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Agribusiness complexes: a worldwide quick scan

Marco van Steekelenburg
Tia Hermans
Peter Smeets

ARCADIS

PLATFORM
Agrilogistiek
clusteren verbinden regisseren

InnovatieNetwerk
Groene Ruimte en Agrocluster

Report

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Agribusiness complexes (ABCs) are spatial clusters of agriculture and non-agriculture related activities based on the principle of industrial ecology (De Wilt et al., 2000). Based on this definition, this study provides a worldwide quick scan of the presence of and developments in ABCs. Aim of the study is to find out whether governments, business world and researchers can learn from developments elsewhere in order to accelerate developments and innovations in their own country or vice versa. According to the responses on our questionnaire, ABCs or look-alikes have been introduced on all inhabited continents in a range of variants, dealing with one or more challenges agribusiness is facing. Look-alikes because examples often do not meet the criteria of the definition of De Wilt et al.: or purposive clustering, and/or a combination of agro and non-agro related activities and/or industrial ecology is lacking. The challenge for the near future is to organize the 'flywheel' effect from the interaction between governments, business world and researchers from various regions in order to initiate innovations and to accelerate the development of ABCs.

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For more information, please contact:
C.M.L. (Tia) Hermans, tel. +31(0)317474432, email: tia.hermans@wur.nl
P.J.A.M. (Peter) Smeets, tel. +31(0)651206758, email: peter.smeets@wur.nl.

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1 Introduction

The process of producing foodstuffs and raw materials and supplying them to consumers requires a highly efficient agribusiness system operating on an international basis. Agribusiness comprises not only primary agriculture and horticulture, but also the various suppliers and trading and distribution companies. Agribusiness is a highly dynamic sector because of the frequent changes in consumer preferences, new technologies and ever changing natural, socio-economic and political factors affecting production conditions. As a result, there are continuous shifts all over the world, with production areas and markets appearing and disappearing.

1.1 Challenges for agribusiness

What challenges is agribusiness facing worldwide? The first challenge is that of the growth of the world's population, which demographic prognoses predict will be about 80 million people a year until 2015, after which it is expected to fall to 50 million people a year by 2050 (Fischer & Heilig, 1997). The challenge consists in ensuring that production growth will at least keep up with population growth, in order to safeguard food supplies. This challenge is aggravated by the worldwide shifts in consumption patterns caused by increasing affluence. To most people, greater affluence means not only eating more, but also eating different products. The increased meat and dairy consumption by more and more affluent people is resulting in ever-greater claims on scarce land resources.

The second challenge results form urbanisation. Historically, people have tended to concentrate on and near fertile land, often in the deltas of large rivers. An ever-increasing percentage of the growing population lives in or near towns and cities, and the spatial requirements of individual residents are rising. As a result, urbanisation is increasing at a far greater rate than the population growth, and is claiming precisely the fertile farmlands near the towns and cities, forcing agriculture to reallocate or intensify its land use.

The third challenge is that growth, reallocation and intensification should not lead to deterioration of soil, water and air quality or inefficient use of water. This necessitates environmental care in the widest sense of the term. In addition, agribusiness will need to prepare for the expected climate changes, involving higher temperatures, changing annual rain distribution patterns, raising sea levels, frequent extreme rain events and shifts in growing seasons.

The fourth challenge is formed by policy changes. The WTO is putting pressure on all countries and trade zones to remove trade-distorting subsidies, tariff walls and other protection measures. Food production companies can respond to this development by saving costs, specialising, finding niche markets and innovating production methods. Some countries, including the Netherlands, are implementing a different type of policy change: the governments are becoming increasingly aware that the current fragmented and sector-based legislation, with its frequently instrumental rather than goal-oriented nature, is actually delaying the adoption of innovations. Experiments are being started to innovate this legislation itself.

The fifth challenge is presented by zoonoses. The recent outbreaks of SARS and avian influenza have underlined the potential dangers of large-scale close contacts between humans and farm animals, while the BSE problem provides another example of a threat to food safety resulting from oversimplified rationalisation and well-intentioned waste processing.

Since different regions of the world face different combinations of these challenges, with different degrees of severity, a variety of factors will determine how agribusiness develops in various parts of the world. One of the new developments is that of agribusiness complexes, or ABCs

1.2 Aim of the study

The present study was intended to provide a worldwide quick scan of the presence of and developments in agribusiness complexes, which could be used to inform governments, the business world and researchers about the current state of affairs as regards agribusiness complexes. It also intended to assess the importance of these worldwide developments.

It is important for governments, the business world and researchers to recognise new trends in agribusiness at an early stage. Governments want to know where they need to intervene to create room for new developments. The business world is interested in investing in those aspects of new developments, which allow relatively large profits, including environmental aspects, financial services, organisation and technology. Their business is no longer only business. Private companies are increasingly interested in social corporate behaviour, investing in aspects like environment, social quality within and outside the production facilities. Researchers want to identify gaps in our knowledge that they need to concentrate on in the longer term, partly to find potential clients for knowledge export. The above arguments made us decide to do a quick scan study of recent developments in agribusiness complexes.

Developments in the Netherlands will be compared with developments elsewhere. It is hypothesised that the Netherlands is one of the leading countries in the field of agribusiness complexes. So there might be mutual learning experiences when we start to exchange knowledge on the basis of this comparison.

1.3 Approach

The study consisted of three steps:

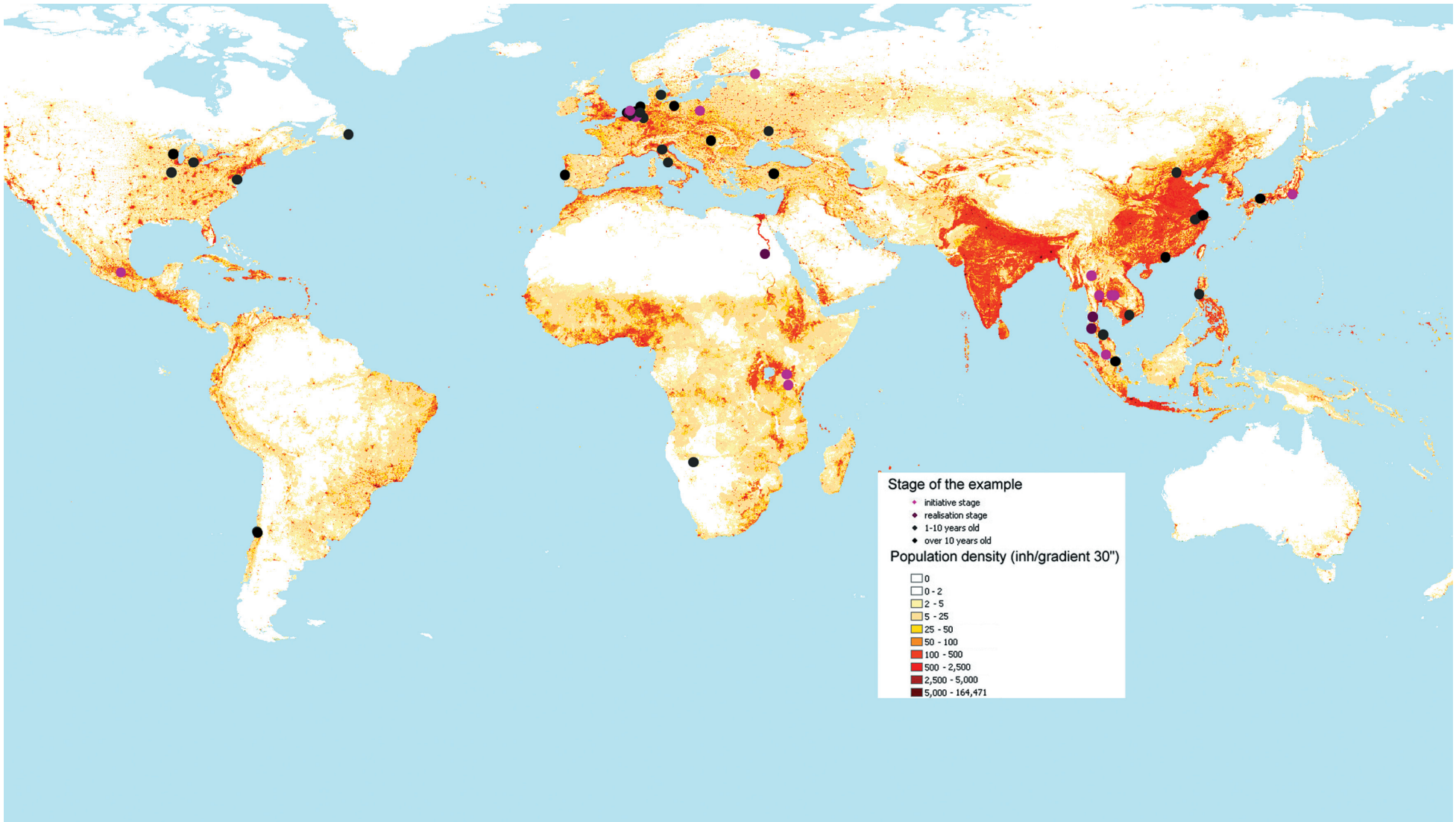
- The first step involved a worldwide survey of examples or initiatives that could be regarded as representing the concept of agribusiness complexes, according to the definition of De Wilt et al. (2000). This survey was done in the first half of 2004. It profited particularly from the network of agricultural attachés maintained by the Dutch Ministry of Agriculture, Nature and Food Quality (LNV). In addition, we used our own networks to collect information. We did not aim for an exhaustive survey. The results of our survey, including the questionnaire, are presented in a database at http://www.agrocomplex.nl.

- The second step involved analysing the examples and initiatives collected in the first step, with the aim of identifying the challenges behind the creation of the complexes. A number of representative examples were selected and discussed in the present report.

- The third step assessed the relevance of these developments for the Netherlands and vice versa. The report also outlines ideas for a follow-up.

1.4 The report

This report starts by explaining the concept of agribusiness complexes. It then discusses the challenges behind the creation of these complexes, after which one or more representative examples of each are discussed. The report continues with some reflections about the reported examples and ends with a suggestion on how to proceed.


Stage of the example
initiative stage
realisation stage
1-10 years old
over 10 years old
Population density (inh/gradient 30")
0
0 - 2
2 - 5
5 - 25
25 - 50
50 - 100
100 - 500
500 - 2,500
2,500 - 5,000
5,000 - 164,471

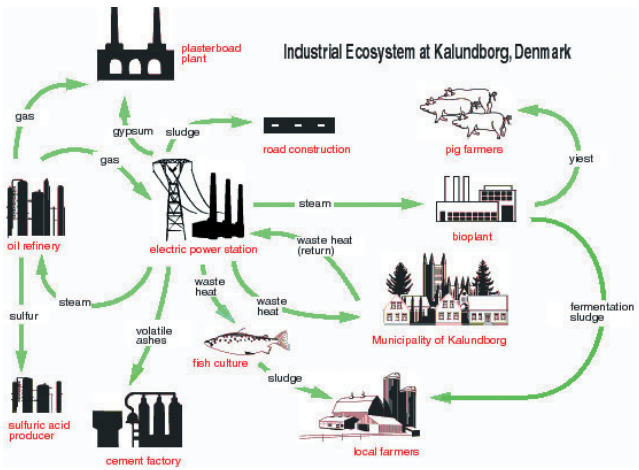
2 What is an agribusiness complex?

The concept of agribusiness complex has not yet been univocally defined, and the relevant literature also uses different terms, such as 'agrobusiness park', 'agro-production park', 'agro-park' or 'agro-industrial estate'. The key element in all definitions is the deliberate spatial clustering of agriculture-related activities. The definition in De Wilt et al. (2000) talks about 'a purposive clustering of agriculture-related and non-agriculture-related activities at an industrial estate or in a specific area, offering potentially interesting prospects for closing cyclic processes, reducing transport and making efficient use of scarce space'. This definition underlines the connection between agribusiness complexes and the principle of industrial ecology. Industrial ecology involves linking various industrial production processes in order to maximise the exchange of waste and by-products. This not only saves costs, but also minimises waste production and hence the unfavourable effects of industry on ecosystems.

We used the De Wilt definition of agribusiness complexes in our request to agricultural attachés and other relations to report developments in their country of residence. This produced some 70 responses, all of which have been made available on the website http://www.agrocomplex.nl/. In the appraisal of the reported developments, we have not been severe concerning complying with the definition, neither concerning already existing or only planned ABCs. Conversely, we have been severe concerning the availability of information. If little more than a name or region is mentioned, the example is kept in the database though not included in the analysis. So we were left with less than 25 examples of which ten are discussed in more detail in this report. Map 1 shows the examples that were used for the analysis.

Map 1: Survey of reported ABCs. The underlay map shows population densities for 1998 (no. of inhabitants per km^2) (Source: LandScan Global Population 1998 Database)

3 Challenges behind the development of ABCs



To supplement the information on ABCs provided by our informants, we searched for additional information on the companies they mentioned, on the Internet, in the available literature or by means of interviews. We were particularly interested in the challenges behind the development of ABCs. In the sections below, we relate these challenges to responses from agribusiness.

3.1 Environment at the industrial level

In all of the examples we found, the environment and, by extension, climate, were the most common challenges. Or in the words of UN executive Roland Strong: 'make the waste of one process serve as the raw material of another'. Three examples are discussed in more detail below: the Industrial Symbiosis project in Kalundborg (Denmark), the Archer Daniels Midland Company in Decatur, Illinois (USA) and the Tsunweni Brewery in Tsumeb (Namibia). A fourth example is a design based on the principle of industrial ecology, Agrocentrum Westpoort (the Netherlands).

3.1.1 Kalundborg Industrial Symbiosis

In the region of Kalundborg (DK), the principle of 'Making the waste of one process serve as the raw material of another' has been translated into 'industrial symbiosis', the industrial co-operation between a number of companies and the Kalundborg municipal authorities, all of which exploit each other's residual or by-products.

The Symbiosis co-operation has developed spontaneously over a number of decades and today comprises some 20 projects. The exchange of residual products between the companies includes wastewater, gas and gypsum, ash, fertiliser and yeast slurry, sludge and a number of other products. The benefits are numerous. To give some examples:

- Total water consumption: The Symbiosis companies have reduced their overall consumption by 25% by recycling the water and by letting it circulate between the

individual Symbiosis partners. A total of 1.9 million cubic metres of groundwater and 1 million cubic metres of surface water are saved on a yearly basis.

- Oil: The Symbiosis partners have reduced their oil consumption by 20,000 tonnes per year, corresponding to a 380-tonne reduction of sulphur dioxide emissions on a yearly basis. Oil is replaced by process steam from energy production at the power station.
- Ash: The combustion of coal in orimulsion firing results yearly in approximately 30,000 tonnes of fly ash, which are used in the construction and cement industries or for the extraction of nickel and vanadium.
- Wastewater: The companies collaborate in wastewater treatment, considerably reducing the environmental impact on Jammerland Bugt.

Criteria for such a symbiosis are:

- The companies must be mutually compatible:

An industrial symbiosis can only work with the right combination of industries in one area. One company's residual products must be able to replace another company's raw materials. Diversity within the local industrial structure is therefore an important condition for industrial symbiosis.

- The companies must be located near each other:

The physical distance between the individual companies is of great importance. The transport of residual products over large distances is seldom profitable, which means that the distance must be as short as possible. Experience at Kalundborg demonstrates that the geographical distance is the most important parameter when energy is exchanged between the companies. Other by-products can be transported to advantage over larger distances.

- There must be openness between the companies:

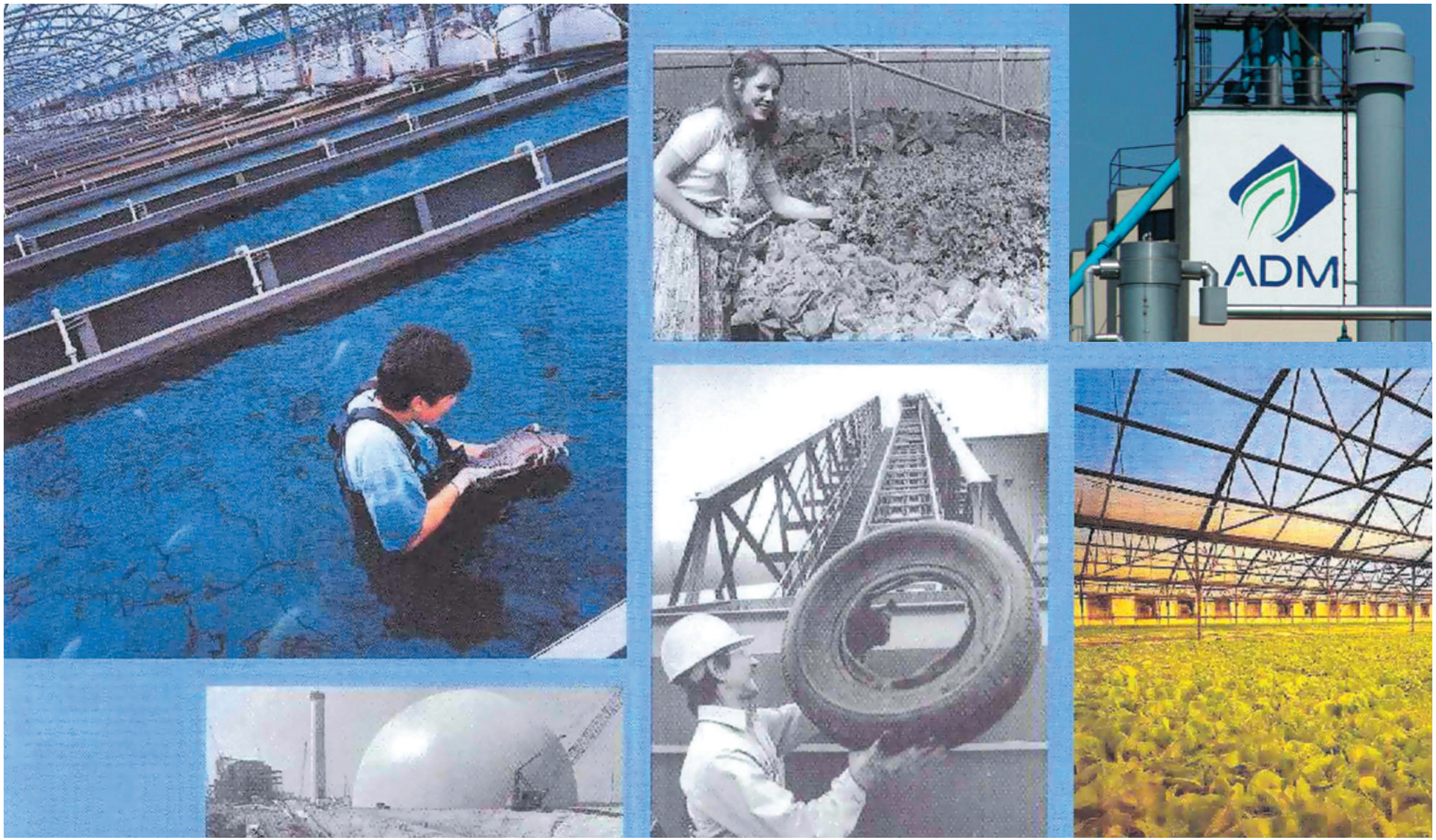
Today the basis of the Symbiosis co-operation at Kalundborg is openness, communication and mutual trust between the partners. The Kalundborg companies are located in a small community that has helped establish excellent conditions for open and intimate working relations.

The Industrial Symbiosis co-operation at Kalundborg is unique in today's world. Only the right combination of companies in a local area can provide a basis for sustai-nable projects. The more companies are involved, the greater the opportunity for sym-biosis, and thus the greater the potential for reducing resource consumption and envi-ronmental strain. In Kalundborg, the symbiosis has been built around a network of 8 partners. Industrial Symbiosis has aroused international interest from many parts of the world.

3.1.2 Archer Daniels Midland Company (ADM)

Set up in the early 1900s by two linseed millers in Decatur, Illinois, USA, ADM has developed into one of the world's largest agribusiness companies, operating around the world, mostly based on acquisition, processing, packaging, distribution and marketing of products from 11 cereal grains and oilseeds. The headquarters is still in Decatur. The company operates more than 250 cereal grain and oilseed processing plants around the world and has a transportation business that matches with its agribusiness.

It is particularly the fermentation processes in agribusiness, which produces large amounts of waste heat and CO_2. For every 2 tonnes of malt produced for beer production, 1 tonne of CO_2 is released. Usually, waste heat is released into the atmosphere via cooling towers, while CO_2 is released straight into the atmosphere. The increased CO_2 content of the atmosphere is one of the factors causing the increased greenhouse effect (see box).


ADM

The problems of atmospheric carbon dioxide are becoming acute. Scientists report that, when humankind began to industrialise more than a century ago, atmospheric carbon dioxide was around 225 parts per million (ppm). Massive use of fossil fuels, cutting down of forests and the multitude of other reasons for carbon dioxide release mean that current atmospheric levels are between 340 and 350 ppm. In some of our city buildings, the level of carbon dioxide in the air builds up to 500 - 600 ppm. While these are still very safe levels for humans to breathe, such levels are not considered to be safe for the world's forests or world agriculture, even though carbon dioxide is a gaseous fertiliser which can help increase plant growth. The reason is that a 550 ppm level of carbon dioxide in the general atmosphere is expected to trigger a 'greenhouse effect', which will lead to significant climatic changes. Whether these changes will occur still remains in some dispute. (Wilson, 2000)

In 1980, the ADM Company decided to use two forms of waste, heat and CO_2, as raw materials from which to develop technology to further help feed the world. So industry has started to look for alternative ways to dispose of waste heat and CO_2, which means that it is the motor behind the development of recycling options. Accordingly, hydroponics growing of a range of vegetables and herbs was adopted. Ten years ago, the Company branched out into aquaculture, the indoor rearing of Tilapia. The examples below clearly show that primary agricultural production provides important opportunities for this, in that vegetable production and fish farming are attractive consumers of both heat and CO_2.

Waste heat

Waste heat is used to warm hydroponic nutrient to around 20° Celsius, for use during the cold winter months, when ambient air temperatures in Decatur fall below freezing. Waste heat is also used to warm greenhouse air in late autumn, winter, and early spring. This form of heating is important to reduce plant growth at times of cold stress. Heat stress is not so much a problem at Decatur.

The Tilapia are fed on soy and corn by-products from the company's agribusiness processing plants. Using the waste heat from industrial processes nearby warms their water.

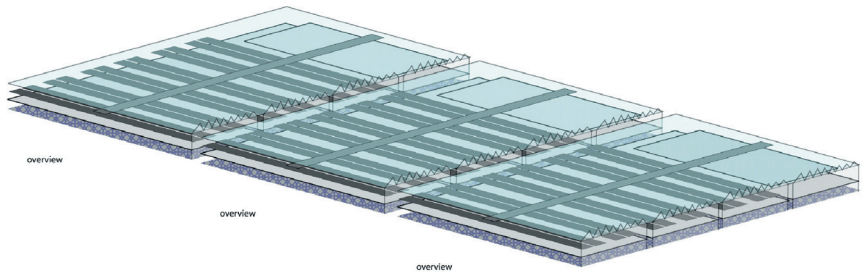
Waste CO_2

The waste carbon dioxide from the corn processing and ethanol production is compressed and liquefied as it comes from the fermentation process. Most of ADM's liquefied gas is sold for making dry ice, and for the carbonating of soft drinks. This is handy revenue that many other ethanol (beer/spirits) producers still seem to ignore - to the detriment of the world's environment. At Decatur, a relatively small amount of the carbon dioxide from fermentation is also used as a gaseous fertiliser for ADM's hydroponics vegetable crops in the nearby 4.2 hectare facility. This is especially important in the colder months, when crop growth needs to be stimulated. According to the ADM hydroponics farm at Decatur, ethanol production could potentially service a huge area of hydroponics with carbon dioxide 'fertiliser' at the rates commonly used. The opportunity, therefore, is significant for hydroponics growers to locate their production close to fermentation plants, where waste heat and carbon dioxide are available. These are mostly in urban or semi-urban areas, which means that they are also close to other important infrastructure, such as power and transport.

According to personal communication of the management of ADM's agropark in Decatur, this facility has a profit margin of about 3% on a yearly base. Not included in this profit are the savings that are realised by the corn and soy processing plants while reducing costs for cooling and expected future CO_2 processing. The literature or website did not give additional information about economic profitability.

Zero Emission Tunweni Brewery

Amsterdam Agrocenter



3.1.3 Zero Emission Tunweni Brewery

Zero Emissions Research and Initiatives (ZERI) is a global network of creative minds, seeking solutions to the ever-increasing problems of the world. The common vision shared by the members of the ZERI family is to view waste as resource and seek solutions using nature's design principles as inspiration. The nature of ZERI projects varies from pure industrial projects, to community based initiatives, to business related enterprises, to government and bilateral and UN aided co-operation.

The Tunweni Brewery at Tsumeb (Namibia) is an example of ZERI's zero-emissions ethos put into practice. It is a small size brewery that produces about 15,000 hl beer annually. One of the major wastes in the brewing process is traditionally water, a resource that Namibia is not exactly overflowing with. For a brewery of Tunweni's size, 150,000 litres of liquid waste is produced every month. The waste comes from three sources: sewage, plant wash down, and boiler blow down. Tunweni utilises this waste by processing it, and eventually diverting it to feed deepwater ponds. In the ponds, six species of fish are stocked for aquaculture harvesting, with a projected yield of eight to ten tonnes per hectare each year. Solid waste, in the form of spent grain, becomes a resource in many ways. 7500 kg of spent grain are produced each month. This is used as a bed on which to grow mushrooms - a very high value cash crop in Namibia. Earthworms are also added to the grain, which feed on it and thereby produce animal protein. This, in turn, is used for high-quality chicken feed and pig feed. The pig and chicken waste is fed into a 'bio digester,' which the sewage water also goes through. This extracts the methane gas from the waste, which is used for heat during the fermentation process. The processed waste is then siphoned into the ponds as feed for the fish. There are, in fact, many more efficiencies produced in the entire process, all of which ZERI insists are profitable both environmentally and monetarily.

3.1.4 Amsterdam Agrocenter

The above examples have been an inspiration in the design of Agrocentrum Westpoort, an agri-production complex to be developed in the Amsterdam port area, under the auspices of the Amsterdam Seaports port authority.

Amsterdam is the largest agri-related port in the Netherlands, importing huge volumes of animal feed and raw materials for the food producing and processing industries. Amsterdam port is regarded as a highly suitable location for the development of an agri-centre, for instance because of:

- the presence of relevant agri-related companies, including suppliers of raw materials for intensive farming as well as a waste processing plant and an energy production plant;
- the availability of the port for efficient inward-bound and outward-bound transport of bulk flows;
- the large number of consumers and large labour potential in the area. This high population density has however a reverse side: the risk of zoonoses;
- the area's favourable location for glasshouse horticulture;
- the clustering of chains in one location and its isolated situation relative to other livestock farms, minimising the risk of animal diseases being introduced.

The design links existing industries (industrial ecology) and adds facilities for intensive livestock farming and possibly fish farming and glasshouse horticulture, allowing the linked chain functions to be combined with sustainable processing of secondary flows. The attractive logistical context of the port, the large-scale opportunities, the links between the various activities and the relations with existing companies allow sustainable processing systems for secondary flows to be profitably implemented. Cost savings are expected from:

- the use of residual flows, i.e., by-products, energy and water;
- the use of electric power, heat and CO2 from fermented manure in horticulture;
- efficient land use;
- limited transport requirements and efficient logistics;
- stimuli for agribusiness and other businesses;
- the marketing of agricultural produce from a transparent and sustainable food production chain.

The plans are currently subject to feasibility studies and consortium formation. A general feasibility study that was conducted on the design of the Amsterdam Agrocenter by consultants of the Dutch National Investment Bank, came to the conclusion that a general reduction of costs could be expected for each of participating prime producers in comparison with existing stand alone facilities.

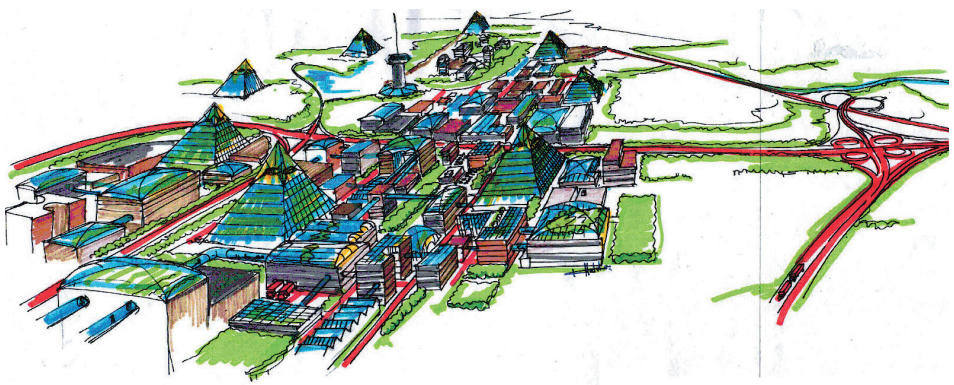
3.1.5 In a nutshell

In all cases where the environment at the industrial level and by extension, climate is the challenge, it concerns fermentation processes in agribusiness which produce large amounts of waste heat and CO2. Logically it is not the primary sector but the industry that takes the initiative to collaborate. The primary sector joins, if at all, at a latter stage. So:

- industry is the motor behind the development of such complexes;
- companies must be located near each other;
- companies must be mutually compatible, i.e. there must be a basis for exchange of rest and by products between the participating companies;
- very large flows of residuals are re-used;
- little data are available on the economic feasibility of existing ABC's;
- the foci are on the 'planet' and 'profit' aspect of sustainability.

Hangzhou Dengta Livestock Farm

'New Mixed Farming'



3.2 Environment at the farm level

In the above examples, industry is the motor behind the development of agribusiness complexes. At the same time, there are farms looking for solutions to their excess manure problems that accompany scale increase and more intense input of capital, so the environment again being one of the main challenges. Three examples are presented below: Dengta Livestock Farm, an existing pig farm in Hangzhou (China), the New Mixed Farming scheme which is being developed at 'Horst aan de Maas' (the Netherlands) and WAZ-Holland Park, a design of an agricultural and sightseeing park to be developed near Changzhou (China). Although these developments only partly match with the definition of De Wilt et al. (2000), we include them to find out whether these examples offer potential to develop into an ABC according to De Wilt et al. (2000) or whether existing ABC's can improve by adopting aspects of these developments.

3.2.1 Hangzhou Dengta Livestock Farm

Hangzhou is the capital of Zhejiang province in China. To supply the citizens with pork, a large-scale breeding farm was built in a suburban area. Since Hangzhou is a very famous tourist city in China, its environment has to be protected. So, at the same time, a biogas plant was built. Dengta livestock farm is the largest pig farm in China, with an annual turnover of 200,000 pigs; the number of pigs on hand is 120,000. A total of 185 tonnes of excrement and 3000 tonnes of sewage are processed daily by the biogas plant. After the solids and liquids in the pig waste have been separated, the solids are transferred to the biologic compost factory to produce organic fertilizer, while the liquids are transferred to produce biogas through anaerobic digestion. The biogas is used as household fuel or to generate power. The wastewater is treated using anaerobic and aerobic digestion techniques, and reaches standard values after purification. The plant at Dengta farm has been supported by economic incentives. The outputs of the biogas plant have to be traded at real market prices to make the plant economically attractive (Gu Shuhua, 2001).

It is the policy of Hangzhou Municipal Government that all breeding farms to be built in the future should include a biogas plant. For each biogas plant, one third of the initial investment will be covered by government subsidy, while the other two thirds have to be raised by the farm itself and have to be covered by a loan.

3.2.2 'New Mixed Farming'

In the northern part of the Dutch province of Limburg, five producers are collaborating with knowledge-generating agencies and the authorities to develop so-called New Mixed Farming, an agribusiness complex based largely on synergy between the various chains. The key element in the New Mixed Farming scheme is the introduction of a materials exchange plant, which is to facilitate all kinds of flows of residual products and by-products for the farms taking part in the scheme. The scheme tries to maximise the flows between the participating farms themselves, while flows to and from the outside world are to be concentrated in one large flow. The scheme's participants so far include pig, poultry, mushrooms and greenhouse producers, while a fish farmer is waiting to join in. The first aim is to integrate flows of manure, minerals, water, heat, cold and CO2, but other forms of collaboration are expected to arise in due time. The farm is to cover an area of 15 to 20 hectares. The pig farm is to house 17,500 animals and produce piglets from 2,500 sows. The chicken farm will produce about 1 million animals per year and rear its own chicks (Agrarisch Dagblad, 18 december 2004).

The various farms involved have different reasons to participate in the New Mixed Farming scheme. The two intensive livestock farms are looking for opportunities for spatial concentration, both because government legislation is forcing farms to do so if they wish to invest and because they expect major cost savings through reduced transport needs and co-siting. The mushroom and greenhouse growers are particularly expecting costs savings from co-siting. The company that is hoping to construct the materials exchange plant foresees great innovative potential from the new technologies that co-siting should allow. Together, the participants regard the New Mixed Farming scheme as a novel entrepreneurial concept, for which they also see great opportunities elsewhere in the world.

The Dutch government is supporting the New Mixed farming scheme. The Minister of Agriculture has granted the project a special status, which means that its implementation is regarded as a laboratory for innovative legislation. In addition, the project is being supported by the Transforum Agro & Groen innovation fund and used as a model project by the Platform Agrologistiek (agrilogistics platform).

3.2.3 WAZ-Holland Park

The type of collaboration effected in the New Mixed Farming scheme has inspired a consortium of designers and knowledge generating agencies that participate in designing WAZ-Holland Park, an agricultural and sightseeing park to be developed at the Wujin Foreign Oriented Comprehensive Agriculture Development District near Changzhou, China. The project was commissioned by the local government (the Wujin Agricultural Zone (WAZ) authority), which wants to develop an area originally intended as a recreational facility for a new suburb of Changzhou as a theme park. Many Chinese recreational areas combine leisure activities with education, and after the WAZ had heard about recent agro-park developments in the Netherlands, it decided to choose modern Dutch agriculture as the theme for this park.

The agro-park has been designed as a demonstration project showing modern Chinese and Dutch farms in action, managing their residual and by-products in a so-called Central Processing Unit: the acquaintance with the principle of 'industrial ecology'. The Dutch contribution involves setting up a chicken farm, a compost-based mushroom production facility and the processing unit. The park will also include existing Chinese farms producing ornamental plants, dairy and tortoises. An area of about 120 hectares in the park has been set aside for the Agro-park, while about 60 hectares will be used for recreational purposes and as a market place for knowledge exchange (Smeets et al. 2004).


Agropark
Market place
Sightseeing
WAZ Holland Park
agricultural and sightseeing park

3.2.4 In a nutshell

- The examples above do not meet the criterion of combination of different sectors, as required according the definition of De Wilt et al. (2000). They are restricted to the agricultural sector;
- To solve the excessive amounts of manure or wastes produced at the farm, the Government and/or the primary sector take the initiative;
- Manure processing to biogas at very large scale breeding farms in China has not yet proved to be economically sound. The Government provides one third of the initial investment. Without being able to trade the outputs of the biogas plant at real market prices, the plant is not economically attractive;
- The scale of the Dutch New Mixed Farming is small compared to the scale of the Chinese breeding farms. In this case also the Government provides funds to further develop the complex and to make the complex profitable;
- The focus is on the 'planet' aspect of sustainability and by doing so, it is expected to result in important savings in costs for energy, raw materials and waste processing.

Shanghai Modern Agricultural Parks

Agrotechnology Park Singapore

3.3 Food security for a growing and urbanising population

A second challenge behind ABC development that is frequently mentioned is the desire to ensure a sufficient and increasingly diversified array of alimentary products for a country's population in a high productive way and with efficient use of space. These ABCs are all situated in metropolitan areas, and have often been designed on the basis of a single production chain. In some cases, the synergy provided by co-siting is being exploited.

The examples of agribusiness complexes we want to discuss in this context have been created in populous regions of Asia: Shanghai Modern Agricultural Parks and Agrotechnology Park Singapore. They were planned and designed by governments, often with the double ambition of not only ensuring food supplies but also stimulating the regional economy. Several similar initiatives are also being developed in the Netherlands, driven by urbanisation trends, our third challenge. Again, the examples do not all meet the criteria of ABC's of De Wilt et al. (2000).

3.3.1 Shanghai Modern Agricultural Parks

Shanghai City and suburbs cover a total area of 6,300 square kilometres. By the end of 2002, the region had a total population of about 13.5 million, corresponding to a population density of 2,125 people per square kilometre. At present, only some 2,700 square kilometres of land have been cultivated.

Besides 9 municipal industrial zones, about 12 modern municipal agricultural parks or gardens have been established in Shanghai suburbs, varying in size from about 10 to 40 square kilometres. Taking the development of modern agricultural science and technology and modern agricultural facilities as its foundation, the production, processing and marketing of green, pollution-free agricultural products as its focus of development, and forest construction as a way to boost tourism, the Gardens attempt to improve their ecological environment and achieve maximum social, economic and ecological benefits.

Most of these agribusiness parks have been developed since 2000. Initially, the focus was on creating infrastructure and linking the region to the regional system of main roads. Current activities in the parks concentrate on fruit and vegetable production, and to a lesser extent on poultry and aquatic products. Compared to mainstream agricultural production in China, their production costs are higher so most of them are producing for high quality niche markets. Some of the parks also process and package products.

At Shanghai Agricultural Parks, as at many agriculture parks in China, it is the intention that domestic and overseas investors co-operate. The major fields of investments they are looking for have been identified as: seed and seedling industry, agricultural bio-tech industry, agricultural greenhouse technology and the manufacture and processing of its equipment, fine processing industry for agricultural products, mass production agriculture and export-oriented agricultural industry, development industry of new and high-level agricultural technology and agricultural leisure and sightseeing industry.

3.3.2 Agrotechnology Park Singapore

The Agro-Food and Veterinary Authority of Singapore is committed to ensuring a stable and adequate supply of safe, wholesome and quality fresh produce to its population. To achieve this goal, it has three strategies:

- ensuring high standards of food safety through an integrated system of accreditation, inspection and testing;
- diversifying the external sources of farm produce;
- increasing self-sufficiency in supplying farm produce by developing modern, intensive farming systems.

Because of its high population density, Singapore needs to maximise the output from its limited agricultural land area. The Agro-Food and Veterinary Authority of Singapore has organised a move towards agrotechnology, which is the application of modern technology and life sciences to intensive farming systems in agrotechnology parks.

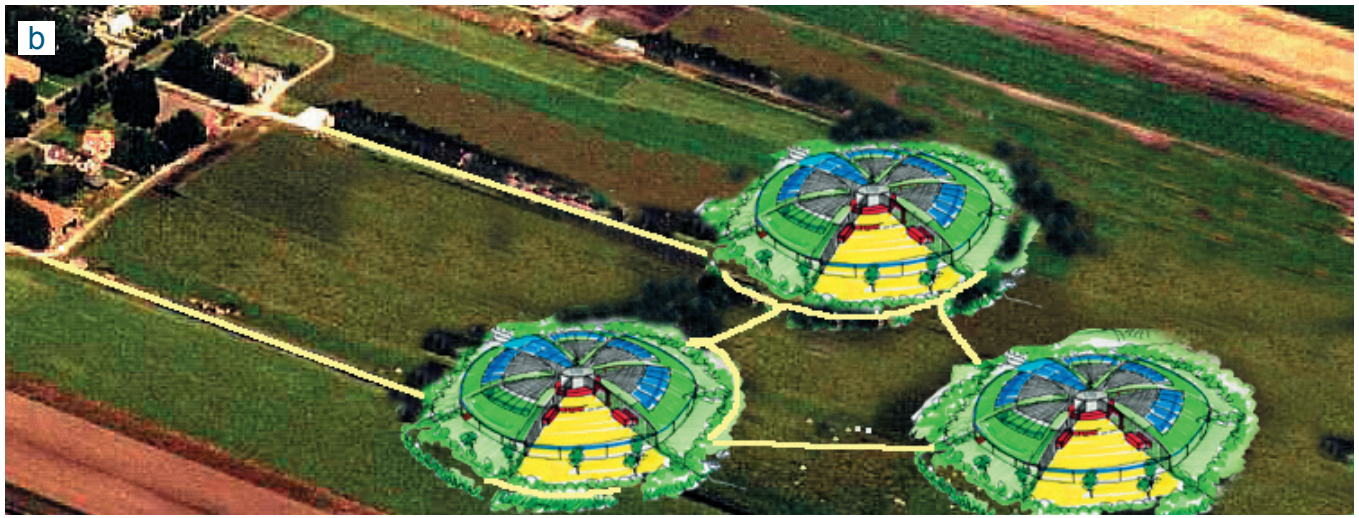
Agrotechnology parks are modern agriculture estates developed with the necessary infrastructure for farming. There are six agrotechnology parks in Singapore. These parks occupy a total land area of 1,465 ha and nearly 700 ha have been allocated to over 200 farms for the production of livestock, eggs, milk, aquarium and food fish, vegetables, fruits, orchids, ornamental and aquatic plants, as well as for the breeding of birds and dogs. Some 20% of the leafy vegetables produced are from hydroponics cultivation.

The modern farms in the agrotechnology parks develop, adapt and showcase advanced technologies and techniques for intensive farming systems, and for the export of high value and quality products and services to other tropical countries in the region.

Like the Shangai region, the Agro-Food and Veterinary Authority of Singapore is looking for oversees investors.

3.3.3 In a nutshell

- The examples do not meet the criterion of industrial ecology as required according to the definition of De Wilt et al. (2000). They are 'ordinary' industrial estates in which co-siting can make extra profits in sharing park management, knowledge exchange and common marketing and logistics;
- Governments are the motor behind the development of these agribusiness complexes in Asia to ensure food security;
- Focus in on the 'people' aspect of sustainability;
- Complexes are located close to densely populated areas;
- The complexes intend to combine local and oversees investors; profit aspect is not yet secured.



Mega-dairy farms

Buriram, the Gor Gai Co Ltd farm

3.4 Phasing out trade-distorting subsidies

The fourth challenge, that of preparing for the phasing out of trade-distorting subsidies, was also expected to produce a response from agribusiness. However, we found no such response in the examples reported in our survey. The kind of response that could have been expected includes huge increases in scale and minimisation of production costs. In primary agriculture, this would mean minimising the costs of land and labour. Low land prices can be found in sparsely populated areas with little urbanisation pressure. Low labour costs are found in low-wage countries or regions with a large labour surplus. As regards dairy farming, for instance, one might expect huge farms in countries like Australia, New Zealand, Eastern Europe and the US. As regards agro-related companies, this means especially low labour costs and good logistic facilities. There have been many reports in the media about companies transferring parts of their operations to low-wage countries.

Because of the large scale of this type of enterprises, large amounts of wastes become available that can be used as input in other industries. So it is a useful leg up to ABC's based on the principle of industrial ecology. Current developments in the Netherlands include ideas for mega-dairy farms, keeping more than 1000 cows (Rienks et al, 2003). The advantage would be a more efficient use of capital goods: the milking parlour would be used 24 hours a day instead of 4 hours a day; a biogas plant would have enough manure to process, and components could be bought to mix concentrates. Focus is on 'profit' and 'planet' aspects of sustainability. The feasibility of such concepts is currently being studied.

3.5 Dealing with the risk of zoonoses

The fifth challenge, that of dealing with the risk of zoonoses, has become highly acute. Zoonoses may arise in densely populated areas with large numbers of livestock. Zoonoses is a collective name for diseases that can pass from animals to humans. Such diseases can be transferred by ectoparasites (such as lice or ticks), endoparasites (such as roundworms), bacteria (like salmonella) and viruses (like flu). The recurrent outbreaks of avian influenza in Southeast Asia in recent years have led to fears of a worldwide pandemic, and the region is now known as an 'influenza epicentre'. According to Rabobank International (2004), a possible response could be investments in high-level industrialised poultry complexes. These complexes should be located at large distances from urban and bird flu zones. In addition, it would be important to have short internal supply lines with the lowest level of external contact and the highest level of bio-security. An excellent system of tracking and tracing should enable the poultry in those regions to separate easily.

Just a few days after authorities in Thailand recognised the existence of avian flu, the deputy prime minister Somkid vowed that the government would take steps to 'turn the crisis into opportunity': the government provides loans to small farmers to replace open farms with industrial poultry houses and chicken raisers have to register every chicken. Compensation after the epidemic is restricted to farmers who have adopted the closed farm system.

At Buriram (Thailand), the Gor Gai Co Ltd farm is raising more than 100,000 chickens in eight modern air cooled and humidified farms. The owner is Danish. Waste and other by-products from the chicken farm are recycled or sold. The chicken manure is collected and packed in sacks and sold as fertiliser. Dead chickens are recycled: the feathers are removed and the chickens are chopped up and fed to the fish.

4 General debate

Our survey delivered some 70 examples of so-called ABC's (according to the respondents) on all inhabited continents, in a range of variants. Of about 40 of them, no information but a name or a place is mentioned. Part of the remaining examples not at all comply with the definition of ABC's of De Wilt et al. (2000) mentioned in the questionnaire. However they are considered in this debate. Some aspects might be relevant for 'real' ABC's and vice versa.

Most examples of so-called ABC's in this survey occur in Southeast Asia and Europe (map 1), and particularly in and near metropolitan regions. These are traditionally the areas where the process of intensifying agriculture is furthest advanced.

The hypothesis is set that it is precisely the metropolitan environment that offers a range of conditions to make ABCs the 21st century version of urban agriculture. What seems particularly important here is the combination of such factors, which tend to co-occur and be highly interrelated in metropolitan areas:

- a high level of knowledge among farmers and entrepreneurs in the agro-chains and agrotechnologic industry;
- a highly developed infrastructure, logistics and chain management;
- direct outlets to and contact with mass markets with a high diversity of consumer demands;
- the availability of cheap labour;
- large supplies of residual products and by-products;
- opportunities to link mono functional chains to a multifunctional network.

This hypothesis should be tested in a follow-up study.

The examples discussed in the paragraphs 3.1 and 3.2 involve medium and large scale enterprises applying the principles of industrial ecology. In terms of the three aspects of sustainable development (people, planet and profit), this means that ABCs have an important focus on the planet aspect. The enterprises are stimulated to do so not only by requirements imposed by governments, but also by their own believe that the application of industrial ecology principles can mean considerable cost savings (i.e. the profit aspect). However financial figures are limited to comments as e.g. lower costs due to 'free' heat and carbon dioxide or transport reductions costs. In addition, other challenges can also stimulate the creation of ABCs. The Chinese example of WAZ-Holland Park shows that a large-scale agro-park concept can also be combined with people's need for images, stories and information about food production (the people factor).

Particularly the examples discussed in paragraph 3.2 are restricted to agro related activities and so do not meet the criterion of purposive clustering of agro and non-agro related activities. It can be asked what this knowledge implies for further development of the concept of ABC's and for the further development of the farms themselves. Are these farms not sustainable in terms of planet or profit or people and should they enlarge with non-agro related activities? Is the presence of non-agro related activities of crucial importance for the development of ABC's in practice? According to De Wilt et al. (2000) combination of agro and non-agro activities enlarges the opportunities of closing nutrient cycles. Spatial clustering of activities additionally offers transport cost savings and transport time savings what is crucial for animal welfare.

The examples discussed in paragraphs 3.3 and 3.4 involve large-scale enterprises. They comply with the criterion of clustering, one of the examples also with the criterion of agro and non-agro related activities but none of them with the criterion of industrial ecology. These enterprises can look for opportunities to incorporate the principle of industrial ecology. What wastes or by-products are produced in one enterprise and can be used as raw material in the neighbouring enterprise? Between countries, the examples differ in scale. It is not clear from the information in the survey whether these differences are due to unique circumstances in the various countries (e.g. whether or not limited space, public aversion, large market) or whether the economic size (i.e. size at which the enterprise is profitable from the economic point of view) is just not taken into account yet. Little evidence is available at this moment because most of the examples are currently subject to feasibility studies or starting up.

In Europe, characterised in these days by demand-driven product development and diminishing government influence, industry has a decisive role to play in the implementation process, leading from design to application. At the same time, however, most enterprises in the primary sector are too small and lack the necessary capital to invest in innovative experiments rather than in incremental improvements. While the chain also includes larger enterprises, these tend to be highly apprehensive about possible damage to their image, at least in the Netherlands (Daalder & Koopman, 2004). Although the national government now intends to start applying the principles of spatial development policies (Ministries of VROM, LNV, VenW and EZ, 2004), the experience gained with the Dutch experiments shows that governments at various levels can seriously impede new developments. Illustrative in this respect, in order to circumvent restricting legislation at various levels, is the experiment of the 'status aparte' for the New Mixed Company in 'Horst aan de Maas', obtained from the Minister of Agriculture. On the other hand, the active involvement of various provincial and local authorities in regions where specific initiatives are being implemented is encouraging. Examples include the Amsterdam port authority developing the concept of Amsterdam Agrocenter and the province of Limburg co-operating with the local authorities of Horst aan de Maas in their support for the New Mixed Company.

In Southeast Asia, the governments often play a decisive role in the implementation of large scale ABCs but still the lack of local and oversees investors is restricting further development (websites of Shanghai modern agricultural parks and Agrotechnology Park Singapore). It might be worthwhile to exchange experiences between the different continents in order to adopt local solutions to improve the developments elsewhere.

This preliminary survey is far from exhaustive. This is primarily caused by the limited group of informants and the limited set of questions we asked them. In the on-going information gathering via www.agrocomplex.nl, we will be able to ask far more explicit questions to a much larger group of informants, and we will also be able to ask not only for existing examples, but also for information about plans being developed and designs, as well as failed experiments. But most important, we can ask about the context within which the ABC's develop(ped).

Governments, the business world and researchers can learn from these cases, as their synergetic interaction is an important driving force for further development and innovation. To this end, first the website needs to be actively managed, and the information exchange on the site needs to be interactive. Second, governments, business world and researchers should meet and work out a most appropriate way of interacting on a regular basis. In the Netherlands, some experience is available from the Agrologistics Community of Practice in which the project leaders of several Agropark initiatives meet with government and knowledge workers and discuss their experiences. When visiting the ADM agropark in March 2005, members of this Agrologistics community and the ADM agropark management both expressed their ambition to co-operate in a similar international community.

5 How to proceed

Trends in agribusiness are visible worldwide, demonstrated by a number of well-advanced ABCs in the database. From the general debate however, a number of questions remain unsolved. Most prominent is how to organise the 'flywheel' effect, i.e. the learning from the interaction between governments, business world and researchers form various regions in order to accelerate the developments of ABCs or ABC-look-alikes and to initiate innovations. It has been given a start by the development of a website, as well as visits that have been paid to a number of ABC's by Dutch government and researchers. However, communication about the findings has been restricted to bilaterals, if at all it happened. If it is agreed that communication is crucial, how should it be organised? At least the ADM agropark management as well as the Agrologistic Community expressed their ambition to co-operate in an international community.

If a construction is founded in which the flywheel-effect can originate, other questions can be answered. The reliability of the hypothesis - the metropolitan environment offers the conditions for development of ABC's - can be tested, the concept of ABCs can be further discussed and developed, attention can be enlarged from planet aspects to the integration of planet, profit and people aspects in the development of ABC's and innovations can be developed for relevant sectors.

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Resources

Various websites:
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http://www.agro.nl/innovatienetwerk/
http://en.shac.gov.cn/ (Shanghai modern agricultural parks)
http://www.ccre.com.cn/ (Hangzhou Dengta Livestock Farm)
http://www.symbiosis.dk/ (Kalundborg Industrial Symbiosis)
http://www.admworld.com/ (Archer Daniels Midland Company)
http://www.ava.gov.sg/ (Agrotechnology Park Singapore)
http://www.ohlthaverlist.com/ (Zero Emission Tunweni Brewery)
http://www.corex.net/visitors/tunweni.html (Zero Emission Tunweni Brewery)

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6	http://www.symbiosis.dk/
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10bottom	Marco van Steekelenburg
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