
Bijjective Structure of Ecological Urban Energy Exchange for Small Town

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Abstract – The article is going on to a good-circle strategy for town agricultural plan with ecological concept based on circular economy and with the core of Multi-Scale Approach (MSA). The idea is based on a bijjective relationship between local urban economy of the town in the neighborhood of the area, creating a self-supporting economy and production of basic products. The core of this paper is related on production of food in the urban context, topic which is identified in the discipline of urban agriculture. The main goal is to indicate some concept and fundamental consideration regarding a feasibility plan for a close-cycle sustainable planning for mix-use Eco-District in connection with the agricultural production system of the surrounding. The literature review summarizes the definition and development of Urban Agriculture with different opinions of scholars. The practical study is focused on the specific case of Lishui district, in Foshan, China, with a new theory of Urban Agricultural Plan will be applied with supporting governing based on the current situation of the city. Case study will be divided into energy balance, feasibility plan and the current problems. This article proposes a reasonable conclusion that a radical change of the policy of food and water provisioning and the recycling system is necessary to avoid the impoverishment of the local farmland and Geo-Political problem at the global level.

Keywords – Urban Agriculture, Ecological Town, Eco-Village, Multi-Scale Approach, Close-Cycle Economy.

I. INTRODUCTION AND RESEARCH BACKGROUND

The trend in the last 60 years since the “green revolution” came is oriented on a strong investigation and activism in the direction of the sustainable life for the small community. In this paper the concept of sustainability is not under discussion because become a common culture in the last 20 years. This trend, traditionally related on the rural life and on Eco-Village, become common in the recent years also in the urban life. For urban life we intend the settlements of human being where the population is over 5.000 people, including cities and megalopolis. This was necessary due the immense consumption and needs of the urban settlements, especially for the large cities and megalopolis. The core of this paper is related on production of food in the urban context, topic which is identified in the discipline of urban agriculture. These studies have a strong background in the recent years, but our discussion is partially different because we intend to focus our attention only of a feasibility plan for small town or district in the cities, with a close-cycle strategy in the neighborhood for production of water and good, plus recycling system of waste. The necessity of this choice came from the fact that in our previous study [1]-[8] in this discipline we doubt on the idea of a realistic sustainability for the contemporary cities, but we strongly support the idea of energy-balance in the Eco-District as a self-sufficient entity in the human settlements.

In our opinion, due the contemporary situation of the big cities and megalopolis in Asia, and in detail in China, a radical change of the policy of food and water provisioning and the recycling system is necessary to avoid the impoverishment of the local farmland and Geo-Political problem at the global level. Energy exchange is not only a concept of physics, it is also important in the research field of urban agriculture. The value of urban agriculture is constantly being concerned, especially in cities with strong environmental protection concepts. In some places, more and more agricultural areas not only meet the needs of urban residents for fresh producing, but also improve

the city's ecological environment. Therefore, it can effectively promote the high-quality development of urban agriculture, promote the deep integration of urban and rural areas, and achieve environmental protection goals.

II. RESEARCH OBJECTIVES

The main goal is to indicate some concept and fundamental consideration regarding a feasibility plan for a close-cycle sustainable planning for mix-use Eco-District in connection with the agricultural production system of the surrounding. The intention is to create a bijective dependency between urban system (at the scale of the Eco-District, single or multiple) and the land-farm around the city. This could create a “close-circle economy” where the necessity of primary good (water and food) needed by the urban life is provided by the rural neighborhood, and the richness created from the urban production enrich directly the rural surrounding, creating a mutual benefit on the small scale. We will focus our study in the specific case of Lishui district, in Foshan, China.

III. NOTABLE EXPERIENCE AND LITERATURE REVIEW

The definition of Urban Agriculture was firstly maintained in the 1960s. The original meaning is “Agriculture in the City Countryside” [9]. Since then, the research flourish concerning different cases of cities. Nowadays, the idea of urban agriculture widely includes matters as agricultural and, related on production of food, provision of water, livestock and similar activities related on production of primary goods. Mvena et al. (1991) provided the potential of Urban Agriculture after doing deep investigation in six towns of Tanzania with similar circumstances data [10]. In their paper, it is described that numerous factors constrain the urban agriculture, which influences the lives of urban residence. Frojmovic (1996) did a survey of municipal initiatives of urban agriculture in Canada [11]. The results assessed the effort of Canadian municipality in supporting and promoting urban agricultural initiatives. In the same work, Frojmovic (1996) wrote another definition of Urban Agriculture: the procurement of food and non-food products through cultivation, animal husbandry, forestry and aquaculture within and/or on the fringe of urban areas. Garnett (1996) described the advantage of urban food and its growing in the UK [12]. Anders Wastfelt, Qian Zhang discuss on family farms near Gothenburg in Sweden. The results identify four simultaneous processes that produce the diversity in forms of agriculture between farms: structural changes, loss of farmland to urban expansion, specialization of on-farm activities and a niching trend of on-farm activities. Some result of the research are: niche production greatly takes advantage of the peri-urban location», enhancing competitive advantage through saving labor costs is enabled by the direct relation to consumers at the peri-urban location, multifunctional agriculture has potential but also raises conflicts between different types of land use in peri-urban areas, a secured access to land for farmers enabled by the local governance which separates the increasing land value from land rent is fundamental for supporting continued peri-urban agriculture [13].

But there are still real problems in modern cities like the access to land and water, and soil contamination [12]. A comprehensive analysis of the phenomena is well illustrated into Jaz Hee-jeong Choi, Marcus Foth, Greg Hearn illustrated the understanding Urban Agriculture system, the experience of urban cultivations and Food Provisioning, with case studies to support the analysis [14]. Robert N. Amundsen explore several kinds of possible urban agriculture type such terrace gardens, community gardens, and educational gardens [15]. According with A.L. Vernay and T.B. Salcedo Rahola the urban agriculture should be an integral part in the eco-city equation [16].

An impressive number of papers is produced in China. Tian Xianghui and Xu Xiaoliang analyze the interacting mechanism between urban agriculture and urban sustainable development basing the analysis on "core-periphery" theory, multi-functionality of agriculture theory using 16 cities from 2000 to 2008 in China as core cases [17]. Song Guang-hui and Xu Lin use the Entropy-Fuzzy Synthesis to evaluate the development level of urban agriculture in nine cities Pearl River Delta following the direction of the Seventeenth Congress of the CPC to persist in the development of modern agriculture and the prosperity of the rural economy is the priority [18].

According with the previous investigations and best practices case studied, there are several advantages of urban agriculture. Regarding economy, the Urban Agriculture helps to relieve the immense needs and insecurity for scarcity of food. About social impacts, Urban Agriculture helps to improve overall social behavior and activities, including emotional well-being, health and nutrition, as well as employment, food provisioning and community social life. Energy used to transport food decreased, cities with locally grown food provided, following the theory of the Zero-Kilometer production [19]-[23]. The appropriate technology improves the process of carbon absorption and release of CO₂ during harvest time prevented. In the 1960s and 1970s of Beijing, China, over 70% of the local vegetables and food were produced by the city itself [24]. This could be for initial attempt of urban agriculture in China.

Concerning the investigation of large scale area and the relationship between urbanization and farmland in the surrounding and mutual relationship, Xinglong Zou and Zhen Shang “[...] with the support of GIS, RS technology and based on recent 10 years Spatio-Temporal Land Use and Land Cover (LULC) data, the landscape pattern dynamics and regional spatio-temporal features related with the LULC change of three metropolis in Asian region, Zhangjiagang (China), Dehradun (India), and Hanoi (Vietnam) are analyzed”. One problem which the research points out is “[...] the issue of low quality and security of food was concerned in these three areas. Government support has encouraged urban producers to modernize and invest in safer developing practices. However, in these cities, as indeed elsewhere, there is an urgent need to recognize the significance of sustainable development, agriculture and native forest area reservation in future planning strategies. This kind of strategies identifies key trends and underlying environmental and socio-economic factors consider the future sustainability of the practice” [25].

IV. CASE STUDY

4.1 Diagrams and Structure of the Plan

Energy balance is the core of the research with several sub-branch research modules. All entire part generates the solution by using Eco-Village theories. The research route can be articulated below:

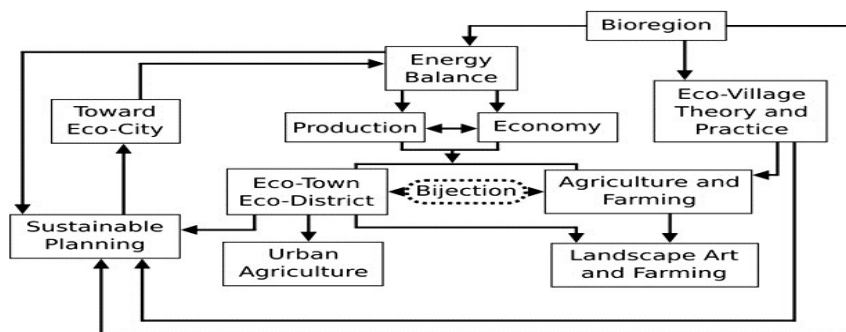


Fig. 1. Bijective structure for energy balance (illustrated by the author).

In biology, Energy Balance is the biological homeostasis of energy in living system [26]. While in energy economy, it concerns all processes within an organization, that have a reference to energy. In physics, it is the ratio of the amount of usable energy acquired from a particular source to the amount of energy expended to obtain that energy resource. Murphy and Hall (2010) gave a review of some of the various definitions of energy return on investment (EROI) [27] with Cutler's definition (2011) of EROI [28].

4.2 Data and Feasibility Plan

The plan illustrated in the scheme could have an application in the area of urban agriculture. The municipality of Lishui Town, Foshan City in China was trying to restore and improve the quality of urban life using a strategic planning with the core purpose of "1 River with 3 Banks Project". With the total population of 30 million, Lishui Town is more than 10 km away to the city center of Foshan City, and the area of the town is around 150 square kilometers. Lishui is located and surrounded by several lakes and rivers, and they cross at the town center. Lishui used to be prosperous by the natural land and view, but during the rapid development of the urbanization, the quality of environment decreased a lot during the past years. The traditional balance between urbanization and agriculture has been broken. Therefore, the local municipality started to restore the ecological system and promoting sustainable economy.

4.3 Analysis and Problems

The living style of local residents have been lasting for hundreds of years. Although the technology has been so developed, the scale and the way of the small town is still different from typical modern developed city in China. The local management of energy is separated and chaotic. This is the reason to be approach the Energy Exchange Theory according to urban agriculture. Our proposal in this and other similar case is to make the flow of energy from the boundary of the city to the core and, at bijective, take the richness of the town into the agriculture area. In other words: the necessity of the town in terms of food and water and green area, including the social issue and leisure, are provided by the agriculture land in the direct surrounding of the city, and at the opposite, the monetary richness created by Lishui could flow into the countryside. The existing infrastructure is one base of the feasibility plan. They can be converted into a set of multi greenway and green footway network to make the city from single function to multi-functions. Taking the advantage from well-connected system of existing rivers and lakes, the eco-strategy defines the new character of the town based on riverside and the water-based space planning. Functional areas contain ecology, culture, water side, port, finance, art, administration, all in a bijective relationship between productive system and natural system. The various green and water-based public area keeps the connection with local post-industrial cultural city.

4.4 Conclusions

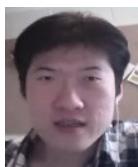
Urban planning for small towns and districts in the Modernity and especially in the developing countries is affected by several radical weaknesses. The problem that we have analyzed in this paper concern mostly the unresolved problem of energy balance in the consumption of non-renewable resources. A key factor which is not well developed yet in the past decades concern the bijective relationship between town and productive rural surrounding. The energy exchange between these two entities could generate an organism with mutual dependence in terms of food, water and social issues. This definitely cannot be a solution for the complete "close-cycle" system between urban and rural surrounding. But it's definitely possible to create a system large enough, following the

bio-regional concept, which is able to provide enough energy by biomass and water and heat and power (CHP) plant, for example, with a good balance between food provisioning and water recycling. The conclusion of this paper is that according with the case of LiShui, this plan is possible but in the limit of small community which have to be in between 2.000 to 5.000 people over this number the closed cycle it cannot be obtained. A possible solution is based on the partition of the town in several Eco-District based on the same concept of (bijective relationship with the surrounding.

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