Sustainable Communities as a Response to Climate Change: Analysis of Geroldsäcker Eco-Housing Project and Recommendations for its Replication Considering Current Urban Challenges

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Abstract. Geroldsäcker eco-housing is a unique project located in the northeast of Karlsruhe, in a 1.24-hectare plot with constructed area of 5.600m². The planning of the project started in year 1989 and its completion happened in 1992. It is composed of 40 residence units: apartments and 3 store row-houses with private garden. The initial concept was an ecological settlement with common infrastructure and spaces for human interaction, using constructive ecological materials and devices for the residences and common areas. The community living sense is one of this project’s highlights. The 120 residents not only share common spaces, such as a community house destined to events and practice of activities, but also developed task groups to cover all necessary workspaces in the settlement. What can be observed nowadays is that Geroldsäcker, even being implemented 3 decades ago, presents several important sustainability aspects in the ecological, social and economic dimensions. What started as a pilot project at a time when the definition of sustainability was still under discussion, can be considered a model not only of sustainable housing, but also as a broader model for sustainable communities. This paper explores the aspects identified in Geroldsäcker eco-housing project leading towards a sustainable community concept. Potentialities and improvement points are analysed, considering current urban challenges, such as high demand and costs for land, lack of public land for experimental projects, efforts to stimulate bottom up processes, the behaviour of current generations, the need for new and environmental friendly constructive patterns, and how to aggregate stakeholders to boost new models of sustainable communities projects.

Keywords: Sustainable communities, Geroldsäcker housing project, sustainable housing.
1. Introduction

Planners have a great challenge today in developing spaces that demand numerous conditions to be fulfilled: spaces must be safe, in areas not considered vulnerable and, in case of any vulnerability, resilience aspects must be considered, they also have to be environmentally friendly and attractive to bring people to live in.

Since the 80’s, sustainability emerged as trend to new developments and behaviours considering that the current lifestyle and population growth would end up consuming many natural resources and compromising the environment for future generations. Parallel to sustainable housing concepts [1–4], other thematic were gaining importance and bringing broader perspectives, such as the sustainable communities.

The goal resides in achieving this concept: planners can provide sustainable spaces, eco-friendliness, transport connectivity and sustainable and resilient houses. However, people have an important role in this process. Sustainable culture must be a part or a root of the development.

Identifying a sustainable community involves several aspects from different perspectives. In this paper, an analysis of the eco-housing project Geroldsäcker is held, and many components are identified boosting this project as not a simple sustainable housing but also as a sustainable community initiative. Key elements that could be applied in other projects are identified, with the objective of upscaling and developing more sustainable communities such as Geroldsäcker.

2. From Sustainable Development to Sustainable Communities

In the late 1980s, the Brundtland Report was published, defining “sustainable development” as the “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” [5].

The definition from Brundtland Report is still in use nowadays, and the concept improved on how can the sustainable development be achieved. Today, the balance of environmental, social and economic variables is indispensable to work with sustainable development [6].

Considering climate change, most course of actions towards minimizing climate change have been reactive adaptations based on past events. It has already become clear that a transition to proactive methods to face the altered future climatic conditions is needed. Such actions can be done by individuals, groups, society or governments; regardless of the level, they all interact with each other, i.e. they are not self-regulating.

The success of these actions usually depends on the scale of implementation and the criterion for evaluation, just because a goal was accomplished in one level it doesn’t exclude it from failure on a different group. It is only when the members share the same values and beliefs that technical and social aspects can be separated and treated independently and as such have a higher change of equal realization [7].

Sustainable houses are what results from social processes behind design and construction, in particular the belief and motivation of their authors. Such motion already possesses high credibility due to the effectiveness of new sustainable technologies, aesthetic presentation that is media-friendly and the framing of eco-friendly as in “low carbon housing”. The interest of said frame is to reduce demand for energy from the grid; when viewed from this perspective, the governments’ interests are set as a primary driver and with the rebrand of policies and activities long advocated, the public’s attention and interest to get involved can be captured more easily.

The life cycle of sustainable houses might be seen as a negative aspect, past experiences make it seem as if sustainable houses cost more, nonetheless the idea behind the scale up process can be applied here as a counter-argument: selling the land for development at a lower price, while retaining financial stake in said development. Housing will be popular, on high demand, and through that some benefits can be obtain with each house that is sold off. Ultimately, cost and benefits will be shared for all groups involved [7].

It is important however, to not drift apart from the premise of sustainable communities, “low carbon housing” is only seen as a sensible financial investment, but masking it this way tends to put some distance between the real solution: a life style where citizens learn and keep deep green values,
where they can clearly feel that their actions or lack of them, have a direct impact on their lives and to those whom surround them.

The best adaptation communities can have, is towards an altruistic connection with the planet. Not because is need it in order to survive, but because the harmony and synergy with the environment allows an easier, healthier and happier life. For us and those who come after.

3. The Advent of Sustainable Communities

After the concept of sustainable development emerged, several authors began to apply the concept to local scales and delivering different approaches, such as sustainable housing, sustainable energy and sustainable communities.

Sustainable communities can be defined as the place that attend the needs of current and future residents in different age scales, promoting high quality of life and opportunities. Natural resources are used effectively and the relations among residents and their environment promotes social cohesion and inclusion, environmental awareness and economic prosperity [8]. Sustainable communities are also well planned and safe places offering equality and good services for all [9].

Governments are in effort to stimulate the creation of sustainable communities. There are many initiatives, especially in Global north governments [10]. A well-known agenda was the Sustainable Communities Plan, developed in England in 2003. The goal of the document was to guide the development of communities considering environmental, social and economic premises, coinciding with the current sustainable development definitions. Some initiatives to provide these sustainable communities include the recovery of urban infrastructures, empty properties demolition and creation of new towns and communities [11].

Generating many critics over land availability and housing market in England, the plan was revoked in 2015, in an initiative to hinder demolitions and provide new uses for empty buildings [12]. The plan was substituted by a range of plans and funding for innovative projects and community-based initiatives. Despite of the plan’s rescission, the concepts explored in the document that characterize a sustainable community are still in use. According to Egan [8], sustainable communities should present the following components (Table 1):

Table 1. Description of Components of Sustainable Communities Concepts (adapted from Egan, 2004)

| Components of sustainable community | Description / main features |
|-------------------------------------|-----------------------------|
| Governance                          | Governance systems that lead to inclusion, participation, representation and leadership. |
|                                     | Strong partnerships, community and voluntary sectors. |
|                                     | Sense of responsibility, community and civility. |
|                                     | Continuous improving. |
| Transport and connectivity          | Transport facilities and accessibility. |
|                                     | Walkability and Cyclability. |
|                                     | Wide telecommunication and internet access. |
| Services                            | Education and training for people. |
|                                     | High quality local health care facilities. |
|                                     | Provision of variety of services. |
| Environment                         | Efficient use of natural resources. |
|                                     | Environmentally friendly actions (recycling, walking, energy saving actions). |
|                                     | Protection of natural resources. |
|                                     | Sustainability consciousness. |
| Economy                             | Jobs and training opportunities. |
|                                     | Land to support economic prosperity and change. |
|                                     | Strong business community. |
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Housing and built environment
- Sense of place for the community.
- Green spaces.
- Range, diversity and affordability.
- Well-designed built environment that describes the community.
- Well planned, diverse and environmentally friendly buildings.

Social and cultural
- Sense of community.
- Friendly, respectful, cooperative and tolerant environment among different members.
- Opportunities for cultural, sportive and leisure activities.
- Inclusion and similar life opportunities.

Considering the definitions explored above, the objective of this paper is to analyse Geroldsäcker eco-housing project in Karlsruhe – Germany and explore its potentialities and improvement points that would lead this initiative into a sustainable communities’ concept.

4. Geroldsäcker Eco-Housing Project
Geroldsäcker Eco-housing is located in the northeast of Karlsruhe, in a 1,24-hectare plot with constructed area of 5,600m² (Figure 1). From this constructed area, 500 m² were designated to offices – including the office of project architect Andreas Löffler. The conceptualization of the project started in year 1989 and it was concluded in 1992. It is composed of 40 residence units in different typologies: building apartments and 3 store houses with private garden.

![Source: Google Earth, 2018](image)

**Figure 1. Location of Eco-Housing Geroldsäcker**

The project area is in a residential vicinity, with vast green and recreational areas and also access to public transport – approximately 500 meters from S-Bahn station – and cycling paths (Figure 2).
Geroldsäcker uses ecological materials and concepts in its construction and infrastructures, which will be further described. Regarding accessibility to services, the project is located in a residential area, even though there are reasonable offer of services nearby, such as small health clinics, supermarkets, educational facilities, and many spaces for leisure and sport activities (Figure 3).

The development and construction of the eco-houses involved the participation of the Municipality of Karlsruhe, KIT - Technological Institute of Karlsruhe, Associated Architects office Löffler & Schneider, Credit Institution Karlsruhe Initiative Group for Ecological construction and the initial community initiative to create the design of buildings [14] (Table 2):
Table 2. Stakeholders’ Role in Geroldsäcker Eco-Housing

| Stakeholder / actor | Role |
|---------------------|------|
| Community initiative Karlsruhe Initiative Group for Ecological Construction e.V – (40 members) | Started with a citizen initiative of 20 people “Ökodorf”, that asked for the KIT support for a common ecological housing project. The community started and managed the process of planning and construction, participating in the concept and design of the eco-houses. |
| Municipality of Karlsruhe | In the 90’s, the Municipality had reserved area to develop pilot projects (experimental buildings). Supporting publicity of the project by making every person wanting to buy apartments in the city aware of the Geroldsäcker project. |
| Architectural Office Löffler & Schneider | Among 12 architectural offices the one of Mr. Löffler won in an anonymous competition, due to the mixed typologies project. |
| University of Karlsruhe | Provided framework for participation of citizens (offering location), while the architects provided components for the modular construction system and planning concept. Technical support for planning, design and construction |
| Kreditanstalt für Wiederaufbau | Financing – credit loan - program ”Ökologisch Bauen Energiesparhaus 60”. |

*Source: Löffler, 2018 [14]*

This model of participation was pioneer in the early 90’s and was unique for the region of Baden Württemberg. Nowadays, the availability of areas for implementing pilot projects is decreasing in Germany, mostly due to land demand [15].

The identification of the sustainability aspects of Geroldsäcker Eco-housing project which can lead to a sustainable community concept was provided by literature research, site visits, interviews with residents and the settlement responsible Wilfrid Bettels [16], the architect in charge of eco-housing development, Andreas Löffler, [15] and [17].

5. Analysis Geröldsacker Eco-Housing Sustainability Aspects

Under the ecological, social and economic dimensions of the sustainability concept [5], the most important factors regarding the project development and operation were identified and are here described (Figure 4). The relation with the sustainable communities is then held in the next session in order to identify the potentialities and points of improvement for these type of projects in German reality.

*Figure 4. Main Aspects Considered for Sustainability in Geroldsäcker Project in Terms of Economic, Social and Ecological Aspects*
6. Ecological Aspects

Under the ecological aspects of the project, the eco-friendly construction features are an important characteristic for the projects’ housing sustainability [18]. System for reusing grey water, composting toilets, harvesting and use of rainwater for gardening, toilet flushing and washing machines, use of solar energy, gas boiler combined with solar system, wall heating system with healthy materials, and also green natural barriers to contain noise from the nearby road are some of the ecological construction features of the project [19].

The project presents a community house for leisure activities and wide car-free opened area, enhancing the adoption of sustainable and non-motorized transport modes. There is one parking space for each residential unit, located in an underground garage. To bring groceries from the supermarket the residents use a trolley to help the transport [16].

Regarding the location of the project, the place is covered by public transport, and a reasonable number of services (Figure 5). Residents, in most of the time, access these services with bicycle and use the car to go to city centre and distant places.

Source: Löffler, 2018 [14]

Figure 5. Photo of The Communal Area of Geroldsäcker Eco-Housing

About 120 inhabitants reside in the eco-housing settlement with an average household size of three persons, with age range from 11 months to 75 years [16]. Partially shared open spaces and a community house enable strong communal living. Inhabitants point out the close and friendly relationship between neighbors as the key aspect for the attractiveness of their settlement. “Cultural events, various leisure groups, barbecues, etc. ensure a diverse and interesting settlement life” [20].

Furthermore, every resident is obligated to do ten hours of communal work per year. Therefore, the community implemented so called “task groups” to cover all relevant jobs that must be done, from administrative work to gardening. Construction improvements in each unit is a decision from each resident. As a result, there are some units that do not have solar panels yet.

When it comes to integration with vicinities, in general outsiders are welcomed by the eco-housing community, however, most of the time face different conditions than community members. The community house can be used by residents free of charge (once a year, afterwards for a symbolic payment of €10), whereas outsiders have to pay €150 for the use of the space. These outside-community members, however, have to be known by at least one member of Geroldsäcker eco-housing community, so they can make use of this space.

The participation in activities such as yoga classes held in the community are possible for outsiders, but also with a higher price (1€/ yoga-class for residents, €2.5/yoga-class for non-residents). Festivals
hosted by the Geroldsäcker-community (e.g. “Friday barbecue”) are for members only. Only very close relatives can be brought.

Buying an apartment in the eco-housing settlement as speculative financial investment is forbidden by the municipality [15]. That means, all residents are owner of their apartments. A selection process ensures that applicants share the same values as the existing community in terms of ecological and social aspects. Apartments for sale are never advertised publicly, and there was never the necessity to do so, and can therefore only be bought by people already knowing the community (mostly family or friends of community members). Renting the apartment to third parts is also forbidden in the community, with rare exceptions.

7. Economic Aspects

Regarding the maintenance of the eco-houses, the expenses of the common areas of the settlement are equally shared. Resources like water and energy are monitored by all residents, being a transparent process. The common areas are maintained by residents’ cooperative work and use of shared tools, such as lawn mower and garden kits. Whenever there is a need of public maintenance or new public procurement, ideas of residents will be collected and then decision will be made.

By optimizing the construction features such as heat isolation, light intake, rainwater harvesting, the monthly utility cost is also quite reasonable, in comparison with other residential areas. Nowadays, residents pay an average cost of water, heating and electricity of €250 per year [16].

The factor contributed to the affordability of this project is the mixture of row-housing and apartment complex, with typologies varying from 23m² to 220m² depending on the need for space. In addition, the modular construction system provided different packages to be installed in the apartments [15]. Residents could choose the package which was best suitable for their financial situation and needs.

The project started as a bottom up process, the community initiative “Ökodorf” consisting of 20 people initiated the project. Gradually, the project acquired stakeholders’ interest and collaboration. The municipality offered the lot for this project as “Emphyteusis” (i.e. property rights is limited to use of land, not ownership) and the apartment prices were restrained not to be higher than the comparable conventional apartments in Karlsruhe [15].

There was no involvement of private investors, only the financial agency. The municipality provided the right to use the land to the community, in the figure of society. The participation of stakeholders was intense in the project, led by community expectations, and even contributed to intensify the workload to develop sustainable materials and the houses [15].

8. Potentialities and Improvement Points from Geroldsäcker Eco-Housing Towards Sustainable Communities

Considering the definitions and components of sustainable communities (Table 1), Geroldsäcker eco-housing somehow explores all dimensions, some more visible than others. As main potentialities of this project, the environment, housing and built environment and social and cultural components are highlighted. It is visible from the first site visits that the construction features, the diversity of house typologies and the planning of not only the houses but common infrastructures explore deeply the environmental friendliness concept. More than construction itself, the community is conscious and has a sense of belonging and responsibility with their space.

Regarding services and transport and connectivity, being a small community, with about 120 people, these components attend what is expected for the community, but it is uncertain how the scenario would be if this community was larger. From the aspect of transport and connectivity, the settlement has easy access to public transport (S-Bahn and Bus line) and bicycle routes that connect the settlement to other regions in Karlsruhe, despite the location of the project in a suburban area of the city. Most residents have cars, however, for daily activities, the bicycle is the most used mode. The car free area inside the project also has an important role of creating a consciousness on the use of sustainable transport modes. One present weakness and possible future strength, for this project and others whom which to use it as a model and build on top of it, is the lack of integration with electric vehicles. While it is true that 30 years in the past this was not a necessity, the new generations are
adopting little by little this new technology, which is increasingly more efficient and economical. This could well be the key to tipping the balance in favour of this type of projects and make them more attractive and beneficial to both people and organizations: integration with new technologies to provide a futuristic notion.

In terms of services, inside the project there is only the provision of the community house for residents and vicinities. Residents have access to a range of services in nearby areas [Figure 3]. In this sense, the discussion of which services are necessary to a community regarding its size arise. When considering the project upscaling for bigger communities, the provision of a variety of services (including health care and education) will be indispensable, but in the case of Geroldsäcker eco-housing, these services are available and “shared” with different communities and neighbourhoods.

Economy is one of the least explored aspects in the eco-housing project, regarding its definitions for a sustainable community. Due to the small scale of the project, there are no job places. What is seen is the community work from the residents in the diverse activities necessary to maintain the settlement. Also, there is no strong business culture in the community. Even so, it is possible to assume that for bigger communities, with a diversity of services, as stated previously, some particular spaces could be transformed to allow small commercial activities to flourish, such as markets, coffee shops or restaurants and small convenience stores. This allows members to engage pro-actively and assemble stronger bonds.

In terms of governance there are many aspects that can be detailed and taken as an example from the project. Geroldsäcker was an initiative of a group of people, interested in a different and ecological approach for housing. The bottom up process is better known as a community-based housing initiative. In order to generate more sustainable communities with this characteristic, identifying potential communities and capacitate community leaders and representatives becomes necessary.

According to Dr. Gerd Kuhn, the main challenge of participatory projects is that group initiatives are often overchallenged by planning tasks. Therefore, allocation of tasks being done either by the community or by the planning agencies must be defined clearly. Transparent communication between the public sector and other stakeholders is essential [17]. Land availability is also an important factor for governance and economy. The eco-housing Geroldsäcker was feasible because of the land availability for experimental housing projects at the end of the decade of 80. These plots for experimental projects, however, started to enter in disuse in German municipalities due to, among other factors, the price of land and the pression of expansion of urban areas [15].

An innovative mean of implementation is the concept procedure [17]. In contrast to the common practice of selling the plot to the highest bidder, surveyor determines an appropriate fixed price. Different actors, such as citizen initiatives, assembly groups (Baugruppen) or real estate developers can apply for the land with their concept. Whereby, the municipality can embed guidelines for the concepts, such as compulsory community spaces. Thus, the decision is taken according to the best idea and quality, creating room for the participatory approach. Means of implementation could be appropriate zoning, land regulation plans and incentives for construction: The city of Tübingen implemented instruments to control land use and occupation to prevent investors from acquiring land in the first place.

An innovative strategy implemented in Kirchheim allows the entrepreneur to build on 20% of the plot, whereas the land use of the remaining 80% is determined by the citizens’ initiatives [15]. In both scenarios municipal authorities should provide legal framework and guidelines, but only engage in the planning procedure when necessary. This way, bottom-up processes are supported, letting communities design their urban landscape according to their needs, maximizing social benefits.

Much of the success of the project was due to the stakeholders’ model, their interests aligned perfectly, allowing a smooth collaboration among all actors; back then, land availability was not a problem and the economic condition was such that set the ground upon this idea began to take form, but in order to ensure the success at a greater scale is necessary to encompass a broader range of actors, in a much more complex model of participation. Nevertheless, it was only throughout the community initiative “Ökodorf” of 20 people, all sharing similar environmentally friendly belief, which started everything. These projects might be affected by the lengthy bureaucracy needed to accomplish big goals, but communities are capable of accomplishing 100 little things faster, so long as
they are guided properly and make all their members feel engaged and develop a sense of belonging. After all, “A thread usually breaks where it is thinnest” [21].

9. Conclusion

Geroldsäcker project has unique characteristics that justify its role as reference in ecological housing and is a successful project in many of its aspects. It started as community initiative, a bottom up process. The community asked for the university support to develop ecological houses and the municipality had, at that time, available areas designated to experimental building projects. Geroldsäcker cannot just be interpreted as an eco-housing project due to its construction features. It involves several dimensions of sustainability that evolves to a concept of sustainable community. From the social and cultural traits of its members, is safe to conclude that they all encourage each other to be sustainable, the “everyone knows each other” culture ensures the feeling of a big family; there is a one to one correlation between how integrated a person is in a community and how much sense of fulfillment it feels. They serve as an inspiration, a role model of how to be a personal hero for the planet.

Sustainability is already part of the corporal agenda, with increasing energy costs, in order to meet this demands investors, companies and governments are already looking for innovative ideas to make this possible; development of new technologies must be meet with the desire, need and knowledge to properly use them; by up-scaling the model, observed threats in the current model can be ameliorated and this new stakeholders can take part, providing financial support, and administrative and technical backups.

Finally, with the improvement of Geroldsäcker model, people will be properly capacitated and able to apply the same concept to other sites in order to create more sustainable communities. As every member brings their collaboration to the table, and experiences firsthand how their actions do have a positive impact in their surroundings, this may ensure an eco-friendly life style that will pass to the upcoming generation.

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