Introduction

Radical changes in agricultural production and consumption are taking place at different levels of scale. At global level a growing shortage of food, biofuels and raw materials is leading to an ever-expanding agricultural area, often at the expense of natural forest. We are also seeing increasing protectionism and the safeguarding of production capacity, for example by land purchases in other parts of the world, also known as “resource colonialism”.

At European level the end of over fifty years of the Common Agricultural Policy (CAP) is in sight. Where originally the CAP was aimed at increasing agricultural production and improving farmers’ incomes, greater emphasis has been placed over the last decade on other functions of the countryside, such as landscape development, nature conservation and community development. The volume of production and level of efficiency have therefore become less important.

These developments are even more sharply present at the national level of the Netherlands. Urban expansion and construction sites for industries, infrastructure and recreational facilities are reducing the agricultural area. The ambition of realizing a national ecological network is also setting limits on agriculture. In addition, socio-cultural pressure is making new
TransForum developed the vision known as "Metropolitan agriculture". The vision indicates that all forms of agriculture – new and in the future – will have to take into account the limitations imposed by the metropolitan area – while also taking advantage of the opportunities that the metropolitan environment offers agriculture. By placing the connection between the urban environment and agriculture centre-stage and otherwise leaving open how this is best accomplished, metropolitan agriculture provides an incentive to explore new ways, without pronouncing judgement on the outcomes in advance. In this way, the discussion moves from one about the pros and cons of a particular form of agriculture to the opportunities for the further integration of all forms of agriculture in the metropolitan area.

In the various TransForum projects, fresh answers have been given to a number of social issues so that there remains room for both agriculture and nature conservation at local, regional and global level. At the lower levels of scale this has been done by outlining an action perspective for those involved, with the local provision of space for agriculture and nature. At the higher levels of scale comparable circumstances have been mapped globally so that the local perspective can also be applied elsewhere. By distinguishing between the level of action – the grain – and the context in which this operation takes place – the frame – an insight has been provided into the various possible action perspectives to promote sustainability and the application of those perspectives in other parts of the world.

"The grain" – the realm of the agricultural entrepreneur

Metropolitan agriculture is the vision that emerges by looking at the characteristics and similarities of the projects conducted by TransForum. In all the projects the drivers of innovation and development are growing urban pressures and strongly developing urban demand. This vision can serve as a guide for further sustainability in Dutch agriculture. By focusing on new connections between the urban environment and agriculture, the displacement of nature by agriculture and agriculture by urban pressures can be overcome.

Metropolitan agriculture makes clear that we should not become alienated from agriculture by displacing it to, for example, areas where socio-cultural aspects feature less prominently. Particularly in the areas around large cities there is a potential and a need to deal efficiently with resources and at the same time to utilise space effectively. By doing more with less in this way, space for nature can be generated in the naturally fertile places. This new form of development means that we actively seek a new configuration for the future metropolis. This is not just a question of either/or but of both at the same time. So it is not a total transformation of both at the same time. So it is not a total transformation of agriculture and its products in the on-going transition from continuing displacement towards a combination of multiple functions at multiple levels of scale.

It is at the level of the grain – the level of the individual entrepreneur in the green space – that we are able to gain insight into the possible action perspectives. In this way the farmer or horticulturalist obtains the opportunity to provide an appropriate answer to the questions, challenges and constraints emanating from the urban environment. If lastling opportunities are created for the farmer in the green space around the city, a halt is called to the aforementioned displacement of agriculture and nature. The evolving relationship between the agricultural entrepreneur and city dwellers is described in Chapter 2.

"The frame" – the realm of the big challenges

The larger surrounding environment in which the farmer must operate dictates both the preconditions and the (market) opportunities for entrepreneurs. This frame thus determines the set of possible action perspectives available to the entrepreneur. Part of this perspective is to link local opportunities and constraints to the wider sustainability issues such as the global shortage of space and resources. A better understanding of local perspectives can also help provide answers to challenges in other (urban) parts of the world. By providing insight into global land-use and especially areas of concentration of population, agriculture and nature, the frame becomes visible. This analysis is described in Chapter 3.
Chapter 4 describes the Dutch situation with the new conceptual framework based on Chapter 3. This creates a picture of comparable regions in the world where the vision of metropolitan agriculture might also be applied. In this way we provide an initial impression of the potential global impact. Metropolises, agriculture and nature exist by the grace of water, flat land and a moderate climate. These are the deltas worldwide. In the Dutch delta there is a “multipolar” structure of urbanisation, i.e. an urban area that is evolving from a number of different centres. This specific structure has given rise to high-intensity but small-scale forms of agriculture such as glass horticulture and intensive livestock farming. Urban growth is now so rapid in many cities around the world that both natural areas and agriculture within those metropolitan areas are at risk of disappearing. A comparison with the Dutch metropolitan region shows that there are also opportunities for the development of high-intensity agriculture on a small urban scale. This type of insight gained from the perspective of metropolitan agriculture can contribute to the more robust development of both regional and global food security.

By switching between the various spatial scales we also obtain a better understanding of the seemingly autonomous process of the displacement of agriculture and nature. In the former agricultural society and subsequent industrial society, distinct circles of agricultural activities surrounded settlements and/or cities. With the growth of globalisation and the shrinking importance of distance – even in an economic sense – mega-cities have evolved that have a very different relationship with the surrounding area. In the present analysis, we seek to provide a view of the resulting complex relationship between urban areas and agricultural production in, around and for the city. We do this by not only paying attention to physical and spatial boundaries but also seeking new connections and relationships between the metropolitan areas and the linked agriculture. This is described in the last chapter.
Physical and spatial displacement

The “displacement sequence” may be observed at various levels of scale. This spatial process has been described by Dirk Sijmons, Professor of Landscape Architecture at Delft University of Technology. Sijmons illustrates the phenomenon on the basis of delta areas, such as that in the Netherlands. Initially, the deltas of the world were dominated by a highly diverse and rich nature. This fertile soil was, however, also suitable for agricultural purposes, so that the natural countryside was displaced in many places by fields and meadows. In our own age we can see that agriculture is being increasingly pressured by urban sprawl. Partly this is because agricultural land is being converted into residential areas and industrial estates, and partly it is also because people from the city often can pay more for housing in the countryside and villages around the

Possibilities of Metropolitan agriculture: the grain

A further analysis of the relationship between city and countryside at local or regional level provides insight into the possibilities of Metropolitan agriculture in any one particular area. By looking at that relationship in three different ways, something of the evolving complexity is brought to light. We do this by successively describing the physical and spatial displacement relationship, the commercial relationship and the social services relationship.
cities. This increases the cost of land and means that farmers struggle to keep up with international competition. Building cities. This increases the cost of land and means that farmers in the vicinity of cities often experience a struggle to keep up with international competition. Building cities. This increases the cost of land and means that farmers in the vicinity of cities often experience a discrepancy between “local value” and “commercial value” on account of the high developmental value of the land on the one hand and the planning controls for agricultural purposes on the other. Many farmers have trouble overcoming this discrepancy, and go out of business or move away to where land is cheaper. The abandoned land and homes will generally become re-designated for non-agricultural purposes.

An additional effect is that the migration of city-dwellers to the countryside sometimes entails “city” requirements, such as a low tolerance of odour and noise. The opposition to the construction of “mega farms” on the North Brabant countryside is an example. Because the provincial government sets a limit on the number of animals that may be kept, many farmers will be forced to get out of farming or to move to areas where the socio-cultural impact of the city with city standards of animal welfare is less marked. These developments in turn lead to the displacement of rural areas elsewhere in the world by agriculture. Further urbanisation however increasingly drives up the price of land in an area within a radius of up to several hundreds kilometres from the city. Within that radius city-dwellers remain able to drive up and down within a single weekend. The rule within that area is: the closer to the city, the higher land prices will be. Due to the high price of land, farmers must intensify if they are still to earn a living. It is therefore not surprising that the most intensive forms of agriculture such as horticulture and intensive livestock farming are located quite close to and sometimes even in urban areas. Von Thünen described this phenomenon as long ago as the beginning of the 19th century. However, due to the enormous scale of present-day urbanisation, there is no longer a single urban core: instead, the urban area is developing out of many cores at the same time. More detail is provided in the next chapter on the frame.

Commercial relationship
Traditionally cities and the surrounding countryside are in a symbiotic relationship in which the “city”, by means of ports and trade, ensures the supply of raw materials such as fertilizer and animal feed and the countryside provides the food for the urban-dweller. The city itself then provides the market where the food is marketed and consumed. This cycle is well described by Carolyne Steel in her book The Hungry City. Further urbanisation however increasingly drives up the price of land in an area within a radius of up to several hundreds kilometres from the city. Within that radius city-dwellers remain able to drive up and down within a single weekend. The rule within that area is: the closer to the city, the higher land prices will be. Due to the high price of land, farmers must intensify if they are still to earn a living. It is therefore not surprising that the most intensive forms of agriculture such as horticulture and intensive livestock farming are located quite close to and sometimes even in urban areas. Von Thünen described this phenomenon as long ago as the beginning of the 19th century. However, due to the enormous scale of present-day urbanisation, there is no longer a single urban core: instead, the urban area is developing out of many cores at the same time. More detail is provided in the next chapter on the frame.

In the opposite direction to the flow of food to the city, there is a waste stream from city to countryside. In the past, this flow consisted mainly of human waste as a nutrient for crops (thereby closing the cycle) and of what we now call organic waste (fruit, vegetable and garden waste), which was used as cattle-feed. The manure-nutrient cycle has been broken for environmental and hygiene reasons, while the peel farmer has disappeared because of the risk of spreading contagious diseases among cattle by feeding cooked kitchen waste.

Today the flow consists mainly of food industry waste going to countryside, ranging from brewers’ grains and molasses to biscuits past their sell-by date. In the future, we may see a reverse movement, in which waste from agriculture may be used as feedstock for the chemical industry, for example in the production of bioplastics.

Social services relationship
On the one hand, rural dwellers are dependent on urban services such as shops, museums, theatres and schools. In addition, the agricultural sector is dependent on capital and knowledge – services that are also (mostly) supplied from the city. On the other hand, city dwellers in their turn depend on the services of rural areas such as water (dry feet for urban dwellers), as well as more intangible services such as hiking, biking, bird-watching and plant studies. The surrounding countryside provides the decor for our Dutch cities, as shown beautifully in the famous painting The Bull by Paulus Potter. The Dutch city landscape may be regarded as one of the main assets of the Netherlands.

The term “décor” in fact does too little justice to that function; for many city dwellers, the countryside acts as a romantic hideaway, where – if only in one’s imaginings – one can escape the urban hustle and bustle. In particular, the function as a refuge leads to a growing social services relationship, with demand being generated by the city. This translates itself into demands posed by the city with regard to acceptable farming practices and the landscape. This ranges from greater attention to animal welfare and pressure for organic farming methods to a ban on certain forms of agriculture, such as intensive livestock farming. The surrounding rural area becomes the garden of the city dweller, sometimes referred to as the “metropolitan park”.

The result of all these demands is that the existing agricultural entrepreneurs around the city find themselves back into a corner. In summary Significant developments are taking place in respect of all three relationships. The displacement of nature by agriculture in the Netherlands appears to be stabilising, but at global level the process continues unabated. As a result of the development of major ports and huge logistic flows, economic relationships...
have become global. Resources come and go from anywhere to everywhere; a direct relationship between town and country is no longer obvious. At a social level, however, there has been a turnaround. These relationships are and will remain more local and can therefore impose a heavy burden on the way in which farmers are expected to farm. In some cases, this pressure can be converted into a new form of agricultural activity that adds value by providing an agriculturally produced response to urban demand.

Action perspectives
The concept of metropolitan agriculture is based around new connections between urban and agricultural areas. In the metropolitan area in the Netherlands, agricultural areas are coming under great pressure from both an economic viewpoint (via the price of land) and a social services viewpoint (through recreation and animal welfare). In response to this pressure, new forms of agriculture are emerging alongside intensive, commercially driven agriculture. Agriculture needs to be made more sustainable by providing an agriculturally produced response to urban demand.

1) Sustainable intensification: This involves the organisation of food production through intensification and clustering with other sectors, under which not just profit but also planet goals are pursued, such as closed-loop farming, and ultimately also people goals, such as landscape improvement and achieving a sufficient volume of production. The New Mixed Farm initiative near the city of Venlo, where the same level of production is achieved with much less use of energy and other inputs, is an example of this action perspective.

2) Sustainable valorisation: This involves broadening out, with the focus on existing markets that serve the economic needs of the city, and which is therefore economically viable, so that not just planet or people goals but also profit goals are served. This approach is for example already widely applied in organic farming. Using other methods of cultivation, marketing or logistics concepts, a link is created to a growing demand from the city. The eggs from the Rondeel henhouse, which has been awarded three stars by the Dutch Animal Protection Foundation, are an example of this strategy.

3) Sustainable diversification: This involves broadening out, with the focus on existing markets that meet the sociocultural needs of the city and are therefore commercially viable, so that not just people or planet goals but also profit goals are served. The 150 or so farmers who joined in the Landzijde foundation offering professional care arrangements in the vicinity of Amsterdam are an example of this action perspective.

Figure 1
The application of these action perspectives opens up new prospects for the existing forms of agriculture in the metropolitan area. By adding new values instead of displacing existing (nature and landscape) agricultural activities will generate new meaning within the metropolitan context. In this way a further offload to local or even global level is prevented. There not only remains room for intensive and productive forms of agriculture, but also the historic “Dutch urban landscape” can be preserved. The discrepancy between the “local value” and “enterprise value” can be bridged by means of these three value-added perspectives. Entrepreneurs will then need to focus together with other stakeholders on connecting up different values rather than displacing them. By also taking into account the context or frame in which this will need to take place, it will also become clearer where the opportunities lie.
Possibilities for Metropolitan agriculture: the frame

Understanding whether, how and where metropolitan agriculture can help develop the connection between city and countryside requires an analysis of spatial developments at different levels of scale. The urban landscape may be defined at various levels (e.g. city, metropolis, metropolitan region). If we have an insight into the scales at which and hence the parameters within which specific developments take place, it becomes possible to identify the effects of different forms of metropolitan agriculture: not just at the level of the individual agricultural entrepreneur (the grain), but also at the level of the frame itself.
Levels of Scale

We distinguish five different levels of scale to clarify the determinant relations between cities and agriculture. Different aspects come into play at each of these levels. The lower levels of scale are concerned with the direct relationship between town and countryside, between farmer and urban dweller. At higher levels, multiple cities make up agglomerations and the latter form metropolitan areas or a metropolis. And apart from the influence exerted by a metropolis, continental and global factors play an important role.

The Composition Analysis illustrated in Table 1 is based around intervals of 3, 10, 30 and 100 km in radius. Each spatial scale can be subdivided into ten components at the next lower level of scale (see Table 1). Within these scales we may examine the distribution of population, and hence the spatial or metropolitan pressure at that scale.

In numbers this means that a circular area with a radius of 300 kilometres (i.e. an area of 300,000 square kilometres) has ten components at the next lower level of scale, each with a radius of 100 kilometres (i.e. an area 30,000 square kilometres). In turn, these ten components or circles consist of ten components or circles with a radius of 30 kilometres and an area of 3,000 square kilometres.

Based on the theory of Composition Analysis we have prepared an urban legend on five different levels of scale, related to the population:

1) **City.** An archetypal city in the Composition Analysis has a radius of 3 km and at least 100,000 inhabitants. A typical example is the Dutch town of Zoetermeer.

2) **Agglomeration.** A level of scale higher (we zoom out) we find the agglomeration, an area with a radius of 10 km and a population of at least one million people. Translated to the Dutch situation we are talking about agglomerations such as Greater Amsterdam, Rotterdam Rijnmond and The Hague Haaglanden.

3) **Metropolis.** Another level higher we have the metropolis, an urban area with a radius of 30 kilometres and a population of at least 10 million. Examples include London and Paris. The Netherlands has no metropolis. The Randstad is a metropolitan agglomeration, having a maximum population of only three million within a 30-kilometre radius. The Flemish Diamond and the metropolitan area of Brussels, Antwerp, Ghent and Leuven are similar metropolitan agglomerations.

4) **Region.** A level higher again we arrive at an area with a radius of 100 kilometres and a population of at least ten million people. This is not a continuous urban area; there are also intervening agricultural and natural areas, but the city does have an influence. The delta of the great rivers like the Rhine and Meuse, which formed the Netherlands, is an example of such a region.

5) **SuperRegion.** One level higher we have an area with a radius of 300 kilometres: the SuperRegion. Netherlands is part of the ABC Rhineland-SuperRegion, an area that includes the agglomerations of Amsterdam, Brussels and Cologne and everything in between. At this level, rural areas are clearly distinguishable, but within a metropolitan context and subject to metropolitan influence.

These subdivisions should not be regarded as precisely defined areas but as a general tool for analysing spatial developments. In this analysis we therefore distinguish
between the frame and the grain, something known in cartography as generalisation. The framework is the lens through which we look and the grains are the building blocks from which the image is constructed.

As maps become smaller scale – from street maps to a globe – more details are omitted and eventually an entire neighbourhood or a city becomes a detail. That does not mean that those details are unimportant. The port of Rotterdam “grain”, for example, is the most important gateway for the ABC-Rhineland SuperRegion. Interventions at grain level have implications for the entire context of the SuperRegion. And on the other hand the frame literally gives meaning and creates possibilities for its building blocks.

**Spatial frameworks**

Both agricultural production and the aforementioned metropolitan levels of scale become meaningful only if we place them within a spatial context. Specifically we may take the global and the European context. At each of these two spatial scales there is a meaningful integration of both agricultural production and urban development. For example: at a global scale, agricultural production faces the challenge of doubling food production to feed the growing and increasingly concentrated world population while at the same time halving the required inputs.

The global spatial frame: doing more with less

Worldwide the demand for land has increased considerably. This is partly motivated by sharp increase in grain prices in the year 2008. Countries with rapidly growing population and an even faster growing prosperity were trying to purchase land elsewhere to avoid an impending shortage of domestic food and agricultural commodities.

If current trends continue - such as rising meat consumption and growing demand for biofuels - then the continuing population and prosperity growth will inevitably lead to an expansion of agricultural land use with approximately 10 million square kilometers. Of the 45 million square kilometers of fertile earth’s surface half is cultivated, the other half is covered with forest, wetlands and other nature areas. The required expansion will therefore mainly take place at the expense of what currently is still nature or wilderness. If we want to avoid the loss of nature and the eco-services they provide to us, it will be necessary to find opportunities for productivity increases in agriculture. One way forward may be the use of resources in metropolitan areas that until now have been overlooked, such as residues and waste heats.

The European context: competing claims

The impending scarcity of food and agricultural commodities compels the Netherlands and Europe to another agricultural policy. After a period of several decades in which the European common agricultural policy was mainly focused on achieving food security, we now see a shift to a rural policy, with farmers not only being rewarded for their products, but also for the services they provide to the urban dwellers with (peasant) nature, landscape, water, recreation and care.

Thus, more diverse functions are added to rural areas. In addition, farmland is still disappearing due to urbanisation and infrastructural land use. Taken together, in Europe there is an ever-increasing struggle between different claims on different forms of land use, but also between different forms of agriculture itself. To reconcile those ‘competing claims’, next to regular spatial policy and planning at different levels there is a clear need for action perspectives that connect seemingly opposing values such as profitability, landscape and nature conservation. By using these action perspectives we can achieve an optimal land use and agricultural production in Europe without further repression or offload to elsewhere.

Jumping the scales: the SuperRegion connects the global with the local

The “lens” of the SuperRegion connects up different levels of scale. Worldwide SuperRegions (with a radius of 300 km) were analysed and characterised within the global and European spatial contexts. The choice of the SuperRegion was dictated as the different levels of scale are connected through this “lens”. For instance, within an urban SuperRegion the price of land is forced up through the displacement by urban functions. The majority of transport movements between city and countryside also occur within an area of this size. The distances are just small enough to be efficient for the transportation of agricultural products to the city. The lorries delivering flowers to markets deep inside Germany every day provide a Dutch example.

Another reason for choosing the SuperRegion level is that an analysis on this scale will cover all kinds of agriculture, ranging from allotment gardens in the city to mega farms in the countryside and from intensive horticulture and animal husbandry to extensive organic farming and nature management with nursing cows.

A final consideration is that by choosing such a large scale we can establish a relationship more easily between the global system and developments at national, regional and even local level. Moreover, on this large scale peripheral agricultural areas like the Midwest of the United States and the Argentine pampas also come into the picture.
Figure 2: Global distribution of 180 SuperRegions. The Metropolitan Agriculture SuperRegions (red dotted circles) represent areas with more than 50 million residents and more than 50% of land area under cultivation.

Metropolitan SuperRegions
Agriculture SuperRegions
Remaining SuperRegions

Metropolitan agriculture: space for the future

<table>
<thead>
<tr>
<th>SuperRegion Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metropolitan Agriculture SuperRegions</td>
<td>8,7%</td>
</tr>
<tr>
<td>Metropolitan SuperRegions</td>
<td>8,7%</td>
</tr>
<tr>
<td>Agriculture SuperRegions</td>
<td>8,7%</td>
</tr>
<tr>
<td>Remaining SuperRegions</td>
<td>8,7%</td>
</tr>
</tbody>
</table>

1. Dryland Cropland and Pasture: 7,4%
2. Irrigated Cropland and Pasture: 3,2%
3. Cropland/Grassland Mosaic: 3,2%
4. Cropland/Woodland Mosaic: 6,3%
5. Grassland: 7,5%
6. Shrubland: 10,9%
7. Mixed Shrubland/Grassland: 0,9%
8. Mixed Broadleaf Forest: 1,9%
9. Evergreen Broadleaf Forest: 0,9%
10. Mixed Forest: 4,3%
11. Herbaceous Wetlands: 0,2%
12. Wooded Wetlands: 0,7%
13. Water: 11,4%
14. barren or sparsely vegetated: 11,6%
15. Evergreen Needleleaf Forest: 4,1%
16. Snow or Ice: 27,6%
17. Herbaceous Tundra: 0,0%
18. Mixed Tundra: 1,7%
19. Wooded Tundra: 3,5%
20. Barren or sparsely Vegetated: 11,6%
21. Snow or Ice: 27,6%

Metropolitan agriculture: space for the future
Leaving aside the SuperRegions with fewer than one million inhabitants and areas with less than twenty percent of cultivated land, there remain around 180 SuperRegions worldwide. These 180 super-regions (see Figure 2) house almost all the seven billion people in the world. Together they cover more than one third of the total land area. Although the 45 million km² of fertile land worldwide is also about one third of the total world land area of 130 million km², this does not entirely coincide with the total area of the 180 SuperRegions. Some agricultural areas, like the very sparsely populated areas with extensive livestock production, have been excluded. Conversely, the SuperRegions also include natural countryside and open water.

We have divided the approximately 180 SuperRegions along two axes. The vertical axis shows the number of inhabitants, thereby drawing a distinction between metropolitan and non-metropolitan SuperRegions. The horizontal axis shows the percentage area under cultivation. This distinguishes the agricultural from the non-agricultural SuperRegions. This system of classification results in four main types of SuperRegions (see Figure 3):

- **Metropolitan SuperRegions (Quadrant I):** 35 SuperRegions with more than 30 million inhabitants, including outliers with more than 120 million, like Java. The area under cultivation is limited to less than 50 percent of the total area. Examples of these Metropolitan SuperRegions are Tokyo and New York City;
- **Metropolitan agriculture SuperRegions (Quadrant II):** 35 SuperRegions again with a population of at least 30 million. The difference from the first quadrant is that more than 50 percent of the area is cultivated. An example is the ABC-RhineLand (Amsterdam-Brussels-Cologne) SuperRegion, with 70 million people and at least 70 percent of the area under cultivation;
- **Agricultural SuperRegions (Quadrant III):** 35 SuperRegions with fewer than 30 million inhabitants and more than half the area under cultivation. An example is the Midwest of the United States with the Minneapolis-St. Paul urban agglomeration;
- **Remaining SuperRegions (Quadrant IV):** 75 SuperRegions with fewer than 30 million inhabitants and where less than half of the land is under cultivation.

Figure 3

SuperRegions positioned along two axes (total population and percentage of agricultural land use). The graph contains 20 of the 180 SuperRegions that have been defined. The numbers in brackets indicate the estimated total worldwide. SuperRegions printed in bold are part of the TransForum network of cities. SuperRegions in or with Delta areas are printed in orange. More information can be found on www.spatialplanning.com.

Scale-related sustainable development

Sustainable development is realized differently at different levels of scale. At the lower levels (up to the city or agglomeration) the concept of Cradle-to-Cradle (C2C) can be applied by giving real meaning to improving the efficiency of production processes and closing material and energy loops. C2C doctored that closing local loops will lead to a situation where waste does no longer occur. All materials will eventually be valued again and used to restart the cycle.

At the intermediate levels (the metropolis and the region) the concept of the ‘layer approach’ can be used to stimulate sustainable development. This approach involves a thorough consideration between substrate, network and occupation by posing questions: Where do we plan new urban extensions? Where does nature thrive best? What can what form of agriculture be logically situated? Also the impacts of possible climate change, including an increased risk of flooding, can be taken into account in the layer approach.

At the higher levels (SuperRegion, Continents and the earth as a whole) the factual Triple-P approach: people, planet, profit makes sense. Hence, this approach deals with making room for economic development (mining, industry and agriculture), for people (cities) and for nature and biodiversity. With the Triple-P approach we can analyze where these claims come into conflict and where they can reinforce each other.
The SuperRegions in Quadrant I number many residents but have relatively little land under cultivation. This means that these regions will be net importers of food, either from their own country (e.g. New York City) or from other countries (Japan). This does not mean that there is no agriculture in these SuperRegions (the metropolitan area between Tokyo and Kyoto, for example, has numerous green rice fields), but it does mean that spatial pressure due to urbanisation is very high.

Spatial pressure is also high in the SuperRegions of Quadrant II, which is characterised by a high population and high percentage of cultivated land (the metropolitan agriculture SuperRegion). To do justice to the various functions of rural areas and the associated forms of “multifunctional” agriculture, recreation and nature conservation, the available space must be handled with the utmost care.

The SuperRegions in Quadrant III have considerable room for intensive land-based agriculture, because they are sparsely populated. Such areas may be found in the United States and Argentina, where land area is not scarce. The endless fields of wheat in the Midwest of the US show that almost the entire SuperRegion is cultivated by intensive land-based agriculture. In general, the higher the scale level of specialisation, the more opportunities there are for economic optimisation through increases in scale and far-reaching mechanisation. But it also means that a kind of monoculture arises, in which other forms of agriculture or nature are displaced.

In Europe there is almost no specialisation at SuperRegion level, except perhaps for Russia and Ukraine. To some extent this is because the spatial pressure is greater, particularly in Western Europe; in part it is also due to the fact that the European Union exists by virtue of a treaty between independent member states. Precisely because of this independence, there has been a separate agricultural evolution in each of these countries. On balance, the Common Agricultural Policy has resulted in the fact that most of the land area (approximately two-thirds) within the European Union is cultivated. By comparison, in the United States of America only a fifth of the total land area is under cultivation. The advantage of a lower level of specialisation is that the areas with monoculture are much smaller and more fragmented, leaving more room for small-scale nature.

As noted above, one of the metropolitan agriculture SuperRegions, in which more than half the land area is cultivated, is the ABC-RhineLand SuperRegion (see Figure 4). If we zoom in a little further to the next level of scale (a radius of 100 kilometres), we can distinguish four metropolitan regions with more than ten million inhabitants: the Western Netherlands, Belgium, North Rhine-Westphalia and the Ruhrgebiet, with the remaining 13 SuperRegions are located in the interior of (mostly) China and India, but are dependent on one or more major rivers for irrigation, transportation and energy and the like. Deltas and large rivers are therefore an important factor in the potential for metropolitan agriculture.

As noted above, one of the metropolitan agriculture SuperRegions, in which more than half the land area is cultivated, is the ABC-RhineLand SuperRegion (see Figure 4). If we zoom in a little further to the next level of scale (a radius of 100 kilometres), we can distinguish four metropolitan regions with more than ten million inhabitants: the Western Netherlands, Belgium, North Rhine-Westphalia and the Ruhrgebiet. If we zoom in still further we may distinguish the Randstad urban metropolis (North and South Wing), the Flemish Diamond and the Ruhr: all areas with a radius of 30 kilometres and more than three million inhabitants. The Frankfurt agglomeration amounts at this level only to some 2.2 million inhabitants.

It is striking that these four metropolitan regions are interconnected via the rivers Rhine, Meuse and Scheldt (Frankfurt via the Rhine-Main-Danube Canal), with the Netherlands forming the delta of these rivers. The same pattern may be found in other SuperRegions. Of the 35 metropolitan agriculture SuperRegions (Quadrant II), 22 have one or more deltas with seaports. The remaining 13 SuperRegions are located in the interior of (mostly) China and India, but are dependent on one or more major rivers for irrigation, transportation and energy and the like. Deltas and large rivers are therefore an important factor in the potential for metropolitan agriculture.
Delta Metropolitan Regions

The delta regions with a radius of 100 kilometres generally take the form of multipolar urbanisation. This is because the original rivers were meandering and regularly shifted. This allowed multiple adjacent settlements to arise and flourish. In the Netherlands, for example, this pattern applies to Dordrecht, Rotterdam, Leiden and Amsterdam up to and including Zwolle (see Figure 5). In the absence of a delta with meandering rivers, more concentric metropolises such as Paris, Mexico City, Johannesburg and London tend to develop.

Another characteristic feature of delta regions is the abundant availability of water, together with periodic flooding. Apart from a rich natural landscape, the fertile soil is also conducive to agriculture, including dams and irrigation to provide large agricultural areas. Both the rivers and the sea offer opportunities for transportation. In combination with the high level of food production this means that a delta region exerts an influence right up to SuperRegion level.

The combination of fertile soil and a multipolar urban pattern has led to various forms of intensive agriculture. Depending on the local climate, subsoil and demand, grape-growing areas arose for example in the Westland region near The Hague, while bulb production evolved around Leiden. Initially, the farms were still largely mixed, with little intensive cultivation.

Gradually, however, the cultivated area of The Hague joined up with that of Rotterdam. There was no longer any possibility of increasing production by expanding the area under cultivation, so that individual farmers were forced to increase yields per acre. They could easily sell their products in the growing cities nearby. In addition, the city proved a source of knowledge, capital and labour, thereby making intensive forms of agriculture such as horticulture much more industrialised. In regions with a central city like Paris or London, there was no such necessity, as the more extensive forms of agriculture could easily take place at a greater distance from the city.

With the insights from this spatial analysis framework, and using the action perspectives from the TransForum projects, an image can be developed for a Netherlands of the future, with lasting spaces for agriculture, nature and the city.
The Netherlands does not have a monoculture of hundreds of square kilometres with an average grain yield of three to four tonnes per hectare, as found in the US Midwest. Instead, there are intensely cultivated fields in an area several tens of kilometres in size (the Flevopolders) that will produce ten tonnes of grain per hectare in one year and 40 tonnes of potatoes in another. Another example is the cultivation of tomatoes in glasshouses, where a yield of 10 to 50 times that found outdoors elsewhere in Europe is obtained. Intensive agriculture in one locality creates the opportunity of more extensive agriculture in other places and combining it with other functions such as the maintenance and/or restoration of the original landscape and opportunities for recreation by the urban dwellers (see box “Space Pump”). The conversion of agricultural land back to nature is also an option,

As noted, the Netherlands forms part of the ABC-Rhineland SuperRegion. Our country is characterised by a high degree of urbanisation and a relatively modest land area (thirty thousand square kilometres), of which about two-thirds is available for agriculture. The availability of a large market and a fairly consistently policy since the end of the 19th century based on the triad of Research, Information and Education plus the above mentioned spatial pressure has led to high yields per hectare.

Spatial configuration of the Netherlands and the ABC-Rhineland SuperRegion

As noted, the Netherlands forms part of the ABC-Rhineland SuperRegion. Our country is characterised by a high degree of urbanisation and a relatively modest land area (thirty thousand square kilometres), of which about two-thirds is available for agriculture. The availability of a large market and a fairly consistently policy since the end of the 19th century based on the triad of Research, Information and Education plus the above mentioned spatial pressure has led to high yields per hectare.

The Netherlands does not have a monoculture of hundreds of square kilometres with an average grain yield of three to four tonnes per hectare, as found in the US Midwest. Instead, there are intensely cultivated fields in an area several tens of kilometres in size (the Flevopolders) that will produce ten tonnes of grain per hectare in one year and 40 tonnes of potatoes in another. Another example is the cultivation of tomatoes in glasshouses, where a yield of 10 to 50 times that found outdoors elsewhere in Europe is obtained. Intensive agriculture in one locality creates the opportunity of more extensive agriculture in other places and combining it with other functions such as the maintenance and/or restoration of the original landscape and opportunities for recreation by the urban dwellers (see box “Space Pump”). The conversion of agricultural land back to nature is also an option,
Apart from intensification or sustainable improvement, value creation and renewal are also desirable in a metropolitan area. Due to the increasing urbanisation more and more people are becoming detached from the traditionally self-evident relationship with agriculture and are consequently losing sight of where their food comes from. By developing new forms of agriculture, for example explicitly emphasising food as an experience, the growing gap between urban and rural areas is closed. In addition to these educational objectives, the pursuit of agriculture in and around cities also provides opportunities for recreation, health care and other functions. In addition, we should not underestimate the importance of green spaces in and around the city when it comes to maintaining and improving a healthy environment, both physical and mental. Earlier on we noted that urban and rural areas mutually interact at a radius of up to 300 km. Within this SuperRegion we need to search for space for the whole range of metropolitan agriculture, taking into account the need for space for conservation and development, recreation and urbanisation.

For a spatial policy at SuperRegion level, in this case ABC-Rhineland, initiatives are already being taken here and there. In the Natura 2000 policy of the European Union, for example, we can see the contours of a European Ecological Network. This however involves only one form of land use, namely nature. Due to a lack of coordination at lower levels of scale, this is moreover a type of land use that can generate a great deal of friction with other forms of land use. A transformation of the existing agriculture in the delta region in the Netherlands based on the added-value strategies associated with metropolitan agriculture can set in motion a development that is not based on a plan or blueprint but on an intrinsic change. This can for example be achieved by developing livestock farming systems that, apart from the production of high quality products, also pursue the goals of health, welfare and the efficient use of resources. Or as the Landzijde foundation has done around Amsterdam in its Green Care project, linking up farming with professional care. This allows existing farmers to specialise in terms of their own domain (production, environmental management or sociocultural services), provided that the other two aspects are taken into account. This will stop the displacement of highly productive farms and increase the emphasis on the natural countryside and social and cultural values, such as the landscape, while also promoting entrepreneurship. The configuration created as a result can serve as an example for other urbanised delta regions in the world.

The ‘space pump’ is the mechanism by which land released by intensification of agricultural production in one location is used for nature and landscape conservation in another region. At local levels of scale, the space pump can help to counter the loss of biodiversity caused by agricultural practices. For example: if smallholders in developing countries can improve their livelihood by increasing their production per hectare, they are less tempted to clearing the neighbouring jungle or using marginal lands. In the Netherlands, sustainable intensification of agriculture also opens up opportunities for the future. By producing more efficiently in spatially concentrated areas, we can maintain the needed production volume without further impacts on the surrounding landscape and environment.

At higher levels (delta region, SuperRegion), the space pump can be used to optimise the structure of the rural area. Intensification and clustering in a limited area offers economic advantages. The concentrated greenhouse areas (Greenports) and intensive livestock farming regions in the Netherlands both demonstrate these advantages. But also ecological benefits can be attained, because concentrating activities in a limited area enables efficiently addressing emissions and re-using waste streams, or simply creating spatial opportunities for nature reserves at these levels of scale.
At global level we are dealing with pressure on agricultural production from the growing demand for food, biofuels and organic raw materials for construction and industry. The threat of protectionism in the form of export bans on rice, grain and other agricultural products means that Europe should at least not cut down on the volume of production, or in other words should maintain an adequate agricultural production system. At the same time, we find ourselves facing “competing claims” in the Netherlands and Europe (and not just there). The area used for agriculture cannot expand indefinitely and must actually shrink to accommodate a biodiversity of species and ecosystems as a provider of ecosystem services. That means space for nature conservation and the preservation of landscape variety. The ongoing urbanisation also requires space for residential areas, industrial sites and infrastructure.

The spatial aspects of metropolitan agriculture are extremely complex. The situation could best be compared to a jigsaw puzzle with thousands of pieces of which we hold only a small number. Even so, we feel that with these few pieces we may already outline the building blocks needed for the further development of a new, sustainable spatial configuration at different levels of scale. Moving between the levels with aid of concepts that can make a difference at the various levels of scale is of vital importance.

And now?

To meet these challenges, we need to look beyond the particular city or region. Indeed, in the case of the Netherlands, we even have to look beyond our borders to the SuperRegion level. The latter is an area with a radius of 300 kilometres containing one or more cities or metropolitan areas. In this case this is the ABC-Rhine Region SuperRegion, covering the Randstad, the Flemish Diamond, the Ruhr and the area around Frankfurt.

The vision of metropolitan agriculture developed by TransForum provides an action perspective for farmers in a SuperRegion. It also simultaneously serves as an analytical framework or instrument for linking the various levels of scale where agriculture and urban areas come into contact with each other. It covers not only the whole range of agricultural systems (intensive/extensive, small-scale/large-scale, specialised/multifunctional, professional/
hobby), but also the various relationships that exist between urban and rural areas, ranging from land use and goods flows to reciprocal services. As such, the vision of metropolitan agriculture turns out to be very useful for analysing and, to some extent managing, land use at different levels of scale.

At the level of the Superregion, we should not immediately set our sights on a “national agricultural network”, as land use at that level is simply too diversified. An agricultural “development policy” based on local and regional strengths would appear far more appropriate. At the local level of scale, the concept of metropolitan agriculture lends itself to the further refinement of land use. This may for example take the form of a search for an optimal configuration or even combination of the various types of agriculture, such as intensive agriculture, multifunctional (extensive) agriculture and organic farming in order to continue connecting agriculture up in all its facets to the urban dweller. This can be achieved by making use of the three value-added strategies, namely sustainable improvement, sustainable intensification, sustainable valorisation and sustainable diversification.

Besides strengthening the socio-cultural relationship, this local level of scale also lends itself to optimising the physical relationships between city and countryside and citizen and farmer, for example, by further optimising the cycle of food and waste: the closer to the city, the more profitable it becomes to close loops. At this level, the concept also lends itself to the creation of space for further urbanisation on the one hand and the promotion of natural countryside and conservation areas by the transformation of farmland on the other.

For a balanced development offering room for both urban growth and the whole range of agricultural production and nature, it is important that agricultural entrepreneurs exploit their opportunities. Additionally, politicians and administrators need in turn to develop a (spatial) vision for the particular area for which they are responsible. In concrete terms, this will lead to the development of coherent views at the level of cities, agglomerations, regions and even Superregions.

For example, developing a vision for the Randstad cannot be performed in isolation from developments at national, European and even global level (such as food production and biodiversity). That means that at the next higher level of scale, the Dutch government should have a vision concerning the spatial development of the Dutch Delta region. Similarly, at the scale above that, the governments of the Netherlands, Flanders, North Rhine-Westphalia and Hesse need to develop a (shared) vision for the spatial development of the ABC-Rhineland SuperRegion.

As noted, the concept of metropolitan agriculture can play an important role in the development of such visions. First of all, it offers a perspective on the various relationships between urban and rural areas at different levels of scale. Secondly, it forces the stakeholders (governments, businesses, societal organisations and knowledge institutes) to create an action perspective through a joint design process. By taking on this challenge, the SuperRegion ABC-Rhineland (embracing the Dutch Delta) can act as an example for the rest of the world.

This West European example can also help with the sustainable development of other places in our urbanising world, certainly when it comes to the 22 areas worldwide that are comparable up to the 310 km level of scale in terms of the existence of a delta region, the actual and potential agricultural area and population pressure. Here too a development is possible where land may be used for nature, agriculture and urban purposes in a balanced way. Obviously there are hundreds more metropolitan areas at the lower level of scale offering potential for the metropolitan agriculture concept, but in terms of the pressure on space these are not always comparable with the Dutch situation.
TRANSFORUM
Marco van Steekelenburg
E marco@spatialisme.com
Henk C. van Latesteijn
E info@valuemediation.nl

I www.transforum.nl