



Metropolitan Agriculture

Wuhan, a developing metropole

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1 Management summary

This report is a part of the report 'Metropolitan Agriculture – Wuhan and Addis Ababa, two developing metropolises', by the same authors as this report.

Background

Increasing urbanization intensifies the competition for space and resources between food production at agricultural land, and the demands of a large city, such as space for housing, recreation, energy, food and other resources. This competition can be transformed to collaboration: build upon the potentials of the food producers and the citizens. This is called metropolitan agriculture, 'innovative agricultural activities that take place in a metropolitan environment, meeting consumer demands, making use of urban (and rural) landscape'. Metropolitan populations are rapidly growing in Asia, as well as in Africa and South America, having a considerable impact on regional development and even the macro economic development of entire continents. Against this background the Dutch Ministry of Agriculture, Fisheries and Food Quality (now Ministry of Economics, Innovation and Agriculture) identified at the onset of the following project goal:

Describe for a specific metropolitan region (the chosen metropolis is Wuhan) the role of agriculture, nature and landscape as park element between the increasing cities in an urban agglomeration and the possibility to use the open space in a metropolitan region for food production for the urban population.

Summary

The Wuhan region in China has a relatively long history of metropolitan development, with a relatively advanced development:

- **Land use.** The Wuhan metropolis has seen industrialization and has developed a ring structure. It expanded rapidly during the 1990's, and has become one of the industrial centres of Hubei. The inner ring of Wuhan is used for commercial and residential activities, the middle ring is used for secondary and tertiary activities, and in the outer ring farmland can be found. The area of agricultural land remained stable.
- **Agricultural production types and production.** Agriculture is industrializing. The traditional farming system of home garden production is changing towards industrial agriculture, and regional specialization. The integrated crop-livestock production system dominates, and contributes most to food supply, especially in areas around the cities. There are no large greenhouse complexes.
- **Supply chain.** The Wuhan metropole could not be adequately analysed, due to shortage of information.
- **Environment.** The environment plays an important role in the development of the metropolis. The Wuhan metropole suffers from river flooding, environmental pollution, excess use of pesticides and phosphate overload from the livestock industry. This has received governmental attention in the Wuhan Urban Agriculture Development Plan (2006-2020), through forestation activities, and the stimulation of sustainable energy use.
- **Government.** Metropolitan development is high on the agenda of the government of the metropolises. It appears that the Wuhan metropole is focusing on developments that have already gone a certain way, as basic needs are already served. The Wuhan metropole has developed plans to better coordinate urban and rural development. The government is involved in infrastructural development, environmental safety, sustainable energy, production increase, mechanization, and multiple land use to integrate rural and urban dimensions (recreation, production, science and technology, culture). Fragmented land ownership may be a hampering factor in the modernization process.
- **Social context.** It was difficult to fully analyse the social context. Most prominent issues were the position of the migrant worker in the Wuhan metropolis, and the issue of settlement in the region of origin.

Perspectives

Three different perspectives on agricultural land use patterns in relation to urban development have been described: the Von Thunen model, the Sinclair model and Modern metropolitan agriculture model. These perspectives are described with examples in Western Europe.

China has a long history of relatively intensive agriculture, close to and inside its cities, as a means of supporting urban self-sufficiency in food. In response to food shortages in the 1960-ies, China reorganised its spatial arrangement by enlarging the administrative boundaries of most of its cities, which from then on also included large areas of agricultural land. This expansion of city limits sparked the development of peri-urban (suburban) agriculture in China: the production of vegetables, fruit, milk, fish, livestock and poultry, as well as some high value-added grain products such as various beans. Suburban agriculture is labour-, and relatively capital-intensive with a high level of productivity of non-staple crops, and it is fully oriented toward urban demand.

Urbanization in China is strongly linked to economic growth, which accelerated in 1979 due to decentralization policies and market oriented reforms. Collective farm management was replaced by household and individual farming. This system allowed farmers to make their own decisions regarding agricultural production. As China urbanised, many surplus rural labourers began to move to the cities, which further encouraged the development and intensification of peri-urban agriculture: urban growth creating a larger demand for diversified agricultural products; rural migrants replaced the labour force in peri-urban agriculture as many of these farmers started to work in the industrial economy; and competition for the scarce land between different economic activities made peri-urban agricultural production more capital-intensive. Villages invite farmers from further away to temporarily lease the land. These specialist “immigrant” farmers are eager to exploit the proximity to the city and seem more willing to maintain or even improve the infrastructure (i.e. irrigation, tunnelling etc.).

China is among the first nations in the world that needed to address the problem of feeding large metropolises. Agricultural production systems have been developed that sustained large urban populations by optimally using limited natural resources. China has a long history of regional and local self-sufficiency, which means that rather intensive forms of agricultural production were and often still are located in or close to urbanised areas. China’s economy developed rapidly over the last couple of decades, both in manufacturing and services. This has put a pressure on (peri-urban) agriculture, in terms of a decreasing acreage of farmland, increasing pollution, but also changing eating habits and lifestyles of the more wealthy urban population. China responded by adopting practices from the West which contributed to increased production, higher quality and more efficient processing and distribution, but also led to more pollution, concerns about food safety and land erosion, etc.

Recommendations

For the metropole of Wuhan the following recommendations are made:

- Focus at implementation of a modern version of the traditional mixed farming systems (i.e. integrated crop-livestock production systems). By better balancing of crop and livestock at regional scale, production efficiency can improved without severe environmental problems;
- Substitution of (part of the) chemical fertilizers by manure in overloaded areas to decrease environmental impacts on land and water;
- Intensification of agriculture by mechanization and/or implementation of modern technologies;
- Cooperation between famers or up-scaling of farms is important. This makes investments profitable, opens possibilities to set up effective control systems and helps to make marketing agreements with supermarkets;
- In deciding upon the strategy for further development of the Wuhan metropolis, it is recommended to distinguish between the agri-industrial paradigm, and the integrated territorial agri-food paradigm (alternative food geography). Underlying aspects are the economic position of primary producers, environmental sustainability, organoleptic quality and diversity, consumers’ trust, and health issues.

- From the perspective of Dutch-Chinese relations it is recommended to exchange knowledge and experience from the full range of agricultural production systems. The Chinese have experience with sustaining soil fertility in circular agriculture, which could be a source of inspiration for Dutch farmers. The Dutch have experience with nutrient management and pest and disease control which might help the Chinese to reduce application rates of artificial fertilisers and other chemicals. This also includes the exchange of knowledge and experience on low cost decentralised systems of anaerobic organic waste digestion.
- The Netherlands has experience with developing and managing large scale intensive farming operations (horticulture and to a certain extent also livestock), which increasingly also meet criteria of environmental sustainability.
- More attention must be paid to park management and cluster optimisation in the Chinese agro parks. It is advised to look at problems and challenges of existing agro parks in China, like adaption of imported innovations to the local situation, and to be the basis of further innovation by the Chinese themselves; education of farmers using the modern technology applied in the parks; and a wider diffusion of knowledge from the demonstration parks to the rural hinterland.

The scenario study for Wuhan resulted also in some recommendations applicable to The Netherlands:

- The Netherlands may re-interpret the development of several metropolitan parks (i.e. the Westland and Midden-Delfland area, the Green Heart) with hindsight as if it was planned as a Chinese agriculture demonstration park. Chinese have shown to be well positioned to mix urban and rural functions, to reformulate city and countryside relations and to bridge the growing gap between consumer and producer.
- The Chinese experience and history of integrating (more or less intensive forms of) food production into the urban fabric may provide an inspiration for Dutch cities that are experimenting with new city-countryside relations.

Points of attention

For a successful outcome of some of the recommendations above, it is important to take in mind some of the lessons learned from previous Wageningen UR projects in China regarding metropolitan agriculture. These lessons also should be considered for the recommendations for Addis Ababa. It proved again important to involve all relevant stakeholders from the beginning of the project. A common interest and shared vision regarding process, goals and expectations is in most cases crucial. Communication with local parties is very important in this; it should be transparent, a good translator is important and one should take in mind local cultural habits.

To make changes at the level of farmers or farmer cooperatives, an agricultural bureau can play a key role to start developments; they have the necessary connections with extension services, education and subsidies.

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2 Metropolitan agriculture

Increasing urbanization intensifies the competition for space and resources between food production at agricultural land, and the demands of a large city, such as space for housing, recreation, energy, food and other resources. This competition can be transformed to collaboration: build upon the potentials of the food producers and the citizens. This is called metropolitan agriculture, 'innovative agricultural activities that take place in a metropolitan environment, meeting consumer demands, making use of urban (and rural)¹ landscape (Synergy)'.

A metropolitan region can in geographical terms be defined as a large population centre consisting of a large metropolis and its adjacent zone of influence. Metropolitan populations are rapidly growing worldwide, having a considerable impact on regional development and even the macro economic development of entire continents.

The functions of the city and the agricultural sector can be integrated, therewith meeting their mutual demands and best utilizing their possibilities. At Wageningen UR Research Centre in The Netherlands, experience has been acquired in a number of fields, such as agro parks, landscape farming, sustainable food chains and care farming:

- Agro parks can be located in the vicinity of cities where cycles of food production, energy, waste, transport & logistic, information flows, etcetera are compacted and optimized.
- Landscape farming integrates various uses of the landscape, such as food production, recreation, culture preservation to the benefit of both citizens and farmers who obtain options for new forms of income.
- Sustainable food chains rely on more direct and transparent marketing of sustainably produced and/or regional products that provide growers with a reasonable price and provide citizens with high-quality food.
- Care farming offers a new approach to providing care for citizens who benefit from participating in agricultural activities.

Wageningen UR has formed an interdisciplinary team to share its expertise with others. Wageningen UR can provide an overview of options for arable farming, horticulture and animal husbandry, varying from capital intensive to labour intensive, from subsistence farming to export-oriented farming. Closure of resource cycles, multifunctional land use, chains and transport, labour availability are some of the issues that need to be considered in finding the best solutions for local situations. This process requires thinking along with, involvement and commitment of relevant stakeholders, who naturally should decide upon future developments.

2.1 Need of knowledge

Metropolitan populations are rapidly growing in Asia as well as in Africa and South America, having a considerable impact on regional development and even the macro economic development of entire continents.

The rising urban and rural populations need robust food production systems that meet the growing demand for food, not only in terms of quantity, but also in terms of quality (freshness, diversity, vitamins and micro-nutrients). This is reflected in MDG7 (ensure environmental sustainability) and MDG1 (eradicate extreme poverty and hunger), and is also acknowledged in the Dutch policy note 'Landbouw, rurale bedrijvigheid en voedselzekerheid'. Arable, horticulture and livestock production have to optimally share natural resources, including land, and the enabling environment has to be transparent and accountable. This can be considered at various scales, one of which is the regional scale at which many distribution and optimization issues are to be addressed. Resource-efficient (including energy) production of high quality food, safeguarding the environment, the position of smallholders, coherent policy, and rules and legislation by governments, and the interests of the urban population that stimulate industrialization, are some of these issues.

¹ While in many cases, metropolitan agriculture is restricted to agricultural activities in the urban environment, we also include the rural environment that surrounds a city.

The resource allocation is particularly dynamic in metropolitan regions, as here the demands of the urban population is conducive to the development of more intensive forms of food production, and may threaten the environmental quality and biodiversity. The dynamics in resource use are often autonomous and not well-planned due to a shortage of information and understanding of the driving processes and poor governmental guidance, leading to a sub-optimal use of available land and other resources, and to the sub-optimal performance of agricultural production systems. This obviously has consequences for the production levels and for the robustness of these production systems.

Better understanding of the complex interactions between urban and agricultural development may support policymakers to set up a dialogue with stakeholders, identify priorities for a research agenda etc. In this project we select one case study in China and one or two cases in Africa to describe and quantify (if possible) context-specific issues.

In 2008 the minister of Development Cooperation, Mr. Koenders, and the minister of Agriculture, Nature and Food Quality (LNV), Ms. Verburg, presented the policy note “Landbouw, rurale bedrijvigheid en voedselzekerheid”. This Note contains five pillars (tracks), which are 1) Increase of agricultural productivity, 2) Enabling Environment, 2) Sustainable Chain development, 4) improved market accessibility, and 5) Food Security and Transfer mechanisms. Supported by a recent published WRR report on the future of the Dutch development cooperation, the ministry of LNV wants to focus her development activities especially in African countries. More information is needed for future strategic choices and set up of future projects. This study therefore also contributes to the implementation of this policy note.

Box 1. Urban Agriculture in two forms, a new policy issue with ancient roots

Urban agriculture has been around for centuries, or even millennia. Pompeii's streets are scarred by the wheels of oxcarts and horse carriages, present day Florence has a covered bridge from which the Medici queen ordered the butchers to be banned because of the smell and noise that they caused. Those butchers were replaced by goldsmiths and jewelers, something more of her taste. And last but not least, many streets or markets around the world have names like Cow-street, Calf-street, Haymarket and so on to testify to the trade of animals and feeds that was the origin of many of such places.

Different patterns of urban agriculture need to be distinguished for proper policy setting. One end of the spectrum is a category that aims to properly use urban wastes in generally not very wealthy conditions, as in the case of Addis Ababa (see the full report). A category at the other end of the spectrum aims to provide the city with food in a more industrial manner, in this report represented with the Wuhan case. Also that distinction is not really new, since for example, the city of Copenhagen had urban dairies well into the 20th century, among others, to dispose of the waste from beer breweries. And in 1939, the Astor & Rowntree commission proposed for relatively wealthy British conditions in 1938 that: “Since much pig feed was imported from abroad, the business could be rationalized by keeping pigs at ports, in buildings next to grain mills on the quaysides! Pig production, in their view, was ‘not an integral part of British agriculture’. The role of pigs in providing income from several sources had thus vanished from the sight of observers and policy advisers, in a phase of agricultural fortune when multiple activities were one of the most successful prescriptions for survival.” (based on Thirsk, 1997)

Also, the World War II saw a ‘blossoming’ of urban agriculture on London's balconies in situations where food security and poverty were major issues on the urban agenda. Eleonore Roosevelt proposed to ‘mow’ the White House lawns by using sheep. That move was, among others, opposed by then emerging large food corporations with the argument that: ‘if this is to be generalized then what will be the future of the American food corporations’ (...). That argument of large corporations finding themselves at the other end of the spectrum than small and relatively poor producers is still very valid today.

2.2 Project goals

Against this background the Dutch Ministry of Agriculture, Fisheries and Food Quality identified at the onset of the project knowledge needs. These resulted in the following project goal:

Describe for a specific metropolitan region (the chosen metropolis is Wuhan) the role of agriculture, nature and landscape as park element between the increasing cities in an urban agglomeration and the possibility to use the open space in a metropolitan region for food production for the urban population.

2.3 Project team

At Wageningen UR in The Netherlands, experience has been acquired in a number of fields, such as agro parks, landscape farming, sustainable food chains and care farming:

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3 Approach

3.1 Metropolitan agriculture – an integrative view

Development of metropolitan agriculture can be considered from various perspectives. For the purpose of this study, we have chosen for the time-perspective, as a number of developments can be identified that take place over time as a metropolitan region develops. Agriculture in that region develops as an integrated element. Our description is not meant to be complete, but to provide an analytical perspective to organize our observations for the Wuhan metropolitan region. For the making of the description of the metropolitan region, the following framework was our basis:

Land use

Land use in the metropolitan region changes over time. Not only does the urban area increase, also intensive types of land use develop in the vicinity of the urban regions, whereas more extensive land use types develop at larger distances. Horticulture, intensive animal husbandry, recreation are some of the activities that develop relatively close-by the urban region. Also, they can be present within the urban boundaries, either as a carry-over from previous times, or as new types of urban agriculture. A group of developing cities may be separated by land that is intensively used for not-urban purposes, in close interaction with urban needs.

A number of issues can be distinguished, among others:

- acreages (metropolitan region, rural and urban areas, production systems, crops, etc.)
- land ownership (own property, long-term lease)
- ground prices
- is land use planning formally managed, who is responsible, does it work, what are hampering and blocking factors?

Production types and production

The 'traditional' land use forms are various types of agriculture, horticulture and animal husbandry. They provide the population in the rural and urban regions, and in export regions, with food and ornamentals, and are a major source of income for the rural population. Also, agriculture, horticulture and animal husbandry are important cultural carriers, greatly contributing to the structure of societies.

Relevant issues are:

- types of farming systems, i.e. extensive agriculture or animal husbandry, open field horticulture, large or small greenhouse complexes, peri-urban dairy systems, home garden vegetable production, etc.
- what are the climatic and environmental circumstances?
- production data like:
 - o Acreages of crops and greenhouses
 - o Number of pigs, cattle, poultry (layers, broilers, ducks, turkey etc.), etc.
- production levels:
 - o production in kg ha⁻¹, litres ha⁻¹, number of flowers ha⁻¹, etc., depending on production system

Supply chains

A wide variety of supply chains exist in metropolitan regions. Food production can be for the local rural population, for the nearby villages, for the fresh market in the cities, for the supermarkets in the cities, for the export markets, etc. As metropolitan regions become more integrated in the world economy, supply chains will diversify. Disentangling these chains requires a large amount of detailed information, which was beyond the scope of this study.

Relevant issues are:

- supply or demand driven supply chain
- supply of inputs per agricultural sector (food and non-food, arable, horticulture, livestock, ornamentals)
 - o capital investments, high-technology: specify in category or type of goods; % local or imported; most important supplying countries when imported
 - o inputs such as fertilizers, pesticides, planting material, packaging materials and various other inputs: % local and or imported; most important supplying countries when imported
 - o partnerships with Dutch suppliers
- output: (arable, horticulture, livestock, flowers)
 - o local market (% of total production)
 - o export market (% of total production, dollars/euro), main destination
 - o partnerships with Dutch trading companies
- sector organization
 - o names of sector organizations (agricultural production, other agriculture related organizations), their nature (bottom-up organized by farmers, top-down organized by government, their most important goals/mission/field
 - o % (or number) of producers (or others) that are member of the organization
- Logistics and infrastructure

Environment

More intensive land use and higher population densities are normally associated with more environmental pressure. Available resources are used more intensively, and environmental pollution easily increases.

Relevant issues are:

- energy availability, use and price
- water availability, use and possible pricing mechanisms
- mineral flows (N, P, K), including losses and efficiency
- pollution

Government

Good governmental policies that are adequately implemented are required for a good and balanced metropolitan development. However, if governments are weak in either planning, implementation of plans, managing developments, etcetera, it is likely that objectives are not met. Also, irreversible developments that are not-wanted may occur, such as environmental degradation, urban construction at the cost of destruction of nature parks, etc. If market liberalization is the dominant driving factor, it is quite possible that governmental policies and capacities can not keep pace with market developments.

Relevant issues are:

- governmental policies at the national and regional level, regarding land use planning, agriculture, food production, food security
- decision power: who, what are the checks and balances?
- approach to supply chain development:
 - o governmental planning vs. free-market processes
- rules and legislation
 - o Land use
 - o Protection of the environment
- support to innovation
- land ownership
- institutional development
- technological support
- financial capabilities

Social context

Metropolitan development is closely associated with the social system. Metropolitan development can serve to reach social goals (e.g. employment, education, housing), and has to meet social requirements (e.g. an environment-friendly approach).

Relevant issues for this study are:

- population size and growth rate
- roles that the metropolitan region fulfils for the metropolitan population (food, employment, recreation, etc.)
- income and welfare
 - o average income of a family or person, in rural and urban regions
 - o purchasing power
- income distribution between for example the rich and poor
- employment
 - o number of people that work direct (production) in rural agriculture
 - o number of people that work indirectly (supply, trade, research, sector organizations, etc.) in rural agriculture
 - o labour costs
 - o labour conditions
 - o labour migration
- education facilities for, and education level (especially in horticulture, agriculture and animal husbandry)
- consumption patterns
 - o total food intake, sufficient calories, vitamins, etc.?
 - o origin of agricultural products/diet: local agricultural production, elsewhere in the country, from import
- cultural context

3.2 Case study China

Wuhan was the selected metropolitan region for China. To describe the current metropolitan situation and relevant developments for this study consisted of the following steps:

- A first global scan of the metropolitan region and WUR activities in Wuhan metropole.
- Collection of relevant information about the agricultural metropolitan situation and relevant developments in Wuhan by the Wageningen UR Office in China
- Findings of the mission are incorporated in this report.
- Establishment of possible (and preferred) directions of development for metropolitan agriculture.
- Assessment of the possibilities, restrictions, and consequences related to some of the developmental directions².

Although we have attempted to be as quantitative as possible in our description and analyses, an important limitation of the Wuhan study is the quality and consistency of available data and information. Although the amount of basic statistical data and information in China is very large (there is an intensive data collection in China, at several levels), sometimes inconsistent data were found.

In order to develop recommendations we inventoried and formulated several lessons learned from previous Wageningen UR projects. Therefore an interview was held with the project leader of several finished and on-going agro park projects in China, as well as an interview with a researcher at LEI, who was among others involved in a chain project in Wuhan. Also an evaluation study of the Greenport Shanghai project was studied.

² For example: geographically separate development of the metropolis and its surrounding region versus integrated development of the metropolis and its surrounding region

Anticipated results

- A description of the key factors in the development of the case metropolitan region (e.g., Wuhan). Some elements are:
 - o Land availability for horticulture, agriculture and husbandry plus appearance (for example in circles around the city, or more integrated with city elements)
 - o Food requirements of the urban population
 - o Recreational and other needs of the urban population
 - o Means of existence for the rural population
 - o Urban park landscapes, and other outcomes of land use planning
 - o Industrial (e.g., agro parks) and large-scale agriculture (e.g., staple food production).
- Two scenario descriptions for the case metropolitan region, including a description of the possible consequences that follow from both scenarios which will enable the Chinese stakeholders to make better motivated decisions.
- A summary report.

4 Focus on China: the metropolitan region of Wuhan

Metropolitan regions in East and Southeast Asia are expanding very fast at the expense of the rural areas. As a result fertile agricultural land is turned into residential and industrial areas and related infrastructure (Van den Berg et al., 2006). Agricultural and rural development, in general, was influenced a lot during the last three decades by three important policy changes (Chen, 2009). First, the commune systems were replaced by the household responsibility system. Second, China reformed its marketing system to a more free and open system. Third, the rural tax system was changed. Especially the first two policy changes have contributed greatly to China's agricultural and rural development, as well as to China's overall economic growth and social development.

For China, in the 11th 5-year plan (2006 – 2010; which mentions among others increased urbanization, cultivation of unused land, and transfer of labourers to non-agriculture sectors) focus was put on the development of metropolitan regions. Within this report the developments were studied for a specific metropolis in China, the Wuhan metropolis. This is a metropolis in strong development, also in terms of agro-production, and the metropolis is well-demarcated. Wuhan is the economic, scientific, technological and cultural centre of Central China. The infrastructure is improved strongly with large government investments, which has attracted a lot of foreign investors. The city has become a major hub city for all modes of transport. It is located strategically on the railway line linking Beijing and Guangzhou, and on the Yangtze River linking Chongqing and Shanghai (Han&Wu, 2004). Wuhan has a population of 8.3 million inhabitants, with a non-agricultural population of 4.6 million inhabitants.

4.1 An introduction to metropolis Wuhan

Wuhan is the capital of the province of Hubei. This province lies in the centre of China, roughly equidistant from the capital Beijing and the cities in Guangdong's Pearl River Delta. To its west, Hubei borders Shaanxi Province and the municipality of Chongqing; Henan, Anhui, Jiangxi, and Hunan provinces border Hubei in a clockwise direction from north to south. At roughly 185,000 km², Hubei is the 14th largest province in the country. For a province named after its proximity to a lake, Hubei's geography is largely defined by the mighty Yangtze River, the world's third largest. Flowing from west to east, the Yangtze enters Hubei at the Three Gorges, presently the site of the world's largest hydroelectric power station. In east Hubei, the Yangtze—along with a major tributary known as the Hanjiang—form the Jiangnan alluvial plane. In this low-lying area, the majority of Hubei's population resides. Western Hubei features a more mountainous landscape and offers a respite from the intense heat that blankets the eastern part of the province. Summer temperatures in the Jiangnan plane area can exceed 40 degrees centigrade, while winters tend to be cold. There is abundant rainfall, year round at best, however, often droughts and floods are alternating each other. The average annual rainfall is 1269 mm and is especially concentrated in 6-8 months of the year. Average annual temperature is 15.8 - 17.5 degrees; the annual frost-free period is generally 211 - 272 days; the total annual sunshine hours 1810 - 2100 hours. Except for the high-altitude areas in the western mountainous area, Hubei's climate typically conforms to a sub-tropical monsoon standard.

First settled over 3,000 years ago, Wuhan has been a major Yangtze River port city since the Han dynasty. Extensive trade - fuelled by its central location within China (see Figure 1.) - caused Wuhan to grow into one of China's largest cities. Wuhan is located in the southeast of Hubei Province. To the east of Wuhan lies the Jiangnan plain, while Hubei's mountainous parts lie to the city's north and west. Wuhan is actually an agglomeration of three separate cities that merged in 1927, under the auspices of Chiang Kai-Shek's Nationalist government. Wuchang, geographically the largest district, lies on the eastern bank of the Yangtze River, splitting Wuhan in two. The western half of the city is further divided into northern and southern halves by the Hanshui River. The northern section is known as Hankou, while the southern district is called Hanyang. There are many lakes near the river, on both sides. The city's water area accounts for 25.8% the total area of the city.

The last decade and a half have brought tremendous change to the city. The city's economic potential has not gone unnoticed by government authorities. In 2004, Wuhan—and all of Hubei—were among the areas included in Wen Jiabao's proclamation of the 'rise of Central China', an initiative aimed at raising the economic profile of the region. (See for more information "Cityscape Wuhan - a regional investment guide. Cityscape Wuhan. Joint sectoral research and investment report from China Intelligence Online", available at www.chinaintelligenceonline.com).



Figure 1. Map of China with the location of Wuhan

Wuhan (i.e. Wuhan municipality) is part of the Wuhan Urban Circle. The Wuhan Urban Circle was formally established in 2008. It is basically the area within 100 km radius of Wuhan, with a total size of 58 052 km². The Wuhan Urban Circle is the biggest 'city group' in central China area, centred by one mega polis (Wuhan), including 8 mid-size cities (Huangshi, Ezhou, Xiaogan, Huanggang, Xianning, Xiantao, Qianjiang and Tianmen) and 4 small cities. Some 1/3 of the total area of Hubei province is included in this area and half of the Hubei population (See Appendix I).

The city area is rich in mineral resources, mainly quartz sandstone building materials, brick clay, manufacturing grey limestone, including bentonite, metallurgical dolomite and glass. Quartz sandstone reserves rank first in the province, gypsum reserves are the third largest in the province.

The map in Figure 2a. shows the location of Wuhan Urban Circle in Hubei province. The dark area in Figure 2b. is Wuhan municipality whereas the lighter area is the rest of Wuhan Urban Circle. The dots are the 8 mid-size cities.

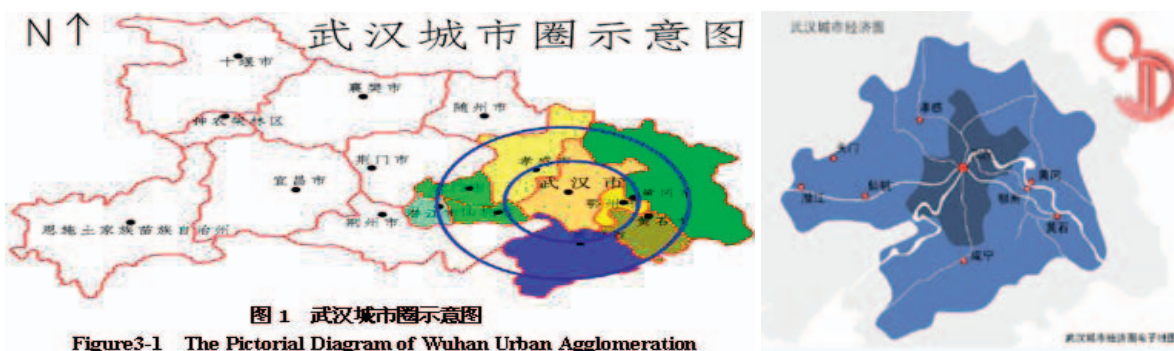


Figure 2. The Wuhan Urban Circle in Hubei province. b. The Wuhan Urban Circle

During the phase of data collecting and analysis, it became clear that for this study it was best to focus at the area called Wuhan Urban Circle.

The average GDP growth rate of Hubei province has been greater than 10% since 1979 and reached 13.7% between 2006 and 2008. The growth rate of the agricultural section is only 4-5%. Average expenditure of residents in 2008 was 4,225 RMB (478 euro), a tenfold of the expenditure in 1990. The disposable income of urban residents and net income of rural residents were 13,153 RMB (1490 euro) and 4,656 RMB (527 euro) in 2008, respectively. In 1990 they were 1,427 RMB (162 euro) and 671 RMB (76 euro). When grouping the rural households by annual net income, the highest income group, earning more than 5,000 RMB (566 euro), counted for 39.3% in 2008 whereas it was only 5.5% in 2001.

GDP of the Wuhan Urban Circle in 2009 was 801.6 billion RMB (90.8 billion euro), of which the primary industry, secondary industry and service sector contributed 82.3, 367.8 and 351.6 billion RMB (9.32, 41.7 and 39.8 billion euro) (Table 1), with average annual growth rates of 8.1%, 15.9% and 14.1%, respectively. The gross production of the agricultural sector in 2009 was 135.6 billion RMB (15.4 billion euro), which is 7.5% more than the year before. In Table 2 the contribution of Wuhan Urban Circle to different data of the Hubei Province is given.

Table 1. Development of Wuhan Urban Circle in 2009 (Hubei Statistic Yearbook, 2009)

Data	Billion RMB	Growth rate (%)
GDP	801.6	14.1
Primary Industry Added Value	82.3	8.1
Second Industry Added Value	367.8	15.9
Tertiary Industry Added Value	351.8	14.1
Agricultural Gross Production	135.6	7.5
Scaled Industry Gross Production	908.9	17.4
Scaled Industry Added Value	292.3	18.8
Disposable Income of Urban Resident	15057	9.8
Net Income of Rural Resident	5191	11.2
Overall Retail Sales of Social Consumption Products	350	
Net Growth of Overall Retail Sales of Social Consumption Products	57.9	
Utilization of Foreign Investment	3.9	14.6

Table 2. Contribution of Wuhan Urban Circle to Hubei Province in 2009 (Hubei Statistic Yearbook, 2009)

Data	Contribution	
Land Area	1/3	of Hubei province
Population	1/2	of Hubei province
Economic Aggregate	60%	of Hubei province
Gross Production	62.0%	of Hubei province
Contribution to Provincial GDP Growth	8.7%	
Scaled Industry Added Value	61.1%	of Hubei province
Contribution to Scaled Industry Growth of Province	10.7%	
Overall Retail Sales of Social Consumption Products	62.9%	of Hubei province
Contribution to Overall Retail Sales of Social Consumption Products Growth	11.4%	
Utilization of Foreign Investment	82.3%	of Hubei province
Contribution to Utilization of Foreign Investment Growth	8.8%	

4.2 Land use

The 1990's was a decade during which Wuhan experienced rapid expansion and restructuring in land use. Transportation and industrial land use grew especially fast during the first half of the 1990s, with new areas added mainly in the industrial district in Hanyang and the peripheries of all the three towns (Wuchang, Hankou and Hanyang). Transportation and industrial land uses kept on growing in the second half of the 1990s, but at a slower pace. This caused the green areas to shrink during the (late) 1990s (Han and Wu, 2004).

A concentric ring pattern characterizes the land use structure in Wuhan. Since 1978, Wuhan changed in stages in economic activities and its land use structure was consequently modified. In the period 1978–1984, Wuhan's economic development continued to rely upon the heavy industries. Policies on economic reform and openness led to a rapid change in the tertiary and the primary sectors, but these changes focused on meeting the daily needs of commodity supply and grain production by increasing productivity rather than structural adjustments. Land use for the tertiary activities increased mainly in the old city areas, by revitalizing the existing commercial areas. Heavy machinery and manufacturing activities continued to operate in and around the middle ring belt. The main characteristic of land use structure in this stage was that the inner ring was a high density, mixed land use area with deteriorated environment and inefficient land use structure. From 1985 to 1992, Wuhan's secondary sector declined in its share in the GDP value added, whilst the tertiary sector expanded significantly. A larger tertiary sector led to the development of new commercial buildings and the removal of some substandard buildings, small workshops and factories in the inner ring. All the textile factories within the inner ring area, for example, moved out and the sites were consequently used for commercial and residential development. Farms in the middle ring area ceased operation and the farmland was used by secondary and tertiary activities. In the third stage (1992–1998), the majority of the industrial and storage land parcels were redeveloped to accommodate commercial and service activities in the inner ring. Large scale shopping and recreational centers were built by upgrading and redeveloping small commercial buildings. The middle ring expanded towards the outer ring, as a result of the newly established industrial clusters such as the automobile cluster in southwest, the high tech development zone in the east and the south, and the logistics center in the east (Han and Wu, 2004).

The Urban Planning Bureau and Land, Resources and Housing Administration are both involved in the area planning process. Decision (support) of the local governor, for instance support of the county mayor, is very likely more important to influence the process than the planning bureau and land resource bureau. There are restrictions (factors, rules) in which these bureaus have to operate. For example, the basic farmland cannot be touched at all for any other usage. When a certain piece of land is needed for a (agricultural) project, this has to be checked at the land resource bureau whether the place is legal for the underlying project.

Table 3. Development of the agricultural land use within the Wuhan Urban Circle

Municipality	Land Area	1990		1995		2000		2008	
		Cultivated Area year end	Cultivated Area per capita	Cultivated Area year end	Cultivated Area per capita	Cultivated Area year end	Cultivated Area per capita	Cultivated Area year end	Cultivated Area per capita
	(sq.km)	1000 ha	ha	1000 ha	ha	1000 ha	ha	1000 ha	ha
Wuhan	8494	240.11	0.036	225.75	0.032	217.84	0.027	207.83	0.023
Huangshi	4583	84.08	0.040	39.70	0.027	79.32	0.032	87.11	0.036
Ezhou	1594	44.33	0.049	40.90	0.041	40.28	0.039	41.23	0.040
Xiaogan	8910	296.41	0.055	289.86	0.050	247.10	0.049	260.05	0.055
Huanggang	17446	335.85	0.051	317.96	0.045	312.36	0.043	328.34	0.049
Xianning	9861	150.46	0.062	188.78	0.053	145.94	0.054	153.60	0.061
Xiantiao	2538	108.29	0.078	104.50	0.065	98.68	0.067	90.14	0.067
Qianjiang	2004	73.39	0.085	69.02	0.042	66.99	0.067	68.41	0.073
Tianmen	2622	110.63	0.072	108.50	0.114	107.62	0.067	106.98	0.078
Total	58052	1444	0.528	1385	0.469	1316	0.446	1344	0.483

Table 3 gives an overview of the cultivated land area between 1990-2008 for all municipalities within the Wuhan Urban Circle. Most agricultural land is located in the municipalities of Huanggang, Xiaogan and Wuhan. The cultivated area per capita is the highest in Xiantiao, Qianjiang, Tianmen and Xianning. Expressed in percentages, the most agricultural municipalities are Tianmen, Xiantiao, Qianjiang (Table 3.4).

Table 4. Percentage of the land area with agricultural land use

Municipality	1990	1995	2000	2008
Wuhan	28.3%	26.6%	25.6%	24.5%
Huangshi	18.3%	08.7%	17.3%	19.0%
Ezhou	27.8%	25.7%	25.3%	25.9%
Xiaogan	33.3%	32.5%	27.7%	29.2%
Huanggang	19.3%	18.2%	17.9%	18.8%
Xianning	15.3%	19.1%	14.8%	15.6%
Xiantiao	42.7%	41.2%	38.9%	35.5%
Qianjiang	36.6%	34.4%	33.4%	34.1%
Tianmen	42.2%	4.14%	41.0%	40.8%
Total	24.9%	2.39%	22.7%	23.1%

Within the whole Wuhan Urban Circle, in 2008 1,344,000 ha out of 5,805,200 ha was cultivated (23%) (See Table 4). It seems that no agricultural land use data for the different agricultural sectors are available at Wuhan level, only at provincial level (see Appendix II). In the tables in Appendix II the cultivated area is the area for open field agriculture. Area of vegetable horticulture, flower horticulture, greenhouses and livestock are not reported in yearbooks. There are a few “agro-parks” in Wuhan, but no detailed information is available.

General speaking, land within Wuhan city will be more expensive than outside, and urban land are more expensive than rural area. In the desk study no exact prices were found. Other factors than distance may affect the price also. For instance in the Alterra Caofeidian project the county mayor later decided to grant the land to whoever will be the anchor investor for free as a sort of reward (i.e. stimulation). In respect to area planning it is important to make the local governor interested in the plans.

4.3 Agricultural production types and production

4.3.1 Agricultural production types

Mixed farming systems are still the dominating agricultural production types in China and contribute most to food supply (Li et al., 2008). The social, economic and ecological sustainability in China, to a large extent, depends on healthy management and continual optimisation of the integrated crop-livestock production system (Hou et al., 2008). However, especially around the big cities in the east of China, there is a shift away from extensive integrated crop-livestock production systems to intensive specialised systems, and this has caused serious environmental problems. In Table 5 the contribution of integrated crop-livestock production systems to food production in China is given. From this table it is clear that especially crop land is used in integrated systems. This is also true for beef and mutton. Pork and poultry meat are only produced for half in integrated systems. Especially around bigger cities in the east of China more and more pork and poultry meat is produced on specialized farms.

Generally it can be said that traditional farming systems in China, the home garden production system, is changing towards industrial agriculture all over China. There are no large greenhouse complexes in China yet (farming systems used in the Netherlands are too modern for Chinese).

Table 5. Contribution of integrated crop-livestock production systems to food production in China (Hou et al., 2008).

Item	National total	Used or produced by integrated crop-livestock production system	
		Amount	% of national total
Crop area (million ha)	130.0	107.5	82.7
Wheat area (million ha)	22.8	17.0	74.4
Corn area (million ha)	26.4	23.0	87.1
Beef yield (million tons)	7.1	6.4	90.0
Mutton yield (million tons)	4.4	4.0	90.0
Pork yield (million tons)	50.1	25.1	50.0
Poultry yield (million tons)	14.6	7.3	50.0

The desk study gave the impression that nowadays there is no more government planning or ordering on production in Wuhan. Farmers can select whatever product they want to make profit. Government guides them in this by providing subsidies.

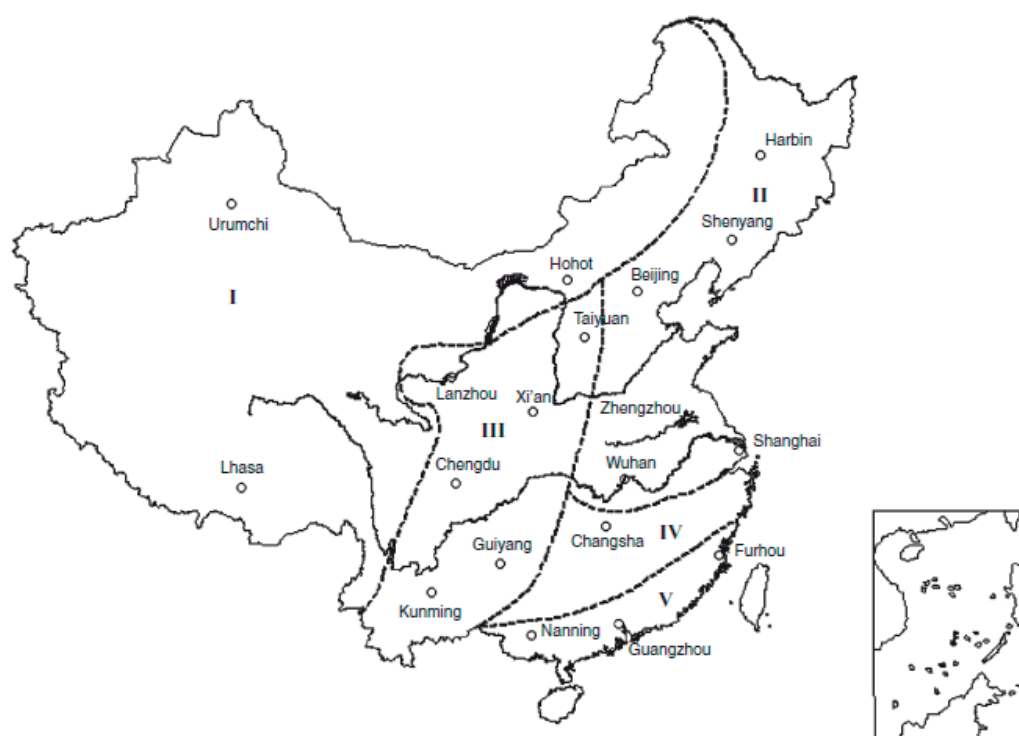


Figure 3. Sketch map of the integrated crop-livestock production systems in China. I. Systems based on rangeland; II. Systems based on grain crops; III. Systems based on crop/pasture rotations; IV. Agro-silvopastoral systems; V. Systems based on ponds. (Hou et al., 2008)

In Figure 3. a sketch map of the integrated crop-livestock production systems in China is given. Generally speaking, the systems in the area of Wuhan are based on grain crops. With abundant grain and straw resources, this agricultural system feeds 34% of cattle, 47% of goats, 26% of sheep, and 42% of donkeys and generates 58% of beef, 50% of milk, 36% of pork, 56% of chicken and 67% of chicken egg production in China. In the Yangtze Plain (also including the Wuhan area), the planted areas of rice and wheat accounted for 44–62% and 9–23% of cropland in most counties, respectively (Hou et al., 2008). According to Hou et al. (2008) interaction between crop and livestock production occurs in the following ways: (i) most livestock are fed crop by-products and grain; (ii) sometimes, small livestock graze fallow cropland, stubble cropland and sparse rangeland; (iii) livestock provide manure and draft power for some crop production.

There are two serious problems in this type of system (Hou et al., 2008). The first is that natural complementarities between crop and livestock have been compromised by specialisation in crop or livestock production. The traditional forage legume/cereal rotation is being replaced by continuous cultivation of corn, soybean, rice or wheat driven by rising price of grain and the rapidly developing bio-energy industry. A second problem is environmental pollution from increasing use of nitrogen fertilizer and from livestock themselves. Large blooms of blue-green algae in famous lakes including Taihu Lake, the Caohu Lake basin, and the Huaihe river basin have occurred in these systems. According to Hou et al. (2008) two types of system coupling is needed to integrate crop-livestock production: spatial integration and temporal integration. Spatial integration of crop and livestock can take place between farms (regional integration) or within the same farm (household-level integration), the latter always being accompanied by temporal integration.

4.3.2 Production

Table 6., Table 7. and Table 8. give an overview of the agricultural production in 10,000 tonnes in Wuhan Urban Circle in 2008. For Hubei province an overview of the crop production can be found in Appendix II. In area size, the most important crops in the province of Hubei are peanuts, grains, and vegetables. Silkworm cocoons (mulberry feed) is a local specialty in Huanggang, while fruits are the specialties from Xiaogan (especially peaches), Wuhan (especially citrus and peaches) and Huanggang (especially Citrus). Mushrooms are produced / harvested in Xiaogan, Huanggang and Xianning.

4.4 Supply chains

4.4.1 Supply of inputs

Only little information is available through the Hubei Statistics Yearbook 2009 with regards to this item. In the Yearbook information is given on the degree of Agricultural modernization in Hubei Province.

The government has many subsidies for different agro-sectors, for instance for grains, fertile breeding sow, high quality seeds of wheat and cotton and so on.

4.4.2 Marketing of output

See Table 6., Table 7. and Table 8. for the output of local agricultural production. No information is available about the final destination of the agricultural output.

4.5 Environment

One of the most important environmental threats to Wuhan is the flooding of the Yangtze river, which happens from time to time (Han and Wu, 2004). How to minimize the damages caused by flooding remain to be a major challenge in Wuhan. Pollution, including air, water, and solid wastes, presents another severe problem (Han and Wu, 2004). In terms of water, about a third of industrial wastewater was untreated, and 26% of the treated water did not meet relevant national standards in 1993. While the above was the situation in the early 1990s, the situation in 10 years from then improved little. The Deputy Director of Wuhan Bureau of Environment Protection, Wu Shirong warned that the Wuhan section of the Hanshui River would be a dead pond in 6 years if the existing trend of pollution continued, referring to the annual discharge of 25 million tons of wastewater into the river (Han and Wu, 2004).

China is growing very fast in livestock production, especially in the east of the country. In the period between 1982 – 1994 annual growth rate of meat production in China was 8.4%. Also for the coming decade until 2020 a rapid increase in livestock production is expected (Delgado et al., 2001). In Figure 4. pig and poultry densities are given for China and some other South-East Asian countries. Pig and poultry densities are very well related to the phosphate (P2O5) overload per hectare, as is shown in Figure 5.

Table 6. Crop production within Wuhan Urban Circle: output of major farms crops per municipality in 2008 (x 10,000 tons)

Municipalities	Grain	Rice	Wheat	Corn	Tubers	Soybean	Cotton	Oil Bearing Crops	Peanuts	Rapeseed	Sesame	Hemp Crops	Ramie	Sugar Crops	Crane
Province	2,227.23	1,533.72	3,29.19	2,26.42	81.04	25.98	51.3	285.74	57.5	214.89	12.69	4.76	4.34	26.47	26.47
Wuhan	129.73	101.85	6.12	11.45	3.87	2.62	3.53	18.45	4	12.06	2.39	0.41	0.41	7.17	7.17
Huangshi	58.14	44.55	2.86	3.69	4.76	0.77	0.39	7.12	0.61	5.5	1.01	0.88	0.88	0.07	0.07
Ezhou	32.34	27.79	1.42	0.55	1.4	0.5	0.52	5.54	0.37	4.61	0.56	0.03	0.03	0.4	0.4
Xiaogan	217.62	176.96	32.53	1.13	2.93	1.98	2.86	19.84	6.03	13.12	0.69			1.26	1.26
Huanggang	304.21	263.16	20.37	1.05	9.04	4.13	7.18	43.4	12.25	29.48	1.58	0.73	0.62	2.87	2.87
Xianning	102.77	87.61	1.33	5.7	4.76	0.9	0.28	7.93	1.41	5.95	0.57	2.29	2.29	4.55	0.455
Xiaotao	67.34	55.5	4.88	2.38	0.63	1.95	2.77	11.8	11.21	11.21	0.42	0.01		1.23	1.23
Tianmen	56.88	41.19	11.31	0.49	0.34	2.23	4.307	9.44	7.85	7.85	0.14			0.7	0.7
Qianjiang	36.49	26.85	7.94	0.23	0.12	0.94	4.74	9.36	9.81	8.91	0.1	0.01		0.32	0.32

Source: Table 7-25 of the Hubei Statistic Yearbook 2009

Table 7. Animal production within Wuhan Urban Circle: output of major animals per municipality in 2008 (x 10,000)

	Large animals in Stock		Sheep in stock		Hogs		Sheep out of stock at year-end	Poultry out of stock at year-end	Total output of meat			Output of eggs
	Total	Cattles Buffaloes	Total	Goats	Hogs in stock at year-end	Hogs out of stock at year-end			Total	Meat of pork	Meat of mutton	
	heads	heads	heads	heads	heads	heads	heads	heads	tons	tons	tons	tons
Hubei Province	319.12	317.50	394.30	387.04	2462.40	3498.30	495.70	39548.80	340.84	292.15	8.12	124.10
Wuhan Urban Circle	172.75	172.32	72.70	72.61	1100.53	1495.84	85.66	24561.37	159.34	114.10	1.38	77.76
Wuhan	23.77	23.73	3.15	3.15	172.77	241.62	5.23	4650.57	28.56	19.36	0.09	13.85
Huangshi	7.62	7.61	3.93	3.93	68.76	96.21	3.39	1406.93	9.44	7.07	0.06	2.90
Ezhou	3.68	3.68	0.69	0.69	57.62	78.00	1.81	1060.91	7.23	5.51	0.03	3.10
Xiaogan	43.60	43.31	17.61	17.61	218.10	272.30	15.11	8259.68	33.87	20.41	0.19	24.23
Huanggang	68.68	68.65	35.02	35.02	287.58	344.33	45.34	3421.99	35.50	25.22	0.68	20.40
Xianning	11.55	11.55	9.88	9.88	120.53	177.96	11.71	2639.46	17.21	13.32	0.29	2.39
Xiaotao	3.56	3.61	0.10	0.01	62.66	110.17	0.18	784.71	9.18	8.26		4.02
Tianmen	6.23	6.12	0.72	0.72	66.46	96.24	0.85	1082.46	9.69	8.27	0.01	4.59
Qianjiang	4.06	4.06	1.60	1.60	46.05	79.01	2.04	1254.66	8.66	6.68	0.03	2.28

Table 8. Local Specialty Production within Wuhan Urban Circle

	Tea		Silkworm Coccons		Fruits				Mushrooms	
	Total (10,000 tons)	Green Tea (10,000 tons)	Total	Mulberry feed	Total (10,000 tons)	Peaches (10,000 tons)	Citrus (10,000 tons)	Apples (10,000 tons)	White Fungus (tons)	Jew's Ear (tons)
Hubei Province	13.03	10.71	12490.00	12384.00	377.66	51.06	255.51	0.89	142.00	15374.00
Wuhan Urban Circle	4.94	3.78	6964.00	6964.00	37.41	11.34	14.18	0.15	12.00	503.00
Wuhan	0.17	0.12			7.67	1.98	2.63	0.01	11.00	26.00
Huangshi	0.04	0.04			3.28	0.11	2.97			5.00
Ezhou	0.01	0.01			2.53	0.42	1.51			1.00
Xiaogan	0.24	0.24			12.05	6.51	0.51	0.07		222.00
Huanggang	2.73	2.69	6964.00	6964.00	7.50	1.80	4.34	0.07	1.00	182.00
Xianning	1.75	0.68			4.38	0.52	2.22			67.00
Xiaotao					3.42	0.55	1.16	0.17		
Tianmen					1.63	0.11	0.26			
Qianjiang					2.53	0.16	0.21			

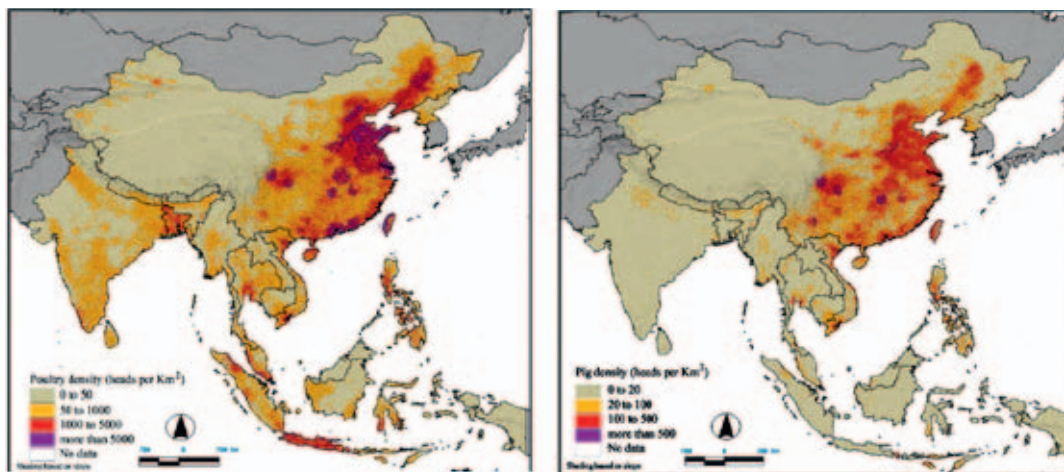


Figure 4. Estimated numbers of pigs (left) and poultry (right) per km² in some countries in South-East Asia for the period 1998 – 2000. (Gerber et al., 2005).

Traditional mixed farming systems in China and other parts of South-East Asia, especially in areas around the cities, have been split into specialised crop and livestock activities. This process was and is driven by market pressure and was not controlled because of weak regulations. The intensification of livestock production, but also of other agricultural systems like horticulture, around big cities are driven by transport costs minimization as well as labour and services availability (Gerber et al., 2005). While there are differences between pigs and poultry, the overall trend of production points towards greater production and processing concentration around urban centres. In overloaded areas, part of the chemical fertilizers could in fact be substituted by manure, thus substantially decreasing the environmental impacts on land and waters.

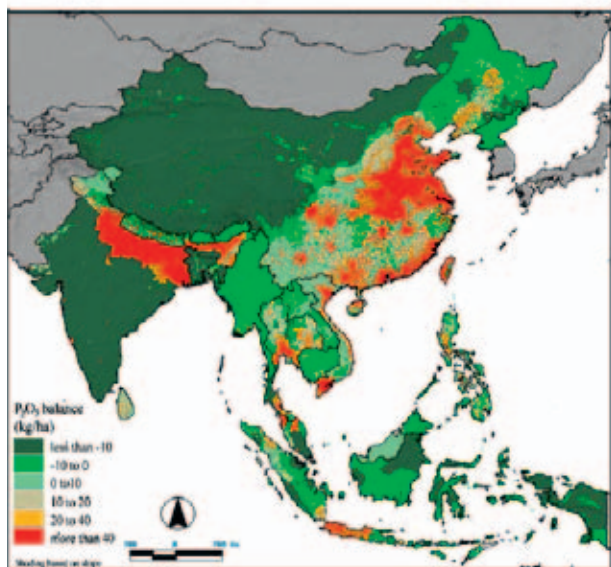


Figure 5. Estimated P2O5 mass balance (P2O5 overload) in kg ha⁻¹ in some countries in South-East Asia for the period 1998 – 2000. (Gerber et al., 2005)

The Wuhan Urban Agriculture Development Plan (2006 -2020) pays a lot of attention to the environmental pollution problem. They report that soil and water are threatened by oversupply of chemical fertilizers, industrial and domestic wastewater, rural water pollution, and deterioration of soil physical properties. Therefore they propose that sustainable development should not only focus on solving current problems of agricultural development and rural incomes, but should also focus on long-term development goals, as effective use, distribution and protection of agricultural resources, improvement of agricultural production conditions and environmental protection. Generally speaking, in agricultural development planning attention should be paid to people (social aspects), profit (economic aspects) and planet (environmental aspects).

In more detail it is planned to take the following measures.

- Control and reduce the use of pesticides and fertilizers;
- Promote technical measures to generate 'green manure';
- Promote use of low toxicity pesticides and promote timely use of pesticides;
- Promote waste utilization technologies, make links to related industries and promote generation of renewable energy from waste;
- Accelerate the development of circular agriculture and clean agriculture;
- Relocation of livestock farms from protected areas to the outer rings of the metropole.

In China there are some methods to control the use of pesticides. National laws specifies which kind of pesticides can be used for certain kinds of crops and vegetables, and provincial and local governments can make additional regulations to make the national law more suitable for local conditions (Chen&Wang, 2005). The pesticides are always sold by specific departments or extension stations, and the assistants or the dealers, give the farmers advice on how to use the pesticides. These advisers are trained by the department of agriculture. This system works efficiently. The farmers can also buy pesticides from private shops. The shops can sell pesticides after getting the necessary certificates, which are given by the department of agriculture and department of industry and business management. However, there are still some shops that sell illegal pesticides (Chen&Wang, 2005).

In recent years Wuhan city area has paid much attention to afforestation. Different forest ecological projects have been performed. Within 5 years' time the city forest green rate was increased with 6%. Also in the coming years a lot of investments will be done on generating sustainable energy from biogas e.g., from livestock manure.

4.6 Government

Agricultural development policy

February 2010 the General Strategic policy plan regarding agriculture development was launched by the central government (Appendix II). This policy plan aims to better coordinate urban and rural development. The central government will continue to improve the policy system to empower and benefit farmers. Also the government will continue boosting financial input into agriculture and rural areas. Budget expenditures will give priority to development of agriculture and rural areas. For example: fixed-asset investment will be channelled first into agricultural related infrastructure and projects in relation to rural livelihood, especially in rural highways, electric and water utilities, and biogas supply (Chen, 2009).

The following is reported by Chen (2009) about infrastructural improvements. China had totally invested over 270 billion RMB in the construction of rural electric utilities. As a result, not only there are much more rural electric utilities than before, but the electricity price has decreased greatly, as well. The price is kept below 0.6 RMB per kilowatt hour for most areas. Great achievements have been made in rural highway construction after a several years of effort. The rural highways cover about 95% of townships and 87% of administrative villages. The previous problem of drinking water supply in rural areas was that water sources were far from the rural residents. This problem has been basically solved by construction. The major problem confronting rural residents now is unsafe drinking water, because drinking water in some rural areas has a high density of mineral and heavy metals. About 320 million people in China drank unsafe water at the end of 2005. The central government invests about 2.5 billion RMB in developing the biogas utilities every year. In addition, the annual investment of local governments is around 4-5 billion RMB. As a result, about 330,000 hectare of biogas can be developed annually. Owing to the construction of biogas utilities, farmers can use clean recycled resources at present, which is good for the ecological environment. At least 6.67 million hectare of biogas can be developed nationwide because of 252 million rural households. However, present construction can only realize less than 3.33 million hectare of biogas. Further construction is needed.

More subsidies shall be channelled to increase the output of grain, potato, highland barley and peanut, as well as the purchase of agricultural machinery. Besides attention for improvement of rural livelihood, the coming years also attention will be paid to integrate the migrant workers into urban life. At this moment the possibilities and social rights regarding permanent urban residence is for these migrant workers with a rural background very restricted/limited.

The Provincial Agricultural Department of Hubei Province reported the following main objectives to improve agricultural production in 2010:

- Stable food production and increase of yield per hectare by optimizing grain varieties and double cropping per year.
- Enhancing the quality of the crop industry, e.g. by accelerating the production development of fruit, tea, edible mushrooms, taro and other horticultural products. Support the development of the peanut industry, and expand the scale of peanut yield.
- Promoting the stable development of animal husbandry. Promoting standardization of the scale of livestock farming. Focus on promotion of standardized pig "150 model"; layer "153 model"; cattle "165 model"; sheep "1235 model" for farmers and other "family-scale farming" model, driven to improve livestock and poultry industry and to increase the income of the farmers.
- To develop healthy fisheries. Strive to achieve 150 demonstration farms to increase fish yield at an annual growth rate of 5% of total aquatic products.
- Support the development of professional communities, and large counties. Accelerate the implementation of the new round of agricultural advantages of regional distribution planning, and further optimize the industrial structure of agriculture, promoting the "One Village One Product".
- Promoting development of agricultural demonstration parks by leading companies,
- Promote the development of farmer cooperatives.
- Implementation of quality brand strategy to improve quality and prices of products.

- Strengthen the certification testing centre at the county level for quality and safety monitoring of agricultural products.
- The implementation of standardization of agricultural production. Actively develop pollution-free agricultural products, green food, organic food and products with geographical identity.
- Improvement of the tracking and tracing system of products.
- Enhance scientific research and promote scientific and technological achievements being implemented in practical farming and product processes.
- Improve the agricultural extension system by strengthening the conditions for capacity building.
- Strengthen the breeding industry to improve the genetic potential of agricultural produce.
- Strengthen the training of farmers. Implementation of new farmers training projects.
- Improve infrastructure to to strengthen agriculture.
- Strengthen farmland protection and quality and improve the land quality monitoring system, standardized quality assessment and monitoring of land management.
- Strengthen agricultural machinery and equipment. Seize the opportunity to increase the purchase of agricultural subsidies, improve the level of agricultural equipment, and agricultural machinery.
- Strengthening the rural information network. Start key information kiosks, "agricultural ICT" and "mobile newspaper" and other services to promote the construction of agricultural information on the new level.
- To promote rural clean energy projects. Development of biogas plants, straw gasification, and solar energy.
- Strengthen management of agricultural resources and environmental protection.
- To strengthen prevention and control of crop pests and diseases. Vigorously promote the "public plant protection, green plant protection" concept, strengthening early warning and forecast of major plant diseases and insect pests.
- To strengthen prevention and control of major animal diseases, e.g. foot and mouth disease, blue ear disease, avian flu and other major animal diseases. The Animal Epidemic Prevention strategy should be strictly implemented.
- Take the initiative to respond to natural disasters in agriculture. Closer coordination with the meteorological department and strengthen monitoring and early warning, and improve emergency plans.

According to the Wuhan Urban Agriculture Development Plan (2006 -2020) the city urban agriculture should meet the following five functions:

1. Industrial economy function. The agricultural structure and efficiency should be further improved and developed; production should be standardized and industrialized; the agricultural industrial chain should be extended and the added value of agricultural products should be increased. This should be done, both to meet consumer demands of urban residents, as well as the realization of agricultural production and farmers income.
2. Ecological balance function. Through afforestation, construction, and wetlands, disasters from flooding should be prevented. With strict planning, management, and effective use, the peri-urban rivers, lakes, reservoirs, forests, wetlands and other ecological resources should be protected. This will make the Wuhan sky bluer, the water clearer, and the environment more green and more beautiful.
3. Tourism and leisure function. With the full use of the suburban landscape and the presence of leisure villas, leisure parks and high-tech farms, tourism, leisure, and tourism agriculture is promoted. In this way people can spend time in quiet, clean and beautiful rural scenery, enjoy the fun farms and experience the fantastic return to nature to improve the quality of life, the harmonious development of man and nature.
4. Cultural and scientific capabilities. To meet the spiritual and cultural life of city residents and the youth to understand the requirements of agricultural knowledge. This can be realized by high-tech agricultural demonstration parks, facilities, agricultural projects and agricultural estates; close to nature for the students and the public.
5. Radiative model function. Give full play to the city science and technology and vigorously promote agricultural technology and management innovation, and actively promote information technology, biotechnology, engineering and other high technology applications in agriculture.

Because of these ambitions for (peri-)urban agriculture in Wuhan area, the Wuhan government is interested in the Metropolitan Agro Industrial Park innovation that is developed in Caoheidian with involvement of Wageningen UR Alterra. Alterra demonstrated to the local government state-of-art agriculture system and techniques and is hoping that Wuhan government will help to promote and start innovations in the Wuhan district. Since policy is a strong factor in performing any economic activity in China, government support is very essential to setup such a project.

Land ownership

In principal all land in China is state owned, including farm land, construction land, and the land (including the house) people live at. But 30 years ago, when the central government decided to give farmers their own decision how to live on their piece of land, every farmer received his “own” land. There are some general regulations though. For instance at least 1.8 billion MU (120 million ha (15MU=1 ha) farmland may only be used as basic farmland for crop production. Information about the locations of the basic farmland can be retrieved from the land planning bureau and the land resource bureau.

The small scale of agricultural operations in general is an important issue for the future. Currently average households own less than 4 acres of arable land. This restricts the level of mechanization and the implementation of modern and new technologies.

Food safety and cooperation among small farmers

There are many rules and regulations to reverse the extensive use of fertilizers, pesticides and other agro-chemicals, but enforcement of these regulations is not an easy task. The fragmented structure of agriculture with millions of small-scale farmers makes it difficult to set up an effective control system. One of the solutions the Chinese government is striving for is to promote cooperation among farmers by establishing producers' organizations. The outcome of this policy is not clear yet, but the number of these organizations is growing very fast, amongst other things because they are allowed to sell and buy products on behalf of their members and to make profit. By entering into agreements with these cooperatives, supermarkets may be in the position to lead the development towards more efficient, more profitable and more sustainable vegetables supply chains (Zhang, 2010).

4.7 Social context

4.7.1 Employment data

No information was found on number of employments in the Wuhan Urban Circle. On provincial level data was available. 321,123 people in province Hubei work in agriculture (i.e. farming, forestry, animal husbandry and fishery). These are 167,074 employees in units in urban area, 148,532 in state owned units, 2,789 in urban collective owned units and 2,728 in other units (Hubei Statistical Yearbook 2009, Table 3).

4.7.2 Issues regarding agricultural employment, social care and future developments

Most important issues regarding agricultural employment are the migrant workers (Nong-Min-Gong). Population in China is generally divided in two groups, i.e. urban population and rural population. More and more rural populations nowadays are intended to work in urban area instead of farming in their hometown, which brings a lot of social economic impact on both urban and rural area. Government is trying to stimulate these “migrated” labours, or those who want to migrate, to settle down in their village of origin and contribute to local development. One of the most important concerns of the local government while making development decisions is how many jobs the proposed project could create as well. The future issue is not only to free the labours from the soil by introducing modern mechanized agriculture, but more importantly, how to arrange that these “exceeded labour” contributes further in economic development.

Urbanization results in a change of land use and in a change in employment. The area of agricultural land is decreasing at high speed in the metropolitan area in favour of constructions. An example of this process for China is shown in Figure 6. for a town near Nanjing (GaoQiao).

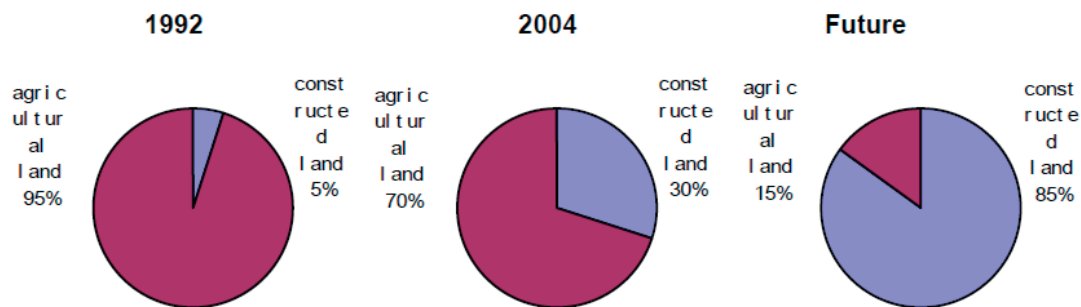


Figure 6. The land use typology of GaoQiao in 1992, 2004 and the future (Zhu et al., 2005).

Employment in agriculture is depending very much on the area of agricultural land, as well. Other forces that influences employment in agriculture are the intensification, which increases labour need, and mechanization, which decreases labour need. For the same town near Nanjing (GaoQiao) the development of employment in agriculture is given in Figure 7.

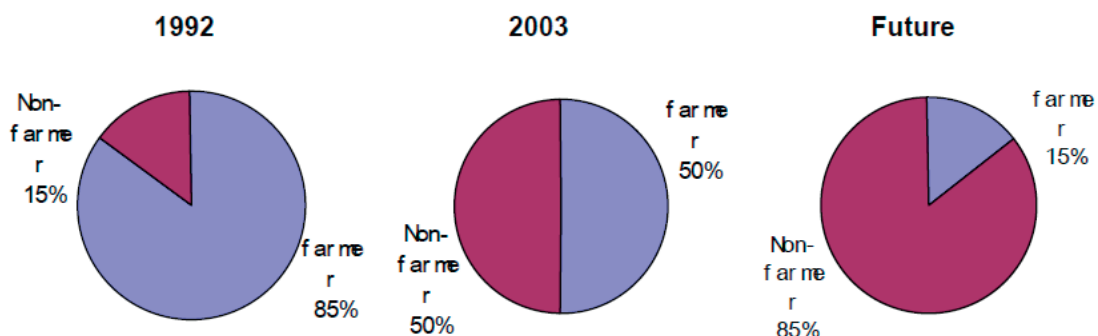


Figure 7. Per cent of employment in farming and non-farming in 1992, 2003 and the future (Zhu et al., 2005)

Chinese people all get a special personal legal document called "Hu Kou", besides their ID card and passport. The "Hu Kou" determines where you belong to (which province, municipality, county, village etc.) and where you are a citizen or a farmer. What social welfares you may enjoy is all decided by where your "Hu Kou" is. For instance only the people with Beijing "Hu Kou" can apply the subsidy in Beijing for buying or renting the apartment.

4.7.3 Consumption

No agro-production consumption data by production source could be found. Basically, China can produce all the normal agro-products by itself and domestic transportation cost relatively low enough for distribution. Information that is available are data about people's consumption level expenditure for both urban and rural household in province Hubei (Appendix I, Tables 5., 6. and 7.).

4.8 Two scenarios for Wuhan

This part of the report will develop two different scenarios for agricultural development in the Wuhan region. First the concept of scenario will be briefly introduced.

Scenarios may describe the most likely developments (based on an extrapolation of the past, or of some other metropolitan regions). They may also describe possible developments (based on the identification of major uncertainties, the Shell method). This contribution however deals with scenarios as a way to illustrate the development towards more sustainable agriculture (i.e. we are concerned with desirable futures, rather than most likely futures or possible futures).

4.8.1 Land Use Patterns and Theories to Explain these Patterns

First we will look at two or three theories which explain how agricultural land use patterns have developed in metropolitan areas. Metropolitan areas can be characterized with high density of population, and high competition for land use (both agriculture and other uses, but also from within agriculture different crops or livestock).

Von Thunen

The first theory explains the different uses of land under the assumption that transport costs are high. This used to be the case in the western world before industrialism and it may still be the case in some parts of the developing world. This is the Von Thunen theory (Von Thünen, 1826). Land close to the city is favoured by farmers because transport costs will be lower, hence they are willing to pay higher prices for that land. At the same time crops that are difficult to transport (voluminous or perishable) will be grown close to the city. A pattern of land use develops with highly intensive agriculture close to the city and less intensive agriculture further away (in descending proximity to the city we have market gardens, dairy, forestry, arable land). There is evidence that before the industrialization this pattern of land use developed around certain European cities. In the Delfland area in the Netherlands for example some form of intensive dairy farming developed close to Schiedam (where the cows were fed on waste from the jenever industry, and fresh milk was sold to the city). We also see the appearance of market gardening close to cities, in the Netherlands these were called "warmoezeniers". Close to the Delfland area, gardeners in what is now called the Westland area, used cow manure to fertilize the soil, and they would grow a variety of crops, high value, highly perishable (Bieleman, 2010). In Belgium we saw this pattern close to Brussels, the market gardeners were called Boerkoezen, and they were so wealthy that socialism did not get a hold on them (Vandervelde, 1924). For Paris it has also been documented that there were market gardens close to the city, fertilized with city waste (night soil) but highly productive and highly diversified.

Sinclair

Gradually agriculture industrialized, technological processes were developed to prevent perishable products going to waste, transport itself became much more efficient. This allowed many agricultural activities to move away from the city, in fact one could say that the typical Von Thunen model did not work anymore, maybe even the reverse was true. The further away from the city, the more intensified agricultural land use may be. This development is analysed by Sinclair (1967), who argues that Von Thunen is right about the basic mechanisms but the circumstances which make the mechanisms work in a certain way have changed, hence the outcome is totally different. Sinclair observed that close to cities farmers seem reluctant to intensify their farm, because they expect the city to expand and take over the land in the near future. Rather than making long term investments in their farm operation, farmers use the time left to mine the soil, plant cash crops, keep fewer livestock, delay maintenance of buildings and relinquish keeping machinery up to date. Further away from the city, farmers are more certain to keep their farm, hence invest more deeply to stay up to date and competitive. Transport costs are almost constant for commodities and relatively small anyway. Apart from the expectation that the city will expand, there are other factors such as that closer to a city the structure of the farmland is more fragmented, nuisance laws may be more restrictive, jobs in the city are more profitable, the agricultural service industry may have left, hence farming may become a small scale, extensive, part time occupation. We see this pattern today in many metropolitan regions: more intensive types of farming leave the peri-urban area and re-locate close to large logistical hubs (auctions) and processing facilities (grain elevators, dairy factories, slaughter houses) which themselves are placed further away from cities. Van Hecke (2010) showed this for Brussels agglomeration in a presentation at the Plattelands-academie in Leuven 2010. Geographical concentration and integration in agribusiness leads to regional specialization, e.g. hog production in Iowa (Morgan et al, 2006), corn fields in the Midwest of the USA, etc. The development of more intensive forms of agriculture further away from the city is of course facilitated by the introduction of public sanitation systems on the one hand and artificial fertilizers on the other hand, which allowed the cycle of nutrients from agriculture to the city and back to be opened. In fact in a country like the Netherlands, the mechanisms Sinclair drew attention to have been accounted for in the official planning philosophy. In daily planning practice the Dutch have always tried to keep hard development contours around cities, clearly separating urban and rural development and allowing as little as possible interaction between the two. In this way it was tried to guarantee farmers close to cities (but outside the red contour) that they could develop their farm (by keeping land prices low, by reducing negative externalities of farms on city dwellers and vice versa, and by guaranteeing the possibility to earn back long term investments on that location). More ambitiously the Dutch have made reconstruction plans to deliberately relocate the intensive greenhouse industry from the Rotterdam/The Hague area to other less urbanized parts of the Netherlands. In the same way, the intensive livestock industry in the Southern and Eastern parts of the country was to be relocated from its closeness to cities and villages (and vulnerable nature reserves) towards Agricultural Development Zones (LOGs), as far as possible away from human settlements in order to prevent nuisance (odour, dust, feed and manure traffic, etc.).

Metropolitan Agriculture

A new development is emerging however, which shows that agriculture in metropolitan areas far from disappearing, has adapted to survive in a highly competitive environment different from that of rural farms (Heimlich, 1989). Contrary to Sinclair sometimes rather small but highly intensive farms emerge very close to metropolitan areas, farms specializing in highly valued specialties for which there is a market, qualitatively distinct from the industrialized commoditized conventional agricultural system (Lapping, 2004). These farms differentiate in terms of offering artisanal, super fresh, highly perishable produce (e.g. strawberry varieties that are so vulnerable that they cannot be distributed through the conventional retail system), or they diversify by offering services in addition to food, such as authentic farm experiences, recreation, education, social care, etc. These services are highly valued by urban customers but it is the very nature of a service that it cannot be transported, hence such farms have an advantage if they are located close to or even inside the city (van der Schans, 2010). The basic philosophy of these "metro farms" (Olson, 2004) is to circumvent the disadvantages and exploit the advantages of being close to the city. Some farms may even appear inside the city; urban farming proper.

They occupy small plots of land or built space (rooftops, balconies) inside cities in order to provide goods and services for city dwellers. Note that Sinclair already included the existence of urban agriculture in his model, especially the low investment type of market gardening, which could take place in temporary vacant plots (in anticipation of urban development). But in the perspective proposed here, urban farming is a structural urban phenomenon which also occupies urban space permanently, e.g. recreational green becomes edible green.

Another development, also noted in passing by Sinclair (1967), is that very intensive forms of agriculture do exist close to cities, notably those types of agriculture that can take place in buildings, hence assume an almost industrial rather than rural form of land use (greenhouses, poultry keeping or mushroom growing; Sinclair, 1967, p. 81). Morgan et al (2006) describe the development of industrial dry lot dairy farming in California, a very intensive form of dairy farming (on small plots where all the feed is bought) in the midst of a large metropolitan area. By clustering this type of farming, benefits are captured, which provide economies of scale for the farmers and reduce nuisances for city dwellers. Morgan et al (1967) explain that this type of farming actually developed as a result of encroaching suburbanisation, the money farmers were paid to relocate was actually re-invested by them in the new location. Unlike Sinclair suggests, the intensification of farming was paid by suburbanisation, rather than being hampered by it. Similarly, the Westland greenhouse area developed as a very intensive form of vegetable growing, in the metropolitan region Randstad, the most urbanised area of the Netherlands. In this case, there was a pressure of urbanisation but this didn't prevent growers from further investing in intensification. Apparently they trusted the Dutch system of physical planning such that it either protected horticulture land for urbanisation, or it would compensate growers sufficiently if they had to be relocated. At some point in time agriculture can become so intensive that it can effectively stop city expansion (buying out farmers simply becomes too expensive). As the Dutch found out, relocation of greenhouses is not so easy, as a complete infrastructure has been developed in the metropolitan greenhouse area, covering aspects such as research and development, transport, finance, labour market etc. If this is the case a reorientation towards the city may be in order, either by using the cities resources more cleverly or by contributing to the cities needs and wants more intelligibly. This approach is advocated by for example TransForum, a Dutch research and action program to stimulate the development towards more sustainable agriculture (Van Latesteijn and Andeweg, 2010). For the Westland area they point to the use of CO₂ from the Rotterdam port petrochemical industrial zone in greenhouse vegetable production, and also the use of surplus heat from greenhouse production in domestic consumption for residential urban areas. Somewhat confusingly this type of intensive large scale export orientated agriculture in metropolitan areas is also called metropolitan agriculture, a term previously reserved for small scale intensive agriculture aimed at the nearby city.

4.8.2 Agriculture development in China

After having introduced three different perspectives on agricultural land use patterns in relation to urban development, based on examples in Western Europe, we now turn to the situation in China.

China has a long history of more or less intensive agriculture, close to and inside its cities, as a means of supporting urban self-sufficiency in food (Pepall, 1997). Intensive use of the soil was possible without exhausting it because the Chinese adopted practices that have been described as prototypically "sustainable", such as they used human excreta and garbage in fertilizing the soil in order to balance the heavy drain of the close succession of crops (King, 1911). In response to food shortages in the 1960-ies, China reorganised its spatial arrangement by enlarging the administrative boundaries of most of its cities, which from then on also included large areas of agricultural land. Beijing for example expanded from 4,822 km² in 1956 to 16,808 km² in 1958, which included ten urban and peri-urban districts as well as eight counties.

As a comparison: in 1949, the total area of the city was just about 63 km², including only four traditional urban districts (Jianming, 2003). This expansion of city limits sparked the development of peri-urban (or suburban, as the Chinese call it) agriculture in China: the production of vegetables, fruit, milk, fish, livestock and poultry, as well as some high value-added grain products such as various beans. Suburban agriculture is labour-, and relatively capital-intensive with a high level of productivity of non-staple crops, and it is fully oriented toward urban demand. This - as it seems a VonThunian pattern of agriculture around cities - also reflects a lack of refrigerated storage and an underdeveloped road system into the rural hinterland.

Urbanization in China is strongly linked to economic growth, which accelerated in 1979 due to decentralization policies and market oriented reforms. These included agricultural price reforms and the elimination of collective farm management. The latter was replaced with household and individual farming, also known as the household contract responsibility system that entrusts the management and production of publicly-owned farmlands to individual households through long-term contracts. This system allowed farmers to make their own decisions regarding agricultural production, and the food supply situation in China improved drastically (Jianming, 2003). As China urbanised, many surplus rural labourers began to move to the cities, which further encouraged the development and intensification of peri-urban agriculture: urban growth creating a larger demand for diversified agricultural products; rural migrants replaced the labour force in peri-urban agriculture as many of these farmers started to work in the industrial economy; and competition for the scarce land between different economic activities made peri-urban agricultural production more capital-intensive (Jianming, 2003). In the Nanjin area for example, as a response to urban economic development, peri-urban farmers seem to lag behind investing in the land, they seem more oriented to take up jobs in the city (Van den Berg et al, 2005). Land remaining idle must be returned to the state, however. Hence villages invite farmers from further away to temporarily lease the land. These specialist "immigrant" farmers are eager to exploit the proximity to the city and seem more willing to maintain or even improve the infrastructure (i.e. irrigation, tunnelling etc.). Hence despite (or perhaps one should say thanks to) the pressure of urbanization a rather intensive form of metropolitan agriculture may persist, up to the point that it is hardly possible for city planners to compensate farmers and relocate them to make room for industrial or residential expansion (Van den Berg et al, 2005). Chinese cities, in this way, seem to have found a response to the mechanism as identified by Sinclair (1967) which suggests that farmers close to cities are less willing to invest under the expectation of further urbanization.

Having said this, agriculture in metropolitan areas in China does have its problems. There are problems of pollution due to fast industrialisation and urban growth, there is the problem of negative externalities of peri-urban agriculture located too close to residential centres (traffic, odour, etc.). Agricultural land is under pressure of urbanisation. Hence, China, in the light of continuing concerns about its basic food security, as one of the first nations in the world, installed a rather strict national policy of agricultural land preservation (Lichtenberg and Ding, 2008). Interestingly, and in response to the growing wealth of its urban population, the Chinese food security agenda, also included a shift from quantity to quality. Food security in China means a sufficient, sustainable, accessible, diversified and nourishing supply (Jianming 2003). This implies a new boost to peri-urban agriculture.

Box 2. Modern Agricultural Science Demonstration Park at Xiaotangshan

The Modern Agricultural Science Demonstration Park at Xiaotangshan is a state-level science and cultural park for agriculture and education in Beijing, close by the international airport. It has fertile soil and is rich in water resources, being crossed by eight rivers, such as the Wenyu River, the Hulu River, and the Lingou River. It also has a 100 km² area of exploitable geothermal resources. Its construction was the first modern agriculture project approved by the Beijing Municipal Commission of Urban Planning that integrates agricultural planning with small township construction. It started operating in 2001. The park covers a total planned area of 111 km², with a farming area of 73 km², involving 54 administrative villages in four towns. Eight sections and one garden has already been completed, which are: 1) a sapling section with industrialized culture of saplings; 2) a farm equipment section that focuses on the production, research and popularization of equipment; 3) a flower section with a flower growing base and a nursery; 4) an aquatic section that focuses on the hatching of sturgeons and the breeding of Tilapias; 5) a processing section that focuses on the processing of feed and food; 6) a holiday section featuring hot spring, entertainment, and gym; 7) a cultivation section that focuses on raising mutton lambs; 8) an international farm section focusing on developing high-quality seeds, farm facilities, farm machinery, biological fertilizer, biological pesticide, and food processing; 9) a seed garden focusing on the cloning of plants and the cultivation of vegetable seeds and orchid seedlings. The central part of the park has a lush vegetation, and in the modern 10 ha greenhouse, flowers, modern fruit vegetable production systems and bonsais are presented. (http://english.51766.com/detail/scenes_detail.jsp?ent_id=bjxtsnykjy)



Pictures of the demonstration park at Xiaotangshan.

By the turn of the century, various municipal governments carried out programmes aimed at modernisation of the peri-urban agriculture sector. For example, in Beijing, as well as in many other Chinese cities, agriculture-oriented science and technology development and demonstration parks were established. Xiaotangshan modern agricultural demonstration park in Beijing, established in 1998, is one of these (see Box 2). Interestingly these modern agro-parks try to integrate several goals at once not just food production. Xiaotangshan modern agricultural demonstration park include Xiaotangshan town, another three towns nearby, as well as 45 villages, covering an area of 112 km² with a population of more than 40,000. The park tries to integrate agricultural project programming and small town construction planning. It seeks to improve the ecological environment and the quality of life of urban and rural residents. Based on the park's unique geothermal resources, it also represents an urban agriculture sightseeing area and tourism-oriented high-tech agriculture. The Xiaotangshan model has advantages over the traditional practice of peri-urban agriculture in China. Instead of being passively integrated into the urban regime, this new approach is actively merging both rural and urban systems, with governments and enterprises playing a key role (Jianming, 2003). Another example is the Shanghai Sunqiao Modern Agricultural Park, established in 19943.

By clustering capital, technology and R&D, the establishment of high tech agricultural demonstration zones aimed to develop and transfer agricultural innovation. By 2007 a total number of 36 parks has been initiated (Long and Tang, 2007), and much more seem to be under construction (paper published on internet 2010, but it is used with caution due to the quality of the English translation). The parks seem to have been rather successful in terms of attracting (foreign) technology and investment, producing high quality food and flowers, absorbing migrant farmer workers, offering recreational services and more generally bridging the gap between urban and peri-urban economic development. There are also some points of concern however, which only seems logical given the lack of precedence worldwide for this nature and scale of agricultural development (Long and Tang, 2007). Problems have been identified in the field of finance, which slowed down in the course of the years, an insufficient level of self-innovative capacity, the lack of ability to grasp the benefits of clustering, and to become the leading innovation powerhouse and diffusion centre of the region (ibid). Furthermore, it is argued that the focus has been more on design and construction rather than park management and cluster optimisation, and that the parks are not yet optimally placed in an overall innovation regime. Park concessions are sometimes unclear, (service) infrastructure is lagging behind both which make park development unstable. Lastly, farmers working in the park are not qualified enough or are not able to apply the high tech solutions they learn back in their home regions (paper published on internet 2010, but it is used with caution due to the quality of the English translation).

4.8.3 Competing paradigms in metropolitan food provision

The development of the modern food system has been characterized (Wiskerke, 2009) by three mutually reinforcing processes: **disconnecting** (consumers are disconnected from producers, relations are anonymous), **disembedding** (food production is increasingly decoupled from its physical and social context), and **disentwining** (food production is separated out from a whole lot of other societal functions that the food system provides, such as education, social integration, and leisure). The outcome of these processes is an agri-food system with advantages, such as cheap and year round food supply, but also disadvantages such as downward pressure on farm income, environmental pollution, loss of quality and variety of food, obesity and other food related health problems (Wiskerke 2009).

There are, as Wiskerke argues, two ways out of the current situation. Both claim to address the major problems of the current system and both claim to be ecologically, economically and socially sustainable in the long run. These are the 'agri-industrial food paradigm' and the 'integrated and territorial agri-food paradigm'. In the agri-industrial paradigm the processes of standardization, globalization and specialization are exploited to their fullest potential in order to reach a more sustainable agri-food system. The paradigm is optimistic about technological solutions to cost price reduction, environmental conservation, quality enhancement, etc. The integrated and territorial agri-food paradigm by contrast tries to solve the problems of modern agriculture by taking into account the natural and cultural diversity of food systems, their regionalization and their value both as supplier of nutrients as well as other vital functions such as recreation and social integration. The paradigm is optimistic about the natural potential of agri-food systems to solve problems such as productivity backdrop, environmental pollution, and food quality degradation. The main points of difference are summarized in Table 9.

These two paradigms have been developed on the basis of an analysis of current trends, they can be interpreted however also as possible scenarios for the future of sustainable agro food production. But first we will briefly discuss to what extent the mutually reinforcing processes identified by Wiskerke also apply to the Chinese situation. This is by no means an extensive characterization of the situation in China, only an illustration of the perspectives suggested.

Table 9. The problems and issues for agri-industrial paradigm versus Integrated territorial agri-food paradigm.

Problem/issue addressed	Agri-industrial paradigm (hypermodern food geography)	Integrated territorial agri-food paradigm (alternative food geography)
Economic position of primary producers	Intensive production 'lock-in'; economies of scale approach; cost price reduction	Economies of scope approach; increase producers' share in consumers' food spending
Environmental sustainability	Technical solutions for environmental problems: agri-industrial parks, pest and disease resistant GMP crops, low/zero emission livestock housing systems; eco-efficient systems for mass distribution of food products	Regionalized food networks; nutrient cycles at regional level; traditional plant varieties and animal breeds adapted to local conditions; low external input production seasonal products; focus on vegetarian diets
Organoleptic quality and diversity	End-of-chain diversification; Created by the food processing industry based on standardized primary product	Created by farmers and/or artisanal food processors; quality linked to region / tradition / nature
Consumers' trust	Quality and safety assurance schemes; industry and retails labels and hallmarks; tracking and tracing	Personal trust based relations; short PSCs; denominations of origin labels; the market and meeting place for P&C
Health	Nutritionism: nutritionally engineered functional food (foodstuff like substances as a carriers of vitamins, calories, proteins, nutrients, etc.)	More fresh food and less convenience & processed products; more physical exercise; organic products; vegetarian diet; enjoy cooking and eating

With respect to the **disconnection** between consumers and producers it is clear that the Chinese food system suffers similar problems as the western food system today. In an effort to increase production standards and processes, China opened up its market for western companies, fast food chains and also food processing companies such as Smithfield Foods, the world's largest hog breeder and pork processor⁴. The industrialization of food processing in China has come with such a speed however, that it is almost uncontrollable, resulting in a lack of transparency, manifested in several food safety scandals, melamine contaminated milk powder only being one of them⁵. Opening up to a market economy is one thing but providing the institutions that build up and warrant trustworthy market transaction is quite another thing⁶. No wonder that there is also a nascent movement today promoting alternative ways of rural development, the so-called New Rural Reconstruction⁷. Organic farming, direct-to-consumer distribution, and the reconstruction of the relationship between city and countryside are its hallmarks. Young urban people return to the countryside to pick up small scale farming, which can provide full knowledge where the food is coming from and what goes into it before it reaches the consumer⁸. Regulation on organic goods remains weak. Competing agencies offer varying degrees of certification and enforcement of the rules is problematic. Many new farmers bypass the organic certification altogether and simply call their goods "natural."

With respect to the **disembedding** of food production from its physical and social context, the modernisation of Chinese agriculture also struggles from problems similar to modern agriculture in the West. Chinese agriculture has intensified greatly since the early 1980s on a limited land area with large inputs of chemical fertilizers and other resources. On the basis of a national survey, in 2010 the government reported the major sources of pollution, for the first time acknowledging the high contributions of effluents from intensive livestock farming and excessive use of fertilizers and pesticides in the fields⁹. Application rates of artificial fertiliser in China tend to be much higher than those of North America and Europe. These have degraded soils and environmental quality in the North China Plain and in the Taihu Lake region in south China (Guo et al, 2010). The environmental deterioration caused by agriculture is all the more striking if we consider that for centuries the Chinese have practiced circular methods of farming, which allowed them to reap relatively high yields from small parcels of land, without impairing the fertility of the soil (King, 1911).

4 http://www.forbes.com/2008/07/01/smithfield-cofco-pork-markets-equity-cx_jc_0701markets02.html?partner=yahootix.
5 <http://topics.nytimes.com/topics/news/international/countriesandterritories/china/food-safety/index.html>.
6 <http://givingupcontrol.wordpress.com/2007/07/25/the-real-lesson-of-the-chinese-food-scandals/>.
7 <http://www.zesterdaily.com/farmgarden/393-going-organic-in-china?tmpl=component>.
8 <http://www.washingtonpost.com/wp-dyn/content/story/2010/11/01/ST2010110106534.html?sid=ST2010110106534>.
9 <http://www.nytimes.com/2010/02/10/world/asia/10pollute.html>.

A famous example is the single-crop rice/mulberry-silk village agro-ecosystem in the Taihu Lake region, which sustained rather high levels of output for centuries, be it at a cost of hard human labour (Ellis and Wang, 1997). There are some moves in Chinese policies to re-apply these principles, such as for example promoting anaerobic digestion of animal waste (Qifeng, 2011), but a more systematic approach to re-introduce a circular economy in agriculture could be taken phasing out, it is argued (Ho et al, 2008), artificial fertilisers without impairing food security¹⁰.

Finally, with respect to the **disentwining** of food production (the mechanism that food production is separated out from other societal functions, such as education, social integration, and landscape maintenance) it must be noted that China after acceding to the WTO is trying to concentrate certain types of agricultural production in certain dominant regions¹¹. Local governments promote agricultural regional specialisation in order to improve their competitive ability, and they also promote specialisation at the household level. One should bear in mind however that the level of specialisation is relative low in China, due to its history of regional self-sufficiency and also due to the fact that (unlike the US or EU) China's domestic market is still to some extent regionally organised (Carter and Lohmar, 2002). After some market liberation in the early nineties, the government soon re-introduced some form of regional and local responsibility. By 1995 provincial governors were responsible for maintaining grains sown area and production in their respective provinces, known as the Governor's Grain Bag Responsibility System. Mayors too were made responsible for local production of fruits, meat, and vegetables around their respective urban areas, a policy known as the Mayor's Food Basket Responsibility System (Carter and Lohmar, 2011). From the agri-industrial perspective this may be interpreted as re-introducing a form of market inefficiency, from the integrated territorial perspective, however this may (also) be interpreted as a sign of system resilience (more research is needed however judge these qualifications). Interestingly, if we return to the agro-park concept, as described earlier, it strikes that unlike the development of agri-industrial production zones in other countries, the concept in China maintains some level of diversification. Agricultural demonstration parks tend to produce a wide products and services from vegetables, flowers, fish, lamb, farm equipment, feed, etc. But agro-parks (should) also play a role in leisure, landscape maintenance, education, employment, more generally bridging the social and economic distance between urban and peri-urban population. In that sense they seem to embody a much more diversified, much more multi-functional approach to food production than the agro-parks we typically find in the west.

4.8.4 Conclusions and recommendations

China is among the first nations in the world that needed to address the problem of feeding large metropolises. Agricultural production systems have been developed that sustained large urban populations by optimally using limited natural resources. China has a long history of regional and local self-sufficiency, which means that rather intensive forms of agricultural production were and often still are located in or close to urbanised areas. Over the last couple of decades China's economy developed rapidly, both in manufacturing and services, and this has put a pressure on (peri-urban) agriculture, in terms of a decreasing acreage of farmland, increasing pollution, but also changing eating habits and lifestyles of the more wealthy urban population. China responded by adopting practices from the West which may have led to increased production, higher quality and more efficient processing and distribution, but also brought with them more pollution, concerns about food safety and land erosion, etc.

From the perspective of Dutch-Chinese relations it is recommended to exchange knowledge and experience from the full range of agricultural production systems, both the agro-industrial side of the spectrum as well as the integrated territorial side. The Chinese have experience with sustaining soil fertility in circular agriculture, which could be a source of inspiration for Dutch farmers (note that the book by King is recently translated into Dutch and presented at the organic farmers fair). The Dutch have experience with nutrient management and pest and disease control which might help the Chinese to reduce application rates of artificial fertilisers and other chemicals. This also includes the exchange of knowledge and experience on low cost decentralised systems of anaerobic organic waste digestion.

¹⁰ <http://www.i-sis.org.uk/chinasPollution.php>.

¹¹ <http://www.ers.usda.gov/publications/aib775/aib775i.pdf>.

The Dutch also have experience with developing and managing large scale intensive farming operations (horticulture and to a certain extent also livestock), which increasingly also meet criteria of environmental sustainability. With respect to the concept of agro parks the focus seems to have been too much on park design and development, more attention must be paid to park management and cluster optimisation. The Dutch have developed an agro park concept where the clustering is based on principles of industrial ecology (closing nutrient and material cycles in an industrial way). Apart from developing complete new parks based on industrial ecology, it may be good to look at the problems and challenges of existing agro parks in China and try to further optimise these. For example, to what extent are foreign innovations just imported and applied, or are they also adapted to fit the local situation, and to be the basis of further innovation by the Chinese themselves. Also there seems to be problems with the education of farmers using the modern technology applied in the parks, and also with the more wide diffusion of this knowledge from the demonstration parks to the rural hinterland.

From a physical planning perspective, it is interesting to note that Chinese cities also include large areas of the agricultural land surrounding it, thus the Chinese are well positioned to mix urban and rural functions, to reformulate city and countryside relations and bridge the growing gap between consumer and producer, topics that are also and increasingly on the agenda of cities in the West. The Dutch may re-interpret the development of the Westland area with hindsight as if it was planned as a Chinese agriculture demonstration park. This would draw the attention to its historical connection with the Midden-Delfland area (manure from dairy cows was used to fertilise the greenhouse soil) and with the nearby city of Schiedam (nutritious waste from the jenever industry was fed to the cows). And to new possibilities to re-establish these connections in new ways, for example the Westland area and Midden Delfland co-evolve, one providing vegetables and fruits, the other providing dairy products and recreational experiences, altogether managed as if it was an Chinese style multifunctional agro park. The same could hold for the Green Heart and other metropolitan parks in The Netherlands. In The Netherlands there is a strict separation between city and countryside, more intensive forms of agriculture are placed as far as possible from urban centres. The Chinese have a longer history of integrating (more or less intensive forms of) food production into the urban fabric, this may provide an inspiration for Dutch cities that are experimenting with new city-countryside relation (for example by re-introducing city orientated agriculture in the urban fringe or in temporary vacant city plots).

5 Summary and recommendations

5.1 Summary

Land use

For the study of Wuhan metropole was focused at the Wuhan Urban Circle. This area is 58.052 km² with 8.3 million inhabitants (with a 4.6 million non-agricultural population). The land use structure of Wuhan is of a concentric ring pattern. Wuhan expanded rapidly during the 1990's. Land for transport and industry grew very fast, while green areas reduced. Hubei, the province in which Wuhan is situated, is known for the production of steel, automobile, textile, pesticide, etcetera. Wuhan is one of the industrial centres of the province Hubei.

The inner ring of Wuhan is nowadays used for commercial and residential use, including the tertiary (service) sector. The middle ring is used for secondary and tertiary activities, in the outer ring farmland can be found.

A quarter of the total metropolitan area is used for open field agriculture (dairy and livestock, vegetable horticulture not included). This percentage stays rather constant the last two decades. Most recent data (2008) shows that the total cultivated area within Wuhan Urban Circle is 1.34 million hectares. This is 7.25 Mu (0.48 ha) per capita.

Agricultural production types and production

The currently average household is sized less than 1.6 ha. This size restricts the level of mechanization and implementation of modern and new technologies.

Hubei Province is an important production base of grain, oil, cotton, poultry, pig and aquatic products.

Grain, rice, wheat and corn are the major crops grown in Wuhan. Also a lot of hogs, cattle / buffalos, and poultry are produced. Some municipalities have specialized in the production of fruits, some other in mushrooms. The traditional farming system in China is home garden production. Nowadays agricultural production is changing toward industrial agriculture. The dominant agricultural system in China is the integrated crop-livestock production system (mixed-farming system). This system contributes most to food supply. With the abundant grain and straw resources this agricultural system a large fraction of livestock can be fed. Especially in areas around the cities, this system is developing into specialised crop and livestock production systems. There are no large greenhouse complexes.

Supply chains

Very few information has been found during the study about the supply of agro inputs. This was mainly information about the degree of agricultural modernization at provincial level.

Also no information could be found regarding the final destination or market of the agricultural output.

Environment

One of the most important environmental threats to Wuhan is the flooding of the Yangtze river, which happens from time to time. Pollution, including air, water, and solid wastes, presents another severe problem. In terms of water, half of the industrial wastewater is untreated or treated but does not meet relevant standards.

China is growing very fast in livestock production, especially in the east of the country. The production of pigs and poultry goes hand in hand with phosphate (P2O5) overload. Traditional mixed farming systems in China, especially in areas around the cities, have been split into specialised crop and livestock activities. The overall trend of production is towards greater production and processing concentration around urban centres. In overloaded areas, part of the chemical fertilizers could be substituted by manure to decrease the environmental impacts on land and waters.

The Wuhan Urban Agriculture Development Plan (2006-2020) pays a lot of attention to the environmental pollution problem. This plan proposes that sustainable development should – besides solving current problems of agricultural development and rural incomes - focus on long-term development goals, as effective use, distribution and protection of agricultural resources, improvement of agricultural production conditions and environmental protection.

Pesticide use is controlled by national laws that specify which kind of pesticides can be used for certain crops and vegetables. Pesticides are always sold by specific departments or extension stations, while advisers in this field are trained by the department of agriculture.

In recent years Wuhan city area has paid much attention to afforestation through forest ecological projects. Within 5 years' time the city forest green rate was increased with 6%. Also in the coming years a lot of investments will be done on generating sustainable energy from biogas (e.g. from livestock manure).

Government

The General Strategic policy plan (2010) regarding agriculture development aims to better coordinate urban and rural development. Government will continue to improve the policy system to empower and benefit farmers and continue boosting financial input into agriculture and rural areas. Budget expenditures will give priority to development of agriculture and rural areas.

Latest years several infrastructural improvements have been done. These affect rural electric utilities, rural highway construction, and construction of water sources for rural residents. Remaining problem is unsafe drinking water, because drinking water in some rural areas has a high density of mineral and heavy metals. Also investments are done to develop new biogas utilities every year, which is good for the ecological environment.

More subsidies shall be channelled to increase the output of grain, potato, highland barley and peanut, as well as the purchase of agricultural machinery. The coming years attention will be paid to integration of the migrant workers into urban life.

According to the Wuhan Urban Agriculture Development Plan (2006 -2020) the city and peri-urban agriculture should be further structured, extended and standardized in order to meet consumer demands of urban residents, as well as the realization of agricultural production and farmer's income. More attention should be paid to protect all ecological resources, to the possibilities for tourism and leisure, and for cultural and scientific capabilities of agriculture. And more attention for the possibilities of high technology applications in agriculture.

In principal all land in China is state owned, but 30 years ago, when central government decided to give farmers their own decision how to live on their piece of land, every farmer received his "own" land.

The small scale of agricultural operations (on average less than 4 acres) restricts the level of mechanization and the implementation of modern and new technologies.

The Chinese government promotes cooperation among farmers by establishing producers' organizations. This will ease the set-up of an effective control system for agro-chemicals. The number of these organizations is growing nowadays very fast. This also will be because they are allowed to sell and buy products on behalf of the members and to make profit. For supermarkets this makes it possible to make agreements with these cooperatives, which will lead to an efficient, more profitable and more sustainable vegetables supply chains.

Social context

Around 45% of the Wuhan population is active in agriculture. The most important issue regarding agricultural employment regards the migrant workers. Government is trying to stimulate these "migrated" labours to settle down in origin and contribute to local development. Decision making of local government therefore focuses also on how many jobs the proposed project could create as well.

Chinese people all have a special personal legal document called "Hu Kou", besides their ID card and passport. The "Hu Kou" determines what village you belong to, where you are a citizen or a farmer and what social welfares you may enjoy. Basically, China can produce all the normal agro-products by itself and domestic transportation cost is relatively low enough for distribution.

5.2 Recommendations

For the metropole of Wuhan the following recommendations are developed:

- There should be more focus on the implementation of a modern version of the traditional mixed farming systems (i.e. integrated crop-livestock production systems). At the moment there is a strong increase of specialized, more intensive production systems going on. This does improve production efficiency, but leads to more environmental problems like a higher nitrogen emission. These problems are becoming a severe problem in the Wuhan region. By better balancing of crop and livestock at regional scale, efficiency can be improved without severe environmental problems.
- It should be considered to substitute (part of the) chemical fertilizers by manure in overloaded areas as a way to decrease environmental impacts on land and water.
- Intensification of agriculture becomes possible by mechanization and the implementation of modern technologies. To make these investments profitable, cooperation between farmers or up-scaling of farms is necessary. Cooperation or up-scaling also opens possibilities to set up an effective control system to reverse the extensive use of fertilizers, pesticides and other agro-chemicals by farmers and to make agreements with supermarkets.
- In deciding upon the strategy for further development of the Wuhan metropolis, it is recommended to distinguish between the agri-industrial paradigm, and the integrated territorial agri-food paradigm (alternative food geography). Underlying aspects are the economic position of primary producers, environmental sustainability, organoleptic quality and diversity, consumers' trust, and health issues.
- From the perspective of Dutch-Chinese relations it is recommended to exchange knowledge and experience from the full range of agricultural production systems (both the agro-industrial side of the spectrum as well as the integrated territorial side).
- China has experience with sustaining soil fertility in circular agriculture, which could be a source of inspiration for Dutch farmers.
 - o The Netherlands has experience with nutrient management and pest and disease control which might help China to reduce application rates of artificial fertilisers and other chemicals. This also includes the exchange of knowledge and experience on low cost decentralised systems of anaerobic organic waste digestion.
 - o The Netherlands has experience with developing and managing large scale intensive farming operations (horticulture and to a certain extent also livestock), which increasingly also meet criteria of environmental sustainability.
- With respect to the concept of agro parks the focus has been too much on park design and development. More attention must be paid to park management and cluster optimisation. The Netherlands has developed an agro park concept where the clustering is based on principles of industrial ecology (closing nutrient and material cycles in an industrial way). Apart from developing complete new parks based on industrial ecology, it may be good to look at problems and challenges of existing agro parks in China: for example adaption of imported innovations to the local situation, and to be the basis of further innovation by China itself; education of farmers using the modern technology applied in the parks; wider diffusion of knowledge from the demonstration parks to the rural hinterland.
- China is well positioned to mix urban and rural functions, to reformulate city and countryside relations and to bridge the growing gap between consumer and producer, topics that are also and increasingly on the agenda of cities in the West, which is visible in the large areas of agricultural land surrounding which are included in the cities. The Netherlands may re-interpret the development of several metropolitan parks (i.e. the Westland and Midden-Delfland area, the Green Heart) with hindsight as if it was planned as a Chinese agriculture demonstration park.
- The Chinese experience and history of integrating (more or less intensive forms of) food production into the urban fabric may provide an inspiration for Dutch cities that are experimenting with new city-countryside relations.

5.3 Points of attention for future activities

For a successful outcome of some of the recommendations above, it is important to take in mind some specific points of attention. From previous Wageningen UR projects in China regarding metropolitan agriculture and from other metropolitan agriculture related projects in which Wageningen UR was involved (for example supply chain projects) the following lessons learned were retrieved.

For any new activities (projects) that will have a substantial impact on or ask full (financial) cooperation from stakeholders or actors, it is important that all relevant parties are being involved or recruited from the beginning of the project. It is important to recruit the right persons for this job; the ones that have the mandate to make decisions and will have to deal with the outcomes of the project or started development. In some cases this means that the role of enterprises and entrepreneurs should become leading instead of the role of the government. A common interest and shared vision regarding process, goals and expectations is crucial in the process, although different goals of each party also are important to have the commitment of the different parties. Furthermore, it is important that the project leader of this type of project is an independent party.

Some of the proposed changes do not only affect the frontrunners that are really involved in the project, but also the surrounding smallholders have to develop in order to develop the whole agricultural sector into a sustainable and strong sector within the metropole. Attention should be given to develop their entrepreneurial skills to handle the consequences of the up-scaling of their farm well.

In China animal welfare is not such an issue as it is in North-West of Europe; the first concern is the demand for healthy food (balanced diet) and food safety is becoming a big issue.

In communication it is important to meet each other with respect and to behave according to the local cultural habits. A good translator can translate the issues at hand, but also smooth out intercultural differences and wrong use of words within the Dutch or Chinese context that could be explained otherwise. Also trust building between parties must not be forgotten, which can be created among others by full transparency in communication.

Another lesson learned in China is that to make real changes at the level of the farmers or farmer cooperative, the agricultural bureau is a key actor. This bureau is the most suited party to start developments through extension services, education and subsidies.

In Appendix III a complete overview of all lessons learned regarding metropolitan projects can be found.

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Appendix I List of consulted people

During the project the following persons were consulted (alphabetical order):

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Appendix II Various data Wuhan

Population

Table 1: Population in the cities within the Wuhan Urban Circle in 2008.

Region (city or prefecture)	Total population (10,000 persons)	Permanent population (10,000 persons)
Province Hubei	6110.8	5711.0
Wuhan	833.2	897.0
Huangshi	257.3	242.2
Ezhou	106.80	41.52
Huanggang	735.1	667.5
Xiaogan	525.1	467.6
Xianning	288.2	251.2
Xiantao	150.7	135.3
Tianmen	164.8	136.9
Qianjiang	100.7	93.6

Source: Table 2-4 of the Hubei Statistic Yearbook 2009

Table 2: Land area and population of the cities (municipalities) within the Wuhan Urban Circle.

	Land Area (sq.km)	Total population (10,000 persons)	Employed persons (10,000 persons)	Employment per industry		
				Primary industry (10,000 persons)	Secondary industry (10,000 persons)	Tertiary industry (10,000 persons)
Total province Hubei	185900	6111				
Total	58052	2994.60	1638.35	442.80	520.76	674.79
Wuhan	8494	897.00	456.00	79.57	156.00	220.43
Huangshi	4583	242.20	139.80	29.40	55.80	54.60
Ezhou	1594	103.30	62.10	21.20	19.50	21.40
Xiaogan	8910	467.60	282.60	91.60	93.70	97.30
Huanggang	17446	667.50	344.00	128.00	93.00	123.00
Xianning	9861	251.20	140.80	42.53	35.57	62.70
Xiantao	2538	135.30	84.65	16.42	33.56	34.67
Qianjiang	2004	93.60	62.10	14.28	18.53	29.29
Tianmen	2622	136.90	66.30	19.80	15.10	31.40

Source: Table 20-1 of the Hubei Statistic Yearbook 2009

Table 3: GDP of the municipalities in Wuhan Urban Circle in 2008.

Municipality	GDP (100 million Yuan)	Primary industrie (100 million Yuan)	Secondary industry (100 million Yuan)	Tertiary industry (100 million Yuan)
Wuhan	3960.08	144.70	1827.65	1987.73
Huangshi	556.57	41.45	297.50	217.62
Ezhou	269.79	41.52	148.09	80.18
Huanggang	600.75	192.58	204.23	203.94
Xiaogan	593.06	131.71	243.95	217.40
Xianning	359.19	81.89	153.67	123.63
Xiantao	233.50	44.77	108.51	80.22
Tianmen	187.35	46.87	74.06	66.42
Qianjiang	211.82	35.71	112.71	63.40

Source: Table 1-17 of the Hubei Statistic Yearbook 2009

Agriculture

Table 4: Total Sown area of Hubei Province in 2008.

	Sown Areas (1000 ha)	Total output (tonnes)
Total Sown Areas of Farm Crops	7,298.31	
Total Grain	3,906.69	22,272,300
Summer Grain	1,207.74	3,862,400
Wheat	1,000.57	3,291,900
Barley	29.78	96,400
Autumn Grain	2,698.95	18,409,900
Rice	1,978.94	15,337,200
Semilate Rice	1,228.21	10,892,400
Late Double- crop Rice	409.62	2460,500
Among Rice:Long-grained Nonglutinous Rice	1,651.31	13,017,700
Tubers	216.09	810,400
Corn	470.37	2,264,200
Sorghum	3.03	11,600
millet	0.06	500
Soybeans	112.31	259,800
Economic Crops		
Cotton	543.00	513,400
Oil-Bearing Crops	1,365.59	2,857,352
Peanuts	17,600.00	575,010
Rapeseed	1,089.61	2,148,900
Sesame	92.96	126,911
Hemp Crops	23.45	47,639
Jute	0.50	2,241
Ramie	22.82	43,398
Sugar Crops	6.62	264,708
Sugarcane	6.62	264,707
Beetroots		
Tobacco Crops	61.26	117,979

	Sown Areas (1000 ha)	Total output (tonnes)
Crude Drugs	73.01	
Others		
Vegetable	1,015.96	28,906,484
Melon and Fruits	90.29	3,085,557
Organic Fertilizer	81.66	81.68

Consumption expenditures

Table 5: Consumption expenditure for food by the urban population in the Hubei province.

	Lowest income house holds	Low income house holds	Medium- Low income house holds	Medium income house holds	Medium- High income house holds	High income house holds	Highest income house holds	Total (yuan)
Total consump- tion expenditure	9478	4381	6338	6909	8712	11009	13930	19910
Total food expenditures	3996	2319	3081	3293	3789	4633	5324	6679
Grain	400.38	238.2	334.73	342.84	399.25	462.03	482.79	608.67
Starches and Tubers	21.12	13.11	18.45	16.73	18.74	25.99	27.32	33.91
Beans and Bean Products	77.7	55	64.91	66.13	75.59	86.57	93.67	119.38
Animal Oil	204.31	138.76	166.25	182.32	193.29	232.48	248.92	305.87
Meat and meat Products	725.22	447.32	607.61	627.97	714.83	827.89	916.16	1060.18
Poultry and Poultry Products	160.78	94.19	129.34	135.36	154.8	187.45	207.12	253.41
Eggs	91.41	58.79	76.07	78.74	86.35	105.93	111.98	141.56
Aquatic Products	227	124.38	161.23	185.68	214.09	264.55	311.38	398.97
Vegetables	488.61	315.08	391.82	416.31	469.73	562.22	600.38	770.83
Flavorings	57.71	31.88	41.38	47.58	53.79	70.06	75.86	98.47
Sugar	30.49	20.27	27.03	27.2	31.85	33.27	36.65	39.94
Tobacco	226.16	123.17	170.26	171.15	220.81	278.1	293.22	387.94
Liquor	90.85	48.57	74.86	73.29	88.96	108.63	114.11	148.38
Drink	45.44	26.58	40.45	38.93	46.5	53.13	59.11	57.7
Dried and Fresh Melons and Fruits	215.1	128.51	173.7	182.25	208.47	252.95	278.19	322.85
Cakes	82.61	47.32	70.75	74.99	81.43	95.38	101.77	115.41
Milk and Dairy Products	148.87	71.82	104.77	126.9	136.85	173.7	214.44	260.46
Others	41.16	24.61	29.05	31.83	40.02	50.13	54.34	68.77
Take Away Foods	659.63	311.4	397.83	465.41	552.52	758.8	1094.21	1484.55
Food Proces- sing and Service Fees	1.73	0.34	0.6	1.48	1.18	3.99	1.93	1.61

Source: Table 4-5 of the Hubei Statistic Yearbook 2009

Table 6: Consumption expenditures for food by the rural population in the Hubei province.

Item	2001 (yuan)	2002 (yuan)	2003 (yuan)	2004 (yuan)	2005 (yuan)	2006 (yuan)	2007 (yuan)	2008 (yuan)
Total Annual Expenditures	2422.68	2520.42	2587.25	3033.24	3675.73	3987.52	4553.70	5384.84
Total food expenditures	856.25	872.49	930.98	1076.35	1192.26	1278.80	1479.04	1711.34
Grain	247.05	245.62	232.01	291.96	266.31	279.99	305.79	323.5
Non-Staple Food	402.39	406.31	438.72	441.65	519.21	521.06	625.66	771.94
Others	105.23	107.86	144.80	206.65	260.45	291.72	329.14	369.51

Source: Table 4-13 of the Hubei Statistic Yearbook 2009

Table 7: Rural household annual consumption in kg on major food per capita.

Item	2001	2002	2003	2004	2005	2006	2007	2008
Grain	264.51	260.81	224.30	218.78	212.05	210.06	204.47	190.30
#Wheat	29.67	30.13	22.06	22.52	22.58	23.11	21.80	22.02
Paddy	208.07	207.42	186.63	182.78	171.47	170.17	168.61	155.37
Bean Products	5.75	7.26	5.58	4.88	6.04	5.87	6.20	5.48
Soy Bean	2.43	3.00	3.09	2.53	2.76	2.73	2.88	2.53
Fresh Vegetables and Processed Products	152.30	153.88	159.76	147.73	152.47	143.75	143.57	132.58
Fresh Vegetables	151.54	139.61	151.15	140.34	147.06	138.12	140.57	130.05
Oil and Fats	9.69	10.75	9.40	3.52	3.70	3.56	3.77	4.11
Edible Vegetable Oil	7.70	8.21	8.75	2.87	2.98	2.89	3.23	3.58
Edible Animal Oil	1.99	2.54	0.65	0.64	0.73	0.67	0.53	0.53
Meat and Processed Products	19.73	20.79	23.09	20.81	24.79	25.27	22.70	22.21
Pork	17.22	18.12	19.50	17.49	20.63	20.91	20.91	17.51
Beef and Mutton	0.33	0.35	0.36	0.37	0.44	0.53	0.52	0.50
Poultry	2.01	2.07	2.74	2.48	3.02	2.91	3.30	3.23
Eggs and Processed Products	3.95	3.47	3.86	3.99	4.14	4.15	4.17	4.69
Milk and Dairy Products	0.21	0.05	0.08	0.11	0.23	0.33	0.50	0.81
Aquatic Products	6.56	7.31	8.10	7.21	8.11	8.51	9.38	8.71
Fish	6.28	7.00	7.74	6.97	7.81	8.18	9.03	8.40
Melons	9.10	6.68	9.00	4.99	4.79	8.08	6.28	4.67
Liquor and Drinks	8.39	11.51	7.29	8.20	10.17	11.93	12.35	11.76
#Wine Spirit	4.15	7.79	3.68	3.68	3.91	4.06	3.87	3.85
Beer	3.16	3.52	3.53	4.46	6.21	7.83	8.42	7.84
Fruits	10.90	8.19	10.05	9.85	10.62	10.87	11.51	10.37
Nuts and Grain Products	0.37	0.31	0.45	0.55	0.76	0.80	0.87	0.97

Source: Table 4-17 of the Hubei Statistic Yearbook 2009

Economics and income

Table 8: Annual net income (yuan) of rural household per capita in cities and prefectures.

Region	2001	2002	2003	2004	2005	2006	2007	2008
Province	2352	2444	2567	2890	3099	3419	3997	4656
Wuhan	3100	3295	3497	3955	4341	4748	5371	6349
Huangshi	2140	2230	2335	2626	2810	3182	3742	4374
Ezhou	2591	2693	2832	3234	3495	3799	4393	5096
Xiaogan	2356	2444	2552	2874	3028	3336	3915	4636
Huanggang	2083	2131	2204	2485	2644	2861	3295	3744
Xianning	2123	2204	2325	2698	2911	3213	3737	4411
Xiantao	3083	3153	3283	3615	3818	4190	4695	5248
Tianmen	2630	2716	2848	3087	3273	3658	4207	4761
Qianjiang	2599	2680	2875	3180	3398	3813	4378	4929

Source: Table 4-19 of the Hubei Statistic Yearbook 2009

Table 9: Urban investment in fixed assets (x 100 million yuan) by use of funds in 2008.

Sector	Total investment	Of which:			
		Construction	Installation	Purchases of equipments and instruments	Others
Total	5332.67	2872.72	323.18	1193.15	943.62
Farming, Forestry, Animal Husbandry and Fishery	116.46	67.22	6.44	17.37	25.44
Farming	22.59	14.41	0.89	2.01	5.29
Forestry	15.89	6.71	1.37	1.12	6.68
Animal Husbandry	34.19	19.90	1.61	6.27	6.40
Fishery	5.32	3.00	0.34	0.57	1.41
Farming, Forestry, Animal Husbandry and Fishery Services	38.47	23.19	2.23	7.40	5.65

Source: Table 5-4 of the Hubei Statistic Yearbook 2009

Table 10: Urban investment in fixed assets (x 100 million yuan) by type of construction in 2008.

Sector	Total investment	Of which:		
		New Construction	Expension	Replacement
Total	5332.67	3211.38	961.77	911.38
Farming, Forestry, Animal Husbandry and Fishery	116.46	51.59	38.34	23.82
Farming	22.59	6.00	13.11	3.06
Forestry	15.89	7.59	5.31	2.60
Animal Husbandry	34.19	21.98	8.44	3.11
Fishery	5.32	2.60	1.59	1.09
Farming, Forestry, Animal Husbandry and Fishery Services	38.47	13.41	9.89	13.97

Source: Table 5-5 of the Hubei Statistic Yearbook 2009

Table 11: Employment of the major municipalities in 2008 (x 10,000 persons).

Municipalities	Employment (year-end)	Employment Grouped by Type of Industry		
		Primary Industry	Secondary Industry	Tertiary Industry
Wuhan Municipality	170.45	3.67	84.50	82.28
Huangshi Municipality	19.32	0.09	11.57	6.66
Ezhou Municipality	15.39	0.04	9.45	5.90
Xiaogan Municipality	12.17	0.86	6.52	4.79
Huanggang Municipality	5.06	0.06	2.10	2.90
Xianning Municipality	6.65	0.10	3.30	3.25

Source: Table 17-2 of the Hubei Statistic Yearbook 2009

Appendix III General strategy plan regarding agricultural development

Policy paper promises more efforts for rural-urban integration

GOV.cn

Monday, February 1, 2010

China will put more investment, subsidies, fiscal and policy supports into rural areas this year so as to better coordinate urban and rural development, the central government said Sunday in its first policy document of the year.

"Working for coordinated development between urban and rural areas is the fundamental requirement of building a moderately prosperous society in an all-round way," said the document.

The document, jointly issued by the Central Committee of the Communist Party of China (CPC) and the State Council, or the Cabinet, promised to improve the livelihood of rural residents, which it said is one of the main tasks in China's efforts to adjust resident income distribution system.

Expanding rural demand should be the key measure in boosting domestic demand, it said, while developing modern agriculture should be considered as a major task in transforming China's economic growth pattern.

It called for more efforts to maintain grain production, increase of farmers' income and good development momentum in rural areas.

IMPROVING POLICY, STRENGTHENING FINANCIAL SUPPORT TO RURAL AREAS

The document said that the central government would continue to improve the policy system to empower and benefit farmers. The government would also continue boosting financial input into agriculture and rural areas.

The document stressed that budget expenditure should first support development of agriculture and rural areas, and fixed-asset investment first be channeled into agricultural-related infrastructure and projects in relation to rural livelihood.

The Agricultural Development Bank is required to offer mid- and long-term policy-based loan services to rural infrastructure and projects related to agricultural development, which Chen Xiwen, director of the Office of the Central Rural Work Leading Group, believed as a breakthrough in China's rural financial service.

"It means a great amount of fund will be channeled into agricultural development, which could fill the long-time policy gaps concerning mid- and long-term policy-based loans", Chen told Xinhua in an exclusive interview Sunday.

More subsidies should be channeled to increase the output of grain, potato, highland barley and peanut, as well as the purchase of agricultural machinery, the document said.

The government would implement more policies for purchasing and stockpiling major agricultural products, including corn, soybean and oilseeds, to stabilize prices of major farm produce.

More efforts will be made to strengthen financial services including micro-credit loans and insurance service in rural areas, according to the document.

It promised that basic banking services would be available in all villages and towns in the next three years.

It called for more efforts to develop township banks, loan-lending companies, and mutual funds in a bid to guide more capital flowing into the rural financial market.

The central government also demanded further expansion of rural consumption market as part of the country's accelerating measures to boost consumption.

MORE RESOURCES TO RURAL AREAS

In a bid to narrow the development gap between the urban and rural areas, the document said the central government would roll out more favorable policies to encourage inputs from various social forces to rural areas.

Enterprises which establish rural welfare foundations would enjoy tax breaks, with no more than 12 percent of their annual profits being deducted before calculation of enterprise income tax.

Large and medium-sized cities, and various sectors should give an impetus to rural areas' development, providing one-to-one support and participating in industrial development and infrastructure construction in rural areas, according to the document.

It also urged related departments to study favorable policies to guide more educational resources and scientific research institutions to tap into the country's vast rural regions.

To ease the chronic financing shortage in the rural areas, the government required financial institutions, including the Agricultural Bank of China, Rural Credit Cooperative, and Postal Savings Bank of China, to further increase agriculture-related credit loans. The Agricultural Development Bank of China was ordered to expand the supporting fields in agriculture, and give more long-term credit support to the infrastructure construction in rural areas.

URBANIZATION

Migrant workers can so far neither settle down in cities nor want to go back to the countryside, said Chen.

According to Chen, 60 percent of the 150 million migrant workers were born in the 80s or 90s of last century who are referred as the "new generation of migrant workers" by the document and are not familiar with farming but dying to be part of the city life.

The document listed new measures to integrate more farmers into urban life.

"Small and medium-sized cities and townships will be the focus of the country's urbanization plan," the document said.

The country will ease the restrictions over permanent residence permits in county seats and townships so that more rural residents can move in and enjoy the same rights and public service as original urban residents, the document said.

To attract more rural labors, the country will put more resources in economic growth at the county level, including preferential policies in land use, reform of government investment and taxation.

The country will encourage city governments to allow migrant workers, who have stable jobs and live in the cities for a certain period of time, to join in urban housing programs.

Migrant workers will also be included in the basic medical insurance and pension program in cities, the document said.

RIGHTS

The government will work hard to solve the problems that harm farmers' interests, such as in land expropriation, pollution and management of village assets, the document said.

An unblocked channel should be built to enable rural residents to express their requests and safeguard their rights and interests in a rational and legal way, it said.

In addition, the document also pledged to promote village democracy. Efforts should be made to regulate the election procedure of village committees and heads, introduce democratic decision-making, and promote transparency in village asset management.

Appendix IV Lessons learned from previous Dutch Metropolitan activities in China

III-A. Lessons learned by Wageningen UR Alterra in Agropark activities

In the last decade four metropolitan projects about (intensive) metropolitan agriculture have been conducted in China by Alterra, Wageningen UR. These four projects were focused on landscape design and Master Plans for Eco-Agricultural parks and Metropolitan Agro Industrial Parks:

1. Shanghai Wetlandpark (at the island Chongming) 2002
2. WAZ Holland park 2004
3. Shanghai Greenport agropark 2007
4. Caofeidian metropolitan agro park 2010

Box 1. Example of learning experience for future project approach In the WAZ Holland park project (2004)

The design was well received, local entrepreneurs were involved and government had allocated areas to local entrepreneurs. At the end of the design phase the governmental support to go into the implementation phase was not adequate. Therefore the realisation of the agricultural park stagnated. Only the dairy entrepreneur has been developing large scale business. The intended agropark is not yet realised. In the next project, Shanghai Greenport Agropark (2007), from the start of the project more involvement of potential entrepreneurs took place. During a preliminary trade mission of interested entrepreneurs and governors where involved to cooperate in design and development of this new agropark.

To make use of lessons learned from these projects for future project activities interviews were held and literature studies. The outcomes are reported below.

The lessons learned in this section result from an interview with Madeleine van Mansfeld and reading of a thesis about Agroparks (Smeets, 2009).

Learning experiences from one project were adapted by Alterra in the approach of the next metropolitan food cluster. See Box 1 for an example of a learning experience of the WAZ Holland park regarding the potential users of and investors in the Agro park.

The most important lesson learned by Alterra in the projects the institute has conducted concerns the change from 'location approach' to 'network approach' (See below Lessons learned number 1). The Shanghai Wetland park project the project was run with a 'location approach'. Although this approach and the project did result in realization of the park, the following projects were not all that successful. Alterra became more and more aware of the importance to involve several relevant parties in the designing from the start of the project and in all next phases of the process. Their involvement is seen as a prerequisite for successful realization of the designed master plan. Alterra has called this network approach KENGI, which stands for Knowledge, Entrepreneurs, NGO's, Government and Innovation. In KENGI the different values of Knowledge, Entrepreneurs, NGO's, and Government has to be matched with one another. This matching must take place from the start of the project to result in co design as pre-requisite for successful innovation. Based on Indian experiences, the 2010 started project 'Caofeidian Metropolitan Agro Park' has started with this 'networking approach'; entrepreneurs and key investors were recruited and truly involved.

Other lessons learned vary from the importance of communication (language), to financial possibilities at the local entrepreneurial level, to the involvement of the right governmental level(s) as conditions for success of the project.

Box 2. KENGI in China

KENGI is the abbreviation for the following terms:

- **K** is of Knowledge, about land use and development methodologies. This can be both Chinese or Dutch Knowledge. Chinese knowledge is focused sectorally and not integrated. As a consequence parties or representatives of all knowledge sector have to be involved. Some of the Dutch knowledge institutes, on the other hand, are focused at integration of knowledge.
- **E** is of large Entrepreneurs. Vision, design and knowledge can entice the interest of entrepreneurs to get involved in the working process as a business opportunity for themselves.
- **N** is of Ngo's. In China are no NGO's active or encountered in the themes that are relevant in the design of Agro-parks.
- **G** is of Government. Government has to be involved at the level that is focused on in the development of scenarios or masterplans. Probably at the level of city or municipality, but foremost on the national and provincial level (In this case national and Shanghai level) .

Involvement of the parties above in a project will lead to:

- **I** is of Innovation

The following lessons learned are concluded by Alterra:

- ◆ Lesson learned 1: From the start of the project all relevant, interested Knowledge, (local) Entrepreneurs, NGO's, Government parties need to be involved/recruited and brought into co-design. Together they work on transitions to bring about innovations. This recruitment of parties is seen as a job for local project developers as a program office or local counterpart, who know culture and modes of operations that are culturally established.
- ◆ Lesson learned 2: Parallel to the agropark development the transition from local farmers to local agro entrepreneurs is very important. In China a lot of small farmers can be characterized as subsistence farming. These farmers produce at very small scale, mainly for own food supply, while the surplus is tried to be sold. Not only the foreseen entrepreneurs in the Agro parks have to develop their entrepreneurship, also the surrounding producers (including the subsistence farmers) have to develop to an entrepreneurial scale.
- ◆ Lesson learned 3: From supply driven to demand driven: Use the pull forces of the urban markets to pull the present rural farmers with new production methods into the value chain
- ◆ Lesson learned 4: In China the governments are dominant players in this type of high tech agro developments. The role of enterprises and entrepreneurs should become leading instead of the government. The fragmentation in power at governments and agencies can be difficult to deal with.
- ◆ Lesson learned 5: Communication (i.e. language and cultural aspects/tradition) can be a problem. A good translator can translate the issues at hand, but also smooth out intercultural differences and wrong use of words within the Dutch or Chinese context that could be explained otherwise. Find out via stakeholder analysis and force field analysis who are the right persons en get in contact with them and build the network; in China it is important to start with the involvement of the highest authorities, which then again can trigger the correct other governmental agencies and different relevant levels.
- ◆ Lesson learned 6: Be aware that data from the Agricultural bureau on agricultural land use sometimes are not very reliable.

- ◆ Lesson learned 7: Sustainability scan of the system innovation. Per phase of development from initiation, feasibility to planning, but certainly during business planning and implementation, the sustainability scan should be exercised for planet, people and profit as well as process aspects.
- ◆ Lesson learned 8: The social discussion about animal welfare in intensive animal farming, as being discussed in North-West of Europe, is not very present in China at this moment. First concern is food for all and answering the demand on meat, fish, and other types of proteins. Food safety is becoming an issue.
- ◆ Lesson learned 9: Participation of a KENGI broker/communicator who is paid by Dutch funds, gives Chinese clients (governments, entrepreneurs) the impression that Dutch government will act as financier of the project during all phases of the innovation process.
- ◆ Lesson learned 10: Before negotiating the investments regarding the Masterplan, it is necessary to re-build trust between Dutch and Chinese partners.

III-B. Lessons learned by Transformum

Transformum conducted a project evaluation for the Greenport Shanghai project (see above). In the resulting report the following critical points, not mentioned yet in the interview with Madeleine van Mansfeld, were concluded:

- The (Dutch) partners in the project all had different interests in the project. And no one wanted the other party to be the project leader. Also partners operated on it own in the project, without informing the others. The communication between the parties was therefore difficult, also struggling with having more than one face to act with from Chinese side to Dutch side. It is very important that the involved parties agree from the start about their roles in the project and recognize the project leadership of the key partner.
- Communication with one of the Chinese parties, the investor, was sometimes rather difficult. This had to do with the hierarchical attitude of the main contact person of that company, who on the other hand lacked the mandate to make decisions.

Critical points experienced by the interviewees can split up into:

1. Differences between the parties regarding ambition, expectations, approach and final goals
2. Differences between the parties in competences and ability to act
3. The coordination of the process as well as the roles of the different parties in the process coordination.
4. Personal interests and relations between individuals influenced the process
5. Several external factors complicated the process.

These point will be explained below.

Differences between parties regarding visions, expectations and approach

The several involved parties in the Greenport Shanghai project all had their own interests and visions. There original joint goals and vision has gone away in the debate on individual gains per organization. Several parties prioritized their own interest instead of the common interest.

- ◆ Lesson learned 11: For future projects it is necessary that already in a early stage parties agree on a shared vision regarding the process, the goals and expectations.

In the project there was a lot of enthusiasm and energy from the project partners/leaders. This led to underestimation of the differences between the different Dutch stakeholders, let alone the difficulties in in this complex process in doing business between China and The Netherlands.

- ◆ Lesson learned 12: Be aware of the difference in doing business between Chinese business and Dutch business.

Notwithstanding the explicit starting point in co design with entrepreneurs and the explicit mentioning that investors would not come from the Netherlands, but only a network of potentially interested entrepreneurs with high tech inputs in knowledge and possible entrepreneurship, the expectations of the assigner where that Dutch investors would come forward. For future project the roles of local anchor investors and the roles of knowledge brought by knowledge institutes or entrepreneurs towards China need to be clear at the start. This has been the approach for Caofeidian, in which the assigner was clear that investors and entrepreneurship has to start in China first.

- ◆ Lesson learned 13: The leading approach ought to be market driven, in which demand of consumer and retail in the cities to be fed is part of the basic analysis. The second is the supply strength of the area in which the agropark will be situated.

Differences between parties in competences and inability to act: composition of network

Some of the committed persons and organizations had conflicting interests. Some persons represented more than one organization in the project, which made their role confusing towards the other parties.

- ◆ Lesson learned 14: Set up a project steering group which is composed of both public and private actors. Make sure these persons have no conflicting interests within their own position. The task of this steering group should be to steer the project with the common goal of all parties in mind.

Coordination and roles: complexity of project and process coordination

There has been several project leaders during the project. Alterra was one of them, but the other parties mentioned Alterra is not the right party for this role, as Alterra does not have the same type of risks as entrepreneurs will have to deal with. Transforum took over this role of project leader. Again this was not received well by the other parties, as they got the feeling they could only play a role under the leadership of Transforum.

- ◆ Lesson learned 15: The project leadership should be an independent party that has a risk taking role in the project.

There was lack of formal go – no go moments.

- ◆ Lesson learned 16: Make a plan with go – no –go moments and make formal reports on regularly basis about the progress and results in the project moments so that the right decisions can be made.

The Dutch agro entrepreneurs felt they were not entirely and too positively informed about the project and process; the management of expectations has been too optimistic.

- ◆ Lesson learned 17: Communication between parties must be transparent.
- ◆ Lesson learned 18: Pay attention to differences in culture between Chinese and Dutch people. In China it is very important to work on a good relationship with the business partner. N.B. It must be noted that in this project the business partnership was non existing. It was a Dutch funded project with a very small co financing part from China.

Personal interests and relationships between individuals

The project suffered because of the personal competition of the involved parties. This meant a higher risk for arguments during the process.

Several external factors

The Dutch agro entrepreneurs (middle sized companies), which were organized as a solid group represented by Know-house BV, were not accommodated or facilitated by the Chinese key investors/project developer to develop the start of their business as a sound joint enterprise. After a long period of trying to set up joint business with the Chinese assigner the Dutch entrepreneurial /provincial government group stopped activities in the Shanghai project. The Chinese assigner and key-officials of the Shanghai government were (sideways) involved in corruption scandal, which made the total Dongtan development and Greenport Shanghai agropark a non issue for several years. Slowly and with very little public noise the Greenport developments are taking place low profile. The basic infrastructure and green structures and some key buildings are presently built and agro-entrepreneurs are entering the area with activities (i.e. greenhouse tunnels).

Summarized, the following advises are given for future innovative projects and processes by Transforum:

- Identify and make explicit the individual and the common interests, stakes and goals. Spend time and energy in formulating a common joint vision and goal as well as goals of each party.
- Assign jointly the single person / organization that will act as the project leader. All parties have to agree with this person. Identify and allocate the different roles of all contributing parties.
- Create ownership and joint responsibility. Full transparency in communication between KENGi members to create trust between parties and to be able to co design within the team.
- Prepare yourself for the difference in cultures or attitudes of Chinese and Dutch parties, but also for differences in background between different Dutch parties.

III-C. Lessons learned by LEI

For the lessons learned below was spoken to Ben Kamphuis, LEI. He has been active with several projects with cooperatives and retail.

- ◆ Lesson learned 19: Take the time to find out who is responsible for what and who is allowed to make decisions.
- ◆ Lesson learned 20: Conduct a need assessment to define the right problem and research questions.
- ◆ Lesson learned 21: Build a good relationship between the project team/leader and the agricultural bureau. The agricultural bureau is the most suited party to start development and cooperation from extension services, education, subsidies in order to change growers and grower co operations.
- ◆ Lesson learned 22: After the phase of global scenario development, it is important to involve planners in the further scenario development. They can inform the project about possibilities and limitations.



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