

SUSTAINABLE SOLUTIONS IN LANDSCAPE CONSTRUCTION TO MINIMIZE ENVIRONMENTAL IMPACTS ON URBAN EXPANSION AREAS

Fernando Bontorim AMATO M.E.¹
Marcelo Vespoli TAKAOKA M.E.²

¹ Polytechnic School – Department of Civil Construction, University of Sao Paulo, Av. Prof. Almeida Prado, nº 83 – travessa nº 2, São Paulo, 05508-900, Brazil, fernando.amato@poli.usp.br

² Polytechnic School, University of Sao Paulo, Alameda Mamore, 989 – 21st floor, Barueri, 06454-060, Brazil, marcelo.takaoka@poli.usp.br

Keywords: sustainability, urban, development, greenfield, design, clustering, land-use, preservation

Summary

The population growth and the need to occupy available land brought bad consequences to the environment, e.g. habitats degradation and reduction of animal species. The urban expansion of the cities through actions that can mitigate environmental impacts in suburb areas is crucial to guarantee natural resources preservation. Identifying homebuyers' behavior, this article aims to recognize, from its conception and planning phase, strategies of sustainability to minimize environmental impacts in developing residential landscaping that seeks cities expansion. This paper is based on the Residential Genesis case, located in Sao Paulo metropolitan area, which adopted environmental sustainable policies through a clustering development strategy. The success of this development has been changing the local real estate industry that is looking for more sustainable projects.

1. Introduction

Rapid urban growth in developing countries has created major social, economic, political and environmental problems: an increasing incidence of urban poverty, inadequate access to shelter and urban basic services, social alienation, the proliferation of slums and squatter settlements, and poor urban infrastructure (PINCETL, 2002). In Brazil, the actions and measures implemented by the public authorities could not, in special, provide the population with suitable habitat conditions. Despite huge efforts there still prevails a high deficit in housing, due to problems arising from bad income distribution, difficulties in the construction industry and restrained offer of plots.

The fast growth of the urban population and the disorderly occupation of urban land, together with a growing rate of social and income inequalities have given rise to strong environmental impacts in the outskirts of the city, deriving from the clearing of native vegetation areas and from the pollution of the rivers (SIQUEIRA, 2001). Over the last decade, the lowest income families, unable to buy or have access to social housing, have had to live outside the city boundaries in very poor conditions with an inadequate infrastructure. The proliferation of slums and squatter settlements negatively impact their immediate environments through exploitation of natural resources, contamination of water and land by disposal of wastes in the locale and degradation and destruction of the habitats with reduction of the number of species.

The existing public resources are insufficient to build new habitats, provide quality public services and public transportation to all the inhabitants of the Brazilian urban centers. The cities cannot afford the costing of the expansion in infrastructure and services of the cities. The future of the cities, increasingly more populated and lacking physical space to grow, tends to depend on an equation between the fight for space through a growing intervention of the public authorities and a more active participation of the private sector. The private sector has a major role in this process due to the lack of government capacity to act on environmental issues. Sustainable development offers an opportunity to create environmentally sound and resource-efficient communities by using an integrated approach to design that is sensitive to natural resources and their protection (KELLENBERG, 2004). The adoption of sustainable solutions in conception, management and construction of new human settlements is essential to guarantee a better development on urban expansion areas and to protect the environment from degradation.

This paper intends to present sustainable solutions in landscape design and construction to satisfy housing needs, during the urban expansion process in mega cities. The text discusses concepts and solutions in residential development to reduce environmental impacts and to promote economic growth, environmental performance and social responsibility. The text presents an empirical contribution to the problem of urban

district regeneration through the successful case study of Genesis, located in Sao Paulo metropolitan area, which adopted environmental sustainable policies.

2. Landscaping Design and Site Selection

2.1 Housing Demand and Householder Behavior

The concentration of economical activities on the commercial and service industries, the new professions and the intensive use of technologies (IT and telecommunications), have changed the way people work, particularly in mega cities. Nowadays, work does not affect only the place people have chosen to live, but also their way of life. The possibility of working home and the flexibilization of time schedule give them freedom in selecting the place they will live. Nowadays, families tend to stick to quality of life rather than to privileged, central localizations. Spotting the trends in consumer behavior leads to new procedures regarding house-building. By acknowledging that people are increasingly more concerned about the environment where they live and specially with the natural resources, one can alter the features of new projects and incorporate such trends into the projects. A growing demand for habitats that contribute to the improvement of social conditions and the environment is crucially important for the private sector to direct their investments towards more sustainable developments.

On planning a given product for the market, the developer seeks to identify which attributes of quality are desired by the defined target-population. The potential buyer makes an evaluation of the current market prices x quality ratio before deciding on a given product. According to ROCHA LIMA JR. (1993), "the closer the product's attributes related to localization, neighborhood, accessibility, design, dimensions, and the intrinsic quality of the material and the finishing products are to the wishes of the buyer, the higher the quality. Such comparison shall not be taken in absolute terms, but compared with the other products on the market whose target is to reach that same buyer." Hence, the adoption of sustainable solutions in projects depends on the acknowledgement by the public, of the value of implementing more sustainable actions in their lifestyle.

People started becoming action-oriented as from the evaluation of the long term consequences regarding the environment. The quality of urban life is a constant preoccupation. Regardless of the educational level, environmental awareness of the population has been raising due to a clear perception that the future depends on attitudes taken in the present. Waste recycling programs, rational use of water, and energy-saving habits are not just fads anymore, nor the products of budgetary restrictions. Those actions are almost incorporated in the everyday routine, in such a way that they reflect a new way of proceeding, often translated into the consuming habits of society, and here one could include the choice of habitat.

Often one's living place has been determined by the answer to the following question: how much contact with nature does the place offer, and how can one grant its preservation? Aspects of nature like trees, forests, wildlife and open spaces are important attributes in new developments. They are plus-adding factors perceived by people -- in a way, however, that is not easily translated into tangible values. The occupation of distant areas in closer-to-nature surroundings, results in longer commuting time for people, and this ensues higher financial expenditure and consumption of resources, e.g. on energy as well as on human resources. The very incorporation to the projects of attributes that are more sustainable, leads to higher costs and prices. It is only natural that this additional "price" cannot be paid by everybody, but rather, is restricted to the wealthier families. Higher-income, more sophisticated markets have the discretionary buying power to better express their sustainable preferences than lower income, more value-oriented market (KELLENBERG, 2004).

The quest for sustainability can only materialize through the realization that there exists a consumer market concerned about the future of the planet, able (and willing) to pay for the additional costs resulting from the attributes of quality incorporated into the development, to preserve and restore the environment. Only then shall the three dimensions of sustainability be balanced: economically, environmentally and socially. Sustainable real estate developments can be one of the best mechanisms in reducing the environmental impacts in the expansion of cities, as they combine preservation and restoration of the environment as their attributes of quality.

2.2 Site Selection for New Human Settlements

The concept of sustainable environment implicitly carries the idea that natural resources must be used as efficiently as possible, and bear healthy interaction between people and the environment both locally and regionally. Hence, the site selection and the way through which the project will be implemented to meet the demands for new habitats are fundamental for a more sustainable development, bearing in mind that plots are nonrenewable resources.

Landowners (and designer if they are involved in the identification of suitable sites for proposed projects) can dramatically affect the protection of healthy sites by simply choosing other places to build. In particular, prime agricultural soils are of exceptional importance for any sustainable society. Many communities limit

building on these types of land in order to ensure continued crop production. Agricultural lands also provide habitat for many nonagricultural plant and animal species and can serve as migratory corridors. Neither designers nor contractors have much direct influence on individual decisions to subdivide and develop, but they can support planning approaches and political initiatives that encourage development on more appropriate land types. Among appropriate types of land for development, two stand out: [i] brownfield, where land damaged by previous use can be restored and put to new use, which decreases demand for development on healthy sites; and [ii] in-fill development, that encourages development of the many leftover spaces found in most urban areas. Skill, commitment, political backing, and innovation by designers and contractors support these land-saving strategies (THOMPSON, SORVIG, 2000).

The environmental quality evaluation systems of the developments can be used to guide the site selection process as long as they can signal the possible impacts on the projects' development. For example, the Ecohomes system: BREEAM (2002) argues that the innovative use of land can help in the development of sustainable communities where there is less demand for traveling by car and where brownfield sites and reclaimed industrial land are used in preference to greenfield sites. Many types of broad-scale planning have been used to protect an endless range of land types – including steep hillsides, fire-prone forests, and coastal beaches – from inappropriate development. Without appropriate site selection at both region and individual scales, the construction techniques cannot be truly sustainable and can in fact cause great damage. Site selection and even unpopular limitations on the right to use certain categories of land are an essential part of progress toward sustainability (THOMPSON, SORVIG, 2000).

From an environmental standpoint, it is usually better to develop on already-disturbed land. At this point, however, market pressures often necessitate greenfield developments. Moreover, government policies still subsidize greenfield development through existing taxes, zoning regulations, infrastructure grants, and other actions that encourage developers to seek greenfield sites for their projects (WILSON et al., 1998).

On admitting that it might not be possible to avoid using greenfield lands because of the scarcity of other sites for habitats, it is fundamental that a definition be established regarding strategies that can weaken the environmental impacts caused by the works of real estate developments. Implementing sustainable solutions at the selection phase implies seeking greenfield lands through a process that can: minimize the damages caused by the installation and maintenance of the physical infrastructure, protect the sites while the works are in progress, preserve the surface soil, save the trees, and adapt the road and drainage systems to the land declivity. Adaptation of the project to the best possible localization can render the project's approval easier and speedier, lower the implementation cost and heighten the chances for success, for the site selection is usually the keystone for successful real estate developments.

Care must be taken to avoid using land of high ecological value and avoid damaging existing urban habitats. Damage can be minimized by either selecting areas of land for development that have already little or no ecological value; such as previously built upon sites and areas of contaminated land. In some cases, a development may be built in a way that enhances the ecological value of a site, which can be achieved by encouraging the nesting of native bird species and by planting with indigenous plants (BREEAM, 2002). The indication of the deployment area in the development is made through previous analysis of the alternatives. FREITAS et al. (2001) state that "urban open spaces that already have infrastructure, are set aside vis-a-vis its available space, which not always is in agreement with the established practice of the large sized habitat clusters".

When a development of greenfield sites is undertaken, there are various strategies to minimize environmental impacts. These include clustering building on just a portion of the site, downsizing the project, protecting significant ecosystems and wildlife corridors, and reducing automobile dependence through compact land-use patterns. As WILSON (1998) points out, the strategy of protecting portions of a site as open space while increasing density on the developed areas is often the best way to preserve and restore land. Open space provides an opportunity for people to learn from and better appreciate nature, while protecting biodiversity of species and native habitats. In green developments, open space should be planned and located to balance needs and opportunities as recreation, preservation of wildlife habitat, carbon dioxide sequestering (using vegetation to take carbon dioxide out of atmosphere), food production, storm drainage, and noise reduction.

In identifying open space set-asides, it is important to consider not only those areas themselves, but also how they interconnect. Careful layout of a site offers an opportunity to provide contiguous wildlife corridors and habitat areas – reversing, for at least that parcel, the widespread trend of ecosystem fragmentation that is occurring nationwide. When possible, open spaces on one parcel should be linked with open space set-asides on surrounding properties. Keeping wide buffer areas along streams and valley bottoms is another important way to provide this sort of unbroken corridor (WILSON, 1998).

Clustering is particularly valuable and applicable when farmland is under development pressure. A 1990 study conducted by Jeff Lacy of Center for Rural Massachusetts found that a comparison of a real estate values in clustered subdivisions versus conventional site plans showed that people are willing to spend significantly more for the amenities and benefits of common open space with smaller individual lots. Clustering homes can substantially reduce infrastructure costs for developers – apparently without reducing

property values. Saving can be achieved, for example, by reduced paved area, minimizing the length of utility lines and sewer systems, and reducing the amount of earth removal (WILSON, 1998).

Sustainable development should identify how to protect in-fill lands located at the expanding fringes of a mega city, which are subject to degradation due to inappropriate occupation. The Genesis case showed it is possible to conciliate economic prosperity through sufficient developer's return over investment, society welfare and environmental preservation.

3. Case Study: Genesis, Sao Paulo (Brazil)

3.1 Conception of an Idea, Site Planning and Design

Developed by Takaoka Corporation (www.takaoka.eng.br), "Genesis" is a residential real estate development with emphasis on the preservation and restoration of the environment, intended to building detached houses. Conceived as from 1999, the development sought sustainable solutions in implementing a residential condominium in an area totaling one and half million square meters. About 30 kms far from the center of the capital city of Sao Paulo, the land is located, as seen in figure 1, in an urban open space between development poles in the cities of Santana de Parnaiba, Barueri and Sao Paulo. These urban open spaces were set aside at the time the growth process of the urban web of cities that make up the metropolitan area of the Great Sao Paulo was being developed.

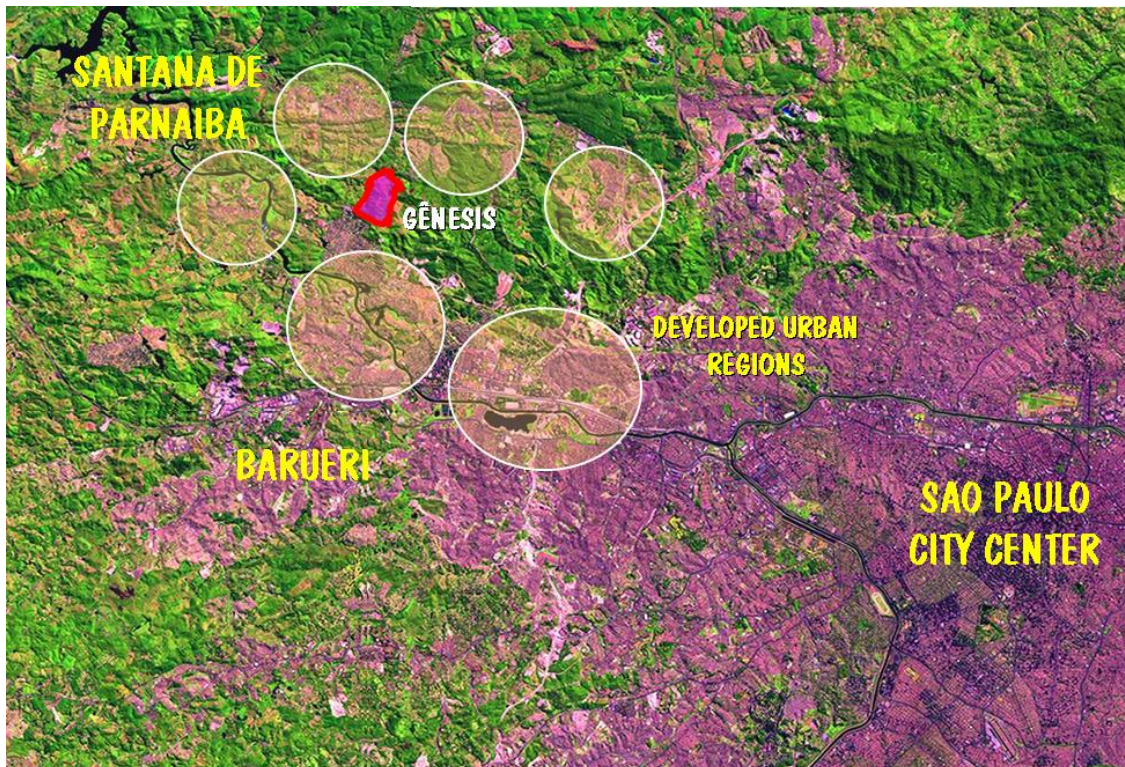


Figure 1 Urban Expansion of Great Sao Paulo and Location of Genesis Development.

Regarding infrastructure and urban services, the region has access to the local road system, public transportation, water supply, sewage & sanitary systems, garbage collection, local drainage systems, electricity supply and telephone services. Furthermore, the plot is mostly surrounded by residential areas, with small commercial stores and convenience services. The region's commercial and service infrastructure is pretty ample and diversified, with good restaurants, supermarkets, bakeries, news-stands, etc.

Before starting design, the developer surveyed 333 households in the region in order to identify their needs and yearnings. Because some sustainable program elements add costs, it is important to determine the degree to which buyers value the benefits and are willing to pay a sales premium, resulting in higher revenue. The challenge is to select the right mix of elements that will result in better financial performance in both short and long run (KELLENBERG, 2004). The survey indicated that they wished a community with more "natural open spaces" and amenities like walking and biking paths, fitness center, playground and others. Responding to the community's concern regarding environmental preservation, the developer has included more areas of open space and wildlife habitat. The decision-making process of the design was based on community opinions.

The selection process for areas to be developed sought to identify deteriorated zones located in the inner portion of the plot, which could be used to cluster the implementation of habitats. The project has two distinct areas for development, and one of them is covered with native woods at a secondary stage which were mostly preserved, as seen in the approved plotting project. The adopted strategy clustered 466 residential lots with approximately 500 square meters each, on a portion of the site that was already used as farmland, downsizing the project. The calculation of the plotting projects in the region, as usually practiced by the other developers, indicated that there could be three times more residential plots than all the plots in the Genesis project. The public departments that accounted for approving the real estate projects have been more and more strict as to the environmental preservation. The proposed more sustainable development met with enthusiastic approval by the authorities and represented a rupture in the paradigm that claimed it was not possible to offer any more green areas.

About two thirds of the plot's total area (a million square meters) were preserved and restored through a reforestation project. So, part of the area became a forest reserve voluntarily donated to the development, that is, over and above the legal requirements for approval. Regarding the areas where the plots are located, there was mostly low vegetation typical of pastureland. The project sought to use preferably this kind of areas of the plot so as to integrate the local residential occupation in a single centralized cluster, thus leaving the woods that surround the development as green areas for the residents to enjoy.

Both in the forest reservation area and in the plotting, the hilly topography is a feature that is also quite common in the region, i.e., rather uneven, with steep declivity. According to FREITAS et al. (2001), "plots with slopes in declivity set aside during the urbanization process, almost always give rise to informal settlements (slums), often with the ensuing social, environmental and geotechnical safety problems". Here, the way the development was carried out resulted in occupation that was not irregular and consequently the existing ecosystem was not destroyed.

3.2 Sales, Financing and Construction

In March 2002, the developers started selling plots for the future residents, even before starting off the works. The excellent receptivity to the concept and to the characteristics of the development resulted in 85% of the plots being sold in just three weeks, at a substantial price premium (over 10%) in relation to the other developments in the region. Genesis was positioned as a green project with high quality construction, which differentiated it from the competition. Many people like to be associated with developments that are forward-thinking and environmentally sound, because there is satisfaction and value from doing the right thing, both on the part of the developer and the homebuyer (KELLENBERG, 2004). Positive press coverage and the addition of many amenities have contributed to spread out the project success, calling other developers attention.

Genesis broke ground in May 2002. Careful site management was implemented to protect existing trees (e.g. by building up an abutment wall) and soil, avoid the need to repair erosion damage (e.g. by planting graminoids in advance), prevent pollution of groundwater and reduce the amount of required landscaping. During the construction phase, many practices are applied to select proper materials, avoid high noise levels, air and water pollution, and reduce waste generation. Several actions were taken towards assuring the sustainability during and after the construction phase, like implementation of practices for sustainable management of the forest through the transplantation of native trees and through a reforestation program. This way, it was possible to widen the range of flora species, capture carbon dioxide from the atmosphere to reduce the greenhouse effect, allow better absorption of rainwater, and protect the soil against erosion. Out of consideration towards the preservation of fauna, wild areas that would allow for the existence of animal species original to the region were preserved, water sources were maintained, and animal crossings were constructed – such were the steps taken to create ecological corridors of conservation.

The development still takes special care of the security and preservation of the environment through: (i) planned occupation of the region: (ii) steady watch of the project areas to avoid squatters (including hunters), and uncontrolled vegetal extractivism, and (iii) environmental education programs. The support to environmental education for residents and visitors, the creation of paths in the native woods for research, education and leisure, the signaling in the region regarding the care everyone must take upon entering the wood, the implementation of research toward environmental preservation, the creation of areas for scouting activities, and planting organic vegetable beds --- these are all measures that aim at integrating the community to nature. While the works were still in progress, there was an additional appreciation that raised the value of the plots by more than 50%, net of the inflation rate for the period. Communicating the value of the sustainable features to homebuyer is key. It is important not to promise more than can be delivered. The type of consumer interested in sustainable communities is very sophisticated, educated and questioning: they want quantifiable information. Minimizing the gap between expectations and delivery is critical for sales (KELLENBERG, 2004). By February 2005, just one year after completion, 24 homes were under construction and 29 others had already been designed.

The project aimed to foster an orderly urban spread, geared to reduce environmental impact in the edges of the city. Fostering the implementation programs for these developments tends to reduce the strong anthropic

pressure in the edges of the cities. Anthropogenic pressure often is the cause of irreversible losses in the local biodiversity.

4. Conclusions

The sustainability issue is highly relevant for society, governments and corporations. They must understand this new urban architecture, where mere compliance with law does not suffice: one must pursue innovation if an actual contribution to the improvement of the living conditions of the present generation is to be achieved, not forgetting the new generations to come. If sustainability is to be reached the biggest challenge lies in finding the equilibrium between economic and social progress and the preservation of the environment.

Green solutions cost money to implement, but this is not stopping many of the enlightened developers who believe the benefits of green far outweigh the costs (KELLENBERG, 2004). The value of open space is hard to quantify. Developers often consider only the revenue lost by keeping a portion of a project undeveloped. But good-faith efforts to protect habitat and open space, while concentrating development in prescribed areas, can offer both direct and indirect financial benefits to developers. Tens or even hundreds of thousands of dollars in legal battles with community and environmental activists can be saved by gaining early support for land protection efforts. And, protected open spaces can dramatically increase the desirability – and value – of property (WILSON et al., 1998).

In the Genesis residential project, born under the concept of clusters with extensive environmental preservation areas, it was possible to identify through the sales success and the increase in the price of the plots, the existence of citizens willing to contribute to the emerging new way of inhabiting the urban lands. The project shows how the development of a new community can be environmentally more sustainable, economically attractive and at the same time, a place that is agreeable to live in. Because they are lifelong developments perpetuated through the generations, developers can grant outstanding personal positions in the local history leaving precious legacies for their descendants

There is increasing recognition in the global real estate industry that an ethical investment approach can produce bottom-line benefits and increased shareholder value (HUGHES; SPRAY, 2002). Society inquires about the contribution of corporations to a better future for the planet, claiming for a socially responsible stance vis-a-vis harmful environmental impacts towards the quality of the ecosystems deriving from productive activities. Organizations now identify that environmental responsibility can be more than simply a marketing argument, but rather, it can be a corporate stand that improves market image, brings competitive advantages before the competition, and saves natural resources (water, energy, raw materials, etc.). Such attitudes can be translated into satisfaction by the stakeholders, cost reduction, facility in the obtaining of financial loans, support by the governmental entities and the sympathy of non-profit organizations linked to the environmental cause.

In summary, acknowledgement must be given to actions taken by the private sector towards the preservation, protection and restoration of the environment at the same time that they seek to promote the socio-economic development of the country grounded on the creation of jobs, habitats and better living conditions for the population. These are laudable initiatives which can be taken as examples for those who still believe the planet to be an unending source of natural resources for humanity.

References

- HUGHES, C.; SPRAY, R., 2002 Smart communities and smart growth – maximising benefits for the corporation. *Journal of Corporate Real Estate*, London, v.04, n.03. pp. 207-214. Henry Stewart Publications.
- KELLENBERG, S., 2004. Making green communities work. *Real Estate Issues*, Chicago, v.29, pp. 24-29. Counselors of Real Estate.
- PINCETL, S., 2002. Practice and theory of urban sustainability in the developed and developing nations. Los Angeles: USC Center for Sustainable Cities. 85p.
- ROCHA LIMA JUNIOR, J. Planejamento do Produto no Mercado Habitacional. Sao Paulo: EPUSP, 1993. (Boletim Tecnico da Escola Politecnica da USP, Departamento de Engenharia de Construcao Civil, BT/PCC/110).
- THOMPSON, J. W., SORVIG, K., 2000 Sustainable landscape construction: a guide to green building outdoors. Washington: Island Press, 348p.
- UNITED KINGDOM, 2002, Building Research Establishment Ltd., BRE Environmental Assessment Method – Ecohomes – The environmental rating for homes. Garston: BRE. 71p.
- WILSON, A. et al., 1998 Green Development: integrating ecology and real estate. New York: John Wiley & Sons. 522p.