productive urban landscapes

urban agriculture in post-industrial cities

minke mulder & claire oude aarninkhof lar 80436 wageningen ur

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Abstract

This thesis report is a research by design into the implementation of urban agriculture in post-industrial cities. Urban agriculture can be seen as a tool to create productive urban landscapes, adapting cities to future changes, improving resilience and establishing a better living environment.
Because landscape should be seen as an inclusive term, embracing both nature, city and everything in between, a theoretical review was done to see how slow natural processes and fast urban processes influence one another. Additionally, contemporary issues (like climate change and food security) affect the development of urban regions and urge the need for a new interpretation. A solution would be the integration of (urban) agriculture into the urban fabric.
With analyses of city green and urban structures in Amsterdam, the potential for food production becomes apparent. To illustrate its possibilities, a former infrastructural barrier was designed into a productive urban landscape. Important is the combination with recreation and dwelling which does reduce the maximum production yield, but improves the overall fitness and quality of the living environment.
The research consists of theoretical as well as design-related and practical elements, because it is carried out as graduation thesis for Wageningen University and as study for dRO Amsterdam. This combination of research and design requires a cyclic process, in which various options are diverged and merged again to achieve a holistic outcome.

Keywords: landscape architecture, landscape, city, urban agriculture, productive urban landscapes, Amsterdam, resilience, sustainability

Table of contents

1 Introduction

Introduction

Environment includes everything: nature, culture and ourselves in an interconnected system. Landscape is that part of environment that is the human habitat, perceived and understood by us through the medium of our perceptions. We cannot escape it (Bell, 1999).
Consequently, dealing with landscape processes and their spatial manifestations is what we find intriguing. The inherent characteristics of both slow landscape processes and fast urban processes provide a dynamic interface. The processes, formerly conceptualized through different lenses – urban/rural, city/landscape – need to be considered as a space-time ecology; all forces and agents should be treated as continuous networks of inter-relationships (Corner, 2006). In order to deal with these processes, a holistic evolutionary and open-ended view is necessary (Koh, 1982).
The introduction of a 'rural' pre-industrial land use function like urban agriculture into the post-industrial city provides us with opportunities to research and visualize the merged urban- and landscape processes, with the aim to instigate further discussion and awareness.

The storyline of this report is told through combining imagery and text. Text and images are intertwined and not utterly independent. It consists of eight chapters, chapter one being the introduction. Chapter two deals with the methodology, including the subject of thesis, location and research outline. Next, a theoretical framework concerning landscape and its processes is discussed. Chapter four elaborates on the definition of urban agriculture and productive urban landscapes, precedents and the conditions of urban agriculture. Following, the potential for implementing urban agriculture in Amsterdam is investigated, leading to chapter seven which includes an illustrative design on a specific site. Finally, chapter eight contains a conclusive essay.

Methodology

2

2.1 Subject of thesis

This research will focus on implementing urban agriculture in the Amsterdam metropole. Urban agriculture involves the production of crops and animals within the city (Berg, 2001). Urban agriculture could be seen as an agent in creating productive urban landscapes. Integrating urban agriculture in the urban fabric can result in environmental, social and economic benefits: preserving biodiversity, tackling waste, cutting municipality's maintenance costs and reducing the amount of energy used to produce and distribute food (Viljoen, 2005; Dekking, 2007). One of the strengths of a productive urban landscape is its capacity to make a practical and highly visible difference to people's quality of life (Garnett, 1996).

Our thesis is as follows:

We suppose that urban agriculture can contribute in creating a more resilient city. Production systems increase the meaningful complexity of the urban fabric. Continuous productive urban landscapes could benefit from public involvement, contain recreational possibilities and enhance the city's visual quality and fitness.

2.2 Location

Urban agriculture is a widespread phenomenon in developing countries. It is a source of income for many people and guarantees a type of green structure in the highly dense cities. This research however focuses on Western post-industrial cities, where green structure is often abundant but also neglected. Adding a production aspect could make this green structure self-supportable, while mitigating impacts from (micro) climate change and possibly creating food awareness and providing highly demanded private production plots (allotments).
Considering size and density of a city, the chosen study area is the metropolitan region of Amsterdam. Amsterdam is characterised by green wedges entering the built environment. Historically the city used to have a direct relation with its hinterland, for example by vegetable production. This provides an interesting case to investigate in the contemporary city context.
The spatial planning department of the municipality of Amsterdam (dRO) is trying to develop a Food Strategy. The strategy includes the investigation of possibilities for urban agriculture, in order to encourage the interaction between food production and society. Our research could contribute to the development of this Food Strategy.

2.3 Research design

The research will focus on defining and implementing (production) potentials of space within a specific city context, by both optimizing the current green structure and looking for new productive spaces. The structure of the research has been based upon answering the next questions:

What is landscape?
A theoretical framework is built to redefine the definition of landscape towards an inclusive term. Furthermore it attempts to clarify the position of the natural and the 'man-made' system towards one-another and states the aim for a balanced landscape. Urban agriculture could be a tool for creating this.

Why is urban agriculture necessary?
Due to predicted climate change and its effects on the urban (micro)climate, the changing relationship between city and countryside, people's declining perception of natural processes and food awareness, and the problems related to food security, adding a productive element to the urban fabric could be indispensable.

What is urban agriculture?
Urban agriculture is defined as the production of crops (and animals) within the city, together with its role as an agent in creating a productive urban landscape. An investigation of precedents and urban agriculture conditions provides guidelines for implementation.

Where could it be located in Amsterdam?
In order to optimize the current green structure and look for new productive spaces, a top-down analysis of the green and a bottom-up analysis of the urban fabric lead to a map of potential locations for implementing urban agriculture in Amsterdam.

What could a productive urban landscape look like?
Principles for creating a productive urban landscape are defined and tested by designing a specific site, the A9 zone between Bijlmer and Gaasperdam. This design has a illustrative character, with the aim to visualize possibilities and instigate discussion.

Within this thesis report, design is used as a tool and as a goal for both visualisation and problem solving. Research by design is characterised by generating knowledge and understanding by studying the effects of actively and systematically varying of both design solutions and their context (Jong, 2002). The design process consists of a number of basic intellectual activities: analysis, synthesis, prediction, evaluation and decision (Lang, 1987). The research design might look like a linear process, yet the interaction between the phases and feedback is evident. A research by design contains a considerable amount of backtracking, when more information is needed or when the designer cannot solve a set of design requirements simultaneously (Lang, 1987). The research contains overlapping phases, influencing and improving each other, by knowledge and experiences that were gained during the process.[fig. 1]. The dynamic character of the process has enhanced our aim for a holistic project, and contributes to discussion.

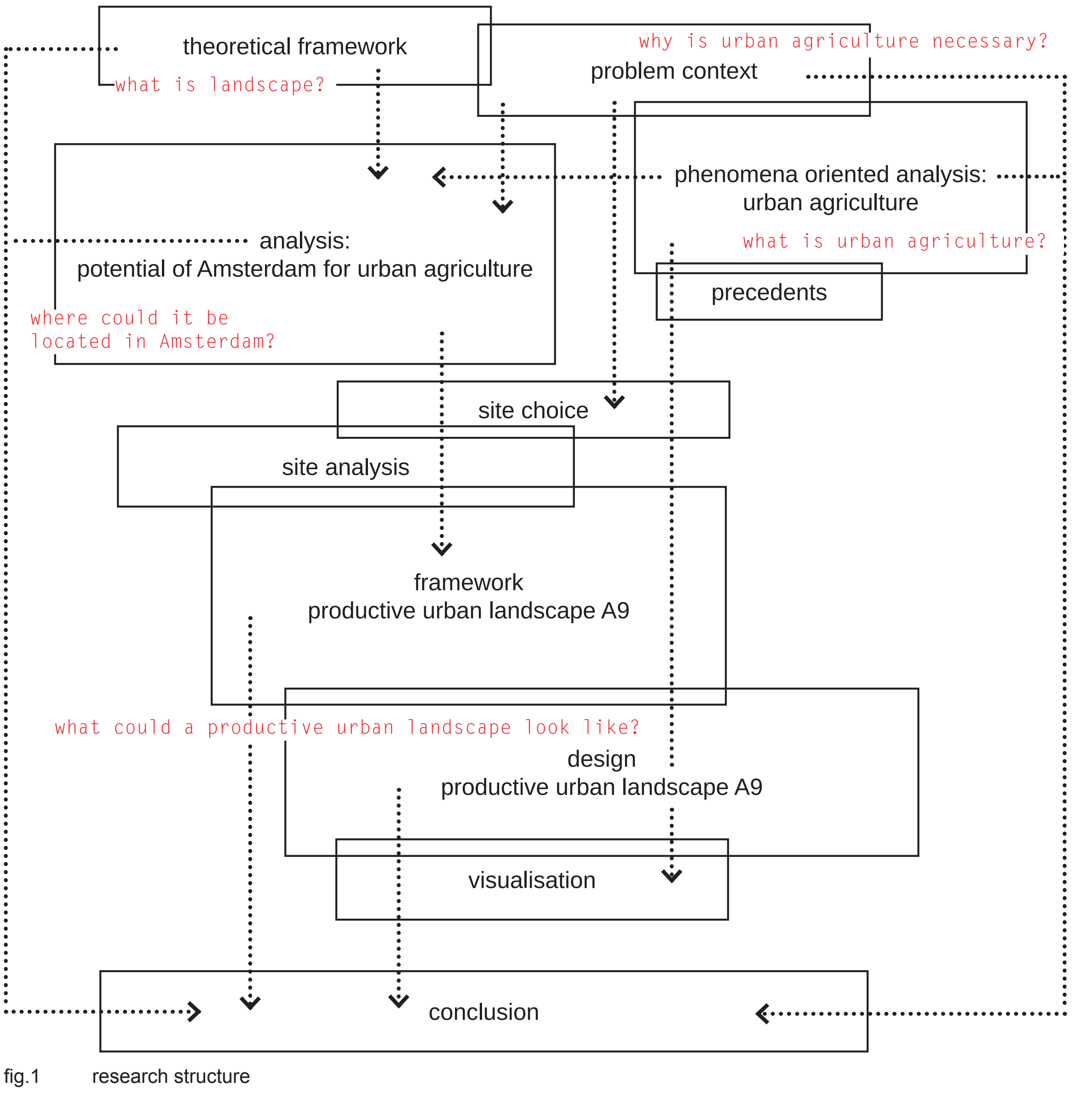


fig.1 research structure

Tutoring

First supervisor:
Dr. Ir. I. (Ingrid) Duchhart (Chair group Landscape Architecture Wageningen UR)
Second supervisor(s):
drs. ing. G. (Geert) Timmermans (Landscape architect dRO Amsterdam)
drs. J.W. (Pim) Vermeulen (Senior Hoofdplanoloog dRO Amsterdam)
Proposal and theoretical framework: A.G. (Alexander) Vollebregt (Spacelab, TU Delft)

Experts

The following persons have helped and inspired us by sharing their expertise:
Dr. L.M. (Leo) van den Berg (Assistant Professor Social-Spatial Analysis Chair Group, Wageningen University)
Dr. W.A. (Willem) Brandenburg (Senior Researcher Saline crops, Plant Research International (PRI))
Ir. C.L.M. (Charlotte) Buys (Projectmanager dRO Amsterdam)
Drs. J.F. (Joost) Smit (Senior Consultant dRO Amsterdam)
A. (Andries) Siepel (Farm Manager Droevendaal organic and experimental training farm, Plant Research International (PRI))

Landscape is...

3

The landscape is a manifestation of systems (Vroom in Duchhart, 2007), instigated by both humans and nature. A visible result on the surface of the earth – a point-in-time expression of a continuous and inevitable process of change (Kerkstra & Vrijlandt, 1988). Landscapes change with the time through processes that increase efficiency, order and productivity. These processes vary in temporality, scale and movement (Motloch, 2001).

The interacting complex of processes forms a system (Odum, 1969). Systems function through the interrelatedness of parts, and exhibit existential properties independent of these parts. A system behaves either in equilibrium or dissipative [fig. 2].
The systems in dynamic equilibrium are slowly changing, with high levels of integration (internal and contextual), interaction and regeneration. The dissipative system is highly spontaneous, rapidly changing and inherently unstable, with internal as well as external conflicts; the emergence of new, more relevant interrelationships is promoted (Motloch, 2001). A fundamental shift in energy flows takes place over time as increasing energy is relegated to maintenance (Odum, 1969). The character of system processes ranges from natural to 'man-made'.

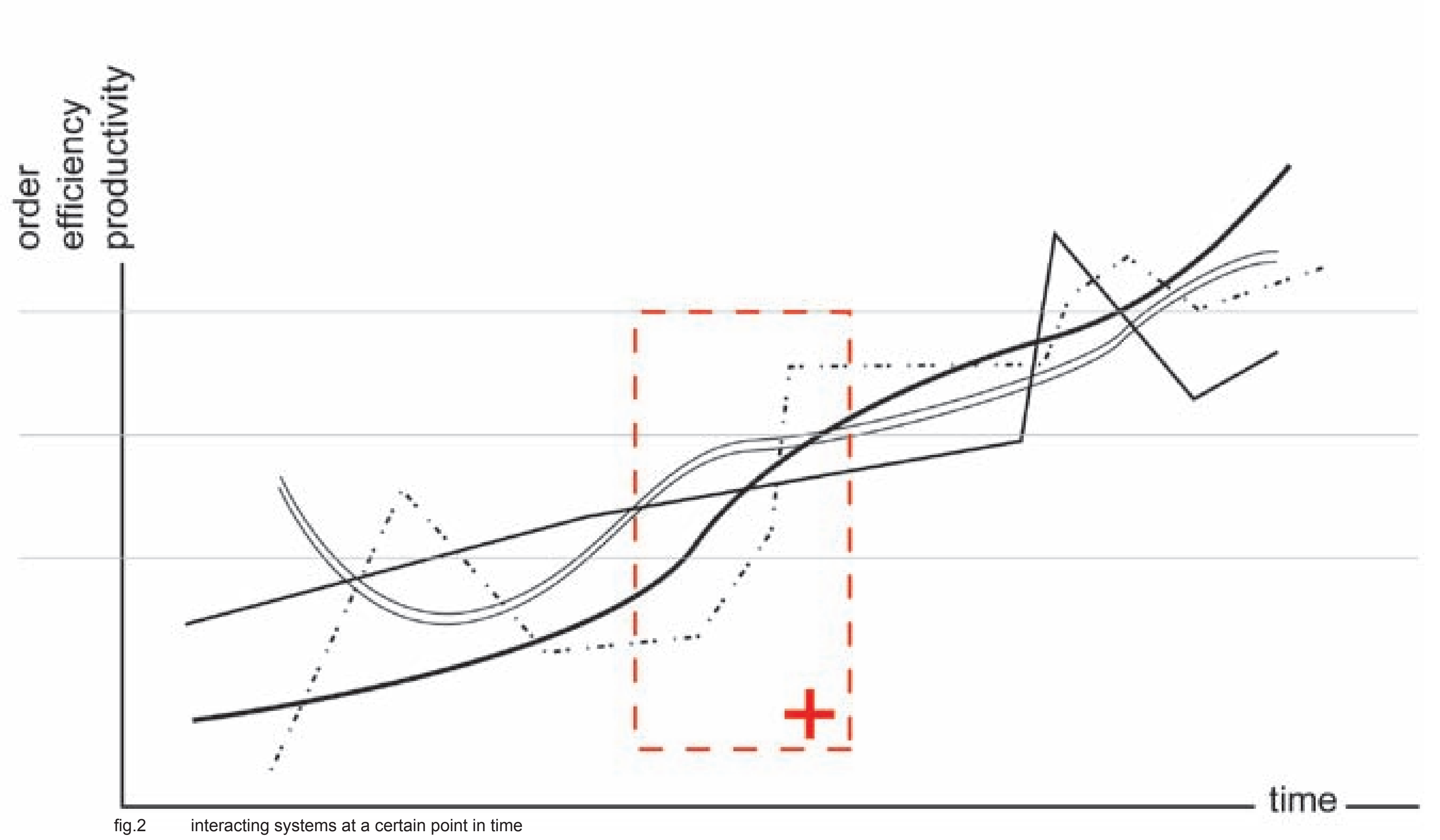


fig.2 interacting systems at a certain point in time

The natural system

The natural system includes geologic and biologic processes (Motloch, 2001):
Geologic processes (geologic processes are those by which rocks are formed, differentiated, eroded and deposited to be reformed again into rocks) include tectonic and erosional forces.
Tectonic forces are powered from within the earth (radioactive decay), and move the geologic plates of the earth, creating tectonic activity and mass. Erosional forces reduce or soften the uplifted form – generating space, including hydrolic forces (movement of water from ocean to atmosphere), glacial forces (ice that flows under its own weight), eolian forces (wind which erodes, transports and deposits settlement) and weathering (mechanical - decay by wind, water, ice, temperature and plant induced breakage of rocks, chemical - minerals formed underground, chemically decompose at the surface) (Motloch, 2001) [fig. 3].

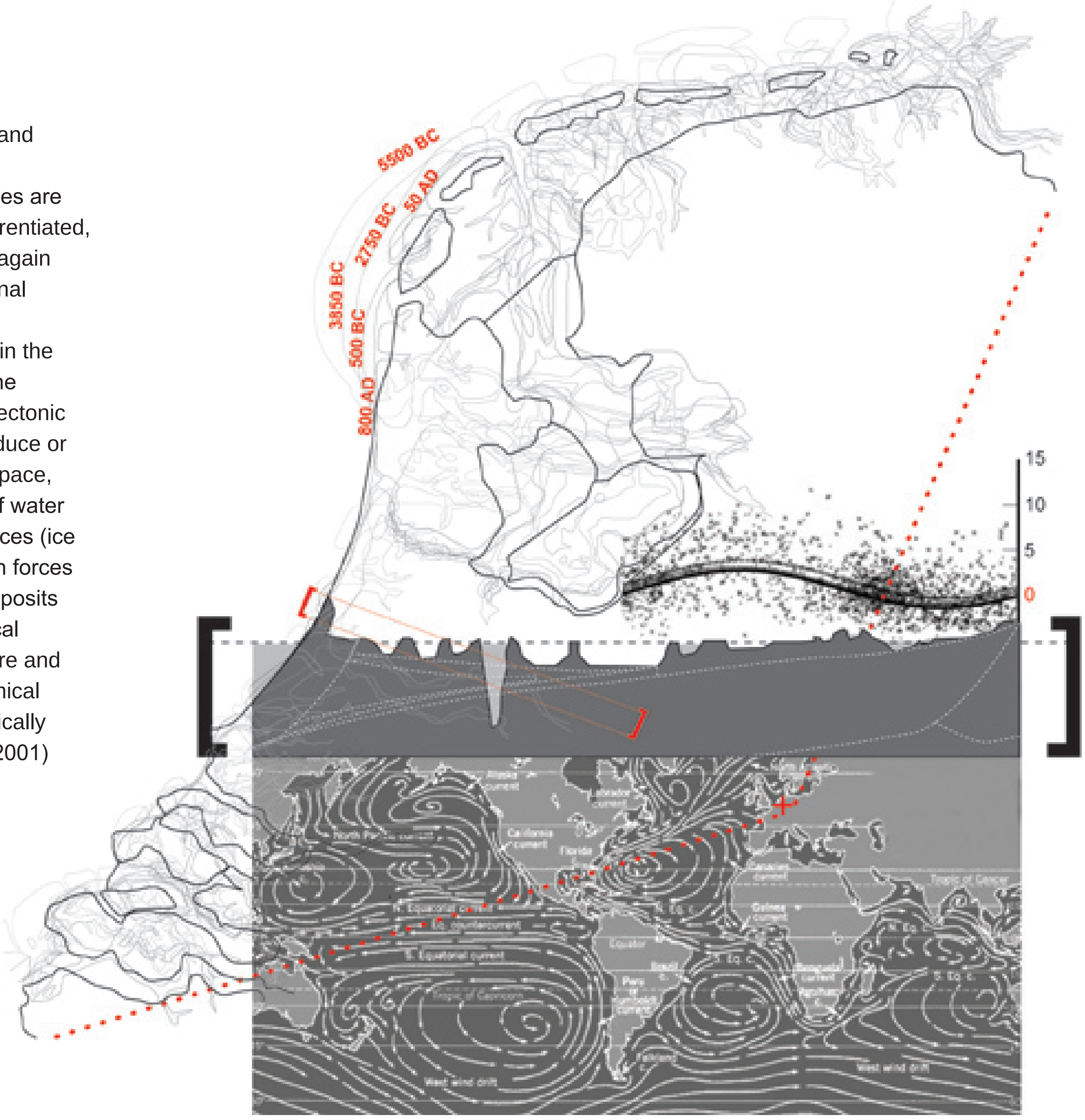


fig.3 geologic processes

Biologic processes are interactions between natural living elements and the physical environment, holistically combined in ecosystems. Ecosystems evolve towards a greater order, diversity, complexity and stability (Motloch, 2001) [fig. 4].

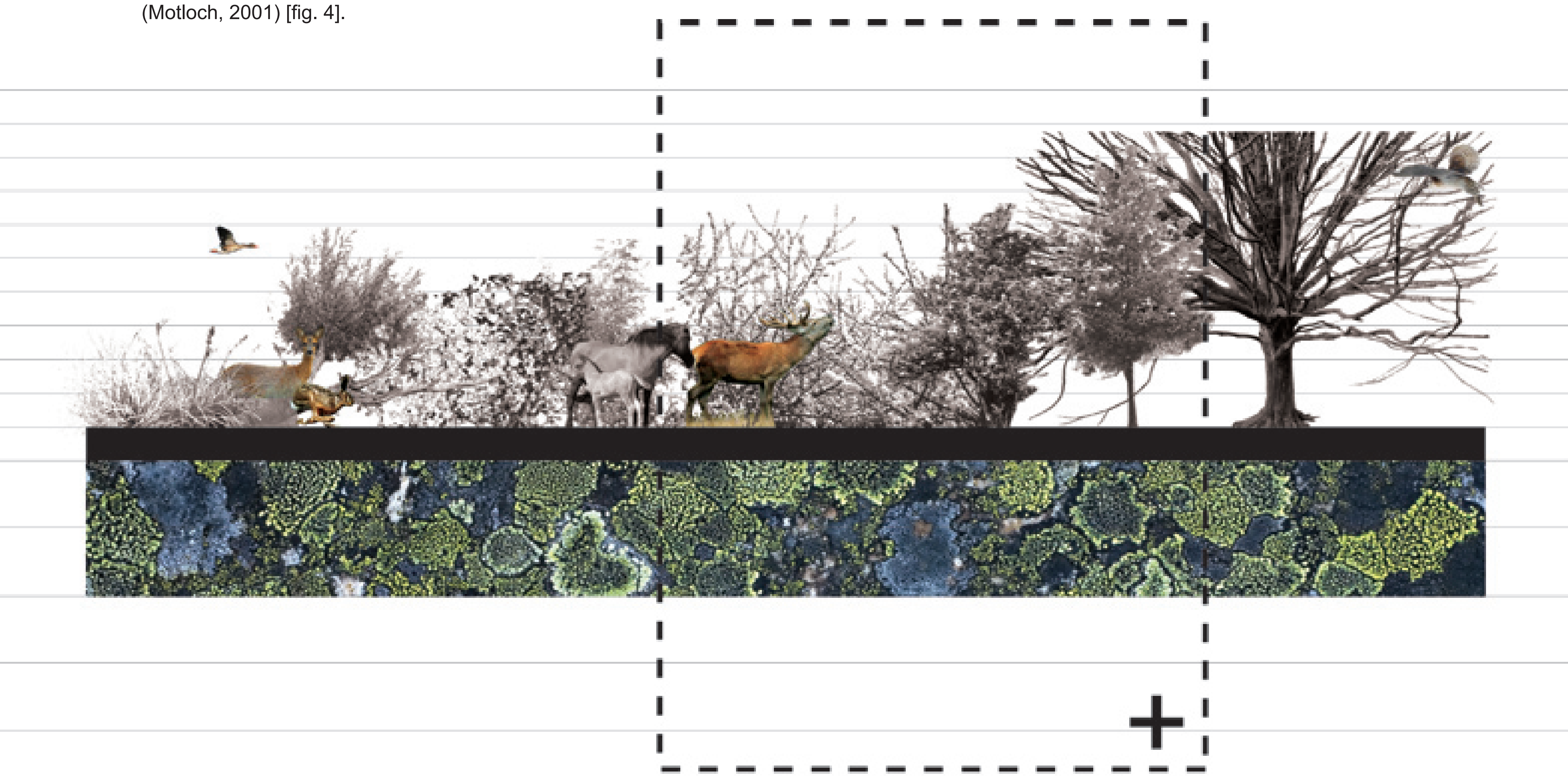


fig.4 biologic processes

The natural system is characterized by rhythm, ranging from short rhythms, such as diurnal and seasonal change, and longer cycles, such as succession, weather and climate [fig. 5]. Diurnal rhythms consist of day and night, light and darkness. Seasonal rhythms involve lifecycles (birth, maturation, aging and death), the four seasons, the annual weather cycle. Succesional rhythms contain the cycles of succession (pioneering, establishment, early succession, late succession, perturbance and reinvasion). Climate rhythms are the actual ongoing consequences of the forces, for example expressed in periods of rainfall and drought (Motloch, 2001).

Reality is immersed in the flow of time. Time is not merely a geometrical parameter associated with motion. It recognises the irreversibility of natural processes as well as the emergence of novelties, creating narrative historical aspects (Prigogine (1977) in Pulselli et al., 2003).

Rhythm truly is something inseparable from understandings of time. Wherever there is interaction between a place, a time and an expenditure of energy, there is rhythm. Three main rhythm characteristics can be defined: repetition and difference, the interferences of linear and cyclic processes, and the cycle of beginning, growth, peak, decline and end. Identical repetition is impossible, because the circumstances are never exactly the same (for example, always the hour, lighting, etc. is different) (Lefebvre, 2004).
The rhythms clearly influence the workings of the 'man-made' system, they are beyond the control of humans [fig. 6].

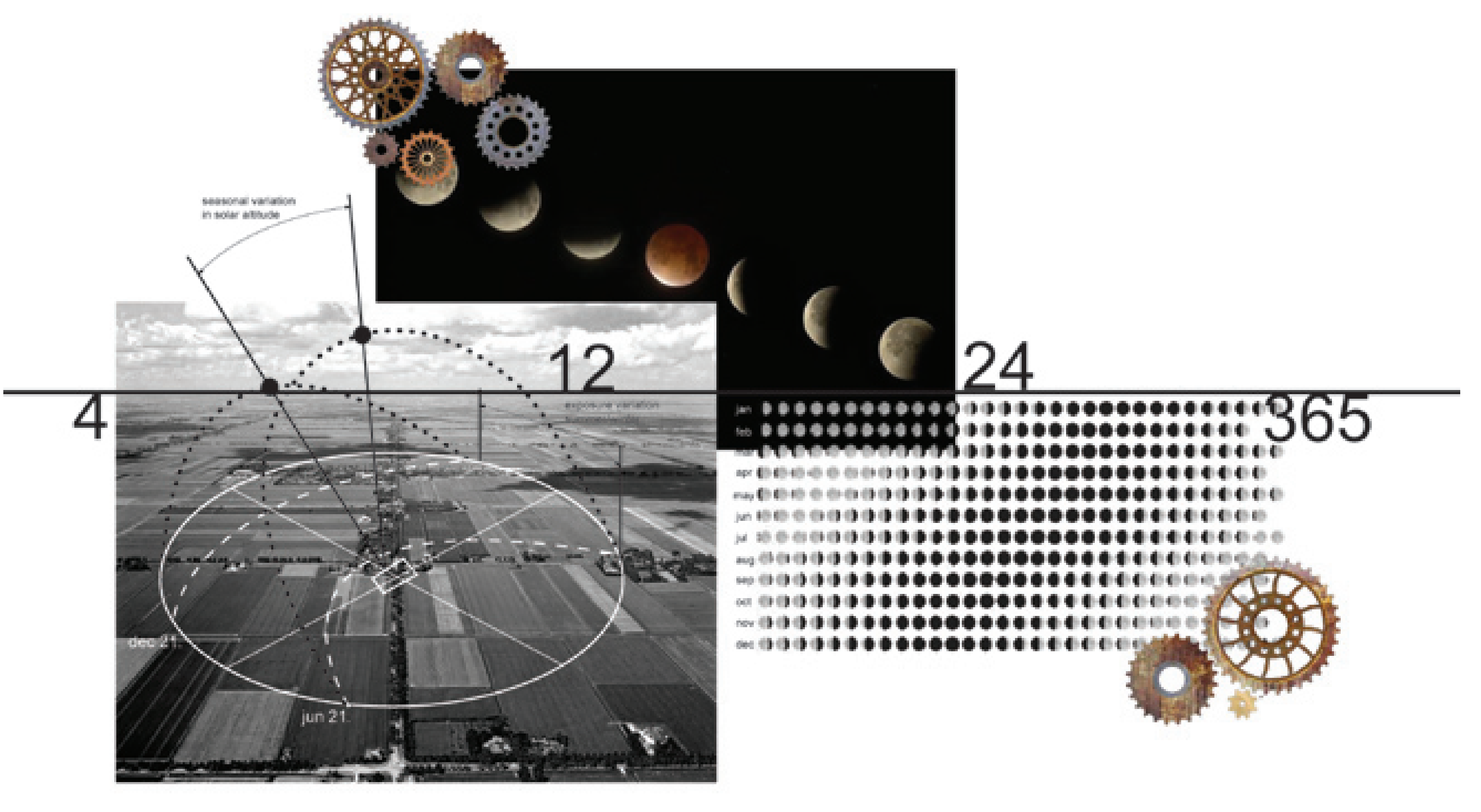


fig.5 rhythm

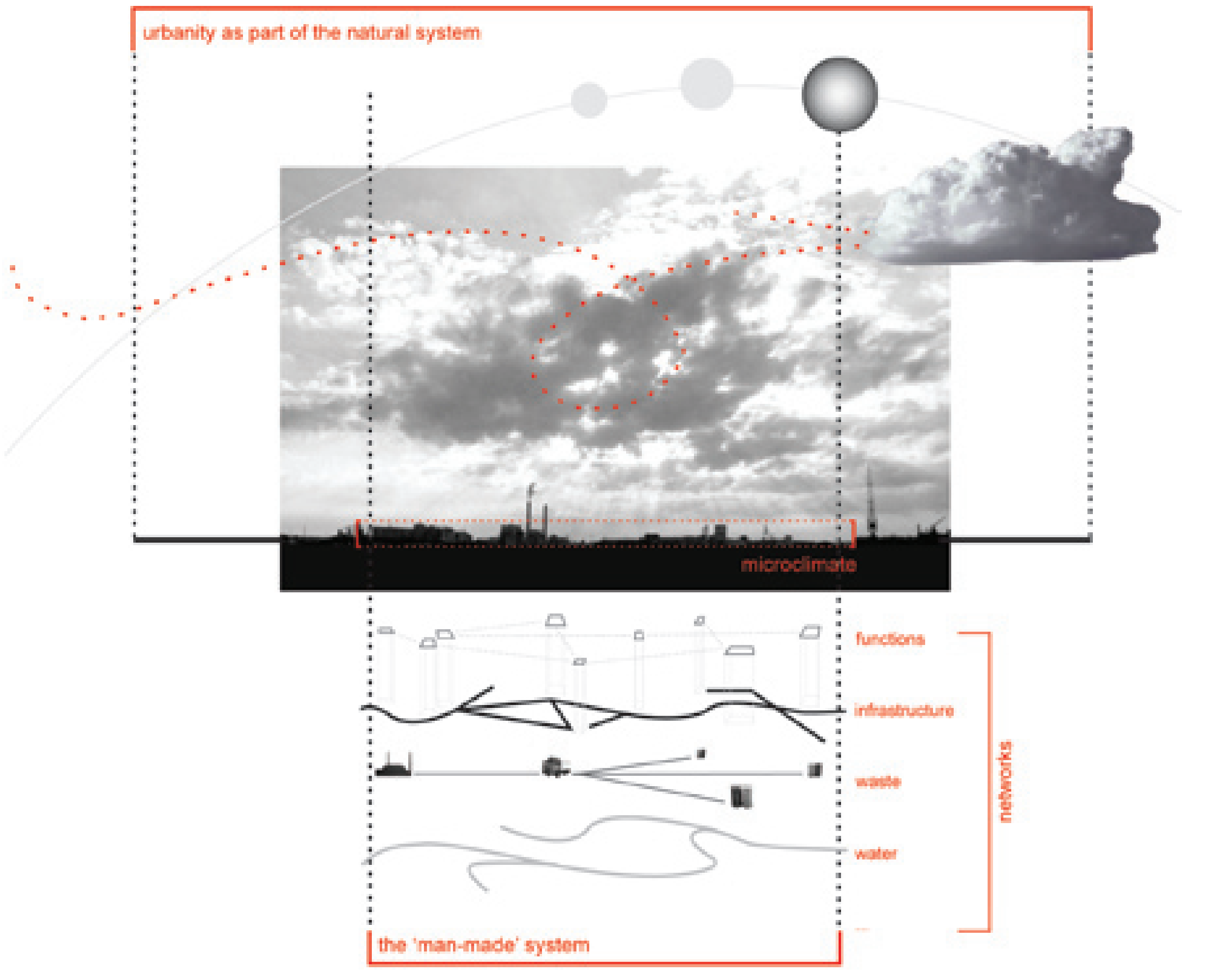


fig.6 urbanity as part of the natural system

The 'man-made' system

The 'man-made' system is a dissipative, non-equilibrium system. It self-establishes towards high levels of complexity and organisation, with the constant need of exchanging energy and matter with an external sink. Technology intends to maintain a steady, non-equilibrium state [fig. 7]. Urbanity as manifestation of the 'man-made' system, can be conceptualised as the ecosystems of and in a city. Ecosystems of a city deal with exchanges of energy and matter in terms of resource flows and consumptions. Ecosystems in a city deal with complex behaviours of urban networks, in terms of patterns of urban mobility. In a town, the natural cycles are almost completely replaced by artificial cycles (Pulselli et al., 2003).

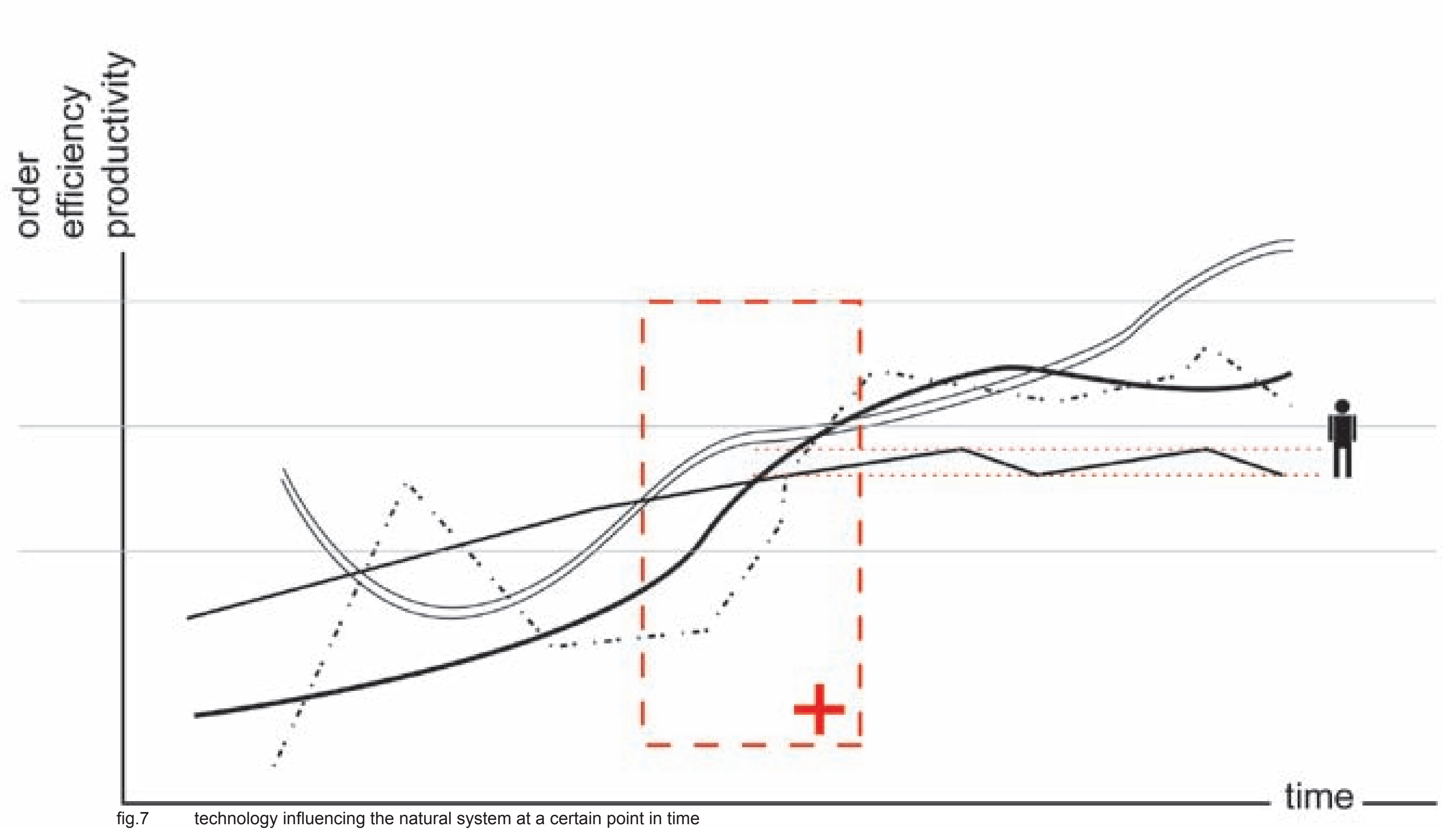


fig.7 technology influencing the natural system at a certain point in time

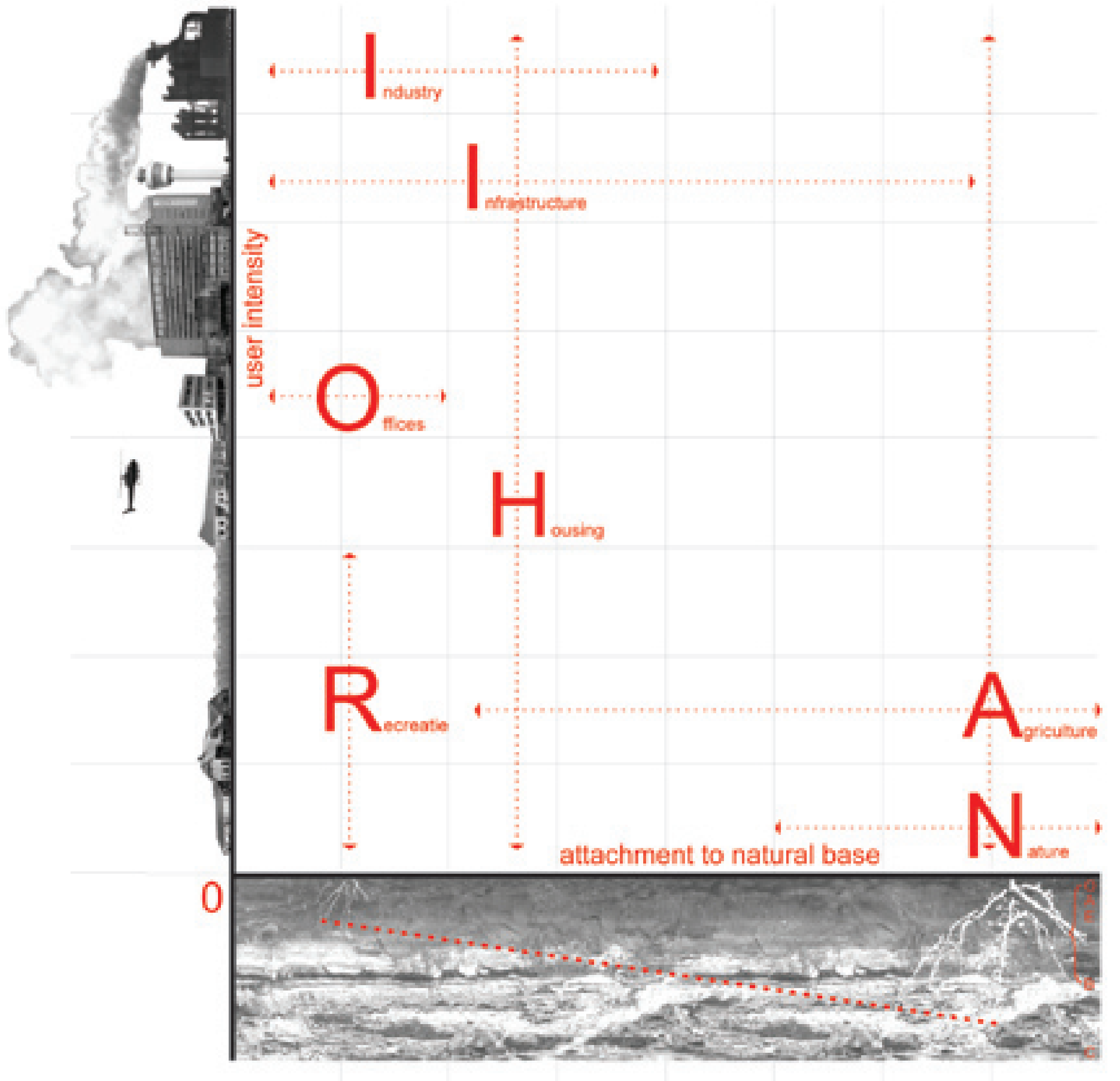


fig.8 catagorising (urban) land-use functions

The interaction between people and technology drives the 'man-made' system. On the one hand, people are part of the landscape. But on the other hand, they are able to disconnect themselves, evaluate and consciously change the landscape through technology interrelated with society's discourse (Kerkstra & Vrijlandt, 1988; Kleefmann, 1992). Society comprises an economic, political and cultural subsystem, that express aspects like conditional dimensions and norms and values (Kleefmann, 1992). Still, numerous individual rational decisions could lead to cumulative unpredictable effects. The 'man-made' system eventually intends to disperse itself, to guarantee connectivity and human habitat. It tries to create order on a superficial level – releasing itself from the natural system.

The attachment to the natural base and user intensity could categorise (urban) land-use functions, varying from low to high intensity of use, and high to low forms of attachment [fig. 8].

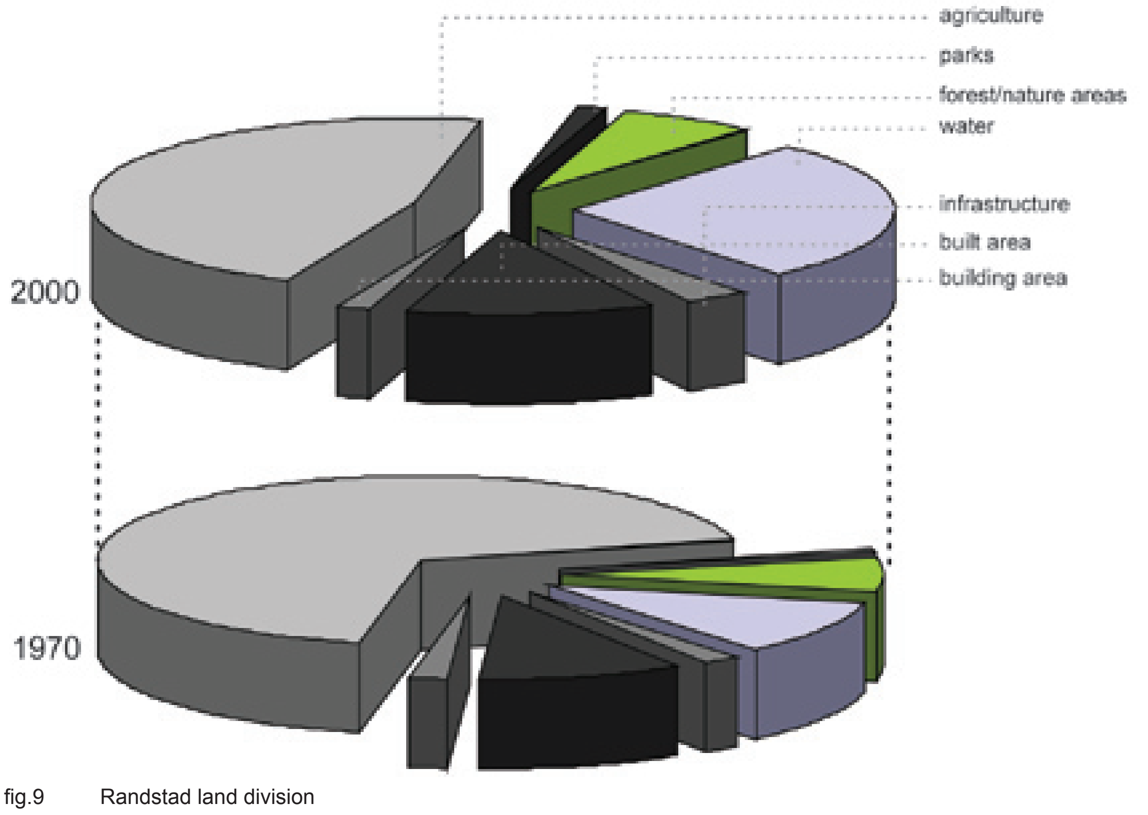


fig.9 Randstad land division

Looking at the division of land-use in the Randstad, urban functions like infrastructure and built area have increased in surface whereas the space claimed by rural functions is decreasing (CBS, 2003) [fig. 9]. The urban pressure on land is high. Urbanity is the most obvious expression of the 'man-made' system. What is 'urban' could be based on accessibility of urban technology (Vollebregt, 2007). It is the centrality of people, energy and matter that determines the level of urbanity. The varying accessibility, physical as well as virtual, creates gradients of urban impact, ranging from a super-urban highly dense metropolis to rural hinterland, all having their spatial manifestations. Conversely the spatial manifestation also defines the level of accessibility characteristic for this specific gradient.

In the Netherlands it is suggested that an 'urban lifestyle' is omnipresent [fig. 10].

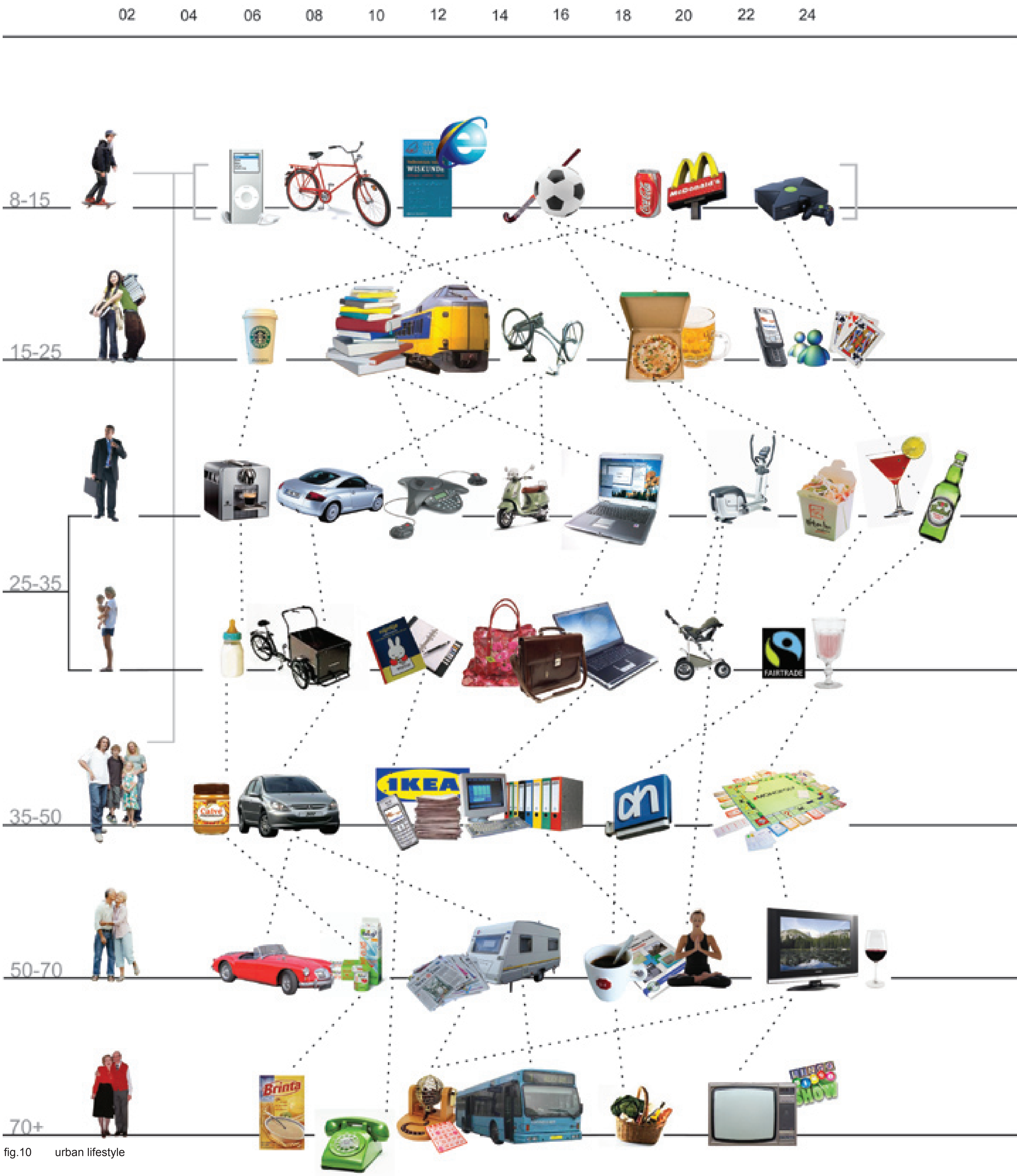


fig.10 urban lifestyle

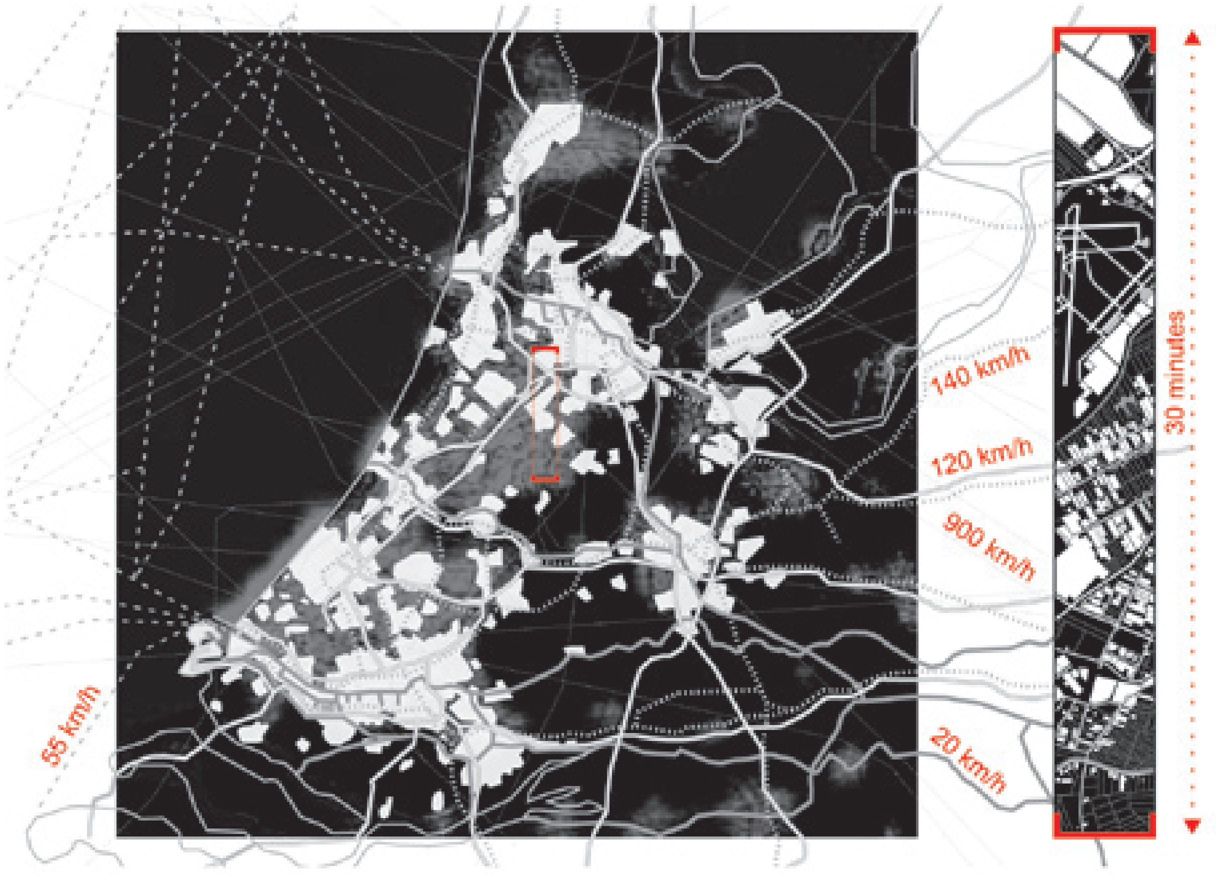


fig.11 gradients of urbanity present in the Randstad

In the Randstad, several gradients of urbanity can be distinguished during a thirty minute car ride [fig. 11].

Urbanity is organised in urban networks. Urban networks, or urban development processes, are mostly about social-economic relationships (Hough, 2004). Urban networks are sets of interactive conditions: people moving through buildings and infrastructures; flows of energy and matter; exchanges of information through communication technologies (Pulselli et al., 2003). The interrelated processes of movement and functional patterns can be conceptualized by scale but always need grounding in the local level (Read, 2007) [fig. 12]. Increasing speed and intensity of urban networks are expressions of technology and indicate a central role for human.

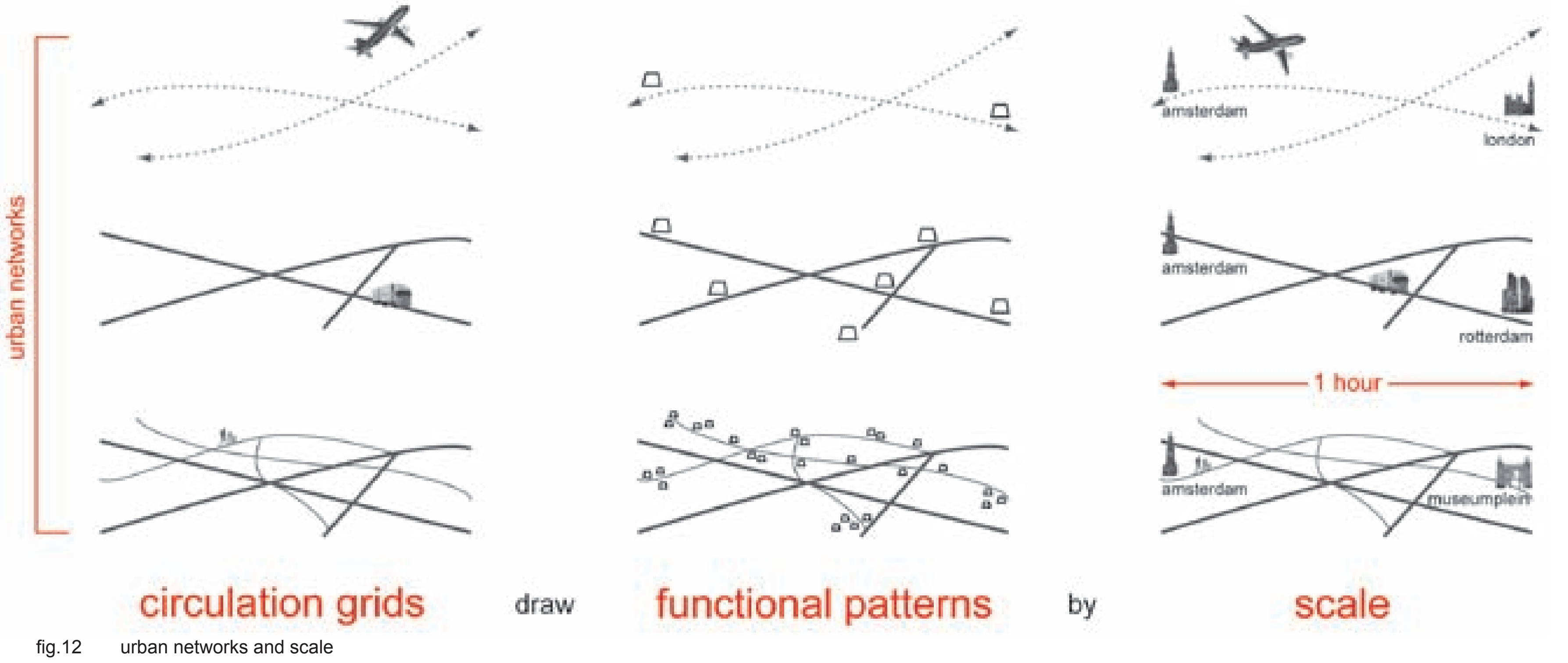


fig.12 urban networks and scale

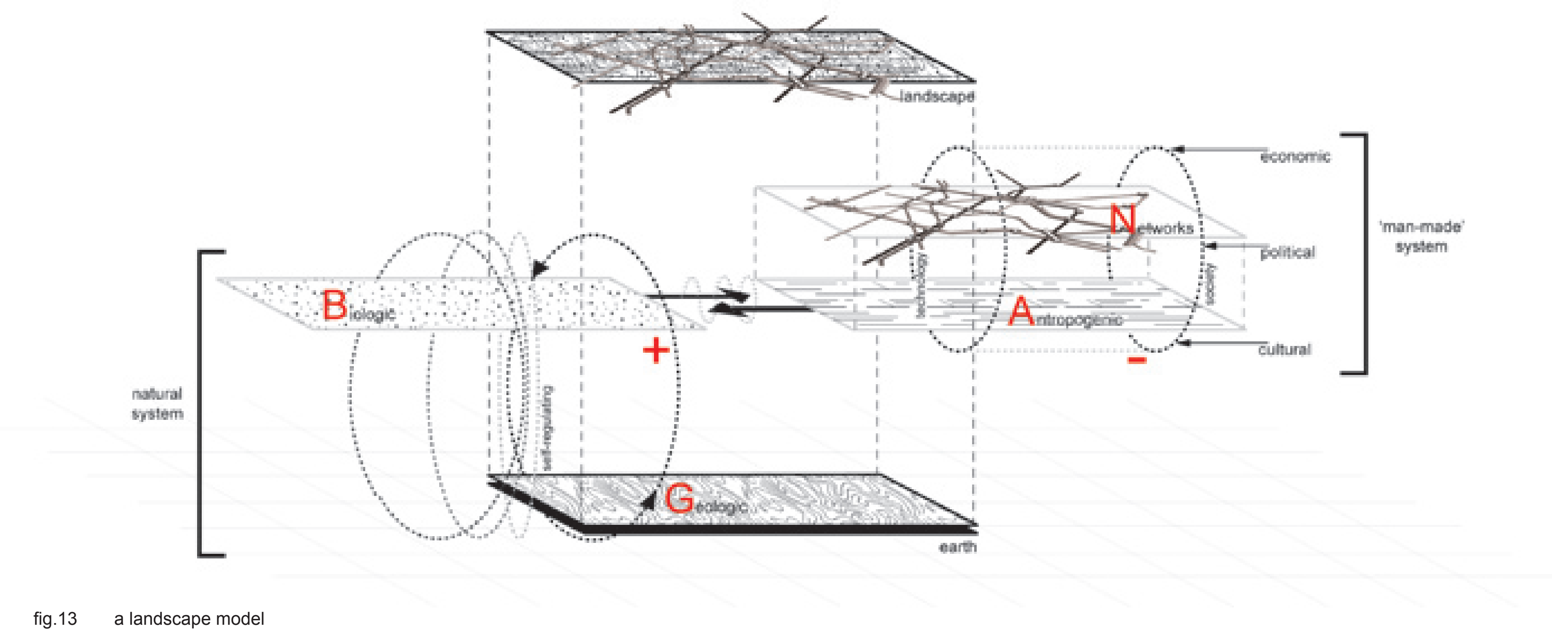


fig.13 a landscape model

Towards an inclusive defenition of landscape

Landscape as a model consists of two dynamic components, the natural system and the 'man-made' system. The components are inextricably connected by intertwining processes through which the natural system is transformed into conditions suitable for society, resulting into a new entity: the social-physical organisation – the landscape (Duchhart, 2007; Kleefmann, 1992) [fig. 13].

The natural system has a dynamic character, but remains relatively stable over long periods of time (Steiner, 2002). The 'man-made' system experiences greater dynamism, therefore when merging natural and urban processes, a natural resistance to the ever dispersing urban networks is missing. Only extreme physical circumstances can disturb the dispersal. The dominance of urban networks leads to fragmentation of ecological patterns, which affects a larger natural system.

The segregation of humans and nature is incompatible with system dynamics, this is why landscape must be seen as an inclusive term that embraces 'nature, countryside, suburb and city' (Motloch, 2001).

In order to create a balanced landscape in which urbanisation does not take over the natural system, the natural resistance needs to be improved. The degree of resistance between one another should create a dynamic interface, resulting in a resilient landscape. This is most urgent in the highest gradient of urbanity. Resilience is the persistence of systems and their ability to absorb change and disturbance and still maintain the same relationships with its surrounding environment (Holling, 1973; Hester, 2006).

Change to resilient landscape

The aim for a balanced system could be based on ethical reasoning and theory, but is becoming a necessity due to five different issues of both environmental and social importance. The following issues are elucidated: climate change, city-microclimate, changing relation city-countryside, health and education, food awareness and food security.

4

4.1 Climate change

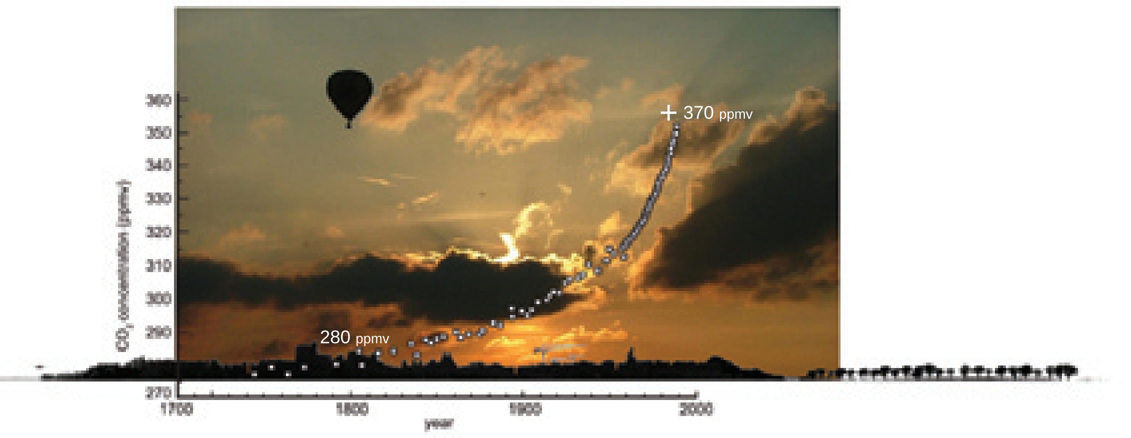


fig.14 global climate change

To begin with, a demand for change in landscapes is caused by the predicted large fluctuations in the global climate. Climate transcends the boundaries of natural and human activities (Hough, 2004).The atmosphere is a global commons that responds to many types of emissions into it, as well as to changes in the surface beneath it. As human balloon flights around the world illustrate, the air over a specific location is typically halfway around the world a week later, making climate change a truly global issue (Karl, 2003). Global changes in the atmospheric composition occur from emissions of greenhouse gases, such as carbon dioxide that results from the burning of fossil fuels, methane and nitrous oxide from multiple human activities (Karl, 2003) [fig. 14]. Due to the long shelf-life of carbon dioxide in the atmosphere, much of the climate change over the next 30 to 40 years has already been determined by historic emissions (Hulme in Gill et al, 2007). Still, changes in human activities of land use, through urbanisation and agricultural practices, is part of the human impact on climate (Karl, 2003).

The rate of human-induced climate change is projected to be much faster than most natural processes. Given what has happened to date and is projected in the future, substantial further climate change is guaranteed. Even with uncertainties in prognoses, the likely outcome is more frequent heat waves, droughts, extreme precipitation and related impacts, like sea level rise and vegetation changes, that will be regionally dependent. The pace of change can be slowed, but it is unlikely to be stopped in the 21st century (Karl, 2003).

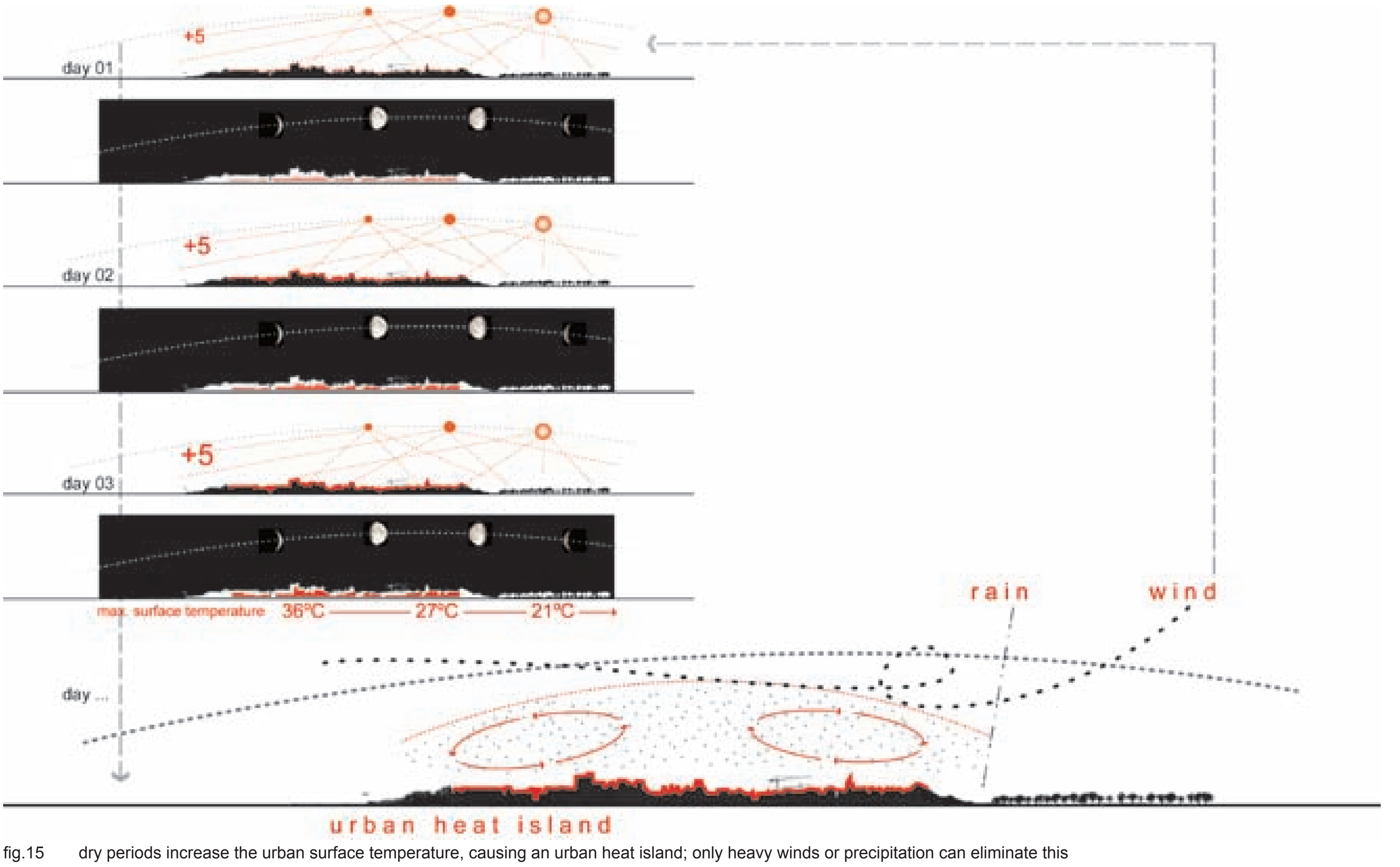


fig.15 dry periods increase the urban surface temperature, causing an urban heat island; only heavy winds or precipitation can eliminate this

4.2 City - microclimate

Cities are dependent on the natural system beyond the city limits, but they do benefit from internal urban ecosystems. City climates differ from surrounding rural areas (Hough, 2004).
Buildings, paving, vegetation and other physical elements of the city are the active thermal connections between the atmosphere and land surfaces. Their composition and structure within the urban canopy layer, which extends from the ground to above roof level, largely determine the thermal behaviour of different parts of the city (Hough, 2004) [fig. 15].

A city's green infrastructure could contribute to public health and increase the quality-of-life of urban citizens – providing services like air filtering (gas regulation), micro climate regulation, noise regulation (disturbance regulation), rainwater drainage (water regulation), food production, erosion control, and recreational/cultural values (Constanza et al., 1997).

One climatological problem is named the "concrete jungle", meaning that urbanization increases the amount of impervious surfaces. The altered surface cover leads to a rise in the rate and volume of surface rainwater runoff and an urban heat island is created as a result of meteorological, locational and urban characteristics (Oke, 1987). The maximum surface temperature is very dependent on the proportion of green cover. In high-density residential areas, for example, maximum surface temperature is 27,9 ºC. Adding 10% green cover could create a 4 ºC decrease, because vegetated surfaces provide shading, evaporative cooling, and rainwater interception, storage and infiltration functions [fig. 16]. This is equivalent to the average predicted rise through global warming by the 2080s (Gill et al., 2007). So, the biophysical features of green space in urban areas offer potential to help adapt cities for climate change.

The raised issues demonstrate that more vegetated surfaces in the urban context increase the quality of urban life by providing people with natural settings for leisure and recreation, and by safeguarding the quality of precious life-giving sources such as air and water (Keipi, 1997). Therefore, 'urban greening' is a necessary act when aiming for a resilient city.

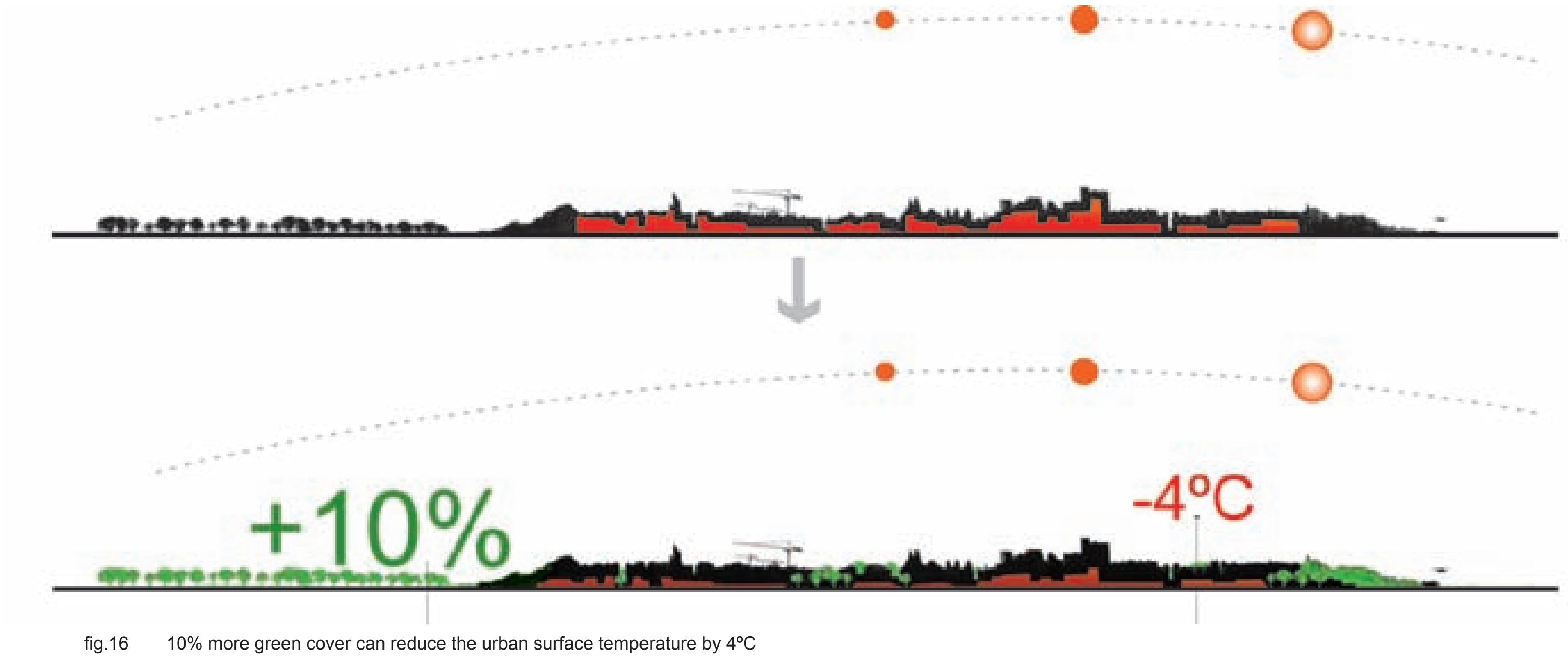


fig.16 10% more green cover can reduce the urban surface temperature by 4ºC

4.3 Changing relation city - countryside

A resilient city is not only based on the dynamic interface of natural and 'man-made' systems. The dominance of the 'man-made' system requires considerations of societal circumstances in which the Dutch situation is set.

At the beginning of the twentieth century, only sixteen cities in the world had populations larger than a million people, yet at the close of the century more than five hundred cities had more than a million inhabitants, many boasting more than ten million residents and still expanding (Corner, 2006). By now, half the world's population lives in cities [fig. 17].

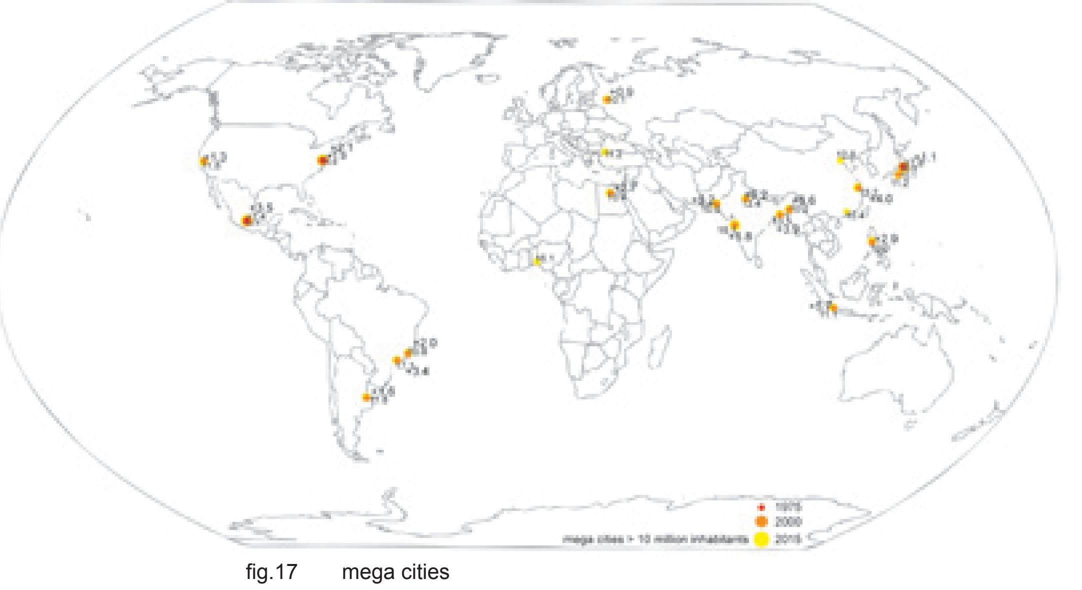


fig.17 mega cities

Over the past century the relation between city and countryside has drastically changed. The city was a compact structure produced by the Neolithic agrarian revolution (Shane, 2006). Necessity dictated a measure of integration between urban and rural occupations (Hough, 2004). City and countryside were directly inter-related at a short distance; the surrounding fields were directly supplying the settlements. The industrial revolution allowed cities to break beyond their former bounds (Shane, 2006). During the Industrial Revolution, when people migrated from the countryside to the city, the skills and knowledge of traditional patterns of rural life got replaced by the living and working patterns of the city. The public urban park, created to improve the urban living conditions, had an entirely different purpose from the countryside it replaced. The crops, orchards and livestock that had been a function of many open areas in the pre-industrial settlements were now replaced by those that catered exclusively to amenity and recreation (Hough, 2004). Conjointly mass-production lines strongly influenced the overall urban structure. Through time production patterns became widely dispersed - first regionally, then nationally, then globally – creating a more open, decentralized "matrix pattern"(Shane, 2006) [fig. 18].

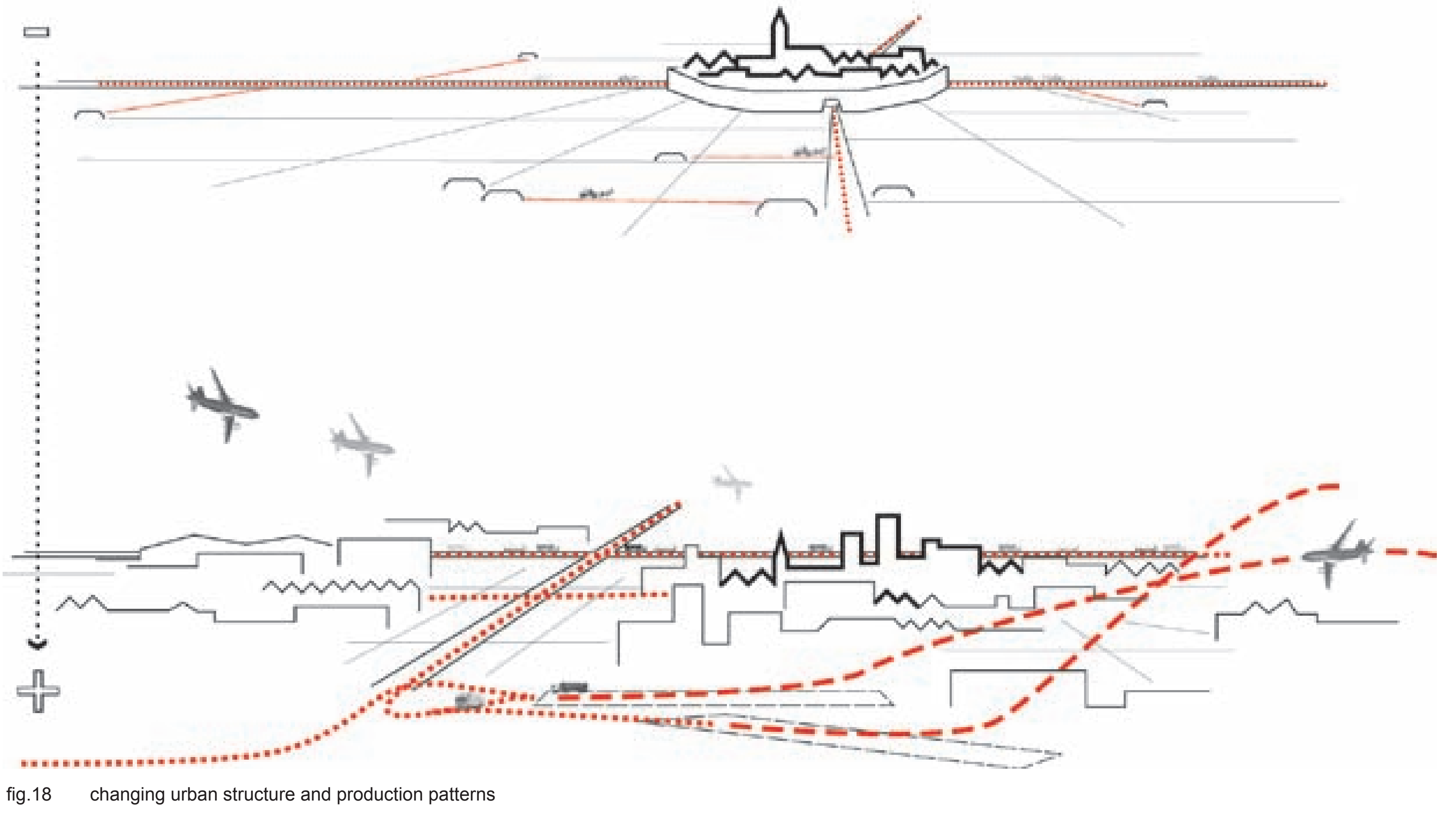


fig.18 changing urban structure and production patterns

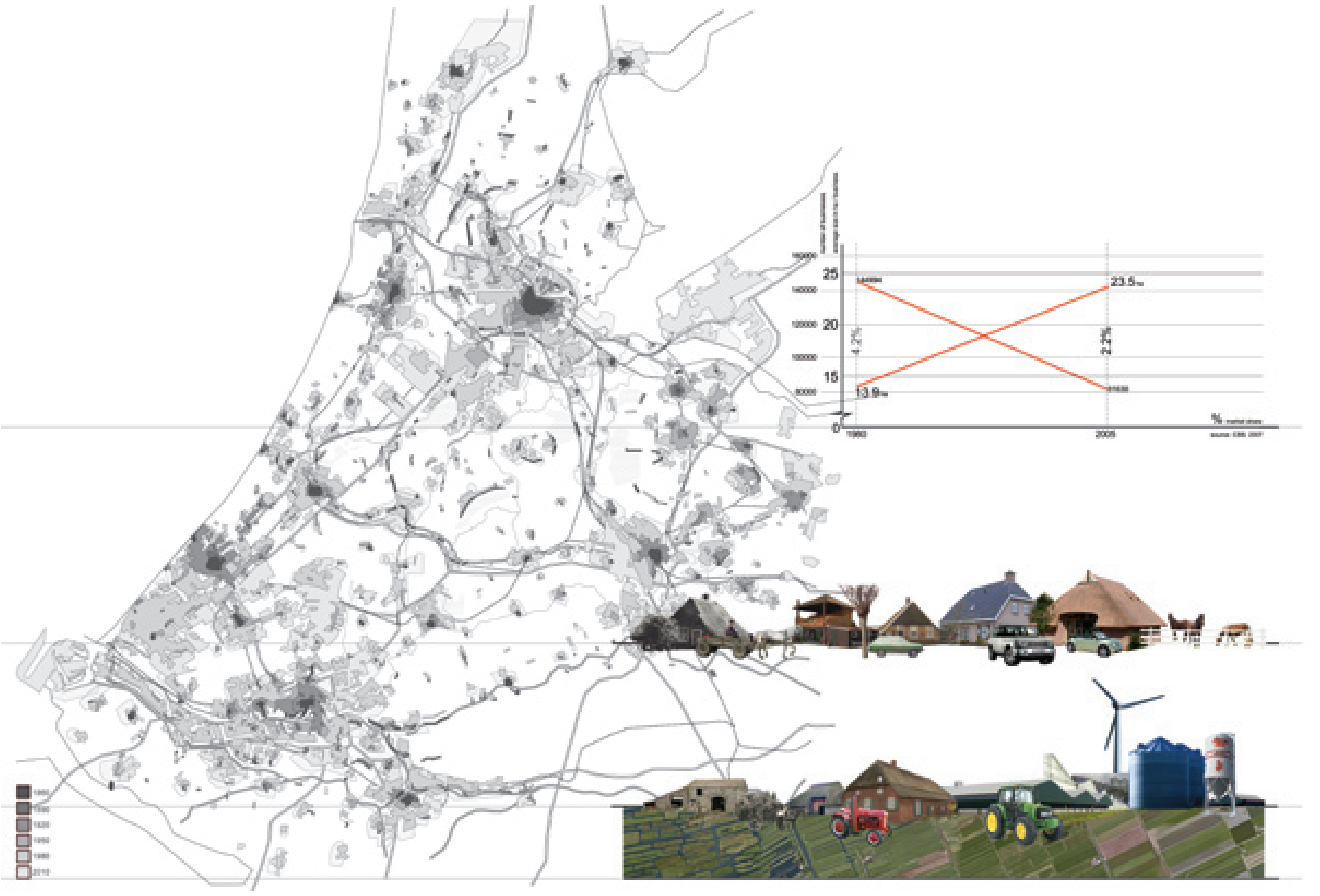


fig.19 urban development of the Randstad; changing perception of the countryside

Until the 1950's the countryside, compared to the city, was a different world with its own rules. This slow world was determined by the growth rate of crops and the maximum speed of a tractor. Today, with artificial production in greenhouses, increasing mobility and demand for facilities, that world does not exist anymore. The processes of the countryside are approaching the fast landscapes of urban area (Wiersma, 2007) [fig. 19].

With the ongoing urbanisation, the countryside is clearly changing. Agriculture is slowly disappearing as a dominant function. The agricultural land is undergoing a process of devaluation, due to the push for competitive export-oriented farming, economies of scale, and agricultural biotechnology. Globally, there has been a massive and silent exodus from farmland, as agriculture is further mechanized and societal development is no longer directly tied to productivity of the landscape (Shannon, 2006) [fig. 20]. Mean while, other functions are claiming their space in the countryside.

Social pressure is instigating change. Both political and social forces now decide on the amount of productive agricultural land (Dam et al. 2006). Agricultural production landscapes were widely appreciated halfway through the last century, but nowadays the consumptive qualities a countryside can offer to society are far more important (Voskuilen et al, 2002). So, the field of force regarding the countryside has changed: production is no longer the main issue [fig. 21].

fig.20 growth of export oriented farming

fig.21 horse stables and farms with side activities

fig.22 citizens seperated from natural processes

4.4 Health and education

The perception of the city as separated from the natural processes that support life has long been a central problem in environmental thinking. Children know more about nature in distant lands than they do about natural things in their own backyards [fig. 22]. Environmental education is important, but can never substitute the constant and direct experience assimilated through daily exposure to, and interaction with, the places people live in (Hough, 2004). Moreover, people living in a 'greener' environment report fewer health complaints, have a better perceived general health and a better mental health (Vries et al., 2003). Where the type of green space is considered, the amount of agricultural green (as compared to urban green and natural green) is in all degrees of urbanity most consistent with perceived general health (Maas et al., 2006).

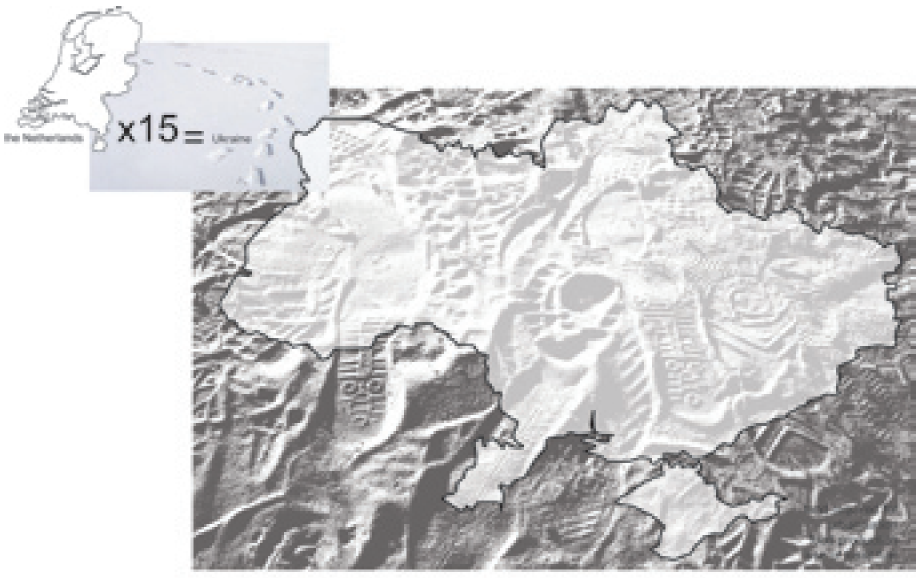


fig.24 ecological footprint

fig.25 mitigating the effects of climate change

both production and consumption in city and countryside

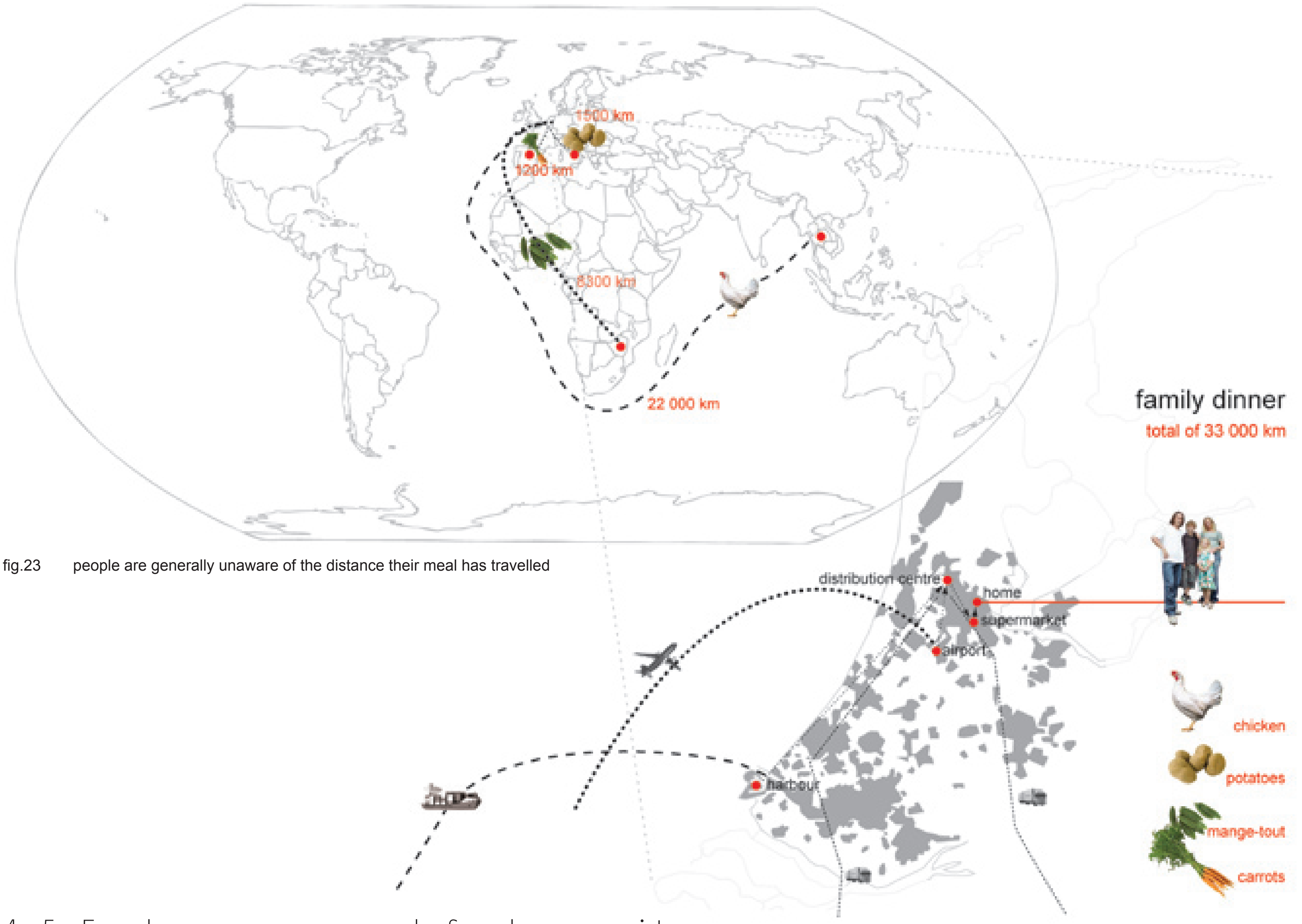


fig.23 people are generally unaware of the distance their meal has travelled

4.5 Food awareness and food security

Fact is that the world population is still growing, and so is the demand for food production (United Nations, 2005). Despite the overall gains in food consumption, in several countries the increases in food production will not be sufficient to allow for a significant reduction in the number of undernourished people (FAO, 2006). The food security, defined as “giving populations both economic and physical access to a supply of food, sufficient in both quality and quantity, at all times, regardless of climate and harvest, social level and income” (WHO Europe, 2000), is at stake.
For its food supply the Western World is strongly depending on import, energy and transport (Lamers, 2007). Consumers are accustomed to being able to buy all foods at all times of the year, regardless of seasonality, and at cheap prices (Paxton, 2005). Over the past thirty years gross world food imports, rose by almost 60 percent (FAO, 2004), accounting for a third of the growth in road freight. The geographical separation of consumers from food production renders shoppers ignorant of production processes and the abuses of the environment (Paxton, 2005) [fig. 23].
It seems difficult to relate individual behaviour to large scale environmental impacts. A model to make a connection between the individual and the global is the ‘ecological footprint’. The ecological footprint is based on an individual’s pattern of consumption (White, 2002). It assumes that every category of energy and material consumption and waste discharge requires the productive or absorptive capacity of a finite area of land or water (Wackernagel & Rees, 1996 in Deelstra & Girardet, 2000). In the Netherlands, 4.7 ha productive land is required per person to support annual needs (WWF, 2005) [fig. 24].
Food supplies to cities are an important component of the footprint. The impact of our transport-dependent food system can be expressed in food miles. Food miles are the distance food travels from where it is grown to where it is purchased or consumed by the end user. The distance food travels adversely affect the way food is grown and treated on its journey along the various links in the food chain (Paxton, 2005). The constant demand for out-of-season products has led to a rise in food miles, increasing environmental, social and economic burdens associated with transport, including carbon dioxide emissions (DEFRA, 2005).
So, the city’s impact stretches far beyond its physical boundaries (Deelstra & Girardet, 2000).

The climate issues combined with societal circumstances lead to believe that aiming for a more balanced, resilient landscape is a necessity. It is the natural resistance that has to be enhanced; by means of climate proofing, closing cycles of nutrients and energy, adding ecological diversity and connectedness, improving visibility and experience of ecological processes, and increasing environmental literacy and food awareness [fig. 25].

increasing health and educating citizens

direct food supply, public involvement

Productive Urban Landscapes

The Dutch Randstad metropolitan region is an example of a complex landscape in which higher gradients of urbanity are most present. Adapting the Amsterdam metropole for future developments requires a more equal balance between production and consumption.
The (spatial) conditions of urban agriculture, together with an analysis of international reference projects, lead to principles for the implementation of the phenomenon.

5

5.1 Definition of urban agriculture and productive urban landscapes

Urban agriculture involves the production of crops and animals in direct synergy or competition with urban activities and use of resources (Berg, 2001). It distinguishes itself from rural agriculture because it is directly related to the city's market rather than to the anonymous international food market. Additionally, structures of urban agriculture need to include functions and qualities normally associated with urban green, in opposition to conventional, increasingly industrial agriculture. This composition of production and recreational facilities increases the meaningful complexity of the urban fabric and is called a productive urban landscape. Productive urban landscapes are open urban spaces planted and managed in such a way as to be environmentally and economically productive (Viljoen, 2005). The addition of a production system is an investment in urban greening, and gives substantial value, whilst still providing the city with immaterial benefits from green. Green space could become more cost-effective.

Urban agriculture might be regarded as an oxymoron; in general 'agriculture' is associated with a rural atmosphere, which is seemingly self-contradictory to 'urban'. But in fact, urban agriculture could be a synenergy rather than an oxymoron, as it is able to position itself as an intermediate between urban and natural networks; a system with both high user intensity and strong relation to the natural base [fig. 26].

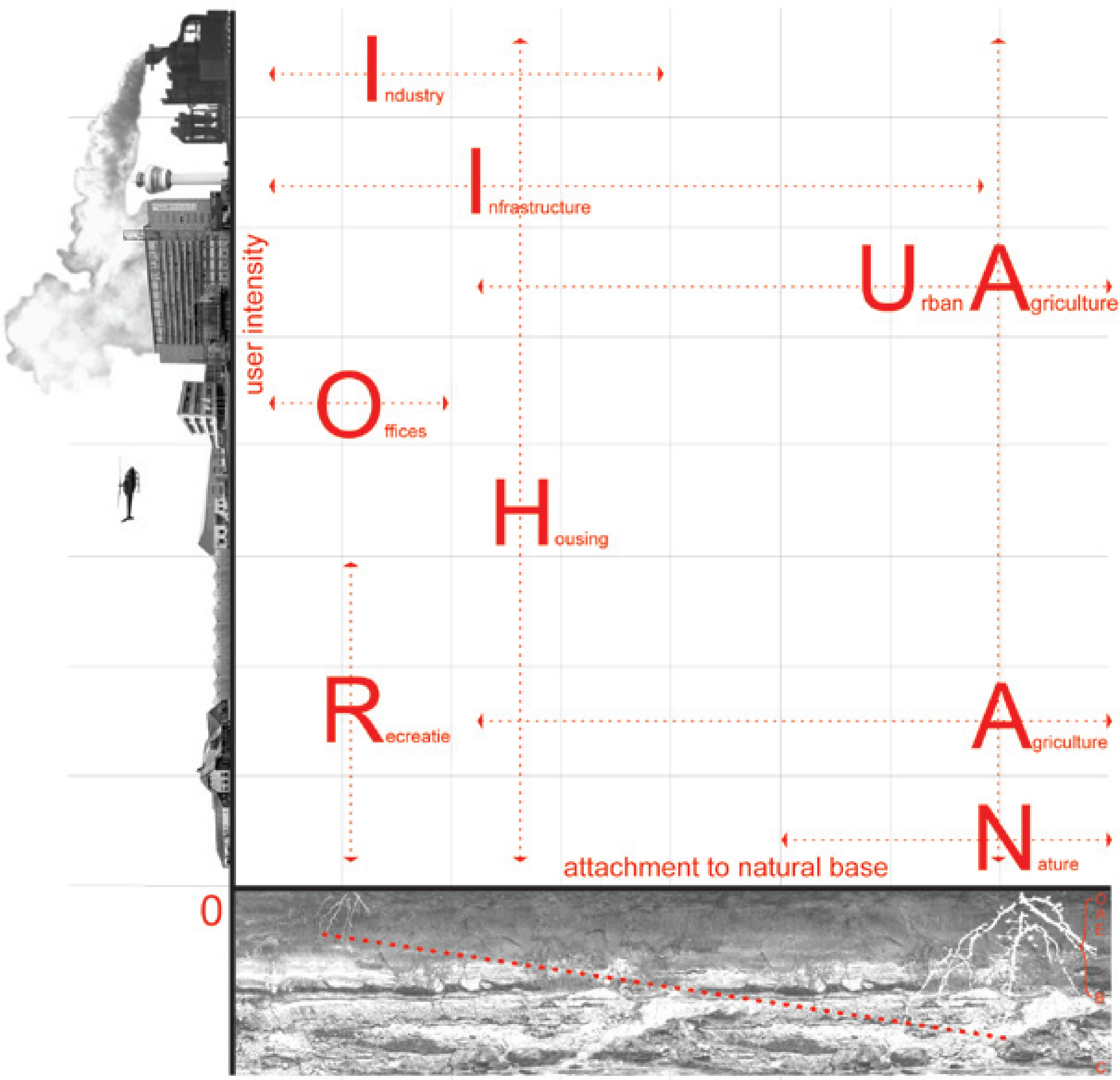


fig.26 urban agruculture contains both characteristics

fig.27 precedents

5.2 Precedents worldwide

Urban agriculture is a widespread phenomenon in developing countries. It is a source of income for many people and guarantees a type of green structure in the highly dense cities. Because of different social and climatologic circumstances, those examples are not representative for the Dutch situation. Still, there are examples of Western metropolitan cities where urban agriculture was implemented, comparable to settings that could occur in the Netherlands [fig. 27]. The main principles are illustrated in the following part.

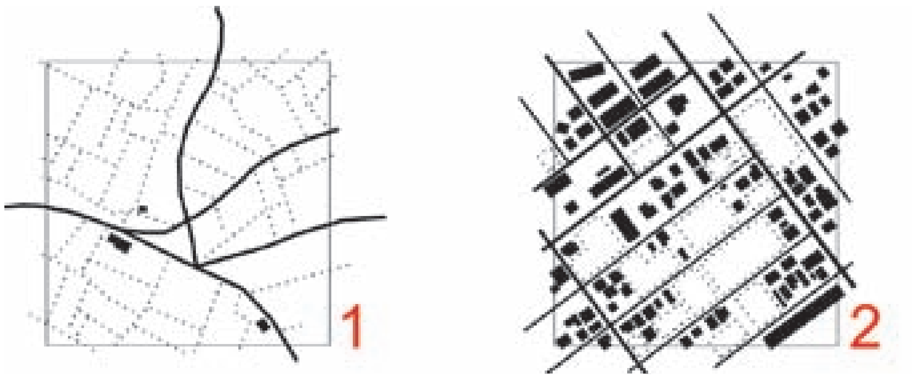


fig.28 Kakuka-Seiri replotting system for urban development

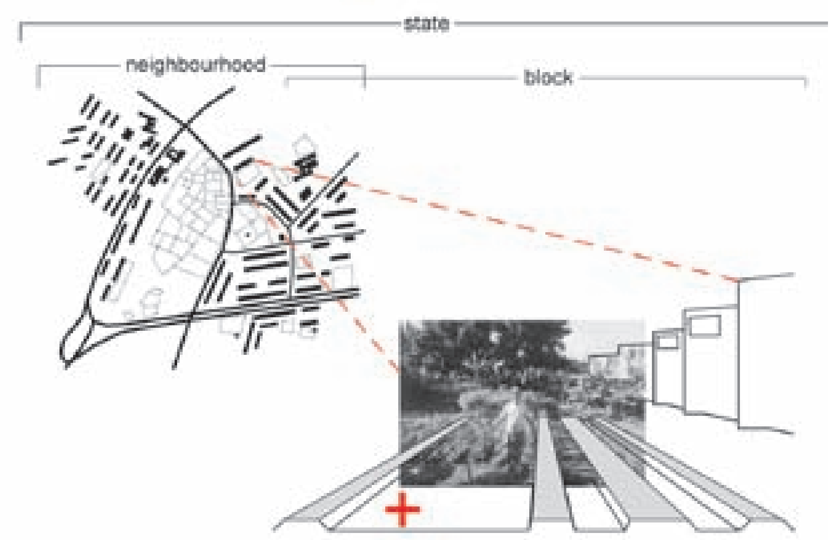


fig.29 popular gardens for the neighbourhood

fig.30 small initiatives have a significant effect

Tokyo (Japan) [fig. 28]

The Japanese words “Kukaka-Seiri” stand for a replotting system, which is based on the principle that landowners should profit from the value increase of their land, when it is appointed for city expansion, without the common interest having to suffer (Berg, 1991). Due to high land prices and tax-advantages for farmers, a lot of landowners in Japan are part-time farmer. Intensive technology leads to high production levels. If an area is designated for redevelopment, a plan for all public functions is created. The landowners reserve about 30% of their land for these public works (roads, drainage, schools, parks, etcetera). The remaining land stays productive, with crops like rice, vegetables and sods. The process has significantly raised the plot prices and each landowner can sell his plots individually for (housing) development.
The size of Kukaka-Seiri projects differs from 25ha (group of landowners) to 165ha (project developer) (Berg, 1991). The preparation takes three years on average, realisation about five. The main advantage of the system is that the Japanese society gets space for public works for little money and the overall profit goes directly to the landowners. However, the speed of development after finishing Kukaka-Seiri cannot be controlled and the continuity of production is uncertain.

Havana (Cuba) [fig. 29]

Before 1989, urban agriculture was non-existent in Cuba, since the socialist government provided everyone with food packages - 50% of the ingredients were imported (Alvarez, 2004). When the Socialist Bloc disintegrated, Cuba lost access to fossil fuels, direct food imports and agricultural inputs, which led to a severe crisis. In 1989 Fidel Castro proclaimed that no piece of land should be left uncultivated, including Havana (Chaplowe, 1998). The main idea of urban agriculture is based on “production by the neighbourhood, for the neighbourhood”, which refers to the cycle of producers, marketing and consumers. Close attention is paid to environmental protection: efficient use of water, and careful management of soil fertility, crops and animals. Chemical pesticides are prohibited (Alvarez, 2004). This has led to several types of urban agriculture, like state farms and popular gardens. The first produces for the national food supply system, the second serves the community more directly. The popular gardens are spontaneously emerging gardens in yards and on balconies, ranging in size from a few square metres to 3 hectares. Garden sites are usually vacant or abandoned plots, planted with vegetables associated with the temporate climate (cabbage, cassava, potatoes, lettuce, etcetera). The majority of participants are men, although women and children also work in the gardens. Horticulture clubs are an important organizational feature. The surplus produce is sold on farmers’ markets – it is prohibited to sell on the street (Chaplowe, 1998).

Montreal (Canada) [fig. 30]

The rooftop garden project is an initiative of Alternatives (an ideologic organisation striving for countering poverty, racism and social exclusion) and Santropol Roulant (ideologic meal service for seniors and disabled people). Throughout the city, there are seven roof gardens, with an average size of 0,05 ha. Moreover, the organisation sells Ready-to-grow-kits, to create your own balcony garden. A demonstration garden is located at the geography building of McGill University.
During the growing season (March-October) volunteers help producing vegetables which are donated to a meal service organisation (The Rooftop Garden Project, 2007).
The technique used is a combination of permaculture principles, hydroponics and organic gardening. This method needs less soil, which makes it suitable for rooftop gardens.
The garden mostly exists of containers and pots placed in rows and structures for vertical gardens. The volunteers help all season, and are rewarded with a festive harvest party. The garden is also used as a community space for, amongst others, yoga lessons and activities for children.

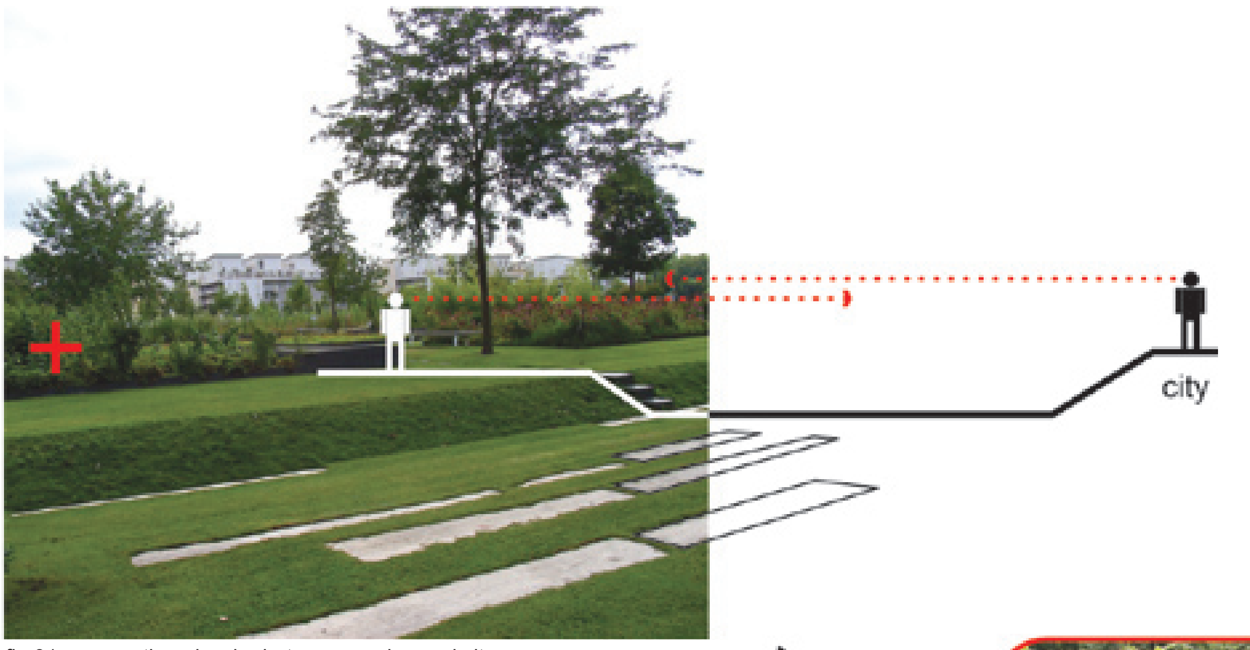


fig.31 a path as border between garden and city

fig.32 an inspirational idea could lead to a well-managed garden

Bordeaux (France) [fig. 31]

The botanical garden in Bordeaux aims to educate citizens about natural processes and the relationship between nature and culture by the exhibition of natural landscapes, cultural crops and experiments in greenhouses. According to landscape architect Catherine Mosbach (who won the competition for this park in 1999, its implementation is finished in 2005) this is possible by appealing to both intellect and emotion (LAE, 2006). Moreover, her philosophy has created a garden in which the plots melt into garden beds in a coherent garden which is integrated in the urban fabric. The garden of 4,6 hectares is surrounded by a dry ditch and a low wooden wall, which also functions as a path. The garden is divided in three zones: the city garden, the crop garden and the gallery of natural landscapes. Connecting the neighbourhoods and the garden, the greenhouses are placed at the north end, including a visitor centre (LAE, 2006).

London (Great Britain) [fig. 32]

Shortage of open space and nature has been the inspiration for concerted and effective community action to create the Calthorpe community gardens, right in the heart of London's business centre (Camden). A 0,5 hectare site, originally for office development, was turned into a garden, managed by members of the community (Kenworthy, 2000.) The annual budget is provided by the Borough, a good deal of which is used to pay nominal salaries to a few local residents who act as official caretakers/managers.
There are quiet sections with water features and seating; grassed areas surrounded by flower beds where many office workers and residents come to eat their lunch; glasshouses and other areas for germinating seeds and tending seedlings; an area expressly for those under 5 years old; tennis courts; a small swamp area where children can catch tadpoles; a playground for older children; as well as an on-site office, information centre, meeting area and a small restaurant. The project has generated more, smaller initiatives in neighbouring streets, all greening the city (Kenworthy, 2000).

The precedents each contain lessons about scale, organisation and societal circumstances. The pre-industrial practice of interweaving urban development and agriculture has completely disappeared during the Industrial Revolution. The increasing prosperity of the Western world has eliminated the necessity of close-to-home food production.

The example of Havana states that a crisis could serve as a catalyst for implementing urban agriculture. When Cuba got cut off from international supply chains, space became available for production (Chaplowe, 1998). The same has happened in Europe during the Second World War. An illustrative example is the Crystal Palace Gardens in London that were purely ornamental before the War (Tomkins, 2006). During the War, lack of food created the necessity to transform the gardens into farmland.

In the urban context, spatial pressure is high. A way of dealing with this pressure is the replotting system in Japan. By incorporating the urban agriculture into the new development process itself, space for urban agriculture is guaranteed. But ultimately the area will be built upon; therefore appointing spaces for urban agriculture and safeguarding them from future development is essential.

In the case of London, the community had to stop a building project from happening, to create the gardens (Kenworthy, 2000). Economically, the building project tends to be a stronger force than the striving for nature and production in the city. But the educational and health aspects, combined with strong sense of community, have created enough power to instigate change.

Therefore, a shift in urban lifestyle is crucial for any shift in urban landscape (Viljoen, 2005). The rooftop gardens in Montreal prove that this shift can occur by small actions, which have the power to instigate a larger mentality alteration. This is done by involving the community in the actual food production and using the space for multiple other leisure activities. By selling boxes for vegetable production at home, everyone can become a successful gardener and start to appreciate locally produced food.

The educational aspect is the main principle of the botanical garden in Bordeaux. But here, the display of crops and natural landscapes in order to educate about nature and culture is integrated in a park with high aesthetic quality (LAE, 2006). In the layout of the park, the productive plots serve as a planting scheme. A holistic approach of community involvement, food production and recreational facilities within a coherent park design proves to be the recipe for a productive urban landscape.

5.3 Conditions urban agriculture

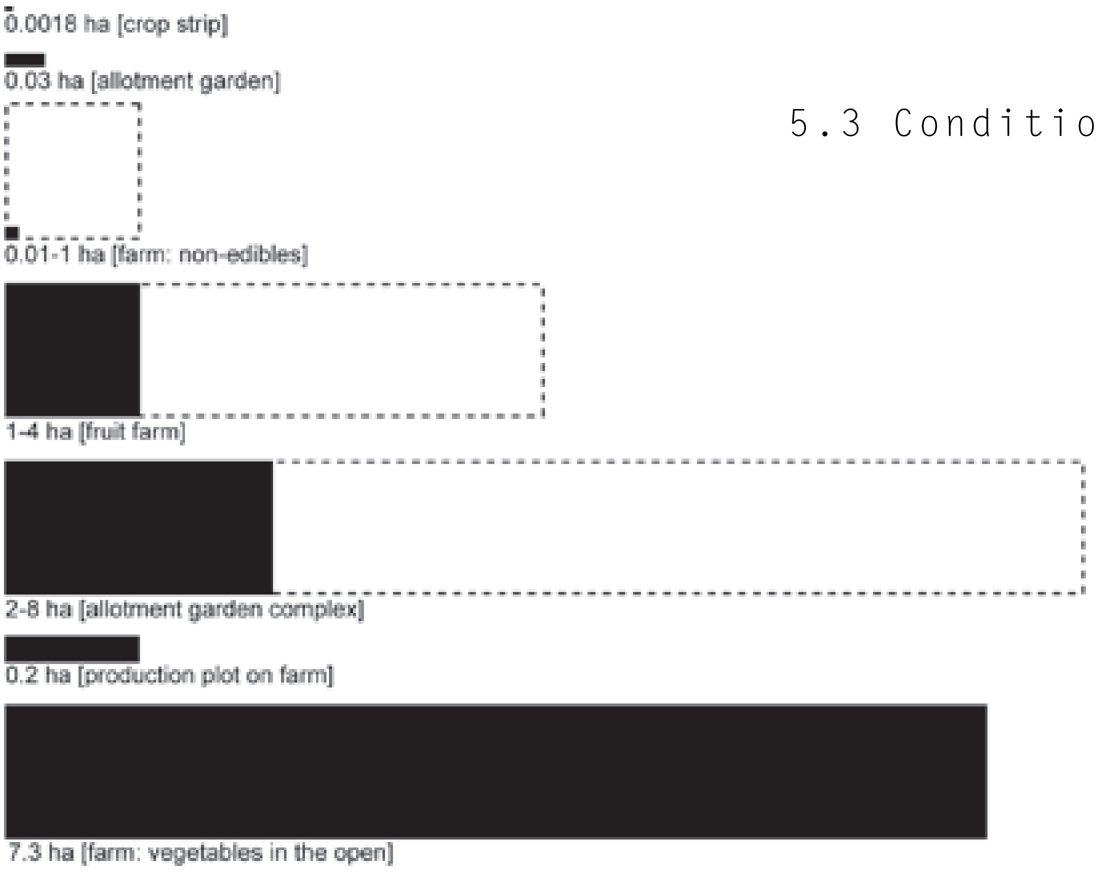


fig.33 scale of production units

When designing a productive urban landscape, the spatial configuration and technical requirements of production systems need to be taken into account. The present situation of organic fruit- and vegetable production in the open, in the Netherlands, was taken as reference to generate production principles.

The scale of production units for fruit, vegetables and ornamentals generally ranges from 20 square meters up to 7 hectares (LEI, 2003) [fig. 33].

Individual plots are organised into larger entities, creating a specific spatial subdivision. There is a difference between private and commercial production [figs. 34, 35].

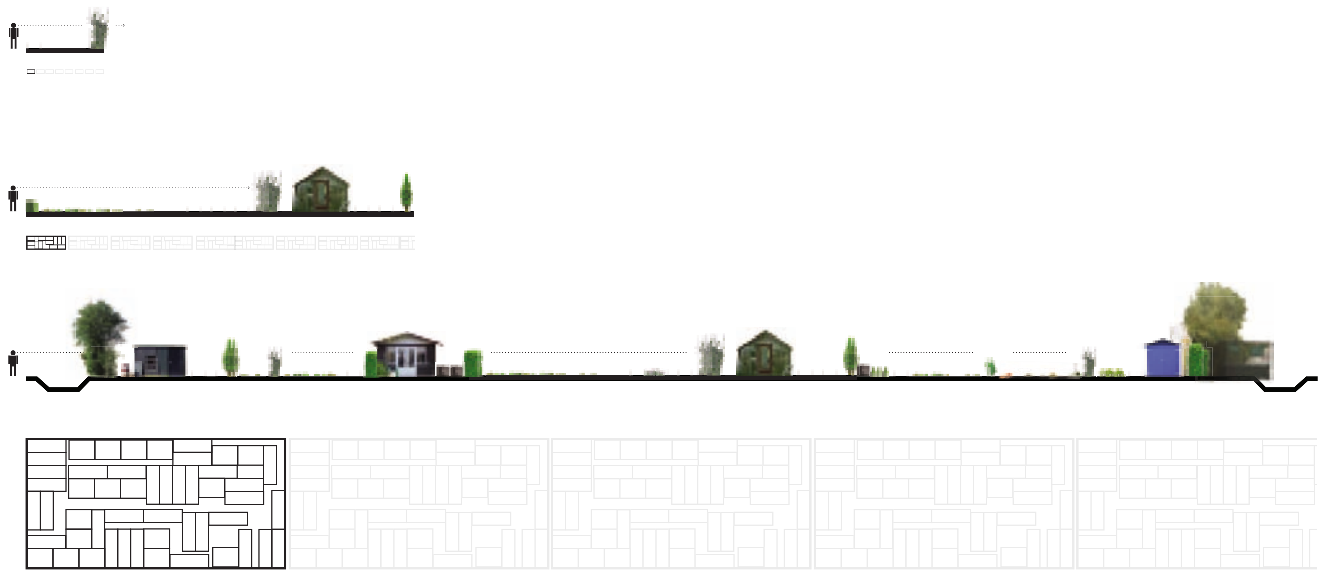


fig.34 private production

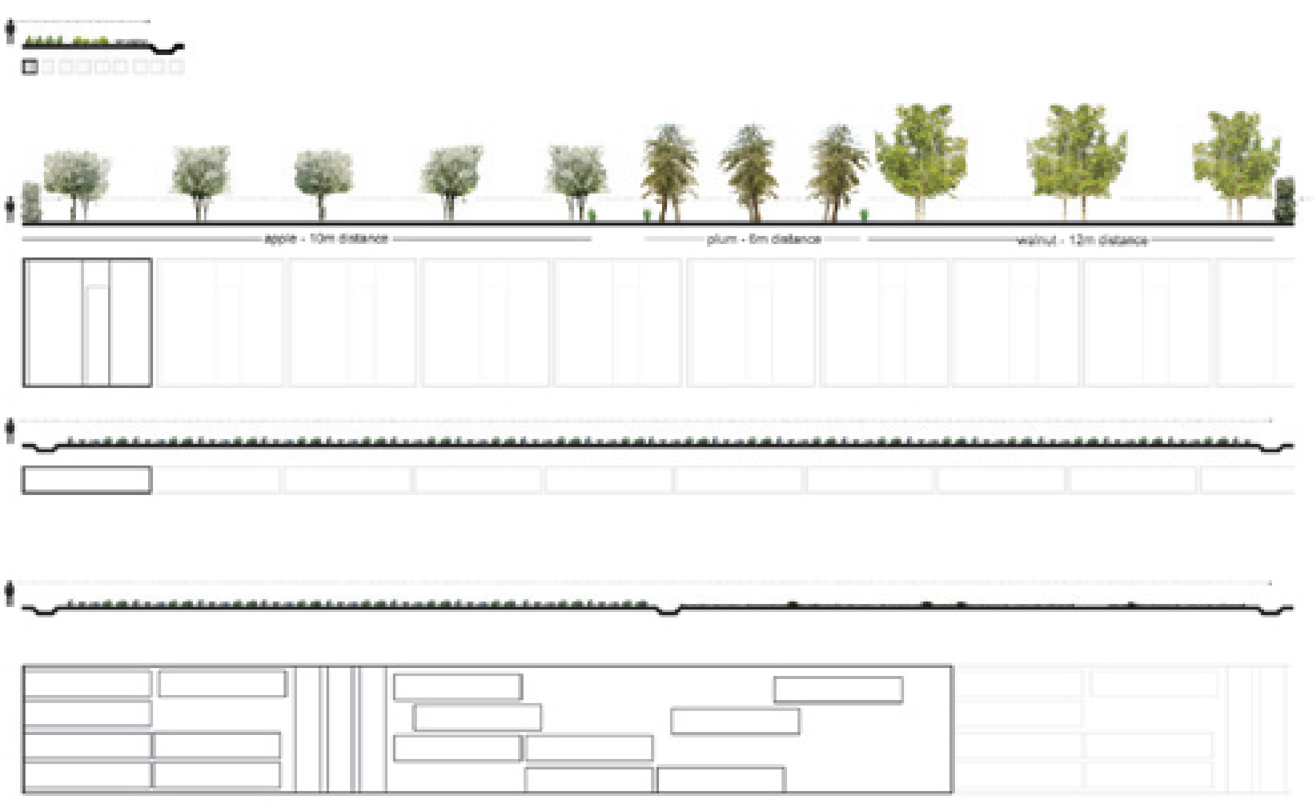


fig.35 commercial production

The various production entities all have limited accessibility, but vary in sight and transparency. When integrating production systems into the urban fabric, the transparency of processes is relevant. The degree of visibility, achieved by possibilities to view and walk around plots, is substantial for integration with urban green. In order to protect the quality of green and the production, illusory access (good sight, no entry) is required [fig. 36].

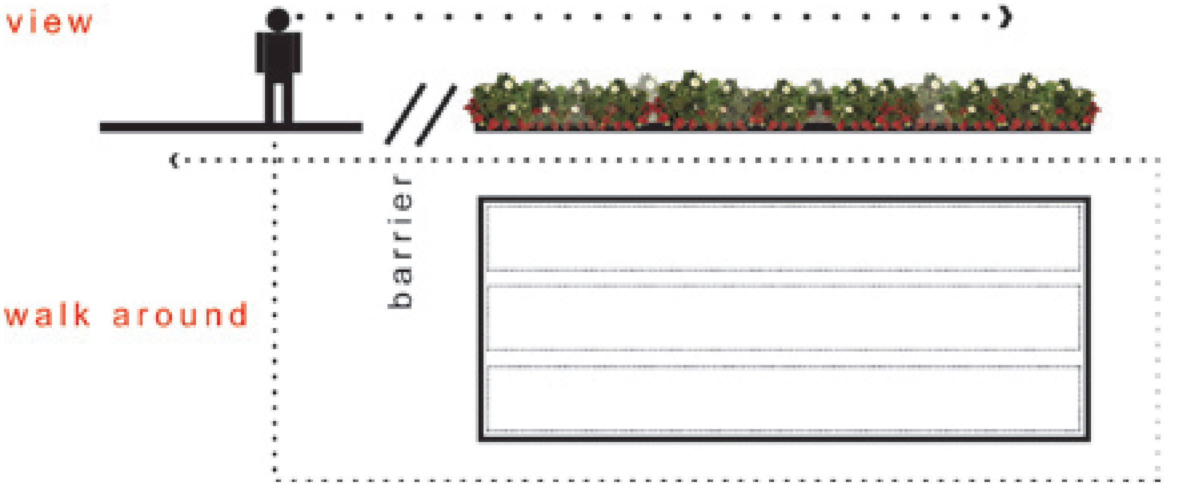


fig.36 illusory access

With the different seasons, the climatologic circumstances change. The angle and intensity of the sun depends on the time of year, along with the urban configuration (Kourik, 1986) [fig. 37].

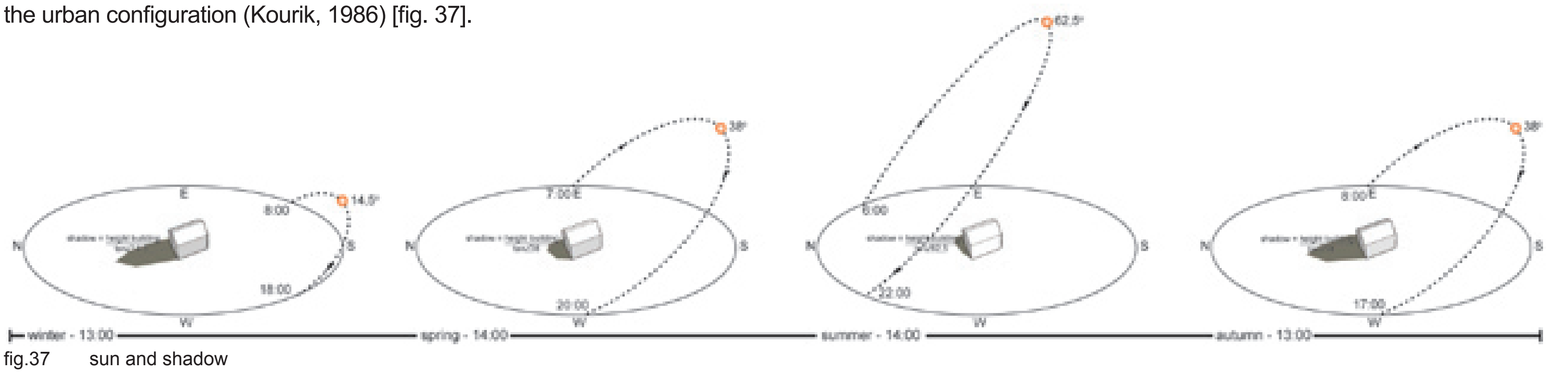


fig.37 sun and shadow

The urban configuration is also important for wind conditions, because high buildings speed up wind locally. However, the velocity within the urban is half of what it is outside. Wind affects temperatures, evaporation, and the rate of moisture loss and transpiration from vegetation (Hough, 2004) [fig. 38].

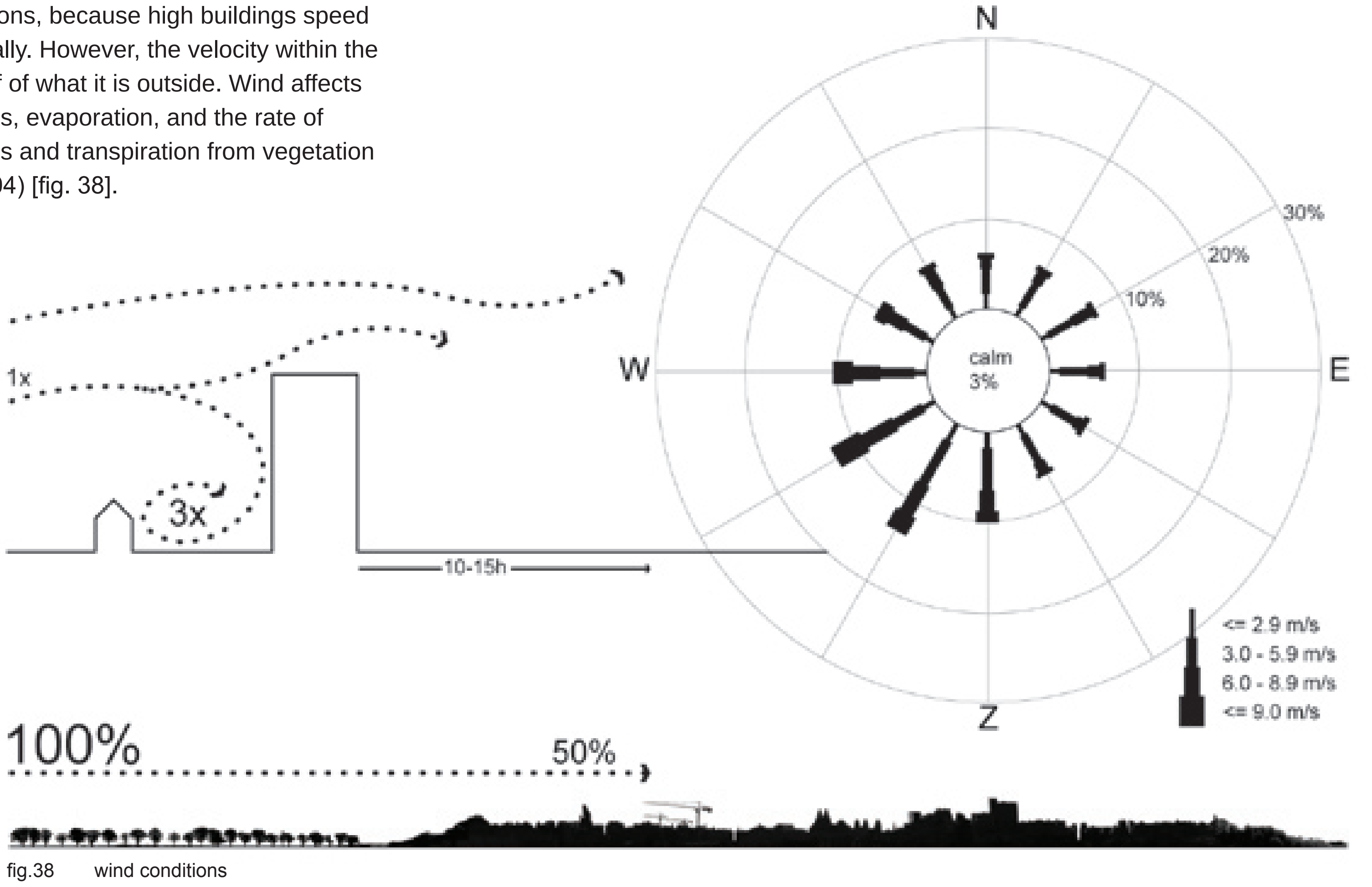


fig.38 wind conditions

Large amounts of impervious surfaces in the city create rainwater run-off, which disappears into the sewage system (White, 2002). Yet the quality of water fallen on roofs is good enough for irrigation (Mollison, 1988). This type of surface run-off proves to be a valuable source in urban production [fig. 39].

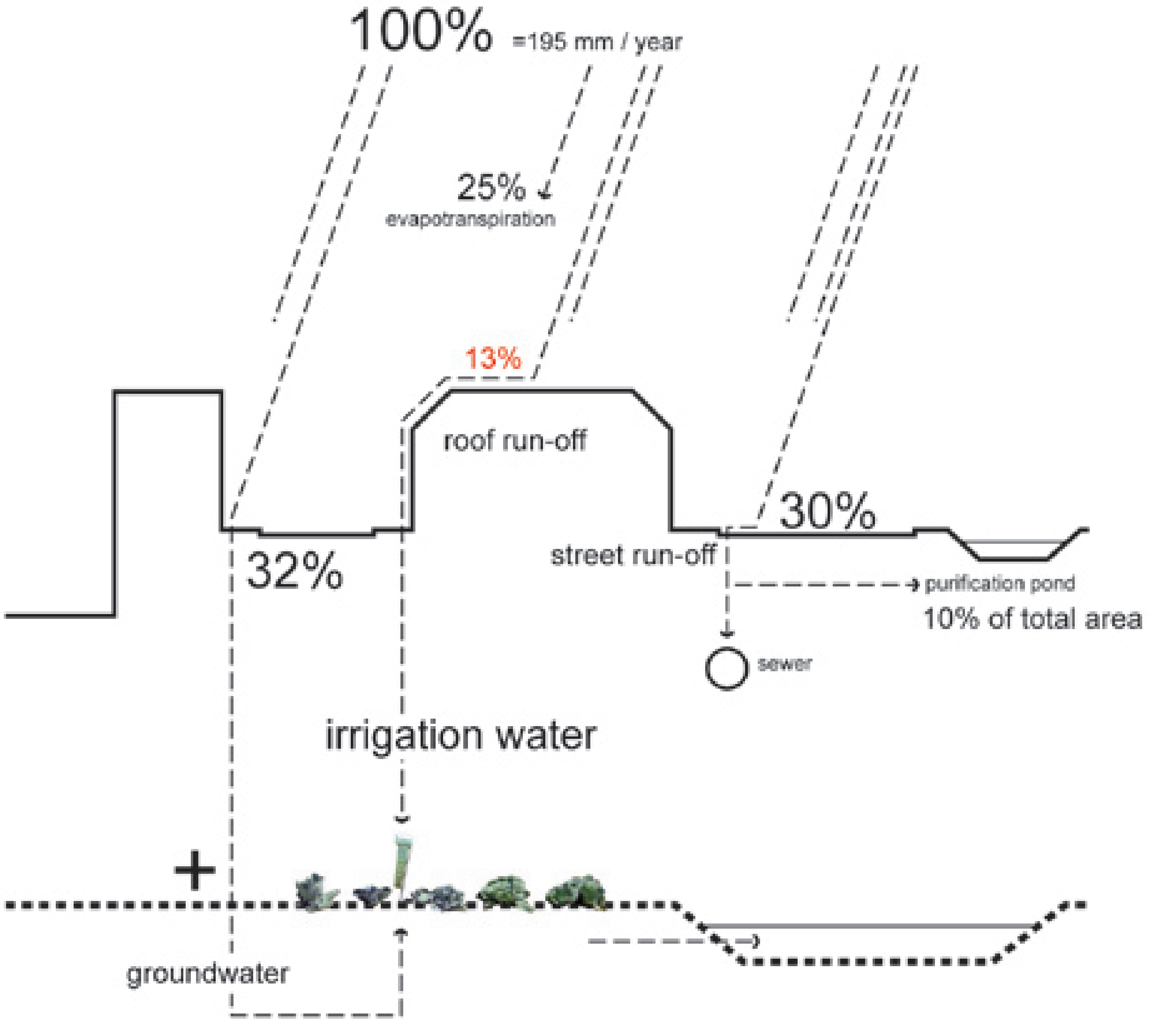


fig.39 urban water cycle

Together with weather conditions, the nutrient cycle is crucial. The nutrient supply in an urban context is different from rural settings, as soil is often contaminated. Traces of heavy metals and pesticides influence the growth of food, and could cause health risks when accumulated in the human body. Solutions consist of soil treatment, avoidance of contact by soil covering, or choosing crops with low potential to accumulate heavy metals (EPHC, 2003) [fig. 40].

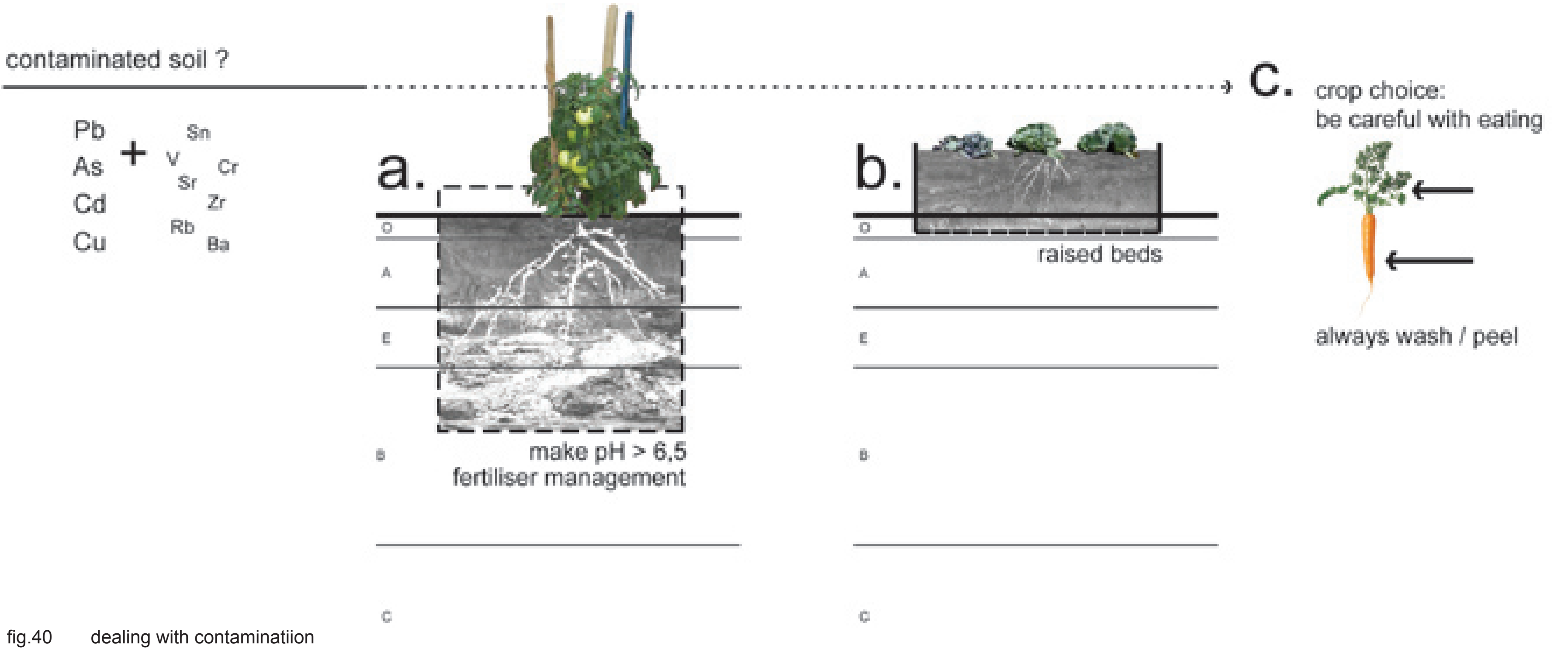


fig.40 dealing with contaminatiion

fig.42 local market

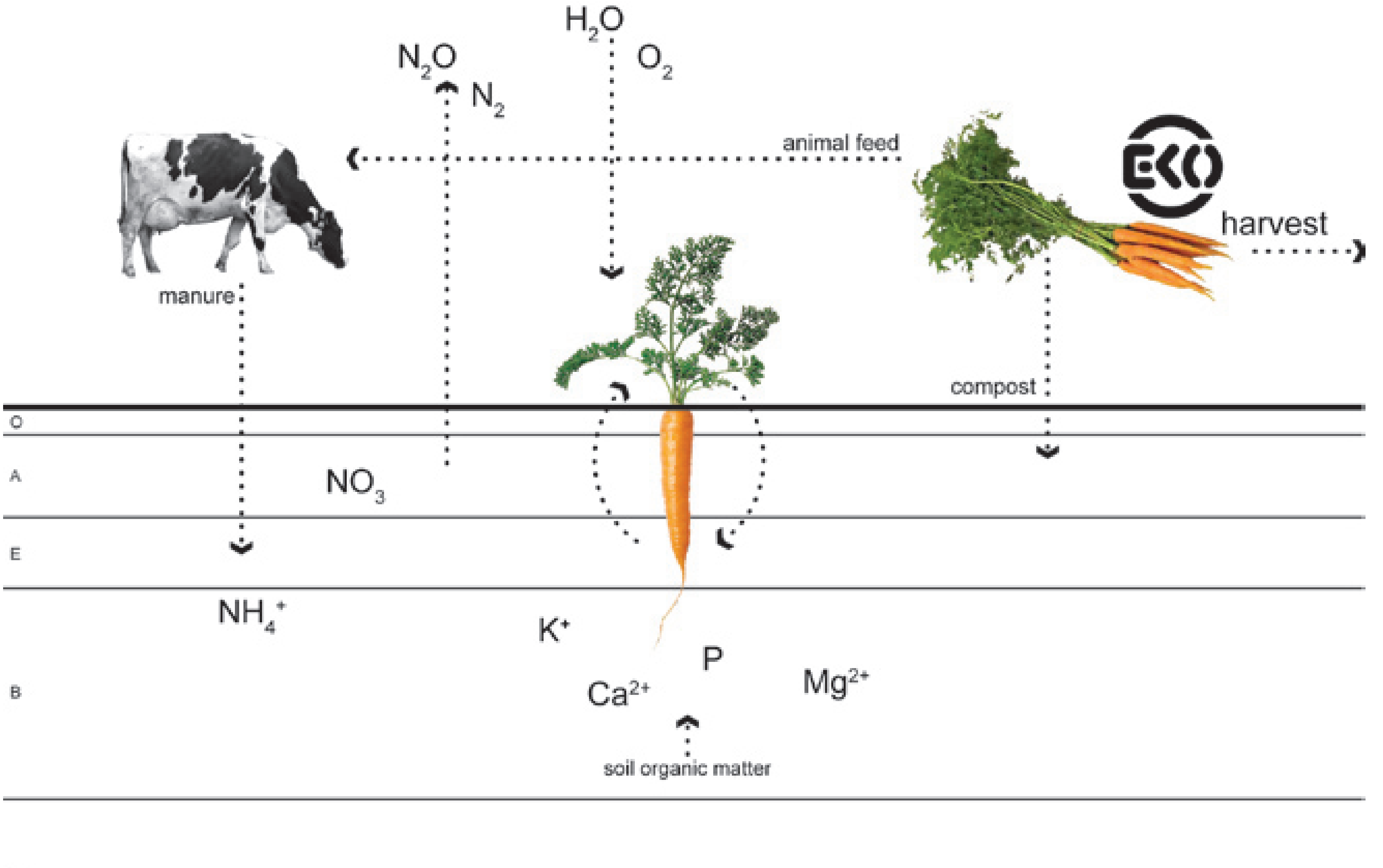


fig.41 organic agriculture

In case of urban agriculture, organic production would be most fitting. Without the use of artificial fertilisers and pesticides, it resembles natural cycles and therefore helps to improve natural resistance [fig. 41].
Additionally, in the dense urban environment health and safety conditions come into play, and there is market for organic food, (illustrated in the Amsterdam region) (Hassink et al., 2005; Biologica, 2007) [fig. 42].

Opposite to most urban green, productive green needs intensive maintenance. This can be executed according to scale; large scale would fit commercial holdings or contractors, small scale calls for community involvement (Berg, 2008). Working with contractors and subscriptions safeguards the continuity in maintenance, whilst still providing the local inhabitants the opportunity to collaborate in their neighbourhood green [fig. 43].

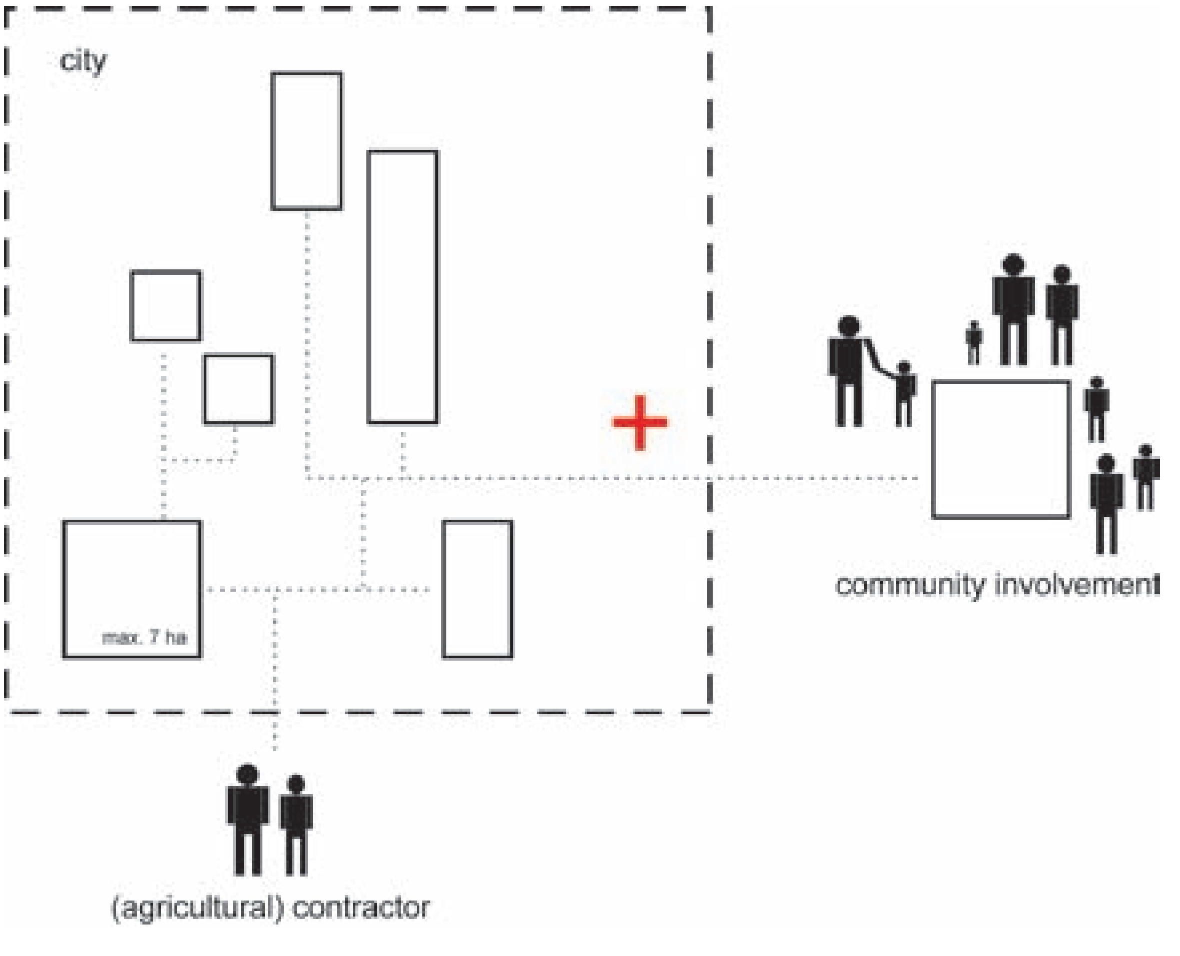


fig.43 organisation principle

Potential of Amsterdam

The landscape is a socio-physical organization in which the natural system has been transformed into conditions for society (Kleefmann, 1992). The contemporary society, as illustrated (before) in the Randstad, demands changes of city-countryside relations. Positioned in the typical Dutch (peat) lowland and dealing with ongoing urbanization, the metropolitan region of Amsterdam clearly expresses the present definition of landscape. Considering its hinterland, size and density, Amsterdam is worth researching the potential of space for urban agriculture.

6

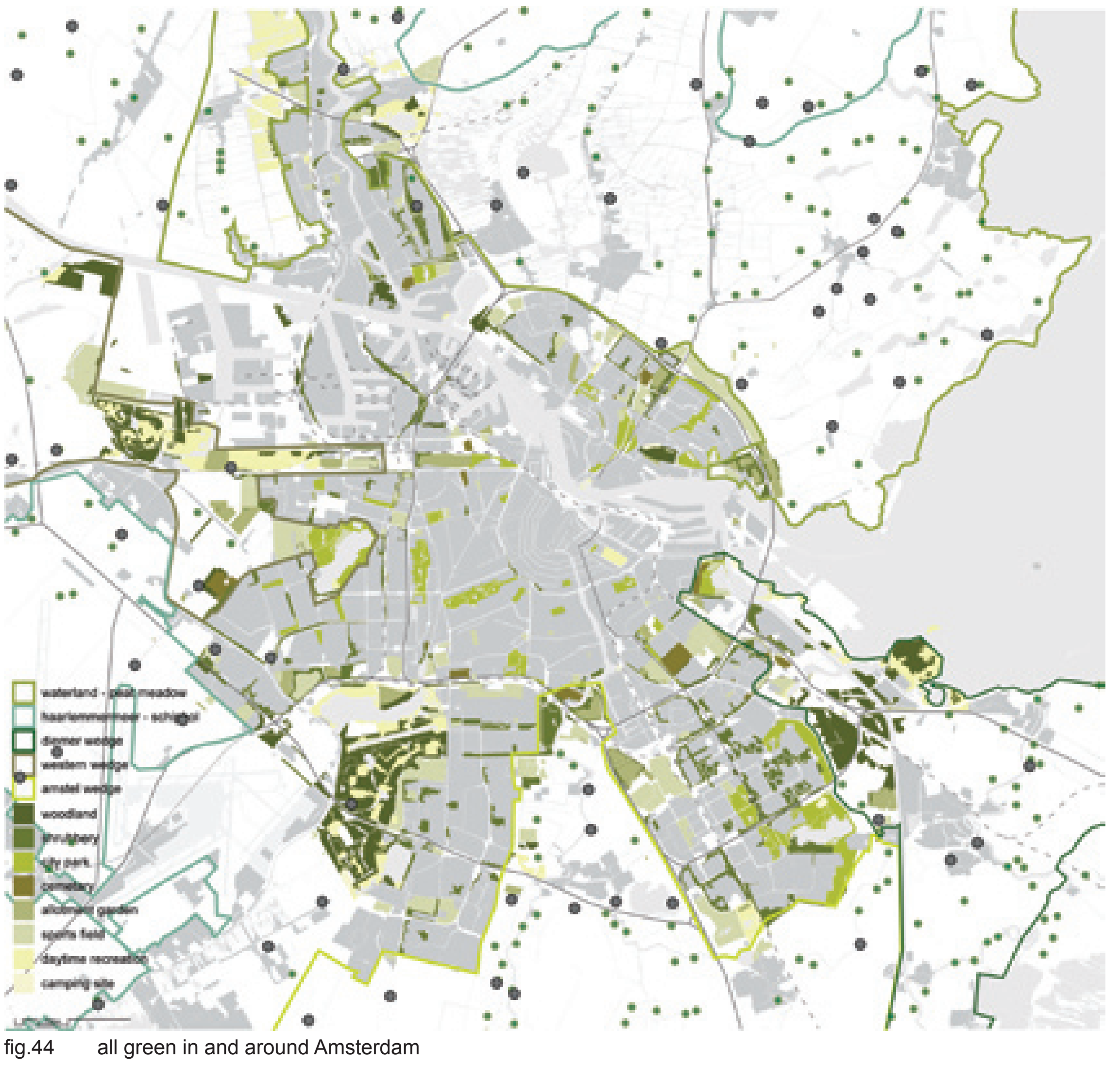


fig.44 all green in and around Amsterdam

6.1 Top-down: city green

The green of the Amsterdam region can be split into surrounding areas and parts within the city [fig. 44]. Five different landscapes surround the city, varying in openness and vegetation patterns. Characteristic are the wedges: green entering the built environment (dRO, 2007).

Visible is the changing character of the surrounding countryside, where farmers no longer 'just' produce. Either nature maintenance or facilities for citizens are now included in their business (Hassink et al., 2005) [fig. 45].

Within the city boundaries green can be distinguished into eight categories [fig. 46].

Most green is combined into a 'green structure' by the municipality, to create a secure layer within the structure of the city (dRO, 2003) [fig. 47]. The green structure is suitable for policy making, but actually manifests itself as a mosaic rather than a structure. The mosaic safeguards certain parts but is equally capable of including all (types of) green.

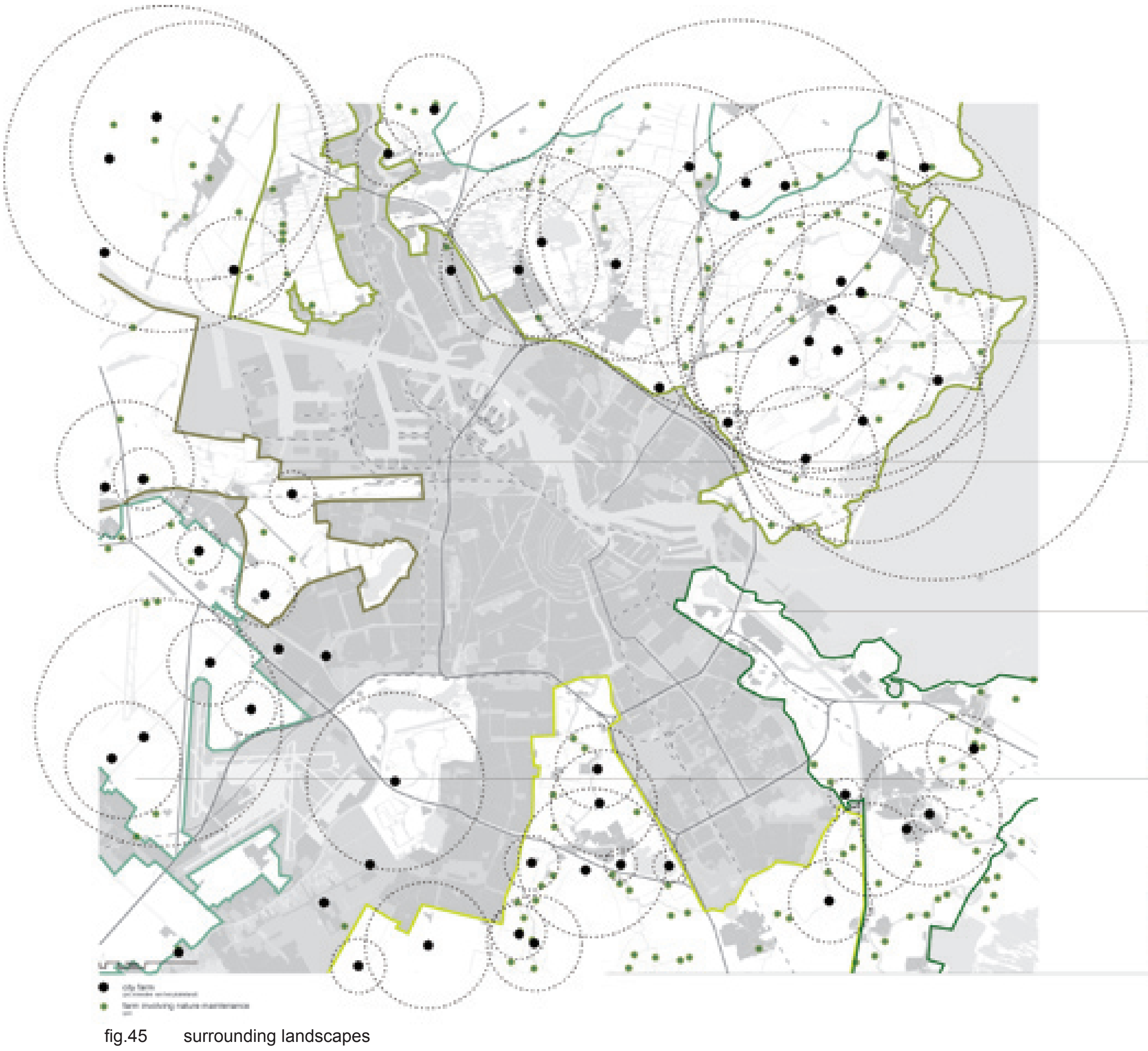
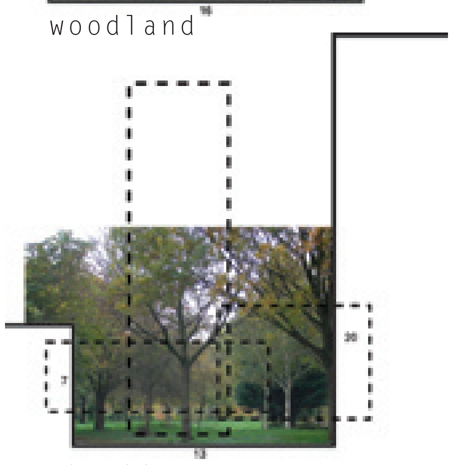
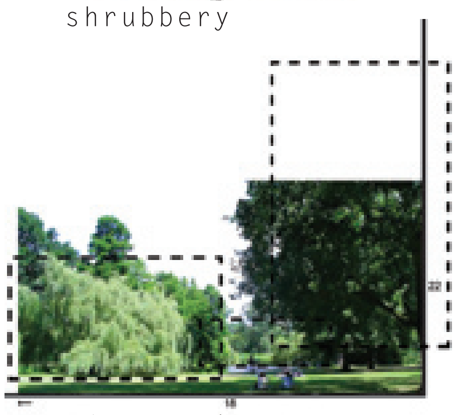
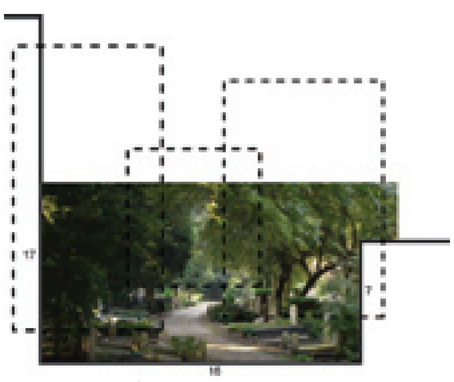


fig.45 surrounding landscapes

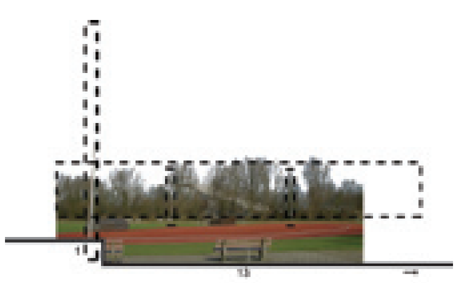

woodland

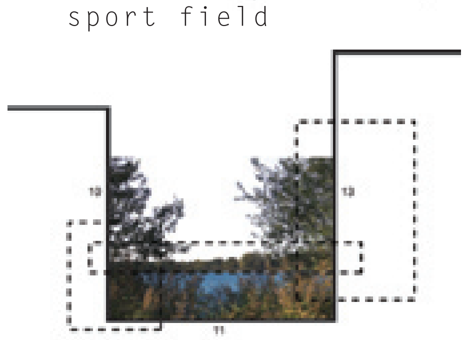

shrubbery


city park


cemetery


allotment garden


sport field


daytime recreation

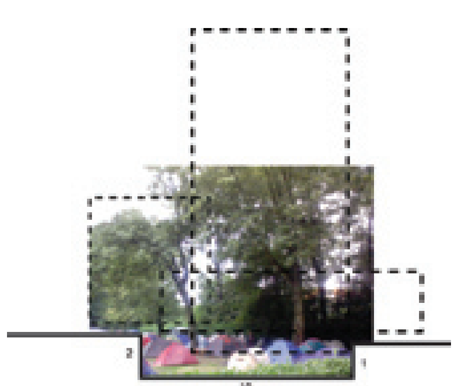

camping site

fig.46 green space within the city boundaries

fig.47 the green structure accoriding to dRO

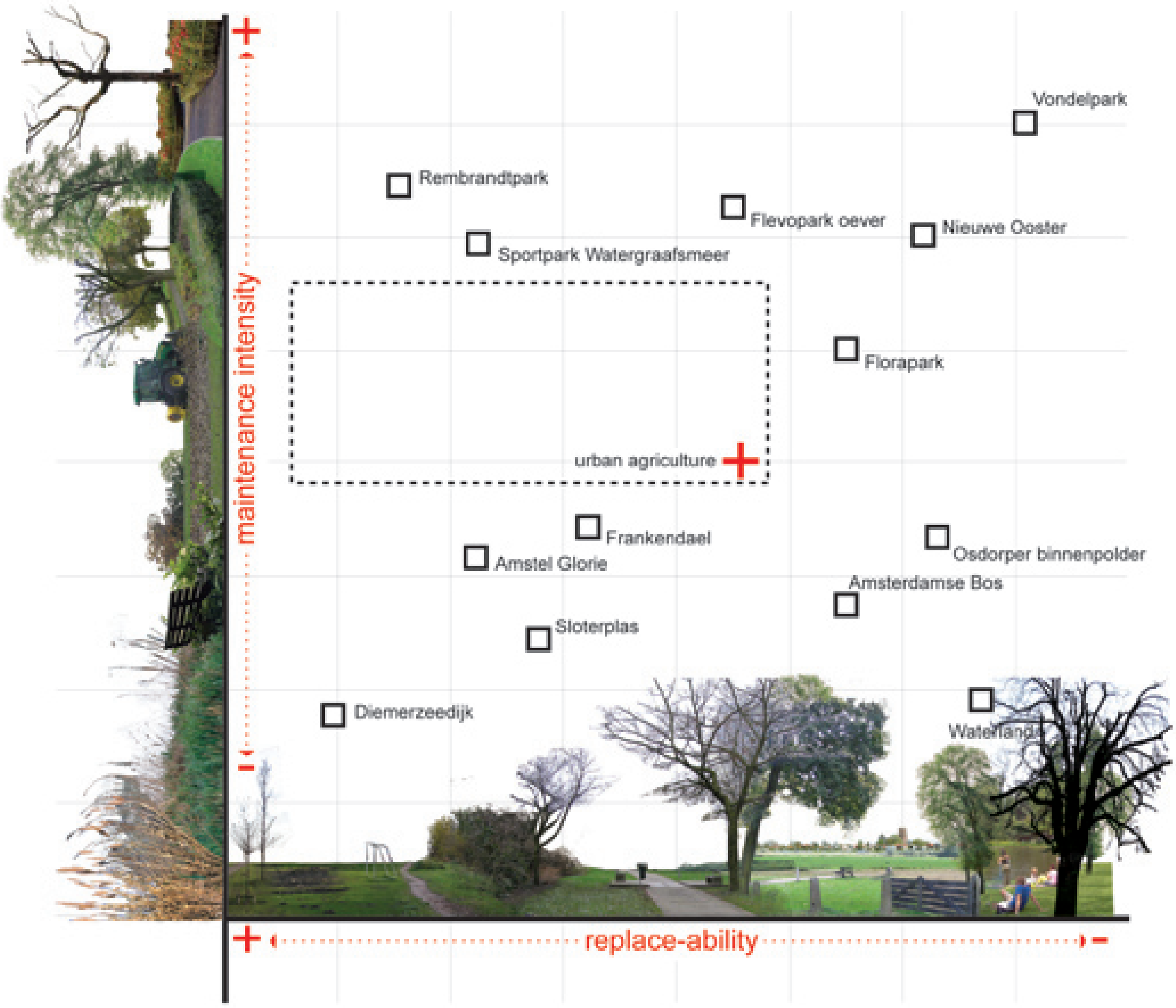


fig.48 green quality matrix

fig.49 green with potential for implementing urban agriculture

To grant this secure layer of green within urban networks, natural resistance should be improved. For natural resistance, the quality of the green is important. The degree of quality in urban green depends on the level of maintenance and the ‘replace-ability’ [fig. 48]. High maintenance implies a cultural character and high user intensity, whereas low maintenance provides growing opportunities and ecosystem development, leading to a more natural character. An indication of ‘replace-ability’ is valuable when protecting ‘old landscapes’; mature vegetation and green with cultural historical significance (dRO, 2003).
The combination of an intermediate level of maintenance (no high user intensity, nor very natural) with replaceable green illustrates those parts of urban green where quality could be improved (dRO, 2003) [fig. 49].
To improve quality, and thus enhance the natural resistance, a new interpretation of green is required. Adding a productive element, and aiming for productive urban landscapes is a way to strengthen the secure layer of urban green.

The areas indicated as replaceable and fairly extensive, are in fact suitable to implement urban agriculture, because agriculture is characterised as cultivated green and has a temporary aspect.

6.2 Bottom-up: urban fabric

The top-down analysis, from surrounding landscapes to city parks, reveals the first possibilities for production within city green. However, since landscape includes the urban fabric, a bottom-up approach will lead to different perspectives.

Amsterdam is built along lines of natural conditions and through classic urban expansion plans (Heeling et al., 2002). Gradients of urbanity change according to time and position in the metropolitan network, dividing the city into different parts. Three different gradients are highlighted, expressing the Amsterdam' range of building typologies and their options for new, productive urban landscapes [fig. 50].

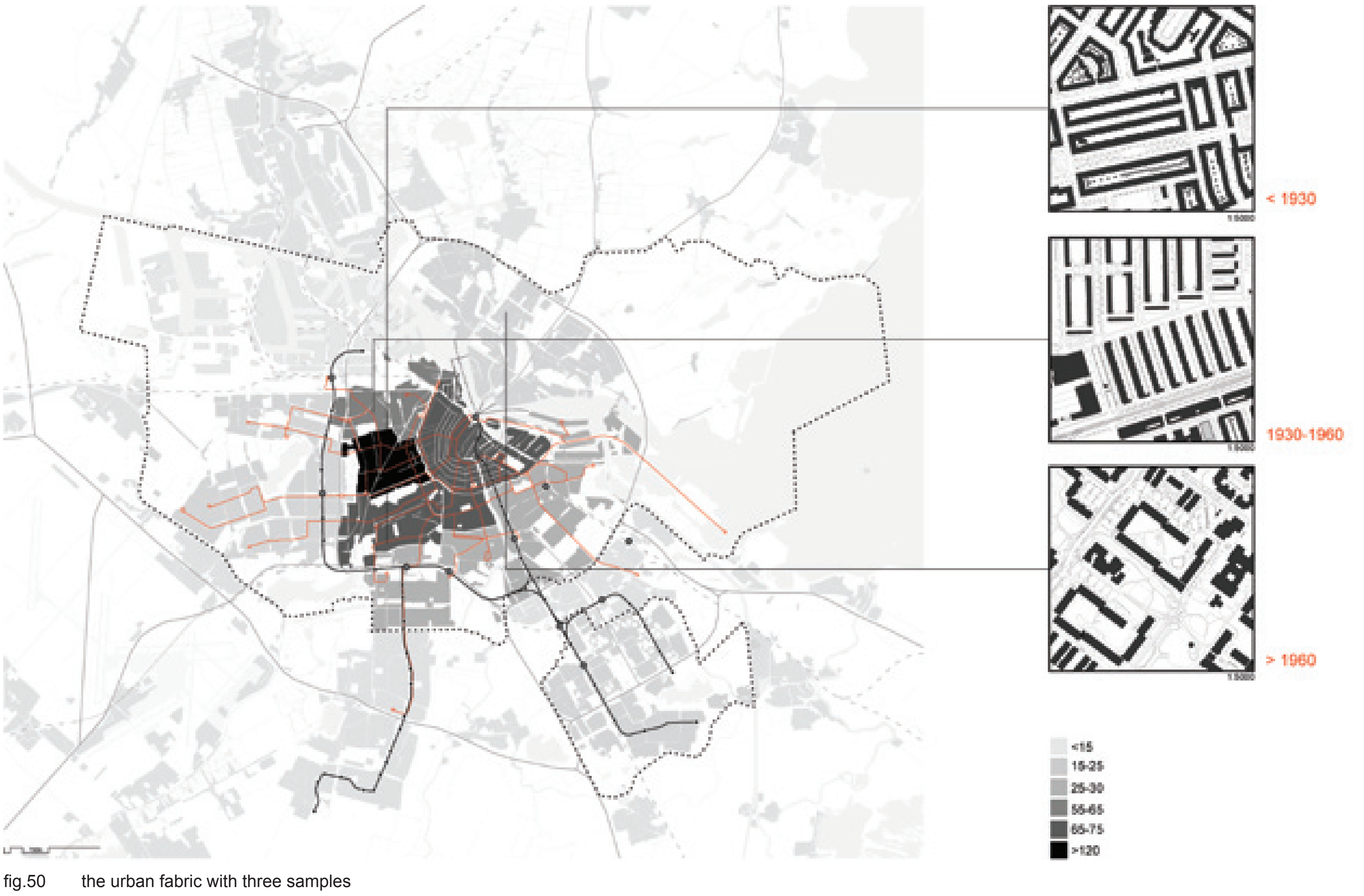
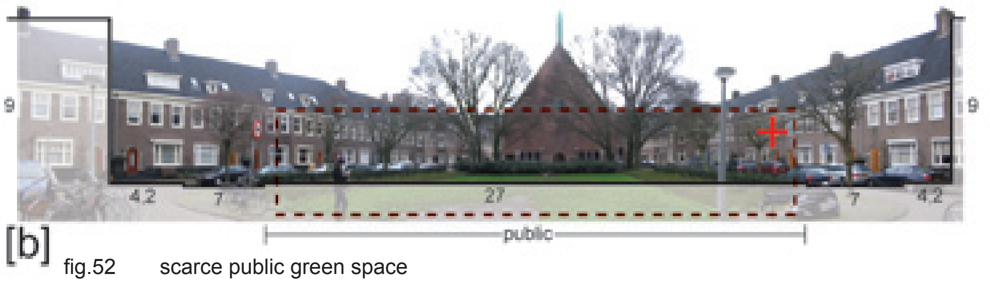


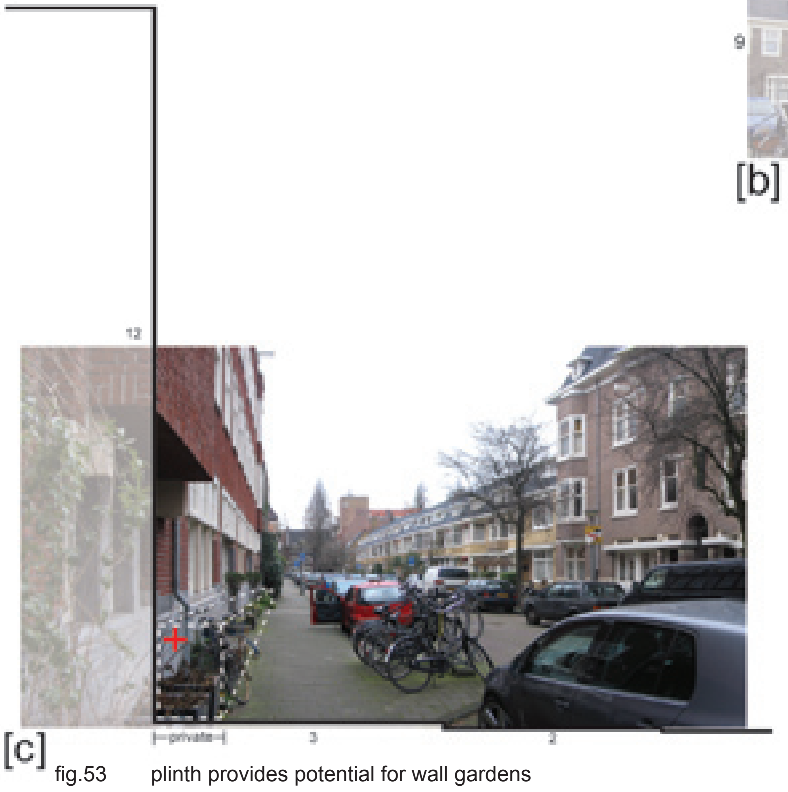
fig.50 the urban fabric with three samples

<1930

[a] fig.51 space for urban agriculture within a street profile



[b] fig.52 scarce public green space



[c] fig.53 plinth provides potential for wall gardens

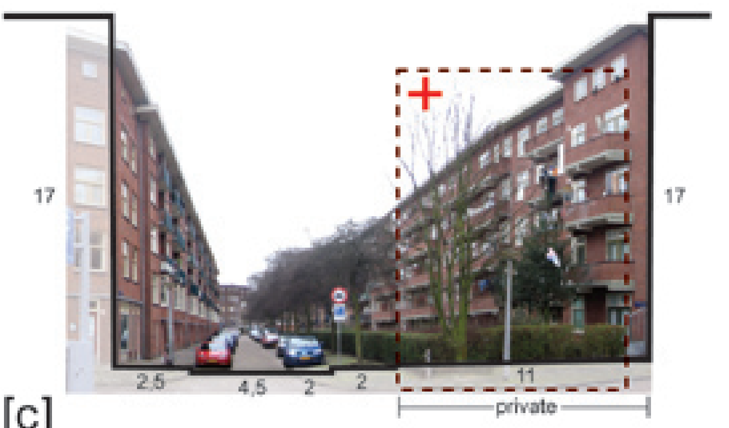
fig.54 potential spaces within the closed buidling block

The Stadion Buurt and Apollo Buurt are components of the 1930s AUP expansion plan, characterised by the closed building block (Heeling et al., 2002). The orientation is inward with mostly private space. Public space is only found as part of street profiles and in neighbourhood playgrounds. The monumental atmosphere further limits the room for changes of public green [figs. 51–54].

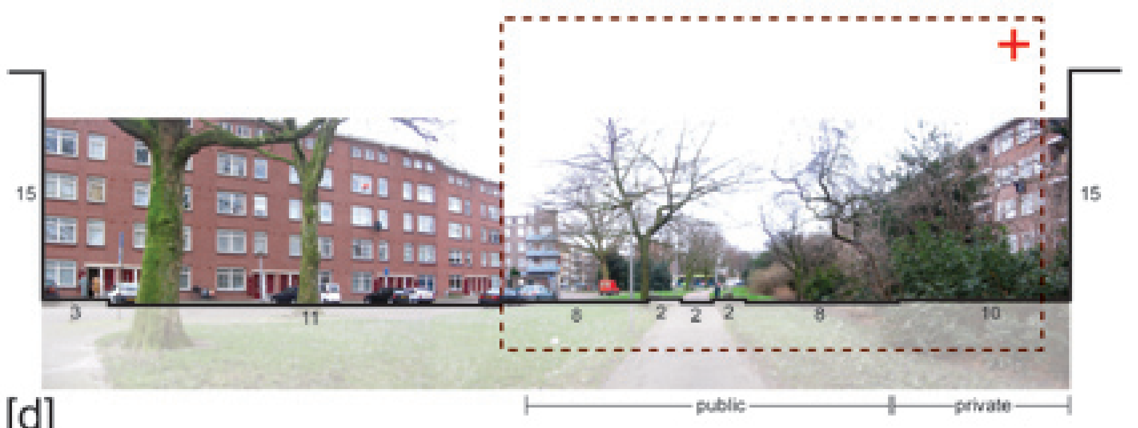
1930 - 1960

[a] fig.55 communal green at the front of the block

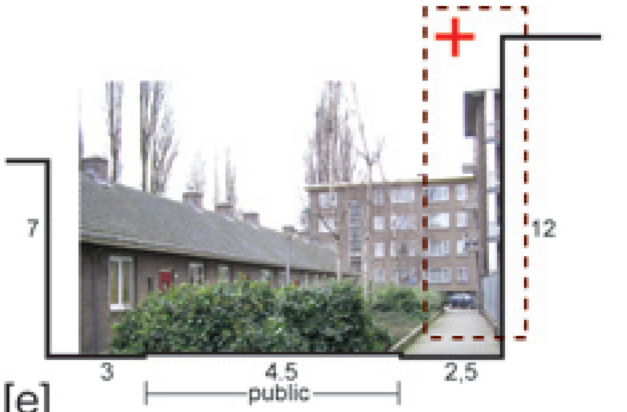
[b] fig.56 semi-private courtyards inbetween the blocks



[c] fig.57 garden and street inbetween the blocks



[d] fig.58 continuous public park zone could incorporate productive green



[e] fig.59 possibilities for wall gardens at south-facing facades

fig.60 potential spaces within the semi-closed buidling block

The closed building block was altered into semi-closed in city districts built after the 1930s. Example is Bos en Lommer, where large parts where constructed between 1930 and 1960 (Stadsdeel Bos en Lommer, 2008). Five-storey-flats face streets with communal green, but also have courtyards. These courtyards are considered to be semi-private; along the buildings façade there is a strip of small terraces, separated by fences from the mainly unused central garden. The open side of the building block is adjoined by public pavement; still the courtyard is never accessible, only visible.
Characteristic is the contrast between front- and backside of the buildings. The poor condition of the courtyards offers possibilities for new plans including productive green, especially because public routes are already present [figs. 55–60].

>1960

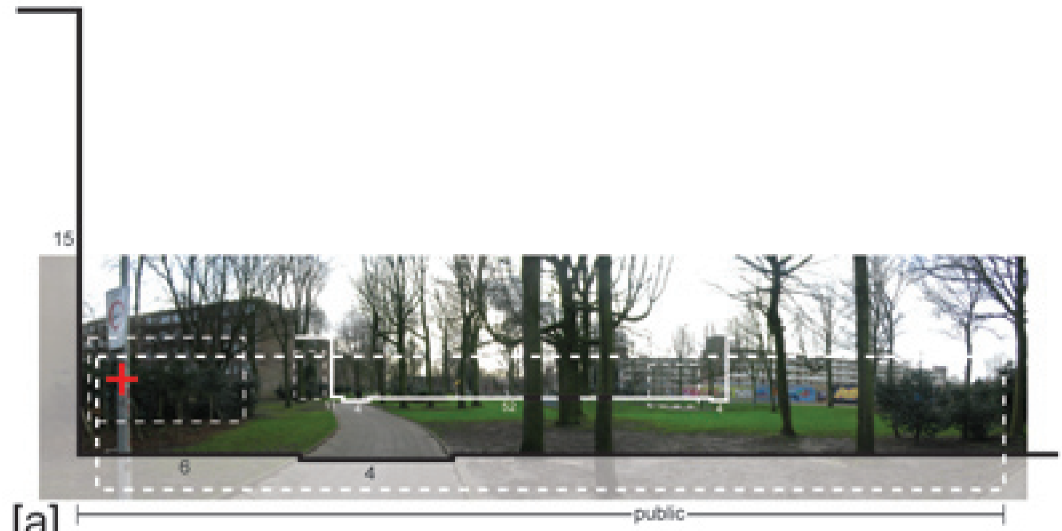


fig.61 continuous park zone connects to public courtyards

fig.62 public green at the front of the gallery flats

fig.63 sequence of private and public green

fig.64 green courtyard with public routes inside the block

fig.65 at the other side of the block, surfaces are paved

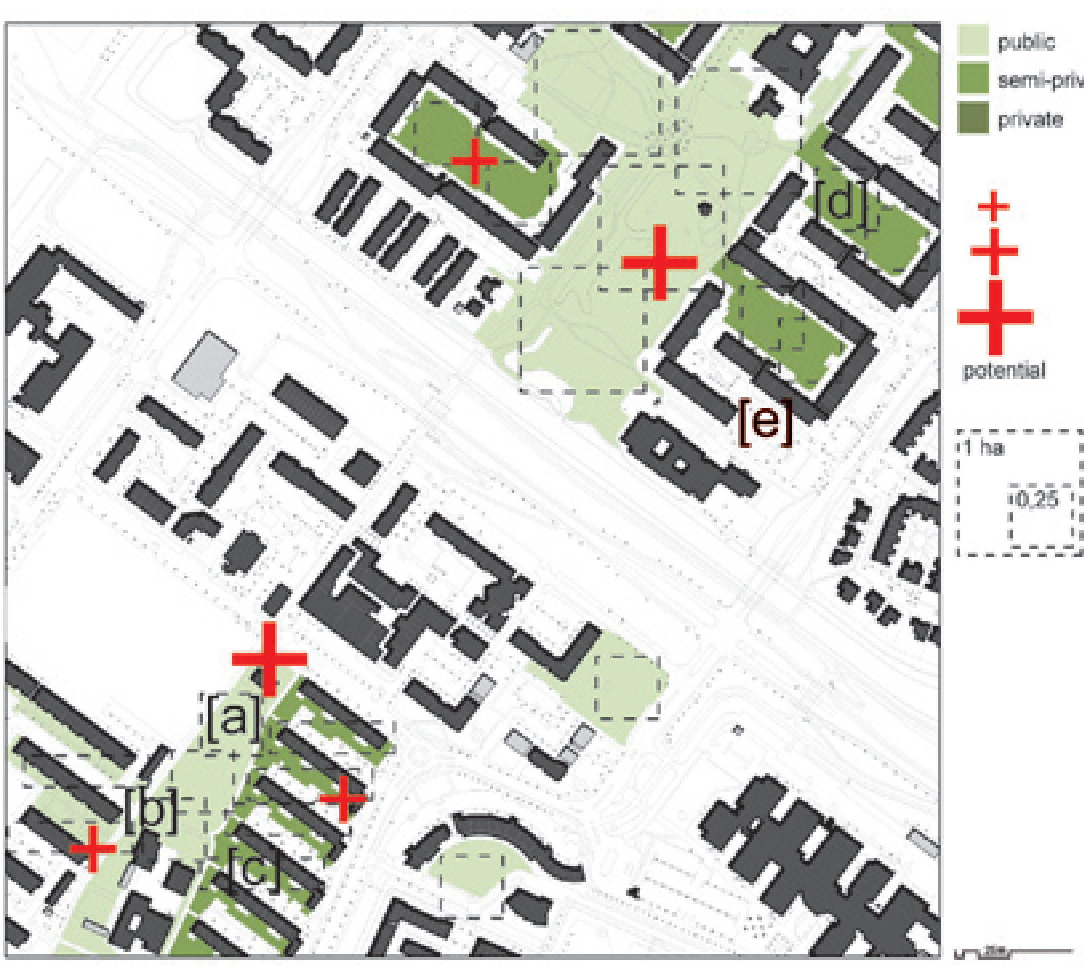


fig.66 potential spaces within the open buidling block

The building block evolved into semi-open and open in the 1960s and 1970s, with emphasis on public rather than private space. The Banne neighbourhood in Amsterdam North typifies this open and green character (Stadsdeel Amsterdam Noord, 2007). A central, public park strip provides room for facilities, and connects the semi-private courtyards. Routes cross the green as well as the building blocks. Only water and main roads limit the accessibility. Green is abundant, but the neighbourhood seems to deal with quantity, not quality. Because of the existing link between building and green, and the mixture of public and private, there is potential to create productive spaces and improve the area [figs. 61-66].

The potential for productive green found in each neighbourhood can be rendered to the city scale [fig. 67].

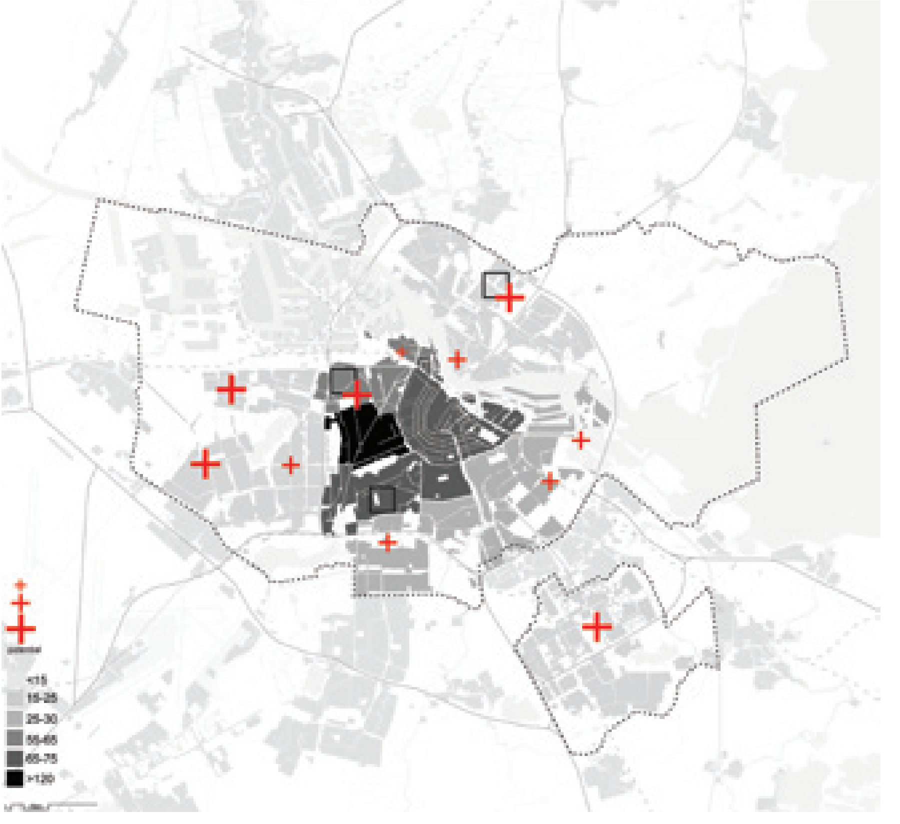


fig.67 plusses indicate potential for productive green

The varying gradients of urbanity dispose themselves differently in relation to the natural component of the landscape. Clearly, the urban network is being developed faster than landscapes would grow in a natural way. Though there seems to be an intermediate level, which lacks progress and at the same time indicates the temporality of the urban fabric: the derelict lands. Sites vacant for development of the planned, man-made system, but equally the unplanned, pioneering natural system (dRO et al., 2007) [fig. 68].

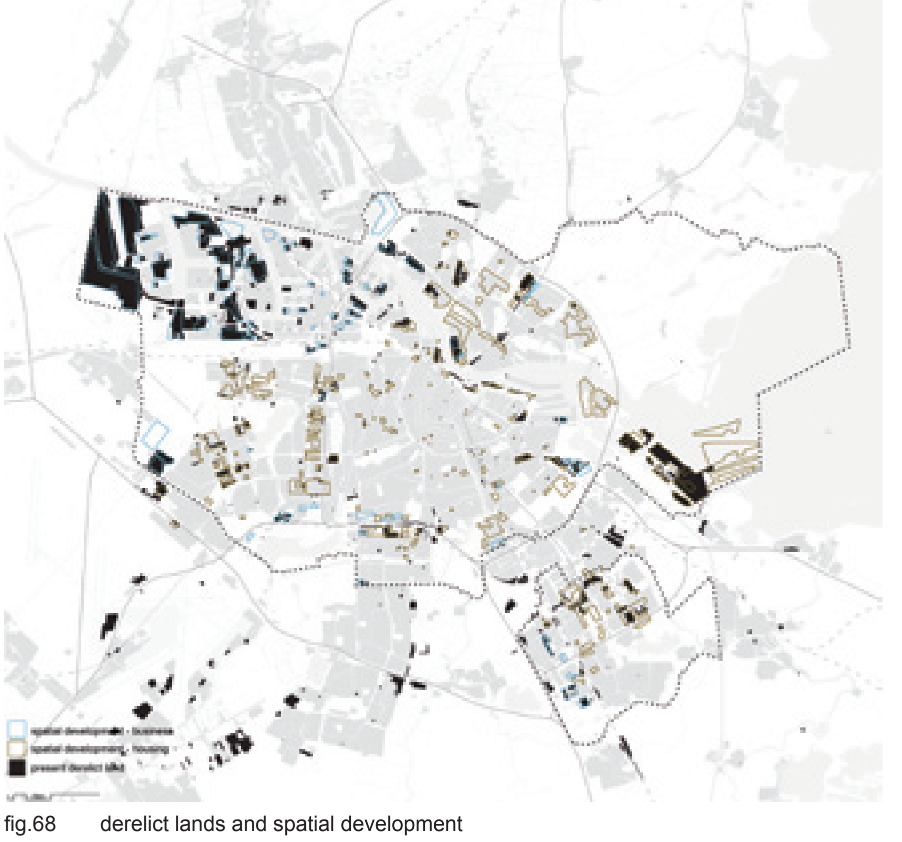


fig.68 derelict lands and spatial development

These derelict lands, combined with production potential offered at different gradients of urbanity, provide a patchwork of potential sites, apt for regeneration into productive urban landscapes that incorporate urban agriculture [fig. 69].

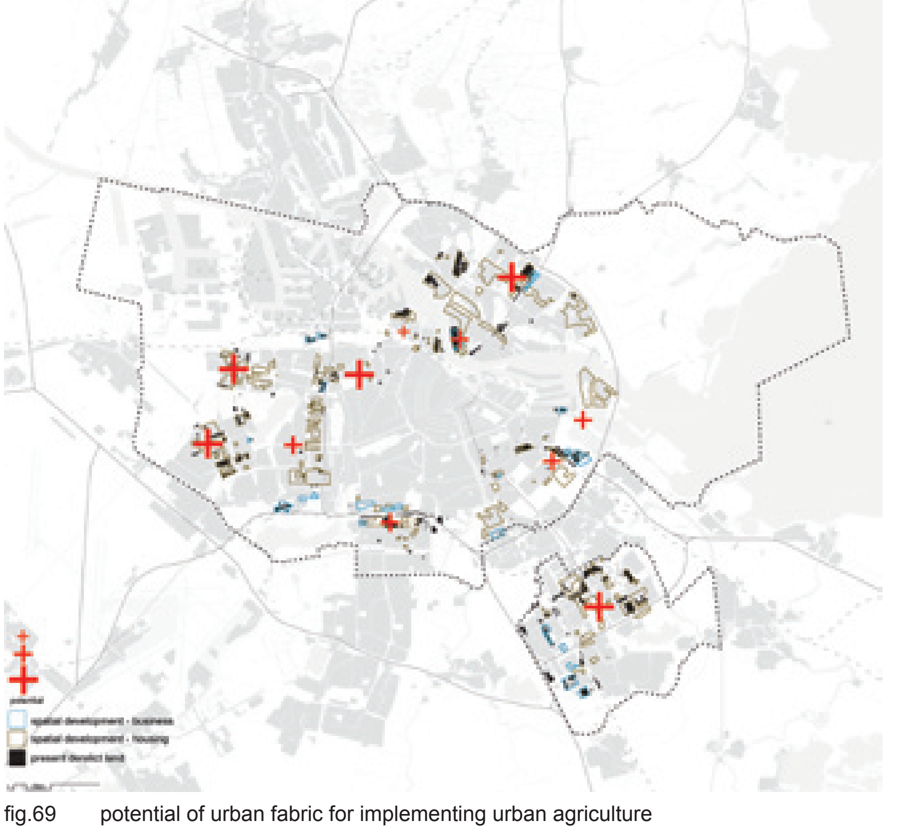


fig.69 potential of urban fabric for implementing urban agriculture

6.3 Map of potential

Merging the results from the top-down and bottom-up analysis, a zone with potential for urban agriculture becomes visible. The possible sites are in fact positioned as intermediates between highly urban and natural networks, a synenergy [fig. 70].

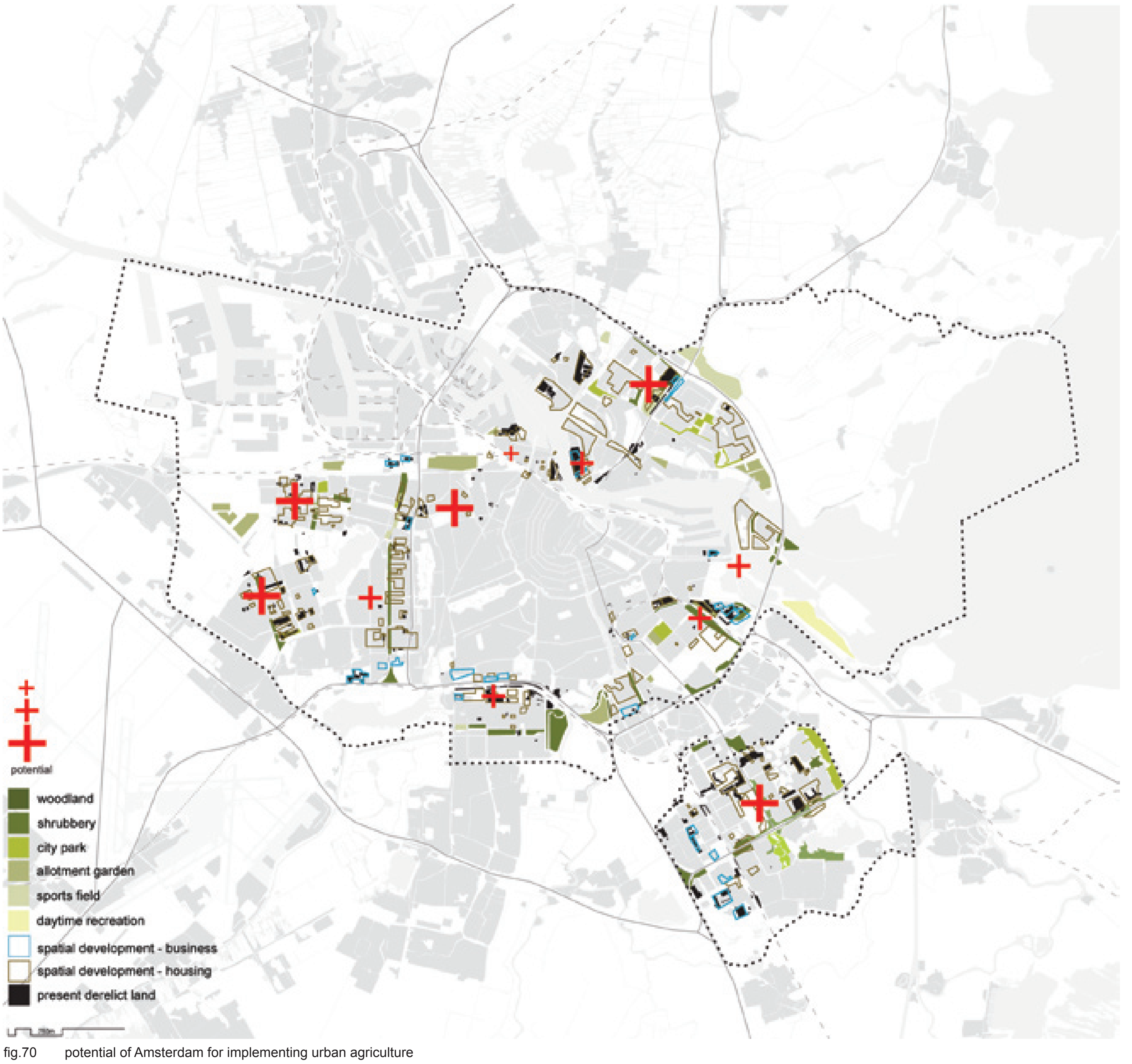


fig.70 potential of Amsterdam for implementing urban agriculture

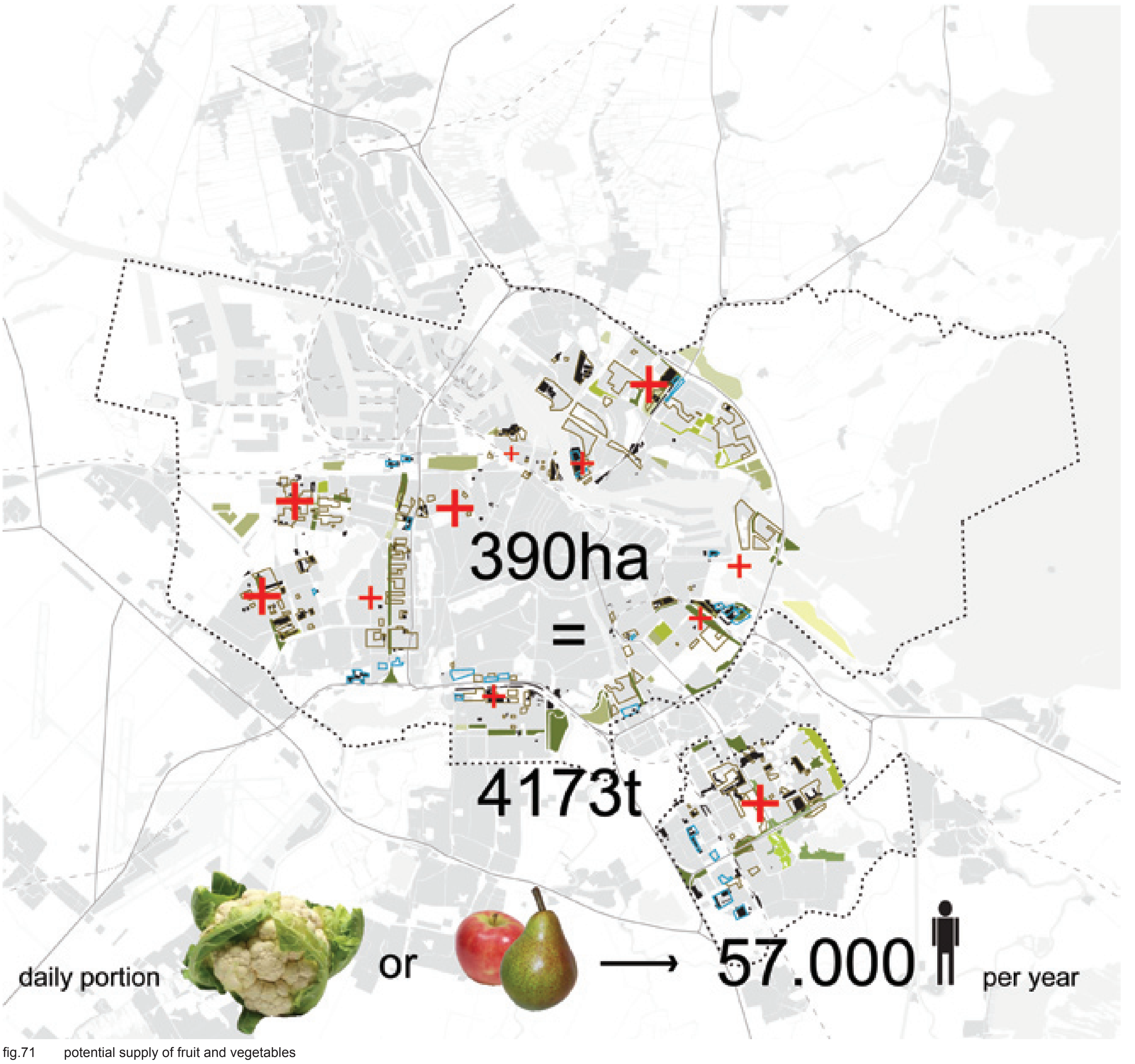


fig.71 potential supply of fruit and vegetables

This production potential of Amsterdam equals a certain amount of hectares. It is possible to calculate the average yield per hectare in an urban context, based on figures from the London Food Strategy. The calculation is only based on fruit and vegetable production and does not include potential yields from window boxes and rooftops (Garnett, 1996).
The total surface area of the potentially productive site in Amsterdam sum up to about 1500 hectares.

table 1 total area for urban agriculture in Amsterdam

	land area (ha)	impervious	% for production	area for urban agriculture
green areas	586	586	50	293
housing projects	764	252	20	50
business projects	110	36	20	7
derelict land	40	40	100	40
total	1500	920		390 ha

From the building projects, only one-third of the area will be impervious, which leaves 920 hectares. Within the potential sites, not all space can be used. Parks serve primarily a recreational function, therefore at maximum only 50 percent can be used for food-growing activities. In public space and gardens 20% is suitable (Tomkins, 2006; Garnett, 1996). This way, the total area for urban agriculture is about 390 hectares [table 1].
Using a productivity level of 10,7 t/ha (based on calculations from the National Society of Allotment and Leisure Gardeners, Garnett, 1996) Amsterdam could produce 4173 tonnes of fruit and vegetables. If you were to provide a daily portion of either fruit or vegetables (0,2 kg), 57 000 inhabitants of Amsterdam could be supplied. This would almost be enough for the entire Oost/ Watergraafsmeer borough [fig. 71].

Croproad Park

The potential of Amsterdam requires an illustrative design; an example to show what a typical productive urban landscape could look like.
The chosen site is a part of the motorway A9. The reason to work in this area originates from the map of potential: the surrounding neighbourhoods resemble the Modernistic building typology with (semi-) open building blocks and an abundance of (neglected) green. Besides, the City Council aims for regeneration of the motorway route, creating a unique 3 km building free zone. This zone could play a crucial role in the recreational network, and simultaneously reconnect the surrounding neighbourhoods. Combining these issues into one project seems like a true challenge [fig. 72].

7

7.1 Location of site

In 2004 it was decided by the Dutch Ministry of Verkeer & Waterstaat that the accessibility of the Schiphol-Amsterdam-Almere region should be improved by enlarging the road capacity (Rijkswaterstaat, 2008). The first proposal in which motorways A6 and A9 would be extended via a route along the Naardermeer was declined, because the Naardermeer is the oldest nature reserve in the Netherlands, and an important corridor for migrating birds (Stichting Natuurmonumenten, 2008). As an alternative, the existing motorway A9 could be widened. If the motorway would be (partly) tunnelled, the road capacity would be improved, enabling better connection between the A6 to Flevoland and Schiphol Airport and Business district. At the same time, the neighbourhoods through which the A9 is currently intersecting, could be released from a huge barrier. This redevelopment of the motorway is a project by Rijkswaterstaat, Dienst Ruimtelijke Ordening Amsterdam, and Stadsdeel Zuidoost. Especially for the borough of Zuidoost, the tunnel would be an opportunity to dissolve the motorway obstacle (dRO / Buys, personal communication, 10-04-2008).

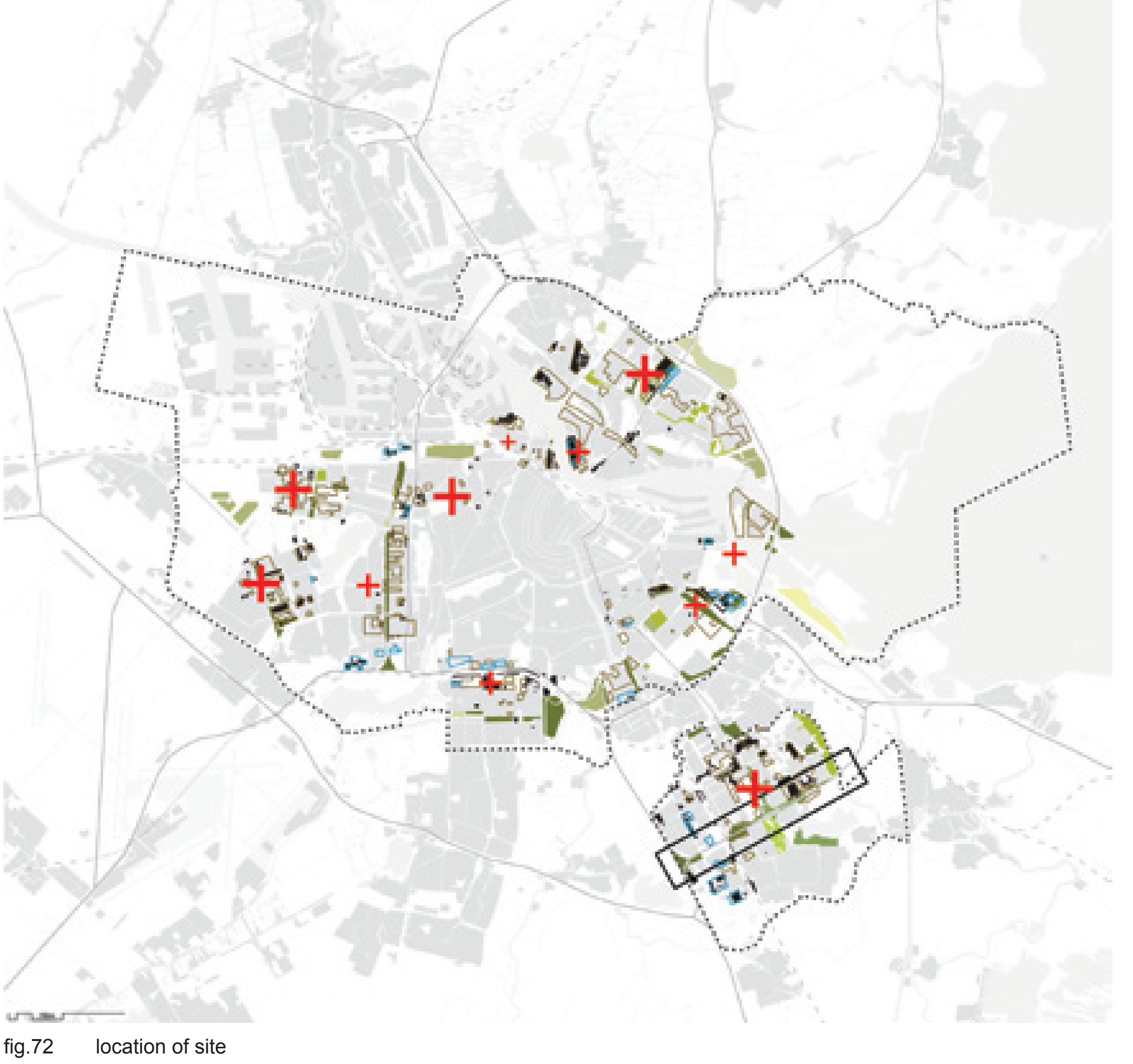


fig.72 location of site

fig.73 programme

Permanent dwelling on top of the tunnel is not allowed for safety reasons, but building adjacent to it should help financing the project (dRO, 2008). The roof of the tunnel will therefore be transformed into a park, increasing the amount of impervious surface in the city (dRO / Buys, personal communication, 10-04-2008) [fig. 73].

The proposed tunnel structure is 3 kilometres long and varies from 72 to 90 metre in width. To prevent congestion the tunnel is constructed with four tubes, two in each direction. The outer tubes lead to the only exit along the route, at the Gooiseweg junction. The route is located on the edge of two different polders, each with their own water level. Therefore the tunnel functions as a dike (dRO / Smit, personal communication, 10-04-2008) [fig. 74].

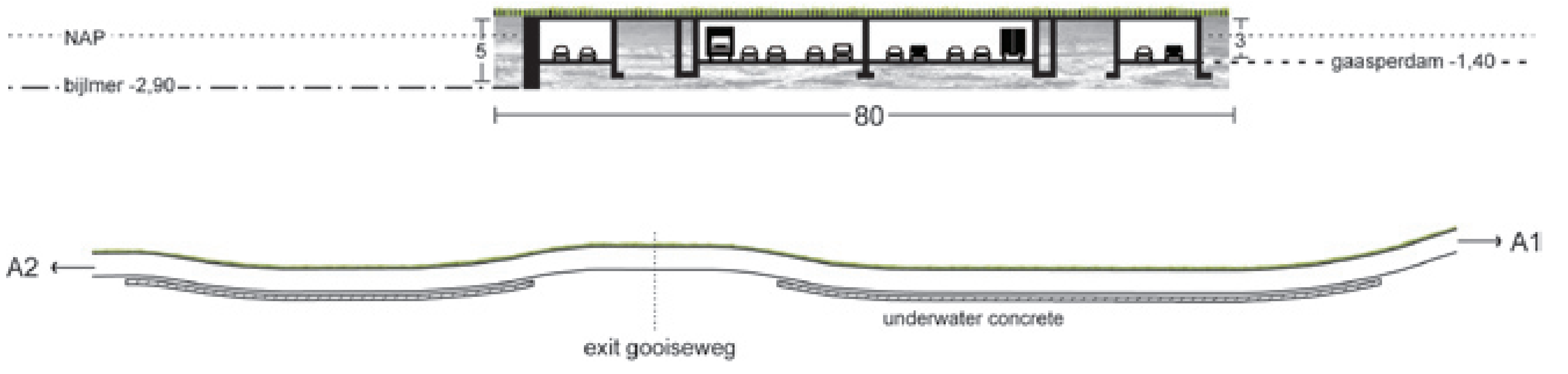


fig.74 the proposed tunnel

The zone on top of the motorway adds new space to the urban fabric. If you were to transform this space into a production site, the maximum yield would be 264 tonnes (calculation based on paragraph 6.3), supplying 3600 people with a daily portion of fruit or vegetables [fig. 75].
But if you were to transform the tunnel roof into a productive urban landscape, local problems and characteristics need to be analysed.

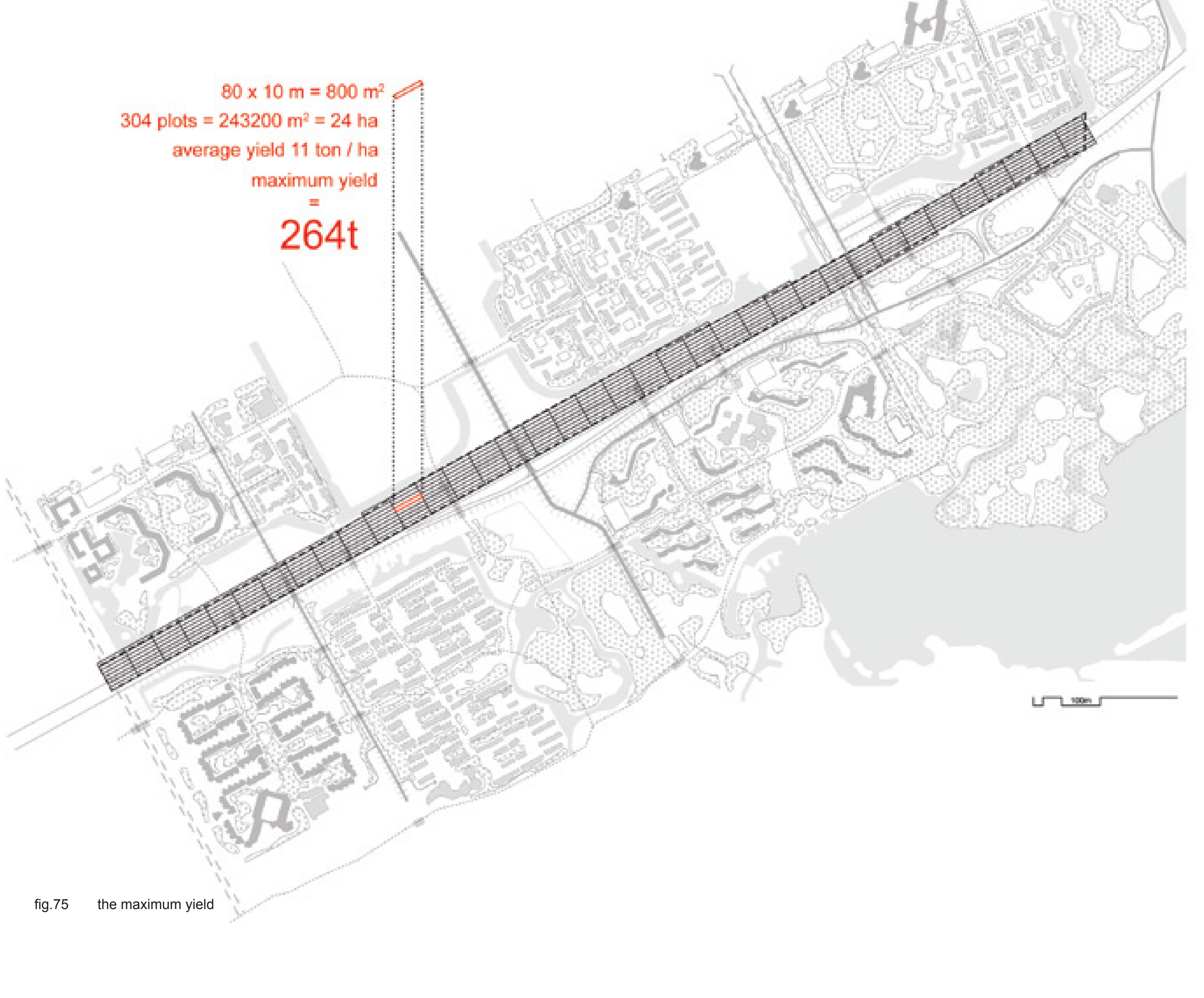


fig.75 the maximum yield

fig.76 location of site inbetween two green wedges

7.2 Findings

The site, in the south-east of Amsterdam, is located between the neighbourhoods of Bijlmer and Gaasperdam, and between the Amstel- and Diemerwedge. Infrastructure functions as a barrier to access the surrounding landscape [fig. 76].
The proposed 3 kilometre building-free zone seems to offer a unique opportunity to

fig.77 connecting recreational routes between the green wedges

connect the characteristic wedges, especially because a cyclist viaduct has recently been placed over the motorway A2 to the Amstelwedge [fig. 77].

The neighbourhoods surrounding the A9 are built in the 1970s. The urban structure contains both high-rise flats and two-storey row housing, and is typified by inward orientation (Heeling et al., 2002). Most blocks are social housing projects. Some of the characteristic Bijlmer flats have been demolished but the replacing housing projects have a similar orientation. At the moment, the backsides of blocks face the future park [fig. 78].

fig.78 inward oriented neighbourhoods

The inward-oriented urban structure is strengthened by its infrastructure. There is an extreme distinction between high and low speed movements, expressed both visually and physically. Main roads are placed on embankments; low pace (recreational) traffic can only pass through tunnels, regarded as socially unsafe [fig. 79].

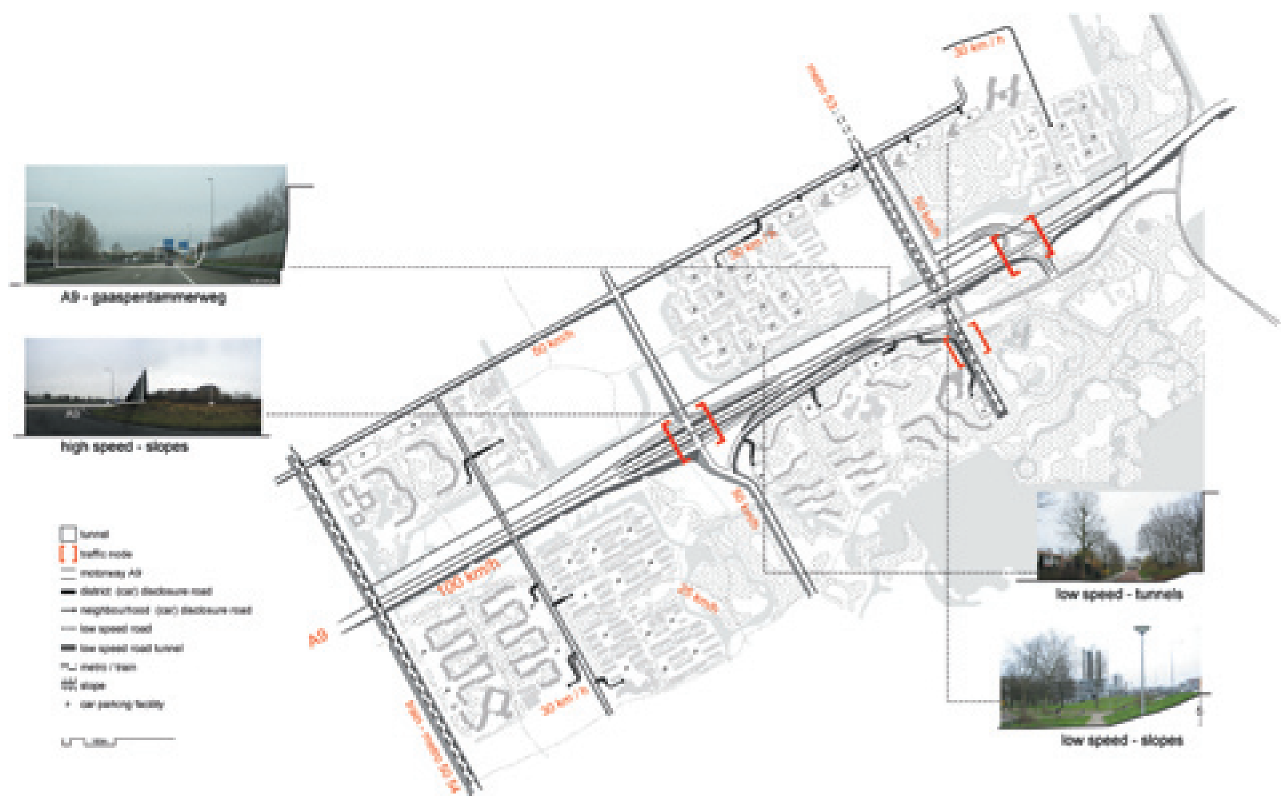


fig.79 disconnected high and low speed networks

The low speed routes are interwoven with the green- and blue network. The huge amount of green further emphasizes the inward orientation of the building blocks and has a negative effect on the routes, extracting paths from sight and thus social control [fig. 80]. Consequently, the low speed network could be improved with the new development.
Both the Bijlmerpark, Centraal Park Gaasperdam and the Gaasperplas border the site, but without obvious connection. All parks seem to suffer from lack of maintenance and functional lay-out. The Bijlmerpark is about to be restructured into a classical English landscape style park with sports facilities (Mecanoo Architecten, 2007).

fig.80 disconnected high and low speed networks

When designing this tunnel roof as a park, regardless whether the park would be productive or not, the previous findings should be take into consideration. The local problems could be solved by the new development, if a recreational route connecting the Amstel- and Diemerwedge is added; if all low speed routes pass the zone at ground level; if the new building blocks get two-way orientation, one towards the existing neighbourhood, one towards the new park; if connections between the three existing parks and the new park are included [fig. 81].

fig.81 findings: local problems and characteristics analysed

7.3 Framework

Together with those findings, the following principles create a framework for the new park, a productive urban landscape.

A 3 kilometre building-free zone in the dense urban fabric of the Amsterdam metropole is unique. Hence, the length of the zone should certainly be accentuated. (by a wide all-purpose path) However, to actually dissolve the barrier of the former motorway, the focus should be on the neighbourhood function of the future park, with cross-connections between the existing parts of the borough on ground level [fig. 83].

Three of these cross-connections are part of the high-speed network, and suitable to be transformed into nodes on top of the tunnel (Lynch, 1960). Nodes divide the zone into smaller parts, and are specific points where people outside the neighbourhood can access [fig. 84].
Part of the high-speed network are dual-carriage-ways, motorways and metro lines. The metro-network functions at city level. It connects Gaasperdam to the city centre. Repositioning the Gaasperdam-metrostation onto the tunnel roof would mean a city-wide public transport connection to the park-zone. This way, far more people could benefit from the unique area.
The motorway exit from the A9 to the Gooiseweg forms the second node, partly literally because the tunnel construction is altered to enter and exit the route. Two road systems with different speeds interfere and provide the possibility for the entire borough to link to the nationwide motorway-network and the inner-city-carriage ways. To protect the continuity of the recreational length-route, that route should flyover the high-speed junction. A cyclist bridge separates the 15km/h-movements from the 80 km/h-movements. It improves safety and more importantly marks the node, and thus park, at higher networks.

The third important node is created by the overlap between the Bijlmerpark, Centraal Park Gaasperdam and the new park zone. This square offers views towards the parks, (from a jetty-viewpoint) and a place to rest between different routes. The metro-node square has a similar functions, because it connects to routes from the Diemerwedge and Gaasperplas. In fact, the top of this wedge is brought into the park zone [fig. 85].

The production system on site is designed to function as a closed cycle [fig. 86]. Water falling on the sedum roofs of the newly built blocks can be stored either on these roofs or in reservoirs near the buildings' plinth (Hough, 2004). The water can be used from the reservoirs for irrigation of the plots. Crops grown on the plots are taken out and sold at the vegetable stalls, located at the node-squares. Inhabitants from the different neighbourhoods can get fruit and vegetables here, take it home and consume it. The left-overs are organic waste. This organic waste is basis for the compost, produced in the compost-installation in the very east-side of the site, next to the farm and nursery (Viljoen, 2005). This unit functions as preparation component of the system. Here, cuttings are planted out or prepared to be grown in the outdoor plots, and maintenance activities are organised. Because of the combination with recreation and dwelling, the maximum production yield [fig. 75] is reduced to 40 percent. Considering its all-encompassing character, this should be seen as the optimal production yield, with a possibility to supply around 1500 people with a daily portion of fruit of vegetables, or even 10 000 people with a weekly portion [fig.82].

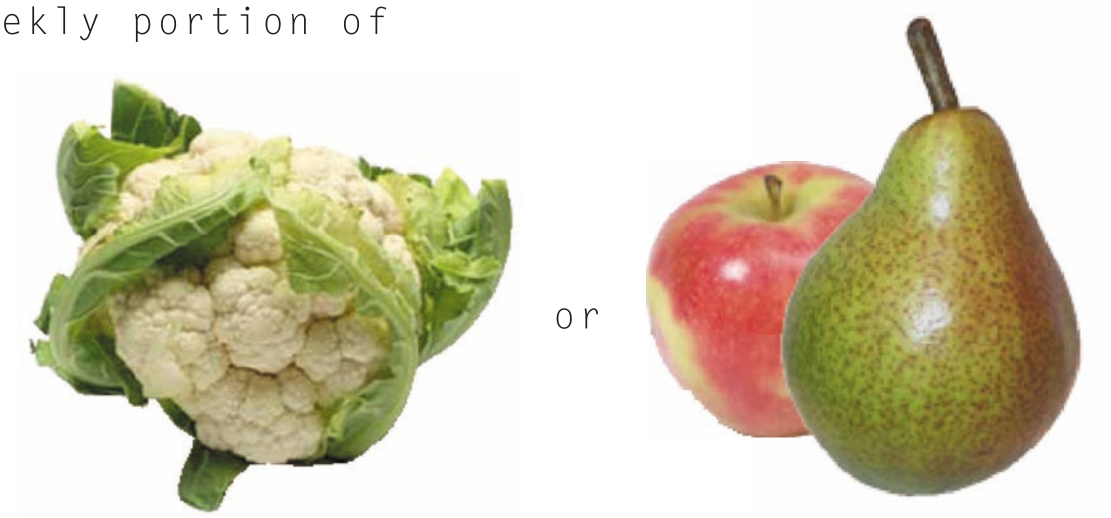
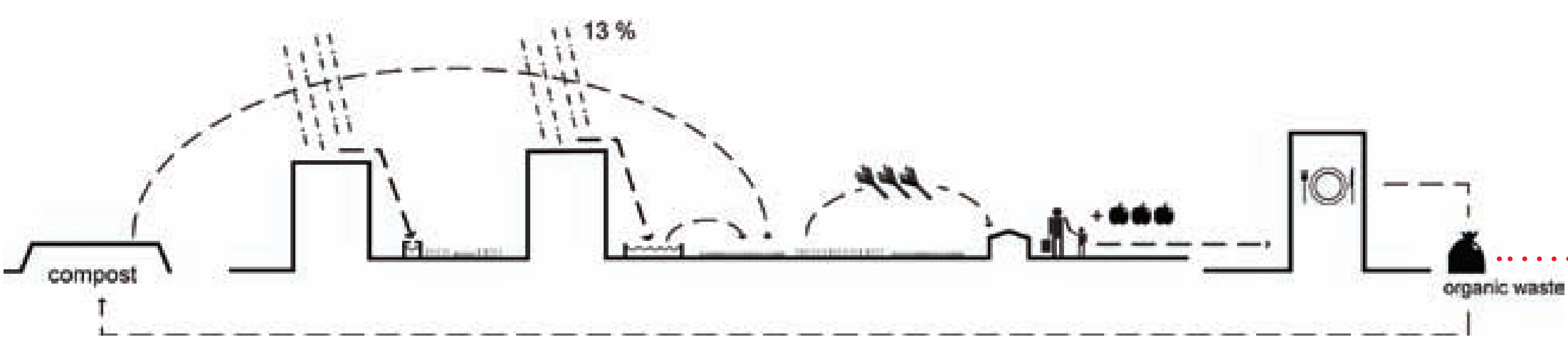


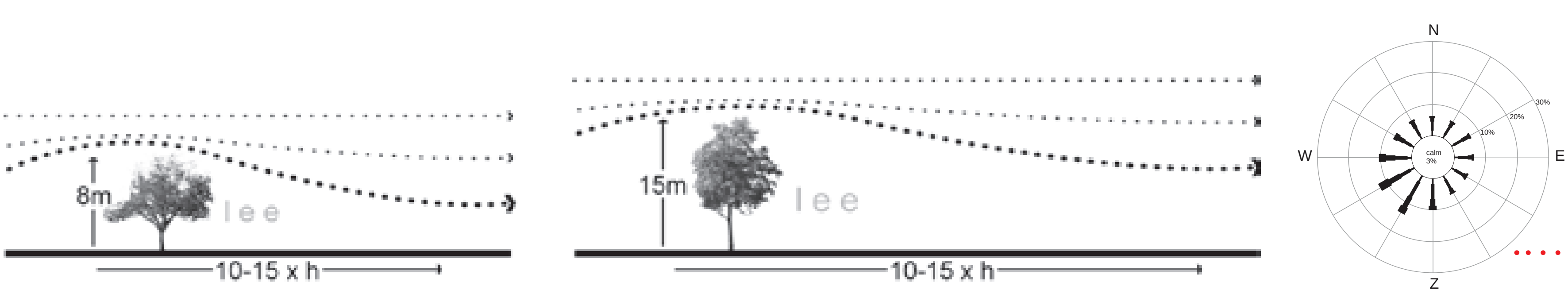
fig.82 potential supply of this productive urban landscape

Besides the production system, the micro-climate is important in a productive urban landscape; on one hand to safeguard production, on the other hand to offer pleasant circumstances to dwell and recreate there (Hough, 2004). The prevailing wind direction of the region is south-west (KNMI, 2002), similar to the orientation of the site. A spatial subdivision by trees is therefore a necessity (Wetering, 2007). Using the existing cross-connections to plant tree lines, helps dividing the site in equal parts and can eliminate 'falling winds' (Hough, 2004). If fruit trees are used in the tree lines, the productive element could already be introduced in the surrounding neighbourhoods [fig. 87].

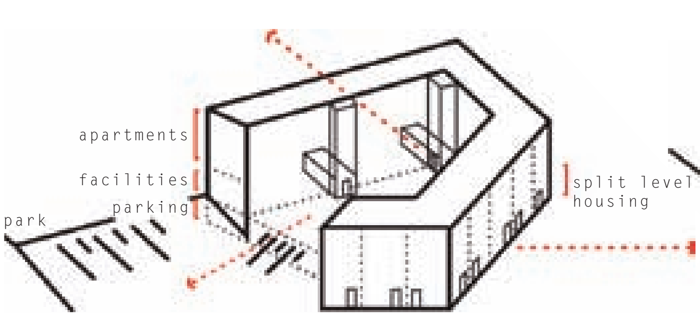
The last elements of the framework are the building blocks. These can be placed adjacent to the tunnel roof in two different ways, either as apartment block or terraced houses.
The apartment buildings have a semi-open character. The semi-open typology refers to the findings from the Amsterdam urban fabric, in which this type was found to be suitable for production purposes. Because the block is not fully opened but semi-closed, there is a sense-of-belonging for the dwellers and protection for the produce, but at the same time the courtyards are visible, or 'to experience' for people passing by (Koh, personal communication, 28-04-2008).
For this building block its two-way orientation, as mentioned before, is significant. The entries and disclosure, the connection to the local road system, are placed at the side of the existing neighbourhoods. Presently, there is only one road entering these neighbourhoods that leads to the central parking lot. Introducing the new road would give the neighbourhood an extra connection and creates a loop rather than a cul-de-sac. From the new road, parking garages underneath the new building blocks can be accessed. Because the blocks have to be constructed adjacent to the tunnel roof, there is a height difference that can easily be reconciled by including a parking garage, which also leaves more room for outdoor public space. At the side of the building block that faces the park zone, there is no road, but a wide plinth. The plinth offers room for facilities and business, low speed movements and access to the buildings' courtyards.
The design of the building blocks should be seen as a suggestion for architects. The exact shape is not fixed, but angles and heights have



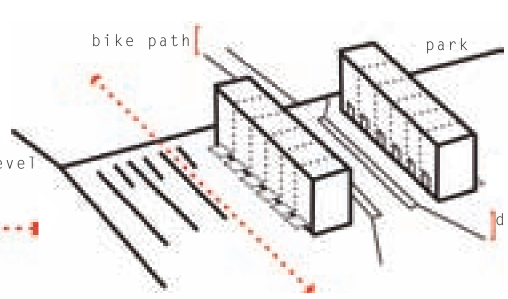
the fruit and vegetable production cycle



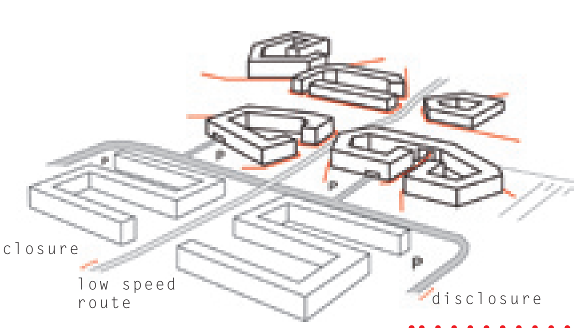
vegetation functioning as a wind break



apartments with green roofs



terraced housing



new road placed inbetween existing and new housing

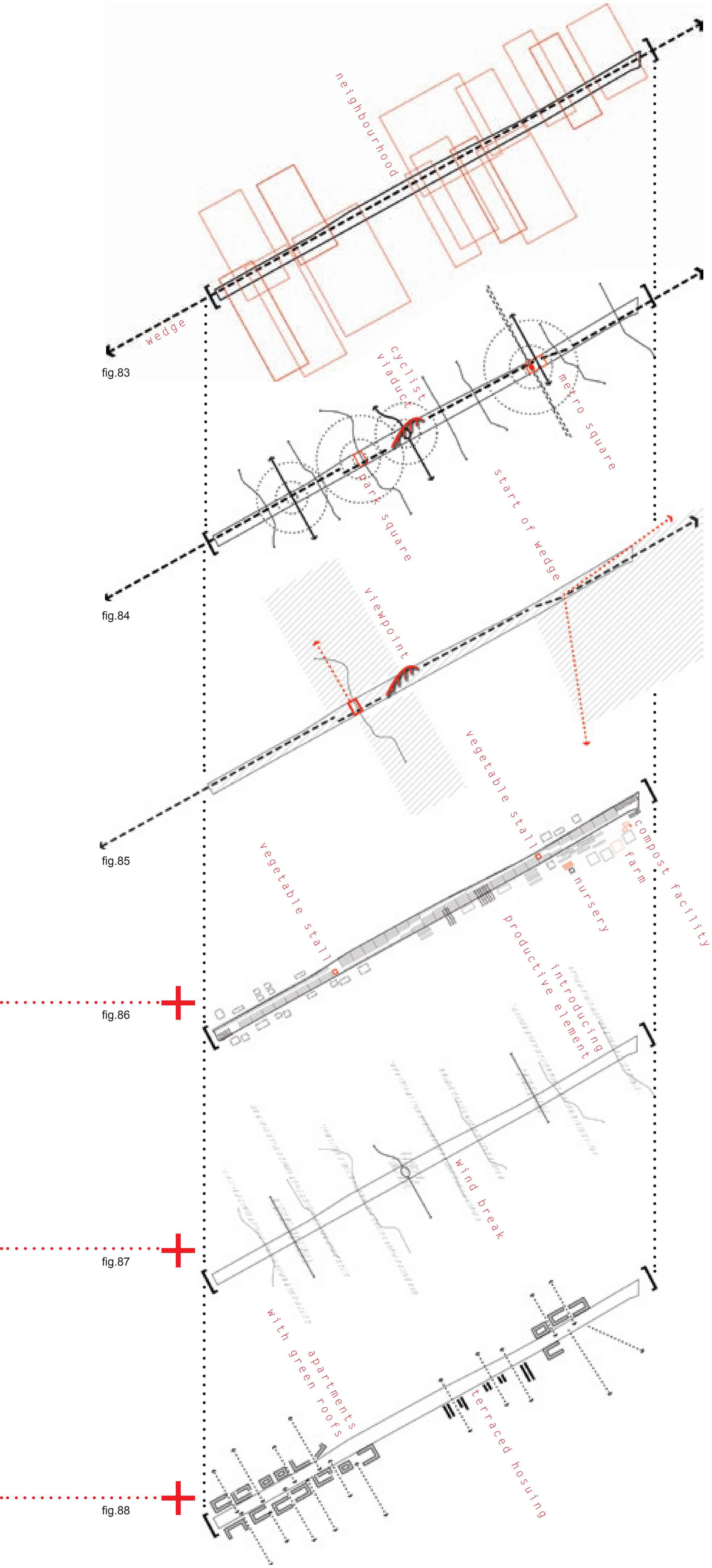


fig.83
fig.84
fig.85
fig.86
fig.87
fig.88

been taken into account to create an optimal living environment. The facades should not form an enormous wall along the park side, but diverge to offer variation and create inviting angles and views, showing parts of the park from surrounding areas, tempting people to go there. Besides, the varying facades indicate consideration of wind- and sun-angles, to improve the micro-climate. South-facing walls are planted ('green walls'), have balconies, and are lower in height to avoid disadvantageous shade on the north-sides. All roofs are planted with sedum, ideal for energy-efficient isolation; it is easily grown because of high levels of solar radiation and suitable for rain water storage (Hough, 2004).
The other type of building block is the terraced house, placed perpendicular to the tunnel roof in the middle part of the site. The two bordering neighbourhoods are lower in height and ground level than the ones in the east and west of the site, therefore this housing type responds to the local situation. The gentle south-facing slope opens up the park zone. Together with the new row housing, the Nellestein neighbourhood gets linked in. The road system should function similar to the part with the apartment blocks, connecting both old and new dwellings [fig. 88].

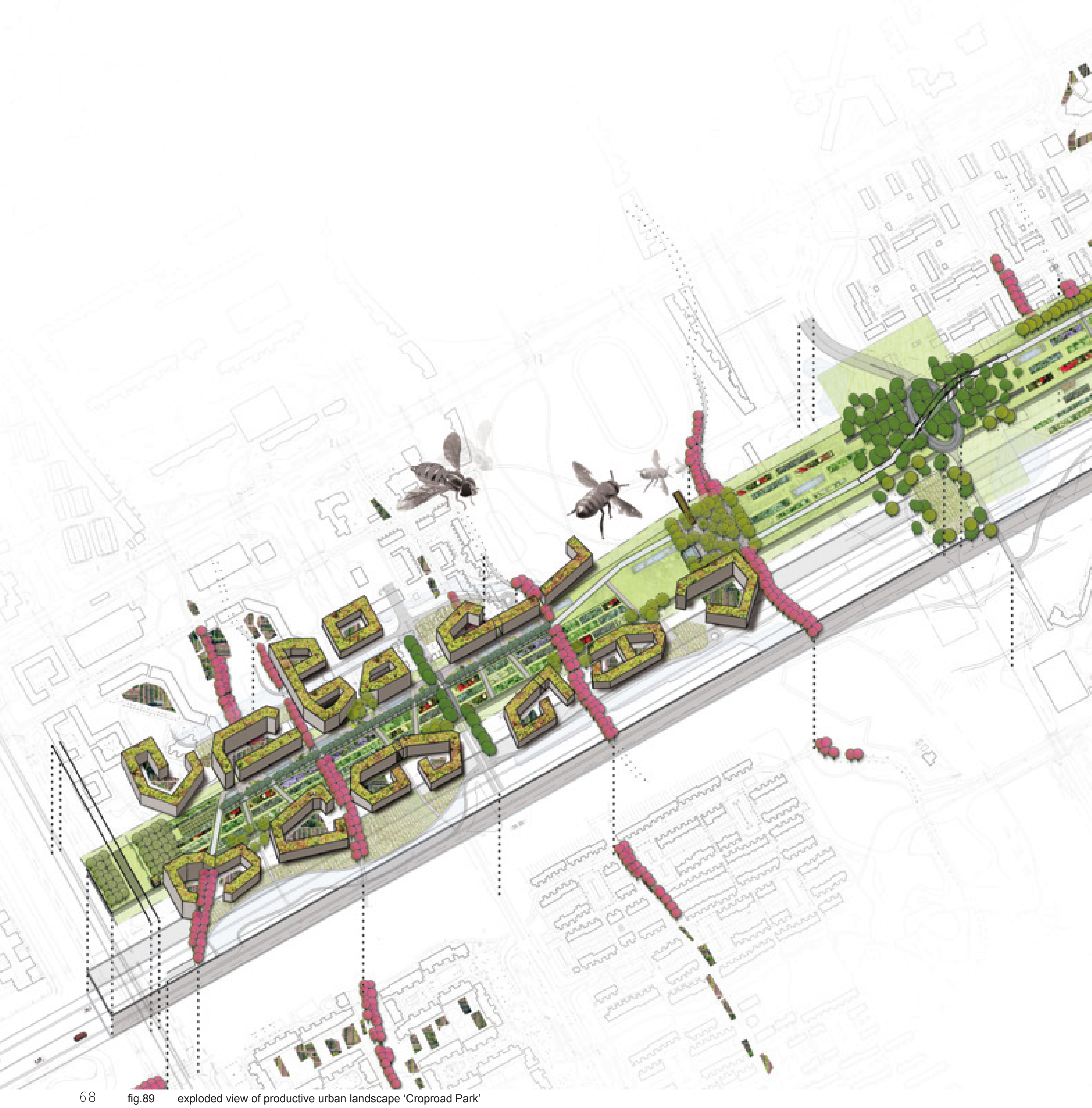
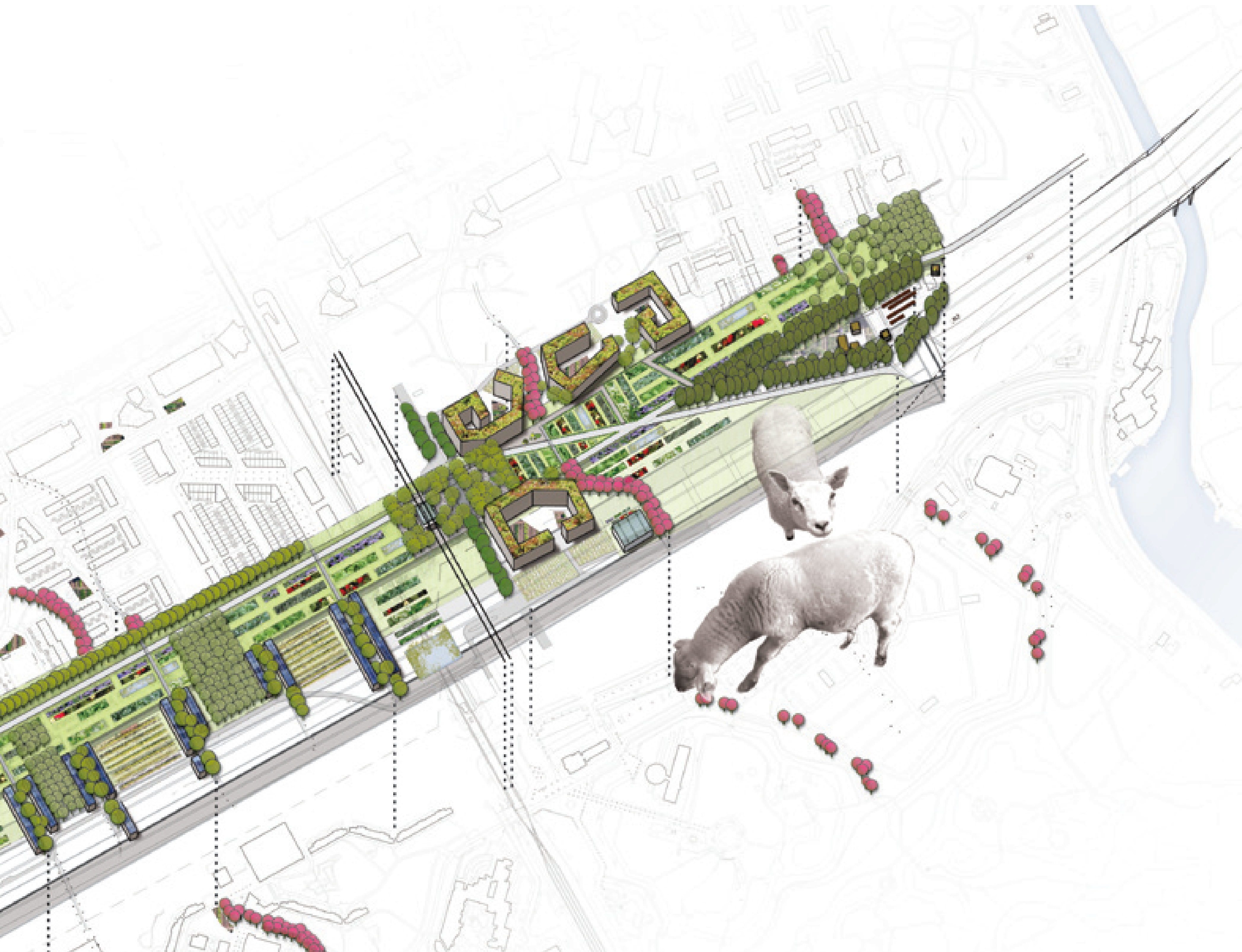


fig.89 exploded view of productive urban landscape ‘Croproad Park’



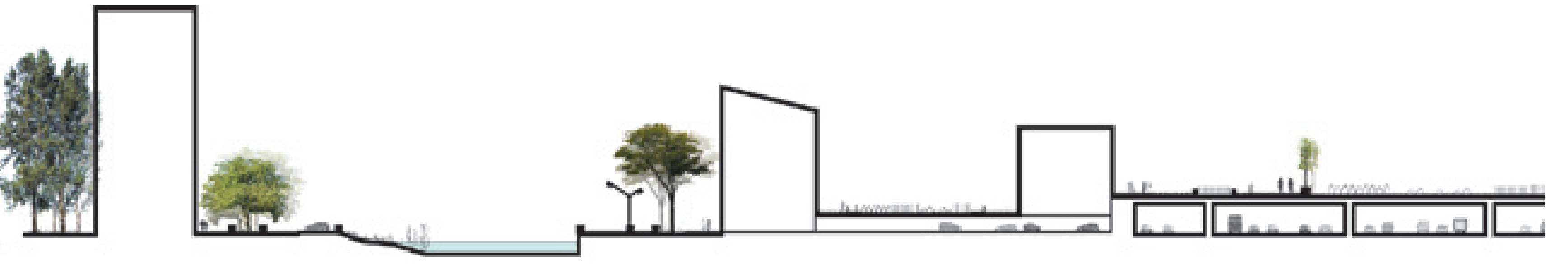
A projection [figs. 89, 90] of the preceding framework principles can be built up in the following steps:

- The ground level consist of a grass embankment, covering the tunnel roof and its slopes;
- road systems connecting to different networks all cross at ground level, except for the main-path-flyover at the Gooiseweg junction;
- the production system includes planted fields in length-direction, hedges and embankments to separate recreational movement from production, and the plant-facilitating unit;
- the water system is two-fold: rain water for irrigation is caught and stored on roofs and reservoirs, surface water runoff is directed to canals that are part of the new road profiles and ponds at the bottom of the tunnel roof slopes;
- the zone is spatially subdivided by trees; Cherry (Prunus) trees accentuate the cross connections and make a statement for the productive park as a 'sea of pink blossom' once a year; Lime (Tilia) trees adjoin the main roads, to catch fine dust (Wetering, 2007) and thus protect produce; the node-squares are marked out with a transparent roof of Honey Locust (Gleditsia) foliage, planted in a loose grid; more rigid are the grids of Apple (Malus) trees, marking the endings of the tunnel and the so-called rooms in the middle part of the park; finally, the main path is flanked by trained Pear (Pyrus) trees to create a boulevard: a strip with a more cultivated, urban feeling to it, paved, with water reservoirs and raised beds; in the middle part of the park the path intersects 'rooms', closed off by Field Maple (Acer) trees; in the eastern part where the path is leading to the Diemerwedge or the Gaasp, the choice of direction is strengthened by Poplar (Populus) trees.
- The different building blocks complete the framework. They mark the edges of the tunnel roof and the park, and connect to existing neighbourhoods through alleys and courtyards.

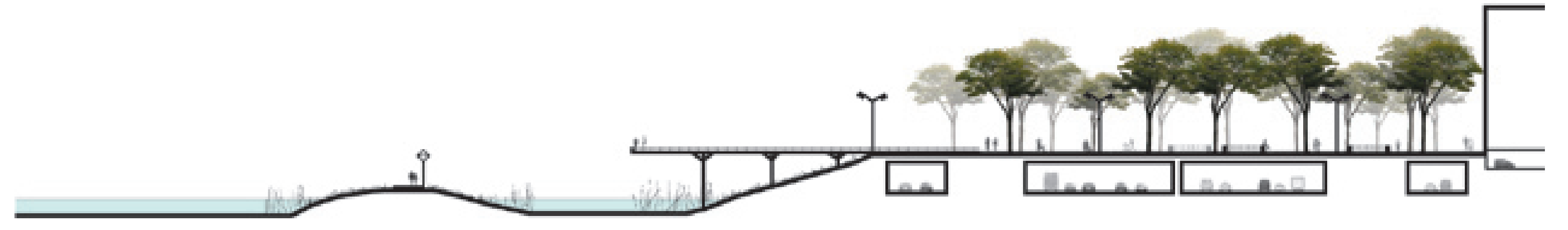
 fig.90 projection of productive urban landscape ‘Croproad Park’. Letters indicate cross sections, roman numbers indicate location of visualisations


E
F'
V
D
E'
D'
plots
farm
nursery
compost facility
vineyard
cherry trees
apple orchard
standard pear trees
honey locust trees
lime trees
poplar trees
field maple trees
field maple hedge
grass
communal courtyard
pond
surface water
herbaceous banks
jetty
main path
cross connection
car road
motorway
parking
apartment block
terraced housing
metro station
tunnel maintenance building
N
50m

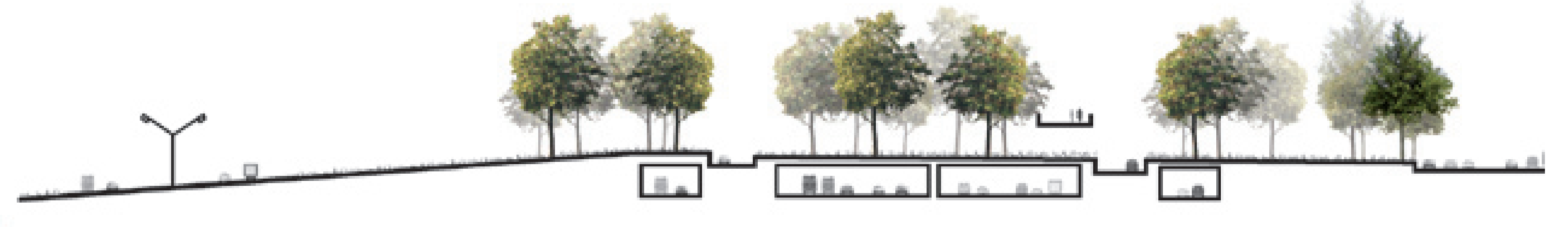
Cross sections (1:1000) illustrate the spatial dimensions of the park zone and its elements.

A


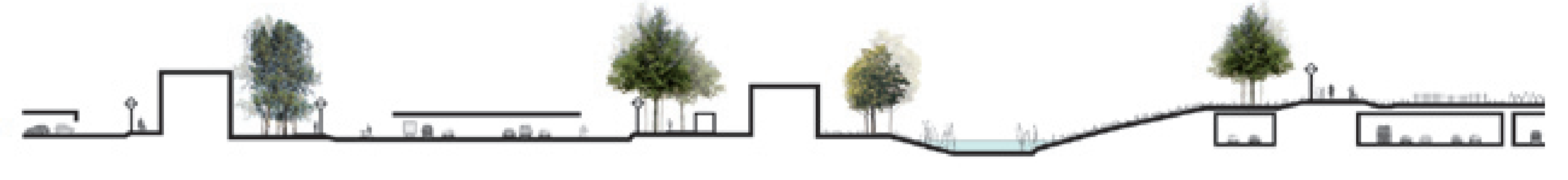
[fig. 91] west part of the park, with apartment blocks on both sides. The new roads, with water embedded in the profile, provide access to parking lot,

B


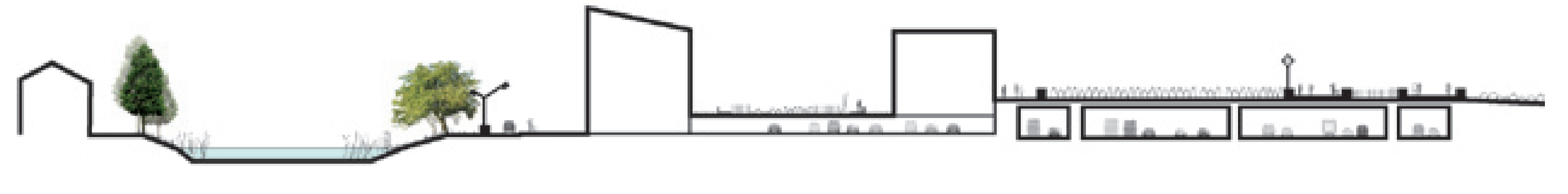
[fig. 92] node-square between parks. A building block defines the square on the south side, on the north side a jetty functions as viewpoint towards

C


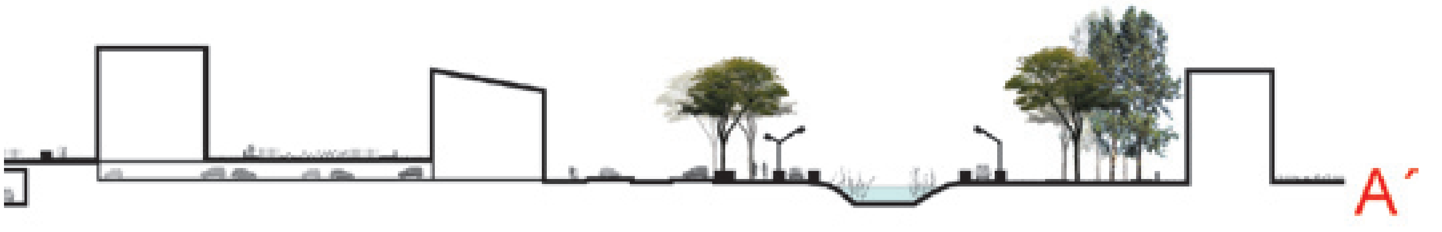
[fig. 93] the junction at the Gooiseweg with exits from the motorway A9. The recreational route is transformed to flyover the roads, floating between

D


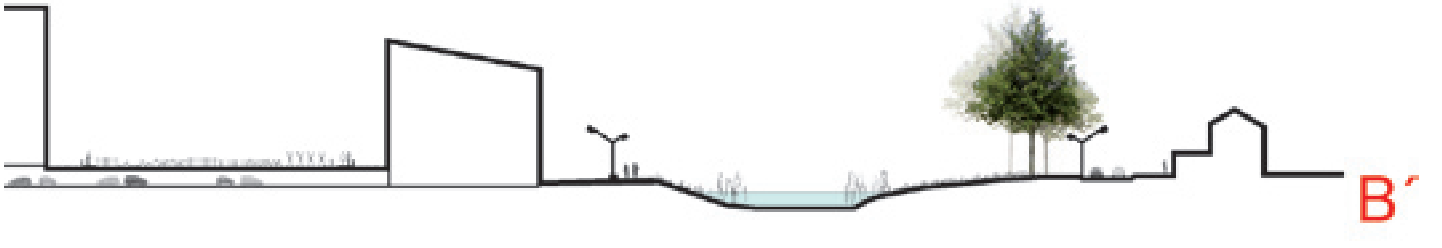
[fig. 94] terraced housing is placed between two existing neighbourhoods, each with their own parking facilities. The park is extended on the gentle

E


[fig. 95] east part of the park, with apartment blocks on the north side, oriented at the metro square. Southwards the park is opened up to the

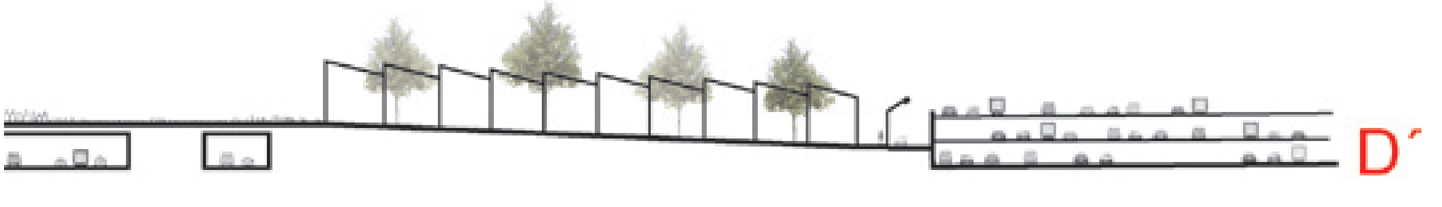


building entries and garages, through which courtyards can be entered.

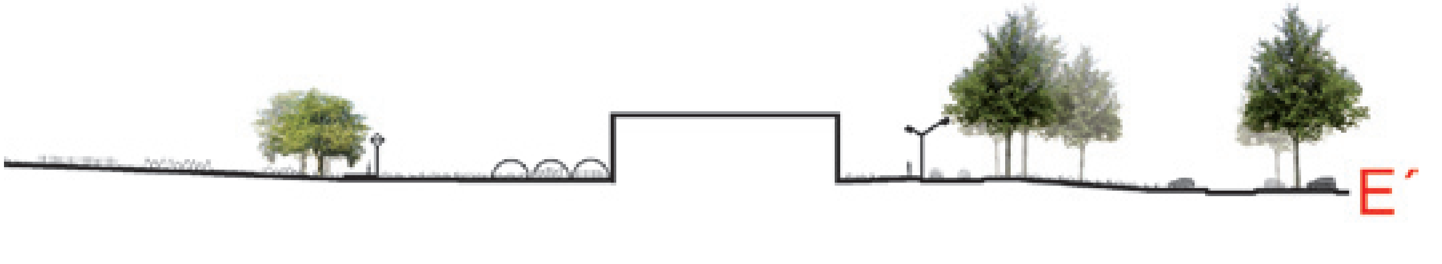


the Bijlmer park. Honey Locust trees create a foliage roof and a more intimate space.

the tops of the Lime trees.



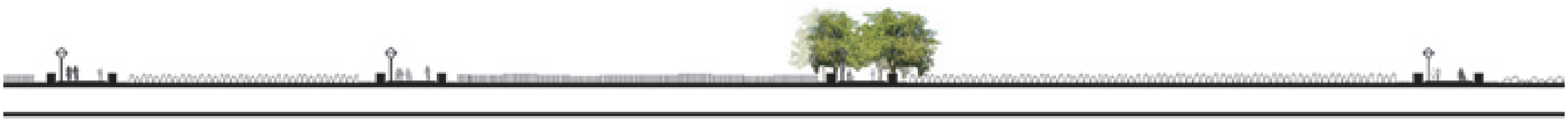
slope, with orchards and vineyards.



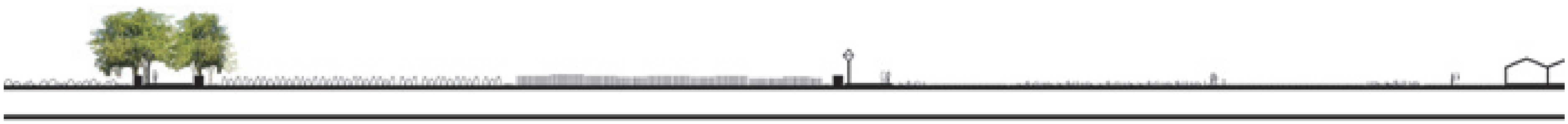
Diemerwedge, containing more agricultural functions like the nursery and sheep meadows.

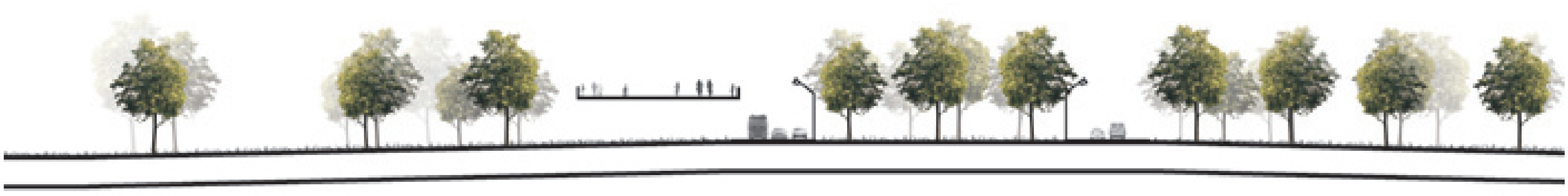
F

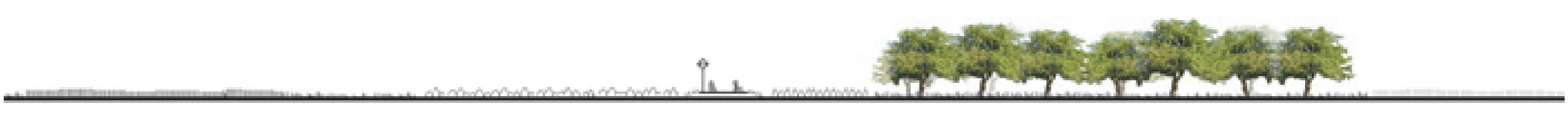
[fig. 96] 3 kilometre length section shows the north-south spatial division. Orchards (with no real productive contribution) mark the endings of the tunnel;



tree masses indicate cross connections and squares; the main path and metro station are elevated.







F'

fig.97 route; as boulevard

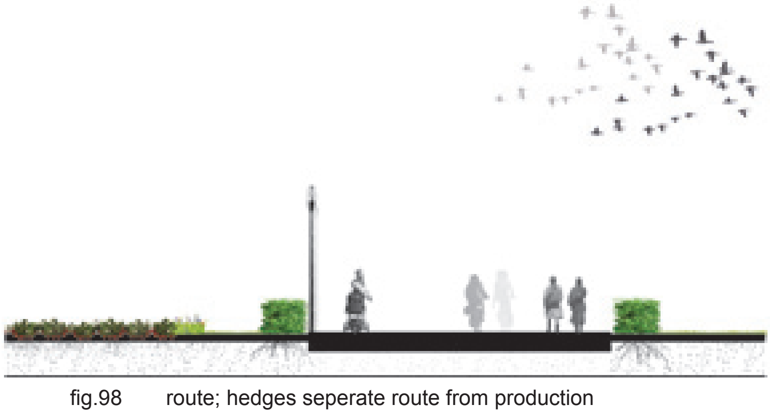


fig.98 route; hedges seperate route from production

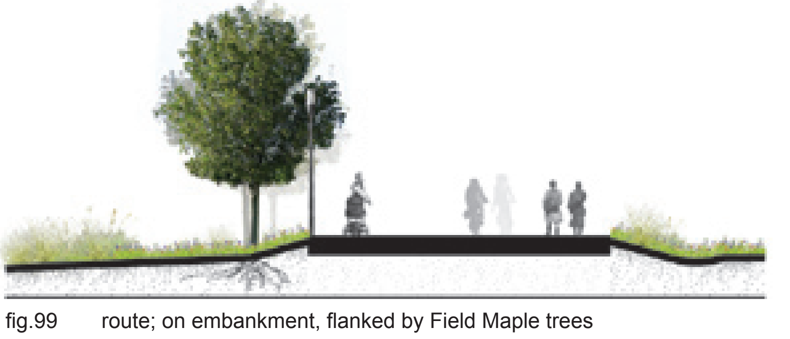


fig.99 route; on embankment, flanked by Field Maple trees

Routing

Small scale cross sections (1:200) show the spatial impact and lay-out of crucial parts of the main route.
The all purpose path (wandering, walking, running, cycling, skating, etc.) is materialised in tarmac, with lighting elements. Throughout the park, the route transforms. Firstly as a boulevard (paved with granite slabs) guided by trained pear trees [Fig.97]. Secondly, hedges restrict the route [Fig.98]. Finally, the main path is placed on a small embankment with Field Maple trees and naturally vegetated waterside at the north bank, crossing the 'rooms' on an embankment to create illusory access Fig. 99].
Three types of cross-connections are illustrated. The paths connecting the new park with the existing neighbourhood are flanked by Prunus trees [Fig. 100]. Crossing car roads are planted with Lime trees and hedges to collect fine dust [Fig. 101]. Smaller paths create closed loops and make it possible to wander around between the productive plots surrounded by hedges [Fig. 102].

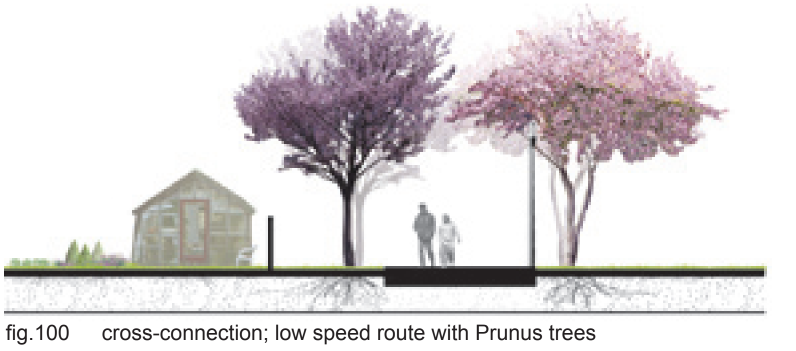


fig.100 cross-connection; low speed route with Prunus trees

fig.101 cross-connection; Lime trees and hedges catch fine dust

fig.102 cross-connection; closed loops by paths through building blocks

Implementation

The order in which principles could be implemented relates to the phasing of the tunnel construction [fig. 103]. The tunnel is built from the Gooiseweg junction in eastern direction first, then westwards. The key is to start with the basic elements of the production system, the plant-preparation unit placed next to the zone. From that point on plots can be laid out. As building blocks will be constructed from the neighbourhood side of the zone, crops can already be grown in the park before presence of new residents, but with help of current inhabitants of the neighbourhoods.
In fact, the social implementation of the park is crucial [fig. 104]. With the emphasis on neighbourhood functions, the community can 'make' the park. Even though an agricultural contractor could be appointed to provide continuous maintenance, input of the local people will determine the functioning of the park (Berg, personal communication, 14-01-2008; Koh, personal communication, 28-04-2008). Their relation to the park is both physically and visually the strongest. Local people are the first to consume the park; the produce as well as recreational possibilities and experiences it has to offer. The allotments in courtyards are a start to create a strong sense of community. Together with fruit trees along the cross-connections in the neighbourhoods the productive element is incorporated. The changes of the seasons become visible at your very doorstep as well as in the park around the corner. This will certainly enhance the educative quality of the park and contribute to the food awareness of people.

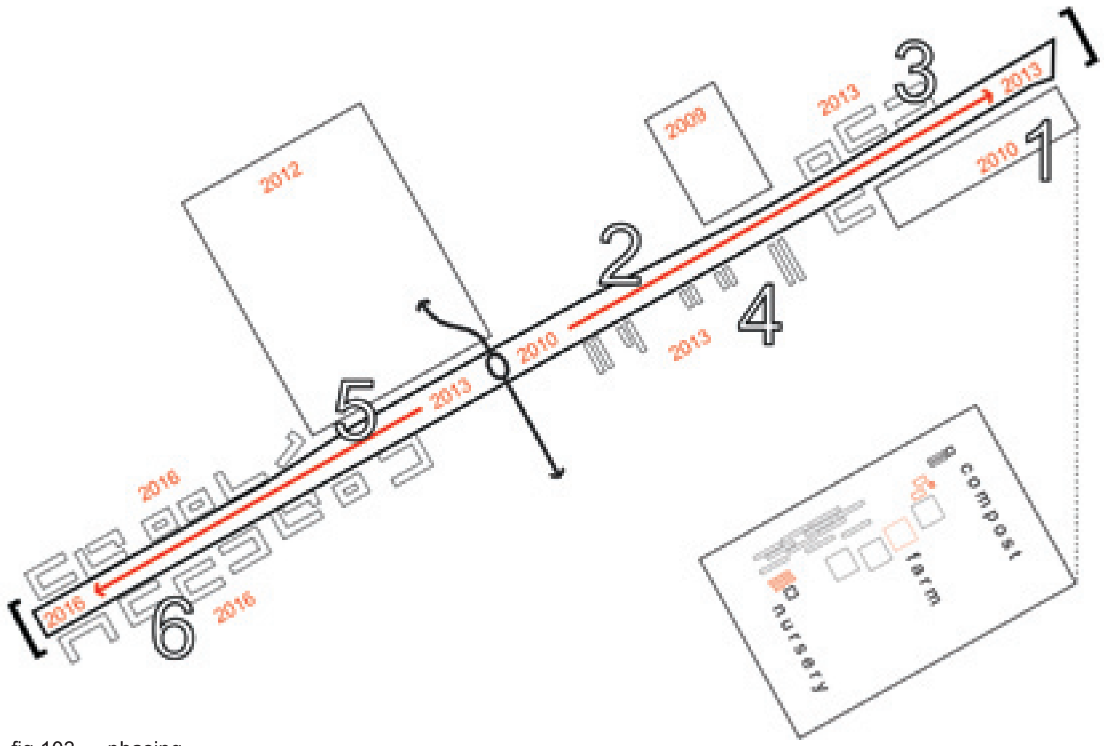


fig.103 phasing

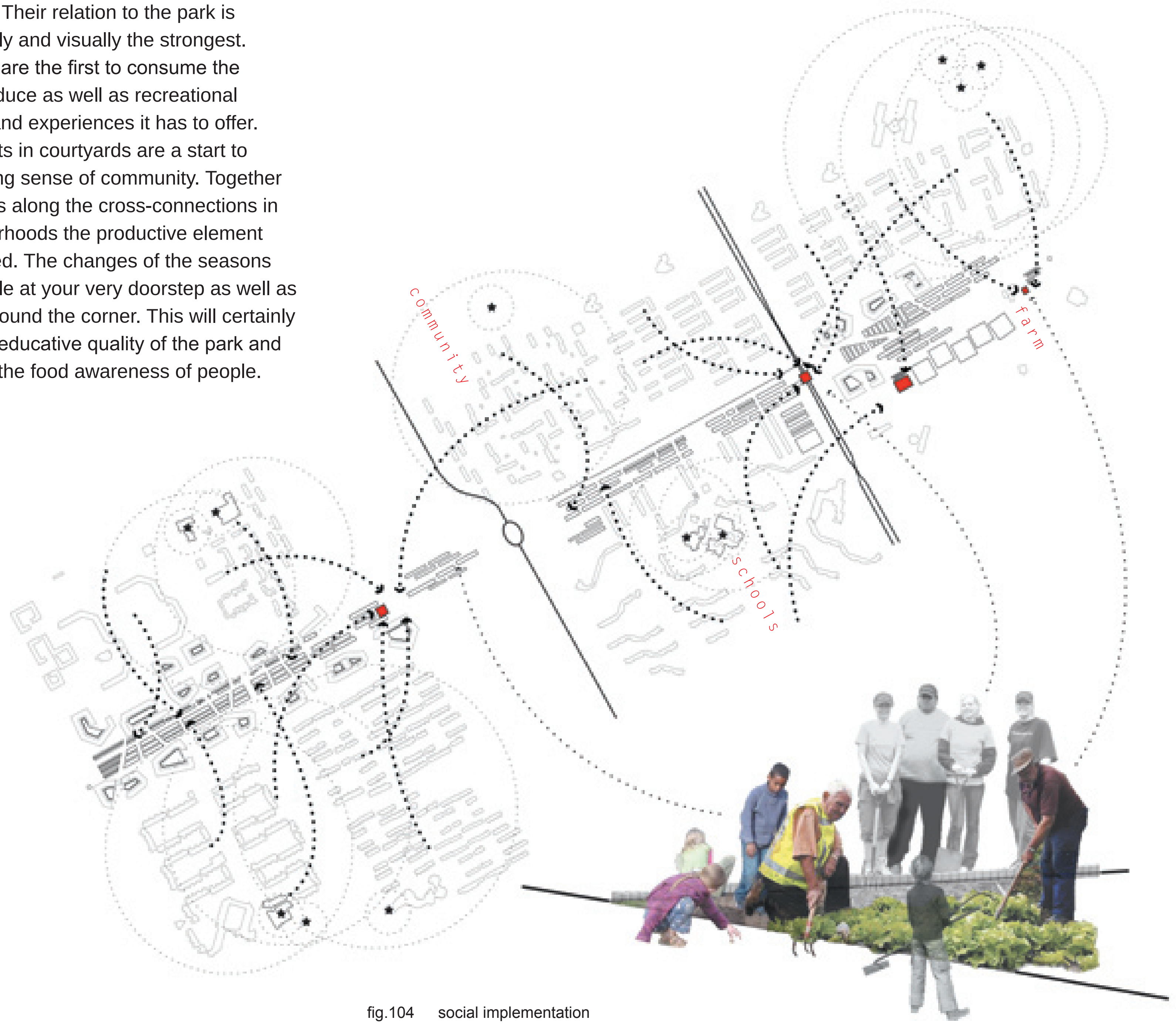


fig.104 social implementation

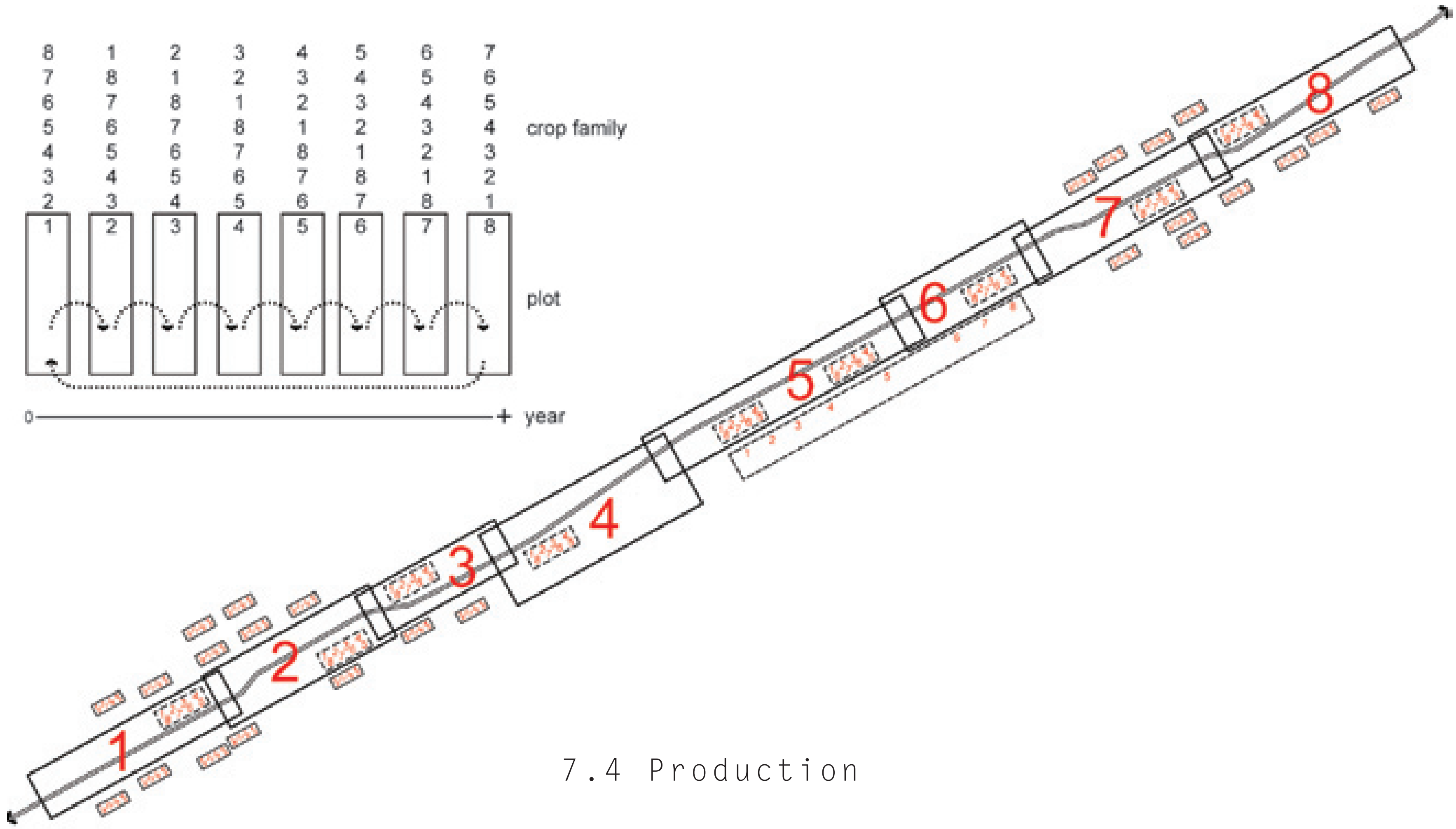


fig.105 eight year rotation

7.4 Production

A direct relation between people and their food production can best be established by producing organically. Organic production of fruit and vegetables requires a crop rotation (Schroën, 1993). In a crop rotation plant are cleverly grown after one another. The different crops can profit from the combination of nutrients left in the soil by the one preceding it (Leferink et al., 1995).

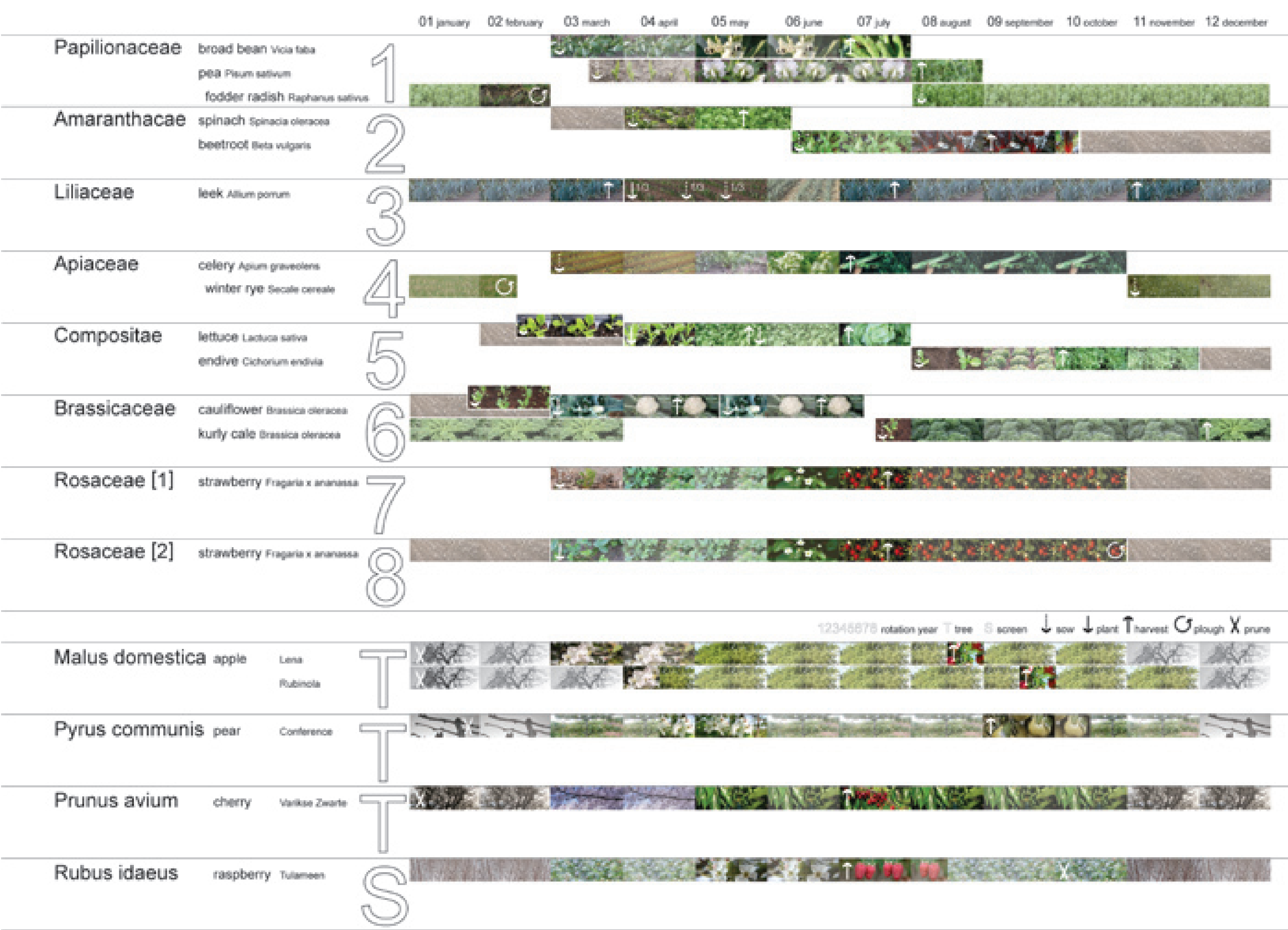


fig.106 plant calendar

A crop rotation is also necessary to suppress diseases. In eight years time it is most likely to have expelled all diseases (Siepel, personal communication, 28-02-2008). The plant calendar with eight-year-rotation forms the basis of the park's vegetation plan [fig. 106]. It shows when crops are planted, sown, harvested or ploughed. The scheme attempts to create an evergreen character and has various harvest moments throughout the year. When there is no crop grown, green manure plants replace it and improve the fields. The rhythm of the park, different from the rhythm of city movements surrounding and crossing it, becomes visible.

Plots are organised in groups of eight, to match the plant calendar and have continuity of production year round. One set of eight is divided along the length path, to experience all different crops whilst cycling through the park. The other sets are placed between pedestrian paths and cycling routes crossing the zone, strongly related to the surrounding blocks and neighbourhood [fig. 105].

A more detailed projection shows textures and colours of the planting scheme [fig. 107]. Herbaceous grasslands grow around plots in the more extensive parts of the park, where no building blocks border the site. Herbaceous meadows and the naturally vegetated water sides are perfect habitats for insects that help the crops' pollination and pest control (Smit, 2008). Biological control of pests is based on the principle of finding natural enemies to the pests. These include parasitoids, predators, pathogens and weed feeders (Weeden et al, 2007). Parasitoids are wasps or flies that lay eggs inside an aphid, where its young will grow and kill the host. The well-known ladybeetle is an example of a predator.

fig.107 detailed projection of plantings

7.5 Visualisation

The appearance of green fluctuates throughout the year. Using the seasonal character helps introducing the natural rhythm in the urban context. The ability to harvest emphasises these natural processes [fig. 108].

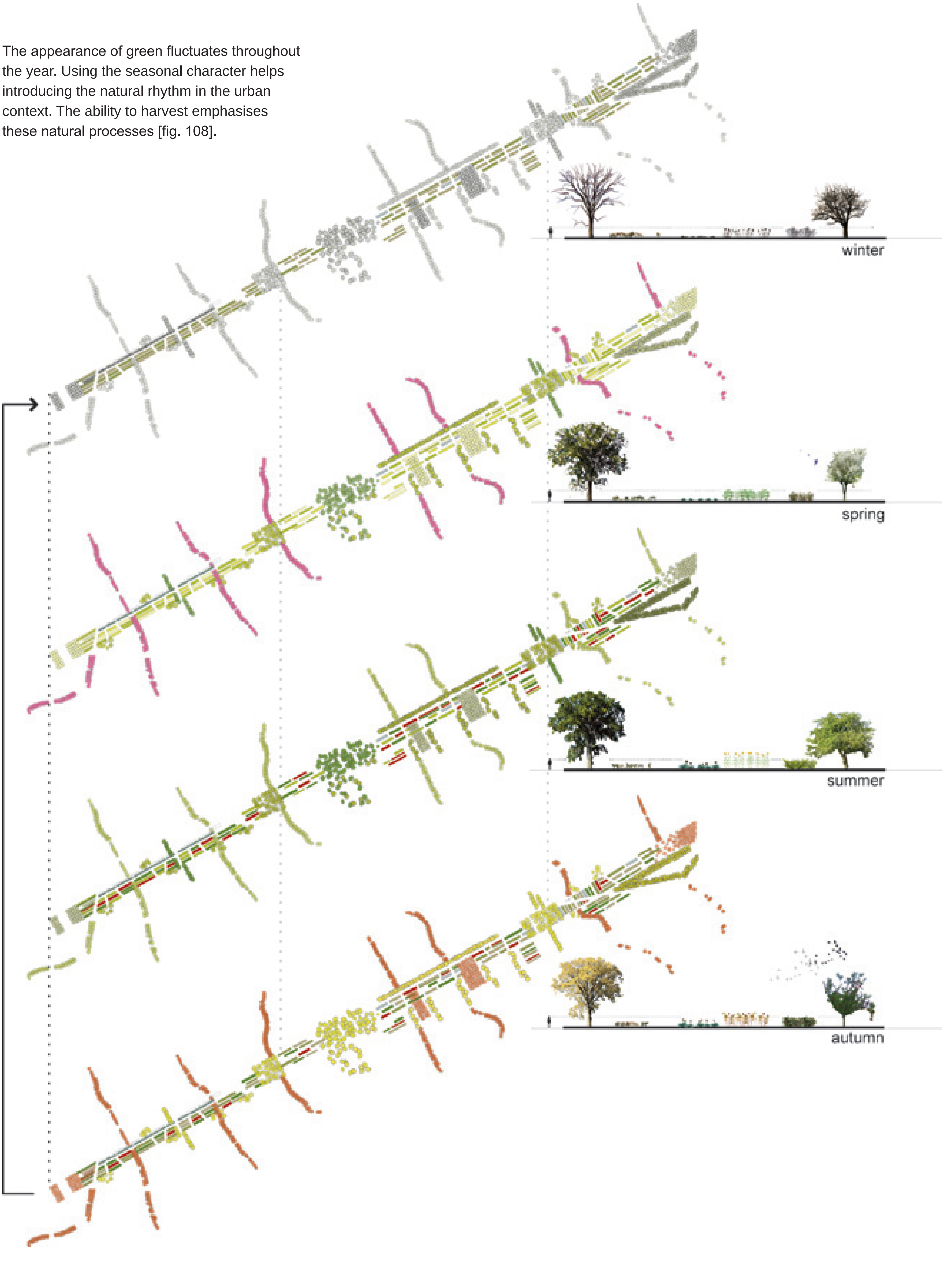


fig.108 seasonal rhythm expressed by its main colors

fig.109 impressions of park elements

To give an impression of how the park will develop throughout the seasons and over the years, four sets of images show different perspectives of the plan.

fig.110 I: winter 2015

Winter 2015: the main path is constructed and plots are already in production, separated from the path by recently planted trained trees and hedges. There is room for containers with seedlings, for on site preparation of the production system [fig. 110].

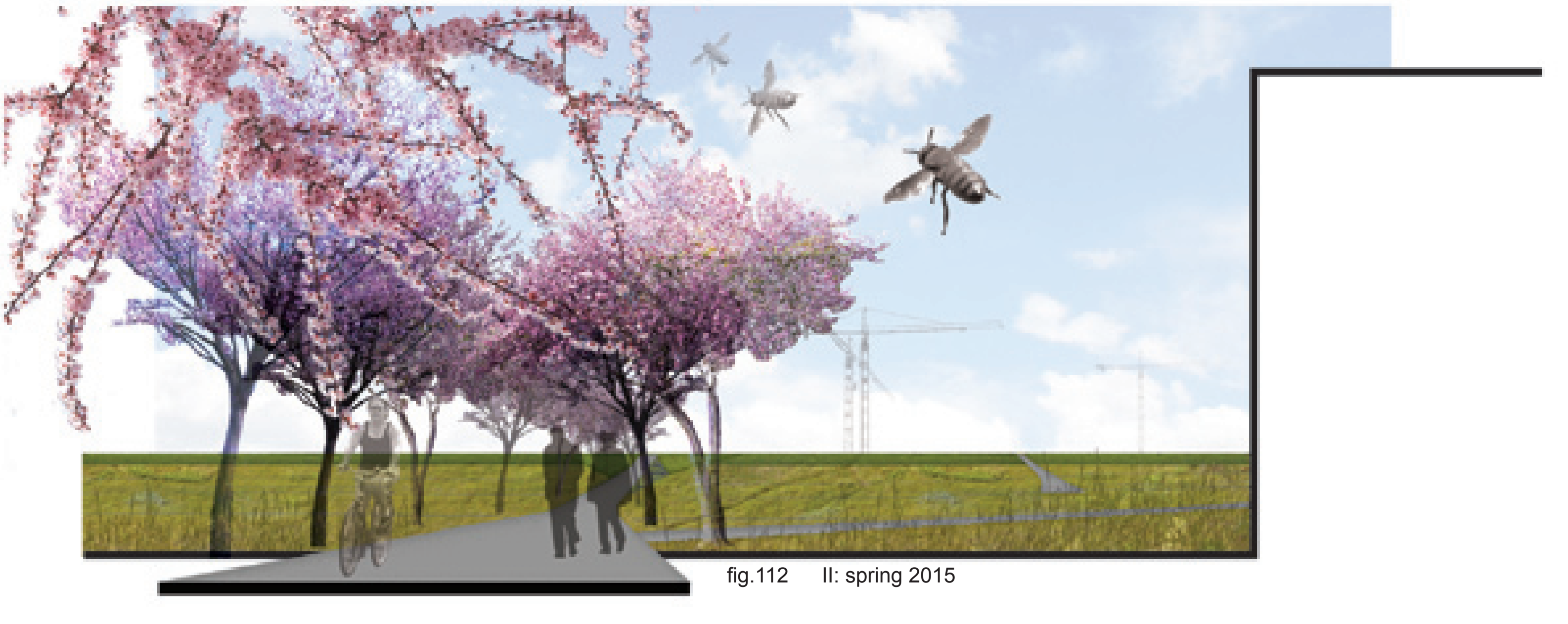


fig.112 II: spring 2015

Spring 2015: paths that connect the existing neighbourhoods to the new park, are planted with cherry trees, blossoming this time of year. The route tilts towards the tunnel roof and production is already introduced in the area [fig. 112].

fig.111 I: winter 2030

Winter 2030: housing blocks are placed adjacent to the tunnel roof. The buildings' plinths contain facilities, and combined with the main route, this strip unfolds itself like an urban boulevard. During the winter season, trees can be pruned [fig. 111].

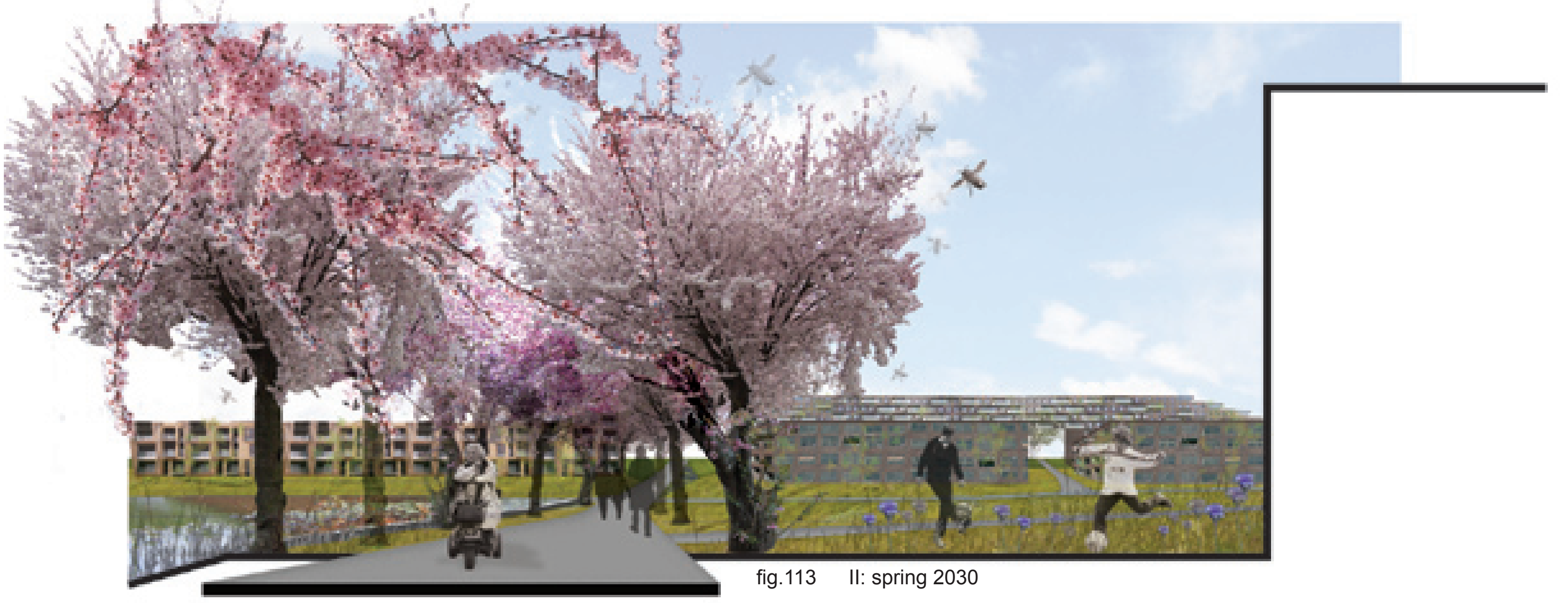


fig.113 II: spring 2030

Spring 2030: the disclosure of the new apartments and existing blocks is merged and combined with water storage in the profile. New paths along herbaceous meadows and playing fields intersect the building blocks and lead to the park [fig. 113].

fig.114 III: summer 2015

Summer 2015: the node between the bordering parks is still open, but the vegetable stall already distributes the first produce [fig. 114].

fig.116 IV: autumn 2015

Autumn 2015: the half of a building block with apartments is constructed, with private gardens and terraces adjoining the foot of the building and its green facades. The central terrain may already be used for production. Lime trees in the back guide and filter the disclosing car road [fig. 116].

fig.115 III: summer 2030

Summer 2030: the node is transformed into a square with raised beds, seating elements, and Honey Locust trees. The vegetable stall is now combined with a café, where people can have lunch under the foliage. With different routes crossing the square, it serves as a place to rest [fig. 115].

fig.117 IV: autumn 2030

Autumn 2030: the building block is completed with split level houses. Hedges and a path separate the private space from the communal allotment garden, that presents possibilities for direct involvement of the residents, especially during the harvest season [fig. 117].

fig.118 V: Croproad Park

A productive urban landscape: square with metro stop provides city-wide connection and links to main path, placed on naturally vegetated embankments, safeguarding production plots and equally creating habitat for useful insects.

8 Conclusions

Conclusions

The previous illustration of a productive urban landscape might set an example of how to implement urban agriculture in post-industrial cities.

A production system tied to urban agriculture can provide a framework and network that stretches beyond the production of food. The (re-)use of resources, like water and compost, mitigates in the urge to create catchment areas for predicted severe precipitation, due to global climate change. The reliance on local work forces for maintenance and harvest encourages community involvement and can improve the social control. The market for food sales generates movement around and about the site, linking people to new places. The addition of a production system is an actual investment in urban greening. The urban green gets more substantial value, whilst providing the city with immaterial benefits from green.

Cities will always be dependent on the natural systems beyond their limits, and linking to these natural systems by urban greening is crucial in developing a sustainable living environment. In times of high spatial claims and urban pressure, ongoing extension of the post-industrial city model cannot be the case. Subsequent to the Neo-agrarian compact city and the Industrial dispersed city, new, contemporary issues require a restructuring of the urban. The design of the modern city and suburb contributed considerably to the loss of shared experience and local knowledge. Subdividing and segregating land-use functions by high-speed arterial traffic and distance make it nearly impossible to bound beyond a small area (Hester, 2006). In fact, the extension of the dispersed system has fuelled the rapid decompression of urban industrial cities, and the decentralisation of both mass production and consumption (Shane, 2006). Since the city is replacing the traditional, agricultural activities in the countryside with recreational functions, inner-city parks made for recreational purposes may well be restructured with functions formerly linked to this countryside: agricultural production. The dispersed production and consumption need to be re-integrated.

The city's character is dynamic. This calls for dynamic symbols for traces of various things in motion – birds, people, messages, cars, money, but also food – which last, if only temporarily, and then become recognisable as urban characteristics. The realisation of symbols through the shaping of land, of mass and of space, is an essential part of the maintenance of cities (Bunschoten, 2001).

It is the understanding of decentralised post-industrial urban form that can highlight the leftover void spaces of the city as potential commons. Where normally, or traditionally, land would be colonised, built upon and landscaped, a reversal of these processes opens the way for a new hybrid urbanism, with dense clusters of activity and the reconstruction of the natural ecology, starting a more balanced, resilient, inner-city urban form in the void (Corner in Shane, 2006). Similar to the case of motorway A9, voids become new spaces. Spaces that are prepared grounds, flexible and open, allowing ad hoc emergence of social patterns and group alliances and eventually colonizing these surfaces (Corner in Shane, 2006).
This can be considered as an attempt to move from Modernist and New Urbanist models of ordering the city to more open-ended, strategic models (Corner in Shane, 2006).

Cities can actually be seen as tools for living, interacting, producing, but they are also expressions of this life, signs of interactions, products of labour (Bunschoten, 2001). Together these qualities make a city into a life-form, constantly generating itself.

Eventually, cities are embedded in the landscape, expressed in different gradients of urbanity. With landscape being the human habitat, we all live in some gradient of urbanity. Cities as objects, as clearly defined spaces with clear identities, do not exist anymore. A city moves, it evolves, like the landscape it is part of. When building and organising cities, complex accumulations of aspects of urban life and development must be considered (Bunschoten, 2001). Changes in city form can enable changes in behaviour and values of urban life. Creating potentially enabling landscapes – productive urban landscapes – does not guarantee their effective use, but changes in environment often do lead to behaviour changes and awareness (Hester, 2006).

Appendix

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Fig.25
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Fig. 109
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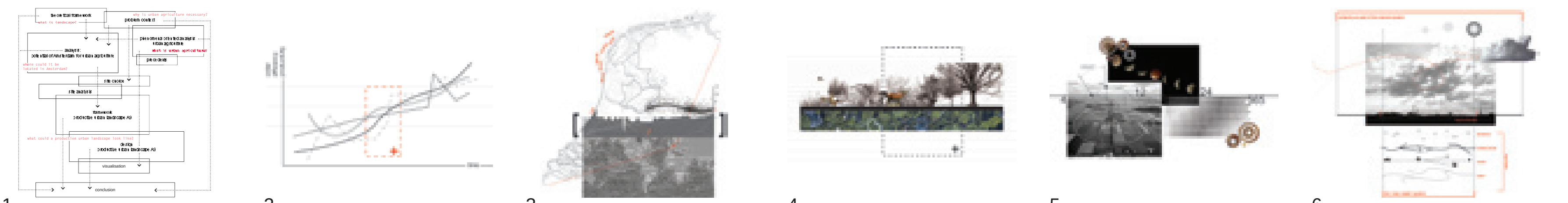
C. List of Figures



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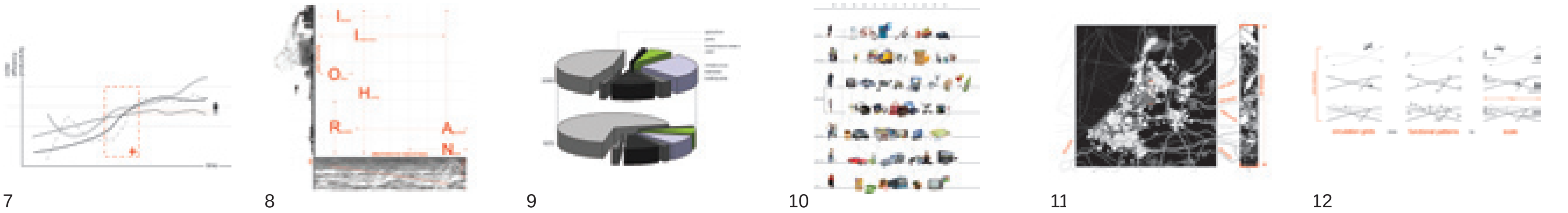

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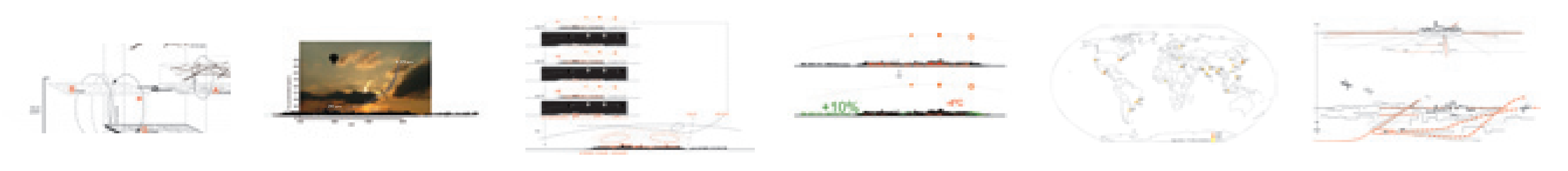

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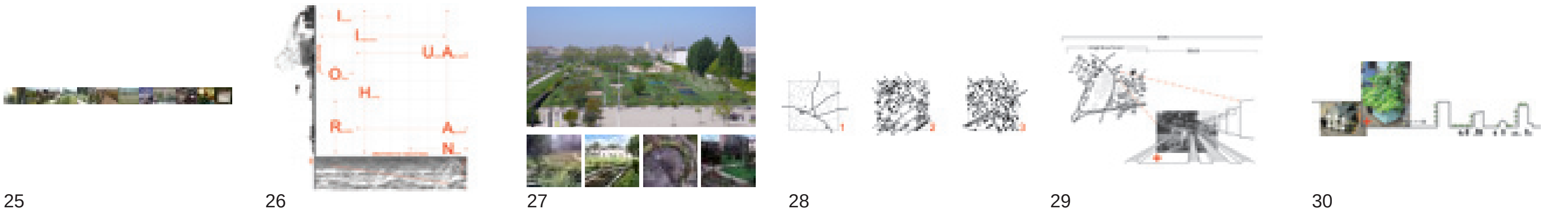

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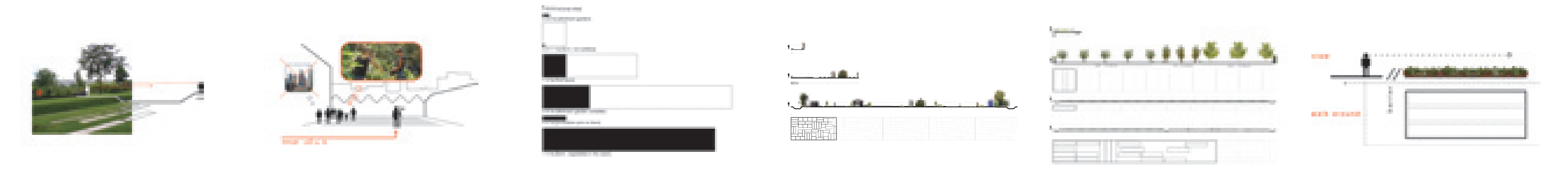

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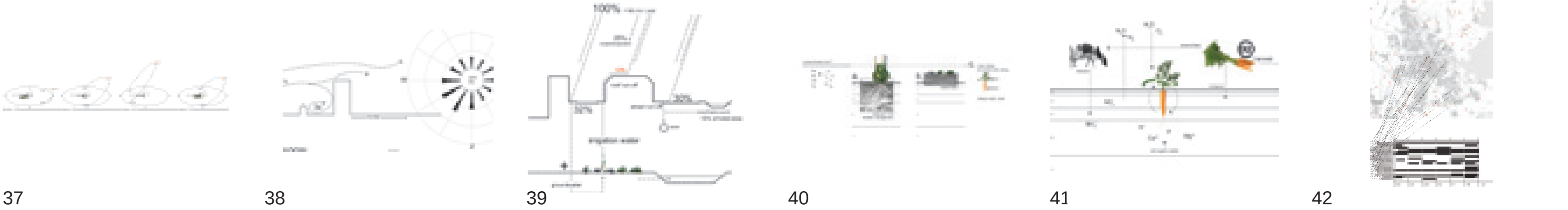

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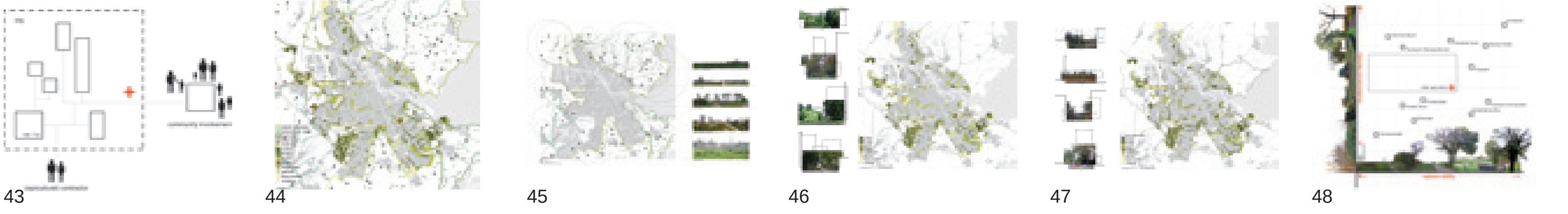

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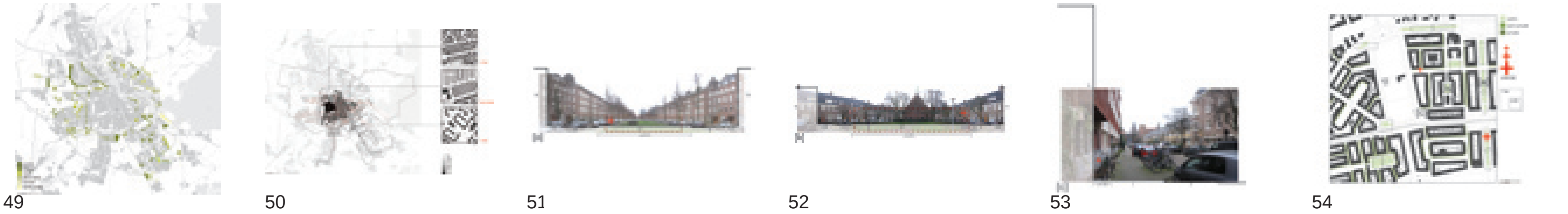

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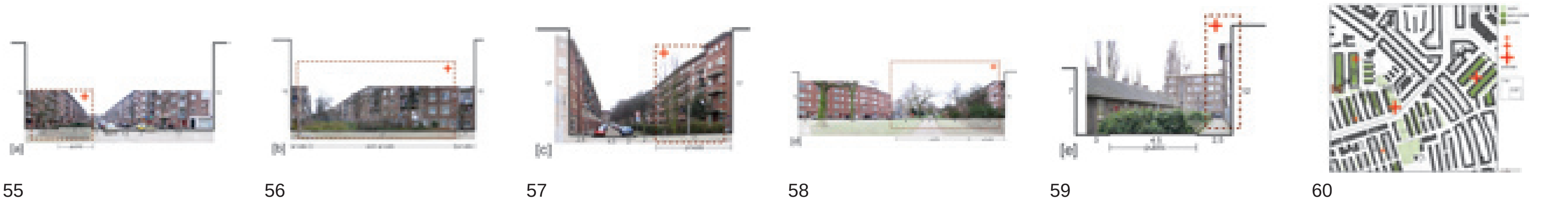

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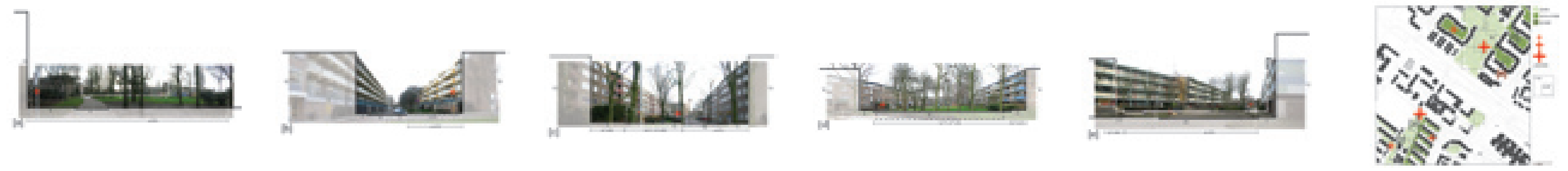

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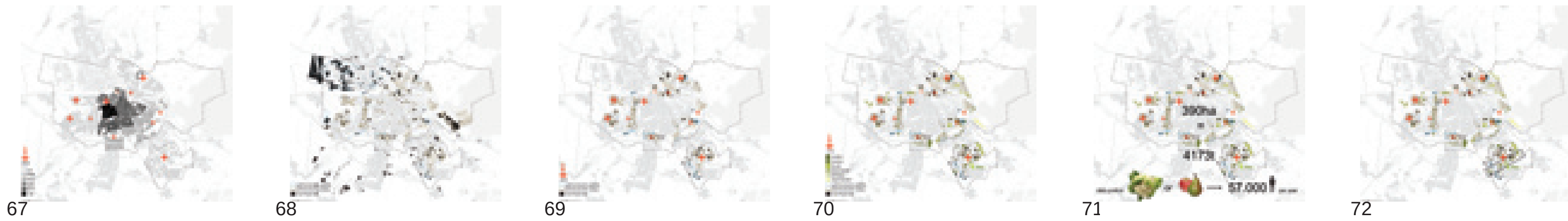

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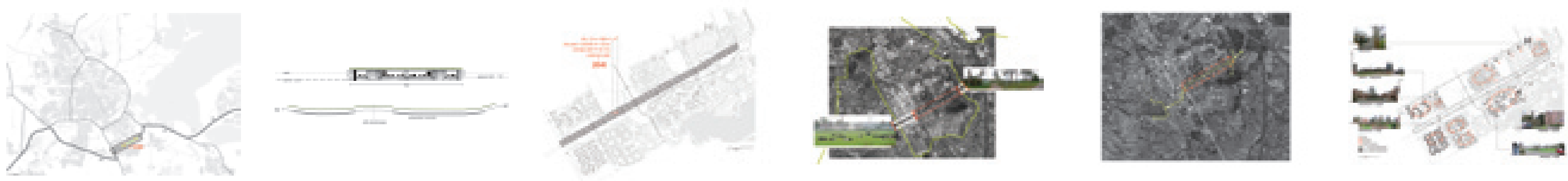

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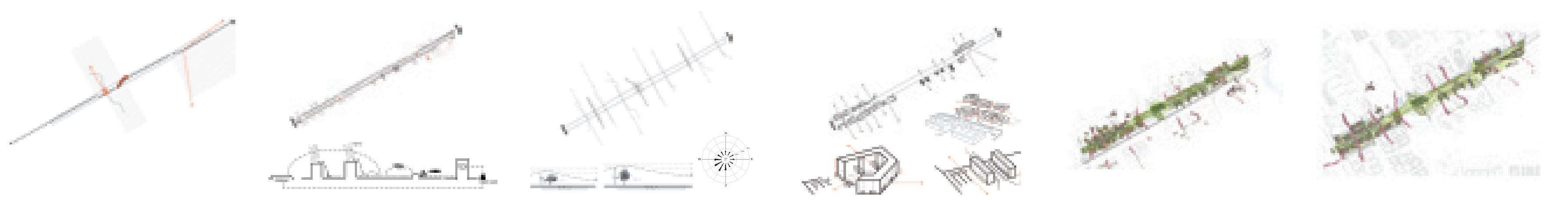

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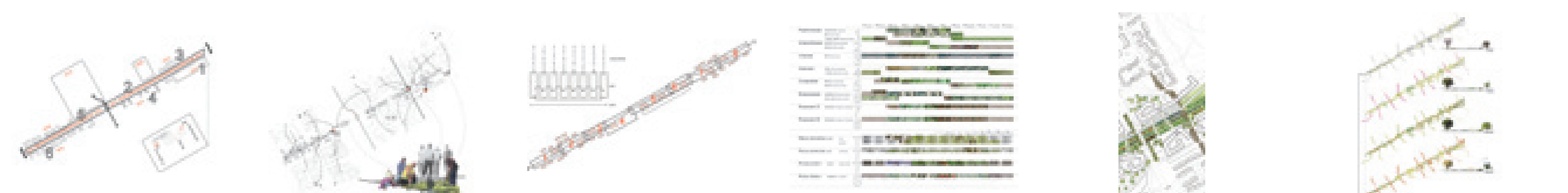

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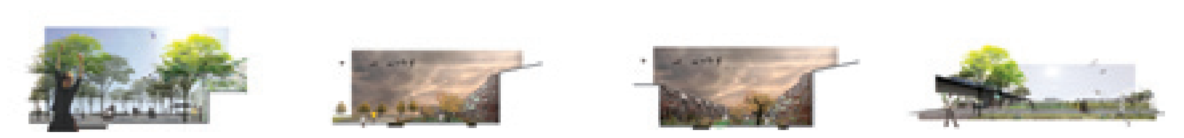

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