

## **Substitute industries and economic change as a chance for cities to become more sustainable**

A Case Study examination of the City of Völklingen, Germany

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### **Introduction**

Globalization causes an ongoing process of structural economic transformations on local and regional level and the relocation of industry changes the economic basis of a lot of cities worldwide. Many of these cities also have to face long-term economic and demographic challenges. The impact on cities and citizens pose big challenges on today's urban planning (Pallagst 2008). Cities struggle to reinvent themselves based on new economic principles (e.g. sustainability) and new substitute industries. Substitute industries are defined as a primary replacement of jobs as well as a strategy for the general revitalization or restructuring of the local economy. The term "substitute industries" does not give any concrete pointers to a specific industry or sector (Pallagst 2017).

However, in many cities around the world, the share of the three economic sectors changed in the last decades, from the secondary to the tertiary sector leaving many old industrial and commercial brownfield sites in urban cores. Furthermore, many citizens have lost their jobs and could not easily be re-employed in the tertiary sector due to different qualifications needed. In the meantime, globalization causes not only economic but also environmental problems by rising cargo trade and relocation of economic branches overseas due to lower production costs (Ellrich, Neuhaus 2012). This creates increased CO<sub>2</sub> emissions, particularly because of longer transport distances. In times of climate change and an alteration to a more sustainable-based economy, this matter is in need to be rethought and analysed. Long-term demographic changes (e.g. aging society & migration) in combination with economic changes result in a social aspect that also needs to be included when aiming at sustainable future development (Pufé 2014). Urban planning can play its share to contribute to a more sustainable urban environment and develop approaches and tools towards more sustainable solutions. Urban planning can provide necessary frameworks and test fields by cooperating with the city in promotion of economic development. New substitute industries, such as commercial urban farming, can be attracted to provide sustainable new future-oriented jobs.

The case study of the City of Völklingen was selected to be on display in this paper based on its path of economic transition: From a mining and manufacturing town to other somewhat more innovative economic branches of the green economy and specifically urban farming. The research presented here is amalgamating select results of the authors master thesis as well as the Technische Universität Kaiserslautern's GIAGEM (Green Innovation Areas in Revitalizing German and Mexican Cities) project, funded by the German Federal Ministry for Education and Science (BMBF). The project as well as the thesis-applied case study research as a methodological approach, involving literature analysis, data analysis, and semi-structured interviews with stakeholders from the case study city. Preliminary research results were then validated in the frame of two workshops in the year 2017 and 2018 with experts from the respective cities.

## 1. The cause and effects of economic change and shrinkage in cities

The causes that can lead to an economic change and shrinkage of a city include various aspects. Characteristics are the following indicators as causes of urban shrinkage and economic change:

- Downwards spiral through global economic and social shifts
- Deindustrialisation of traditional locations in western economies
- The decline of a city-defining economic sector or several areas
- Outflow of the population of inner cities (suburbanization and long-distance migration)
- A special concern in monostructured spaces (Henckel 2003, Liebmann and Kühn 2010).

There are also other reasons for the already described, mostly economic phenomena (that are derived from different political and economic systems in west and east Germany), as well as the spatial relocation of entire industries and the associated job losses: The general difference is on display within Germany between the old mining and industrial regions in West Germany and the deindustrialized regions in the eastern part of the country. In the East, structural change was prevented due to the political system until reunification. As a result, the process of structural change and the associated urban shrinkage came suddenly and to unpredictable severity. In the West, however, it was and is a slow process (Ellrich and Neuhaus 2012, Glock 2007, p.1).

The natural population development in Germany is negative in terms of the natural birth rate since 1972. In addition, there is a shift in the average age and rising life expectancy. This so-called aging of the population is the result of the outmigration of mostly young, qualified and employment-oriented citizens from eastern Germany to western Germany as well as from old industrial centres (effected by economic structural changes) to cities with more modern oriented economies and employment opportunities. Furthermore, the migration from rural to urban areas for the same reason can influence population developments.

Thus, it can be concluded that the demography changes by its negative birth rates and due to population migration in the absence of prospects on the labour market and lack of education opportunities (Spiegel Online 2007, Deutsche Akademie für Städtebau und Landesplanung 2002, p.7ff).

At the moment, Germany is experiencing positive population growth on average. This is mainly based on immigration from economically weak European countries and on refugee movements from the crisis areas of the Middle East and Africa since the summer of 2015 (Breuer 2017).

A result of economic decline in the old mining and steel industries is a weakened local and regional economic base. The declining economic situation is characterized by a lower supply of jobs for the citizens, which in turn can lead to an increased outmigration of young and well-educated people as well as to a drastic labor shortage in the long term (Institute for Regional and Urban Development Research and Construction of the State of North Rhine-Westphalia (ILS NRW) 2003, S.A4).

The spatial consequences of structural change include among other things are inner-city vacancies and the urban sprawl or suburbanization of the urban peripheries (so called doughnut effect). Higher-income families looking for a single-family home in the countryside mainly practice this. Other effects can be the “perforated city”. It indicates visible unstructured shrinking within the city, resulting in urban brownfields or abandoned buildings everywhere in the city (Glock 2007).

With the loss of jobs, a spiral of self-accelerating decline can begin, resulting in sometimes existential-threatening consequences (for the municipalities). The question arises: Can the

shrinkage of a city be absorbed, mitigated or prevented if enough alternative, new jobs are being created?

The answer could be the formation and location of new clusters. Many municipalities or regions have their own cluster concepts for this purpose and try to locate and promote them in a targeted manner. In doing so, the focus is primarily on the new economy, e.g. information and communication technology companies or the green economy. But developments in the logistics industry also play a major role. An area dominating here is, for example, the increase of logistics centers, both in their number and in the claimed area (Henckel 2003, Haas 2017a). The most well-known types of **substitute industries** in Germany are industries or services that are credited with a certain innovative or economic power. The following typologies are the most common examples: **Culture and cultural industries** are becoming increasingly important for German urban development policy. It plays a special role in the "renaissance of the cities", since people live, produce and consume culture throughout every day. Thus, culture is constantly changing, it cannot be assumed that the same kind of project or initiative will work everywhere (Dengler 2010, Florida 2003). The substitute industry of **education and medicine** have always been important aspects for citizens. In the future, with increasing global competition for education and research resources, with the aging of society, and with medical advances, this importance will increase even further (Schober 2014, p.9; Peuling 2017). The production of goods and services around **High-tech and IT** will continue to be unabated in the coming decades. The developments are happening across all sectors of the economy and are characterized by a great dynamism of innovation. Therefore, the promotion and settlement of companies and institutes of this economic branch is considered to be particularly future-proof and is very popular with municipalities (Bundesministerium für Bildung und Forschung 2017). **Festivalization** is a new informal urban development instrument that emerged in the 1990s. The term refers to public events that have an influence on the city (planning). These include, for example, major sporting events such as Olympic Games or football championships, as well as other cultural events such as city festivals or performance shows like world exhibitions or fairs (Häußermann and Siebel 1993, p.7 ff.).

This development also includes the development of tertiary institutions (including service, research and education centers) within the city centers. These are called new forms of urbanization. Other aspects include the rediscovery of old means of transport such as the rail-bound infrastructure. But airports are also increasingly seen as an important means of more urban and regional development. Here, the influence of the logistics industry and the increased mobility behavior become visible. They count as a positive location factor and are regarded as the key to economic (re-) ascension (Henckel 2003).

Creating and locating new and alternative jobs for workers who have lost their jobs as a result of structural change is a tedious and complex task (Peuling 2017). The key to success seems to be the creation of a replacement or substitute industry for the municipality and its employees. The effects and consequences of city shrinkage particularly effect urban planning and municipal areas. At the same time, the question always arises as to whether it is possible to counteract these developments by means of a city-planning instrument, for example with the establishment of new companies and the associated new jobs. Urban planning needs to provide a new framework for the affected cities to make this reinvention possible.

## 2. Substitute industries and the tool's revitalizing role

Substitute industries can be economically, ecologically and socially profitable for a city if the choice on „the right“ industry and solution for the city is made. Also, the question arises “Can substitute industries generate or at least stabilize growth in a shrinking city, stop the

population shrinkage and restore jobs?". The following chapter further defines and explains the instrument of the substitute industry, as well as needed vocabulary to understand the nature of the tool.

## **Revitalisation**

Prior to the establishment or implementation of a replacement/ substitute industry strategy is the principle of revitalization. Revitalization (in the spatial sense) means that a city has basically set itself the goal of reviving a neighborhood, a district or the whole city. This includes both the repair of public infrastructure, the adaptation of public services to the population and a willingness to intervene in local economic development. The public sector can partially control this or set impulses in a direction of development. For example, it is possible to ban certain industries or trades (Peuling 2017).

However, it is more important to incentivize and promote specific industries where the city already has a certain base. Incentives can i.a. in the offered location, in the networking with science and research, in the connection to universities, colleges, in the technical infrastructure, in the possibility for clustering or even in financial nature. The financial incentives are divided into the activities of the municipality, in a deduction of trade tax or in the assumption of development costs and in an external share of public funds, such as corresponding subsidy programs of state, federal or European Union (Peuling 2017). Depending on the starting position of the city concerned, an individual case-by-case solution is necessary. There is not one strategy for a revitalizing measure (Pallagst 2017).

## **Substitute industries**

In order to understand the concept of the substitute industry in the context of this work, it is necessary to explain and classify this tool.

Many shrinking cities have lost a major employer, or a whole branch of industry. They try to (re-)create jobs by means of targeted settlement of new companies in various branches of industries. In this case, the correct name in the sense of meaning would be the term "new settlement of alternative economic branches" (Pallagst 2017, Kunzmann 2009).

The term "substitute industries" is used to describe the primary replacement of jobs as well as the strategies for the general revitalization of the local economy. The term "substitute industries" does not give any concrete pointers to a particular industry or sector. There is no "right strategy" in dealing with shrinking cities and the location of one or more replacement industries from one industry or sector. Each city and region has other unique focuses in their (economic) history and therefore needs individual consideration. Nevertheless, some economic sectors are ahead of others when it comes to settling a particular replacement industry: Preferred industries include the tourism, logistics, cultural & creative, education & medical, high tech & IT and green technologies and infrastructures industries (Pallagst 2017, Pallagst et al 2017b, Pallagst et al 2018).

## **Green infrastructure**

The green infrastructure (also called blue-green infrastructure) represents a strategically planned, urban network, which is composed of natural and semi-natural areas. These form a networked ecosystem that performs various functions for the community. For example Air pollution control, natural water management and the habitat for humans and animals. These areas are characterized on different levels of scale of different natural spatial configuration and equipment (European Commission 2013, American Planning Association 2007).

Often, revitalization projects focus on the use of inner-city fallow land, especially on the use of vacant, individual plots of land. These formerly commercial real estate or land areas provide a place where commercial and social projects such as urban or community

gardening and urban farming can be implemented (Pallagst et al 2017b, United States Environmental Protection Agency (EPA) 2014).

The use of fallow or abandoned urban spaces offers the potential for a sustainable transformation of formerly polluted sites, as well as job creation in new emerging or revitalized areas, thereby sustainably changing and shaping the identity of places (Pallagst et al 2017b, United States Environmental Protection Agency (EPA) 2014).

The connection to high-tech or traffic projects is close. Green infrastructure can also be linked to new regenerative energy and new mobility concepts (Pallagst et al 2017b).

### Urban Farming

One of these links of green infrastructure and the bioeconomy, as the more environmentally friendly oriented branch of industries, is urban farming. Urban farming combines the aspects of green infrastructure with a social context in terms of the creation of jobs as well as new farming produce as new resources. It has many positive effects, such as the reduction of the ecological footprint or the food security of urban residents. In recent years it became more popular and can be seen as an opportunity to revitalize densely populated cities, also due to the growing need of city residents to engage themselves in horticulture and to participate in civic projects (Pallagst et al 2017b, Peuling 2017).

By definition urban farming or urban agriculture is the use of land by individuals or groups in urban and urban like areas or their peripheries for the cultivation of food, for whose agricultural land consciously urban spaces are sought and used. The cultivation usually is closely connected with ecological and economic cycles as well as with the social life of the city (Stierand 2016). Urban farming is possible on small and large scales. Smaller scales are often referred to urban gardening. In this case, all forms of food production in settlement areas are included, such as inner-city farms or peri-urban gardens and solidarity-based as well as social agricultural projects (Haide 2014, p. 5).

Furthermore, there is a broad variety of urban farms, not solely the production of agricultural produce. There are many different forms of urban farming: **Leisure Farms** aim to combine the range of recreational activities associated with agricultural activities within or near the city. The farms offer ranges from practical experience with animals and crops, dining and agritourism or the equestrian sports. At **Therapeutic Farms**, the garden, forest, landscape, animals and plants are used for recreational or work-related activities. Target groups are in particular psychiatric patients, mentally stressed persons or people with learning disabilities. In the Netherlands, therapeutic farms, with a strong national organization are a successful concept in peri-urban areas. **Social farms** are designed to promote the integration of disadvantaged and marginalized people, for example by offering them jobs. Networks of social farms have already been developed at national or regional level in Germany, Italy, France, the Netherlands, Belgium and Norway. **Educational Farms** are often affiliated with Leisure Farms and may have a recreational component, but the educational function is dominant. These Farms usually offer recreational or educational activities to learners of all ages in urban areas of Central Europe (for example in Geneva, Toulouse or Stuttgart) (Lohrberg et al 2016).

From a historical view urban farms are not an invention of the 20<sup>th</sup> century. A very early form of urban farming is being practiced since the 14<sup>th</sup> century in the Mexican capital, Mexico City created by the Aztecs: The Chinampas Gardens, with sustainable and organic food production 20km outside central downtown (Sieg 2018). In the US there are efforts to establish the term Agrarian Urbanism or Agricultural Urbanism in urban planning to highlight the growing importance of food security. The Prinzessinnengaerten project in Berlin describes itself as an Urban Agricultural Project with the goal (Haide 2014).

However, since large-scale **urban farming**, run by company's rather than individuals or small groups, is more relevant to this case study than it is on a small scale because of its job creating nature. A good example of large scale urban farming is the town of Völklingen in the

land locked German State of Saarland: Here, a **sea fish farm** was built within the city on an area formerly used as a coking plant. New future-oriented jobs were created in an old industrial location in a new branch of economy for the city (FRESH Corporation AG 2018).

Critics try to put the importance of urban agriculture into perspective, because they do not allow self-sufficiency of the cities yet. As the technology of urban farming, on large-scale food production is still being developed, it is expected to become more efficient and productive in the future. Today it is important to recognize benefits in the overall urban perspective. Urban agriculture produces many other goods in addition to agricultural produce: education, social cohesion, effective use of space and design, as well as the quality of life of its citizens. Urban Farming thus has a diverse potential for the city and its society (Stierand 2016).

### 3. The case of the City of Völklingen

The city of Völklingen, located in the German State of Saarland, showcases how green infrastructure is leveraged as a substitute industry in a former mining town. As Völklingen - in the early 2000s - came to a point when there was no significant job-creating industry left, the city decided to actively try to attract new industries and initiate revitalising projects. This practical example is characterized by its innovative approach of creating new, future-oriented jobs at the old industrial and mining areas. Therefore, the City of Völklingen has promoted a new industry for fish farming in the town (results of the GIAGEM Workshop in 2017).

#### Historical Background

However, the years of decline because of the monostructured economy has become a major problem for the city since the 1980s, as more and more factories (huts, mines, etc.) have had to close down due to increasing globalization. In 1973, 20,260 workers worked in the mining industry, representing 64% of jobs in Völklingen (with a population of 48.000 citizens). In 2016 the city's economy offered around 12.500 jobs in total with a unemployment rate of 11,1% (German median 6,1% for 2016) (Stadt Völklingen 2016, FIRU 2007, p. 42).

The geographical situation of the steep Saar Valley (at the German border) and the lack of awareness of alternative economic activities have resulted in this overall disastrous economic situation of the city. The municipal administration in Völklingen began to take care of the restructuring of the economy only around the turn of the millennium, beginning with the recognition of the Völklinger Hütte as a UNESCO world industrial heritage in 1994 (Stadt Völklingen 2017a).

As the city's financial dept restricts significant investment the city's public services company 'Stadtwerke', which is in charge of supplying the inhabitants of the city with the usual basic services such as water and sewage, electricity, gas, refuse collection, took on the role of looking for alternative, innovative and sustainable business plans. New forms of income should be generated with the aim of safeguarding the future viability of municipal utilities and at the same time improving the city's economic situation as well as create new jobs (results of the GIAGEM Workshop in 2017).

#### The Sea Fish Farm

As the new and innovative branch to be implemented in the city of Völklingen, Stadtwerke identified marine aquaculture, which is part of the emerging branch of bio-economy as well as urban farming. Aquaculture offers an alternative to both overfishing and the negative impacts of coastal marine fish farming. All in all, it helps reducing the ecological footprint of the production of fish. The site of the former coking plant Fürstenhausen was chosen to host Stadtwerke's aquaculture project. After the decontamination on site was completed, Stadtwerke built a pilot plant for marine fish farming. Part of the joint vision by Stadtwerke and the city of Völklingen was to generate future-oriented jobs in a new branch of economy with the first commercial land locked sea fish farming facility of its kind. The project is part of the global trend towards urban farming, as the fish farm can be built virtually independently of

the sea or other bodies of water in almost all (urban)locations (Saarländischer Rundfunk Online (SR) 2018; GIAGEM Workshop 2017; Höll 2017).

With its innovative use, the sea fish farm can be seen as a best practice for a commercial urban farming project. Its nature is a new kind of land use type with the purpose of revitalizing vacant or abandoned spaces. It is of experimental and innovative character. The fish farm addresses a number of public, private and civil society actors as well as bringing a change to the city in social and economic terms as well as offering a new vision for the city's future (development). The nature of urban farming projects in general is an 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 urban planning and implementing bioeconomic (or other entrepreneurial) uses in urban revitalization processes (Pallagst et al 2017b).

Today, the area around the project has undergone a tremendous redevelopment process initiated by the city government. However, plant construction and the cultivation of saltwater fish far from the sea proved to be complex (Saarländischer Rundfunk Online (SR) 2018; results of the GIAGEM Workshop in 2017; Höll 2017).

The beginning as a public project (2007-2015) was characterized by problems and the project could not be implemented as originally planned. This is partly due to the nature of the project since this was a pilot project without existing blueprints. Thus, there was no empirical data for orientation help in planning, implementation as well as the strategy. On the other hand, it must be stated that employ important job-positions with public utility employees or politicians did not provide the necessary expertise to successfully implement this type of project (Fresh Völklingen GmbH 2018, Zeller 2017).

Since the Sea Fish Farming project was a pilot project with no precedents, the costs could not be accurately calculated as there were unpredictable funding gaps and additional costs. The plant did cost around € 25 million (including commissioning costs of around € 3 million), from an estimated construction costs of € 12 million (Fresh Völklingen GmbH 2018, Zeller 2017).

This initial process was characterized by a highly contested mix of over-ambitious goals and mismanagement. Despite its innovative approach, the project is still stigmatised by the bad image of its first years of implementation.

Due to this process, the fish farm was sold to a private investor in 2015 and is called Fresh Völklingen GmbH now. Nevertheless, as the project stands now, the sea fish farm was able to reach its primary goal of the development phase- namely create future oriented jobs for high and low skilled workers, generate revenue for the city and introduce a new industry to the City of Völklingen as well as providing a vision of the future development of the City in commercial urban farming.

### **Basic data of the project**

To better understand the marine fish farming facility, the most important characteristics and data are listed below:

- Project, the first of its kind, no comparable facility or standards worldwide.
- The area size of the Fresh Völklingen GmbH is 10,000 m<sup>2</sup>, the production area is 6,400 m<sup>2</sup>.
- The large saltwater pools have a capacity of 1,800m<sup>3</sup> of water. There is a fresh water requirement of about 1% per day. This compensates for water loss through evaporation and fumigation.
- The breeding facility consists of four large pools and a 100% mechanical-biological water treatment plant that adds no chemical additives. Therefore, the saltwater pools

create a closed circuit, in which the water is purified in a biological way, free of artificial additives.

- Runs on 100% renewable energy and heat generation.
- In its current structure, the plant can produce between 500-700 tons of fish annually (depending on the species)
- Achievement of EBIT at the beginning of 2018 (neomar 2017, Fresh Völklingen GmbH 2018, GIAGEM Workshop 2017).

A **theoretical second plant** with a production volume of 1000 ton of fish per year (i.e. about 1/3 larger than the existing one) costs according to in-house calculations of Fresh Völklingen an estimated € 15-18 million (plus commissioning costs). The construction phase should take 2-3 years. The amortization is expected to be reached in 8-12 years (Zeller 2017).

A **production cycle** lasts for different lengths of time, depending on the type of fish, and covers the entire period. From the arrival of the juvenile fish in the quarantine station to the breeding and harvesting of the adult fish.

- Dorade & sea bass: 380 - 400 days to 400 - 600 grams
- Kingfish: 350 - 420 days for a strength of 3 kg - 5 kg (Zeller 2017).

One declared aim of the "Fish Farm Project" of Stadtwerke Völklingen at the beginning was to restore some of these **jobs**. But not only the question of the number of jobs, but also of the qualification requirements of the employees arises, since the former industry of the city-coking plants and mining jobs usually required low-threshold qualifications (Peuling 2017). Fresh Völklingen GmbH occupies about 3% of the former Fürstenhausen site (37.5 ha) where about 500 employees were permanently employed in the former coking plant (Zeller 2017). In the Sea Fish Farm are about **20 workers** permanently employed. The proportion of highly qualified employees is noticeable. Although there are also employees with vocational training or as untrained employers in the production, most of the employees have completed and specialized university degrees. With regard to the question of new jobs for former workers of the steel and mining sector, there is much to suggest that only after significant retraining the opportunity to find a new job at the sea fish farm is possible.

A conducted **SWOT- analysis** finds the project to meet goals as well as showcases weak spots, chances and opportunities.

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>- <b>Ecological, local production</b> of fish, short distances = lower CO<sub>2</sub> balance than imported fish</li> <li>- <b>Brownfield regeneration</b> on former coking plant area</li> <li>- <b>Good traffic connections</b> to the region and within Europe = easy accessibility of the markets</li> <li>- <b>Technology works</b>, the world's first inland saltwater aquaculture</li> <li>- <b>Constant advancement of the system</b>, high degree of innovation of the private owner company</li> </ul>	<ul style="list-style-type: none"> <li>- <b>No competent governance /</b> governance / project development (as a public project)</li> <li>- <b>Public entity restricted / less flexible as a private investor</b></li> <li>- <b>long building delays</b>, because prototype</li> <li>- <b>Stadtwerke Völklingen have almost gone bankrupt</b> (about 20 - 22 million € loss)</li> <li>- <b>High initial investment</b> of approx. € 15-18 million for further plant</li> </ul>

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| <ul style="list-style-type: none"> <li>- <b>Private sector operates plant economically</b> (EBIT beginning of 2018)</li> <li>- Site requirements relatively low, <b>can be built almost anywhere</b> in the world</li> <li>- Very <b>good employment ratio</b> per hectare compared to the former coking plant</li> <li>- <b>Powered by 100% renewable energy</b></li> <li>- Fish farm has <b>space to expand</b></li> <li>- <b>Jobs hardly threatened by automation</b></li> <li>- Fundamental part of the growing <b>urban farming market</b></li> <li>- <b>Represents the future of food production</b> as world demand for fish and overfishing increase</li> </ul> | <ul style="list-style-type: none"> <li>- <b>High academic quota</b> among employees, therefore hardly any job replacement for local unemployed</li> <li>- <b>Only created 20 new jobs</b></li> <li>- Small business, relatively few jobs</li> <li>- <b>Bad image</b> due to the initial phase</li> <li>- <b>Specialized product</b>, not mass-produced at a high price</li> </ul> |
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Opportunities	Threats and challenges
<ul style="list-style-type: none"> <li>- <b>City and region actively involved in business development</b></li> <li>- <b>Potential for skilled workers is available</b> (through further training of jobseekers)</li> <li>- <b>Worldwide interest</b> for research and economic reasons &amp; requests for planning and construction of the fish farm system</li> <li>- <b>Increasing global interest in sustainable &amp; high quality food</b></li> </ul>	<ul style="list-style-type: none"> <li>- <b>Depending on globalization</b>, relocation may be possible for more profitable assets in the future</li> <li>- <b>No financial support from the municipality</b> and its own operations due to the budgetary situation</li> <li>- <b>Location not in a metropolitan area</b> = smaller local market</li> </ul>

From the analysis, some conclusions can be drawn: The plant fulfills the primary objective of the Stadtwerke. It produces fish as a new resource and has created new local jobs. The innovative technology is constantly evolving and working. Since the Stadtwerke has sold the fish farm to a private investor, the plant can also be operated economically. Furthermore, this pilot plant has the potential to serve as a blueprint worldwide due to the low site requirements.

#### 4. Key lessons learned and recommendations

Regardless of the suboptimal project history in terms of bad execution by the Stadtwerke, the project itself can be seen as a success. This is based on the functioning technology of the prototype, on the now economical operation and the sales success of the fish. Furthermore, the facility itself is relatively modest in terms of location and can theoretically be built in most

cities and regions around the world. This convincing advantage paired with the learned lessons of the development phase and the acquired know-how could turn the sale and plant engineering into a sought-after export good of the City.

The production of food cannot be centralized in geographical terms and is best organized locally, also in terms of climate and environmental protection. In times of increasing food sensitization and the ongoing trend in urban farming solutions, this is a forward-thinking design and method. It should be noted, however, that market saturation can also occur in the food industry if demand is over met.

The weaknesses of the fish farm mainly include the history of construction and management of the project. Both major management mistakes were made and the extent of the construction of pilot plants of this size consistently underestimated. This was partly due to unqualified managers, who did not have the necessary expertise in the project planning of such a system and on the other hand, massive financial miscalculations. The question also arises as to whether public-sector companies, such as the Stadtwerke should take on such a project.

Above all, the favourable conditions of the zeitgeist for sustainable and resource-saving technologies should be considered an opportunity for fish farming. The international interest in urban farming, which includes fish farming, is not diminishing and there are many requests for the construction of such facilities in other countries. The sale of the patent or the further production of fish farming systems could further increase value creation in Völklingen as well as have positive effects in the labour market and increase business tax revenues in the city. A set of recommendations for the Cities in similar difficult structural economic situations can include:

- Investment in the education of jobseekers
- Consolidation of public finances
- Establishment of a (private and public) funding and subsidies coordination office
- Improve public relations and communication
- Strengthen regional cooperation and networks
- Advance brownfield conversion - use potentials
- Expand local (economic) strengths further

On a project level it is to say that:

- Ensure basic and good governance
- Build on existing strengths
- Use projects as an image carrier for the city or region
- Use of the marine fish farming project as a model and learning curve for future developments

One lesson learned is that with future projects of this kind Völklingen will be responsible of the relevant actors, interested investors and public companies work cooperatively on further development of this project. Follow up investments such as the construction of a Shushi producing plant in the vicinity as well as other closely related up- and downstream companies are on the horizon. The regeneration of Völklingens economy could have just started to kick off.

## 5. Conclusion

Classical urban planning reaches its limits when dealing with shrinking cities. There is no universal solution or general recipe for dealing with shrinking cities. These new challenges can only be met in new ways. However, these paths differ from city to city, as the starting conditions in each municipality are also dependent on the individual case and not every city can be developed with the same strategy.

When dealing with shrinking cities, an experimental path is usually chosen, new forms of urban planning and development are tried out, and action concepts are tested for which there are still no blueprints. The way forward is to reach sustainability for future developments. This requires a change of mentality of the city administration. In addition to (new) instrumental challenges, a high degree of openness and communication as well as long-term aspects are perceived as important.

The case study municipality has decided to actively shape the socio-economic structural change. This implies that - as shown - positive as well as negative results can be achieved. The positive effects here are primarily the achieved primary goals of the projects. On the one hand, future-oriented jobs should be created and on the other hand, the urban economy generally strengthened to reach sustainable developments. Additionally, existing strengths should be further developed and promoted. It can be learned from the historical developments that monostructured economies cause difficult situations in communities when this economic sector is in crisis.

The substitute industry as a sustainability strategy to create revitalisation trajectory's in these communities. As a result, jobs have been created on old, existing areas. But at this point, there is a need to look at the size of the Vöklingen case study. Only about 20 jobs have been created in a company. This is not (yet) a substantial success that can turn the city's economy noticeably around. The analysis of the case study shows that the replacement industry has been set up with the aim of "recovering jobs". However, these jobs cannot or hardly be filled by the workers who previously worked in the city's industrial sector.

The aspect of sustainability in terms of nature conservation, nature resource savings, CO<sub>2</sub> emissions, to just name a few indicators, is also an important aspect of substitute industries. Especially regarding the urban farming case study of the sea fish farm. As the world's first inland saltwater fish farm it is seen as an important tool against overfishing of the oceans as well as coastal aquaculture, known for controversial methods and rich in consequences (e.g. use of antibiotics in the open sea). The sea fish farm bypasses the current discussion on the (health) threads of plastic waste in the oceans due to being an enclosed system without waste contamination or the need to use antibiotics. The sea fish farm contributes to the growing global demand for healthy fish and environmental protection. In addition, the low CO<sub>2</sub> consumption is to be highlighted in the local, organic production of marine fish in comparison with imported goods.

The time aspect, more precisely the time delay, is rarely taken into account in the substitute industry instrument. Many years or decades can pass between the demise of an industry and the creation of a new employment opportunity. Furthermore, the quality of jobs is shifting, so that new jobs often require a much higher level of education than previous ones.

The recommendations for action that emerged from the analysis aim at cities and project managers to adapt their strategies and continue to play an active role in structural change and to set in motion sustainable developments despite certain setbacks. For the future, the main focus in these communities should be on learning from the mistakes of past projects and incorporating these insights into future initiatives. The transferability of the recommendations is not always given, although partial results can also be transferred or learned from.

In this context, it should be noted that the question "Can substitute industries generate or at least stabilize growth sustainable in a shrinking city, stop the population shrinkage and restore jobs?" could not be fully clarified in this work. In the case study the answer to this question is negative, due to different scales of crisis and the project size.

However, it is clear that the creation of new jobs can compensate for the loss from the mining or the manufacturing industry, but this depends on the type and size of the new initiatives. Although new jobs are often not created in the same number and usually only in changed demand in education quality. The sea fish farm created an equal amount of academic and non-academic jobs. Most of the times substitute industries are focusing on academic jobs,

which is not helping the local job market in city's affected by structural changes. The fish farm can be seen as a best practice example in this concern.

However, city planning and development has always been subject to constant change and is constantly confronted with new challenges. As a result, there are always new challenges and repercussions that must be considered when recruiting and locating replacement industries, and whose consequences on the urban environment are still often unknown. Here the result is usually completely open. There is no guarantee of success. An example of the unknown effects is the digital revolution, in which the potential positive and negative effects on cities are still difficult to predict.

Based on the experiences of the city examples presented briefly, it can be concluded that there is no clear answer to dealing with alternative industries. These are neither to be understood as a "panacea" nor as a "symbol of false hope". After all, it is a step in the right direction to anticipate a sincere analysis of the location and the city for the revitalization initiative, since not every municipality has the same prerequisites and potential and consequently cannot rely on the same strategy.

In conclusion, it should be noted that all measures to a certain extent can at least slow down the shrinkage processes. Existing resources can be used to rebalance cities between shrinkage and growth. Even if it is not possible to counteract all the external factors it is nevertheless important to constantly set new innovative and goal-oriented impulses in order to actively shape the future in a more sustainable way.

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