cutting costs and energizing local economies. However, the substantial, positive, and multifaceted influence of this decision was unexpected.

Drawings of the rock walls boasted tight jig-saw puzzle connections with intricate intersections and hidden mortar bonds. When the local masons made a mockup of the wall, the first attempt was dominated by thick mortar joints and imprecise connections. It was not until the fourth mockup that the masons achieved stunningly tight joints and efficient use of mortar that they could then begin work on the hospital walls. When the masons completed the first building, wrapping from the

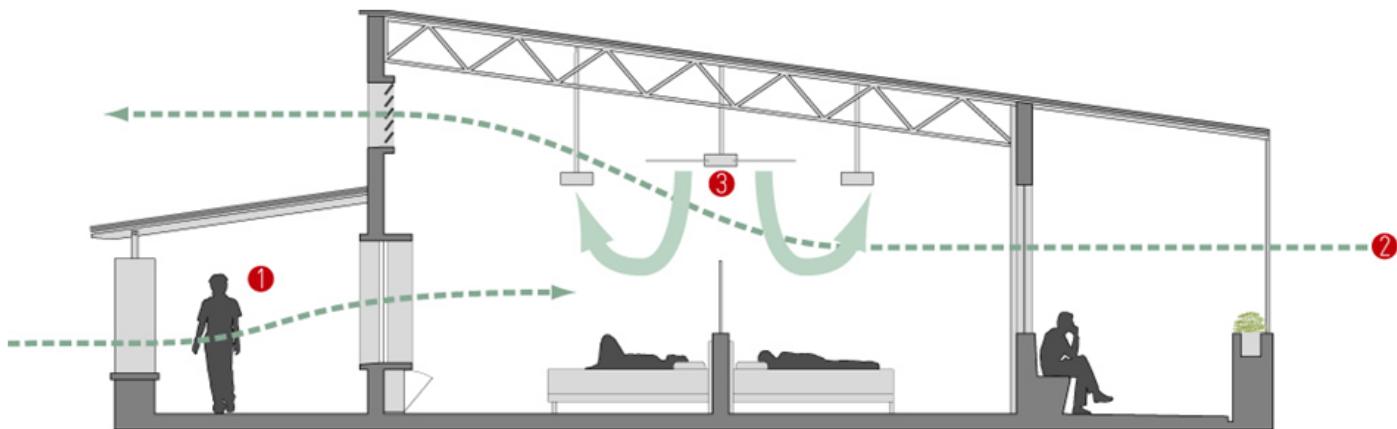
first corner all the way back around to the same spot, they had achieved such a high level of precision that they asked if they could knock down the original five meter wall and rebuild with this refined technique. To the architects and the foremen, this represented a solid example of design's ability to affect change. Skill, pride, craft, and quality had all emerged from just a bit more attention and a commitment to articulation and clarity on the site. Often, architects are not available for this type of consultation on site when working in remote areas like Butaro and thus quality, cost, and commitment to craft all suffer. In this case, the product, the architecture, the hospital, and the laborers all benefit. Recently, after hearing of the stone work of Butaro, these same masons were asked to build walls outside of Butaro, in both Ruhengeri and Kigali. The sustainable material and commitment to design produced a sustainable job force, a demand for higher quality standards, a means of developing craft excellence, and an outlet for displaying the enhanced abilities of the local craftspeople.

### 2.3 Impact of a natural ventilation strategy

Design solutions cannot emerge without a deep commitment to understanding local context. When designing a hospital, it is essential to study the key issues that dominate the region that the medical facility will serve. Since 2005, medical professionals affiliated with PIH had been working in Rwanda using a community-based approach to provide healthcare to impoverished areas. They were confronted by a deep problem in medical infrastructure where airborne diseases like Tuberculosis (TB) would emerge more potently over time, undermining their tireless efforts to treat patients.

PIH revealed that this was not just an issue in Rwanda, but also in the other countries throughout the world in which they had been serving since Dr. Paul Farmer founded the organization in 1985. Even as PIH expanded its services and shifted their policy and strategy for treating patients, TB infection continued to spread and the disease became even harder to treat as multi-drug resistant strains of TB became prevalent. In Mountains Beyond Mountains, Tracy Kidder describes patients coming to health centers with one strain of TB and leaving resistant to another one. Even worse, some patients would appear at a rural clinic with broken legs and walk out with TB [2].

If diseases like TB are transmitted through the air, then the infection rate will steadily increase when the air is stagnant. However, if fresh air is constantly being circulated, then the infection rate will decrease, showing that ventilation is fundamental to an effective infection control strategy. In developed countries, hospitals have extensive mechanical ventilation systems to bring fresh air into the building to prevent airborne diseases from incubating. In Rwanda, such a high-tech ventilation system is not locally available and consumes extraordinarily large amounts of electricity thereby making the operational costs of such a system too high to be considered a realistic option for implementation. The goal of a mechanical ventilation system is to increase the number of times the volume of air in a room is replaced by a



1. Exterior Circulation – Reduces exposure to transmission
2. Ventilation – Combination well placed operable windows and fixed vents increase air changes
3. Large Industrial Fans – Increases air turnover while maintaining patient comfort

fresh volume of air, which is measured in air changes per hour. The Butaro District Hospital uses a natural ventilation system to attain the same ends by utilizing architectural techniques that do not rely on imported advanced technologies and that are cost effective, easily replicated, adapted to local constraints, and that consume minimal amounts of energy. According to research conducted by Roderick Escombe, using such strategies can increase air changes per hour up to twice the amount that mechanical ventilation can provide [3].

Drawing on the expertise of in-house professionals certified in Engineering Methods for Airborne Infection Control from the Harvard School of Public Health, MASS focused on integrating infection control standards into the early stages of the design process. Some of the first design decisions were driven by a desire to maximize natural airflow throughout the hospital in order to mitigate the transmission of airborne disease. The hospital itself is a campus of several buildings as opposed to a central structure, which helps to maximize the airflow through each building. The footprint of each building on the campus is oriented in the direction of the prevailing winds to maximize the speed of the airflow. While wind is never constant, efficient ceiling fans significantly increase air turnover. Meanwhile, the pitched roofs encourage and increase stack ventilation from higher to lower pressure to maximize the amount of natural airflow through the buildings. Additionally, the pitched roofs create the opportunity for clerestory windows thereby increasing diffused natural light inside and reducing electric lighting costs and needs.

The internal organization of each building reduces the likelihood of airborne infection. The typical hospital design of rooms on either side of a hallway will block airflow from one side of the building to the other side. This scenario, called a double loaded corridor, can incubate disease if hallways are not ventilated well. Since Rwanda is a warm climate, the buildings are designed in ways that require people to walk outside wherever possible, eliminating infection-prone interior hallways and large waiting areas.

Additionally, by including isolation rooms for the most severe TB patients and by separating doctor and patient circulation as much as possible, the risk of infection is lower for people in the hospital who are not already suffering from airborne disease. In addition to these integrated architectural techniques, ultraviolet (UV) lights are used in waiting areas because UV lights help to kill airborne contaminants.

The measures taken in the Butaro District Hospital have contributed to raising the importance of infection control strategies in the design of medical facilities in Rwanda. The country director of MASS in Rwanda also works as the director of the Department of Architecture at the Kigali Institute of Science and Technology and integrates these ideas into the curriculum to educate and incubate the next generation of locally trained architects in such sustainable design principles. Because of the advocacy around this project, the Rwandan Ministry of Health now includes national standards for infection control and uses both PIH and MASS staff as consultants. Lack of standards is one of the root causes of poor performing buildings. The Butaro District Hospital addresses this by showing that high-profile, socially valuable architectural projects can change policy and have a significant impact on the development of effective local design practices.

#### 2.4 Lessons Learned from Butaro

Eco-conscious sustainable design strategies have more than just environmental benefits. Using the locally sourced pumice stone had a substantial economic impact on the local economy sending funds directly to the region in which the hospital was being built. The process of construction became a laboratory for building capacity and improving skills, which had economic benefits for the masons' careers. Meanwhile, natural ventilation techniques lowered upfront and even maintenance costs. Natural ventilation will reduce the rate of infection in the hospital, reduce healing times, and thus eliminate unnecessary medical costs. Finally,



changes at the policy level for standards in the design of medical facilities are imperative to creating appropriate infrastructural solutions in public health. These strategies reveal that there can be a reverberant economic, social, and environmental impact from relatively low-tech concepts that are locally appropriate and distributed easily, inexpensively, and repetitively. Post-occupancy assessments are soon to be conducted to better evaluate the successes and shortcomings of the project based on the function of the intended passive systems and feedback from doctors and patients. With this in mind, the team has established a weather station and research project to assess the performance of the natural ventilation system, recognizing that adjustments and better understanding of its performance in practice will improve designs in the future.

### 3. Ecotourism: from green washing to sustainability

#### 3.1 Exploitation under the guise of sustainability

The concept of eco-tourism emerged in the global “green” consciousness of the last decade and is now among the fastest growing subsectors in the tourism industry. For example, Costa Rica committed to an eco-tourist economy and subsequently tripled its number of tourists from 350,000 to 1.1 million from 1998 to 2001 [4]. The popularity of eco-tourism represents a change in tourist perceptions, increased environ-

mental awareness, and a desire to explore natural environments. According to the Ecotourism Society, ecotourism is “responsible travel to natural areas that conserves the environment and improves the well-being of local people [5].” Eco-lodges proliferate and are a fundamental component of this interest surge, reflecting a growing change in the consciousness of travelers to have a lighter impact on fragile cultural and environmental ecosystems.

While ecotourism at first seems like the ethical way to engage a community and place, it can have negative and negligent impacts as well. One result, referred to as “greenwashing,” involves the use of slogans and aesthetics to advertise a project’s eco-consciousness without providing true impactful amenities. Greenwashing is in essence a disguise to mask typical and sometimes exploitative businesses as “sustainable” ones that in effect have helped to muddy and confuse what one should consider “green.” In *Ecotourism and Sustainable Development: Who Owns Paradise?*, Martha Honey writes, “Much of what is marketed as ecotourism amounts to only eco-tourism lite, which offers tidbits of nature or minor environmental reforms such as not changing sheets every day or, worse, ‘greenwashing’ scams that use environmentally friendly images but follow none of the principles and practices of ecotourism [6].”

Doing field research and analysis of local precedents near the Butaro District Hospital in Rwanda, MASS un-

covered data showing proof of greenwashing and also confusion over what “green” actually refers to in the context of resource poverty. For example, there is one existing eco-lodge in Rwanda that is surrounded by fields of poor hillside communities yet charges \$1000 per person per night. When an electrical grid could add a huge economic stimulus to a community without power, an eco-lodge proclaiming energy independence in a community that has little access to energy seems overly convenient if not unnecessary at the price range offered. Meanwhile, hundreds of local people could have potentially been employed in ways related to this project, yet only a few people benefit from the income reaching the remote village. Instead of the efforts to promote a true social engagement, exploitative cultural charades are performed at the often unnatural isolation of the guests. This “green-island” effect has taken hold in many economies. Ironically, the lodge professes a sustainability pledge, exposing a reality that the terms “sustainability” and “green” can be interchanged without much oversight and have been eroded of meaning. Without viable alternatives or rating systems, this trend will continue. A clarification and articulation is required to understand better the impacts, both negative and positive, that these interventions can engender.

### 3.2 Burera Eco-Lodge

When a client in Rwanda expressed interest in building an eco-lodge near the Butaro District Hospital, MASS was asked to help with the design and conceptualization of the project. The Burera Eco-Lodge concept comes from principles learned over years living in the Butaro District. These principles are based on furthering expertise, creating new jobs and job markets, using local materials as much as possible, and using the community design process to realize the building. Because this project is for paying tourists, thinking could be expanded to include the influence of the lodge’s profit on agronomy, land rights, as well as education and trade development.

Set high above Lake Burera, the Burera Eco-Lodge is conceptualized as an alternative to greenwashing and as an example of tourism models that will advertise, rate, and benefit communities as much as or more than it benefits the customers. Working with a unique client and a spectacular site, the Burera Eco-Lodge seeks to generate a new model of tourism, with the aim of directly benefitting local communities. In working closely with Public Nature, a non-profit organization with expertise in social justice tourism, the design provides an alternative to the pervasive model of a high end hotelier working in complete economic and social isolation from the local context. Instead, the lodge stands on a moral imperative to create unique new and active tourism opportunities for the community to own, replicate, and benefit from. Acting as a venture philanthropist, the Lodge is seen as an engine to engage new markets and allow for communities to build business around its investment potential. Ideas include walking and biking networks, outreach centers featuring experimental plots for new farming and silvi-

culture techniques, a cooking exchange academy, and the development of commercial centers in more remote communities to support the guests’ outreach. The result will be a high end eco-lodge experience that is rooted, supported, and made more valuable by its relationship with the surrounding communities.

In addition to these proposed amenities, this project will be evaluated by strict benchmarks of environmentally and socially conscious sustainability. Rated through a set of metrics highlighting social impact, cultural value, education, job creation, new economic opportunities, impact on health, and community design outreach, the Lodge will allow guests to see their impact directly as well as understand how such an investment can become a fixture of a thriving and healthy civic community. This project has the potential to help redefine, using metrics, what “green” and “sustainable” should and should not refer to in the context of rural Africa.

## 4. A new rating system is required

### 4.1 Martha Honey’s metrics for ecotourism

Because greenwashing has become so common, Martha Honey has proposed the creation of a rating system in which eco-lodges and other ecotourism projects can be vetted by and for customers to assess community impact and experience. She argues that “real ecotourism must involve seven vital and interrelated characteristics: travel to nature destinations; minimizing negative environmental impact; building environmental awareness; direct financial benefits for conservation; financial benefits and empowerment for local people; the respect of local culture; and the support of human rights and democracy [7].”

Honey’s rating system is a good start but it suffers from a definitive way to quantify impact. Like many “green metrics,” the social and environmental criteria in this rating system are intertwined, making quality hard to determine. Furthermore, Honey’s expansive metrics do not clarify “sustainability” as much as they could. Her use of the term still acts as a catch-all for “good impact” instead of as a concept that refers to cyclical input and output divided among legible categories. In essence, sustainability and greenwashing emerge because of a lack of quantifiable metrics for the social impact of buildings. This is a primary reason why sustainability has been focused primarily on green buildings and not the more holistic potential of definitive environmental, social, and economic sustainability.

A parallel can be seen in the agriculture industry, in which so-called sustainable practices are ineffective because they have an inappropriate focus on capital-intensive standards and the private sector [8]. A study by Philipp Aerni shows that effective sustainable agriculture can be achieved in a more bottom-up solution in which farmers have agency to be entrepreneurs in a multifunctional context [9]. Aerni writes, “Farmers that feel to be in charge of their lives and able to successfully participate in the global economy may contribute to social empowerment in rural areas (social dimensions), generate more income and employment in the region (economic dimension) and become

more interested in managing their scarce environmental resources in a sustainable way (environmental dimension) [10]." Similarly, locally incubated architecture communities in developing countries need such agency to have innovative roles in initiating sustainable change. While Honey's metric system is an improvement from the standard metric system in resource rich countries ignore such aspects of sustainability by focusing on limiting the consumption of environmental resources, her system eludes the importance of considering such ways in which local entrepreneurship can facilitate multifaceted sustainable initiatives that lead to systemic change.

#### 4.2 Bryan Bell's Social Economic Environmental Design (SEED) Network

To change the status quo of this defensive approach to architectural sustainability, a metric system must be developed in tandem with exceptional projects that seek to showcase architecture's dormant social responsibility. Bryan Bell, a leader in articulating the social impact of design, has been developing a metric system to rate a buildings social environmental and economic impacts. The SEED Network was developed as a compendium to the environmentally focused certification program, LEED, which is the standard American metric system that rates the sustainability of an architectural project. SEED is an effort to showcase the larger impacts that infrastructure has on societies, cultures, environments, and economies. Bricks and mortar are just the end result to a dynamic and complex matrix of environmental, political, economic, social and cultural engines that could, if driven right, greatly benefit places of need. Bell's network focuses on the following five principles [11].

- SEED Principle 1: Advocate with those who have a limited voice in public life.
- SEED Principle 2: Build structures for inclusion that engage stakeholders and allow communities to make decisions.
- SEED Principle 3: Promote social equality through discourse that reflects a range of values and social identities.
- SEED Principle 4: Generate ideas that grow from place and build local capacity.
- SEED Principle 5: Design to help conserve resources and minimize waste.

Bell's system is based on the belief that architecture is a valuable way in which communities and individuals can address economic and social change. Crucially, he separates the two into different categories. Design and implementation are promoted as a collaboration between professionals and locals who are naturally experts on the needs of the community. While the LEED system is a series of checklists focused on the architectural design, the SEED Evaluator is a series of essays focused not only on the design intent, but also the effec-

tiveness of economic, social, and environmental sustainability strategies from schematic design through post-occupancy. This is intended to hold the designer and the client to a higher level of accountability. Each project is evaluated in the context of the community that it serves.

Bell's work addresses the larger impacts of the building without muddying the concept of sustainability as vague synonym for positive impact. Without such refined metrics, it is difficult to articulate why one project is successful over another, as well as why one project has some successful and some unsuccessful elements that could be improved without losing its integrity. However, a rating system is not infallible: the success of an individual project, or indeed of a social system, depends upon levels of social commitment and engagement to maximize impact over the long term.

#### 5. Conclusion

These Rwandan case studies show that expensive and foreign technologies are not needed to make significant contributions to sustainable design. In fact, by using local materials, local labor, and informed architectural strategies such as natural ventilation, it is possible to expand the impact of design to areas of health, education, and policy. In addition, choreographing the economic impacts of infrastructure development could allow for new economic opportunities, better environmental performance, and positive social change. This holistic vision of sustainability has as much relevance in resource rich countries as resource poor settings. Unfortunately, greenwashing is corroding sustainable design projects and even people with the best intentions get caught up in specific aspects of design that have minimal and isolated impacts at best. A more rigorous system of metrics is needed to evaluate a design's holistic, integrated approach to sustainability not only to reveal the falsity of projects obfuscated by greenwashing, but to develop guidelines for affecting community-based change at the local level.

Environmental sustainability alone cannot be considered as the primary means by which architecture can revolutionize development. While low-cost and locally available techniques like natural ventilation represent an eco-conscious approach to design in resource constrained settings, projects like the Butaro District Hospital show how a holistic design process can positively impact public health while socially and economically transforming a place. If architecture serves the poor, then building and the building process must do more than construct walls and roofs. When one member of the MASS team was asked the reason for building one first rate hospital instead of two second rate hospitals, he replied, "Rwandans don't deserve a second rate hospital. Plus, we can build a first rate hospital for the price of a second-rate hospital." Good design matters in establishing dignified spaces for individuals and communities and good architects are practitioners at using the built environment to propose new models of social, economic, and environmental sustainability in the context of constraint based design.

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## REFERENCES

- Bell, B. (2005) Guiding Community Design: Mission and Principles, SEED Network. <http://www.seed-network.org/principles/>
- Kidder, Tracy. (2003) Mountains Beyond Mountains, The Quest of Dr. Paul Farmer, A Man Who Could Cure the World. Random House, New York, NY
- Escombe AR, Oeser CC, Gilman RH, Navincopa M, Ticona E, et al. (2007) "Natural Ventilation for the Prevention of Airborne Contagion", PLoS Med 4(2): e68. doi:10.1371/journal.pmed.0040068
- Harrison, David. (1992) Tourism and the Less Developed Countries. Belhaven Press, London.
- Honey, M. (1999) Ecotourism and Sustainable Development: Who Owns Paradise? Island Press, Washington D.C.
- Ibid.
- Johnstone, R. (1999) The Greening (and Green-washing) of Kenya's Tourism, Eco-Resorts. <http://www.eco-resorts.com/Archives/mediakit8.php>
- Aerni, Philipp. (2009) "What Is Sustainable Agriculture? Empirical Evidence of Diverging Views in Switzerland and New Zealand", Ecological Economics, 68.6, 1872-882.
- Ibid.
- Ibid.
- Bell, B. (2005) Guiding Community Design: Mission and Principles, SEED Network. <http://www.seed-network.org/principles/>