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VERTICAL FARMS AS SUSTAINABLE FOOD PRODUCTION IN URBAN AREAS. ADDRESSING THE CONTEXT OF DEVELOPED AND DEVELOPING COUNTRIES CASE STUDY: BRICK BORN FARMING, DRESDEN, GERMANY

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Keywords: food security, vertical farm, global balance, sustainability, urbanization

Abstract: Food is one of the essential thing for human existence. Population growth, urbanization and climate change put big pressure on space and resource utilization. Traditional farming and strategy for food supplying are not sustainable anymore. Urban Farming is a response to these challenges, by finding alternatives of utilising the urban space as a platform for plant cultivation. One of the ways is through Vertical Farms which are enclosed facilities with absolute control of environment, producing high qualities and quantities of fresh food, all year round. In spite of the advantages, there are only a few of such facilities in the world. Initial investment and maintaining costs are the biggest issues. This put in the context of Global North and Global South gap, turn the economic disadvantage into a very difficult thing to overcome. This paper is analysing Vertical Farming as a complex concept that can be decompose in many constitutive parts and it's looking on how this parts can be translated for other contexts, where economy is unstable. For this purpose the case study of BrickBorn Farming project from Dresden, Germany is discussed. The progress of the project and the development to this time shows potential for knowhow that can be fitted in many economic and social contexts. This way the global problems are addressed to possible global solutions which can lead to a better global stability and equal chances of development, with the main goal of achieving food security.

1. Context of the problem

We live in a time of fast pacing and continuous development of societies. In the last centuries, humankind used the cognitive qualities to use the planet for its own progress. The better quality of life is searched by everybody but self-actualization, as the popular theory of Arthur Maslow says, can be reached just by solving the other layers of the pyramid. The psychological needs are the base of Maslow's pyramid. Food and water are among the things that people need in order to survive and both are interconnected and not infinite. Progress for humankind leads to accelerated growth in numbers. It is predicted that by the year 2050, there will be 9 billion people on the planet. In this context the basic needs like food, seem challenging.

Food security is an urgent topic at the moment, and challenges that face the planet seem to be non-eluding. Agriculture and horticulture are the motors of food producing in the World. Global diversity is, of course, important to understand how significant, food security as an issue is, but the global problems are always the same. Beside the increasing number of the population, urbanization is also a factor to be considered. Not only that we will be more people on the planet, but also around 80 percent will live in urban spaces. That can be translated as more land required for leaving places and less farmland. There is already predicted that we will need more land than available, in order to sustain in the future, but this urban sprawl puts even more pressure on the challenge.

Human impact on the nature in the race of fast economic success, has led to a number of negatives effects on the environment. Rapid Climate Change (RCC) is a result of human non-sustainable

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intervention and development. This is a process that has only one way and people are trying to slow it down to gain more time to act, but the effects are visible and can lead to catastrophic events. Especially from the food security point of view. Draughts and floods, among other major weather events can jeopardize entire farmlands and have huge negative impact for economics and health of the people (Aubry, et.al. 2012).
The problem of feeding the world in 2050 is one of the biggest challenge humanity has to face. This lead to focus energy of researchers, practitioners, governments and communities in order to find solutions, to prevent more damage, reduce exacerbation and apply new sustainable, long term thinking solutions.

2. Urban Farming

Some keywords that define the problems that humanity will face, are interconnected. This means that the problems have some identical centre points, which means that solutions focused on the centre point can bring good results for multiple issues. We identify this centre points as population growth, big demand of food and urbanization. A possible solution can be that getting food inside of the cities will solve demand for high number of people without having to think how to stop urbanization (Grawel S. and Grawel P., 2012).
This solution is defined as Urban Farming (UF) and it gets more and more attention. UF can be applied in different ways. The most popular are roof gardens, living walls, community gardens, urban allotments, vertical farms etc. All have in common efficient use of space and resources in order to produce food in the cities with no negative impact on the environment. Locally grown food is getting higher in demand as people wanting to know more about where and how the plants are grown. This is a good thing for encouraging involvement, but also has some limitations (Sigrid, 2002).
Climate remains a big risk factor of cultivating the crops in unprotected horticulture. The Vertical Farm (VF) is a way of Urban Farming that adds the controlled environment in the equation. This means that the crops are grown inside buildings where all parameters that are needed for cultivation are controlled and is independent of the weather events. Vertical Farms have a number of advantages that puts this alternative agriculture approach in the spotlight.
Firstly, growing plants indoor, independent of the weather and the seasons, allows year-round cultivation of vegetables, herbs etc. (Despommier, 2011). It is very important to provide fresh food in so called "off season" and helps avoiding high prices and fluctuations. The transportation and logistics for getting fresh food out of season is not only bad for economy but also impacts negatively the environment. VF is defined by high technology applied in crop cultivation. LED lighting (Fan, et.al. 2013), controlled fertirrigation, soilless cultures, sensors and software that allow the growers to check and manipulate the environment are some of the features that give the users so much flexibility and mobility, obtaining high yields in shorter time. This alternative way of agriculture shows that it can be a way to tackle the future challenges for food security (Fischetti, 2008).

3. Vertical Farming – developed and developing countries

3.1 Current state

As stated in the previous chapter, VF has become a centre piece in the discussion on food security and urban planning for sustainable food production. Although all the advantages show good ways of facing the threats of urban sprawl, growing population and scarcity of resources, there are not many function facilities at the moment. That might stand as a surprising fact but the keys are the costs. VF

is a highly technologized edifice that uses resources efficiently and also produce more in less space, but the initial investments are too high for many growers to start. The costs can be recovered in some years, but the initial investment is simply too high. The features used in the VF are as expensive as effective (Zhang, et.al. 2002). LED lighting although getting more and more popularity and increasing competitively of producers, is still a high end product. As all new technologies, development and higher demand will eventually lower the prices and become more affordable. Until we reach that point, time should be used as a beneficial factor and solutions should be implemented in order to develop progressively.

Even if there are funds enough for starting a VF facility, the maintaining of a fully functioning food producing facility at this scale is costly. And this varies worldwide which shows the potential or the challenge of this technology to be applied (Fig.1).

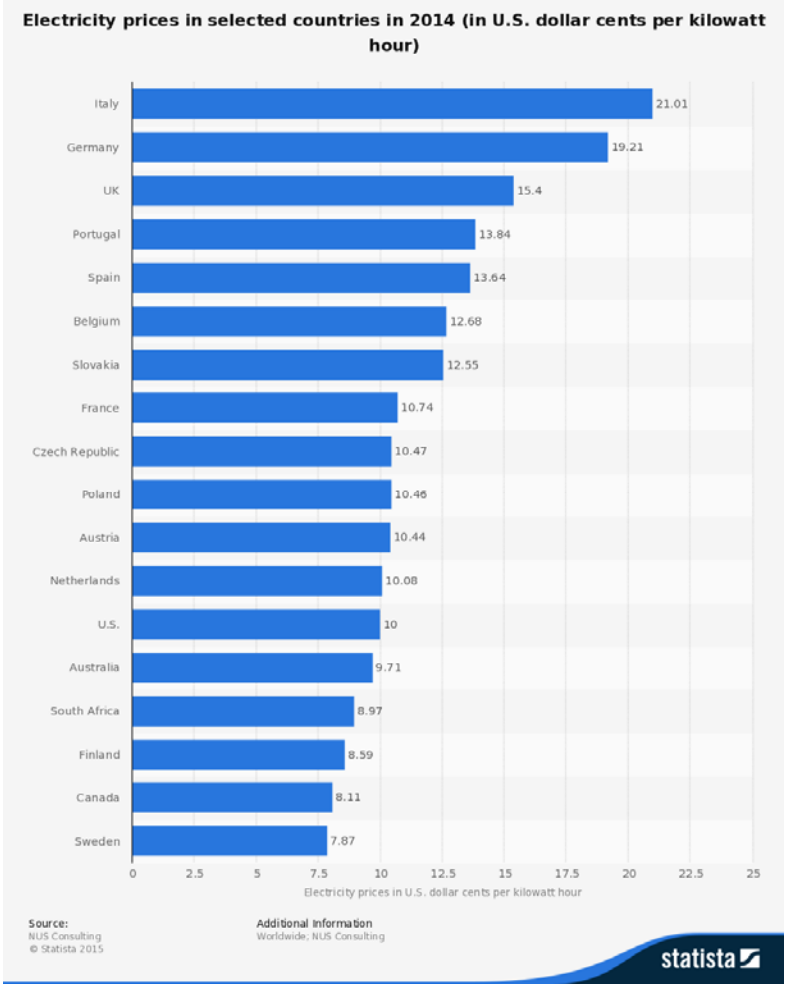

Figure 1. Energy prices comparative worlwide. (NUS Consulting statista, 2015).

The Vertical Farms existing today can be found in USA, Japan, Singapore or Korea. The advantages of having this technology in order to produce food are already explained from the environmental, and economical point of view. The geographic localisation of these facilities can be explained from the kilowatt prices and availability of the vegetables. In USA, electricity is rather cheap in comparison with other countries, even with those ones that have a stable economy. This allows maintaining and operating a VF. There are more and more VF appearing in the US, showing that the first ones proved

to be successful. This is encouraging for researchers, practitioners and governments all over the world to focus more energy in this topic and make possible that this facilities can be implemented worldwide. In far east, there are also a few VFs. In Korea and Japan, for example, there is low availability of fresh vegetables coming from open field cultivation (Beghin, et.al. 2003). There are many greenhouses that produce food, but VF gets more attention because of the total control and independency of weather and seasons. Also, in this part of the world the acceptance for this kind of high technology applied is very big, and so it can enter the market and get the approval of the consumer very fast.

3.2 Challenges for developing countries

As we stated, the food security problems are global and are affecting countries worldwide. The vertical farming, can respond to this problems, but until now, there are more theoretical principles. The research on this theme is wide enough to be translated into practice, but high cost of implementation still need to be solved in order for practice to be achievable. This can be done by common effort from industry, academia, research and governments (Iles and Marsh, 2012). If key players in the field join forces, the cost can be assured in the name of sustainability and long term thinking (Rickby and Caceres, 2001). There are already discussions, ongoing projects and even associations worldwide in order to make lobby for the technology and help implementing as fast as possible.

The countries that will suffer the most from the climate change and food insecurity are actually the poorest ones (Fig.2). Developing countries are already struggling to produce food and secure the wellbeing of their citizens. Low technology traditional agriculture is not a good match for the adverse weather events and for the increasing population and urbanization (Pauchard, et.al. 2006).

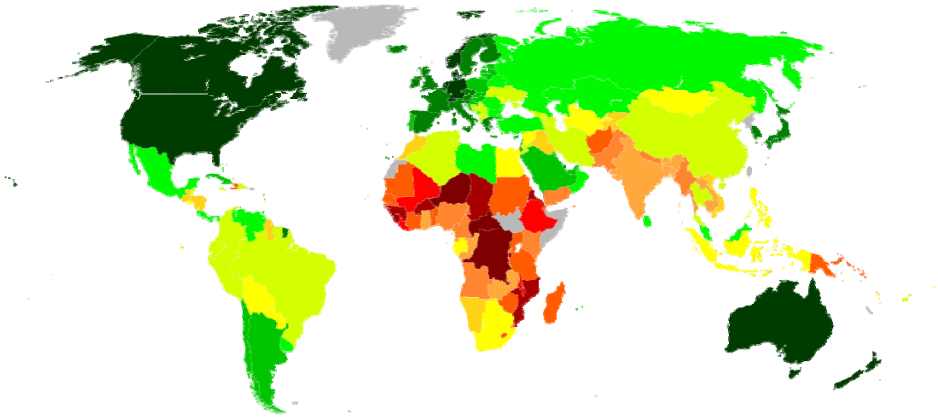

Figure 2. UN Human Development Report (2014)

In this article we focus on how VF can respond to future challenges in regard to food security and urbanization. We already stated that developed countries intensify their efforts to implement this facilities of food producing in the cities. The high initial investments and electricity prices are the biggest factors that stop the initiation. This means that developing countries have no potential of such strategy to take place in the cities. Food producing at the developing countries level is lacking technology and it's rarely intense agriculture. The adaptability of these countries to climate change and unpredictability of the weather put them in a dark spot for the challenges of the future. More

research projects have to be developed with regard to the applicability and poorer countries too (Cohen and Garett, 2010).

Adaptability, flexibility and scalable

The VF represents one of the possible solution of producing food inside cities with positive impact on the environment, and smart and efficient use of space and resources. This factors qualifies VF as a sustainable way of food producing. The biggest challenge until now is the economic one (Zezza and Tasciotti, 2010). Although year-round production, with increased yield and less resources needed can return in important profits. But the obstacle represent the initial investment. Developing countries have less competitive economical background than developed countries. Costs are a big factor that can make some strategies seem unsuitable for them.

Table 1. Motivation for Urban Agriculture listed by developed countries, newly industrialized countries and developing countries (Brohm, et.al. 2012)

Developed countries	Newly industrialized countries	Developing countries
Recreation/rehabilitation	Fresh local food	Healthy fresh self-made food
Self-made local food	Auxiliary income	Source of income
Environmental education	Ruin use/ waste land use	
Decrease of crime	Shortening of transport distance	
Waste land use	Decrease of crime	
Social integration		
Improvement of micro-climate		
Increase of biodiversity		
Sustainable urban development		
Organic food		
Consolidation of communities		
Neighbourhoods		
City beautification		
Less CO_2 emissions		

It is a fact that the problems are global so the solutions should be as well; there is interdependency between Global North and Global South (McClintock, 2010). The first is using the most of the world's resources that are in many part in Global South. But the biggest discrepancy relies in economic development.

Quantity is a normal dependent of the economic factor, but quality should not be the same. Scale is very important when we discuss novel strategies for food security. If the projects are scalable, then countries with less strong economies can apply them in a smaller scale. This can allow them to build up in a progressive way, using the time as an advantage. Profit reinvested can lead to succession development and so help shrinking the gap.

To discuss the flexibility and adaptability of VF, we do not have to think of the facility as a whole, but to decompose and apply just the things that will add value to those who use it. Going back on the advantages of this technology VF is an alternative to traditional plant cultivation, through offering alternatives for resources needed. LED can mimic and replace sunlight, water is recycled and more than 90% can be saved, no pesticides are used etc. A fully equipped VF will have all this features in state of the art fashion. But in some parts of the world some resources are enough so the focus can be tuned towards other. This strategy in terms of resource efficient use is part of the VF ideology. The elements that compose the complex facility can be understood separately and just the ones that can bring value and are affordable should be priority and others should come later as an update of

the features. If more people will design this kind of modular and flexible projects, the flow of knowhow between countries will be faster and more achievable.

4. Case Study – BrickBorn Farming, Dresden, Germany

4.1 Site

BrickBorn Farming (Fig.3) is a project of a proposed Vertical Farm in the city of Dresden, the capital of Saxony, in Germany. The project begun in 2013 lead by Prof. Dr. Fritz-Gerald Schröder from University of Applied Sciences, Dresden.

Figure 3. BrickBorn Farming (original)

Dresden is one of the greenest cities in all of Europe, with 63% of the city being green areas and forests. Having this reputation, the contrast of the small industrial area in the west part of the city strikes one and give a sence of alteration in the urban canvas of the capital of Saxony. In this part of the city, there is an abandoned factory that was intended as a food production facility.

4.2 Background

The building was designed by the german architect Kurt Bärbig, and was constructed between 1927 and 1930. Although the function of the building was to produce processed food, and the building is empty since 1991, time until some tried to use the space, for other functions.
The building is important for the city of Dresden because it represents a historical heritage from one of the important architects of Germany. Kurt Bärbig that lived between 1889 and 1968. In 1923 he was appointed as the sole architect of Dresden in the German Academy for Town Planning. Bärbig's progressive thinking, characterized by social aspects of urban and landscape design pays homage to the spirit of the times of objectivity, material relatedness and an effort to "period of promoterism". Born in Dresden in 1889, he immigrated to Brazil in 1934 and came back to the ruined city that was a result of the World War II. In 1952, he was head of freelance architects in the competition for the redesign of Dresden. He had an important involvement in rebuilding the city as we know today.
The food factory he designed, has particular features that make it as an important edifice of the urban space. He designed it as a processed food production facility including bakery, brewery and

distillery, but it was not completed due to the world economic crisis from 1920s. The one that were accomplished by that time were the meat factory and the vehicle hall on the other side of the street. The building has 12.000 square meters available space and was designed according to functional principles, and defines the space in the street with the curved façade. There was a six sided glass tower, typical for the 1920s architecture that was lid from inside, and served as advertisement and attention drawing tool, towards the site.

4.3 Construction specifications

Sandstone, stone, plaster are known as typical facade materials in Saxony. Actually brick, clinker are associated with north Germany, Hanseatic cities such as Lübeck and Hamburg. In the Saxon cities of Dresden, Leipzig and Chemnitz there are several notable buildings, ensembles and settlements in the early decades of the 20th century, which are influenced by the material of clinker with its various ochers, reds, browns - a building material that can be considered more sustainable.

4.4 BrickBorn Farming – Vertical Farm in Dresden

In 2013 BrickBorn Farming (BBF) project was started as an idea of Vertical Farm in the abandoned food production factory designed by Kurt Bärbig. The project aims to find suitable solutions for implementing plant cultivation technology in the building, in order to produce fresh food in the city while starting a pioneer project in the field that can stand as a model of future food production and planning in the urban areas. Since then, the project went to more developing phases and the idea was repeatedly communicated, gathering experts and potential stake holders in a common discussion about the possibility of implementation. Nevertheless, there is still a high level of research and development work needed, in order to achieve a profitable solution when the market is ready for this technology. A special challenge is the high technical complexity as well as large energy demand. Various aspects regarding food production in urban areas should be linked, which is an objective of the project.

4.4.1 Guidelines of the project (http://www.brickborn-farming.de/)

Coordination cooperation
The most fundamental challenge, however, lies in the common dialogue between all workspaces. The focus is on plants and animals. In order to produce food and sustain the business, it requires the best possible optimization of the production factors use such as energy, water, fertilizers, feed, etc. Complex relationships, which can be solved only through a holistic interdisciplinary property development.

Plants, mushrooms and algae cultivation
The cultivation of plants is naturally taken place outdoors. Cultures which are not adapted to the respective prevailing cultivation climate, yet can be produced in greenhouses. However, the year-round cultivation of any plant can be carried out only under absolutely controlled conditions. Greenhouses under central European conditions are optimal only partially, since it is often too hot in summer and in winter, the insulation performance of the glass is not sufficient to be able to grow profitably. The protected cultivation in buildings prevents bad influences on plant growth under expert supervision and efficient use of cultivation factors. Particularly suitable for building bound

growing systems, different leaf and fruit vegetables, strawberries, herbs, precious mushrooms and algae can be cultivated. Development potential exists primarily in the fields of optimization and adaptation of cropping systems, automation and plant monitoring.

Aquaculture
Controlled breeding in water living organisms (fish, molluscs, crustaceans and algae) will progress in the coming years. There were problems so far especially with the water treatment and the high heat demand of some plants. It is increasingly trying to provide circuits to further increase the profitability of the systems, for example, in combination with the growing plants. As a module in a building-related food production, aquaculture is intended to represent the main focus in the field of animal production. However, these circuits can make sense only when there is a design that will not make any compromises for any of the participants in it.

Plant culture
Not every plant culture is entirely suitable for the protected cultivation in buildings. However, the classical plant breeding offers the potential to create modern, adapted varieties, their characteristics are not only the best growth but also healthy products, and they may also follow new trends quickly, and realize consumer requirements specifically.

Supplemental lighting
The development of efficient high-performance LEDs is at the centre of numerous experiments. However, the use is not yet fully suitable for large-scale crop production. The lamps commonly used are not optimally adapted to its range of plant growth, and consume a lot of energy (Fan et.al. 2013). The combination of reinforced and novelty in conjunction with intelligent lighting control and tuned light recipes can lead to a successful and profitable possibility.

Energy
Energy is the central issue in the production of plants and animals in protected cultivation. Electricity and heat are really intensive production factors which denotes a friendly environment approach in order to have the best impact. Energy saving, energy recovery, energy storage and transport must be pursued. The building-bound production offers a variety of options. So waste heat harvested from lamps, can be used to temper water in the fish production. Production waste can flow in the energy recovery and facades are also used as solar power areas. Important here is the development of systems for transferring heat energy in transport and storage media.

Architecture, urban development and conversion
There are number of municipal buildings possible for the production of food. Vacant industrial buildings, skyscrapers, unused military facilities represent just a small selection. In addition to the preservation of monuments, revitalization effects surroundings of the production facility and can have positive effects on urban development. The construction of new buildings can be useful.

Monitoring systems
All cultural processes must be constantly checked for compliance with optimum parameters. One of the most difficult challenges in the projects is monitoring living organisms and obtaining meaningful derivation of the health from their vital functions, but results in a higher guarantee of success for the production. This creates a need to develop new sensors connected to intelligent regulation and control algorithms for the protected production.

Marketing, acceptance, Education
New methods of cultivation can arouse mistrust among consumers. The numerous advantages of the urban, building-related food production, must be conveyed transparently and comprehensibly. The insight into the production building and the exact explanation of the modern methods are probably the best tools to achieve the necessary acceptance form. Can be relined confidence through the compilation of studies on the ecological balance and the safety of the processes and products.

Project Development
The planning and implementation of a complex project requires a comprehensive preparation. Starting with the determination of a suitable property, the find operators, investors and marketers to concepts of financing a high degree of networking and advocacy is needed. The project development has to lie in competent hands that can consider all aspects in advance.

Hygiene, food safety
In the open field cultivation and water bound aquaculture, the organisms are exposed to every imaginable influences. Animals absorb these situations better, because they have an immune system and possibly able to escape from negative influences. However, plants need protection in order to achieve optimum growth. The protected cultivation in buildings allows the maximum optimization of plant growth claims, and so no residues occur. The mandatory hygienic measures has to be observed for humans, so plants and animals can be significantly better enforced here.

4.4.2 Communication of the project

Part of the challenge of starting such a project, is getting acceptance from the community. This can be done through consistent and progressive communication efforts where the ones that worked to develop the project should be transparent and present the advantages of implementing this technology. Food security is not influenced just from producer to receiver, but also customer behaviour is an important factor (Sharp and Smith, 2003). In the future, the growing population will create a high demand for food, but also the expectations are high. Of course, this varies on the global scale, but always the end user of the products has as important role as the producer.
On the other hand, communication, marketing and making the concept as visible as possible leads to future collaboration with industry, academia, scientific areas and governments, which can further develop and help implementing the project.
In the first year, after the concept was developed, it was presented in a number of conferences and symposiums at a national and international level, where the new ideas were shown and put for discussions. This returned important feedback from specialists in the field coming from industry, academia, science or politics and positioned the project on the map of future technologies to be applied. Among this conferences, there was Future Horticulture Conference, under the auspices of the Federal Ministry of Food, Agriculture and Consumer Protection of Germany, "Regional Concepts for the Energy Change" that took place on the central campus of BTU Cottbus-Senftenberg and was a cooperation between German and Polish governments. Then, the project was presented also in China, at “BIT's World Congress of Agriculture" that took place in the garden city of Hangzhou 200 km south-east of Shanghai, where there were more than 1000 participants from 63 countries.
These communication efforts were important to establish new targets for further developing and optimizing the project, as well as building networks in the field that can lead to future collaborations or more focused efforts head into this subject.

4.4.3 Further development

The initial concept presented strengths and challenges in term of implementation in the near future. This lead to a number of workshops that aimed to debate the BrickBorn Farming from as many perspectives as possible, in order to tackle the challenges and understand all the implications and effects.

International workshop - Concurrent Engineering

This workshop was organised at the University of Applied Sciences from Dresden. It took place in three intensive days, with participants from the Master Course of Horticulture of the host University, PhD students, and developers of BBF with partners from Germany, Romania and Japan. The objectives were set prior to the meeting and a common ground of documentation was set, where everybody could contribute with ideas and references that could be used in the workshop. In the "concurrent engineering process" so-called experts work simultaneously on a common technical development. The tasks and objectives were set and distributed to ones that had expertise in the certain field. This type of working together in the same room with different task but common goals, sped up the process, compressing the time and reducing the risk of later becoming necessary changes and also, improves coordination between experts involved in the workshop. The entire process was coordinated by Prof.Dr. Fritz-Gerald Schröder, and the information and progress was shared between participants on a common data set, while the direct verbal and media communication are characteristic to very positive results.

In the workshop the focus was on technology applied, product development, investment, profitability and studying what are the needs for this project to be successful and how can be further developed and implemented. The teams were working on crop and crop systems, climate and irrigation control, economy, design, supplemental light and facility management. In the end all information was ad in a common report that gives perspectives for the upcoming steps.

The results showed that the biggest challenge is the supplemental lighting with LEDs, which will become the highest costs of production. More research on better optimization, and implementation of supplemental lighting must be done in order to raise the affordability for large scale production. But the strategies developed and analysed both environmentally and economically, show the flexibility of the project with modular growing systems (Fig. 4).

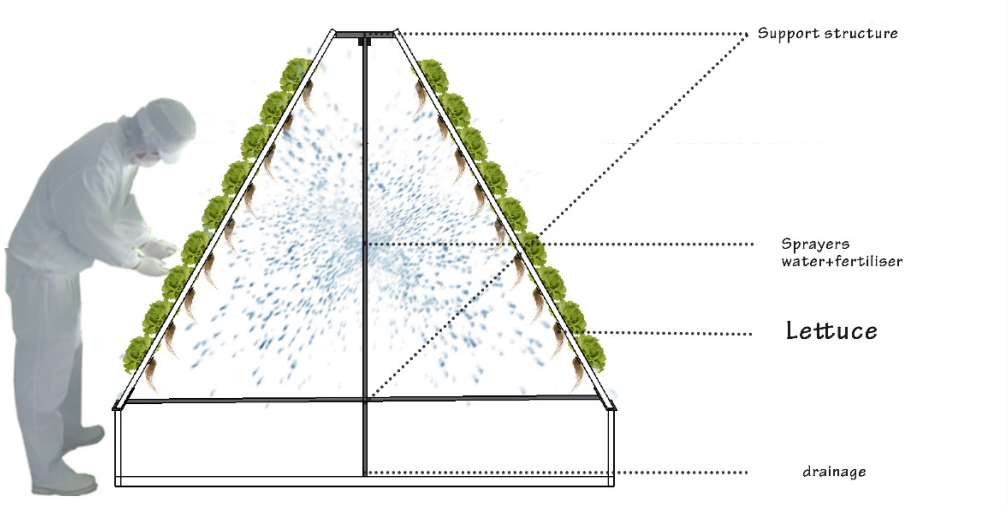

Figure 4. Lettuce growing A-frame system. (INTEGAR, 2014, drawn by R.M. Giurgiu)

Green Infrastructure Seminar

"As urban sprawl and landscape fragmentation continues worldwide, the concept of green infrastructure has recently been gaining increased attention from policy, research and practice. In a nutshell, green infrastructure (GI) aims at enhancing the connectivity, stability and productivity of *green* in its widest sense. The scope ranges from agricultural spots in the urban fringe, via urban brownfields to rooftop gardens in condensed city centers" (Green Infrastructure seminar, Nürtingen-Geislingen University, 2014).

The seminar was organized by Nürtingen-Geislingen University, Germany and Kassel University, Germany, and it was 100 % online with participants as international students dealing with landscape architecture and neighboring disciplines, from all over the world. Teams of 4 were formed and from October 2014 to January 2015, the students had the opportunity to see weekly presentation of case studies relevant to the topic, both from research and practice. A multidisciplinary engagement was encouraged. The teams had to firstly prepare a personal case study and present the threats and the solutions on a wiki page format. Interaction between students and cases was also allowed and encouraged. The second phase was working on collaborative project.

One team formed from students from Romania, Macedonia, India and Jordan have selected brick Born Farming as a challenge to study and think of ideas in term of green infrastructure through Vertical Farming. The students identified some threatening issues that can be addressed in the following design process. *Food Security:* The floods or other climatic events can result in poor crop yields and threaten the food security of the city. *Lack of Green in Industrial Area:* Although projects of GI techniques are planned on a long term, the industrial area is still dominated by big buildings, lack of green space, and an uninviting environment for the community and visitors. *History and Culture:* The Food Production factory failed due to the World Economic Crisis from 1920, but the fact that is not now active with any function, may lead to losing the cultural heritage that the Architect Kurt Bärbig left behind.

The second approach was through a number of analytical drawings of the site from different point of view. Urban context, attractions of the city and the dynamic of the use of space (Fig.5) was noted. On a more micro level, activities and functions of the neighborhood were analyzed. Urban allotments were also found and mapped to see which the opening of the community to urban farming is. To address the flooding problem, the river systems were mapped with flooding dams and reservoirs. The environmental parameters like sun, wind, precipitation schemes were analyzed. The building site and structure was studied as a potential space for food production, research and community engagement. This documentation was used for further projective analyzes.

For the projective drawings, each participant made some drawings related to what each found most significant as a potential for development in this case study. There were ideas about a food production combined with research in the field and also focus on education and community engagement. The surroundings of the building were also proposed as sustainable green infrastructure by applying a strategy for development with permeable pavement, greenery and linking to nearby park and other green zones from the city. The other means of urban farming, like urban allotments were linked to this case study with focus on education, innovation, rejuvenation of a "non interesting" area with the ending result of food produced in a clean and novel way that sustains the city. Deeper in the green infrastructure area, were proposed strategies of site valuable waste produce that can be reused. For example waste of heat or water from the active factories nearby the building can be headed towards the food production Vertical farm (Fig.6), which can use heat to lower costs and use hydroponics to phytoremediation of the water and reuse it in the process.

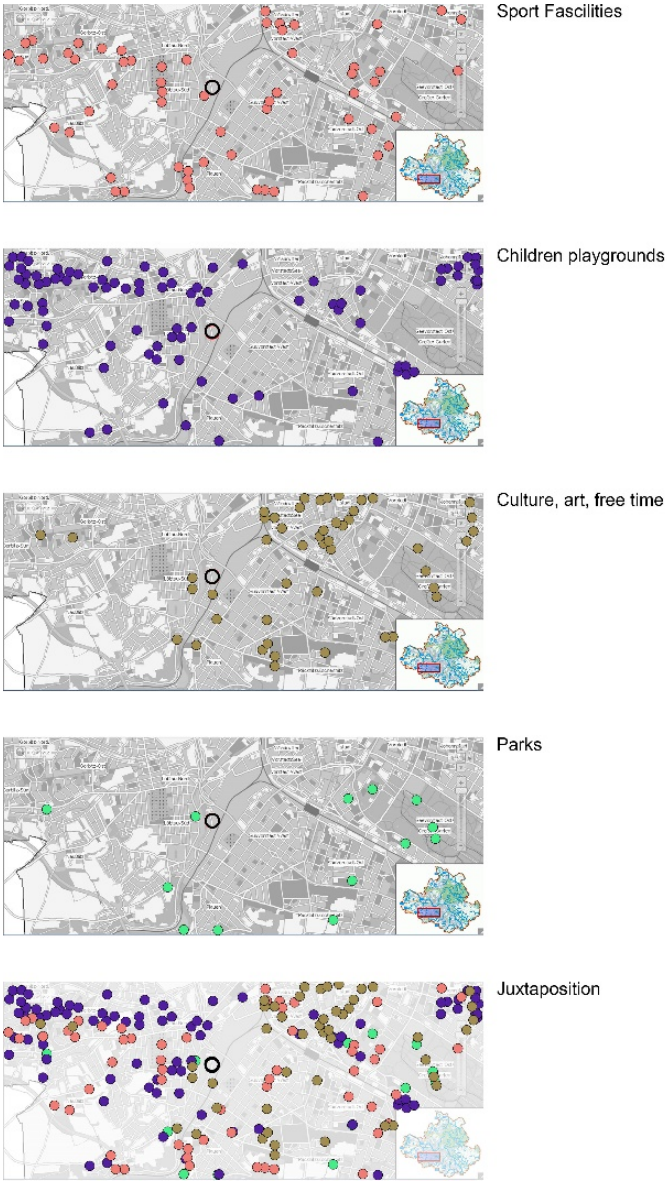

Figure 5. Mapping of functionalability in the neighbourhood of BrickBorn Farming (Ivana Lilikj, 2014)

The final step was to make a collaborative design synthesis where the main ideas and approaches were coagulated into a singular project outline. Here were highlighted the important of the BrickBorn Farming project as food production facility in the city, but also it would become a new social node in the city, where innovation, education and research would be valued and shared. And though becoming a model of other facilities that can be developed for a more sustainable future.

Agricultural systems of the future

BrickBorn Farming was selected as a case study to be debated in the competition of visions 2015 entitled Agricultural Systems of the Future, from the Federal Ministry of Education and Research of Germany. The aim of the competition was to interview as many representatives from research, industry, organizations, politics, administration or the media about their ideas and about future

developments of agricultural systems, in order to derive research and technology policy-relevant innovation fields for agricultural research.

Until mid-July total of 96 visions and concepts were received, of which 31 were selected by the Expert Advisory Group. The Brick Born Farming consortium was able to convince with its submitted sketch and was invited to present the concept as part of the creative workshops conducted in Potsdam. The workshop was the follow-up of the contest of the visions to further develop in a creative process innovative future models and solutions for the agricultural systems of the future. Using the Design Thinking approach led by moderators and coaches of the Hasso Plattner Institute Potsdam (HPI Academy). The ideas were developed in intense teamwork following common understanding of the issue and objectives.

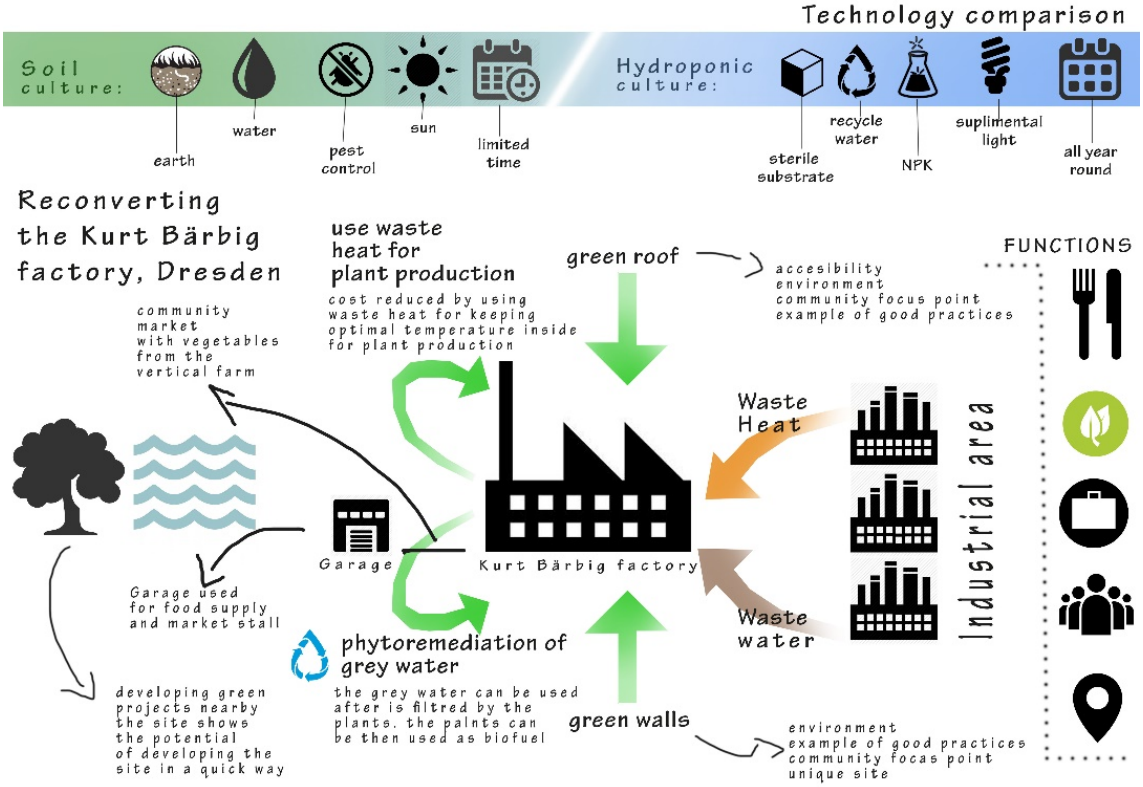

Figure 6. Projective drawing. Srategies proposed (Radu Giurgiu, 2014)

4.4.4 BrickBorn Farming – conclusions

Urban farming is a response to the food insecurity challenge and rapid urbanization. Vertical farming is a way of food production within cities, while using the resources efficient, and having most possible control over the environment with no independency of outdoor events. BrickBorn Farming is such a concept, developed for an abandoned building from Dresden, Germany. Although it is designed on a specific site, the development progress shows the flexibility of the systems, which can be adapted to other buildings and scenarios. The project is looking continuously to new ways of helping to bridge the theory with practice and stands as a case study that can be replicated in other areas (Vandermeulen, et.al. 2009). At this moment, the facility needs a big investment and many

players involved in order to make it function. But the efforts to diminish this gap could be used as knowhow for other small scale facilities in other parts of the world.

5. Conclusions

Food Security is an important topic on a Global level. Rapid Climate change, urbanization and population rise, together with the scarce resources bring new challenges for the humanity to face in the future. The gap between the Global North and the Global South ads more difficulties into the equation because the solution designed for addressing the challenges must be adaptable and scalable. The flexibility of the new ideas and concepts is an important factor if we can respond globally.

Urban farming grows in popularity because it has a number of advantages. The environmental one is the biggest advantage, with low impact in this regard, but also is defined as a solution to sustain mega cities with fresh food. Urban farming can have many applications and ways to do it, but should always respond to the local challenges and global ones and use the site information to adapt them.

Vertical farming is one of the ways of producing food, but differing from the other ways through independency of weather events. This brings the technology in the spotlight as the rapid climate change make the weather unpredictable and strategies for traditional agriculture can fail and produce huge negative effects for food security. Although all the advantages listed bring Vertical Farms as optimal solution, there are very few facilities functioning. The reason is the initial price of investment and the maintaining prices, especially in the countries with high price of electricity. This challenge can be overcome if we understand the Vertical Farm as a complex concept constructed from many different parts that act together as a sustainable long term food production facility. This will give the flexibility needed to use the key elements and adapt to the existing potential of investment.

BrickBorn Farming is a case study from Dresden, Germany, where an abandoned building show a high potential of becoming a Vertical farm. This project is on continuous developing and search of innovation, ideas and partners to get from theoretical concept to practice. Communication efforts and developing workshops are done in a time that the debate is more acute and more are becoming interested in a novel way of food production, in the cities. The development and guidelines of the project can be taken out of context, understood and adapted for other sites and scenarios. The international approach has led to a good transfer of know-how and even from today it can inspire other projects as it.

Countries that face problems not just from the global challenges regarding food security but also economic instability (Cohen, 2004), can use the knowledge and develop projects that use the time as a factor for progressive development. Parts of Vertical Farming concepts can be adapted and used in developing and semi-industrialized countries. There should be more collaboration on this level and research experiments should start in such countries, too. The global threats over food security have to be address on a Global level with efforts from many countries and societies.

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