

Article

Green Innovation Areas—En Route to Sustainability for Shrinking Cities?

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Abstract: Green Innovation Areas have been developed in the US context of urban development in order to jump-start innovative solutions in abandoned areas. Prospective types of uses in these areas are not predetermined, but should be experimental and innovative. So far they can comprise vast greenhouse uses to less extensive clover fields, but their potential is not yet fully discovered. Implementing new and innovative economic uses in urban areas is relatively new in research for urban areas, in particular, when development types like bioeconomy are implemented. The joint German–Mexican research presented in this article aims at exploring the use of vacant inner urban spaces as Green Innovation Areas—discussing their potentials for sustainable development of shrinking cities.

Keywords: shrinking cities; green infrastructure; sustainable land use; urban and regional development; Germany; Mexico

1. Introduction

All over the world, many cities are undergoing structural changes—many of them showing symptoms of economic crises [1]. In these ‘shrinking’ cities, the transformation of former brownfield sites has left a large number of urban areas vacant. How should these cities be revitalized? Very often, sustainability and also substitute industries play a major role in these attempts [2,3]. Previous research by the authors made clear that revitalization often utilizes green infrastructure for more sustainable types of uses such as urban gardening, farming, or agriculture [1,4]. Indeed, abandoned urban areas offer options for a sustainable transformation of former industrial or commercial sites [5], and also for generating jobs in emerging areas thus, transforming the identities of places.

The joint German–Mexican research presented in this article aims at exploring the use of vacant inner urban spaces as so-called ‘Green Innovation Areas’—discussing their potentials for sustainable development of shrinking cities.

1.1. Background: The Phenomenon of Shrinkage

In recent years, many cities started efforts for dealing with the issue of shrinkage, thus, many policies, planning strategies, and various projects were developed. Generally speaking, their purpose was to provide a counterbalance to the causes of shrinkage and to halt or invert the downward-spiral of decline. In part, these efforts were based on planning as a means to expand urban or economic development, in part to manage decline. However, these strategies share the notion of improving the quality of life in the respective shrinking cities and the abandoned urban areas.

The theoretical background of this paper is based on the observation that—when looking at its causes and effects—the phenomenon of shrinking cities can be distinguished from general trends of population losses. The megatrend of globalization and its implications on the local level can influence urban development on national, regional, and local levels. This dialectic of globalization and localization and its implications on local networks was framed by Swyngedouw as ‘glocalization’ [6]. Of particular interest is the question of how urban development will deal with the challenges imposed by shrinkage. The development in between globalization and local policies shows increasing importance of strategies which are not based on growth.

One decisive factor for the strategies to be applied is if a city has accepted its fate of shrinkage. Then most likely cities will actively take on policies and measures in order to manage decline. These approaches often comprise right-sizing and greening strategies with the purpose to initiate community gardens, urban agriculture, green belts as new forms of open space and landscape.

Thus, the shrinking cities phenomenon might create new prospects for sustainability and also the quality of life for citizens, although it comes at the prize of tear-downs and demolitions of urban quarters. Also in the US context of shrinking cities, many cities, most of them in the Rust Belt, have started to combat shrinkage in order to search for more sustainable land uses and development patterns apart from growth.

Greening, green infrastructure, and green spaces became more and more of a wide-applied urban development tool [7], not only in shrinking cities. Thus, ‘greening’ can be viewed as a strategy on all planning levels, from state to city.

For shrinking cities, which display large amounts of brownfield sites and abandoned spaces waiting for reuse, greening embraces revitalizing these spaces for a variety of uses, be it parks, urban gardens, new habitats, flood-mitigation, and/or agricultural areas [8]. In addition, more sustainable urban development policies can be implemented, including bicycle paths, walkability for pedestrians, and a range of beautification measures for urban areas [9].

Consequently, greening shows opportunities for sustainable development in social, economic, and environmental terms. The potential for greening shrinking cities is yet to be discovered, and it might take a while for communities to realize that many abandoned areas will not be places of future development. These areas could instead be considered in new networks of green infrastructure. Moreover, the benefits for residents are apparent, as these new green spaces improve the quality of life, supply additional spaces for recreation, and increase property values [10]. Additionally, greening can also leverage economic potentials in urban areas, enhancing entrepreneurial opportunities in the city.

1.2. The City of Flint’s Path of Shrinkage

Flint/Michigan is an example of a shrinking medium-sized industrial city located in Genesee County the so-called Rust Belt of the USA. The city was founded in 1819 as a trading post and quickly grew to some importance, due to its location. At the beginning of the 20th century, the Buick motor company relocated to Flint and became a part of the new founded General Motors Company (GM), which fueled the city’s growth at that time [11]. This strong dependence on one branch, respectively one company, caused enormous problems when GM cut down its employment from 80.000 people in 1978 to 50.000 people in 1992 and only around 8.000 employees in 2006 [12] (p. xxi); [13]. Consequently, rising unemployment lead to out-migration [14] (p.140 ff.). In 2010, for instance, Flint was counting 102.000 inhabitants, about half of the population it had in 1970 [15].

The loss of population over the last 40 years left the community in a desolate state. This becomes obvious when looking at the abandoned building stock of more than 11.000 vacant buildings and almost 6.000 buildings in some state of deterioration [11]. Moreover, more than 40% of people in Flint lived below the national poverty level in 2011, an increase of almost 15% since 2000.

In order to deal with vacancies and decline, the city applied a range of strategies and policies. Until the early 1970s, the federal program for urban renewal was used to tackle urban blight and redevelop the areas. By the end of the 1970s the development was focused on private investments

supported by federal funds in form of Urban Development Action Grants (UDAG) and Community Development Block Grants (CDBG). Flint received 10 of these grants (out of 112 in total in the state of Michigan) and was, thus, successful [16] (p. 57). In the 1990s, some improvements in the downtown district could be achieved [16] (105 ff.).

In 2003, Michigan passed one of the most progressive land banking laws in the US-based on the work of Genesee County. With this new land banking law, the County was able to adopt a brownfield redevelopment plan that utilizes a unique Tax Increment Financing strategy. This enabled the Land Bank to redevelop its properties in a more effective way [14] (p. 144).

Starting in 2011, the city initiated a master plan process labelled “Imagine Flint” in order to shape the overall development of the city utilizing a community-based approach. Various projects like the “University Corridor” or the riverfront development were included in the plan. In addition, this plan highlights greening as a strategic tool in the city’s revitalization path. In particular, the master plan introduced so-called ‘Green Innovation Areas’ as a new land use type. The reason to develop this new land use type was the high number of vacancies in residential areas throughout the city which should partly be converted to areas of green infrastructure. In turn, this should open up employment opportunities in the city’s neighborhoods. This is, in particular, of interest as the tax base in shrinking cities is dwindling, yet costs for the maintenance of infrastructure remain high. At the beginning of 2014, the zoning codes to implement the master plan were approved.

Green Innovation Areas could be a solution for attracting business opportunities. Nevertheless, in the case of Flint, it left many open questions, in particular, from the residents whose neighborhoods would be downsized and transformed into uses which seemed uncertain. In addition, a huge drawback in the city’s revitalization efforts occurred with the city of Flint’s water crisis in 2014, posing a threat to public health [4].

Despite all the struggles the city of Flint has to face in coping with the decline, the place types developed in the city’s master plan appear to be an innovative tool in terms of planning approaches. This is, in particular, the case with the place type Green Innovation area. Based on the insights of the Flint case with the yet to be defined category Green Innovation Areas, the authors initiated a joint German–Mexican research project which will be outlined in the paragraphs below.

2. Green Innovation Areas (GIA) as a Development Path for Mexican and German Cities?

2.1. *The Green Innovation Areas in Germany and Mexico (GIAGEM) Experience—Framing Joint German and Mexican Research on Green Innovation Areas*

Following the National Research Strategy “BioEconomy 2030” of the German Federal Ministry of Education and Research [17], an interdisciplinary approach is considered necessary which ties in with aspects of societal change—involving different stakeholders in knowledge exchange and by bundling individual research topics. In addition, approaches for regionally- and locally-adapted land management and decentralized approaches should be tested [17,18]. Major challenges lie within sustainable use of natural resources, and in supplying land for bioeconomic uses in a way that minimizes land use conflicts [18]. What would that imply for establishing bioeconomy in an urban realm?

Traditionally, public policies of bioeconomy have been imported and imposed by external pressure on Mexico without considering the local conditions, leading to high levels of influence and power of economic and/or political elites and provoking serious conflicts. Consequently, it is required to formulate policies, strategies and regulatory frameworks in a country with weak governance.

As mentioned in the introduction, shrinking cities often turn to substitute industries to create a new economic basis. The implementation of new and innovative modes of production attached to a bioeconomic development scheme in the urban realm is so far not represented in research for urban areas. Issues and land use conflicts, often raised by civil society, might extend towards nuisance, over-exploitation of space and rising land prices, leaving many open questions for urban research when it comes to implementing bioeconomic uses in urban areas. Nevertheless, bioeconomic development in urban areas might be a vital source for sustainable development perspectives—in

particular, in shrinking/old industrialized cities, thus, enhancing the quality of life and economic perspectives for citizens.

Already in 2007, Jordan et al. [19] called for a more integrated and sustainable approach towards bioeconomic uses: “Financial and policy support should be given to the multi-stakeholder processes of learning, deliberation, negotiation, and experimentation that are needed to establish and evaluate research and demonstration projects” [19] (p. 1571). In the same direction goes the discourse of a co-creation of society and biotechnology: First attempts in this respect suggest a quality based agricultural production based on regional/local food chains and a ‘strategy of territoriality’ based on sustainable land uses [20]. The concept of a regional bioeconomy has since then taken shape with further research studies, such as where examples of urban gardening in the city of Berlin are showcased as best practices of bioeconomic uses [21]. Nevertheless, a discourse on the potentials and strategies regarding bioeconomic uses in postindustrial cities is yet in its infancy—let alone a means of implementing bioeconomy as a land use type in urban planning and development processes and decision making.

The German–Mexican team designed the project as a proposal for a joint call for bilateral projects by the German Federal Ministry for Education and Research (BMBF) and the Mexican Consejo Nacional de Ciencia y Tecnología (CONACYT) in the area of bioeconomy. Investigating bioeconomy from the realm of urban and regional development was a novel approach, and thus, the project was approved for funding. The project work was carried out from October 2016 until September 2019. The approach was motivated by further exploring Green Innovation Areas as a new land use type.

As highlighted earlier in this paper, the US city of Flint, one of the major cities caught in a long term spiral of economic transformation and decline, has brought about the urban planning category ‘Green Innovation Areas’ in order to implement creative and innovative solutions in existing vacant spaces. The hypotheses underlying the research presented here is that leveraging vacant inner city spaces could offer novel solutions for industries, such as bioeconomy, and kick-start urban transformations in a strategic way. As part of the German–Mexican research collaboration, the project GIAGEM (Green Innovation Areas in Germany and Mexico) aimed at enhancing the use of vacant inner city spaces as Green Innovation Areas for bioeconomic uses and their potentials for implementation in German and Mexican cities. GIAGEM investigated the following research questions:

1. Which key knowledge transfer aspects regarding green Innovation Areas can be derived from ongoing projects (Germany, Mexico)?
2. What are the legal, administrative, economic, and societal conditions for green Innovation Areas and for developing areas for bioeconomic uses in Mexican and German cities?
3. In what way can existing approaches, such as Green Innovation Areas serve as prototypes for other cities (toolkit)?
4. Which areas for further research can be identified by the partners, setting the frame for coordinated projects?

The main output of this research was a roadmap defining the different steps in order to prepare cities and local communities, as well as SMEs in planning and decision making processes to implement bioeconomic uses in urban areas as an innovative and sustainable urban land use.

2.2. Methods of the GIAGEM Research

Methods applied in the frame of the project GIAGEM include qualitative and quantitative approaches building on the individual competencies relating scientific and operational practice in urban development and comparative research and urban transformation processes. A literature review was employed for data acquisition of Green Innovation Areas as the potential for bioeconomic uses. In addition, a comparative model for the German and Mexican projects and cases was developed, outlining basic requirements and indicators for GIAGEM. In addition, comparative research methods were applied for studying the projects in order to identify the strengths and weaknesses of previously

applied strategies for Green Innovation Areas. These factors will enable a learning process on green Innovation Areas, and on different strategic approaches on how to deal with this space for bioeconomic uses.

To accomplish these goals, case studies were carried out, applying a contextualized comparative approach to find variations, and common features and differences [22]. The selection of case studies was also based on the following hypothesis:

- Problems of urban development, in particular shrinkage, are leading to a change in traditional planning strategies, which influences the use of planning strategies.
- Planning strategies are embedded in the local cultural context and cannot or hardly be transferred to other cities regardless of similar conditions.

To discover best-practice examples, as well as advantages and disadvantages of strategies and measures utilized in shrinking cities, the method of embedded case study research [23] was applied. With this approach, in-depth analysis of actors, their motivation, actions, chances and limits, can be assessed.

The core of the investigations relied on primary data from sets of distinctive, semi-structured, in-depth interviews in the years 2017 and 2018 with government agencies (city planning departments, regional entities and ministries), political decision-makers, NGOs, developers and academics. These interviews were prepared and evaluated on the basis of statistical data, archive material and a sound review of literature on urban development in Mexico and Germany.

The interview questions on all cities partly focused on the current situation regarding population development and housing and possible critical points in the history of urban development (e.g., major shutdowns of plants, the introduction of policies, etc.). Furthermore, specific policies applied in neighborhoods. In addition, specific aspects regarding the cities were considered, such as growth pressure in some parts of Guadalajara, and the metropolitan/regional setting of the Ruhr Area in Germany.

Once the findings were gathered, good-practice examples of Green Innovation Areas were identified and described in a table using a comparable criteria grid. The purpose was to give insights into the project and show requirements for possible replications on other brownfields in a structured and comparable way. Of particular interest was the aspect of governance, how projects were initiated, steered, managed, monitored, and evaluated. This shed light on the particular context of local planning and development in Mexico and Germany.

Moreover, recommendations for the future implementation of Green Innovation Areas were formulated. Hence, these examples represent a kind of a toolbox to implement Green Innovation Areas and to give inspiration for innovative ideas.

In addition, two research workshops (one in Mexico, one in Germany), offered a platform for discussion of concepts and approaches among researchers and public and private actors in an interdisciplinary mode, engaging both fields: Shrinking cities/urban development and bioeconomy. On this basis, strategies and policy recommendations were derived, and the possible ambiguities and gaps in knowledge regarding planning for shrinking cities were outlined in a handbook for city governments and the private sector.

3. Insights and Results from GIAGEM Case Studies

In terms of case study research, the authors identified several German and Mexican cases to be investigated, that were grouped in terms of their approach towards bioeconomy with respect to the food sector, energy sector, and socially driven.

The findings for the four of these cases are most representative of GIAGEM in terms of their scope and aims, are summarized here (for the full report, see Pallagst et al.). *The Role of Green Innovation Areas in Revitalizing German and Mexican Cities, 2019, University of Guadalajara*). The four cases were selected as they are beyond the initial development phase and have been operating for several

years now. Thus, there are already experienced with the potentials and also possible risks to be avoided. Moreover, they represent the main areas of the research: Food sector, energy sector, and socially driven examples.

3.1. Aquaculture Fresh, Germany

3.1.1. General Approach and Aims

One important part of the bioeconomy sector is food production. While many people would consider urban plant-based farming, the first approach in this segment, the example displayed here stems from animal-based products. Among the German cases examined is 'Fresh Sea Fish Farm' located at Völklingen. Interviews for this case study were carried out in November 2017 with the staff of the fish farm, and a former government employee.

Increasing demand for fish worldwide led to overfishing. Aquaculture, thus, offers an alternative to satisfy demand and reduce the ecological footprint. Located on a former coke plant, the area has undergone a tremendous redevelopment process initiated by the city government.

The plant utilizes several innovative measures, and from the beginning, its operation is accompanied by an on-site research hub operated by the University of Applied Sciences of Saarland, and a specifically created chair for Aquaculture. The aquaculture plant comprises four large fish water pools and operates in a resource-conscious mode based on closed-looped biological purification (see Figure 1). Almost 100% of the energy is generated by solar-, wind- and hydropower (interview with the staff of the fish farm, November 2017). The aquaculture includes four large fish water pools and uses the resources in closed-looped biological purification. The Fresh Völklingen system is designed for an annual production of 500–700 tons of fish. A further extension of the fish farm is possible as adjacent areas are already reserved for this purpose (interview with staff of the fish farm, November 2017).

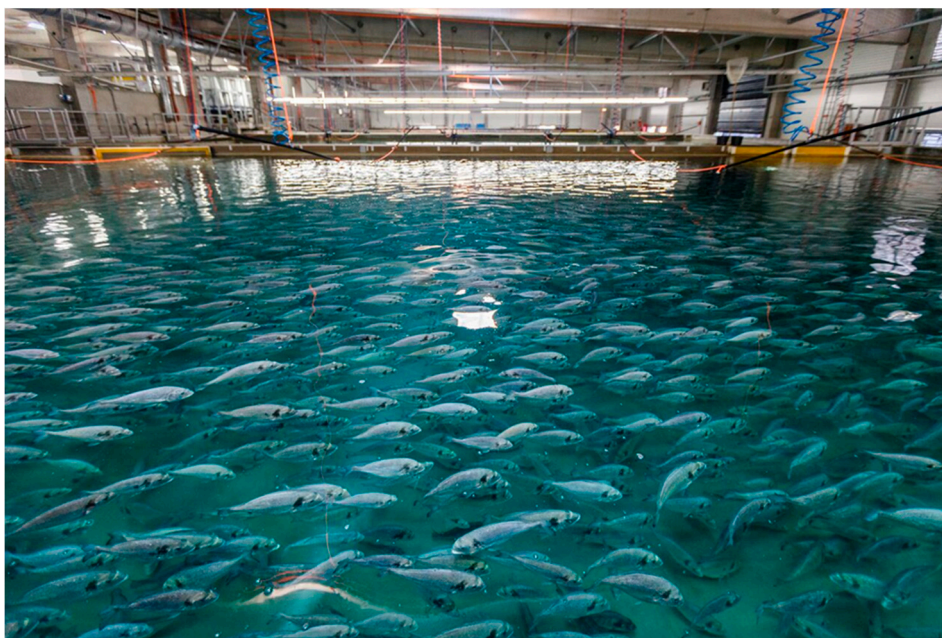


Figure 1. Fish in the fish farm Fresh (picture courtesy of Fresh).

3.1.2. Location and Background

The city of Völklingen is located in the state of Saarland, on the banks of the River Saar. The aquaculture company is situated on the site of a former coking plant in the city of Völklingen (see Figure 2). The total area of the company involves around 10.000 m². The production area covers around 6.400 m². The area is zoned as industrial land.

The fish farm at Völklingen is the first of its kind, and with no comparable standards available. The initial development process, which was driven by a city-owned company, was overshadowed by a highly contested mix of over-ambitious goals and mismanagement (interview with staff of the fish farm, November 2017). The development was all in all too focused on creating an innovative plant, and did not consider the market in an adequate way. The long line of mismanagement and the skyrocketing development costs of in total 25 million Euros, almost lead to a governmental crisis in the state of Saarland (interview with a former government employee, November 2017). In 2015, the plant was close to bankruptcy and was sold to a private entrepreneur for about two million Euros. Since it is operated under the wings of the private sector, the plant is starting to generate profit. Despite its innovative approach, the project is still stigmatized by the bad image of its development phase (interview with staff of the fish farm, November 2017).



Figure 2. Location of the fish farm in the city of Völklingen (photo courtesy of Fresh).

3.1.3. Reflection on the Case

The fish farm at Völklingen demonstrates that a formerly vacant industrial site can be re-claimed with an innovative use. In this respect, the location of the farm shows attributes of green innovation. The idea behind Fresh is a brilliant end of pipe solution regarding food security. Since the sale of the fish farm from the public services to a private investor, it is operating more efficiently. The interviews made clear that a public-private partnership could have secured good governance in the planning phase. Apart from the troubled start of the project, the Völklingen case is highly relevant as a Green Innovation Area, and it also has the potential to be implemented in other locations.

3.2. Energy Park Mont-Cenis, Germany

3.2.1. General Approach and Aims

The energy sector is strongly tied to the intention of bioeconomy in supporting energy transitions from fossil-based fuels to more sustainable energy systems. The Green Innovation Area Mont Cenis highlights an energy park created on the site of the former mining plant “Mont-Cenis” in Herne/Germany, located in the Ruhr Area. Interviews for this case study were carried out with city planning staff and the project manager of Mont Cenis in February 2017.

At the core of the site lies the academy for advanced training, which is surrounded by a glass climate envelope (see Figure 3). This structure also provides a solar power plant, fueled by photovoltaic modules which are installed in the glass roof and the facades. The glass enclosure of the advanced training academy covers an area of 20,000 square meters with 3200 integrated photovoltaic modules. The cogeneration power plant is located adjacent to the Academy. In this plant, mine gas from the former coal shafts is released and processed in three cogeneration units. The generated heat and electricity is then led into the public grid, supplying the academy building and a newly developed housing area and a nearby hospital.



Figure 3. The building of the training academy at Mont Cenis (Picture courtesy of Sabrina Förch).

In addition to the development of the energy park, a new residential area with approximately 250 residential units, a daycare center and a nursing home were planned and built adjacent to each other. The goal at that time consisted mainly of improving the quality of life of the residents [24] (p. 26). As part of the revitalization of the mine, the Mont Cenis Square was realized as a new urban space, which connects the entire facility of the energy park with the district of Sodingen (interview with the project manager, February 2017).

3.2.2. Location and Background

The project area is characterized by its central location in the Ruhr Area, and also in the state of North Rhine-Westphalia. In addition, the city of Herne, and thus, also the project area is located in the area of the International Building Exhibition (IBA) Emscher Park [24] (p.18).

The coal-mine Mont-Cenis was more than 100 years the motor of the city of Herne and the urban district Sodingen. Since the 1950s, the city of Herne has lost population, due to economic transitions in the coal and steel production of the Ruhr Area. In 1978 the coal-mine closed and herewith the land became vacant as this area was cleared. After the closing of the coal-mine and the demolition of the existing buildings, the area was abandoned for several years. In 1989, after the agreement between the city and the State, the restoration of this area set in from 1990 onward [25].

With an agreement between the city and the state, in 1989, it was decided that an Energy Park with an Advanced Training Academy from North Rhine-Westphalia should be established at this location. In 1994 the regional development agency Mont-Cenis was created [25].

The training academy was built in an elliptical shape at the park grounds (see Figure 4). The building also hosts the district administration of the city of Herne, hotel facilities for the participants of the academy, a gathering hall, a casino, a gym and the training facilities and its administration [24] (p.40). The roof-integrated solar power plant generates around 600,000 kilowatt hours of electricity per year with a 1-megawatt peak output [26].



Figure 4. Aerial view of the city district of Herne-Sodingen [27].

At the time the project was implemented, the knowledge for developing the climate envelope and the use of the coal mine gas as energy supply was low. For this reason, today, several technical problems appear which need to be addressed (interview with the project manager, November 2017).

3.2.3. Reflection on the Case

Today the project stands as a symbol of structural change, as the former mine was converted into a site for sustainable energy generation, for education and for recreational activities. As a result, not only the city of Herne, but also the entire Ruhr area was given an impulse to deal with shrinkage. The “Energy Park Mont-Cenis” also made a contribution to climate protection and became a role model for urban development for the entire city of Herne [24] (p. 11).

With this project, the image of a small and structurally weak city could be improved through creating the new community center at Herne-Sodingen. Another positive effect is the connection of the Energy Park to a newly created urban area (interview with the project manager on 2nd November 2017). Moreover, there is an interest to constantly improve and increase the sustainability, the climate protection and efficiency of this area. This opens up new possibilities for energy production for the future. When creating something new on vacant land, it is important to take the conditions of the site into consideration. By combining different uses, the total costs can be lowered. Altogether, the interviewees mentioned that this project is very positively rated by the public and is good-practice for successful public management and governance.

3.3. *Parque Agroecológico Zapopan, Mexico*

The socially driven examples expand the classical bioeconomic sector towards the day-to-day lives and benefits for the inhabitants of a city. They create benefits for civil society and cater to the needs of residents. These examples are associated with the food and energy sector, but their main focus is not an economic one, it is genuinely social. For this reason, the project team decided to frame several examples under the header “socially driven examples”.

3.3.1. General Approach and Aims

Among the two Mexican cases presented in this paper was the ‘Parque Agroecológico Zapopan’ (PAZ), a community based urban farm located in the city of Zapopan in the metropolitan area of

Guadalajara, Mexico. Interviews were carried out in April 2018 with government staff, academics, NGOs, and users of the park. PAZ is an innovative public space that combines the direct participation of the community of an urban farm project, thus, supporting sustainability culture, as well as training workshops on different agroecological themes to generate a unique space in the city (interview with government staff, April 2018).

It aims at establishing urban and environmental policies based on current programs and plans considering environmental instruments in the municipal territory. PAZ is a space open to all public where, through workshops, practice and coexistence, there is collective learning on issues related to agroecology, self-sufficiency, environmental knowledge and social awareness [28] (see also Figure 5). Within the programs of the Public Space Authority of the municipality, PAZ focuses on the needs of the community in order to generate job opportunities and entrepreneurship in the agroecological park (interview with government staff, April 2018). In addition, several ecological workshops, cultural and sports activities are being held within the areas [29].



Figure 5. Different uses within Parque Agroecológico Zapopan (PAZ) [30].

3.3.2. Location and Background

The Agroecological Park is located on a farm with almost two hectares in the Metropolitan area of Guadalajara that has the highest rate of violence and criminality [31]. Located on the site of a former rubble dump, Teocintle Collective, a community group, started this project. With support from the local government, it formally opened in 2015 (interview with park users, April 2018). The area of PAZ covers 1.8 hectares, adjacent to a neighborhood with about 40,000 inhabitants. Together with other ecological projects, PAZ is part of a network of agroecological parks in the Guadalajara Metropolitan Area (see Figure 6), which is facilitated and steered by the city government.

Local Authorities from the municipality of Zapopan want to empower the citizens, increase capacities with projects and workshops that are specialized in urban agriculture (interview with the park manager/city government staff in April 2018). As a result, the Local Authority of the Public Space of Zapopan, through the Zapopan Agroecological Park, offers a space for community building and collaborative work [31].

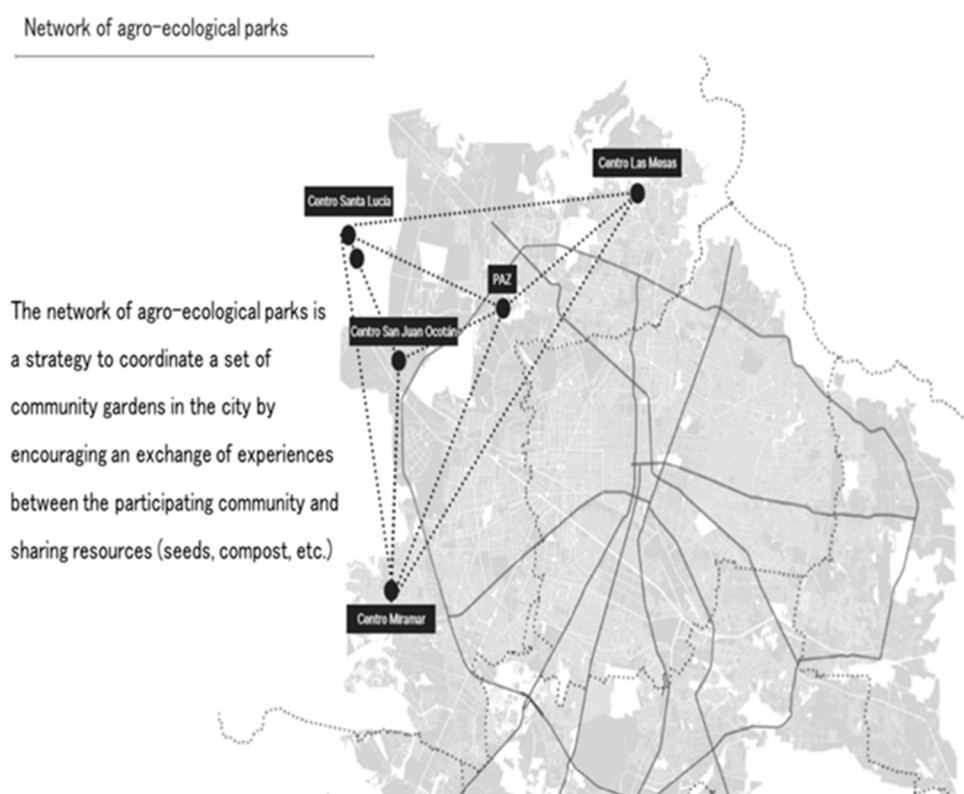


Figure 6. The network of agroecological parks in the Guadalajara Metropolitan Area [30].

3.3.3. Reflection on the Case

The municipality of Zapopan highly supported this project with the collaboration of other organizations and universities, in order to promote self-consumption and environmental education. The interviewees pointed out that a major positive aspect of the PAZ is its sustainable and environmentally conscious orientation. The agroecological park seeks to better integrate the relationship between landscape and city in a novel way. It, thus, advocates for educating a new generation of environmental activists. Moreover, it offers a model of community development that includes the formation of citizen leaders committed to their environment.

Of particular interest is that the PAZ is not a stand-alone case, but it is embedded in a network of parks, the city of Guadalajara created (see Figure 6). By this means, a broader learning process can be initiated, sustaining the development of the entire city. This was only possible by a strong involvement of the city government, offering funding, expertise and management during the process. This demonstrates the important role of governance in this project, which led to a successful implementation.

3.4. Totem Organic Rabbit Farm, Mexico

3.4.1. General Approach and Aims

The case study Totem Organic Rabbit Farm also represents a socially driven example. Totem is a social enterprise operating within the bioeconomical field of food. It is designed to fulfill the basic needs by implementing a business model with a social impact. The interviews for this case study were carried out with academics and the founders of Totem in April 2018.

It is an innovative project that combines the direct participation of the community to support sustainability. This project focuses on working, especially in marginalized communities, which are formed mostly from the migration of families from the countryside. Dedicated to raise and produce rabbits, this farm will help the population having access to organic and quality animal protein at low cost for people who live in vulnerable communities. It contributes to food security, improves the

biological utilization of food consumption, its scope and distribution (interviews with academics in April 2018).

The production is a sustainable and organic scheme, with the implementation of various eco-technologies, such as dry baths, solar oven, rainwater harvesting, bio-construction techniques and the production of food through orchards, gardens and a living pharmacy (see Figure 7). This is accomplished by closed cycles, resulting in a decrease in operating costs. To achieve these goals and objectives, Totem staff identified communities with similar parameters of marginalization, and created alliances with institutional organizations and civic organizations working in the area were (interview with academics, April 2018).

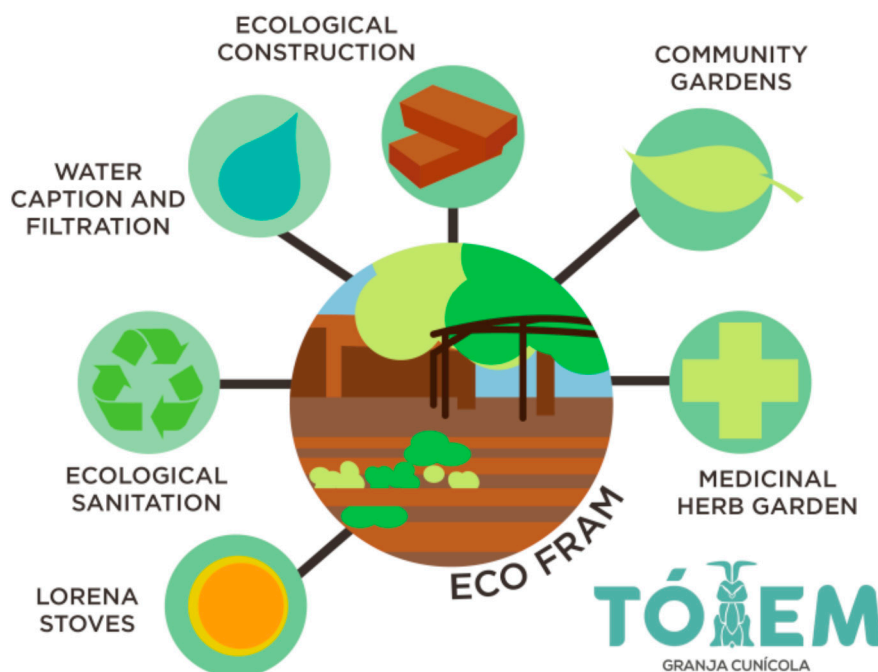


Figure 7. Components applied in the rabbit farm Totem [32].

3.4.2. Location and Background

Due to increased rural-urban migration, the phenomenon of informal settlements occurred in many Mexican cities, also in the metropolitan area of Guadalajara. These “irregular” subdivisions are located on the periphery of the city, entering, in some cases, the suburban parts of the municipalities. Totem is specifically operating in two of these irregular communities, Lomas del Centinela and El Rehilete (see Figure 8). Both are informal settlements (so-called ‘colonies’) located to the northeast and to the west of the municipality of Zapopan, at the periphery of the city (interview with the founders of Totem in April 2018).

In order to sustain its start-up phase, Totem conducted a Social Entrepreneurship Laboratory for six months in 2016. In this laboratory, Totem carried out fieldwork in the El Rehilete colony. Different problems were observed and validated with the community in order to design solutions and business proposals. In 2017, Totem won a grant in the “Challenge Impact Ideas of Socialab Mexico”, and was able to start its activities (Interview with the founders of Totem in April 2018). Since then, Totem has worked with a range of governmental organizations, as well as community groups and non-profit associations.



Figure 8. Housing conditions in the colony of El Rehilente [32].

3.4.3. Reflection on the Case

The interviewees stated that Totem could achieve production based on ecological criteria and animal welfare, taking care of the way in which animal protein is produced. By this means, Totem is promoting the benefits of a sustainable company, and it begins to change certain paradigms in the market. As a social company, the project seeks to provide a new generation of jobs that offer training and employment to the people of the community.

The potential of the company is in the fact that bioeconomy is driven by a social component. From an urban development perspective, the rabbit farm Totem provides business opportunities, particularly in marginalized communities, and thus, enhances the quality of life of its citizens.

These cases show different approaches towards dealing with abandoned spaces—the German case Fresh started as a top-down approach, and is now entirely privatized; the Mexican cases are strongly based on cooperative sharing.

4. Discussion

This article has shown that Green Innovation Areas are quite heterogeneous in their scale, timing, and type of business, and also their objectives. However, they all sustain innovative bioeconomic business types within urban areas, also in close proximity to settlements.

4.1. Framing Green Innovation Areas

As the place type, Green Innovation Areas was introduced in the city of Flint's master plan without a basis in research, one of the first steps in the projects was to further explore what Green Innovation Areas could or should be. The term 'Green Innovation' was introduced during the 1990s in the economic sector, primarily as a business strategy [33–35]. By definition, "Green innovations help companies insert environmental issues into their strategies in order to create or consolidate their competitive advantage." [33] (p. 2). In the economic realm, Green innovation refers to markets and business model innovations. Its broad acceptance is demonstrated by the EU launching a strategy for eco-innovation, defined as follows: 'Eco-innovation means all forms of innovation activities resulting in or aimed at significantly improving environmental protection. Eco-innovation includes new production processes, new products or services, and new management and business methods, the use or implementation of which is likely to prevent or substantially reduce the risks to the environment, pollution and any other negative impact of the use of resources throughout the lifecycle of related activities.' [36].

Nonetheless, from a spatial planning perspective, the term ‘green innovation’ has not been utilized for an area-based approach before. Thus—Based on the place type model introduced in the city of Flint’s Masterplan—the authors transferred the notion of Green Innovation Areas into a broader context of urban development. For the purpose of this research, the authors outlined the following definition:

‘Green Innovation Areas (GIAs) are a new kind of land use type with the purpose of revitalizing vacant or abandoned spaces. GIAs are locations for new innovative uses which are not yet specified, yet they are of experimental and innovative character. The range of uses can be attributed to the area of bioeconomy (among others). GIAs address a number of public, private and civil society actors. They aim, in particular, at connecting the communities’ and the entrepreneurs’ interests by means of long range land use planning and sustainable land use allocations. In doing so, they support two aspects: Sustainable and land conscious settlement planning, and implementing bioeconomic (or other entrepreneurial) uses in urban revitalization processes.’ At the time the definition was framed, the case studies were already selected, and it became clear that some of them bear not only a technological and environmental, but also a strong social component. For this reason, a social component was added to the definition.

Green Innovation Areas, as showcased here, have the potential to connect the sphere of bioeconomy with the requirements of urban development and land use.

4.2. Context for Sustainability

Coming back to the theoretical background of glocalization mentioned in the introduction to this paper, it becomes clear that any use will have to consider the existing regulations and requirements of the locale when it comes to reusing parts of the inner urban fabric.

The question arises, after having compared and worked with a set of innovative examples and the respective stakeholders, what can we learn from these examples in order to better understand the notion of Green Innovation Areas en route to sustainable development? The following aspects can be derived from the examples in terms of the three pillars of sustainability.

4.2.1. Social Impact

This may or may not come as a surprise, but most cases of bioeconomy we found in Germany and in Mexico show a high affinity to social factors. In some cases, sustaining neighborhoods (cases Fresh, Mont Cenis, PAZ, and TOTEM), community building (cases PAZ and TOTEM) and supporting society at large (all cases) are the main goals. However, the spectrum of societal factors is wide, and it varies from recreational purposes (as shown in the case of PAZ) to creating business opportunities (as demonstrated in the case Fresh Völklingen) to preventing malnutrition in marginalized communities (which is one of the goals of the case study TOTEM). All in all, as the cases demonstrated, close ties exist between social factors and the realm of bioeconomy. For this reason, social factors should be considered in any bioeconomic development.

4.2.2. Economic Impact

In the best practice examples, two major factors can be seen:

1. The economic impact is often highly connected to innovative business ideas, as the cases of the Völklingen aquaculture farm FRESH, or the Mexican rabbit farm Totem, among others, demonstrate. This innovation can transform the local economy in part, and create new jobs. However, they operate on a small scale, and can most likely not be a replacement for vast job losses, e.g., in a manufacturing sector.
2. The economic impetus of these examples cannot be viewed disconnected from other factors—they are strongly rooted in sustainability goals and reach out to environmental aspects and also social aspects.

4.2.3. Environmental Impact

Green Innovation Areas can be a source for the environment, as they operate in a clean economic scheme (as seen with the German examples Fresh and Mont Cenis), and they often function to preserve the green infrastructure of a city. This was, in particular, demonstrated with the Mexican examples, where the interviewees stated that the network of green spaces created in the city of Guadalajara, with PAZ being one of them, would most certainly be built up with residential or commercial uses in order to generate profits for developers. The use as a green innovation area, thus, helps sustain these spaces in the urban area. These areas can in part be seen as a 'common good', in particular, when it comes to neighborhood-based food production, as shown in the Mexican cases PAZ and TOTEM. Moreover, with the case of Mont Cenis not only a training academy was created, but a new urban area, including a public park. By this means, at the area of the former coal mine, a new node in the green infrastructure of the city of Herne could be installed.

4.2.4. Governance

In addition to the three pillars considered above, governance proved an important factor when it comes to initiating and implementing Green Innovation Areas. The Völklingen example displayed mismanagement which caused problems and a bad image for the fish farm. Other examples placed governance at the forefront of their projects (PAZ), and, are thus, capable of building solid connections and structures for the projects. Much different from our initial assumption, the Mexican cases displayed strong capacities of governance. One learning outcome would be to not underestimate the requirements of management, professional know-how and capacity-building of projects in the frame of Green Innovation Areas.

4.3. The GIAGEM Experience

Our initial hypotheses, as described in part two of this paper, dealt with changes in planning strategies in the context of shrinkage and decline. According to Nassauer and Raskin, 'the spatial scales and temporal processes of abandonment and vacancy in the most highly vacant cities may present thresholds representing socio-ecological dynamics that call for novel planning and design approaches' [37] (p. 250). The cases shown in this paper demonstrate novel approaches reflecting 'out-of-the-box' planning strategies: In the city of Herne, the redevelopment at Mont Cenis changed the perception of environmental planning for future development projects of the city. The same could be observed in Guadalajara, where a network of green spaces was designed for the entire city with PAZ being one of them. In addition, the rabbit farm Totem influenced the empowerment of irregular settlements, which are often neglected spaces in urban development, and thus, offered innovative solutions and new opportunities for the citizens. At Völklingen, the fish farm replaced an old industrial use with a one-of-a-kind development.

In this respect, Green Innovation Areas are a new means of revitalization for shrinking cities, but there are many loose ends when it comes to labelling it the next toolbox for sustainable development and revitalization. Some of the open questions that remain are:

- What exactly should Green Innovation Areas stand for: Socially driven grassroots movements? Opportunities for entrepreneurs? Places for specialized research and development?
- How can co-production and co-sharing within the new Green Innovation Areas be steered to create sustainable communities?
- Who should be in charge of developing and governing Green Innovation Areas—from the stage of planning up to implementing them?

Most importantly, in the authors' opinion, Green Innovation Areas combine social movements and entrepreneurial ideas in an innovative way. They should be explored in an interdisciplinary way, not only from the viewpoint of technological innovations of bioeconomy. Implementing economic uses, thus, requires a thorough consideration of the spatial conditions.

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