6 Human living

This chapter deals with aspects of natural population growth, the adaptation of the human species to its habitat (adaptation), the adjustment of the human habitat to the species (accommodation, technique), the distribution of human population on European, Dutch and Randstad levels, the development of these in the last 30 years from the perspective of government policy and the effects of different distribution variations on the ways in which land has been drained and opened up, and on biodiversity[44].

By adopting this fundamental approach of Jong and Achterberg (1996), a standard legend/key for regional and urban architectural plans arises *en passant,* that makes them comparable and thus applicable for in-depth effect analyses in the areas of ecology, technology, economics, culture and politics as elaborated by Jong, Dieters et al. (1996).

References

Jong, T. M. d. and J. Achterberg (1996) Het Metropolitane Debat. 25 Varianten voor 1mln inwoners (Zoetermeer) Stichting MESO**:** 54.

Jong, T. M. d., M. Dieters, et al. (1996) Het Metropolitane Debat. Voorlopige Morfologische Analyse van Twaalf Plannen voor de Randstad (Zoetermeer) Stichting Meso.

6.1 Adaptation and Accommodation

6.1.1 Anthropogenesis

For millions of years, human characteristics have been tuned to the natural environment in which people had to survive (adaptation). Therefore, it is useful to acquaint oneself with this 'reference' environment as such, and, now and then, to allow this nature to be the tutor of architectural (and mechanical engineering) forms. Even in the most advanced studies into the development of autonomous robots, the mechanics of insects are attentively observed. Also in the other development that is thought to be important for the future — biotechnology — nature is often 'the tutor of art'.

In the history of human origins (anthropogenesis)[a] , human adaptation and environmental determination have played a major role.
Approximately 6 million years ago, due to climatic and environmental changes in Africa, *Homo habilis* exchanged a forest habitat for savanna.[45] Approximately 2 million years ago, *Homo erectus* developed from this animal. In turn, different human-like animals developed from this creature and later became extinct. Fifty thousand years ago only two of these species remained, the Neandertalers and *Homo sapiens sapiens.* The Neandertalers became extinct at this time, leaving *Homo sapiens sapiens* as the sole survivor. For approximately 1 million years, this species' use of tools has served as a criterium to demarcate humanity: the capacity to oversee a series of acts of which only the first (e.g. the making of tools) can be carried out immediately.[46]

The origins of the human race, preceding *Homo habilis*, has produced a large number of ergonomically interesting 'aboreal pre-adaptations' (adaptations to the former forest environment), such as the ability to grasp with the hands, stereoscopic vision, upright posture, the production of a limited number of offspring at each pregnancy, a lengthy up-bringing of the offspring, etc.[47] The tropical rain forest is then by no means as frightening as is it is made out to be. It is a fantastic experience to cut a path for oneself through this twilit environment: it feels as though one is returning home after 6 million years. All the senses are stimulated in a changing, yet balanced, way. One can seldom see further than 100 metres ahead and is constantly obliged to focus the eyes on objects both nearby and further away. Moreover, it is an environment similar to a Gothic cathedral: full of vertical light-seeking pilasters, in which, occasionally, the sun festively forces its way to the bottom. This demands continuous attentiveness, but, on the other hand, the senses seldom become overloaded.[48]

In this century, we are witnessing the clearance of the last primitive forest peoples and their culture and habitat. Nevertheless, a cultural-ecological study of these communities that are so closely linked with our reference environment could be of importance for future urban design.
The transition from forest dwelling to life on the flat savanna lands must have made the eyes lazy, but the hands and the head more diligent. It is particularly these border environments where people seek cover and where they build their own protective shelters.

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[a] De opvattingen over de antropogenese zijn jaar in jaar uit sterk in beweging. De hier uitééngezette opvatting is ontleend aan het wat oudere maar voor ons doel vrij volledige boek van Harrison, G. A., J. S. Weiner, et al. (1964) Human Biology (Oxford) The Clarendon PressHarrison, G. A., J. S. Weiner, et al. (1970) Biologie van de mens (Utrecht/Antwerpen) Het Spectrum N.V..

6.1.2 Habitat, household management and population density

With the help of technical resources, the human species can maintain and organise itself to suit its own wishes in every biotope (accommodation). In general, such accommodation results in pioneer, grassland and brushwood vegetations. Sometimes, mankind changes the dominance relationships in the landscape to such an extent that, in places, the old situation remains protected (nature conservation) or new successions are allowed to come into being (nature development).

Different populations live in different densities (Fig. 605)[49].

HABITAT	% Percentage of total land area on earth	% Percentage of total world population	inhabitants per km^2
Dry lands and deserts	18	4	10
Tropical forest/ shrub crops	15	28	60
Grassland areas	21	12	20
Semi-forested areas	7	39	190
Mediterranean shrub overgrowth	1	4	130
Temperate to cold area	10	1	3
Arctic/tundra area	16	<1	1
Living area in the mountains	12	12	30

Harrison, Weiner et al. (1964); Harrison, Weiner et al. (1970)

Fig. 605 *Population densities in different habitats 1970*

Each habitat has resulted in different forms of household management (Fig. 606).

	Food-gatherers	Hunters	Pastorales	Nomads	Simple cultivators	Advanced cultivators
Equatorial forests	Siamang	Pygmies, Melanesians			Amazone, Nw.-Guinea	Indonesia, Java
Tropical forest and scrub	Grand Chaco indians	the Bantu	the Bemba		Indo-Dravidians, South Americans	Bantus
Tropical grasslands (savannahs)	Australoids	Hadza (East Africa)	Nilotes		North American Indians	Hamites
Drylands and deserts	Bushmen and Australians			Bedouins, Tuaregs	Oasis dwellers	Oases (riverine)
Temperate forests	Australians, Mesolithic Europeans	Tasmanians, Predmost	Iron Age Europeans		Chinese	Peasant Chinese
Mediterranean scrub	Strand lopers	Californian Indians	Balkans	Berbers	Neolithic Iron Age, Maori	Medieval Europe
Temperate Grasslands	Paleolithic Europeans		Mongols	*boerjaten,* mongols	Siouan Indians	Pawnee indians
Boreal	Fuegians	Samoyeds		Lapps		
TUNDRA		Eskimos		Lapps		

Harrison, Weiner et al. (1964, 1977 p 398) Harrison, Weiner et al. (1970)

Fig. 606 *Habitats, economies and cultures*

From this it appears that there is no simple relation between habitat and household management, as believed by physical determinists at the end of the last century.(Claval, 1976). However, there is some relation between household management and population density (Fig. 607)[50].

POPULATION	km^2 per head	heads per km²	for 100 people	
			km radius	nominally
		Food gatherers		
Upper Palaeolithic (Eng.)	500	0,002	126	100
Australian aborigines	60	0,017	44	30
Tierra del Fuego islanders	20	0,05	25	30
Andamen Islanders	1	1	6	10
		Developed hunters/fishermen		
Eskimos and Indians	500	0,002	126	100
Eskimos (Alaska)	80	0,0125	50	30
Mesolithic man (Eng.)	25	0,04	28	30
Pampas Indians	5	0,2	13	10
British Columbians	0,1	10	2	3
		Arable farmers and nomads		
Neolithic man (Eng.)	1	1	5,6	10
Pastoralists and nomads	0,25	4	2,8	3
	0,03	33	1,0	1
Iron Age man (Eng.)	0,25	4	2,8	3
Middle Ages (Eng.)	0,05	20	1,3	1
Middle Age man	0,02	50	0,8	1
Swidden farmers	0,001	1000	0,2	0,1

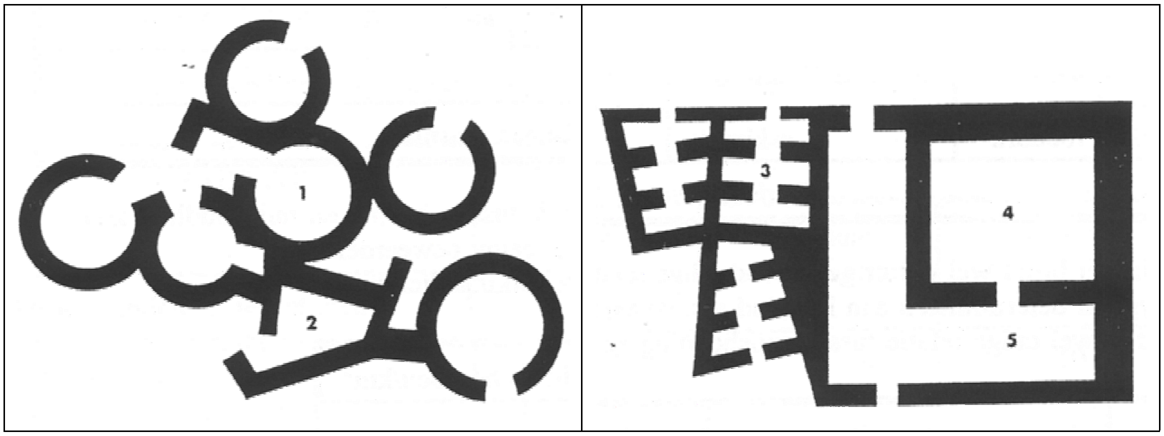
Harrison, Weiner et al. (1964); Harrison, Weiner et al. (1970)

Fig. 607 *Economies and population density*

In the last two columns, the areas are translated into the radius of a circle with the same or almost the same area for a group of 100 peopl[51]
The same approximated sizes will play an important role in comparing different urbanising models.

The transition from hunting to agriculture has had enormous societal consequences.

In the village Beidha, in Jordan, the floor plan of dwellings changed from round to square during the 500 years from 7000 BC. This reflects a probable social development towards more task division and functional differentiation in living (Fig. 608).[52]



1 Living room
2 Storage places in the neighbourhood

3 shops
4 community building
5 inner courtyard
living in storeyed buildings

Leonard (1974)

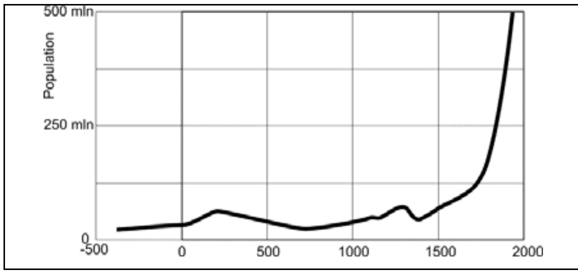
Fig. 608 *Historical floor plans of dwellings that reflect the transition from hunting to agriculture*

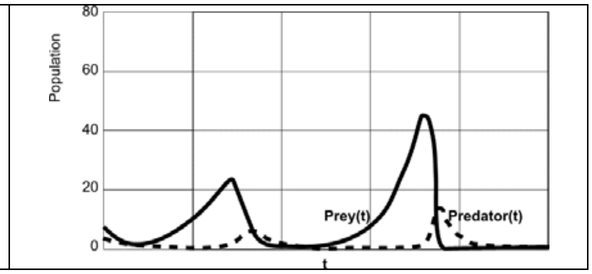
6.1.3 Population growth

If an animal or plant species gains dominance in a new habitat, then, initially, the population of these species can increase unhindered, but sooner or later it comes up against boundaries in the carrying capacity of the environment (in terms of Opschoor and Weterings (1994) and Koten-Hertogs, Beckers-de Bruyn et al. (1995) environmental utilisation space milieugebruiksruimte), or (in the case of human beings) boundaries, which they themselves fix, within the existing biocoenosis (ecological community). If we couple the beginning of mankind with the use of tools, then the species is approximately 1 million years old. Agriculture (the Neolithic revolution)[53] was invented 10,000 years ago (1% of 1 million!). By means of agriculture, the species was able to enlarge, single-handedly, the carrying capacity of the environment and thereby to increase its population according to from approximately 4 million to 200 million by the height of the Roman Empire in Europe and the Han Dynasty in China.

Round about the beginning of our era this growth appeared to have slackened off, but, in the last 1000 years, growth has occurred again, which, as yet, appears to be exponential (see **Fout! Verwijzingsbron niet gevonden.**, blz. **Fout! Bladwijzer niet gedefinieerd.**).
The slowing down of growth around the beginning of our era can be explained by the fact that all available agricultural land was in use at that time. Erosion occurred due to overcropping, forcing some human communities to leave their homelands, and tribal migrations(tribal) began to take place. Because of the limitations of agricultural land, people learned to be more careful with the soil by implementing two- or three-year rotations, by applying fertilizers (nitrate cycle), by improving the plough and the storage (of the produce), etc. After the Neolithic Revolution, the next big revolution came with the mastery of inanimate energy (Industrial Revolution beautifully described by Cipolla (1970)). Each technological revolution created the conditions for far-reaching economic, demographic, cultural and political revolutions and these, in turn, had enormous ecological consequences[54].
Technical, agrarian and hygiene innovations can counteract the original environmental limitations and allow unlimited population growth for a time Jong and Priemus (2002) discuss these and other approaches.

Fig. 609 shows that in Europe, during the Middle Ages, significant population fluctuations occurred partly because of erosion and starvation, and partly because of (pest) epidemics.[13]
The new exponential growth has mainly taken place after the Middle Ages, after technological developments had made their influence felt in the fields of agriculture, trade and hygiene.
Illness, such as the enormous pest epidemic around 1300 interferes with population dynamics in a similar way to the activities of predators in a population of their prey[55]





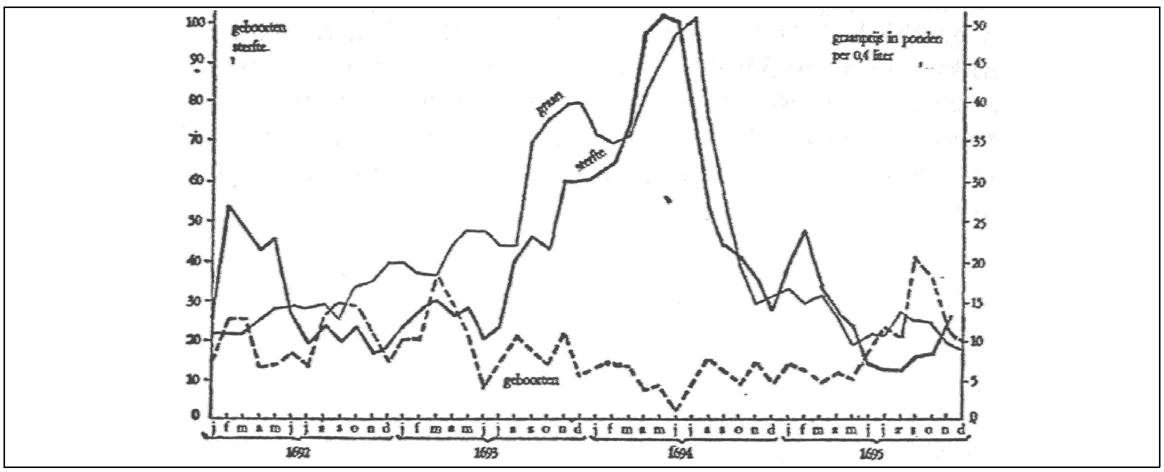
Schlicher van Bath (1960)

Fig. 609 *The anticipated developments in population numbers in Europe.*

Jong and Priemus (2002)

Fig. 610 *Predator and prey according to Lotke-Volterra*

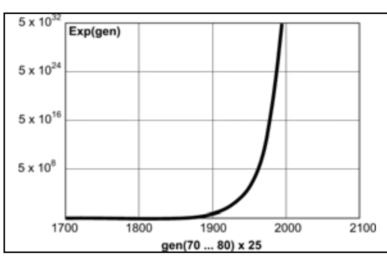
Historically, hunger is recognisable by the number of deaths, and is often related to the staple food. Increases in the price of grain are generally followed by more cases of death. Then, once the crisis periods have ended, the numbers of births increase again. This relationship is not only evident in history, but is still actual today, and will become more evident as the current world population develops[56].

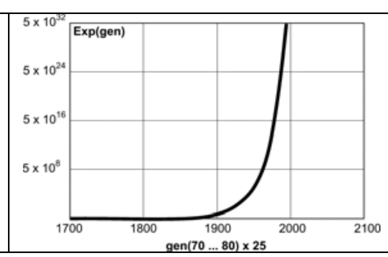


Lachiver (1964)

Fig. 611 *Demographic crisis in Meulan, near Paris 1693-1694*

If there was no immigration or emigration, and the death rate remained constant, then population growth would be completely dependent on the number of children born. If the number of children *k* born to each individual was 1, then the population would remain constant, if $k<1$ then the population would decrease, if $k>1$, then it would increase. The total population *y* of parents y_0 and children ky_0 is then y_0+ky_0 (Fig. 612).





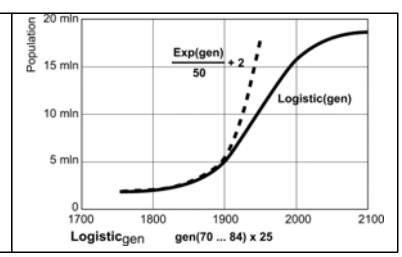


Fig. 612 *Unlimited growth*

Fig. 613 *Adapted by parameter*

Fig. 614 *Limited growth because of carrying capacity*

Where death rates vary per generation, there is also a variation in birth rates. To contain these variations within one model, it is no longer sufficient to use a time-segment approach. Instead, one has to examine the population per cohort (Fig. 615). The branch of science that concerns itself with these activities is called demography.

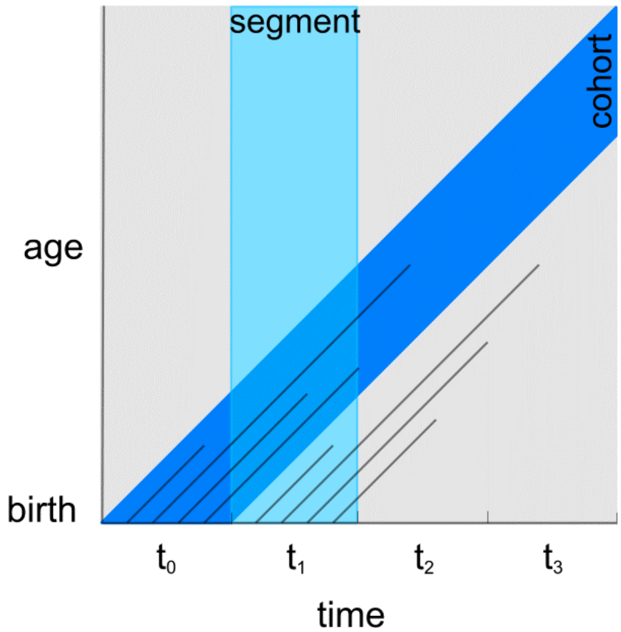
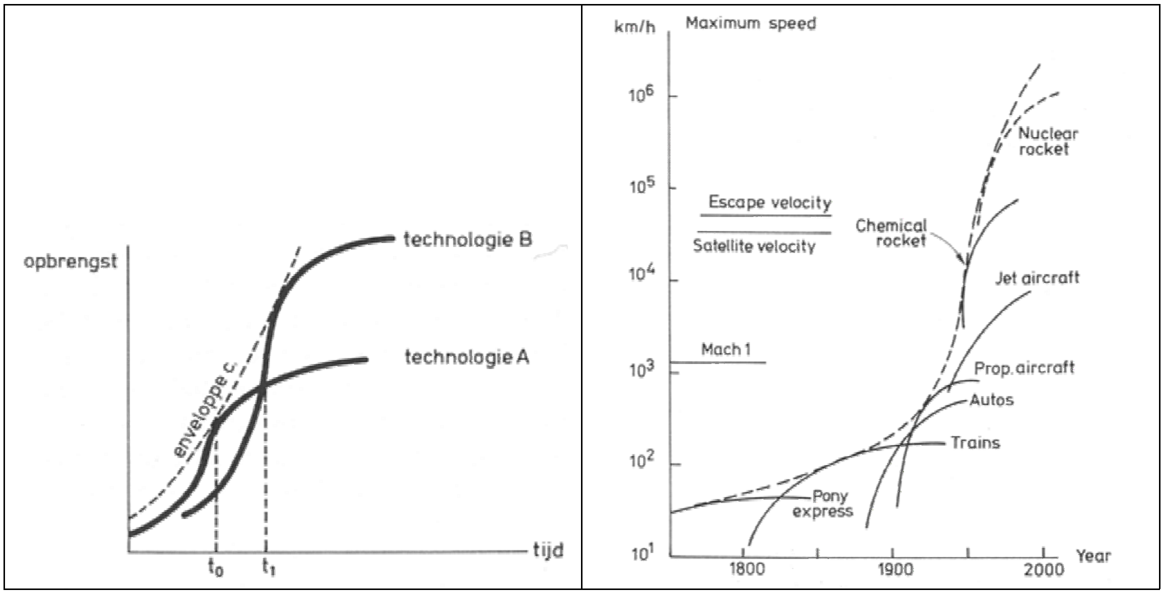


Fig. 615 *Population in a certain period and per generation (cohort).*

Growth that is limited by the usable area of environment, or the carrying capacity of the ecosystem, is represented by a logistic curve (Fig. 614). Should we, for the time being, interpret the future of our population as one of unlimited or of limited growth?[57] Many people like Meadows, Meadows et al. (1992) think or hope, in view of limited raw materials, that growth will be limited. The logistic curve works beautifully for fruit flies, but when applied to the population of the United States, based on the demographic statistics from 1790 to 1910, reality proved this mathematical approach to be incorrect after 1950: growth is still exponential.

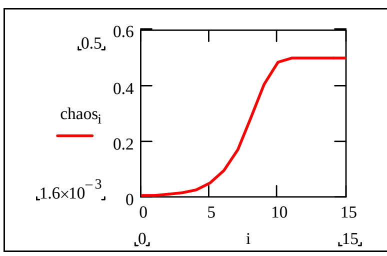
From technical history, we have learnt how a succession of technological innovations, in its totality (the 'envelope curve') can be reinterpreted as exponential growth (Fig. 616).[58]

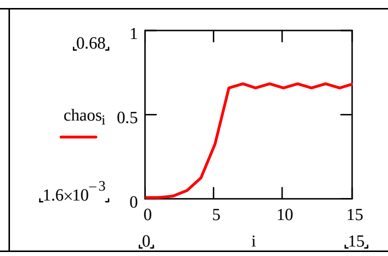


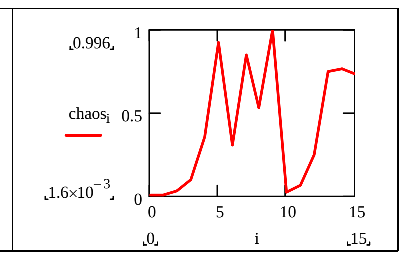
Ayres R.U. (1965) en Jantsch E. (1967), cited by Doorn and Vught (1978)

Fig. 616 *The envelope curve*

Fig. 617, and the following figures, illustrate a reflexive chaos function $chaos_{i+1} := a \cdot chaos_i - a \cdot chaos_i^2$ for example with $chaos_0 := 0.0016$ and i := 0 … 15 that looks similar to a logistic curve on a=2 , but which shows chaotic shifts on higher values of the parameter a [59].







See also Jong and Priemus (2002)

Fig. 617 Chaos using parameter *a* = 2

Fig. 618 Chaos using parameter *a* = 3

Fig. 619 Chaos using parameter *a* = 4

Limits to growth

Death has been largely and lastingly restricted by medical science to older age groups, although not everywhere to the same extent. The most important variable factor that determines world population growth is the fertility or reproduction factor. Worldwide, of course, immigration and emigration play no role at all. The big question is: When will the current exponential-like growth in population level off again? The Earth is still able to feed a multiple of the current world population, but the distribution is so uneven that an unacceptably large proportion of this population is starving and dying. In time, not only will distribution be a problem, but the total amount of food will become insufficient.[18]
At the same time, during the last 25 years, erosion has made 10% of the agricultural land unusable. Rising world temperatures will intensify this process by causing more deserts to form.

According to CBS calculations, the Netherlands can expect population numbers to flatten off after 2040.[60].[a]

[a] http://www.cbs.nl/nl/cijfers/statline/index.htm

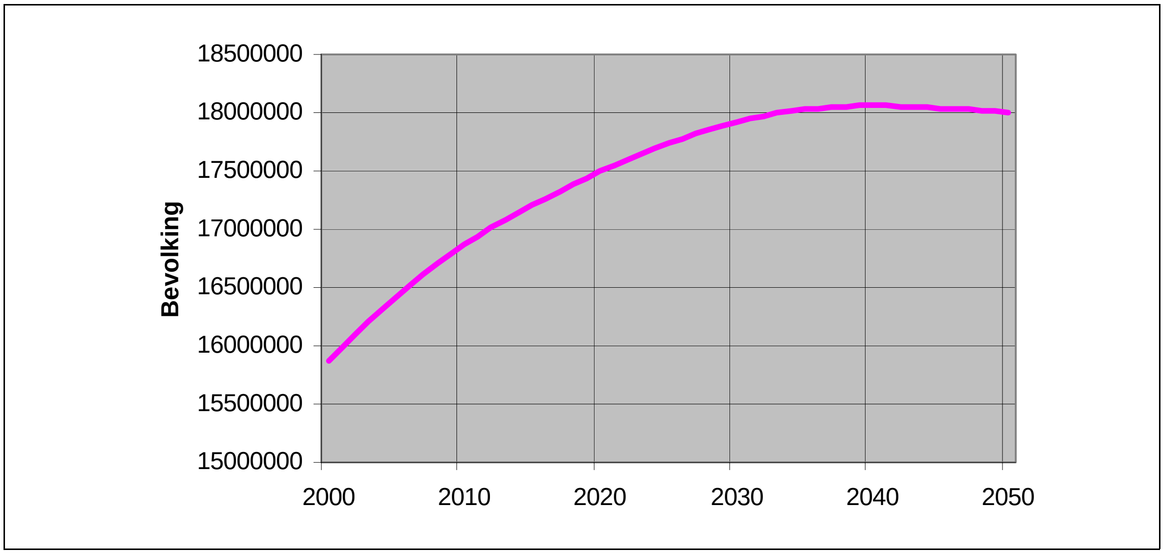


Fig. 620 *The CBS population prognosis for the Netherlands, 2002*

This development is expected in most Western countries, due to the decreasing number of births. Elsewhere in the world, so long as children are seen as the only form of health and pension insurance, this flattening off of numbers is not expected. The ecological crisis can then largely be seen to be linked with development problematics.

Contraception

One of the most harrowing Western influences is that, so long as the mother breast-feeds her child and carries it with her, natural contraception is broken off.[20] If the mother stops feeding her child for just one day, then she immediately becomes fertile again. A mother can feed her child for more than three years, but the Western example of laying a child in a cot and feeding it with a bottle has gained a higher status. The result is that a woman can become pregnant every nine months.
Western influence has not only brought about higher fertility in the Third World, but also a harrowing neglect of children still in their first phase of life. Every time a new child is born to its parents: the youngest child always receives the most attention.

Contraceptive devices are used by almost all ‘primitive’ peoples.

	infanticide	abortion	restricting coitus
	Food gatherers and hunters		
Australian tribes (the Aborigine)	+	+	-
Tasmania	+	+	-
the Bushmen	+	-	-
Indians	+	+	+
Eskimos	+	+	-
	Arable farmers		
Indians	+	+	+
Africa	+	+	+
Oceania	+	+	+
+ = number of confirmed cases - = no reported cases			

Harrison, Weiner et al. (1964); Harrison, Weiner et al. (1970)

Fig. 621 *Methods of restricting the population used by ‘primitive’ peoples*

In the Middle Ages, hard meaures were taken to reduce the population. If an area of land became over-used, at the very least or mildest, people were forced to move to marginal land. The history of marginal small-holders, tinkers, bandits, in short ‘the destitute’ ("ellendigen", "uitlandigen" exactly meaning: ‘those who have been turned off the land’) has never been written. The army, the cloister and the celibate can be seen as forms of contraception in the Middle Ages.

In this way, one can also explain how social norms in a farming community can be tightened (traditional costume!). People who were unable to live by such high norms were ‘excommunicated’. The exaggerated norms were used as ‘a stick to beat the dog’. Up to as late as the last century, in Staphorst, the black sheep was actually forced into a cart and driven out of the village[61]

6.1.4 The urban environment

The biggest mass migration ever was the movement from the country-side to the towns that resulted from the Industrial Revolution. The spatial and social consequences of that process are summarised under the term ‘urbanisation’.
A progressive division between production, exchange and consumption (working, transport, living and recreation) has taken place, both in space and time, so that monofunctional spaces and interfunctional activities (activities that are only useful within a series of activities) have come into existence. This division of functions does not only take place between households, but also on the level of the individual households themselves. For everyone, there is a separate time for living, working and enjoying recreation. The household is losing its traditional functions such as providing training, religion, assurance and by that size and coherence.[62].

How people spend their time gives a good indication of their daily lives and their use of space. Less and less time is needed to sustain life. Apes and people who currently live at subsistence level, and many households in the past, need(ed) to spend 40% of their time on that. Nowadays, by dividing tasks, we only spend approximately 8% of our time earning our daily bread, if one includes children, pensioners and others exempt from paid employment.

The fact, that communities whose main activities are unrelated to the environment to which they have become attuned in the course of their history, can lead to long-term, unbalanced, over- (or under) stress in the organism. Insufficient adaptation to this stress causes lop-sized development. For example, one can wonder why hardly anyone has perfect teeth or cannot see clearly, without artificial aids, by his fiftieth birthday.
Living in closer proximity to others increases the risks of spreading infectious deseases, anonimity, loss of social control and new forms of criminality, even though according to Freedman (1975) the psychic effects appear not to be too adverse. A new biological tendency has come into existence that causes isolation, strongly polarising life into public and private spaces as Bahrdt (1957) described[63]. Accommodating to abnormal climates also sets physical demands on this isolation. The resulting ‘inner environments’ not only become a new habitat for humans, but also for birds, rats, mice, fleas, mites, fungi, bacteria, pets and house plants. Asthma, as the third largest cause of death after cancer, heart and vascular disease, is a problem mainly in temperate climates.

In addition to physical illnesses, there are also psychiatric disorders that can be linked with the new living environment, such as more frequent instances of schizophrenia in inner cities, although the cause can also be said to lie in the attraction of inner city areas for sufferers of schizophrenia[a]. Although many tests have been carried out on sensoric deprivation (the lack of sensory stimuli)[b], one should perhaps talk instead of ‘motoric deprivation’in the modern urban environment, in other words, the lack of accompanying motoric sensations from the muscles, and, more generally, the awareness of one’s own body and thereby of non-fictitious ‘reality’. The time spent in the car, in front of a television screen, at a sports competition arouses all sorts of sensoric emotions which have no logical motoric counterpart. Stresses cannot be resolved motorically by physical exertion. This is one of the causes of heart and vascular disease. Where people live in close proximity to each other and where internal spaces are fragile, the ‘motoric sequel’ becomes systematically suppressed, from childhood onwards. This could provide an explanation for the popularity of sport and violence. Specialisation and the division of tasks splinter the unity of life, not only spatially (this happens here, and that there), but also in time (first this, and then that). The number of interfunctional activities is growing and is laying a heavy claim on tolerance to frustration, both for individuals and groups of people.[64].

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[a] Het verhoogd voorkomen van bepaalde ziekten zoals schizofrenie in bepaalde delen van de stad is in de jaren '70 geregistreerd door de GGD van Rotterdam. Daarbij kwam ook een andere causaliteit aan de orde. De omgeving leidde niet zozeer tot een ziekte, maar selecteerde de immigratie van probleemgevallen op andere kenmerken, zoals inkomen.
[b] Sensore deprivatie, het verstoken blijven van zintuiglijke prikkels, is dikwijls experimenteel onderzocht. Zie voor een kort overzicht van het onderzoek tot 1978: Jong, T. M. d. (1978) Milieudifferentiatie; Een Fundamenteel Onderzoek Faculty of Architecture (Delft) Delft University of TechnologyJong, T. M. d. (1988) Milieudifferentiatie (Delft) DUT Faculteit Bouwkunde.

The intensity of use
People, animals, plants and apparatus need space and time to remain functional and to realise their aims or possibilities. At a certain level of intensity of use, they start to restrict each others' space and time so that displacement and waiting times occur, respectively. Systematic planning (spatial) and organisation (temporal) in the functioning of human beings and society become necessary as soon as either people or apparatus start to carry out, for example, more than 0.01 hr/m^2 of activities per year at a particular site (the present levels for agriculture in the Netherlands). If an activity takes place somewhere (a series of undertakings to meet a certain aim), then no other activity can take place on that same site and time. Therefore, if the intensity of use is greater than 0.01 hr/m^2, one has to separate any two activities in space (planning) or in time (organisation). If a separation is made on a certain scale level, it is also necessary to connect it to another scale level when, from time to time, activities such as natural or economic cycles need to be linked. This combination of separations in general, and connections here and there, and now and then, is a form of selection. Each wall with a door, town wall with a gate, every prohibition with exceptions is a selector[65].

Separations in space and time can come into being because of physical regulations or by territorial and prodecural consensus ('you here, me there; now you, then me'). At higher scale levels, arrangements prevail; at lower levels, physical measures prevail. Consensus can be in the form of an order ('forbidden access'), which, in a democracy, is founded on delegating authority to give orders within certain areas of responsibility. Consensus can also be promoted by conducting an information or advertising campaign ('stop certain activities in this nature reserve' or 'come to the meeting').
As soon as activities can be divided by barriers, walls, arrangements or more informal consensus (culture) and then by (spatial or temporal) selective links brought into association with each other again (logistics!), then much higher intensities of use than 0.01 hr/m^2*year are possible.[66].

Intensity of use is an important factor. It is one of the factors that determines to what extent an environment can be supplied with facilities (density of investment), by guaranteeing a certain level of utilisation. The intensity of use also determines the speed of aging, and is related to the contribution made to the national product, energy density, ecological pressure, and the risk factor in dangerous situations, etc. Nevertheless, this measure is not used very much in Environmental Planning because it is difficult to estimate the use of time and to bring this to the same denominator as the use of space.[67]

In 1983, the intensities of use of various spatial functions were, globally: (Fig. 622)[68]

	hr/resident*year	m^2/resident	hr/m^2*year
ACTIVITY			
In and around the house	6552	137	48
Learning away from home	374	6	62
Moving	387	91	4
Social/cultural	539	8	70
Recreation	162	47	3
Sport	36	17	2
Shopping	238	2	135
Agriculture	11	1667	0.01
Exploitation of minerals	1	5	0.3
Industry	185	30	6
Public utility companies	8	10	0.8
Building firms	71	20	4
Trade	51	3	17
Transport & communication	33	2	22
Other services	77	4	19
Government, etc.	61	1	102
Use of time: both paid and unpaid			

NNAO, Ontspannen scenario, MESO Den Haag 1986

Fig. 622 *Use of time/use of space = intensity of use*

Een grovere maat voor de gebruiksintensiteit die het tijdsaspect verwaarloost, maar dank zij de huidige honkvastheid van de mens toch betekenis heeft, is de inwonerdichtheid (zie **0**).

Use of time
Residents optimise their use of time to achieve a balance between maximising their income and the availability of free time and space. They have thereby long been prepared to accept travelling times of three quarters of an hour twice a day between their homes and their work. Because of this, a tentative effect analysis can be made of the various urbanisation alternatives in this optimalising process. By doing this, however, an impulse is given to far-reaching analyses of the economic, cultural and managerial effects.

The use of time can be judged on different time scales: the daily rhythm, the weekly rhythm, the yearly rhythm and lifetime.On the first three time scales, the above-mentioned optimalising process leads to recognisable questions of priority in everyone's life:

the daily rhythm: Am I going home early or late today?	Do I give priority to (a) the family or (b) to work?
the weekly rhythm: This weekend:	will I be (a) at home or (b) am I going out?
the yearly rhythm: This year:	will I be (living and enjoying recreation) (a) with someone else or (b) alone?

Fig. 623 *Setting priorities in the use of time*

The (a) variants give more free time and strengthen the argument for national distribution and for Bundled Deconcentration; the (b) variants are conducive to more income and individual free space, thereby strengthening the argument for concentration in the Randstad and for a Compact City strategy. Eight alternative uses of time can now be distinguished:

	<tradition-directed						opportunity-directed>	
	A		S1				S2	B
daily rhythm	a	a	a	a	b	b	b	b
weekly rhythm	a	a	b	b	a	a	b	b
yearly rhythm	a	b	a	b	a	b	a	b

Fig. 624 *Alternative uses of time*

These possibilities of using time lead to different opinions about how space should be organised. Political schools of thought can also be positioned in this scheme.
<traditionally oriented parties (such as the CDA) will choose (a) variants in all time scales (A); opportunity oriented parties (such as the liberals) will choose (b) variants (B); and the socialists will differentiate the variants into 'blood groups' (S1 and S2) that are, respectively, more <tradition- or opportunity> oriented.

These time-use alternatives also lead to another use of space between living, working and facilities and to another mutual proximity, other transport needs and to another economic accent.
Voor NNAO is voor het Ontspannen scenario by Jong (1985) uit een schatting van het tijdgebruik in de volgende eeuw via de gebruiksintensiteit per bestemming en ruimtebehoefte voor 2050 berekend.

Within the Randstad, however, there are boundaries to the maximalisation of collective free space within the opportunity-oriented> perspective of urbanisation.
The process of specialisation and division of tasks in urbanisation, splinters the unity of daily and weekly life, both spatially (this is happening here, that there) and in time (first this, then that).
In contrast to this, large and new freedoms have come into existence. We become about twice as old as we did at the beginning of the last century, and, in addition, have about twice as much free time.
According to CBS (1994) since World War II, the number of people per dwelling has halved, from 5 to 2.5 people, so that, within a radius of 10 metres (R = 10m), we have at least twice as much space.
Within a radius R = 100m, we have small areas of green, and within a radius of R = 1000m, large areas of green. We are suburbanised *en mass* in order to have a magnificent view close at hand.
And there the story comes to a halt, because on each higher scale level, the emptiness disappears.

Historically, the preferences for traditional- or opportunity-oriented uses of time can best be read against the aims of political parties with respect to space, expressed in their programmes over a period of 40 years. They can be styled in terms of the concentration and deconcentration of urban areas on national, regional and local levels (**Fout! Verwijzingsbron niet gevonden.**).

Traditionally, the liberals have wanted a national concentration of urban areas, because that would benefit the competitive position of the Randstad. On regional and local levels, however, they have always preferred deconcentration to allow free choice of place of residence or establishment. In contrast, up to the 1980s, the socialists favoured deconcentration on the national level to encourage a fair distribution of residence and employment opportunities throughout the country, but concentration on the regional and local level for the benefit of public transport and the political cohesion of minority groups. To preserve the historical identity of the provinces, the Christian Democrats have favoured national deconcentration. On a regional level, they have favoured concentration in order to have provincial capitals with recognisable regional religious and civil administrations. On local levels, they again favoured deconcentration (suburbanisation) because, in their view, only small communities can offer a caring society in which the family, the corner-stone of society, can flourish. In this way, freedom, equality and brotherhood become recognisable and controllable in different design principles and on various levels of scale (see **Fout! Verwijzingsbron niet gevonden.** and **Fout! Verwijzingsbron niet gevonden.**).

The largest number of possibilities for future generations will be achieved by realising maximum diversity in environments. Determining which scale levels require which forms of diversity (legends), is the most important task that urban architectural research has to face. The composition of the population and the life cycle of every individual provides changeable patterns of time-use, and, for this, specialised spaces are needed. One ‘best’ overall solution is the worst solution. The intermediary forms between On-going Deconcentration (D_{100km} ... D_{10m}) and Complete Concentration (C_{100km} ... C_{10m}) probably offer more possibilities than these extremes in themselves, but they also eliminate future possibilities for the Randstad, such as the availability of free space of the size of the Green Heart that can only be achieved where there is complete concentration. However, that, in turn, interferes with the identity of towns and cities, would require abandoning buffer zone politics.

6.1.5 Attraction

Gases, liquids and solid grains of dust such as the Earth and its moon restrict themselves in their behaviour to the probability that the balance between the force carrying particles, such as the gravitons that they emit, and by which they are hit, will change (Hawking, Stephen 1997). Only by this will their movement change in size or direction (Newton, Isaac 1687). Human behaviour is more difficult to model, because it is oriented towards horizon-broadening possibilities, with which they come into contact, daily, from all over the world via, for instance, television and internet.

Nevertheless, because of their large numbers, in the long term, people’s improbable individual choices cancel one another out statistically, in such a way that traffic flows between urban centres can be modelled reasonably well in proportion to their masses, and taking into account the effects their mutual distances (distance function). According to Newton (beautifully described by Feynman, Leighton et al. (1977,1963)), for lifeless matter, the distance function is inversely proportional to the square of that distance. If we represent cars as gravitons between cities and take urban masses to be people or work and living sites that, potentially, are mutual sites of departure and destination, then, within that model, the distance function and the proportionality (scale factor) can be adapted to actual reality, for example by taking a power *b* other than the square *b*? = 2. In addition, the model also has to take into consideration that the number of gravitons (transport type and budget) is limited, and that, not only the distance, but also factors such as congestion, can reduce the effect of masses in the neighbourhood, that are attracting each other.

All such ‘costs’, including travelling time, increasing partly due to distance, but mainly because of useless delays, are summarised in current traffic models by the term ‘*travel resistance*’ *c* (costs) (see Bovy, P.H.L. and N.J. van der Zijpp 2000). Between two population masses, this travel resistance is operationalised in the travel uitility function *y* as an effect of *c*: $y = f(c)$. This function reduces the attraction of the masses: the higher the costs, the smaller the travel utility. However, the travel utility function *y* does not always decrease with an increasing ‘resistance’ *c*. Both the way in which the costs are calculated, and the different ways in which they always affect the travel utility negatively, ignores

the heterogeneity of an urban field with fast lines and multimodally attracting road junctions or turnings. As far as I am aware, there is still no model for the individual and collective benefits of regional specialisation by making interregional combinations. The attraction of mutually specialised masses is greater than that of mutually unspecialised masses (specialisation function). Then, indeed, for the Netherlands, with the current way of modelling, 90% of all traffic movements are kept within a radius of 30 km (region) around the departure address.
The environmental advantages of narrowing the horizon that have been disproved (Jong, T.M. de 2002), are at odds with the resulting degeneration of the increasingly isolated nature areas in the Delta. Nevertheless, on every scale level, life itself shows the evolutionary effects of specialisation and combination.

However, also in humans, there are instances when an improbable collective testament, such as the organising of the VOC by Van Oldenbarneveldt (Romein, J.M. 1938,1971) creates a rarified zone (ijle zone Groenman (1960)), in which, for example, Amsterdammers with initiative felt more at home in Indonesia than in Zaandam. That also happened thanks to a Zaandam where the Russian Tsar, Peter the Great, learnt to build ships. Traffic can increase with distance when one divides tasks on a larger scale. Trade rests on that principle, and so does the ecological division of tasks between land and water, and between male and female flowers that exchange their life experiences with the help of insects. The attraction of Disneyland has another travel utility function than commuter traffic, certainly when Parisians are becoming bored with it. Commuter traffic generates the problems that traffic specialists are hired to solve, so they gear their models to these. Models that are based on a travel utility that is, by definition, reduced by distance are unable to provide structural solutions to the problems. During the period concerned, Amsterdam, already a metropole with 100,000 inhabitants, became a world city with a national web of punctual towing boats (Vries, Jan de 1981). Disneyland is a similar improbable example of organisation and offshore entrepreneurial spirit. Organisation is a matter of specialisation and combination.
However, our colonial past gives reason for us to be ashamed of expansion, certainly if it costs energy. Ever since Stadtholder Willem III, setting sail from Hellevoetsluis, exported our commercial democracy to England by conquering it, in a final effort, with an armada three times larger than that of the Spanish, (Israel, Jonathan I. 1995), we would rather stay closer to home. Ever since Thomas Jefferson visited our country in order to study our republican constitution (Eskens, E. 2000), the roles have been definitively exchanged with Anglo Saxon players. From Scherpenzeel, no one will establish a New Amsterdam again, if there is still enough space in Munnekeburen, however full it will become, but investments from New York are welcome. Whether the investments come there or not, will again depend on the percentage of key actors who, mostly by chance, discover that it would be better to grow (for example) coffee outside one's own region, than at home. If people are alert, this will not lead to exploitation this time, but to cooperation.

Between the region and the world, however, there are still a number of scale levels on which the travel utility can be increased for some destinations by including rarified zones that create green areas close to home. If we show a collective will for fast lines of interregional public transport, communication and decision making, then the travel utility function in the travel models can be adjusted. However, the question is: On what level do we want to spread our towns and green spaces? Bundled deconcentration within the region (RPD 1996) has been disposed of since 1983 (RPD 1983): it broke up the green spaces in urban landscapes. Its variant, a regional network town, breaks green spaces into even smaller pieces. The compact city (RPD 1988) increases travel resistance locally due to congestion, whereby the strength of cooperation between the big cities decreases in full accordance with prevailing traffic models. That is a self-fulfilling prophesy. Wings that do not divide their tasks, but, without sufficient coordination go their own way, are probably unable to make an international flight. Moreover, in the unintentionally expanding compact city, green areas are only accessible by car. In addition, on public holidays, part of the free weekend is claimed by traffic jams. That can only be compensated by holidays in further-away places that make a joke of the travel utility function. The result is a vicious circle of local travel resistance and less cooperation.

The Delta metropole is not a regional, but an interregional network city. It is a world city not because of its masses, but because of spatial specialisation, masses become more attractive, and better and faster decisions can be made than elsewhere in the world. That saves the energy of interregional competition for attracting international acclaim. International power is achieved through interregional cooperation, based on a division of tasks. In doing that, one aspires to create an international site and expansion base for business establishments with extensive green and blue spaces within cycling distance from home.

Regional division of tasks
The classical *trias urbanica* of management, culture and market is recognisable in the centre of every medieval town, where townhall and church make space for the market. This is where the surrounding consumption and production converge, managed in the town hall, reflected in church. This territorial division of spaces by task has, since then, been subject to scale enlargement. Until after World War II, Bonn, Cologne and the Ruhr area, The Hague, Amsterdam and Rotterdam had divided these tasks interregionally to give managerial, cultural and economic accents, respectively. Due to the movement towards a service economy after the war, cultural identity came to have more of an economic meaning. A culturally equipped town or city furthers the chance of a productive meeting. Thereby, Amsterdam, gained better chances of being chosen as a place of settlement by the key actors responsible. Rotterdam and the Hague regained a cultural identity by means of international film and jazz festivals, unmatched architecture, and decision-making culture. Making faster and better decisions requires the lubricant of cultural eye-opening. In the much smaller, but more central, inland Utrecht, the 'captains of service' confer at the crossroads of polders, rivers and forests, with dunes and harbours on the horizon. Here too, the converging peat, clay and sand diversify ecosystems while from here they determine more uniformly the ecology as far as the Urals (Constandse, 1967). Also in the opinion of the youngest generation, growth should not be concentrated there. There, key actors from the heart of Europe are shown a route via the Rhine axis in their Delta over the Mondriaan-like network called Holland (see Fig. 625).

Jong and Paasman (1998)

Fig. 625 *Potential continental, fluvial and national network systems .*

In addition, in the Delta, rail and road transport via the south and east can be brought together on an even greater scale along the European coasts to choose our water and air space as main ports (and the reverse). This will be achieved, if the foreign actors are received in a well-considered, cooperative network of towns, each suited for its own task, attractiveness as a place to settle and with it own identity. There are large projects with small consequences and small projects with large consequences. The Delta metropole is not directed towards projects in which the one section expects to dominate the other, but, in the end, steals an advantage.
Does one section choose projects that deprive the other of success, or can people delegate among themselves so that, together, international functions can be given the best position in the whole network? The latter requires subnational decision-making skills, regional loyalty and again local decisiveness. If one chooses non-traditional regional solutions, using traditional national means, the Delta's inherited urban constellation can be turned into an international novelty. One can grow interregionally by trimming regionally, integrating by mutual specialisation, by accepting one-sidedness in order to excel, and by developing the rest elsewhere. Managerial initiative, innovation, growth, integration and versatility are a question of scale. In contrast, on another scale, they require loyalty, tradition, trimming, specialisation and one-sidedness.

The implicit presuppositions of the Stedenland perspective (VROM 1998) that preceded the 5th government amendment on Environmental Planning, illustrate this kind of scale paradox. They are made explicit in Fig. 627.

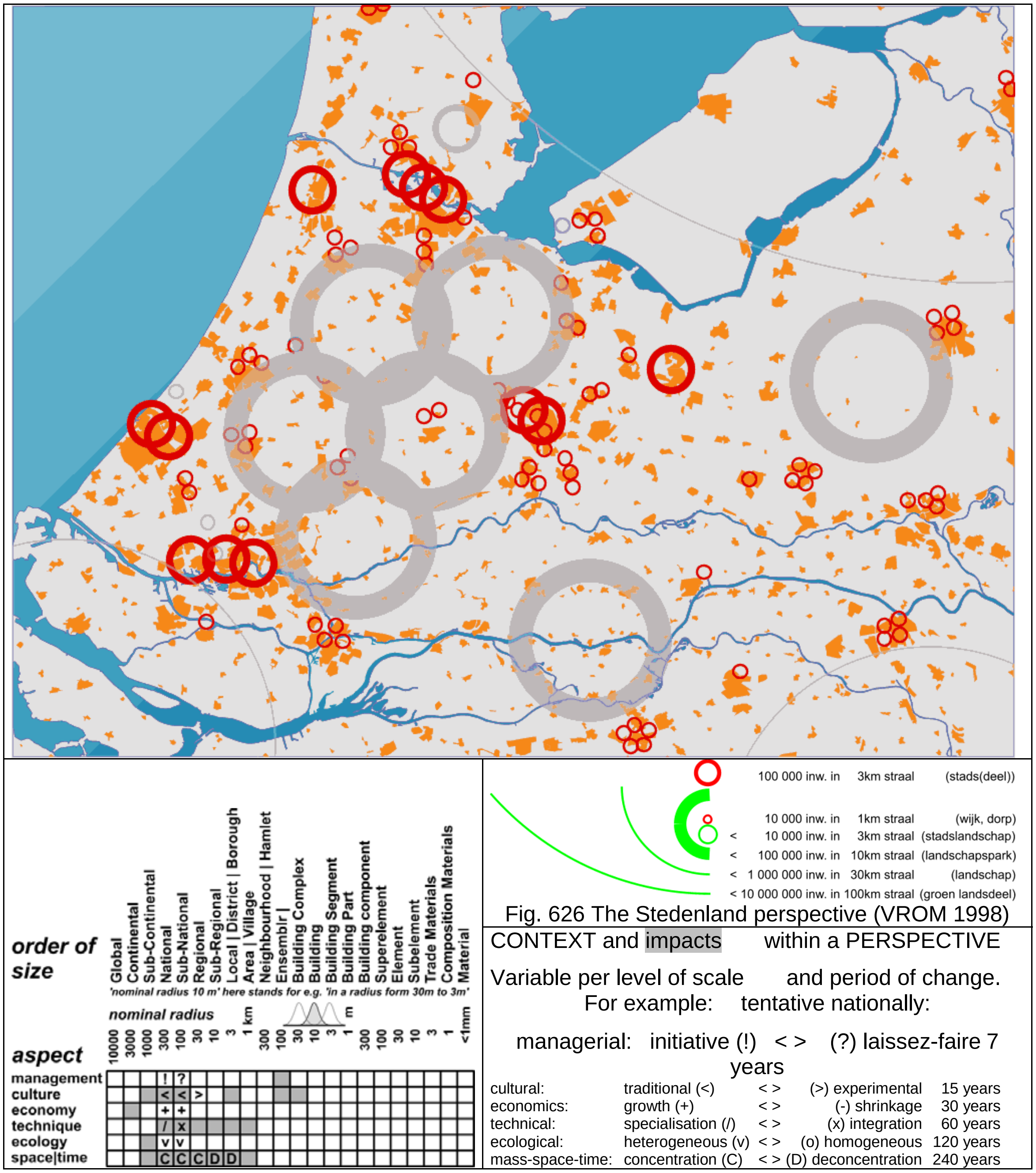


Fig. 627 *Context organ (example: the Stedenland perspective [VROM 1998] and effects [grey])*

According to the combinatorial system, it is possible to play 10^{65} other chords/accords on this organ. The Delta metropole accord is much the same. The difference is that subnational deconcentration and a great effort to achieve technical integration that facilitates the division of national tasks has been requested (VROM 2001, 2002).

The division of tasks consists not only of where projects are established, but also the network. A didactive rule of thumb that, for each higher unit of road system, an approximately three times larger mesh width should be maintained, turned out to be more realistic than was first thought. It has been calculated in three different ways that, by doing this, an optimum of accessibility and construction costs is achieved (Nes, R. van and N.J. van der Zijpp 2000). However, this would mean that, in the Netherlands, there would have to be nine orders, each with its own design speed and exit frequency (Jong, T.M. de and M. Paasman 1998): continental, fluvial, national, regional, local motorways, urban motorways, district, neighbourhood and residential streets drawn with a mesh width of 1000, 300, 100, 30, 10, 3, 1, 0.3, 0.1 kms, respectively, if one draws the same mesh length and breadth. The first three are drawn in Fig. 625, and if one styles the remainder, then one gets a typology of dry connections with square meshes, as shown in Fig. 628. These can be stretched using the same mesh density.

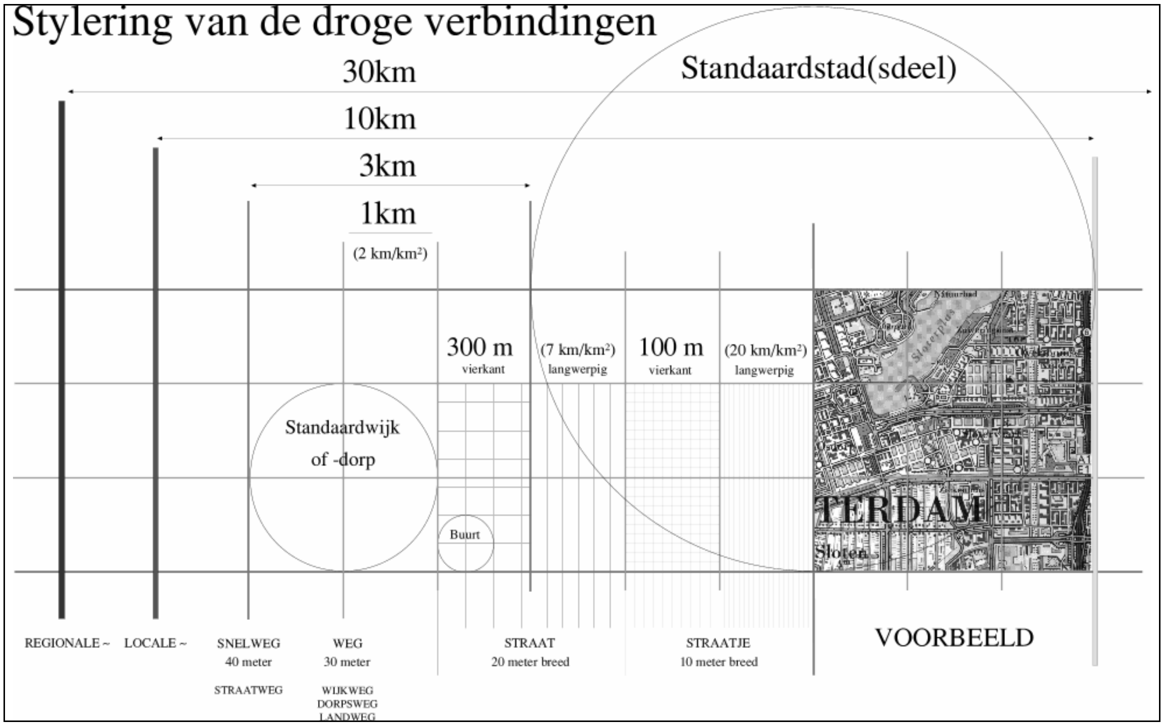


Fig. 628 *Regional, local and urban motorways; district, neighbourhood and residential streets*

In the absence of exact knowledge about departure sites and destinations, designers can sketch in the missing links with transparent, squared elastic paper. The design will alternatively consider first the network as the directing force and then the settlement site (Angremond, Kees d', Pieter Huisman et al. 1998; Jong, T.M. de 1998). However, very many exits would have to disappear to improve travel times and safety (Reuzer, Bart and Marijn Schenk 1999). Though, especially within towns, the national strategy is to reduce the number of orders at the expense of travel time, but in favour of an assumed safety (Duurzaam Veilig; Sustainable Safety Project). Therefore, the current travel utility function remains calculable and negative. Is that what we want?

Travel utility and resistance

$f(c) := \frac{a}{c^b}$

$a := 6.67 \cdot 10^{-11}$

$b := 2$

another notation is:

$f(c) := \frac{a}{e^{b \cdot \ln(c)}}$

c^b can be represented as a power of e=2,718: $e^{b \times \ln(c)}$

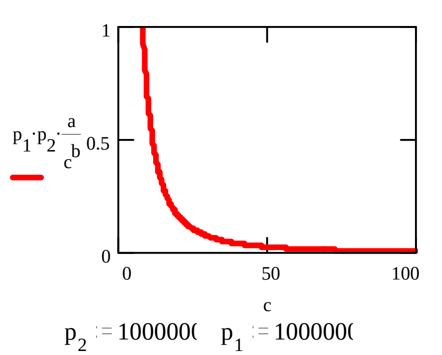
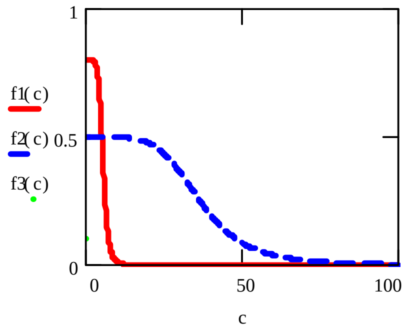


Fig. 629 *Gravitation according to Newton*

According to Newton, the power of attraction between two poles is proportional to their masses p_1 and p_2 and inversely proportional to the square (*b* = 2) of their mutual distance *c*. Cavendish later determined the proportionality constant *a* as 1/1.5 x10^{10}. If the mass of both poles is 1 million, then the function looks as shown. However, according to this graph, neighbours must exert a strong, almost infinite, force of attraction. In the case of humans, this would mean that every desire to travel further would disappear. Consequently, the coefficient *f*(*c*) =

a/c^b for travel calculations has to be adapted.

Bicycle, car and train:		Determining parameters		
		starting point	stretching	deflection
$f1(c) := \frac{a_1}{1+e^{\beta_1+b_1\cdot\ln(c)}}$ $f2(c) := \frac{a_2}{1+e^{\beta_2+b_2\cdot\ln(c)}}$ $f3(c) := \frac{a_3}{1+e^{\beta_3+b_3\cdot\ln(c)}}$		$a_1 := 0.8$ $a_2 := .5$ $a_3 := .1$ at 0.8, the function starts at 80% of the height 0<a<1	$\beta_1 := -12$ $\beta_2 := -18$ $\beta_3 := -20$ at -20, the function reaches its zero value for the last time -20<β<-12	$b_1 := 7$ $b_2 := 5$ $b_3 := 3$ at 7, the function deflects for the first time. 3<b<7

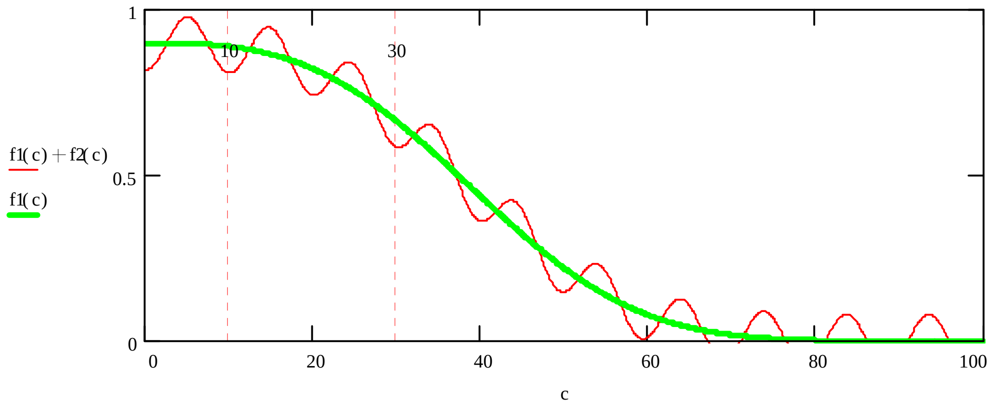
(Bovy, P.H.L. and N.J. van der Zijpp 2000)

Fig. 630 The type of log-logistic travel utility function that is used in the WOLOCAS model, with which new VINEX districts were calculated

If the parameters are chosen well, the above function fits in well with the current empirical reality. In the graph, the travel resistance *c* can be largely identified with the distance travelled in kilometres. Thus, one can read from this that the travel utility of a car is, on average, greater after about 5 km than that of a bicycle. After about 50 km, the travel utility of a train is greater than that of a car.

If one takes away from this function the 1 and the β of the denominator, then one is left with only the Newton variant of *cb* in the denominator, or, written differently, $e^{b \times \ln(c)}$. Then, for very small values of *c,* the function approaches infinity, although, for people, this is unreal. The 1 in the denominator now ensures that the travel utility as coefficient of the masses can never exceed 1, however small the power of *e* becomes. Because of this, the attraction of the masses by the travel utility is only reduced, not increased. The β determines when the travel utility becomes nil: for the train that is much further away than 100 km, so that the travel utility appears to be constant up to 100 km.

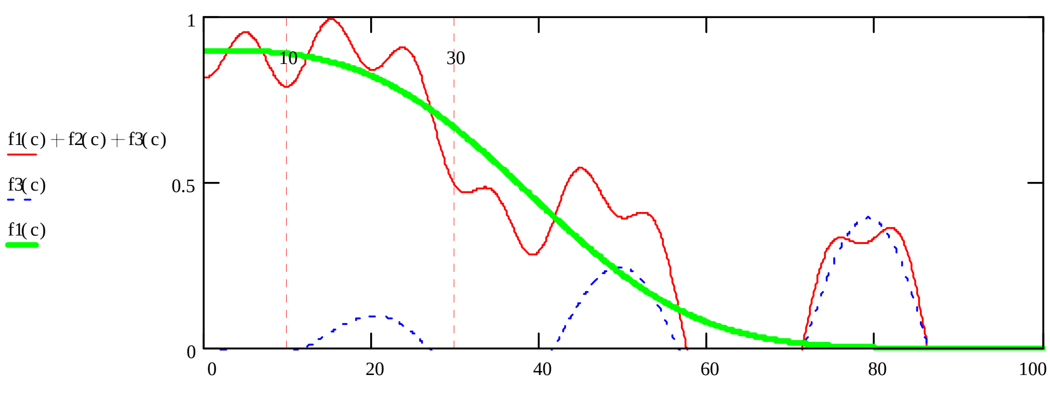
Therefore, the present traffic models assume that between two human masses, each increase in travel resistance *dc* implies a decrease in travel utility *dy,* so that their relationship is negative *a*: $dy/dc = -ac^b y$. The above function is a modified example of all functions that agree with this differential equation. That is true in a homogeneous field, but not in an interregional heterogenous field of a network with different speeds, levels of exits or (public transport)stops. Everyone knows that taking a exit further on can sometimes result in more travel utility. Suppose that the mesh width of local motorways is 10 km on average. From my departure point, it is a 5 km drive to the next local motorway. In that case, the travel utility of 10 km is smaller than that of 15 km. After all, after 10 km, I am on the motorway, between two exits. The graph could therefore fluctuate as follows when a radial motorway has an exit every 10 km:



Here, *f*1(*c*) is the log-logistic travel utility, and *f*2 is a sine with a period of 10 km superimposed on it.

Fig. 631 *Fluctuations of travel utility with a periodic infrastructure of 10 km*

For a train, these fluctuations are caused by the station stops: I cannot end my train journey between stations in the event of my seeing no utility any more in continuing the journey. With regional tracks occurring regularly, every 30 km, even more fluctuations with a 30 km period are superimposed on them. Without a division of tasks, broadening the travel horizon in a homogenous urban field increases the accessible area, and thus the destination possibilities by the square of its radius. The proportion of these possibilities that is actually utilised within an available budget in the form of money, means of transport and time, is the scale factor *a.* One can take this increasing travel utility into consideration as an effect of the costs of fundamentally decreasing travel utility function *f*(*c*), such as below, with an increasing amplitude of stops or exits situated further and further away. In the graph below, it is thus assumed that, at the first and second exit or stop on these lines, the utility, and thus the amplitude, will increase somewhat due to increased destination possibilities. This effect is strengthened by interregional task division.



*f*3(*c*) is a sine with a period of 30km and increasing amplitude

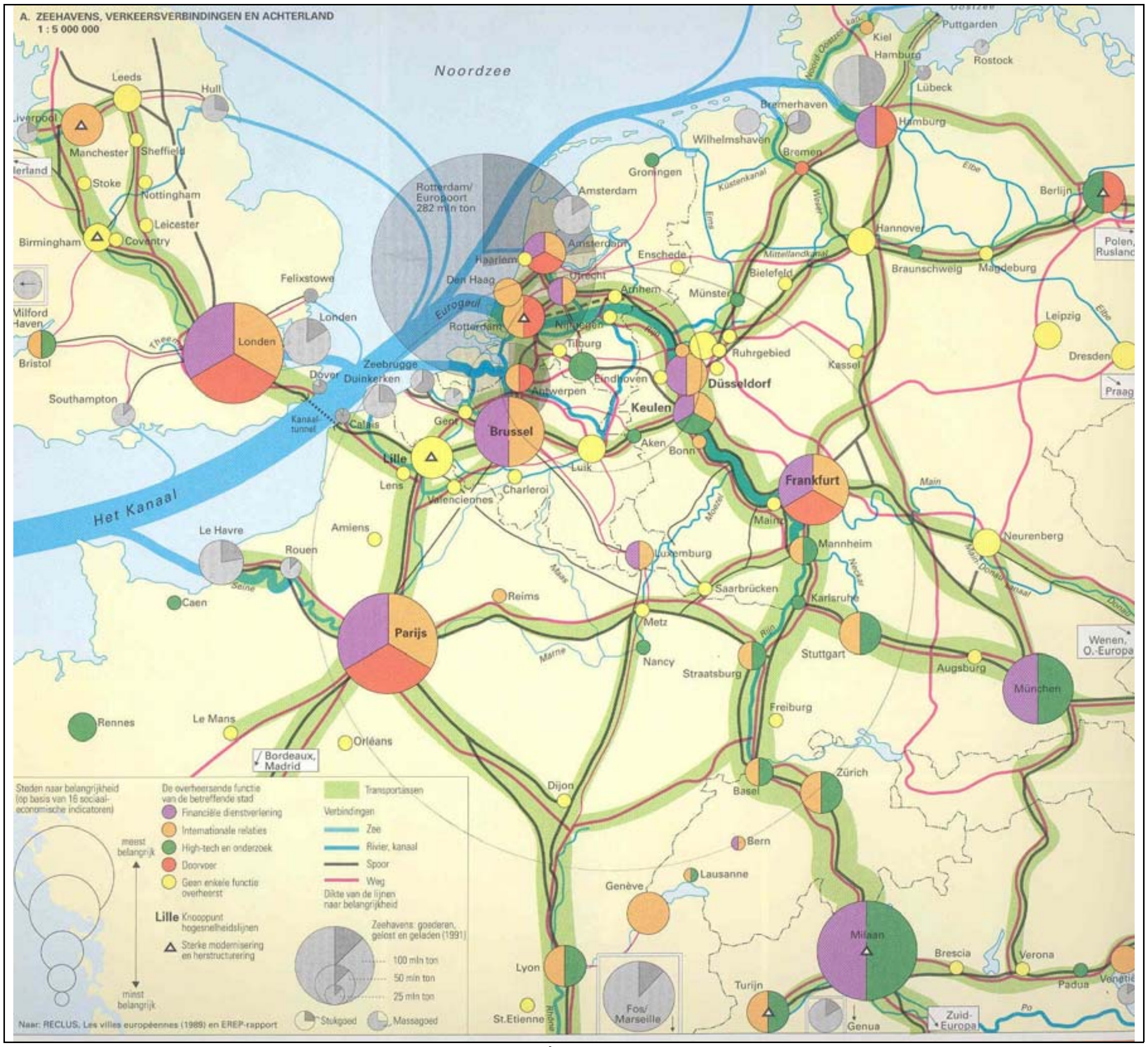
Fig. 632 *Fluctuations of the travel utility with a periodic infrastructure of 3 and 10 km and with increasing travel utility*

It is clear that, in this case, travelling 50 km has more utility than 40 km. In addition, the higher design speed on these speed-specialised lines, less plagued by stops and exits, lowers travel resistance, so that the kilometres used to calculate *c* shrink in travel time. I will leave these sorts of mathematical complication to more experienced calculators, with pleasure!
The conclusion could be that well-thought-out construction or improvement of fast infrastructure results in rarified zones designated as green areas, which are positioned radially around human masses in the direction of other masses, and have a greater travel utility for intersections situated further away than for the pure log-logistic decreasing travel utility functions without fluctuations. This is a beginning of the traffic concept for an interregional network city.

In the current model philosophy, a positive travel utility is expressed more purely as a factor of the power of attraction of the masses, than just by the mass-effect-reducing travel utility function *f*(*c*). For each urban concentration, a traffic model can apply separate empirically determined corrections to the mass effect. However, in the case of interregional task division that is not logical. The power of attraction between regions, due to increasing interregional task division, appears to be more like electromagnetic attraction caused by a difference in positive and negative charges, which supplement one another. However, where there are more than two tasks, there are more sorts of charges than + and -, and the range is greater. It is essential that the attraction is not a characteristic of a mass, itself, but of its specialisation compared with other masses that are charged differently. Alternatively, equal charges cause repulsion. For this, a separate, not necessarily reducing, but accrediting, specialisation function will perhaps have to be devised.

Then, in working out the travel resistance *c* itself, the travel time as a cost post will be taken as being almost synonymous with distance and other inconveniences. However, travel time can be used as contact, work or rest time *en route*. In particular, it will be possible to facilitate work time in the future by means of communication technology. The remaining travel time does not always increase with distance, but is mostly due to slowness and delays when changing from one form of transport to another, and this can be included in *c.* This is why the design of multimodal intersections and means of transport, and their multifunctional, urban integrated and communicative equipment, is the primary project for a Delta metropole. At the same time, the most important item on the agendas of managers, designers and key actors is the mutual determination of the identity of regions, agglomerates and towns with respect to growth in task division. The new public transport between them must not eliminate chance, but organise it. One cannot confine oneself, then, to adapting *c* in existing models on the basis of empirical starting points, when some costs can be changed into benefits by shrewd design.

6.1.6 Networks



RECLUS, Les villes européennes (1989) and EREP-rapport, cited in Wolters-Noordhof (1996)

Fig. 633 *Population, socio-economic weight and connections in a radius of 1000 km.*

Fig. 29 gives a global impression of the population of central Europe, with the highest densities shown along the Rhine. This figure also shows those centres that score highly in a large number of socio-economic factors. The highest scores are for London, Paris and Milan. Centres of secondary importance are Brussels, Frankfurt and Munich. Amsterdam and Rotterdam are aligned with a large number of centres of tertiary importance. The beginnings of a 21st century network, with a mesh width of approximately 100 kmG are also visible in this figure. Southern Europe and the large population of eastern Europe are attempting to join this economic network. Railways parallel to the northern and western coasts form a forerunner and starting point for, what is still, a hypothetical 300 km grid (see Fig. 625.[69]

The Netherlands is situated in the corner of this grid, as a terminal with main ports for transfer to air and water.

As in Fig. 24, where names are given to each proposed orthogonal mesh width for dry networks, this can also be done for wet connections..

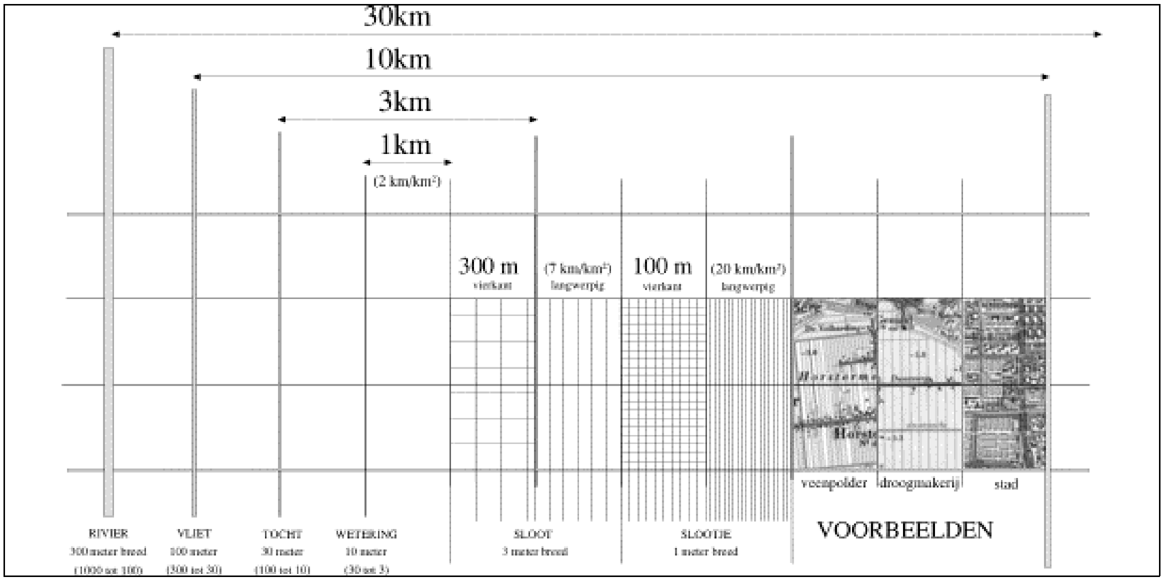


Fig. 634 *The styling of wet connections can be expressed as the density in nominal orthogonal mesh widths*.

Dry and wet networks are given a ‘functional charge’, as follows:

Nominal mesh width	***30m***	***100m***	***300m***	***1km***	***3km***	***10km***	***30km***	***100km***
Density (km/km^2)	*70*	*20*	*7*	*2*	*0.7*	*0.2*	*0.07*	*0.02*
wet connections								
name	**trench**	**small flooded ditch**	**a flooded ditch**	**watercourse**	**race**	**brook**	**river**	**lake**
indicative width 1%		*1m*	*3m*	*10m*	*30m*	*100m*	*300m*	*1000m*
andere naam			stream	stream	stream	stream		
		urban canal	urban canal	urban canal	urban canal	industrial canal/waterway	canal	canal
functions			draining			drainage pool (from polders)		
Nominal mesh width	***30m***	***100m***	***300m***	***1km***	***3km***	***10km***	***30km***	***100km***
dry connections								
name	**path**	**street**	**main street**	**road**	**urban highway**	**local highway**	**regional highway**	**national highway**
an exit every ...km	*10m*	*30m*	*100m*	*300m*	*1km*	*3km*	*10km*	*30km*
indicative width		*10m*	*20m*	*30m*	*40m*			
functions	pavement	opening to a hamlet	neighbourhood street	district road, village road, country road	urban highway, main road	urban highway	provincial highway	national highway
	footpath	residential walk	walking route	cycle route	cycle ride			
Duurzaam Veilig (long-term safety)	free of cars	restricted entry for cars	sojourn function	opening to an area	throughway			
public					bus	express	fast bus	Interliner
Nominal mesh width	***30m***	***100m***	***300m***	***1km***	***3km***	***10km***	***30km***	***100km***
railway line					tram	lightrail	regional	national
a supportive base					*300m*	*1km*	*3km*	*10km*
functions						*the underground/metro*	*local train*	*intercity train, Argus*
					hybrid systems	*hybrid systems*	*hybrid systems*	

Fig. 635 *The time-related functional charge of networks*

Scale articulated reasoning to connections leads to the next legend[70]:

NETWORK		BLUE LEGEND		BLACK LEGEND	
density	mesh/ exit interval	width 1%	NAME	width	NAME
km/km^2	km nominally	m nominally		m nominally	
0,002	1000	≥10000	**sea**		
0.007	300	3000	**lake**	300	**continental highway**
0,02	100	1000	**stream/pond**	200	**national highway**
0,07	30	300	**river/waterway**	100	**regional highway**
0,20	10	100	**brook/canal**	80	**local highway**
2,00	3	30	**race**	50	**city highway**

Fig. 636 *Scale articulation of networks*

The density of exits or crossings on the own level is normative for network density. This unit has more relation with ride length than with traffic intensity. In connection with the red and green legend one can imagine their superposition as follows:

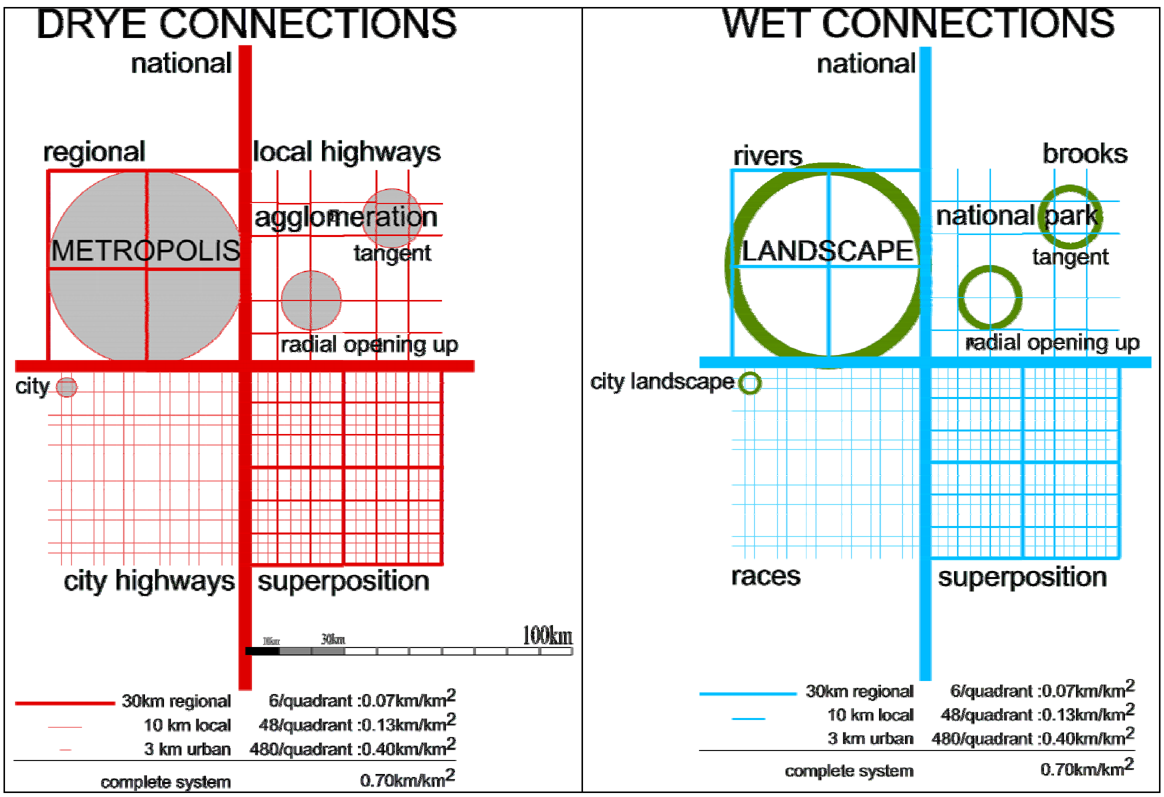


Fig. 637 *Superposition of networks*

Superposition of the higher order over the lower order, the density of the lower order decreases[71]. By superposing the wet connections over or under the drye connections, both networks interfere (interference). This can be done in different ways. Separating instead of bundling them fragments space more. The diversity of interference has important ecological and cultural identity impacts.

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6.2 The History of Dutch habitat

6.2.1 Dutch heritage.

At the end of the 20th century, due to a reduction of its market coupled with higher productivity, agriculture lost its primary position in national self-sufficiency. Globalisation leads to a division of tasks internationally as Steekelenburg (2001) elaborates. The task for the Netherlands is trade and the conservation of rare natural areas.

RIVM (2001)

Fig. 638 *Potential natural vegetation*

The lowlands of Zeeland, Holland and Friesland as a whole, with a boundary consisting of young dunes and older ones, up to 5000 years old, together with their potential vegetations, are viewed as rare on a European scale, within a radius of at least 1000 km. Dyke construction has enlarged the area and diversity of the land in the course of a 1000 years, with Old Marine Clay polders and reclaimed land, albeit to the detriment of rare saline plant communities. However, by doing this, the largest area of potential estuarine vegetation in north-western Europe has come into being. Further inland there is a just-as-rare and irreplaceable zone of potential reed swamp/swamp forest. 'From Amersfoort to the Urals, one does not encounter another landscape that is so full of big surprises' (Constandse, A.K. 1967). Further up-stream lies the largest, though less rare, area within this radius, of river-dependent vegetation. The sandy soils, situated on higher ground, form the beginnings of a potential European oak-beech forest. Although not a rare form of vegetation, these

Legends

1 salt-marsh vegetation with, among other plants, sea lavender and salt-marsh grass: transitions from a salt to fresh-water environment.

2 dune heath, -grassland and -thicket, dune birch forest and dune oak forest, birch– common oak forest

3, 4 marsh fern–alder swamp, and similar

5, 6, 7 ash–elm forest, and similar

8 blanket bog, and similar

9 moist alder, birch, common oak forest

10 dry birch–common oak forest

11 moist durmast oak forest, and similar

12 dry durmast oak, and similar

13 oak–hornbeam, and similar

14 millet grass–beech, and similar

15 woodrush–beech forest with oak

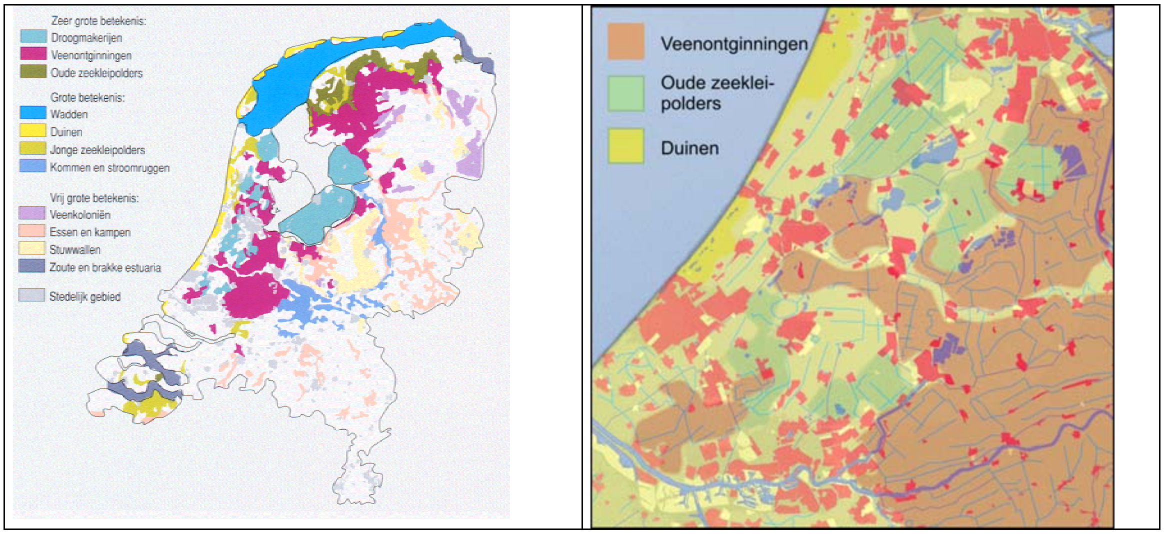
16 beech forest, alder- and ash natural forest, and similar

Sticht.Wetensch.Atlas_v.Nederland, Piket et al. (1987) page 13

Fig. 641 *Potential natural vegetation*.

Only where water floods the land regularly or for a lengthy time, where wind moves sand, and where grazing animals keep meadows in forests open would vegetations other than forest be able to maintain themselves.

Against the background of this ‘nil variant’, in the following paragraphs the effect of human intervention is demonstrated in images that have been developed by the University of Utrecht.[72].



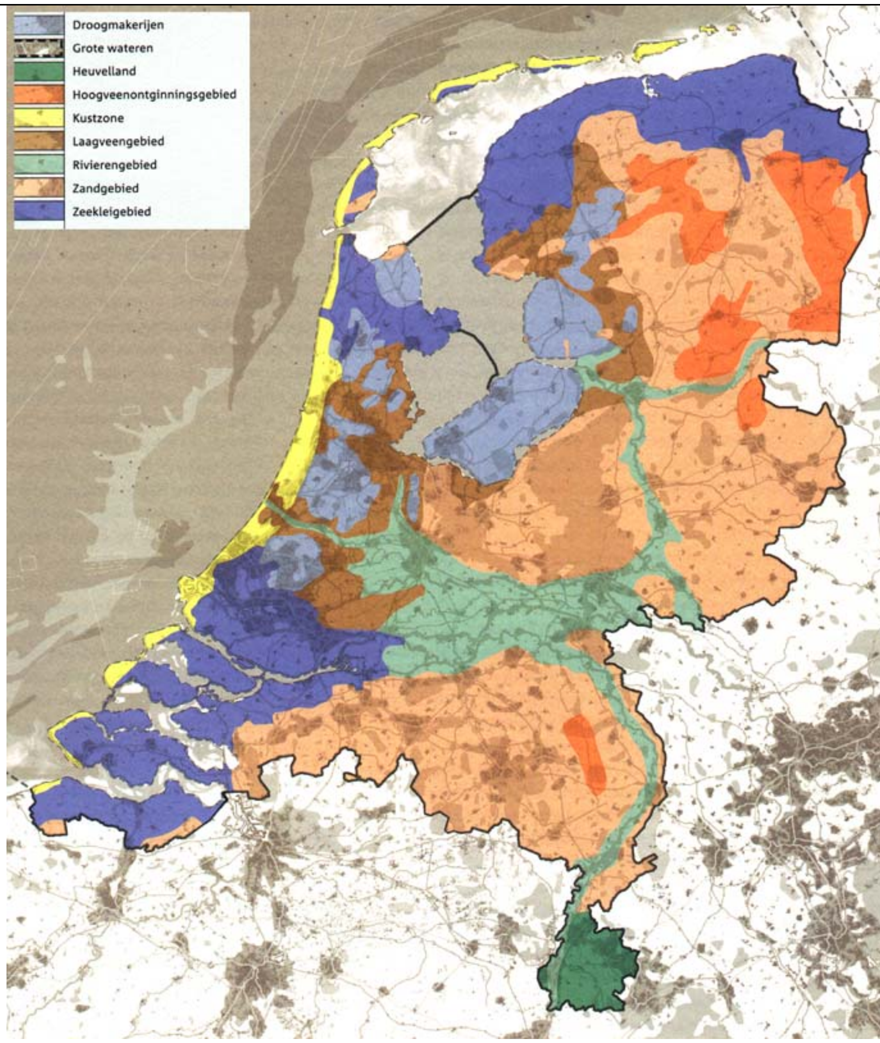
RIVM (2001) page 16 LNV (2002)

Fig. *640 Internationally important landscapes*

6.2.2 Human impact

If, apart from providing a stable system of water management, the Netherlands would be left undisturbed by human beings from now onwards, then the following forests would come into existence:

forests are highly valued nationally as recreation areas. Ecologically, pine forests in our country are viewed as recent, artificial anomalies.

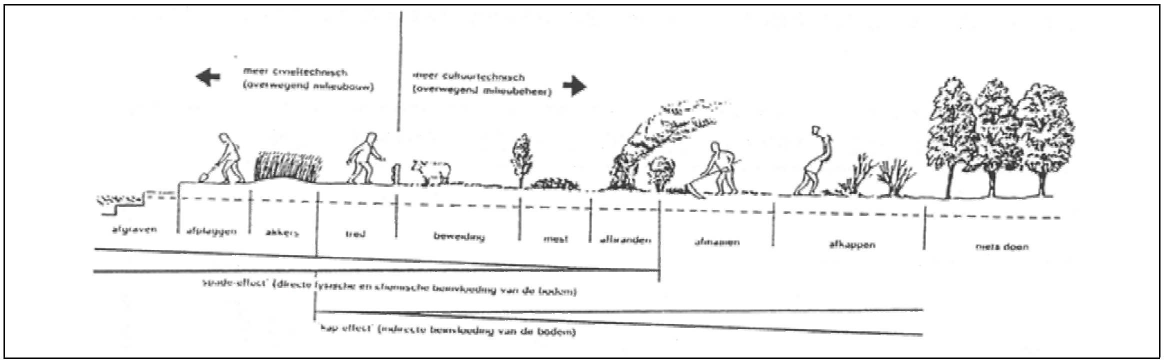


LNV (2002)

Fig. 639 *Nine types of landscape*

If one looks in more detail at these important international possibilities (in a section of 60 x 60 km), then the landscapes of very great significance that one recognises are the Old Marine Clay polders, the reclaimed land and the peat exploitations in our country in the neighbourhood of Leiden. In addition, the mud flats (Wadden), the dunes, the Young Marine Clay polders, fluvial basins and ridges are also of great international importance. The landscape types identified by LNV show the Old Rhine to be an extension of the fluvial area, surrounded by areas of peat lying below the present water table (*laagveen*), bordering on areas of Marine Clay.On both sides of the Old Rhine there is an interesting series of potential transitions.

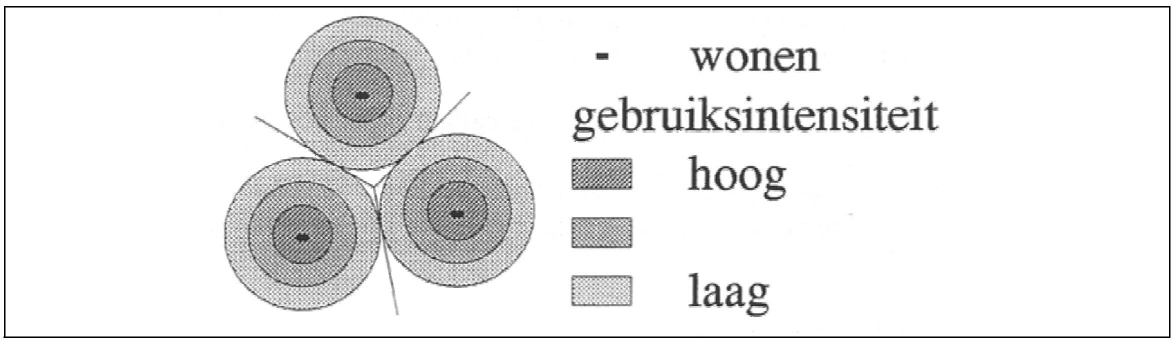
The influence of humans expresses itself in draining, raising, hardening, digging up, treading upon, burning, systematic grazing, mowing, ploughing, harvesting, fertilising and polluting. Because of these activities, earlier stages of plant successions are kept in existence artificially.[73]



Leeuwen (1971)

Fig. 642 *Human interventions in relation to dynamics.*

For centuries, this ‘anthropogenically added dynamic’ decreased with the distance from residential buildings

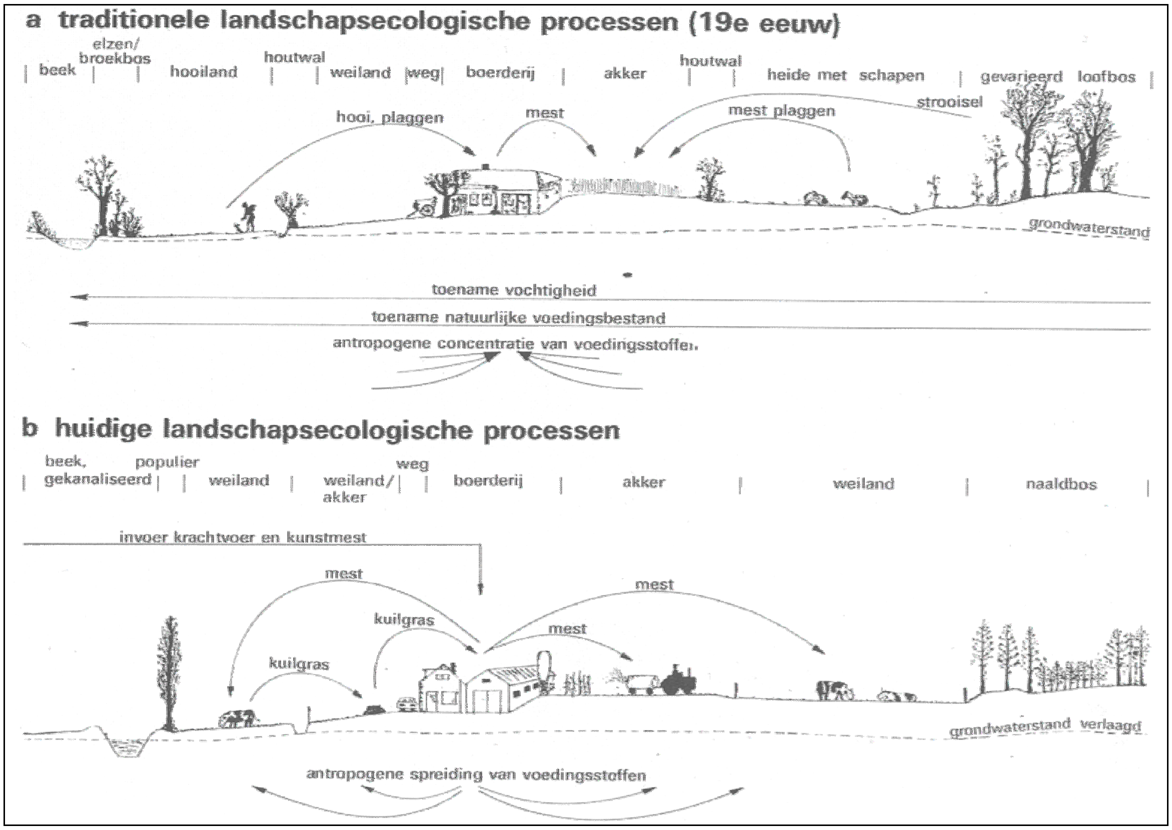


Thünen (1921), Leeuwen (1973)

Fig. 643 *Intensity-of-use gradients around farm and town*

The intensity-of-use gradient around farms and towns was strengthened by a mineral gradient. For centuries, traditional agricultural systems have enriched local soils with minerals to the detriment of poorer soils further away, that thereby leave behind specialised, and thus rarer, types of vegetation, such as hay fields, heathlands, shrublands and forests. Where people stored minerals for use in agriculture, only a few rapidly maturing species grew there. However, where people removed them, an increasing diversity of slow-growing, but uncommon, specialist species, cooperating of necessity in ecosystems, grew undisturbed and in scarcity. Over the centuries, this has led to an increase in the number of plant species. [74].

Farms and settlements on the high, infertile sandy soils were mostly situated along rivers and streams. On slopes between the lowest wet soils (known as ‘green soils’in animal husbandry) and higher, drier soils (‘common lands’ used as arable land) the nitrogen cycle used in mixed husbandry gave the best chances of survival. Fights took place to secure these scarce sites, so that, once established there, the tendency was to concentrate, organise and defend the common land. The result was a village (*esdorp*, in Dutch) built around a village green or *brink*. This concentric village shape contrasts sharply with the ‘linear village’ (*lijndorp*, in Dutch) from which, along both sides, and at 90º angles to the village street, strips of fertile but wetter peat soils were colonised and drained. In the *dijkdorp,* farmsteads, also positioned at 90º angles to the street were built on the higher, drier ground at the side of the street, which followed the highest line of the dyke.

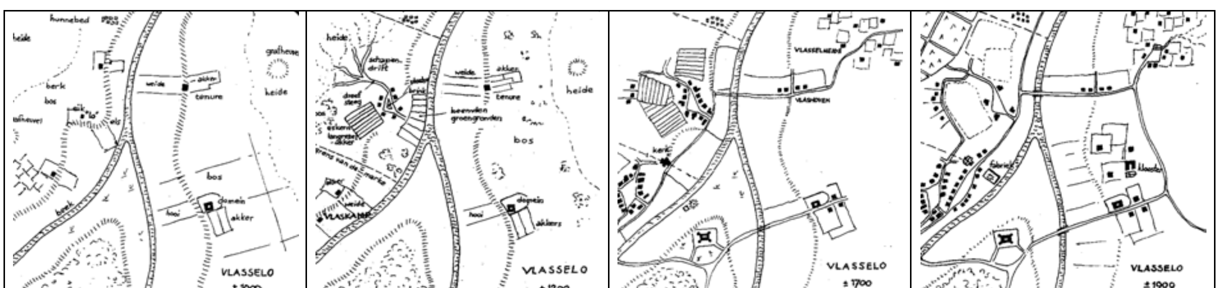


Atlas van Nederland Part 16:18)

Fig. *644 Traditional and present-day ecological processes with respect to landscapes*

Modern agricultural methods, especially the discovery of artificial manures round about 1900 have changed these developments drastically from rare, infertile and thus species-rich biotopes into biotopes that are equally fertile overall and thus to biotopes that are predictable, but with few species.[a] [75]

In Fig. 645 Steegh (1985) designed a concept for the development of settlements on sandy ground



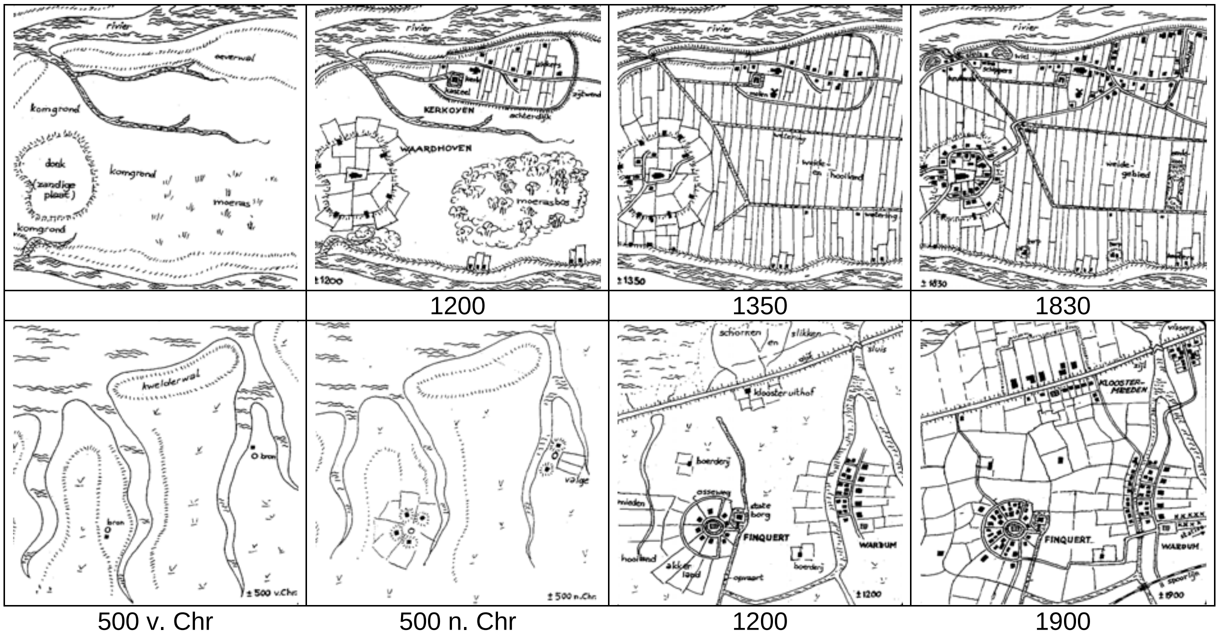
1000 na Chr.	1200	1700	1900

Steegh (1985)

Fig. 645 *An ideal-typical development of a settlement on sandy ground.*

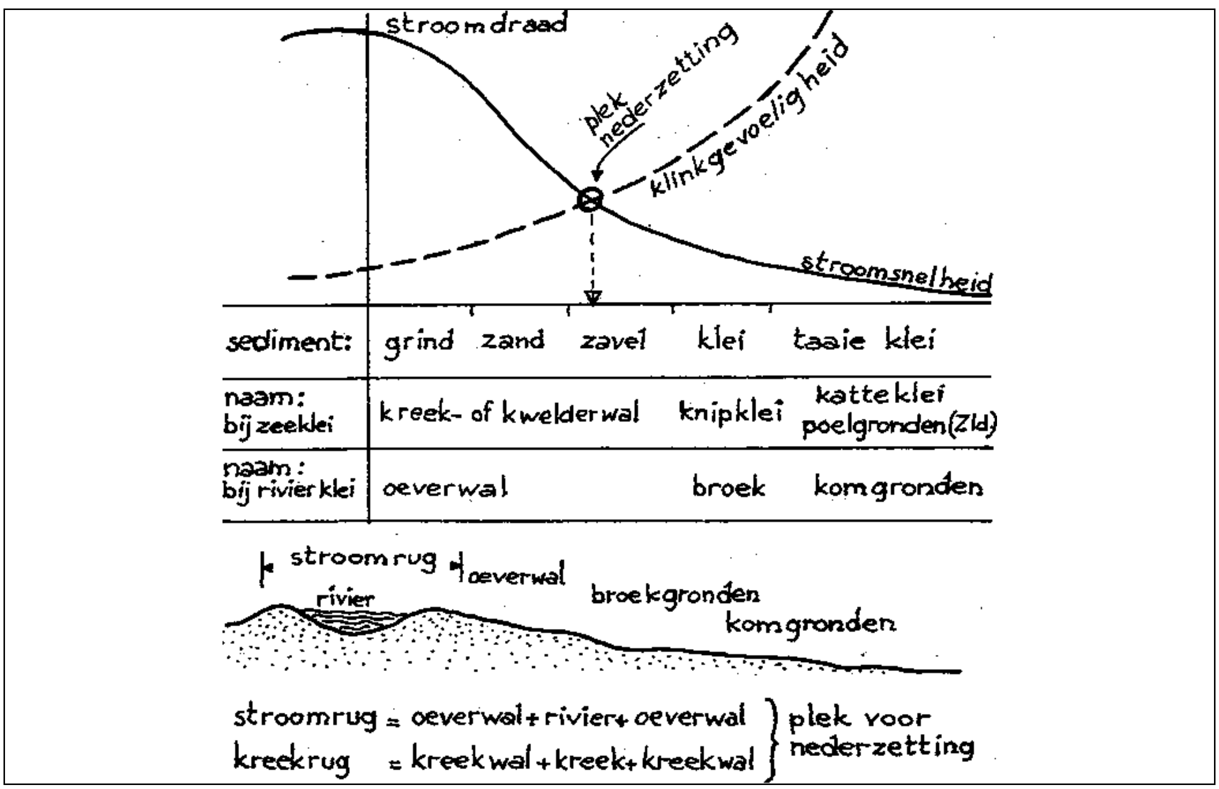
However, the oldest settlements that are still recognisable date from Roman times. Since those times, churches, farms, and sometimes settlements, in coastal areas, especially in Groningen and Friesland, have been built on raised mounds of earth (a *terp*).(Fig. 646).

[a] Nederland heeft overigens van nature een aantal zeer voedselrijke gronden zoals rivierafzettingen, zeeklei en loss.



Steegh (1985)

Fig. 646 *The ideal-typical development of terp villages on Marine Clay areas.*



Steegh (1985)

Fig. 647 *Conditions for situating settlements along the water's edge*

The best preserved land surveying outlines from the Roman times are of the loess region of South Limburg: an underlying NW-SE and NE-SW grid of 707 x 707 metres or fractions of this. By creating lots of land by cutting it into blocks ('quadrangulation') in this rational way, Roman army veterans were rewarded with a villa as a retirement present. Steegh (1985) shows how these developed further in his ideal types 'Willerich', 'Willerrode' and 'Wilderbaan' (Fig. 648). Following the decay of the Roman

Empire, the feudal court system began to use material from the most strategically situated villas (not too high, not too low, along a road crossing a nearby stream or river) to build a *curtis* or *sala* with an encircling wall in the form of a shield from which the farms (*tenures* or *casae*) around were managed. The agrarian surplus was sent to the Lord of the Manor via the old Roman road. Since the time of Charlemagne, one tenth of the produce had to be given to the church, so the local manager built a church to collect these tythes himself and so that he only needed to maintain a priest. A smithy, brewery and safety-seeking small-holders formed a compact village centre and the *curtis* became the castle.

Wetter areas allowed a larger number of village wells to be dug, so these villages had a more dispersed shape. A tenant farmer, whose land bordered on water, who later gained independence, would divide his land among his children into a larger number of units. In this way, a street village was formed, comprising easily defendable 'closed courtyards'. This is still a well-known type of farm building, even today, in the landscape of South Limburg. Millers' dwellings were added to the water mills and the lord of the castle built a new castle with gardens bordering the water, thereby displacing a number of farms that had occupied that land.

150 na Chr.	1000	1500	1900

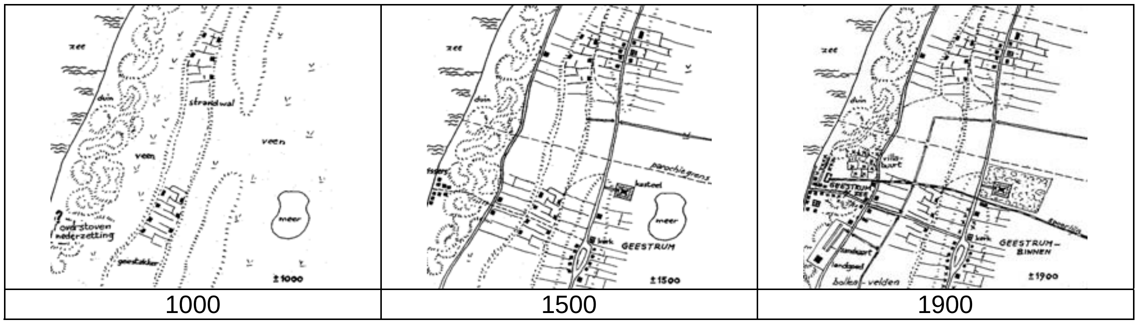
Steegh (1985)

Fig. 648 *The ideal typical development of settlements on the loess soils of South Limburg*

Sometimes, the Lord of the Manor systematically developed waste ground into a street village such as 'Willerrode'. The church remained on the site of the old castle in the centre of the village, where now the lord levied tolls, and an inn to accommodate the post stagecoach was built. After centuries of stagnation, the construction of a tramline to the coal mines in the vicinity brought about far-reaching changes. The inn became a centre for the mineworkers. The higher personnel built houses along the tramline and a mineworkers' colony, 'Wilderbaan', grew up with its own shops, a new church and a patrons'cloister, financed by the mine owners, with boys and girls schools. Supply industries established themselves there with workers' districts and bungalows built on sites which had the nicest views. On pages 161-162, Steegh (1985) names many villages where elements of ideal typical 'Willerich' are recognisable.

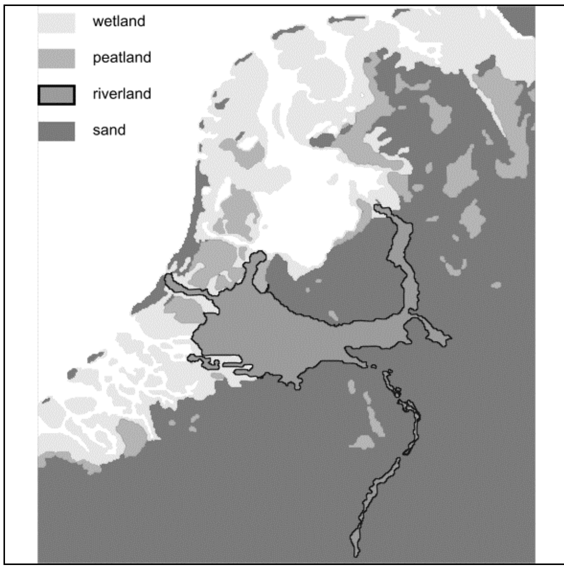
6.2.3 The last millennium

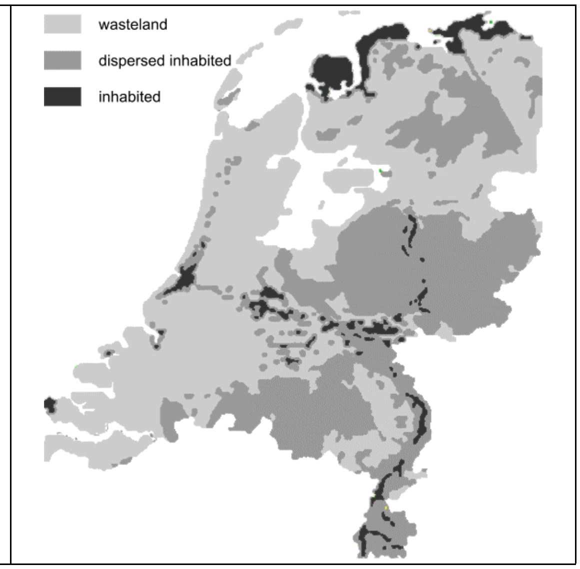
From 1000 AD onwards it is people who have determined the appearance of the Netherlands. Round about 1000 AD, the human population lived on *terps* (in Friesland), along the rivers, behind the dunes, and, in a more dispersed form, on the sandy soils.



Steegh (1985)

Fig. 649 *The ideal typical development of settlements on sandy soils behind the dunes*



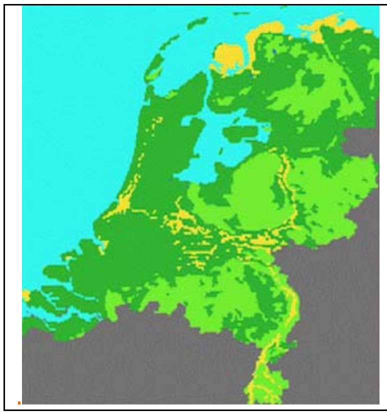


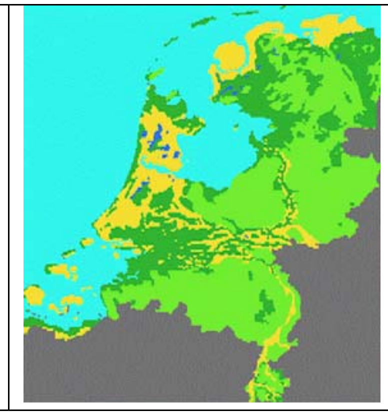
University of Utrecht

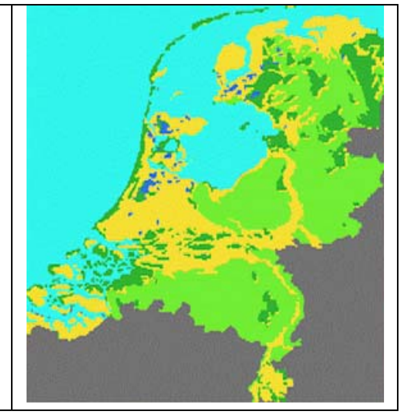
Fig. 650 *Natural regions before 1000 AD*

Fig. 651 Settlements in the Netherlands in 1000 AD

After about 1000 AD, the sea advanced in the south of the country. The Delta waterways came into existence, but the free play of water and land was prevented by dams built by the rapidly growing population.







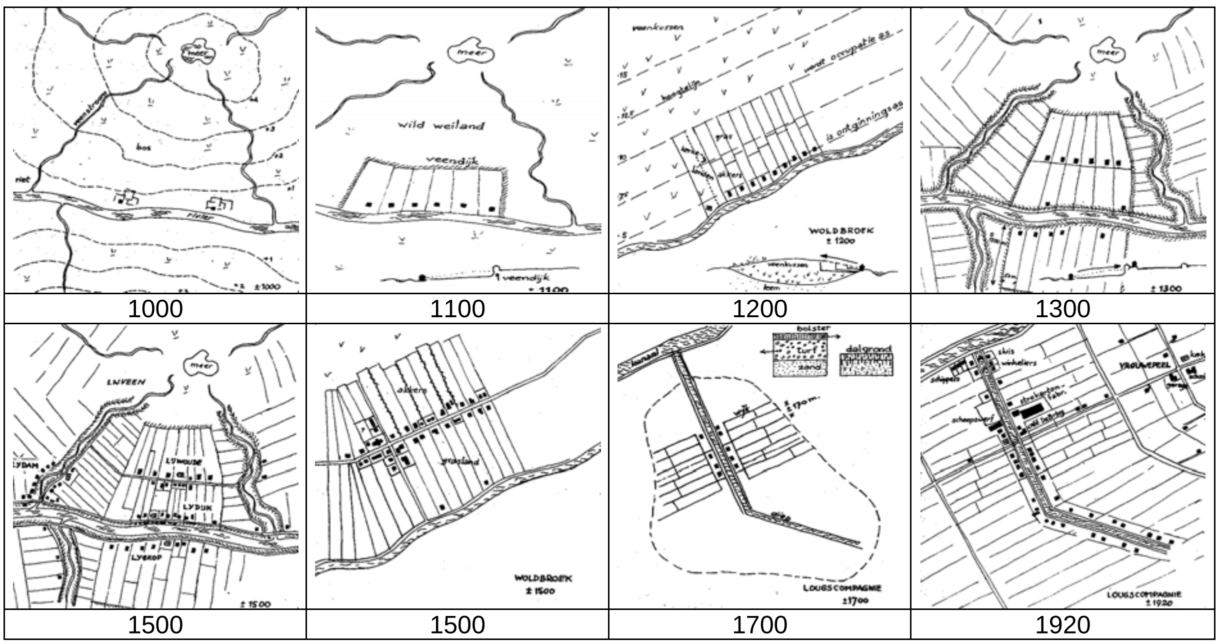
University of Utrecht

Fig. 652 *(*Fig. 651*) 1000 AD.*

Fig. 653 *1100 AD*

Fig. 654 *1300*

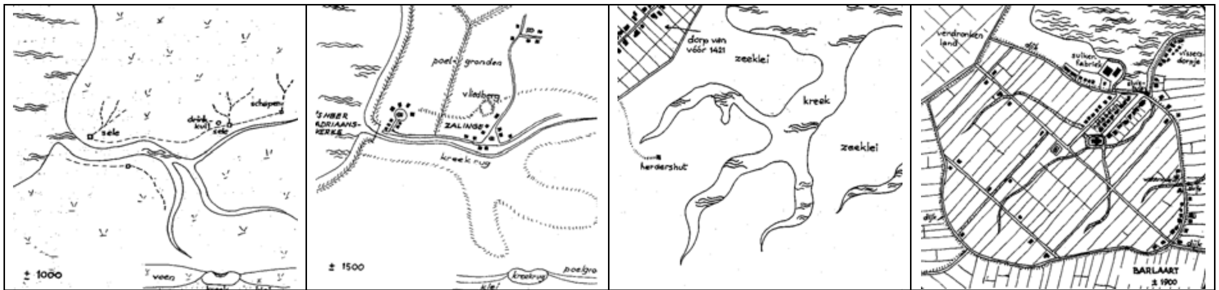
There is evidence of an enormous expansion in agriculture and settlement in the centuries immediately subsequent to 1000 AD. In particular, people learnt how to reclaim and cultivate peat bog (fen).



Steegh (1985)

Fig. 655 *The ideal typical development of old and new peat settlements*

There were a number of small towns at this time. In the course of a century, the Netherlands was far-reachingly colonised. Around 1300, the towns began to grow. There was also growth on the sandy grounds, and forests started to disappear. The sea retreated in some places and advanced in others. By about 1300, there was hardly any ‘nature’ left any more.



1000 | 1500 | | 1900

Steegh (1985)

Fig. 656 *The ideal typical development of new settlements on the clay soils*

The ecological history of the low-lying lands is closely linked to reproduction, family links, illnesses and occupations, in short, to the ecology of the human species.
Count Dirk II married a descendant of Charlemagne and, in 987, was granted full ownership of his fiefdom in North Holland by Emperor Otto III. Dirk III extended the fiefdom to include wet lands in the south. The only people who lived there at that time, were those living along the Old Rhine and at its mouth, at Leiden (Lede, water course Vries (1962)). In 1063, Dirk V was the first to adopt the title Count of Holland, but it was not until approximately 1100 that the name Holland came to be used for the whole county. What happened during that century? The reconstruction made by the University of Utrecht for NNAO shows an unmatched colonisation of these low-lying lands. The first dateable information about the participation of Dutch farmers in the colonisation of peat areas in eastern Germany (Hollerbroek) appeared in 1113. These farmers were especially welcome because of their skills in draining low-lying areas.

Dirk VII's brother, Count Willem I, had a grandson, Floris V, 'The blokes' God', who was married with Beatrix. By founding democratic water boards, he prioritised agrarian development that was based on the growth of population resulting from draining the land. He met with resistance from feudal aristocracy, such as Gijsbrecht van Amstel, who were becoming empoverished, which, in 1296, cost him his life. Towns, and particularly Dordrecht, were centres for the toll system of Holland and needed to extend the trading basis on which they were founded. Most of them were granted their town charter in the 13th century. This was the century during which the influence of Holland grew to such an extent that Count Willem II became the Holy Roman King of Germany with his polder model. The Pope was making preparations to crown him as emperor when he was beaten to death on the slippery Friesian ice. However, his grand nephew, Willem III, was able to marry the daughter of the French king and arrange marriages for his own daughters to the English king, Edward III and the Bavarian emperor, Ludwig.
However, that last-mentioned strategy led to renewed feudal interference. The emperor went fishing for the fattened cod that Otto III had allowed to slip off his hook (the Hook and Cod Disputes [*de Hoekse en Kabeljauwse Twisten*]). Struggling to free themselves from the aristocratic–feudal 'Hooks' were the 'Cod'-supporting farmers and citizens, such as those of Delft.

The County of Holland remained relatively free from the pest epidemics that had brought about a demographic reversal in Flanders and the towns of the Hanseatic League. Bruges partly lost its cloth trade to Holland (Leiden). The movement of herring shoals from the Baltic Sea to the North Sea, and herring gutting skills that had been discovered in the mean time, gave fishermen there an ecological advantage. They sailed to wool-rich England and gradually took over the freight trade. After 1500, partly due to the St. Elizabeth flood in 1421, Dordrecht was forced to relinquish its position as main port to Delft, Rotterdam and Amsterdam. After the Treaty of Utrecht in 1475, the towns of Holland took over the Baltic trade from the Hanse as Jansen (1995) describes. Counts became Stadtholders. For one more century Holland accepted a foreign head-of-state before starting to fight for definitive freedom.

Then, in 1585, Antwerp capitulated to the Spaniards, led by the Duke of Parma. Antwerp, with its multicultural way of life and its urban hinterland, had become the trading centre of the 16th century world. It was the northern entrepot for products from countries around the Indian Ocean as Bouman (1979) describes. This is where modern banking and economic individualism bundled into companies began. During the following four years, almost half (approx. 38,000 people) of its largely Protestant inhabitants fled to the north as Israel (1995) describes, thereby laying the *laissez faire* foundations of the partly immigrant-inhabited metropole of Holland and its trade emperium.The French did not help the young Republic gain acceptance and sovereignity, as the Orange's continued to hope, but they did help by diverting the attention of Philip II, and thus the Duke of Parma, southwards. That gave Maurits opportunities and Van Oldenbarneveld succeeded in bringing competing parties together to form the VOC. That Maurits continued to believe in predestination, and thus in aristocracy, cost Van Oldenbarneveld his life.

The making of dykes, widespread partition of land and draining in Holland encouraged population growth. This caused the peat areas to settle and allowed little by way of occupation other than animal husbandry, fishing and shipping. For this reason, the Hollanders were dependent on grain from the regions around the Baltic Sea. Fortunately, the Hanse preferred to transport their Baltic goods via the, in the mean time deepened, waterways of Holland, to their entrepot in Bruges, than over the dangerous North Sea. In exchange for the much reduced damage to their ships by using this route, the Hanseatic League paid tolls to the Counts of Holland.

This income for the Counts brought tax relief to the farmers. As they had made their own land, they no longer saw themselves as being bound by the requirements of the feudal system (Jansen (1965)). Uneven economic growth reduced any natural areas that still existed to a few areas of blanket bog. The low-lying peat bogs were used as fuel, and winds exposed the underlying Marine Clay. The Mast Forest in Breda was planted to provide shipping with masts. However, the impulse of Golden Age slowed down when people began to live off their private means instead of investing. This resulted in the wet land of Woud being left behind and caused the French to establish a department of Public Works in 1798.

This is how the relatively recent nature of the Netherlands, has come into existence. It is so different from anywhere else in Europe that a separate legend unit is needed to register it on the European nature map. Bohn The task of impoldering the land was completed with the use of the steam engine. To work on the remaining 'waste grounds', the Heide- and Grondmij were established at the end of the 19th century. These relatively new natural areas were later reduced again to provide employment during the 1930s, when unemployment levels were so high.
Artificial fertilisers were discovered round about 1900. Since then, fertilising areas of soils with low-mineral content has favoured rapidly maturing crops, to the detriment of slowly maturing specialist species. Animal husbandry, drainage and atmospheric deposition have all contributed to this process. Just as it is easier to dissolve sugar in coffee than to take it out again, so will much time be needed before these levels of fertilisation are cut down. For this reason, it is not just rarity expressed in kilometres that counts, but also (ir)replaceability in years. One can use the product of these two values to gauge the value of natural areas against the rareness and replaceability of human artifacts.

The early urbanisation of Holland
Around 1550: more than half of the population of Holland lived in towns that had grown up for the purpose of conducting trade.

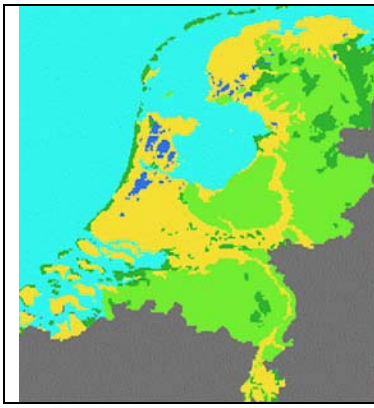
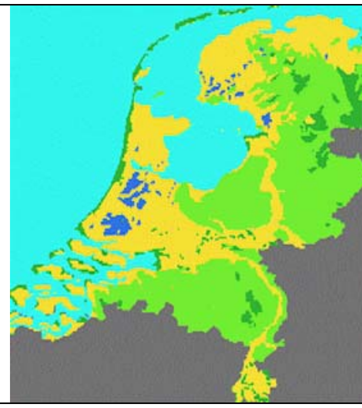
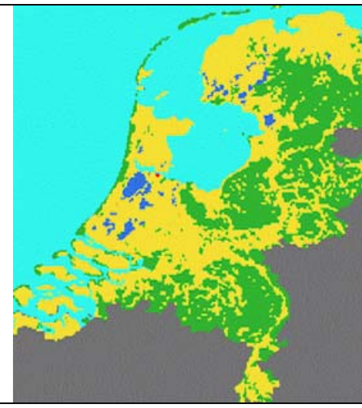




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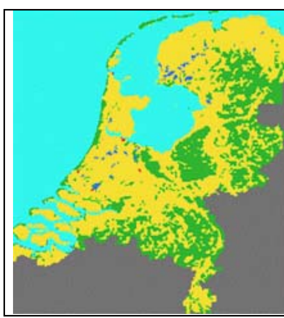
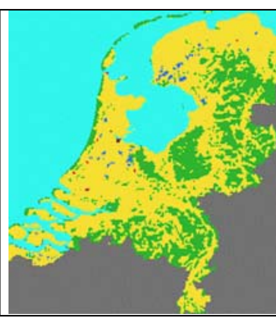
Fig. 657 *1550* Fig. 658 *1675* Fig. 659 *1800*

The Golden Age and the economic decline that followed.
Around 1675: the towns in the west had grown fast. A network of tow-barge canals had come into existence.[15] Development on the sandy soils had come to a halt.
Around 1800: following the impoldering of North Holland, large areas of blanket bog were reclaimed. More dykes were built. From a hydraulic point of view, the land was in a deplorable state.[16]

6.2.4 Recent centuries

Around 1850: the growth of industry in Twente and in North Brabant. Impoldering of lakes caused by peat exploitation in the western fenlands. The digging out the peat of the blanket bogs of the higher eastern areas.
Around 1900: western areas were still the most urbanised. The population of Amsterdam exceeded 500,000. The railway network was completed.
Around 1930: industrialisation on the sandy soils reached a peak. Agglomerations began to form everywhere.
Around 1960: Land reclamation and the Delta works, in addition to large urban and industrial expansion.

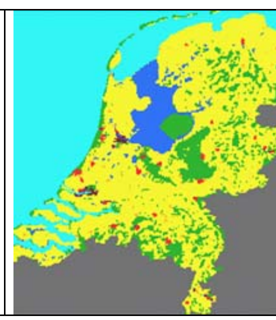


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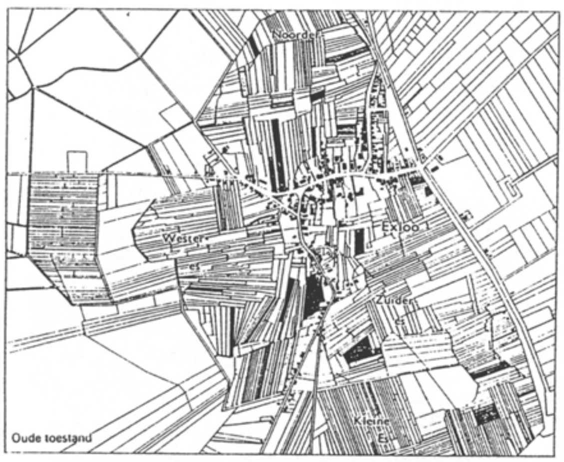
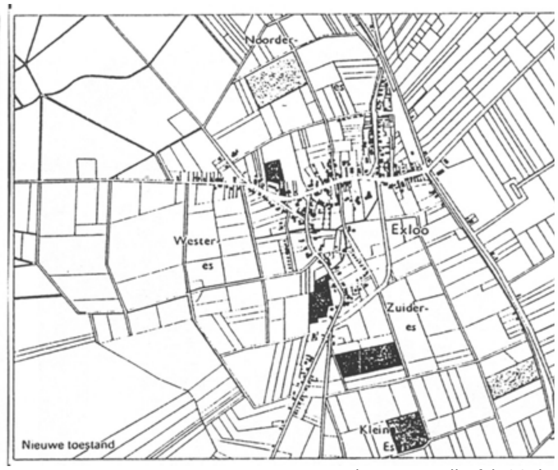
Fig. 660 *1850* Fig. 661 *1900* Fig. 662 *1930* Fig. 663 *1960*

In the second half of the 19th century, two cultivation associations, the Heidemij and the Grontmij were established to bring new nature areas under cultivation again, that had originated since the Golden Age. These associations played an important role in land consolidation.



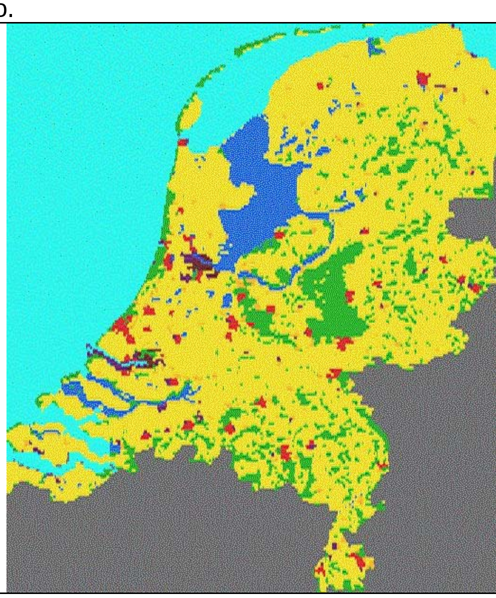


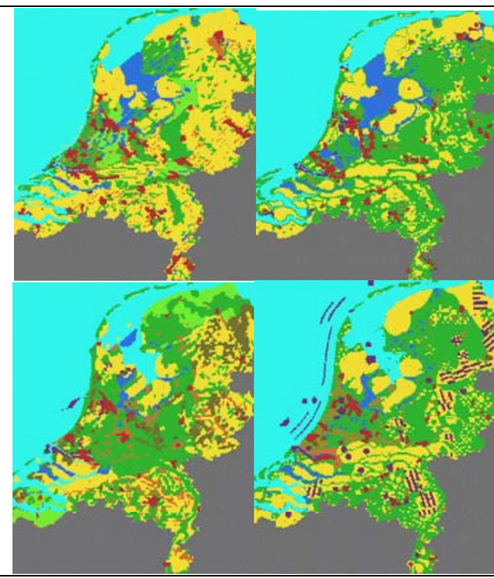
Wolters-Noordhof (1981)

Fig. 664 *Before land consolidation* Fig. 665 *After land consolidation*

An interest in nature conservation and management arose at the beginning of the 1900s. Since 1970, there has been an increasing interest in managing nature and in introducing policies to conserve nature by consolidating land. At present, land consolidation is also an instrument to nature conservancy policy-makers (in riverine and peat bog areas).

Road and air transport play a large new role, but a threatened environment requires a place of its own, too.

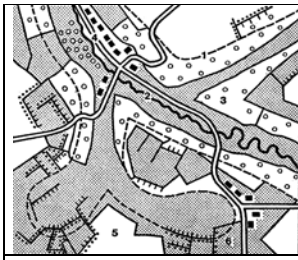
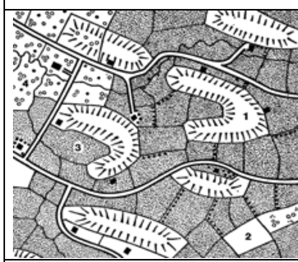
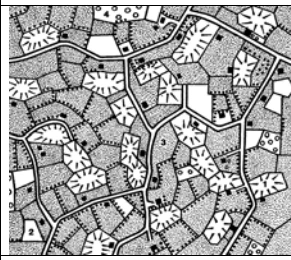
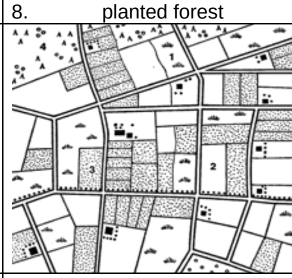
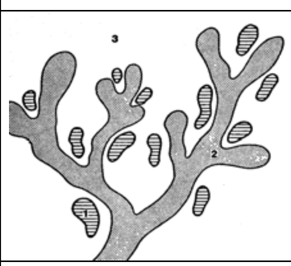
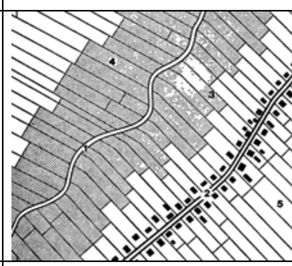
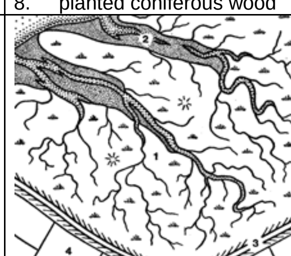


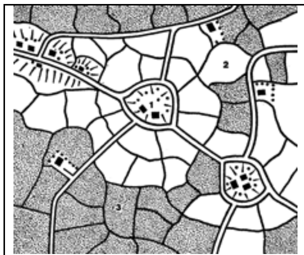
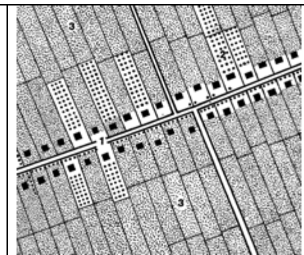
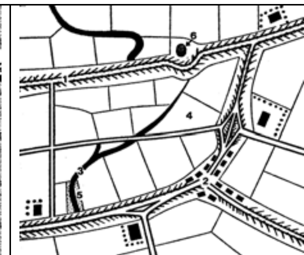
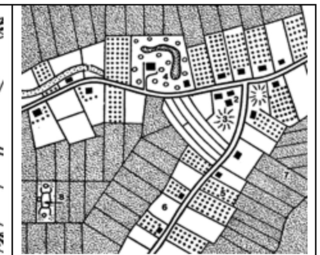
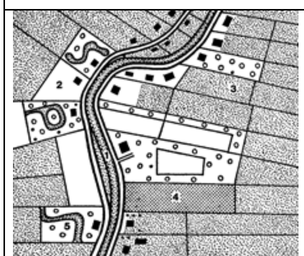
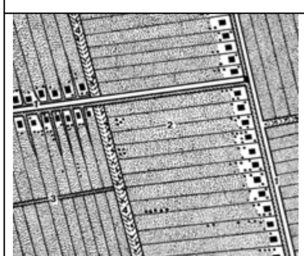
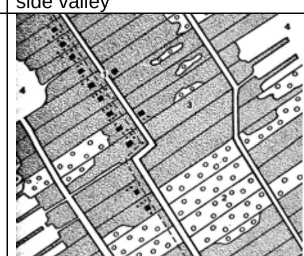
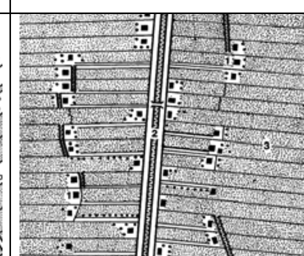
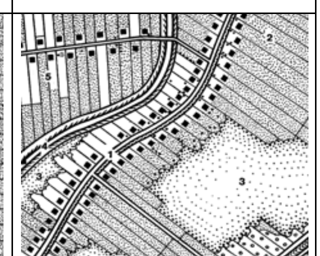
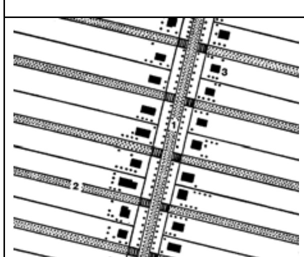
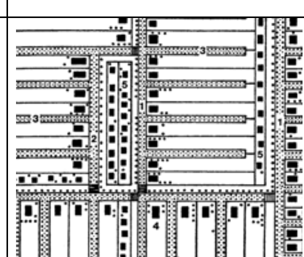
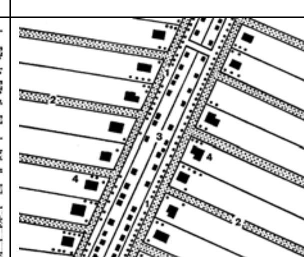


NNAO (1987; NNAO (1987)

Fig. 666 The Netherlands in 1989 Fig. 667 *Ideas for 2050*

6.2.5 Reading maps, according to Visscher (1972)

			
South Limburg 1. edge of valley 2. stream 3. wooded side of valley 4. settlement 5. arable land 6. grassland with wooded banks	North-Limburg 1. arable land on a fluvial terrace 2. old fluvial dunes 3. hedged landscape 4. old fluvial beds 5. river 6. settlement	North -Brabant 1. dune ridge (duinrug) 2. small peat bog/fen mere 3. stream 4. woodland along a stream 5. settlement on old arable land 6. fluvial- or water meadows 7. cultivated land outside the valley of a stream 8. planted forest	Central Slenk 1. road 2. grassland 3. arable land 4. remains of a woodland
			
Wind-borne sand dunes 1. parabolic-shaped sand dune 2. . small arable field on flatter terrain 3. grassland between hill ridges 4. woods on a country estate	Achterhoek 1. hill with old arable land 2. little field on plain surface 3. grassland of lower grounds 4. little wood	heathland reclamation 1. heath 2. field 3. grassland 4. wood	Lateral moraines of East-Twente 1. contour of lateral moraines (stuwwal) 2. old farmland on flank of lateral moraine 3. grassland surrounded by wood on moisty grounds 4. settlement 5. wet woods (broekbos) 6. grassland of younger relamations 7. farmland of younger relamations 8. planted coniferous wood
			
Lateral moraines of West Twente 1. contour of lateral moraine (stuwwal) 2. meltwater ridge 3. settlement 4. old farmland on Eastern flank of lateral moraine 5. grassland on moisty plans 6. heath 7. planted coniferous wood	Ash trees along the valley of a stream 1. field (es) 2. stream valley (beekdal) 3. tableland	Parcelled landscape of the northern Netherlands (slagenlandschap) 1. stream 2. road village (wegdorp) 3. lot border 4. grassland 5. farmland (bouwland)	Nature areas beyond the dyke(s) in South West Netherlands 1. salt marsh (schor) 2. mud flat (slik) 3. sea dyke 4. farmland

			
terp landscape 1. terp with buildings 2. field 3. grassland	Parcelled landscape of West Friesland elongated lots 1. regional village (streekdorp) 2. orchard 3. grassland	The dyke system of SW Netherlands 1. dyke planted with trees 2. dyke village 3. creek relic 4. farmland 5. grassland on creek bed 6. pool as relic of bursting of the dike (wiel)	Fluvial landscape 1. abandoned river bed 2. settlement 3. raised old arable land 4. country estate 5. orchard 6. field 7. grassland
			
Country estates of West Utrecht 1. river 2. field 3. grassland 4. orchard 5. country estate	Beach banks between Leidenand Haarlem (strandwal) 1. road village 2. country estate on ridge 3. wet wood on sea side valley 4. canal for shipping digged sand 5. bulb field on digged part of sea side ridge 6. grassland in moisty sea side valley	Water collection on dune landscapes 1. dune ridge 2. lower part of dune area 3. digged perpendicular watercourse (dwarswetering) 4. small wood dyke (houtkade) bordering village area 5. surface dune relic (donk)	peat bog area with peat stream 1. stream with regional village 2. grassland 3. digged perpendicular watercourse 4. small wood dyke bordering village area 5. surface dune relics
			
A peat bog (fen) with excavated waterways 1. regional village 2. grassland 3. digged perpendicular watercourse 4. small wood dyke	The peat bogs (fens) of NW Overijssel 1. water region village alongside watercourse 2. marsh wood (moerasbos) 3. grassland 4. pool from peat extraction	The peat bog (fen) at Kamerik 1. buildings on clay ridge 2. canal with rest of building alongside 3. grassland parceled out in strips	A peat bog (fen) with lakes and drainage systems 1. regional village 2. grassland 3. lake (plas) 4. ring-dyke 5. polder with grassland and field
			
A fenland community along a canal	Fenland communities along canals	Fen community along a canal that gives dual access ’	North-east polder (*Noordoostpolder*)

1. canal 2. perpendicular canal (wijk) 3. farm	1. canal 2. back canal (achterdiep) 3. perpendicular canal (wijk) 4. peat extraction with farm 5. strip with dwellings	1. road alongside canal 2. perpendicular canal (wijk) 3. strip with dwellings 4. farm	1. road with farms surrounded by wood belts 2. canal 3. fields 4. wood with unimproved roads

Visscher (1972)

Fig. 668 *Landscape elements on maps*

6.2.6 References to History of Dutch habitat

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6.3 Recent figures

Every year, as far as one can remember, the CBS has produced the *Statistisch Zakboekje* (Statistical Pocket Book). This inexpensive publication gives an overview and a popular extract of CBS statistics (currently, in all its majesty, to be found on http://www.cbs.nl/). You can find characteristics of 240 urban facilities. Dividing their number by total population of The Netherlands you can calculate how many people you need to support each facility at average (see page 611). The deviation from this average determines the functional profile or identity of a region, conurbation, town, district or neighbourhood.

Those who are familiar with this pocket book are mostly of the opinion that one is not an intellectual unless one has a subscription to it. I support this view. At some point early in the year, as soon as my new copy falls through the letter-box, I settle down in a comfortable chair to look through it. Then, I am unavailable for a few hours, as, with the help of this impressive statistical material, I see numerous popular myths collapse before my eyes.

Recently, the title of the booklet has been changed to *Statistisch Jaarboek* (Statistical Yearbook). This gives more distance, but, currently, it appears in the bookshops at the same time as the inexpensive CD-ROM. This is a great blessing, because now all the tables can be transported to Excel and then the feast of selecting and working with this material can begin. A number of establishments are listed for every organization and branch. In view of my new responsibility for Urban and Regional Design, I have taken my CD-ROM *Statistisch Jaarboek 2001* and put the relevant urban architectural tables from the following chapters, in Excel, on http://www.bk.tudelft.nl/urbanism/TEAM/ (click 'databases'):

1 Population
1.1 Population
1.2 Health and well-being
1.3 Education
1.4 Culture, recreation and other uses of time
1.5 Legal protection and safety
1.6 Residence

2 Employment, incomes and social security
2.1 Employment and wages
2.2 Incomes, property and expenditures
2.3 Social security

3 Businesses
3.1 Demography of businesses
3.2 Business book-year accounts
3.3 Automation and research and development (R&D)
3.4 Agriculture and fisheries
3.5 Energy and minerals
3.6 Industry
3.7 Building industry
3.8 National trade and service industry
3.9 International trade
3.10 Traffic, transport and communication

4 Government, politics and management
4.1 Government finances
4.2 Politics and management

5 Macro-economy and the money and capital market
5.1 National accounts
5.2 Money and capital market
5.3 Producer and consumer prices

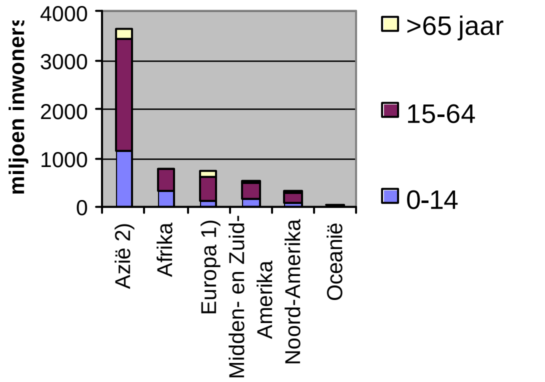
6 Geography and environment
6.1 Geography
6.2 Environment

Fig. 669 The content of the Statistisch Jaarboek 2001
(See page 618 for a specification relating to the tables used)

In these Excel files, I have included a number of urban architectural facts of importance for the graphs and tables discussed here.

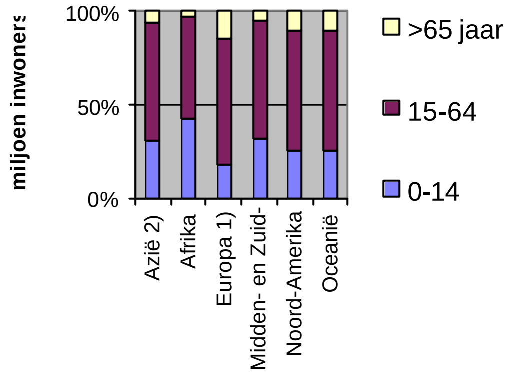
6.3.1 Population

Compared with Asia, Europe is not only small, but, in contrast to all other continents, its population is much older (*Fig. 670* en *Fig. 671*).



(1) Including Russia, excluding Turkey. (2) Including Turkey.

Fig. 670 Number of residents per continent



Source: U.S. Bureau of the Census International Database

Fig. 671 Age range per continent

Population development in the Netherlands

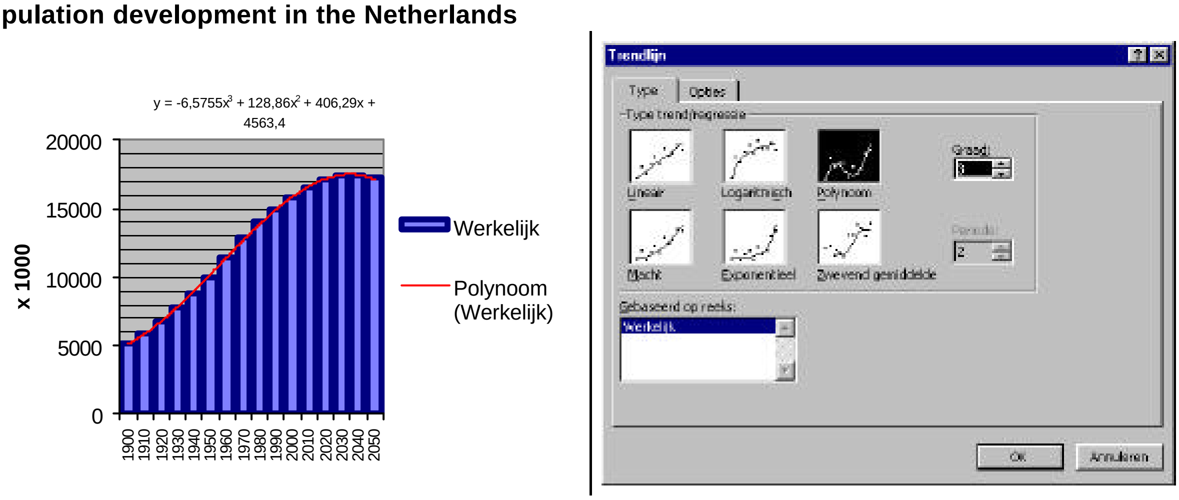
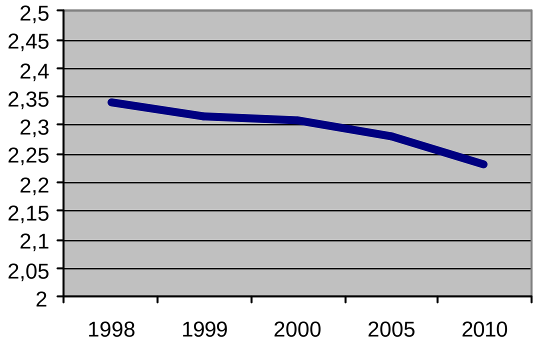


Fig. 672 How the Dutch population has developed, using a trendline from Excel

When you make a chart in Excel to show how the Dutch population has developed (omitting the years between the 10s), you discover that, for a century, every 10 years, the population has increased by a million. Select a chart and click on the toolbar 'chart/add trendline' and you will find the above menu. If you choose a third-degree polynomial and, from 'options', click on 'show equation in chart', then you get the above result. A polynomial appears to fit in well here, and perhaps allows extrapolation over a few extra years, but has no rational linkage at all with reality. Formulas which seem to behave more closely to reality can be found in (Jong, de T.M. and Priemus 2002).

Population characteristics

After World War II, the number of people per household (which almost equates with 'occupance per dwelling') decreased from 5 to 2.3 and the expectation is that it will decrease even further. From an urban architectural point of view, this is an important figure because this halving of occupancy meant that, for the same population, twice as many dwellings had to be built (*Fig. 673*). Family dilution has mainly come about due to the increasing number of single-family households (*Fig. 674*).



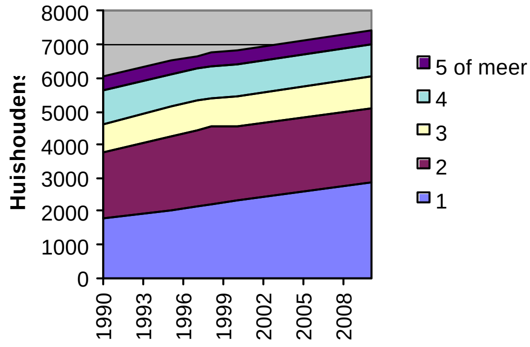
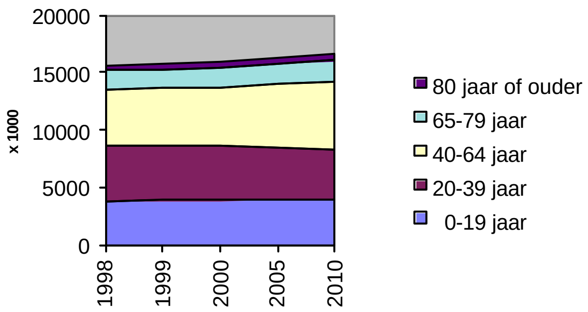


Fig. 673 Average number of people per household

Fig. 674 Number of people per household

The population continues to age, but the question is whether, under the new politics, the number of immigrants will continue to grow as was forecast in 2001.



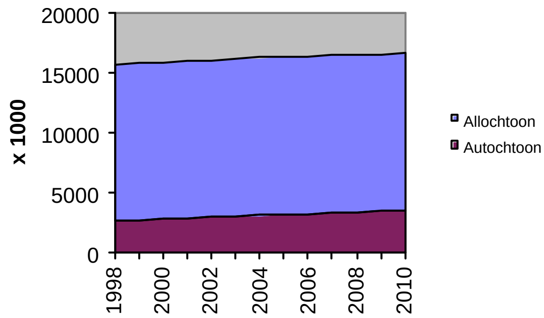
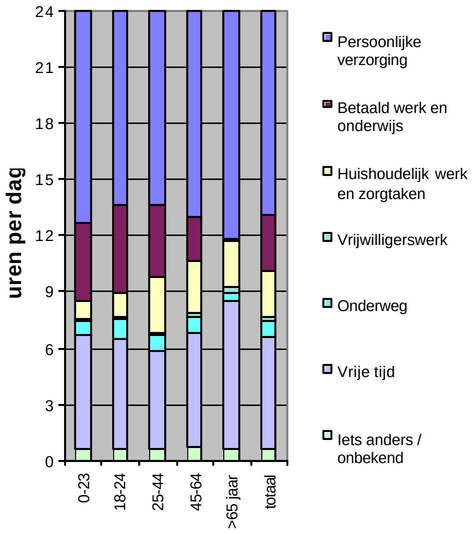


Fig. 675 Changes in age range

Fig. 676 Proportion of first and second generation immigrants

Time utilisation



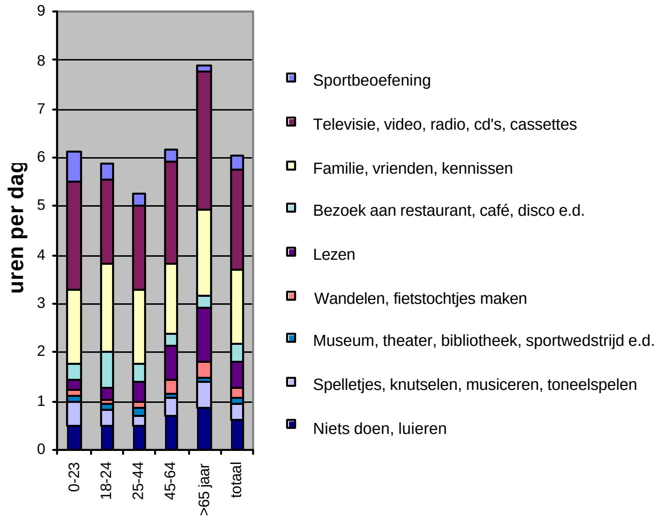


Fig. 677 Time utilisation in 1997

Fig. 678 Use of free time in 1997

Daily population movements

The average total distances travelled, mainly by car, per person per day is fairly constant at 35 km (*Fig. 679*). Commuting accounts for almost 10 km of this distance (*Fig. 680*).

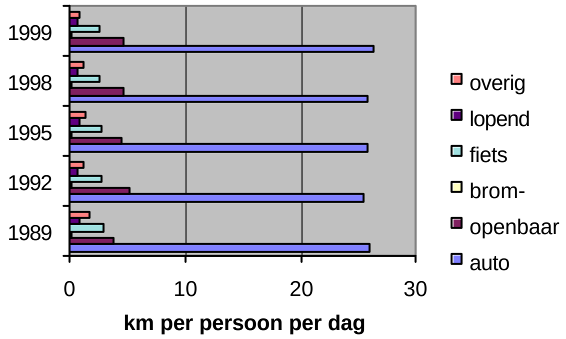


Fig. 679 Total distance travelled per means of transport

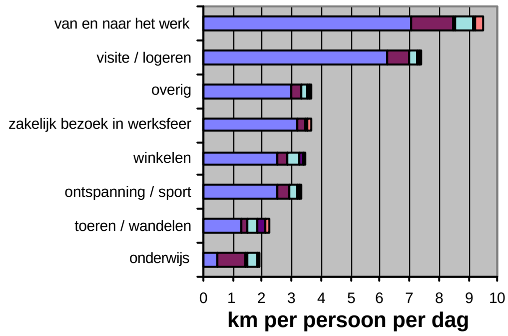
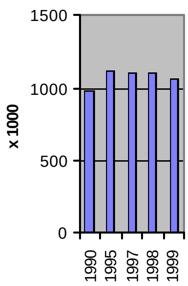


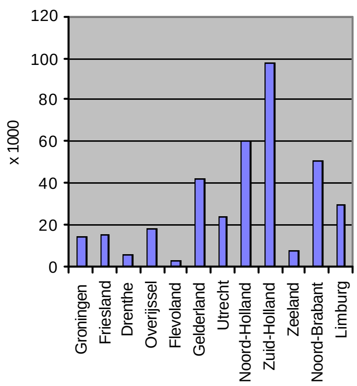
Fig. 680 Distance travelled per motive and means of transport

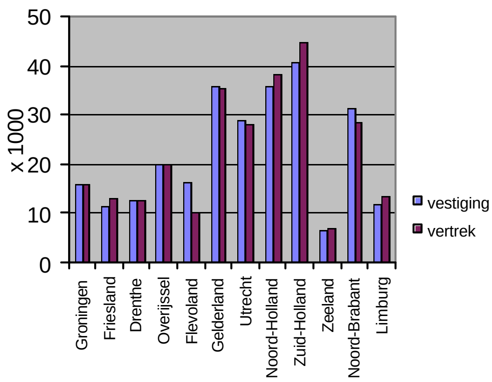
Removals

In 1999, 1,696,000 Dutch people moved to another place of residence in the Netherlands. More than a million of these changes of address were within the same municipality (3 km radius), more than a quarter of a million within the same province (30 km radius) and almost 0.4 million from one province to another (300 km radius).

Removals in 1999 within	3km	30km	300km	total
	1058000	267000	371000	1696000
	See *Fig. 681*	See *Fig. 682*	See *Fig. 683*	







Number of removals

Fig. 681 Municipal *Fig. 682 Provincial* *Fig. 683 National*

The largest number of removals took place within and between the provinces South and North Holland.

6.3.2 Urbanity

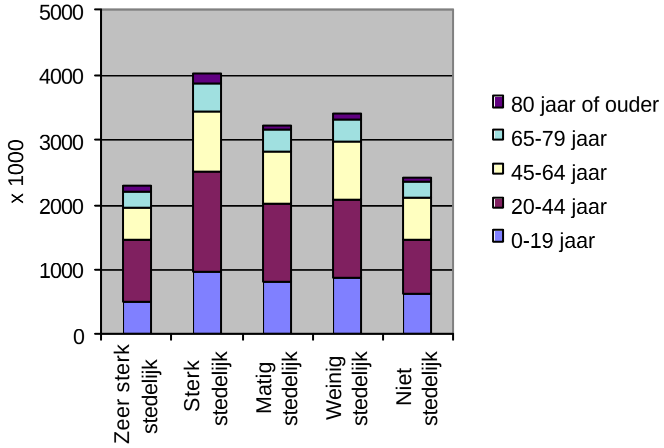
The CBS's definition of urbanity is as follows:

urbanity: For the classification of urbanity the numerical values for the neighbourhood address densities of the different municipalities are categorised into five groups or classes. The boundaries of the classes have been chosen in such a way that all the classes contain about the same number of residents. In this way, the following categories can be distinguished:

?? very strongly urban municipalities with a neighbourhood address density of 2,500 addresses or more per km^2 ;
?? strongly urban municipalities with a neighbourhood address density of 1,500 to 2,500 addresses per km^2 ;
?? moderately urban municipalities with a neighbourhood address density of 1,000 to 1,500 addresses per km^2 ;

?? hardly urban municipalities with a neighbourhood address density of 500 to 1,000 addresses per km²;
?? non-urban municipalities with a neighbourhood address density of less than 500 addresses per km².

The number of residents who live in these environments is therefore divided rather similarly, with small variations in age (*Fig. 684*).



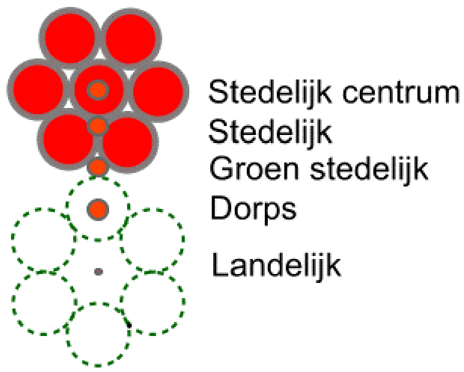


Fig. 684 *Inhabitants by urban environment category, according to the CBS*

Fig. 685 *On the map*

In the Fifth Memorandum, the RPD used a similarly grouped classification to that of a stipple chart, for reading off a location (*Fig. 685*).

Order of municipality by size

On 1st January 2000, this population was resident in 537 municipalities. When one lists these municipalities according to size, one gets the 'ordering' of municipalities. In *Fig. 686*, using the ordering in this list, 1 in 40 of the municipalities is named. This does not produce a straight line, because the size of municipalities from the largest, downwards, diminishes rapidly, at first, before slowing down.

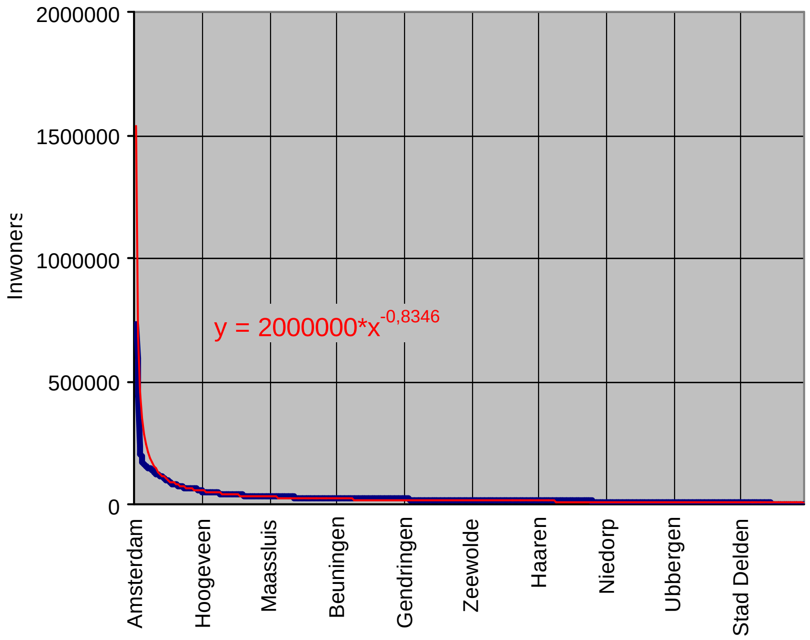


Fig. 686 *Ordering municipalities using a power trendline in Excel*

When make the *y* axis is made logarithmic, the graph becomes clearer:

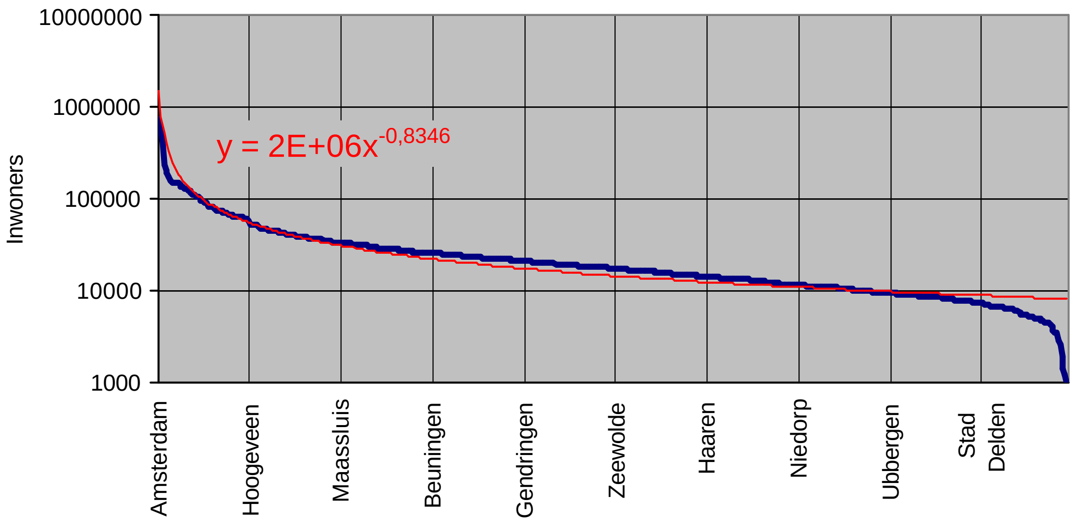


Fig. 687 *Ordering municipalities, expressed logarithmically, using a trendline in Excel*

Then it also becomes clear that, for the smallest municipalities, the trendline is no longer accurate: reality decreases faster for populations from below 10,000 to the smallest municipality (Schiermonnikoog), probably due to the geographical restrictions of the island boundary.

Order of agglomerations

The historical boundaries of municipalities cut through the reality of amalgamated built-up areas (urban agglomerations), so that these graphs give an incorrect picture of the Ordering of urban areas. However, the *Yearbook* also gives a table of urban agglomerations of over 100,000 inhabitants. The somewhat out-of-date definition of this type of agglomeration is given in the *Yearbook* as follows:

urban agglomeration: A central town with surrounding municipalities that (on 31st May 1960) fulfilled the following conditions:

- ?? more than 50% of the commuters resident there must be employed in the central town;
- ?? in addition, the above-mentioned commuters must comprise at least 15% of the working population of the central town.

This table is shown next to the upper section of the municipality table (*Fig. 688*) in *Fig. 689*.
In general, municipal density is much higher than agglomeration density.

	inhabitants	km² land	no. inhabitants/ha.
Amsterdam	731288	165,13	44
Rotterdam	592673	208,61	28
DenHaag	441094	67,92	65
Utrecht	233667	61,42	38
Eindhoven	201728	87,31	23
Tilburg	193116	117,42	16
Groningen	173139	80,15	22
Breda	160615	127,00	13
Apeldoorn	153261	340,30	5
Nijmegen	152200	53,70	28
Enschede	149505	140,04	11
Haarlem	148484	29,45	50
Almere	142765	131,62	11
Arnhem	138154	98,57	14
Zaanstad	135762	74,50	18
DenBosch	129034	85,00	15
Amersfoort	126143	62,88	20
Maastricht	122070	57,01	21
Dordrecht	119821	80,58	15
Leiden	117191	22,16	53
Haarlemmermeer	111155	180,01	6
Zoetermeer	109941	35,59	31
Emmen	105972	340,56	3
Zwolle	105801	95,35	11
Ede	101700	318,29	3

Fig. 688 *Municipalities > 100,000 inhabitants*

	inhabitants	km² land	no. inhabitants/h
Amsterdam	1E+06	365,12	27
Rotterdam	989956	355,50	28
DenHaag	610245	187,50	33
Utrecht	366186	140,93	26
Eindhoven	302274	181,27	17
Leiden	250302	87,26	29
Dordrecht	241218	153,42	16
Heerlen	218078	109,22	20
Tilburg	215419	159,47	14
Groningen	191722	126,09	15
Haarlem	191079	76,67	25
Breda	160615	127,00	13
Amersfoort	154890	121,50	13
DenBosch	154368	118,55	13
Apeldoorn	153261	340,30	5
Nijmegen	152200	53,70	28
Enschede	149505	140,04	11
Arnhem	139576	126,50	11
GeleenSittard	127322	98,13	13
Maastricht	122070	57,01	21
Zwolle	105801	95,35	11

Fig. 689 *Agglomerations > 100,000 inhabitants*

From these tables, it appears that some agglomerations (Heerlen and Geleen–Sittard) are composed of municipalities smaller than 100,000 inhabitants, while a number of municipalities (Almere, Zaanstad, Haarlemmermeer, Zoetermeer, Emmen and Ede) with more than 100,000 inhabitants are missing, partly because, due to commuting, they have been included in the agglomeration of a larger municipality nearby. *Fig. 690* shows the Ordering of the agglomerates in *Fig. 689*.

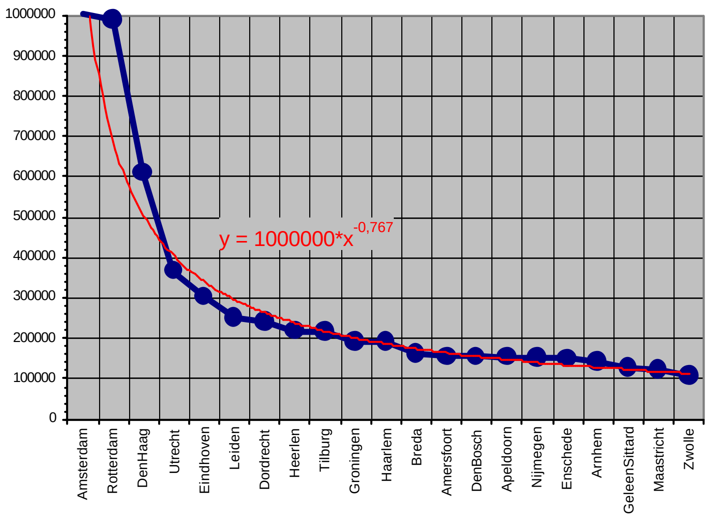


Fig. 690 *Ordering of agglomerations*

In the Netherlands, two large agglomerations dominate the ordering. If Amsterdam had 2 million inhabitants, the ordering would fit better into the formula. When we map the deviations from the formula (*Fig. 691*), then Amsterdam or Rotterdam, and, to a lesser extent, The Hague, are incongruous. This can indicate an international position, which has its own order. Following this line of thought, then, Utrecht falls within the national ordering.

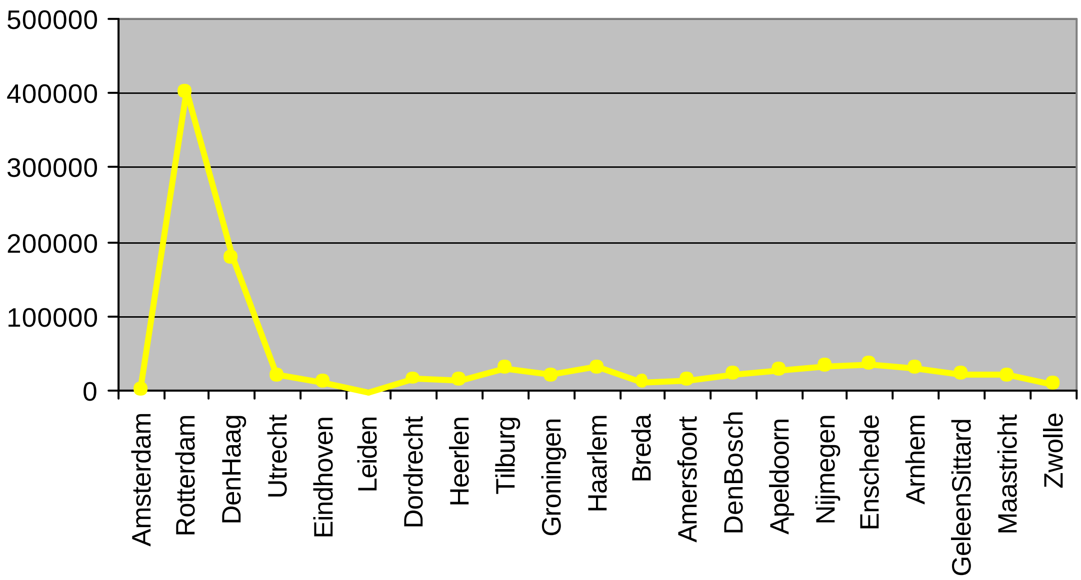


Fig. 691 *Deviations from the ordering y = 1000000*x-0.767 in the higher regions*

Order of facilities

Throughout the *Yearbook*, numerous tables are included that mention the number of established premises for every organization and branch. I have been able to find those statistics for 256 types of establishment, but many are still missing, such as prisons, police stations, ministeries, embassies, surrogate family homes, boarding schools, monasteries and convents. The figures are taken from different years. For each year, I divided the population of the Netherlands by this statistic, to calculate the average support base needed for each type of facility. The size and importance of these facilities (see **Fout! Verwijzingsbron niet gevonden.**) (see Appendix 2) equates with the size of the urban area (*Fig. 692*).

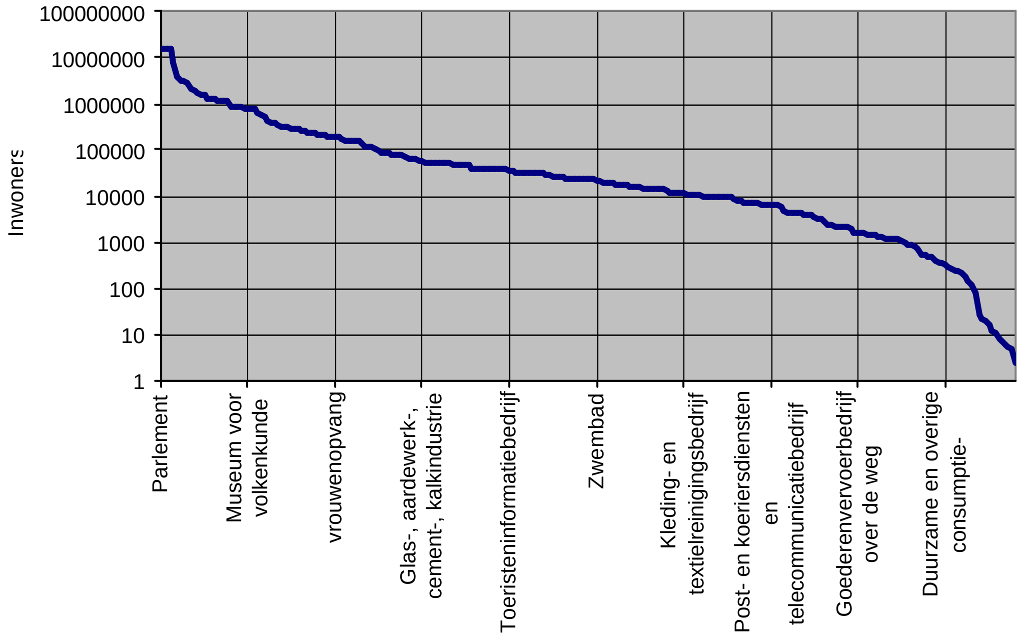


Fig. 692 *Ordering of 244 types of establishment, shown logarithmically*

From this, one can see that, for a population of 100,000 inhabitants, a ‘town’, that most facilities can find a sufficient support base. Local deviations from this Dutch average also contribute to (part of) the functional identity of the town (or urban district). For those who would like to know more about these urban facilities, *Fig. 693* gives a good picture.

Urban facilities

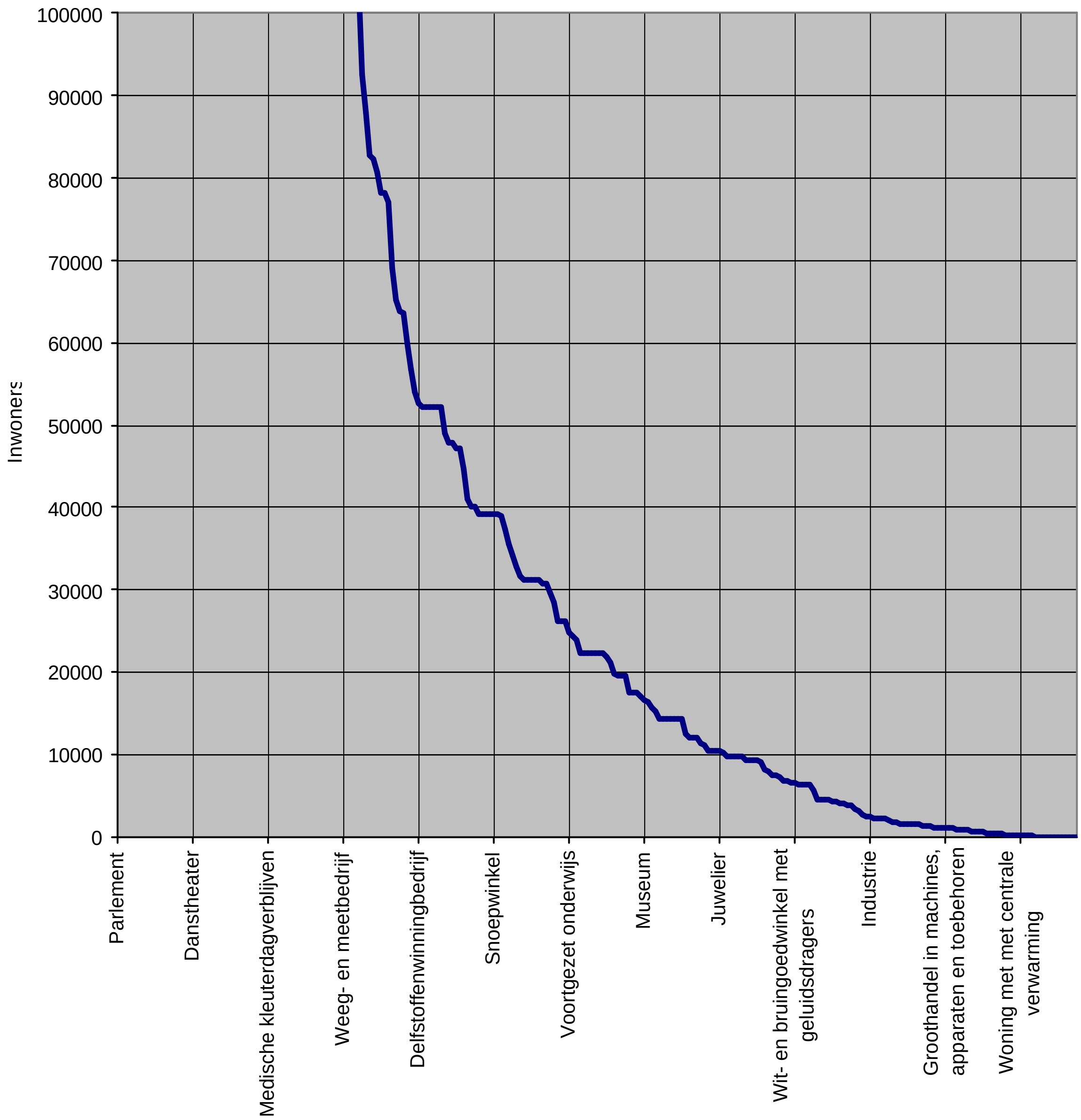


Fig. 693 *Ordering of facilities for 100,000 inhabitants*

What is noticeable is that it has a certain multi-staged characteristic. In the vertical parts, urban growth apparently allows little growth in the level of facilities that it can offer; in the horizontal parts, rather more. With 10,000 inhabitants (village, district) one already has a base that is large enough to support half the number of facilities. To examine this part of the graph in more detail, *Fig. 694* gives a good picture. For populations between 45,000 and 62,000 inhabitants, the number of types of facility hardly increases at all.

District or village facilities

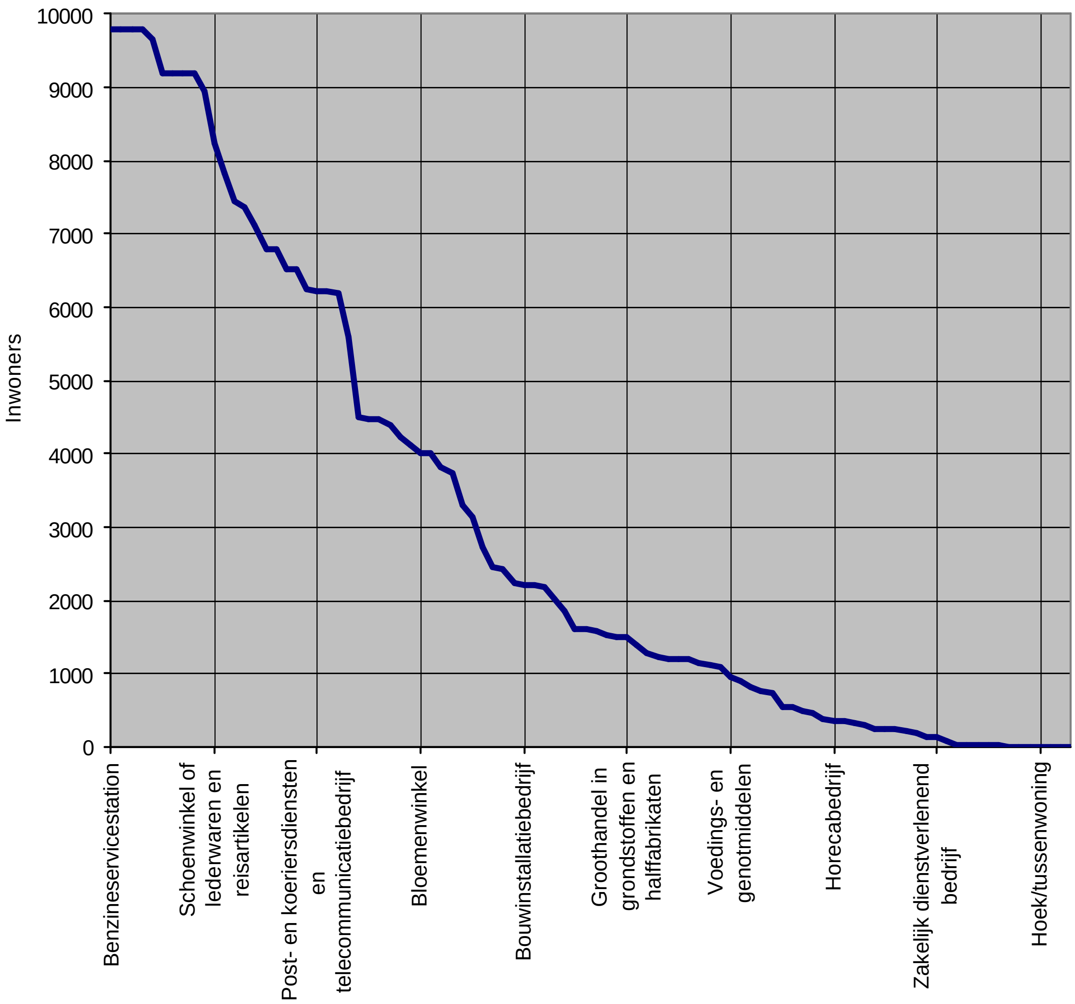


Fig. 694 *Ordering of facilities for 10,000 inhabitants.*

Homes

On 1st January 2000, in the Netherlands, there were approximately 6,588,000 homes, the value of which totalled € 575,945,000,000, divided into categories, as shown in *Fig. 695*

	year	population	number	growth/year	support base
Home	1999	15760	6390100		2.47
Own home	1999	15760	3303700		4.77
Rented home	1999	15760	3086400		5.11
Home with central heating	1999	15760	89700		176
Flat/appartment, etc.	1999	15760	1965000		8.02
End of terrace-/terraced house	1999	15760	2689900		5.86
Home with a garden or grounds	1999	15760	75600		208
Home with a garage and/or a carport	1999	15760	33600		469
A detached house	1999	15760	979400		16
A semi-detached house	1999	15760	755800		21
A 1 or 2-roomed home	1999	15760	580500		27
A 3-roomed home	1999	15760	1273800		12
A 4-roomed home	1999	15760	2164100		7.28
A 5-roomed home	1999	15760	1556300		10
A home with 6 or more rooms	1999	15760	815400		19

Fig. 695 *Housing categories and their number in relation to the total population of the Netherlands*

From *Fig. 696* and *Fig. 697* it is possible to determine the average age and price of homes in the Netherlands.

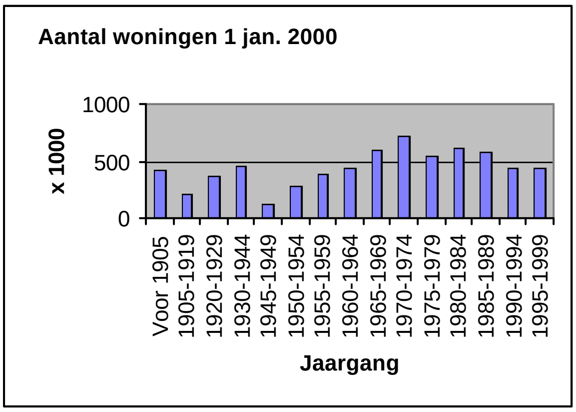


Fig. 696 *Number of homes per year of construction*

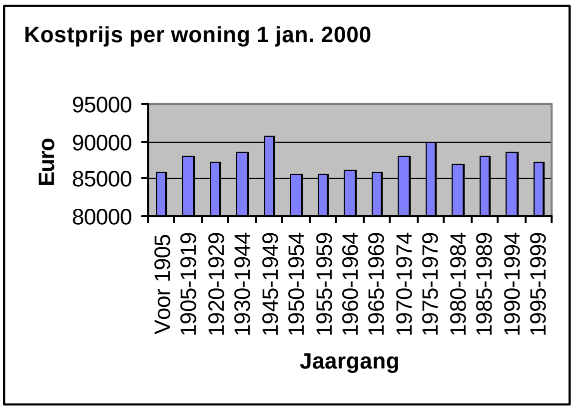


Fig. 697 *Value of home per year of construction*

The majority of people in the Netherlands live in accommodation that was built after World War II, between 1960 and 1990 (*Fig. 698*). Single-person households are mainly accommodated in rented homes. Couples usually buy their own living accommodation (*Fig. 699*).

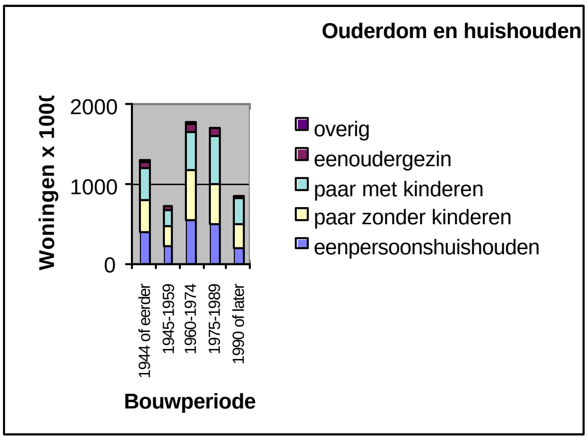


Fig. 698 *Occupancy per year of construction*

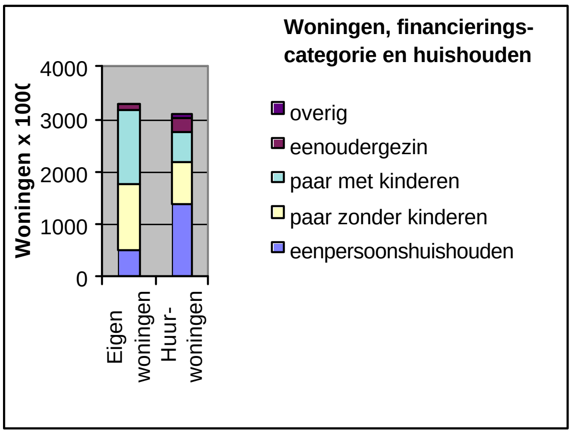


Fig. 699 *Occupancy per financing category*

6.3.3 Public facilities

(National) Territory

In 1996, the Netherlands occupied a territory of 41,526 km^2 , divided over various provinces and land-use categories, as shown in *Fig. 700*. Of these categories, forest, nature and water can be seen as public facilities, to a greater or lesser extent. Built-up areas occupy a relatively small area.

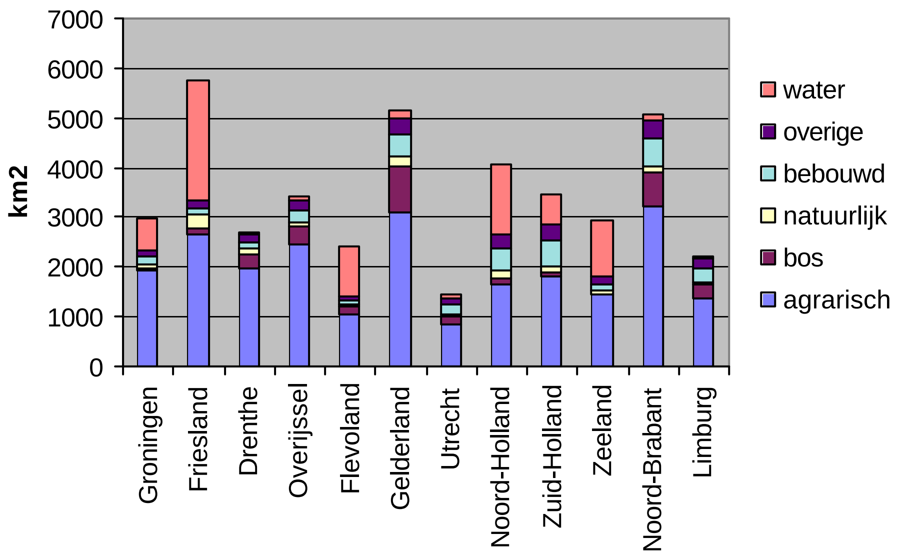


Fig. 700 *Land use in the Netherlands*

Roads

In 1999, the Netherlands had 117,430 km of surfaced roads (if one was to include unsurfaced roads, this would be approximately 95% of the total road network). The growth of this road network is shown in *Fig. 701*. Although not all means of transport are public facilities, they form, together with the surfaced roads, a transport system (*Fig. 702*).

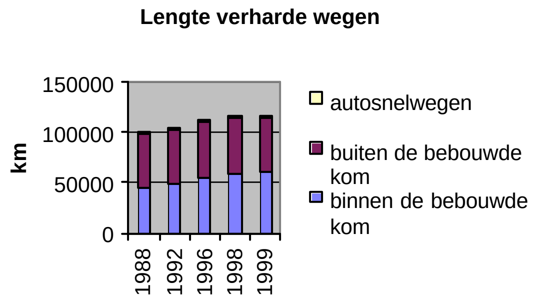


Fig. 701 *Extent of surfaced roads*

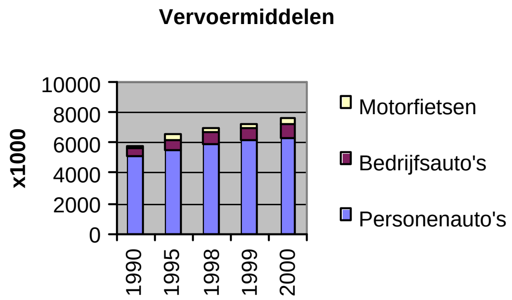


Fig. 702 *Means of transport*

Outside the built-up areas, the prevailing road network has an average mesh width of approx. 1 x 1 km (density 2 km per km^2). Within built-up areas, the mesh width is almost 100 x 100 m (20 km per km^2). Motorways have an average mesh width of approx. 30 x 30 km (0.07 km per km^2).

	length	surface area	density	average mesh width in km
motorways	2256	29261	0.077	30
outside the built-up areas	54820	26060	2.104	1
inside the built-up areas	60354	3201	18.85	0.1
total extent of surfaced roads	117430	29261	4.013	
railways	2808	33873	0.083	30

Fig. 703 *The density of the road network*

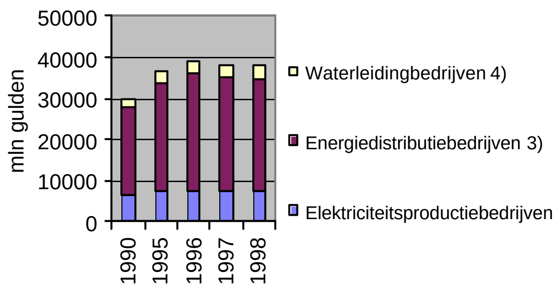
The density of the railway network can be compared with that of the motorways. Approximately 135 people are needed as a support base for a kilometre of road.

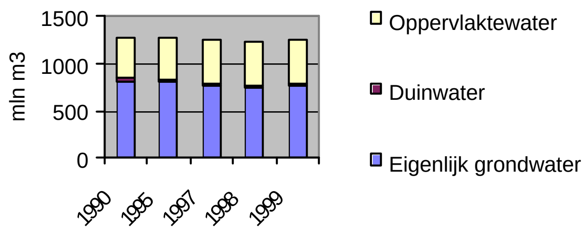
Utility Companies, Energy, and Mineral Deposits

The number of water boards has decreased from 32 in 1990 to 20 in 1998, without a noticeable decrease, either in the number of employees or in cubic metres of water produced (*Fig. 706*). As with agrarian firms, this indicates concentration.

Establishments for:	year	population	number	growth per year	support base
Electricity producing company	1998	15654	5	0%	3130838
Energy distribution company	1998	15654	70	-1%	223631
Water Board	1998	15654	20	-9%	782710

Fig. 704 *Number of utility facilities compared with the size of the Dutch population*





Note 3: Including power installations(>50 GWh per year), in the context of joint ventures, exploited by energy distribution companies and industrial companies.
Note 4: Excluding multi-utility companies

Fig. 705 *Production value of utility companies*

Fig. 706 *Water production*

Health and Welfare

Fig. 707 is a table showing 20 different types of public health facilities. By dividing the population by the number of facilities, a potential support base emerges that indicates the number of inhabitants that would be needed to support this type of facility. Due to an irregular, historically determined distribution of the facilities and the factors determining their establishment at a specific location, their distribution is, of course, unevenly concentrated, which, in turn, means that the actual support base, locally, can also vary.

Establishments for:	**year**	**population**	**number**	**growth per year**	**support base**
after-school care centres	1998	15654	992	18%	15780
hostels caring for vagrants and homeless people	1999	15760	228	5%	69124
host-family care centres	1998	15654	189	1%	82826
half-day crèches/nurseries	1998	15654	169	9%	92628
full-day crèches/nurseries	1998	15654	1749	16%	8950
family doctors'/ general practitioners' (gps') practises	2000	15864	4809	0%	3299
established general practitioners (gp)	2000	15864	7217	1%	2198
childrens' independently homes	1998	15654	789	4%	19841
homes for the mentally handicapped	1999	15760	151	2%	104372
homes for the those with sensory handicaps	1999	15760	12	-1%	1313352
community care centres	1999	15760	75	3%	210136
childrens' hospitals and hospices	1999	15760	13	1%	1212325
medical day centres for infants	1999	15760	56	8%	281433
psychiatric hospitals	1999	15760	76	-1%	207371
dentists	1998	15654	7030	-1%	2227
nursing homes	1999	15760	334	0%	47186
care homes for the elderly	1998	15654	1380	-1%	11344
crisis centres for women	1999	15760	80	25%	197003
independent dispensing chemists	1998	15654	1547		10119
hospitals	1999	15760	136	-2%	115884

Fig. 707 *Number of health facilities compared with the size of the Dutch population*

The growth figures for the latest available year, compared with the year prior to that, give an indication of the figures for the years to come, but, in the longer term, they must be calculated more closely (see e.g. *Fig. 708* and *Fig. 709*) in the light of rational expectations of their expected use.

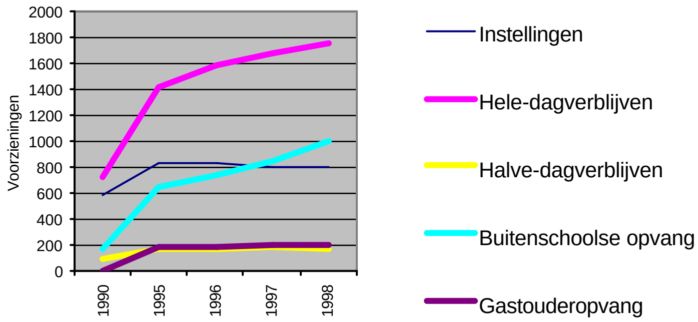


Fig. 708 *Development of facilities for children*

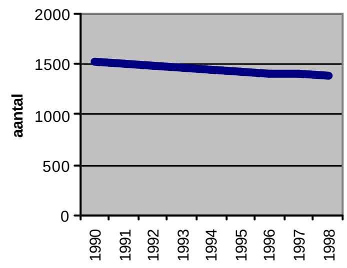


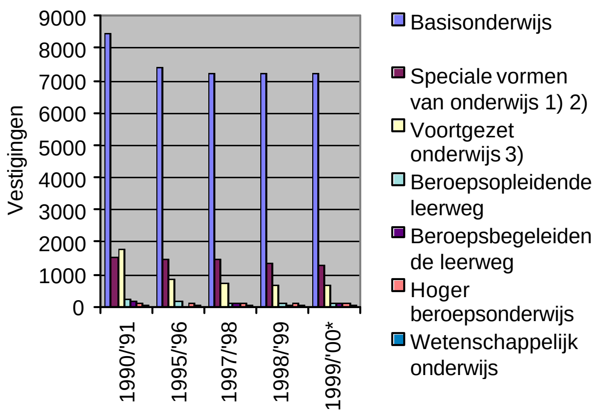
Fig. 709 *Facilities for the elderly (care homes for the elderly)*

The statistics listed here do not reflect the number of *users*, but rather the number of establishments that are more relevant from an urban architectural viewpoint. The number of users per *establishment* is determined by a number of organisational factors that change in the course of time. In turn, this number determines the local use of space per establishment.

Education

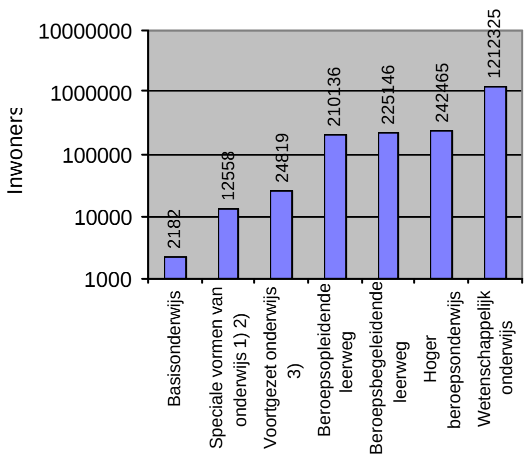
Establishments for:	year	population	number	growth per year	support base
primary education	1999	15760	7224	-1%	2182
day-release learning path	1999	15760	70	-4%	225146
vocational learning path	1999	15760	75	-7%	210136
higher vocational education	1999	15760	65	-3%	242465
special forms of education	1999	15760	1255	-2%	12558
secondary education	1999	15760	635	-6%	24819
scientific education	1999	15760	13	1%	1212325

Fig. 710 *Number of educational facilities compared with the size of the Dutch population*



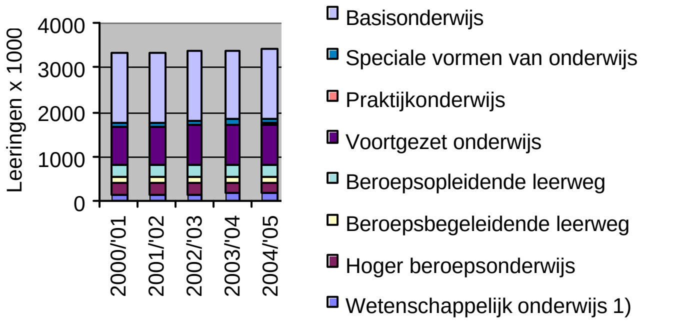
Note 1: Number of departments.
Note 2: Including practical education.

Fig. 711 *Development in the number of schools*



Note 3: University Preparatory Education (vwo), Senior General Secondary Education (havo), Junior General Secondary Education (mavo), Preparatory Vocational Education (vbo) and Learning Path Supporting Education (*lwoo*)
CBS-publication: Education Year Book.

Fig. 712 *The average support base needed*



Note 1: Including part-time education.

Fig. 713 *Expected number of pupils*

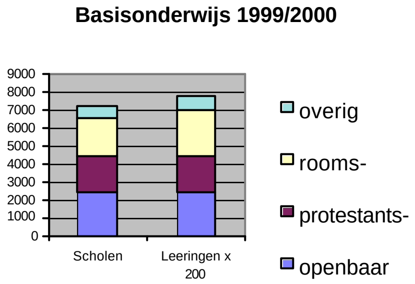


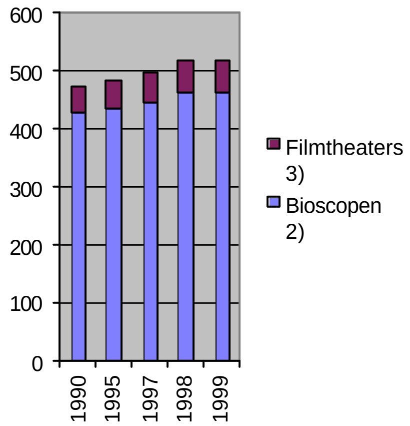
Fig. 714 *Establishments and users*

Cultural and Recreation

Establishments for:	year	population	number	growth per year	support base
amusement hall I	1998	15654	420		37272
amenity park	1998	15654	35		447263
ballet theatre	1997	15567	2	-6%	7532471
cinema	1999	15760	461	0%	34187
cabaret theatre	1997	15567	20	2%	761849
casino or lottery	1998	15654	40		391355
creativity centre	1997	15567	63		247097
dance theatre	1997	15567	8	6%	2048304
dance theatre	1997	15567	13	-2%	1173400
zoo	1999	15760	27		583712
film theatre	1999	15760	57	-2%	276495
music and creative arts centre	1997	15567	52		299367
hotel with 1000 over-night stays per year	1999	15760	29053	4%	542
academy of fine arts	1997	15567	244		63800
yacht harbour	1997	15567	400	3%	38918
camping grounds, holiday chalet complexes, youth and group accommodations	1999	15760	3595	-3%	4384
museum	1997	15567	942	1%	16526
mixed museum	1997	15567	19		819321
industrial and technical museum	1997	15567	260		59873
fine arts museum	1997	15567	102		152619
historical museum	1997	15567	491		31705
natural history museum	1997	15567	50		311342
museum of ethnology and folk history	1997	15567	20		778355
musicians' performance stage	1997	15567	50	1%	310514
music school	1997	15567	129		120675
muziektheater	1997	15567	44	4%	355413
theatre for operettas, musicals and revues	1997	15567	8	1%	1954030
horticultural gardens, show gardens and arboretums	1999	15760	104		151541
different types of performing platforms	1997	15567	4	-2%	3736106
place of performance for ensembles	1997	15567	9	0%	1729679
place of performance for improvised music	1997	15567	13	5%	1219356
place of performance for large orchestras	1997	15567	6	1%	2731071
place of performance catering for 300 concerts per year	1997	15567	189	1%	82409
puppet theatre	1997	15567	13	2%	1203642
open-air sports facility	1997	15567	4090		3806
indoor sports facility	1997	15567	2115		7360
theatre	1997	15567	78	0%	200780
playhouse	1997	15567	48	-2%	321413

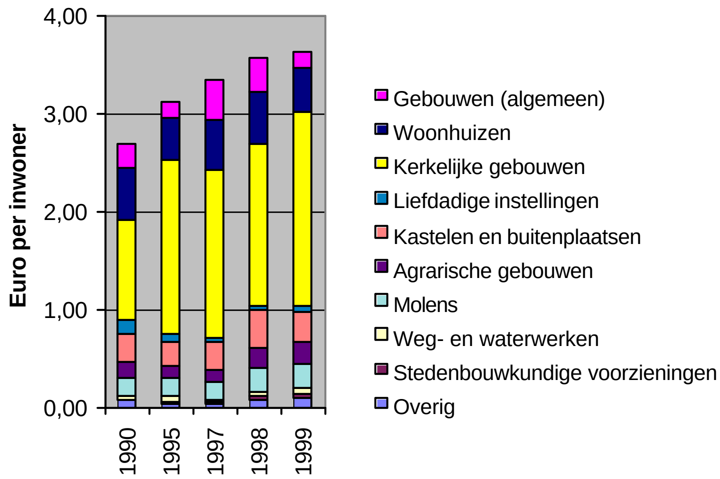
Establishments for:	year	population number	growth per year	support base
watersportclub	1997	15567	950	0%	16386
zeil- en surfschool	1997	15567	90		172968
swimming bath	1997	15567	710	0%	21926
swimming bath complex	1997	15567	140	3%	111194
open-air swimming bath	1997	15567	245	-2%	63539
indoor swimming bath	1997	15567	325	1%	47899

Fig. 715 *Number of cultural facilities compared with the size of the Dutch population*



Note 2: Including two drive-in cinemas
Note 3: Excluding non-specifically equipped performance rooms

Fig. 716 *Cinemas and film theatres*



Source: (Cinemas) Dutch Federation for Cinematography; (film theatres) Dutch Film Theatre Association

Fig. 717 *Expenditures on historic building projects*

6.3.4 Businesses

On 1st January 1999, there were 752,825 active businesses in the Netherlands, divided into the main categories as shown in *Fig. 718*. A number of these are more finely subdivided in the paragraphs below.

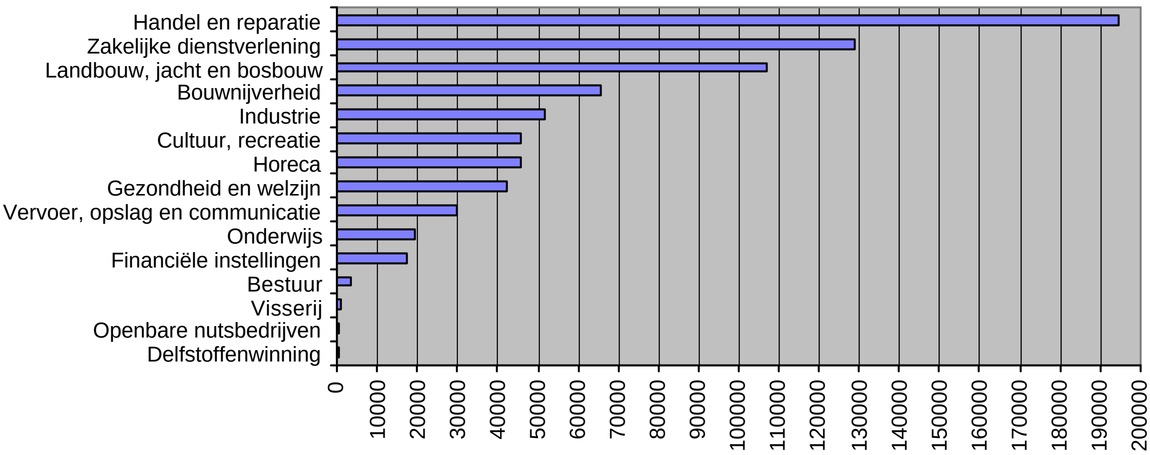


Fig. 718 *Business establishments in 1999*

Agriculture and Fisheries

In 1999 there were still more than 1 million active agrarian firms in the Netherlands (see *Fig. 719*).

Establishments for	year	population	number	growth per year	support base
agricultural, hunting and forestry firm	1999	15760	106815		148
fishery firm	1999	15760	745		21155

Fig. 719 *Number of agrarian firms compared with the size of the Dutch population*

The increase in the scale of these firms can be seen in *Fig. 720*.

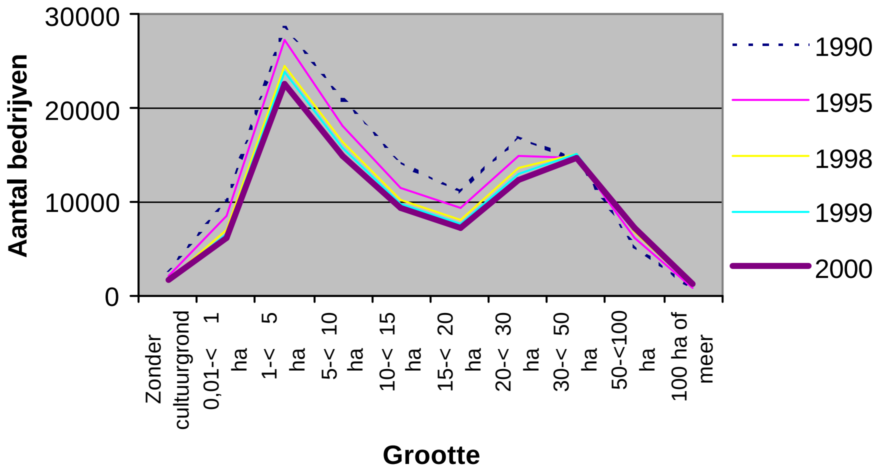


Fig. 720 *The increase in the scale of agrarian firms*

Schaalvergroting van individuele bedrijven betekent al bij gelijkblijvend oppervlak vermindering van het aantal bedrijven (*Fig. 721*), maar vermeerdering van het aantal grote bedrijven (*Fig. 722*).

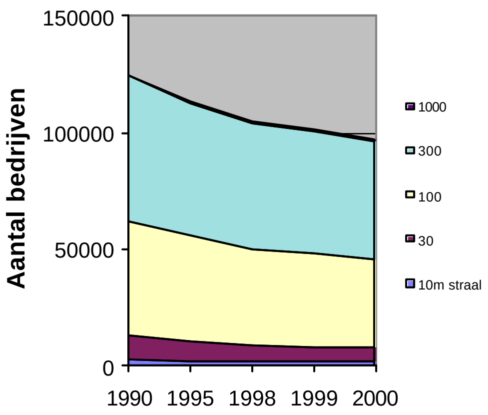


Fig. 721 *The development in the order of size of agrarian firms*

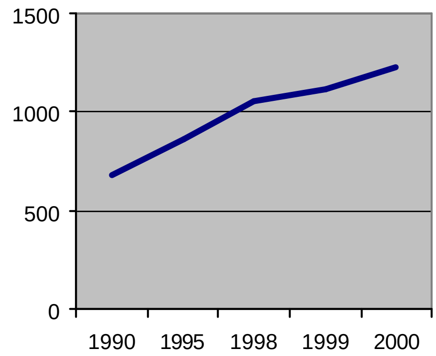


Fig. 722 *The growth of agrarian firms larger than 100 ha. (with a radius of 1 km)*

The surface areas in hectares in these charts have been recalculated into radii used in urban architecture (*Fig. 723*).

	from	To	Radius	Number of firms				
-	**m²**	**m²**	**in m**	**1990**	**1995**	**1998**	**1999**	**2000**
Without arable land			10	2714	2061	1691	1585	1769
0,01-< 1 ha	100	9999	30	10046	8453	7010	6515	6086
1-< 10 ha	10000	99999	100	49556	45253	41076	39613	37355
10-<100 ha	100000	999999	300	61906	56568	54038	52712	51042
100 ha of meer	1000000	9999999	1000	681	867	1058	1120	1231

Fig. 723 *Areas in hectares recalculated into radii used in urban architecture*

Industry

Establishments for:	**year**	**population**	**number**	**growth per year**	**support base**
chemical industry	1998	15654	327	1%	47872
clothing and fur industry	1998	15654	77	8%	203301
electrical apparatus industry	1998	15654	390	0%	40139
food-processing and drinks industry, tobacco processing industry	1998	15654	891	1%	17569
furniture and related industries	1998	15654	382	-3%	40980
glass, earthenware, cement and chalk industry	1998	15654	276	3%	56718
industry	1998	15654	6433	1%	2433
leather, leather goods and footwear industry	1998	15654	41	-7%	381810
machine and apparatus industry	1998	15654	915	3%	17108
metal products industry	1998	15654	1093	4%	14322
office-equipment and computer industry	1998	15654	24	-8%	652258
paper (goods) and carton (goods) industry	1998	15654	203	15%	77114
publishers, printers, reproduction	1998	15654	654	-1%	23936
rubber and synthetic-material processing industry	1998	15654	351	1%	44599
textile industry	1998	15654	178	-5%	87945
transport vehicles industry	1998	15654	332	-3%	47151
wooden, cork, and cane goods industry (excluding furniture)	1998	15654	194	5%	80692

Fig. 724 *Number of industrial branches compared with the size of the Dutch population*

Building Industry

Establishments for:	year	population	number	growth per year	support base
building company	1998	15654	31459	1%	498
building company specialised in finishing off buildings	1998	15654	8514	4%	1839
building company specialised in *b&u, gww*, excluding excavation	1998	15654	14268	0%	1097
building company specialised in preparing building sites	1998	15654	1095	3%	14296
building company specialised in hiring out building machinery and personnel	1998	15654	479	-1%	32681
building company specialised in installation	1998	15654	7103	-1%	2204

Fig. 725 *Number of companies in the building industry compared with the size of the Dutch population*

Inland Trading

Establishments for:	year	population	number	growth per year	support base
florists	1998	15654	3900		4014
bookshops	1998	15654	1100		14231
building material retailers	1998	15654	1300		12042
computer retailers	1998	15654	500		31308
pet shop	1998	15654	1500		10436
diy retailers	1998	15654	3900		4014
chemists	1998	15654	1700		9208
chemists selling medical goods, perfumes and cosmetics	1998	15654	2100		7454
durable consumer goods and other forms of consumption -	1998	15654	50500		310
cycle shops	1998	15654	2300		6806
audio and amplification equipment retailers	1998	15654	700		22363
glass, porcelain and earthenware retailers	1998	15654	700		22363
greengrocers	1998	15654	2200		7116
wholesalers	1998	15654	61496		255
wholesale suppliers of business requisites and packaging	1998	15654	2524		6202
wholesale suppliers of raw materials and semi-fabricated goods	1998	15654	10420		1502
wholesale suppliers of wood, building materials, iron and metal goods	1998	15654	5727		2733
wholesale suppliers of machinery, apparatus, accessories and parts	1998	15654	13899		1126
wholesale suppliers of non-food consumer goods	1998	15654	21193		739
wholesale suppliers of food, spices and energisers	1998	15654	7733		2024
(textile) handicrafts shop	1998	15654	600		26090
household goods retailers	1998	15654	900		17394
household linnen retailers	1998	15654	100		156542
ironmongery (hardw are) and tool shop	1998	15654	700		22363
jewellers	1998	15654	1500		10436
jewellers selling costume jewellery	1998	15654	300		52181
cheese shop	1998	15654	600		26090
stationers	1998	15654	2000		7827
kitchen equipment retailers	1998	15654	500		31308
dress fabric retailers	1998	15654	400		39135
lamp and lighting retailers	1998	15654	400		39135
retailers of leatherware and travel goods	1998	15654	300		52181
lingerie retailers	1998	15654	700		22363
furniture shop	1998	15654	1700		9208
furniture shop with home textiles, lighting goods and floor coverings	1998	15654	5000		3131
musical instrument retailer	1998	15654	400		39135
sewing and knitting machine shop	1998	15654	200		78271
opticians	1998	15654	1100		14231
perfumery	1998	15654	300		52181
poulterers	1998	15654	300		52181
health-food shop	1998	15654	300		52181
shoe shop	1998	15654	1600		9784
shoe shop with leatherware and travel goods	1998	15654	1900		8239
butchers	1998	15654	3700		4231
off-licence	1998	15654	1100		14231
sweet shop	1998	15654	400		39135
toy shop	1998	15654	700		22363
sports and camping-gear retailers	1998	15654	1600		9784
supermarket, grocers	1998	15654	3500		4473
tobacconists	1998	15654	1700		9208
textile supermarket	1998	15654	400		39135
textile retailers	1998	15654	9900		1581
garden centre	1998	15654	600		26090
paint and wallpaper shop	1998	15654	700		22363
fishmongers	1998	15654	700		22363
carpet shop	1998	15654	500		31308
foods, spices and energisers	1998	15654	16300		960
shop	1998	15654	66800		234
shop selling glass, porcelain and earthenware; household articles or toys	1998	15654	2300		6806
shop selling durable household goods	1998	15654	3800		4120
photographic shop	1998	15654	800		19568
retailers of medical and orthopedic goods	1998	15654	100		156542

Establishments for:	year	population	number	growth per year	support base
retailers of kitchen apparatus, other electrical goods and audio equipment	1998	15654	2400		6523
interior decorators, general assortment	1998	15654	1300		12042
home furnishing retailers	1998	15654	1100		14231

Fig. 726 *Number of trading companies compared with the size of the Dutch population*

Inland Services

Establishments for:	year	population	number	growth per year	support base
job centres/employment bureaus for assessing, attracting and selecting personnel	1998	15654	1300		12042
architectural and technical design and drawing consultancy	1998	15654	13200		1186
suppliers of spare-parts and accessories for cars	1998	15654	400		39135
car servicing company	1998	15654	3500		4473
tyre servicing company	1998	15654	200		78271
job pools (job-opportunity projects)	1998	15654	100		156542
garage for industrial vehicles, trailers	1998	15654	800		19568
petrol station	1998	15654	1600		9784
bookkeepers, accountants	1998	15654	13200		1186
cafe	1998	15654	12700		1233
cafeteria, snack bar	1998	15654	10400		1505
bodywork repair firms	1998	15654	1500		10436
catering (w.o. party-catering)	1998	15654	1600		9784
car tyre wholesalers and trade intermediaries (middle men)	1998	15654	300		52181
wholesalers and trade intermediaries in spare-parts and accessories for cars	1998	15654	1500		10436
hotel, b&b (bed & breakfast), conference centre	1998	15654	2500		6262
camping ground	1998	15654	1700		9208
camping ground or holiday chalet park, bungalow park	1998	15654	2800		5591
cantine (incl. contract catering)	1998	15654	800		19568
cantine and catering	1998	15654	2400		6523
hairdressers	1998	15654	11300		1385
testing or checking office	1998	15654	500		31308
dry cleaners	1998	15654	1400		11182
motor cycle retailers	1998	15654	500		31308
private car garages	1998	15654	13000		1204
advertising agency	1998	15654	12200		1283
restaurant	1998	15654	9700		1614
restaurant, cafeteria, snack bar	1998	15654	20400		767
beauty salon, pedicure or manicure	1998	15654	13600		1151
cleaners for buildings and transport vehicals	1998	15654	6400		2446
temporary employment agency	1998	15654	900		17393.55
holiday chalets or bungalow park	1998	15654	1100		14231

Fig. 727 *Number of service-providing firms compared with the size of the Dutch population*

Traffic, Transport and Communication P.M.

Establishments for:	year	population	number	growth per year	support base
inland shipping company	1998	15654	4200	-1%	3727
forwarders, ship-brokers or chartering brokers	1998	15654	1620	-5%	9663
road freight haulage companies	1998	15654	9750	5%	1606
loading, unloading and trans-shipment companies	1998	15654	320	7%	48919
airports and other air transport services	1998	15654	30	0%	521806
air transport companies	1998	15654	10	0%	1565419
storage/warehousing companies	1998	15654	510	2%	30694
pipeline transporting companies	1998	15654	10	0%	1565419
post, courier services and telecommunications companies	1998	15654	2520	11%	6212
travel agencies	1998	15654	1030	-5%	15198
travel organisations (tour operators)	1998	15654	550	0%	28462
taxi firms	1998	15654	2520	-7%	6212
tourist information offices	1998	15654	440	19%	35578
tram and bus/coach companies	1998	15654	290	-6%	53980
land transport service companies	1998	15654	390	8%	40139

Establishments for:	year	population	number	growth per year	support base
water transport service companies	1998	15654	240	9%	65226
weighing and measuring companies	1998	15654	110	-15%	142311
ocean-going shipping companies	1998	15654	510	-9%	30694

Fig. 728 *Number of transport companies compared with the size of the Dutch population*

6.3.5 References to Recent figures

See page 611

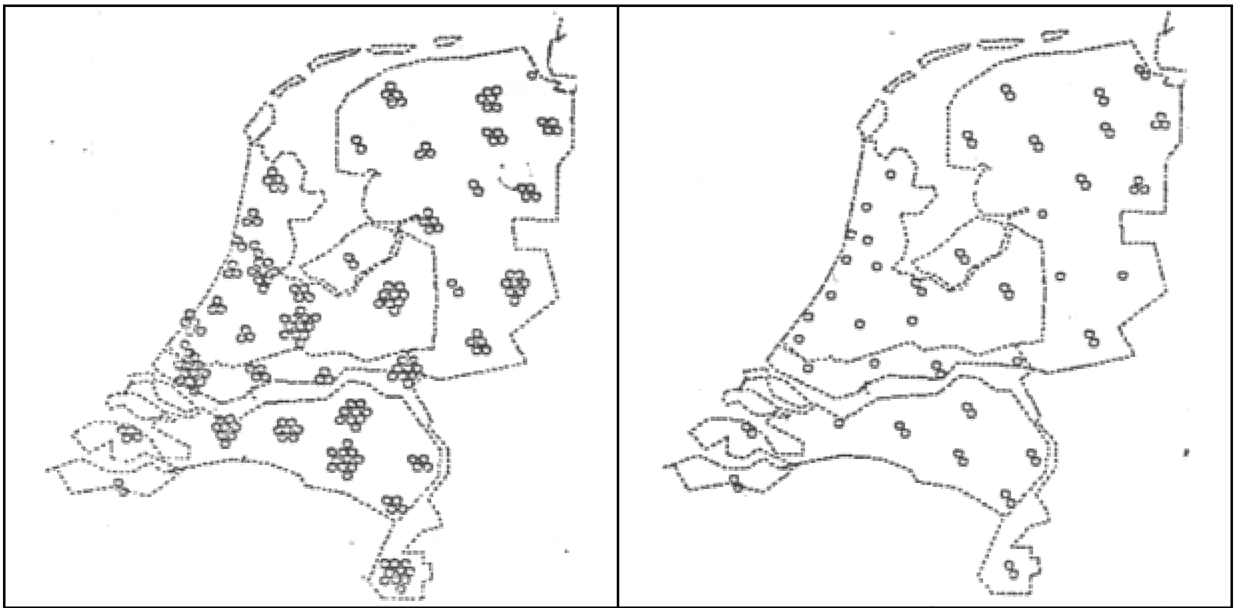
CBS, C. B. v. d. S. (2001) Statistisch Jaarboek 2001 (Voorburg/Heerlen) CBS.

Jong, T. M. d. and H. Priemus (2002) Forecasting and Problem Spotting in: T. M. d. Jong and D. J. H. v. d. Voordt Ways to research and study urban, architectural and technical design (Delft) DUP

6.4 Densities

6.4.1 300km National density

A rougher measure for intensity of use that does not take the time aspect into account, but which, because of the present tendency of people not to move house, does have significance, is population density. For the Netherlands as a whole, this is now about 430 inhabitants per km^2 , or, in other words, more than 4 inhabitants per ha, with extremes ranging from about 0 to 20,000 inhabitants per km^2. The inverse of population density is spatial use: currently, in the Netherlands, this is about 2,500 m^2 per inhabitant. If the population grows but the area of land remains the same, then the population density will increase, and the land use will decrease. The advantage of a land-use unit is that different intentions for usage can be discerned. In the Netherlands, for example, roughly speaking, we have 1,500 m^2 of agrarian land per inhabitant, 300 m^2 of nature areas and forest, 400m^2 of water and approx. 300 m^2 of urban areas. Of this urban area, 190m^2 are 'residential areas'. According to CBS's definition of ground statistics, these are homes with green areas, hardened surfaces and primary facilities, such as shops, schools for pre-school and primary education, as well as other residential facilities such as caravan camps, house-boat harbours, service flats, etc.[76]



in dots of 10 km2 *in dots of 100 m^2 per inhabitant.*

Fig. 729 *Residential area per COROP area*

The above figure shows the distribution of this part of the urban area, divided over 40 statistical (COROP) areas, expressed in the absolute sense and per inhabitant.according to CBS (1994) .
In the figure, on the left, the absolute surface of the residential area is shown in dots of 10 km^2 (drawn on a realistic scale within the survey area concerned, but not exactly on location: because of styling, the tolerance is approx. 10 km).

From this, it appears that the residential area per inhabitant also varies in space. In the west of the Netherlands, an average of about 100 square metres of residential area is available per inhabitant; in East Groningen, about 300 m^2 ; and in a number of other places between those two extremes, about approx. 200 m^2 per inhabitant (100, 33 and 50 inhabitants per ha., with 2.5 people per house and, respectively, 40, 13 and 20 homes per ha.).[77]

Thus 'norms' for the number of m^2 of residential area per inhabitant differ regionally. That also applies for other facilities, such as (daily) recreational areas or drinking water basins. Apart from variation in space, land-use norms also show a variation in time: they change. The use of Planological Index Numbers for the amount of space needed for facilities is relativised by these spatial and temporal variations.[78]

If one divides the density of inhabitants by the local number of occupants per household, then one arrives at the local density of homes. However, since WWII, the number of people per household, especially in the towns, has dropped from about 5 to 2.5 occupants per household; and this number continues to fall. This, by the way, was the main reason for scarcity of housing in the later post-war period, and for the urban explosion after 1960. There are not only great variations in time in the number of people per household, but also large regional differences. The number of people per household is the lowest in the Randstad and it is here that the numbers have decreased the most rapidly in the last 50 years. In **missing title of a figure**, the urban areas in the Randstad in 1965 are compared with those in 1990.[79]
During this period, the Randstad hardly grew at all in numbers of inhabitants (from 5.3 million to 6.1 million) but, in built-up area, all the more. This was caused, among other things, by fewer people living in one household (family dilution).

The regional spatial effect becomes obvious when one redraws, in proportionally accurate units of 100,000 and 10,000 inhabitants, a map of the approximate overall urban spatial use of 300m^2 per inhabitant (These are shown as circles with a radius of 3 and 1 km, respectively. Read: 1 km 'radius' or 1 km 'in the round'; say: 'towns' (3 km) and 'villages' (1 km).
If these circles overlap, then one has to conclude that the urban density is higher than the average national density. If there are about 10 of these circles (1 million people) within a radius of 10 km, then one can talk of 'agglomerations' and draw them as one circle.
According to this representation, the old situation was characterised by three large and three small agglomerations and only a few small (separate) towns. In 1990, the first thing that strikes one is the dilution of households: the agglomerations had grown, but without attracting new inhabitants. One can call this form of expansion 'deglomeration'.[80] This drastically influences not only the built-up areas, but also the open areas in between.
As soon as urban areas are no longer surrounded by rural areas of the same order of size as the urban area, a reversal in the image of the urban area occurs: the town is no longer situated in the countryside, but the countryside is now enters the town.[81] according to Tummers and J.M. (1997)

The fragmentation of urban and rural areas on different scale levels can be visualised in the legend in Fig. 203.[82] The figures shown in this table are not absolute. They can be interpreted with a tolerance of up to the previous or the next figure shown in that column. The location of the legend units has a tolerance of 10 km, calculated from the centre, and the surface area, of 1 km from the edge.

The legend units shown in red are represented as circles with a size that reflects the present average urban spatial use in the Netherlands of approx. 300 m^2 per person; 190 m^2 urban residential area[a] 34, 60m^2 working area[b] and 87 m^2 of infrastructure (most of which cannot be attributed to the living and working areas, because a part of it lies outside the built-up area and therefore does not need to be regarded as an urban area)
The necessary infrastructure outside the built-up area depends on the dispersion pattern of the built-up area, and, to a lesser extent, how the green areas are used

For linear-shaped legend elements, a similar sort of semi-logarithmic series is needed. Referring to **Fig. 203**, **Figure 24** shows nine levels of access.[83]
Something similar is possible for drainage (**Fig. 30**). 'Without information to the contrary', in the (former) low peat areas, the legend units are considered to be completely filled with the named networks. In dunes, nature conservancy areas, and higher ground, a number of lower orders with higher network densities disappear. In urban areas, road ditches and drainage channels disappear. Their function is taken over by a relatively broad and fine-meshed underground drainage network.[84]

On page Fout! Bladwijzer niet gedefinieerd. a complete legend is given for representing the dispersion patterns in a stylised manner on a regional scale, and, on the basis of this, they can be compared. The estimated economic, cultural and/or managerial efforts needed to realise the areas drawn into the design can be indicated using different thicknesses of lines. This more or less reflects the importance of the element in the design. At the same time, this provides an elegant way of distinguishing existing

[a] 'Woongebied' omvat de categorieën woongebied (139 m2/inwoner), begraafplaatsen (2), sportter-reinen (17), volkstuinen (3), parken en plantsoenen (10), sociaal-culturele voorzieningen (11), overige openbare voorzieningen (6), volgens de definities van CBS (1994) Bodemstatistiek 1989 ('s-Gravenhage) Staatsuitgeverij / CBS publikaties..
[b] ''Werkgebied' omvat de categorieën vliegvelden (3), stortplaatsen (2), delfstoffenwinning (4), industrie- en haventerreinen (33), overige bedrijfsterreinen (5), bouwterrein (15) volgens dezelfde definities van het CBS. 'Infrastructuur' omvat de categorieën spoor-, tram- en metrowegen (7), verharde wegen (71) en waterreservoirs (9).

areas from the new ones proposed (the 'planning layer'). The thinnest lines represent existing areas. Apart from this, the legends are literally 'open' in the sense that the circular legend units can still be coloured with functional accents or identities. For the time being, the circles can be seen as 'little magnifying glasses' which conceal unfilled-in details of towns, villages, hamlets, landscaped parks, urban landscapes or urban parks. The drawings function as 'colouring pictures' that have not yet been filled in.[85]

6.4.2 30km Regional density

In the existing situation, according to CBS 2002, the number of inhabitants per municipality is shown according to their area (300 m^2 per inhabitant) in circles of 100,000,10,000 and 1000 inhabitants. In this pointillistic representation, a higher density than the current average in the Netherlands can be read off directly from overlapping circles. Dispersion within a municipality is determined by the position of the built-up area on the map.

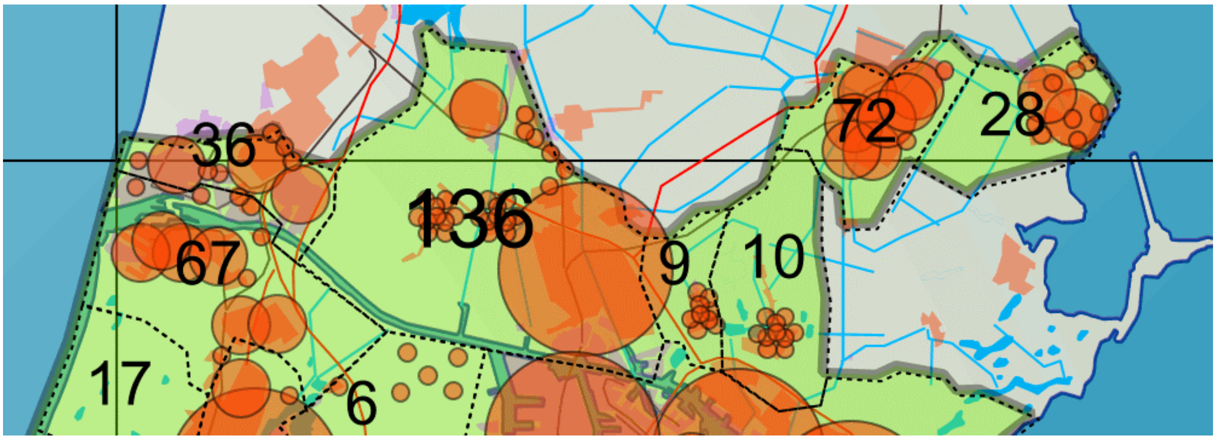


Fig. 730 *100 000, 10 000, and 1000 inhabitants per municipality represented as 30, 3, 0.3 km2 built-up areas localised on urban topography.*

To that has been added the capacity of existing municipal residential building plans, which, according to the New Map of the Netherlands 2000, is roughly estimated as being 570,000 inhabitants (**Fout! Verwijzingsbron niet gevonden.**). This capacity has been aggregated with that of the existing built-up area to create a basic map for the year 2005, thereby making it possible to compare the designs. In this way, ten units of 10,000 inhabitants (for example Amstelveen and Nieuwegein) could be aggregated into one unit of 100,000 inhabitants. In a simple way, this represents increasing urbanisation, locally, as distinct from expansion in general. The remaining capacity of 5^{th} Policy Document of Spatial Planning NRO5 (intermediary scenario) has been drawn onto this background as a reference (**Fout! Verwijzingsbron niet gevonden.**)

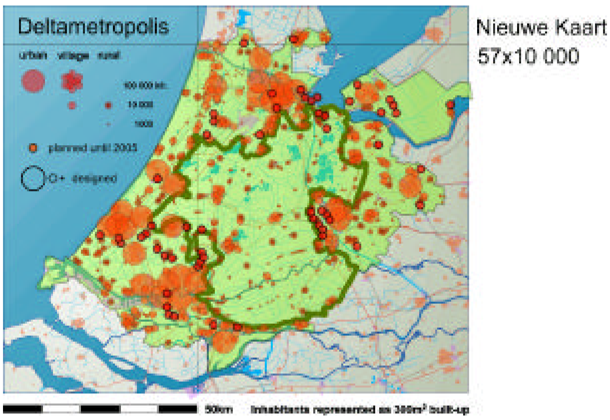


Fig. 731 *The year 2005: including existing plans*

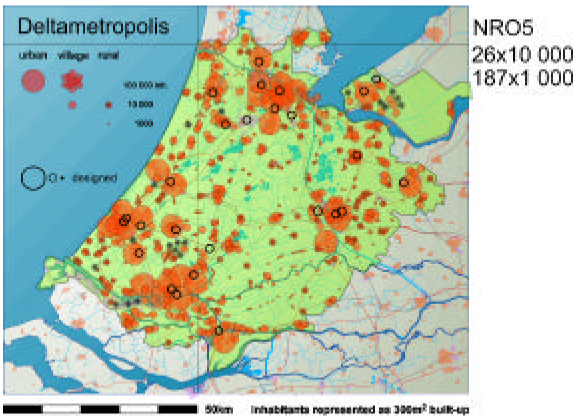


Fig. 732 *The year 2030: NRO5*

(**Fout! Verwijzingsbron niet gevonden.**) shows the mapped images of the existing situation, the plans that, according to the New Map of the Netherlands, are being carried out, and the part that remains after being subtracted from that for NRO5, according to the tabulated EC intermediary scenario (ABF).

	Present	NRO5	100 000	10 000	1 000	100 000	10 000	1 000	100 000	10 000	1 000
Population (*1000)	**2000**	**2030**	**2000**			**+ New map, 2005**			**+ remainder for NRO5 in 2030**		
Urban centre	710	988	7			7			9		
Urban area outside the centre	2818	2448	22	61		24	41		22	24	
Urban green areas	415	655		41			41			65	
Village centre	1337	2090		101	327		161	280		180	289
Rural living	251	505			251			400			505
Working area	512	454			512			380			453
Total	**6043**	**7140**	**29**	**203**	**1090**	**31**	**243**	**1060**	**31**	**269**	**1247**
+ New Map			**2**	**40**	**-30**	↴	↴	↴			
+ remaining capacity NRO5							**26**	**187**		↴	↴

Fig. 733 *Present situation 2000, existing plans 2005, National plan 2030*

The remainder for NRO5 is interpreted as a densitising operation of an extra 10,000 inhabitants in or around the centres that are being stimulated (**Fout! Verwijzingsbron niet gevonden.**). By chance, this was the same as the number of centres.

Interpretation of the National Master Builder plans

Fig. 734 *Interpretation NRO5*

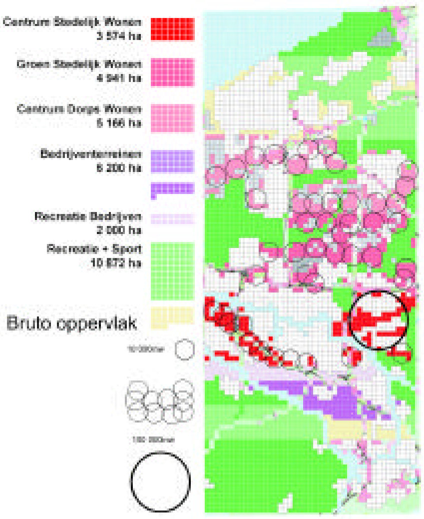


Fig. 735 *Interpretation OMA*

OMA's and TKA's designs (**Fout! Verwijzingsbron niet gevonden.** and **Fout! Verwijzingsbron niet gevonden.**, respectively) are calculated back to the numbers of inhabitants from the design sketches, and, after subtracting the New Map, are distributed according to the topography of the drawings. In OMA, 7, 12 and 13 squares of 25 ha are converted into circles of 10,000 inhabitants (**Fout! Verwijzingsbron niet gevonden.**). Ten circles in the centre of Rotterdam, within a radius of about 3 km are aggregated to a circle with a radius of 3 km (100,000 inhabitants).

	no. of homes per ha	no. of occupants	no. of inhabitants per ha.	no. of inhabitants per field	no. of fields per circle	fout	fields	ha	inhabitants	circles of 1km
Urban centre	30	2	60	1500	7	0.67	143	3574	214440	21
Urban green areas	15	2.2	33	825	12	0.12	198	4941	163053	16
Village centre	14	2.4	33.6	840	13	0.00	207	5166	173578	16
								13681	551071	54

Fig. 736 *Reading units of population from the map of OMA*

For TKA's design, the density per residential environment is given as shown in **Fout! Verwijzingsbron niet gevonden.**, converted into units of 10,000 inhabitants.

TKA	no. of homes per ha	no. of occupants	km2	inhabitants	Circles of 1km	-NKN	remains
very urban	100	2	3	60000	6		6
urban centre	50	2	31	310000	31	4	27
urban	20	2.2	146	642400	64	29	35
expensive homes	15	2	126	378000	38	14	24
rural	10	2					
				1390400	139		92

Fig. 737 *Reading units of population from the map of TKA*

Fig. 738 *Interpretation TKA*

Fig. 739 *Interpretation Snozzi*

Snozzi's design is interpreted exclusively and globally from the drawing (**Fout! Verwijzingsbron niet gevonden.**).
In H+N+S's design, ABF estimates the capacity of the Green Heart to be 51,000 homes. This means about 100,000 inhabitants, represented as one dotted circle of 100,000 inhabitants, because although a dispersion of 100 inhabitants (shown by small dots) might be possible, it is no longer visible or discernible.

OMA, TKA and H+N+S's designs could now be represented in one drawing (**Fout! Verwijzingsbron niet gevonden.**). Snozzi's design includes the entire Deltametropole and is therefore drawn separately (**Fout! Verwijzingsbron niet gevonden.**). The legends are restricted to units of 100,000 (3 km radius) and 10,000 inhabitants (1 km). In the background, units of 10,000 inhabitants have been divided into units of 1000 inhabitants (300 m), where the topography requires it. This has not been done in the design layer, which improves overall comparability.

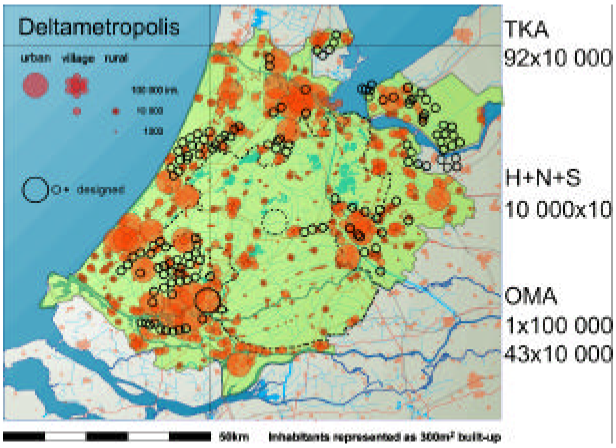


Fig. 740 *Three complementary designs 2050*

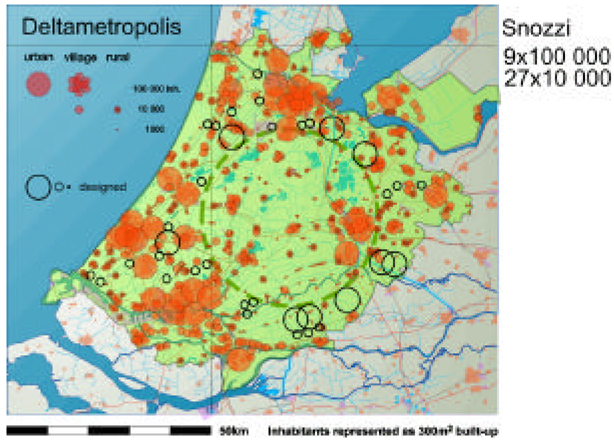


Fig. 741 *Alternative Snozzi*

6.4.3 10km conurbation density

In **Fout! Verwijzingsbron niet gevonden.**, the capacities of the complimentary plans have been compared separately and in total, and have been itemised according to context (Urban centre, Urban, Urban green areas, Village centre, Rural, Working area). In doing that, the existing plans have been calculated in according to the New Map of the Netherlands. These plans are only included once when aggregating the three designs. The experiment is then to compare NRO5 with five alternatives: developing the South flank only, the Green Heart only, the North flank only, developing these three together, or following Snozzi's design.

Context	Population x 1000			OMA, South flank				H+N+S Green Heart				TKA, North flank				Total				Snozzi			
On the map, these are recognisable as:	Now present	Existing plans	NRO5-EC trend	100 000	10 000	1000	Inhabitants + existing plans	100 000	10 000	1000	Inhabitants, including existing plans	100 000	10 000	1000	Inhabitants + existing plans	100 000	10 000	1000	Inhabitants + existing plans	100 000	10 000	1000	Inhabitants + existing plans
Name:	2000	2005	2030																				
Urban centre	710	700	988	1			800				700		8		780	1	8		880				700
Urban areas outside the centre	2818	2810	2448		11		2920				2810		25		3060		36		3170	9			3710
Urban green areas	415	410	655		16		570				410		35		760		51		920		3		440
Village centre	1337	1890	2090		16		2050				1890				1890		16		2050		24		2130
Rural living	251	400	505				400		10		500		24		640		34		740				400
Working area	512	380	454				380				380				380				380				380
Total	**6043**	**6590**	**7140**	**1**	**43**		**7120**		**10**		**6690**		**92**		**7510**	**9**	**27**		**8140**	**9**	**27**		**7760**

Fig. 742 *Five alternatives for NRO5 and their population specified to their urban or rural context*

It can be concluded from (**Fout! Verwijzingsbron niet gevonden.**), that OMA already realises the NRO5 programme in the South wing, while TKA exceeds it already in the North wing. The three plans together exceed the NRO5 programme by 1 million inhabitants. Snozzi arrives at an extra capacity of over 600,000 inhabitants. These extra capacities are mainly achieved in urban areas outside the centre. Centres score lower than in the NRO5 design.

The internal composition of the living environment
To calculate the costs, uniform, trend-conforming assumptions have been made concerning the share of work, infrastructure, green areas and water in the living environment in each urban context (see **Fout! Verwijzingsbron niet gevonden.**)

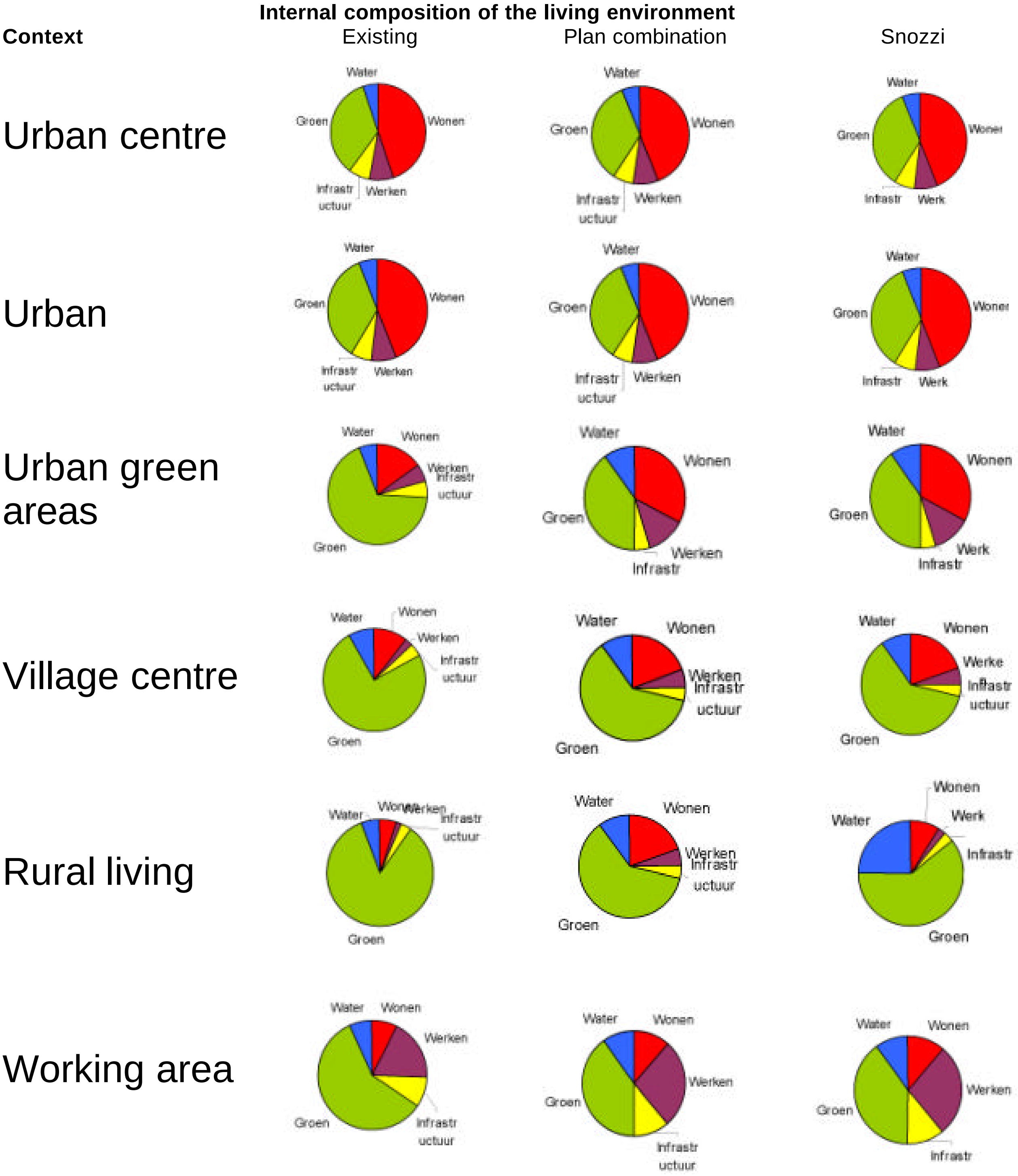


Fig. 743 *Internal composition of the living area*

The present composition of (centres) of urban areas is being maintained. In the centres of villages, in rural areas, and also in working areas, fewer green areas have been taken into acount.

Costs, homes, and jobs

Because of these assumptions, the costs calculated in Fig. 175 are disputable, but they offer a comparison for the time being.

x € 1 000 000 000	OMA						HNS						TKA					
Context	living	working	structure	green	water	total	living	working	structuur	green	water	total	living	working	structure	green	water	total
Urban centre	16	8	1	1	0	**25**	1	1	0	0	0	**2**	5	2	0	0	0	**7**
Urban areas outside the centre	14	3	1	2	1	**19**	20	4	0	0	0	**25**	31	6	1	3	1	**42**
Urban green areas	28	11	0	0	1	**41**	2	1	0	1	0	**3**	17	6	0	1	1	**25**
Village centre	18	5	0	2	0	**25**	22	6	0	4	0	**32**	22	6	0	4	0	**32**
Rural living	2	1	0	1	13	**16**	7	0	2	29	24	**61**	10	3	1	13	19	**45**
Working area	1	1	0	1	0	**3**	0	1	0	2	0	**4**	0	1	0	1	0	**3**
Total	**79**	**27**	**2**	**7**	**15**	**130**	**53**	**12**	**3**	**35**	**24**	**128**	**85**	**24**	**2**	**22**	**21**	**154**
€ per inhabitant	434	151	9	37	83	**715**	293	67	17	194	134	**706**	470	133	13	120	114	**850**

x € 1 000 000 000	Combination						Snozzi					
Context	living	working	structure	green	water	total	living	working	structure	green	water	total
Urban centre	8	4	0	0	0	**13**	1	1	0	0	0	**2**
Urban areas outside the centre	35	6	1	4	1	**48**	58	11	2	6	1	**78**
Urban green areas	24	9	0	0	1	**35**	3	1	0	1	0	**5**
Village centre	27	7	0	1	1	**37**	30	8	0	1	2	**40**
Rural living	12	3	0	2	10	**27**	4	1	1	16	19	**41**
Working area	0	0	0	1	0	**2**	0	0	0	1	0	**2**
Total	**107**	**30**	**2**	**9**	**13**	**161**	**96**	**22**	**3**	**25**	**22**	**169**
€ per inhabitant	593	168	10	48	72	**891**	532	120	19	140	119	**930**

Fig. 744 *Priliminary calculation of the costs*

In this way, NRO5 is estimated as costing € 721 per inhabitant. From (**Fout! Verwijzingsbron niet gevonden.**), it can be very tentatively concluded that, with the exception of the OMA plan, all the other plans lead to higher expenses. On the same grounds, an estimate can be made of the number of homes and jobs.

For the time being, an attempt to do this has been made in (**Fout! Verwijzingsbron niet gevonden.**). This figure gives a comparison in percentages with the trend (intermediary scenario) that served as the point of departure for the NRO5 design.

	NRO5		Existing		OMA		H+N+S		TKA		Combination		Snozzi	
	homes	no. of jobs	plans											
	no. x1000	no. x1000	NKN homes	jobs	homes	jobs	homes	jobs	homes	jobs	homes	jobs	homes	jobs
Urban centre	494	722	71%	69%	81%	106%	71%	69%	79%	77%	89%	87%	71%	69%
Urban	1224	1482	115%	93%	119%	88%	115%	93%	125%	102%	129%	105%	152%	123%
Urban green area	298	372	63%	72%	87%	178%	63%	72%	116%	133%	141%	161%	67%	77%
Village centre	871	792	90%	104%	98%	96%	90%	104%	90%	104%	98%	113%	102%	117%
Rural living	211	250	79%	106%	79%	77%	99%	56%	127%	169%	146%	196%	79%	106%
Working area	197	376	84%	62%	84%	75%	84%	62%	84%	62%	96%	71%	96%	71%
	3294	3994	93%	87%	100%	100%	94%	84%	106%	101%	115%	111%	111%	102%

Fig. 745 *Preliminary calculation of homes and jobs*

From (**Fout! Verwijzingsbron niet gevonden.**) it can be seen that in all the plans, except for that of OMA, the growth in the number of jobs does not follow the same trend as the growth in the number of homes available. This agrees with the decrease that can be expected in the number of people per household. In Snozzi's plan and in the Combination, this decrease amounts to almost 10%, and in the other plans to almost 5%.

Method of calculating

The point of departure of the plans is the total surface area of pointillistic housing units, as interpreted from the plans. For the benefit of the calculation, on the work sheets (see http://www.bk.tudelft.nl/urbanism/TEAM/ 2003 for working Excel sheets) more far-reaching assumptions have been made regarding the context and composition of the living environments than could be read out of the plans themselves. The existing relation (in 2000) between living and working was used as the internal relation. In addition, the percentages for infrastructure, green and water were based on the well-known assumptions for NRO5, but were adapted to achieve the same capacity as the pointillistic reproduction. These percentages (the middle, left block in (**Fout! Verwijzingsbron niet gevonden.**) determine the relation between the absolute values (the top left block in (**Fout! Verwijzingsbron niet gevonden.**).

Fig. 746 *Method of calculating*

The existing situation in 2000 (in grey) is shown, as a reference, next to every input column (in yellow) or calculated output (in orange). Inversely, the absolute values have determined the percentages here. The direction of the calculation is shown by arrows in between both blocks. In the right-hand blocks, the capacity of inhabitants and jobs is calculated in absolute values and in percentages, by multiplying the absolute area values for living and working by an assumed number of homes and jobs per hectare. The lowest left-hand block now shows the changes in km^2 and converts these according to the assumed costs per km^2 (lower middle matrix) into a very general estimate of absolute costs and costs per inhabitant.

Application

To compare and evaluate plans, strategies or projects easily in a decision process, they have to be drawn in the same way. Quantitive data and their location should be read from drawing visually at a glance. In the above paragraps a method is given to reach that aim in a design relevant way. In all exercises such a ‘programme check’ is obligatory. The ‘perspective sjabloon’ gives a possibility to calculate the surfaces easily only by filling in the blank values. In the example below the perspective ‘ruimtedruk’ is filled-in.

	“within district”													
absolute values	inhabitants		total surface Delta-metropolis		of which distributable living		work		public infrastructure		green		water	
	2000	*2030*	2000	*2030*	2000	*2030*	2000	*2030*	2000	*2030*	2000	*2030*	2000	*2030*
	inh		km2											
"district area"	x1000													
central urban	710	*1.003*	118	*160*	51	*80*	25	*40*	8	*9*	26	*22*	8	*8*
urban	2.818	*2.841*	538	*630*	242	*288*	44	*66*	39	*45*	186	*204*	27	*28*
green urban	415	*666*	356	*387*	54	*112*	20	*41*	19	*22*	242	*192*	21	*21*
village	1.337	*1.583*	1.614	*1.438*	169	*249*	45	*79*	64	*74*	1.208	*905*	128	*131*
rural area	251	*427*	929	*845*	49	*112*	14	*26*	31	*36*	783	*618*	52	*53*
work area	512	*467*	765	*859*	58	*62*	139	*210*	67	*78*	447	*454*	54	*55*
	6.043	*6.987*	**4.320**	*4.320*	623	*904*	287	*461*	228	*264*	2.892	*2.395*	290	*296*

Fig. 747 *Dispersion of functions within 6 categories of districts*

relative factors	dwelling occupation		density		living		work		infrastructure		green		water	
	2000	*2030*	2000	*2030*	2000	*2030*	2000	*2030*	2000	*2030*	2000	*2030*	2000	*2030*
	inh/dwelling		dw/ha		dw/ha		apl/ha		%	*%*	%	*%*	%	*%*
			district		ngbh		netto							
central urban	2,1	*1,9*	29,2	*32,7*	67,6	*65,0*	254,0	*204,6*	6,8	*5,8*	22,2	*13,6*	6,8	*5,1*
urban	2,2	*2,1*	23,5	*21,7*	52,4	*47,5*	160,7	*125,5*	7,2	*7,2*	34,6	*32,4*	5,0	*4,4*
green urban	2,3	*2,2*	5,0	*7,9*	33,0	*27,4*	105,0	*71,8*	5,3	*5,7*	67,9	*49,5*	5,9	*5,5*
village	2,6	*2,4*	3,2	*4,5*	30,5	*26,2*	84,2	*65,9*	4,0	*5,1*	74,8	*62,9*	7,9	*9,1*
rural area	2,5	*2,3*	1,1	*2,2*	20,4	*16,2*	65,7	*48,1*	3,3	*4,2*	84,3	*73,1*	5,6	*6,3*
work area	2,4	*2,3*	2,7	*2,4*	36,0	*32,7*	50,9	*44,0*	8,8	*9,0*	58,4	*52,9*	7,1	*6,4*
	2,3	*2,2*	6,1	*7,5*	42,0	*35,8*	95,2	*76,0*	5,3	*6,1*	67,0	*55,4*	6,7	*6,9*

Fig. 748 *The same as* ***Fout! Verwijzingsbron niet gevonden.*** *in relative measures per ha or %*

The accompanying table 'ruimtevraag' is automatically adapted. The filled-in surfaces will be found back in the involved column, translated in concerning circles to be drawn in the programme check.

						2000			Ruimtedr.			Compet.			Spreiding			Own.per.		
Surface living area in km2	2000	Ruimtedruk	Competitie	Spreiding	Own persp.☞	3km☞	1km☞	300m☞	3km☞	1km☞	300m☞	3km☞	1km☞	300m☞	3km☞	1km☞	300m☞	3km☞	1km☞	300m☞
central urban	51	80	84	73	0	1	7	2	2	7	6	2	8	9	2	5	4	0	0	0
urban	242	288	295	248	0	8	5	0	10	1	7	10	3	9	8	6	11	0	0	0
green urban	54	112	112	109	0	1	8	2	3	8	6	3	8	7	3	7	6	0	0	0
village	169	249	248	226	0	5	8	8	8	7	4	8	7	0	7	8	10	0	0	0
rural area	49	112	114	109	0	1	6	6	3	8	8	4	0	2	3	7	6	0	0	0
work area	58	62	65	57	0	2	0	5	2	1	9	2	2	6	2	0	0	0	0	0
Totaal	**623**	**904**	**918**	**822**	**0**	**18**	**34**	**23**	**28**	**32**	**40**	**29**	**28**	**33**	**25**	**33**	**37**	**0**	**0**	**0**

Fig. 749 *Spots to draw in different perspectives*

To meet better the dispersion characteristics (form) of the design, a circle of 3km☞ can be represented as 10 circles of 1km☞, a circle of 1km☞ as 10 of 300m☞. The colour of living areas should be red, not devided in 'central urban', 'urban' and so on, because the sprawl of locations tells that story already.
The colours should instead represent the other tables of 'ruimtevraag': work (purple), infrastructure (grey), green (green), eventually divided in parks, sport, recreation, nature and agriculture (increasing lighter tints of green to yellow or white) and water (blue).

Draw the existing situation (2000) in thin lines, and make the proposed new projects recognizable with thicker lines according to the expected financial effort, found in the 'perspectiefsjaboon'.

6.4.4 The concept of density on lower levels of scale

Urban density measures are ratios of objects per area. The objects to be counted should be equal. That is why the floor surface, to be measured in m^2 is much better a measure to get a ratio of climatised surface per earth area than the number of houses of different size. For example the Dutch housing policy Secretary of State 1973-1977 Van Dam approximately doubled the number of houses produced per year in the Netherlands by halving their floor surface. Coincidentally the demand of one person households for smaller houses was increasing. It was a great political succes, but few politicians realised that Van Dam did not increase the newly built floor surface substantially.

Even more important is the area in the denominator of the quotient. Density measures are comparable only when the areas you take into account are the same. Density changes much by changing the area concerned when the number of objects does not change equally. The square meter I occupy at the moment I am writing this paper has a population density of 1 inhabitant per m^2. That is 10 000 inhabitants per ha or 1 000 000 persons per km^2! But when I take my room ($10m^2$), house ($100m^2$) or property ($1000m^2$) into account, the population density at this moment decreases to 100 000, 20 000 or 4000 persons per km^2, because the number of persons does not increase proportionally.

So density measures are not reliabe when they concern different areas as a base of comparison. That is more important than the units of the numerator (counting children half, adults full and elderly double has less effect on population density than counting half the area). So an 'ensemble density' is something else than a 'neighbourhood density', a district density, a town density, a conurbation density or metropolitan density when we interpret these categories as proposed in Jong and Voordt (2002) (**Fout! Verwijzingsbron niet gevonden.**).

Fig. 750 Names of built and unbuilt urban surfaces on different levels of scale					nominal radius	nominal area	digits
	Dutch		**English**		R	A	
	bebouwd	**onbebouwd**	**built**	**unbuilt**	m	m^2	
1	bouwdeel	plek	building part	spot	1	3	1
2	bouwsegment, kamer	plaats, patio	building segment, room	place, patio	3	28	2
3	gebouw, tuin	kavel, perceel	building and garden	parcel, plot, lot	10	314	3
4	gebouwencomplex	erf, stadseiland	building complex	property , urban island	30	2827	4
5	ensemble	buurtpark	ensemble	nghbhd park	100	31416	5
6	buurt, gehucht	wijkpark	neigbourhood, hamlet	district park	300	282743	6
7	wijk, dorp	stadspark	district, village	town park	1000	3141593	7
8	stad(sdeel)	stadslandschap	town, town quarter, area	town landscape	3000	28274334	8
9	agglomeratie	landschapspark	conurbation	landscape park	10000	314159265	9
10	metropool	landschap	metropolis	landscape	30000	2827433388	10

By counting the digits of the area concerned we could state boundaries of these categories easily to be *named* with a useful tolerance by their *nominal* radius (**Fout! Verwijzingsbron niet gevonden.**). When I see an area expressed in m^2 with 6 digits I name it a neighbourhood.

Digits	Min. area	Max. area	Min. radius	Max. radius	Nominal	Symboll	Gross	Tare
	Smin	Smax	Rmin	Rmax	Rnom		name of area	including for example
	m^2	m^2	m	m	m			
1	1	9	1	2	1	A	building part,	small spaces
2	10	99	2	6	3	B	building segment,	rooms, unbuilt spots
3	100	999	6	18	10	P	parcel, plot, lot or building	gardens, unbuilt places, patios
4	1000	9999	18	56	30	I	urban island, property , building complex	open space in private parcels (lots, plots)
5	10000	99999	56	178	100	E	ensemble,	pavement directly opening up building complexes, small public green area
6	100000	999999	178	564	300	N	neigbourhood, hamlet,	a neighbourhood park, small water, neighbourhood infrastructure
7	1000000	9999999	564	1784	1000	D	district, village,	a district park, district water, district infrastructure
8	10000000	99999999	1784	5642	3000	T	town, town quarter,	a town park, town water, town infrastructure
9	100000000	999999999	5642	17841	10000	C	conurbation,	adjoining town landscapes, conurbarion infrastructure
10	1000000000	9999999999	17841	56419	30000	M	metropolis,	adjoining landscape parks, metropolitan infrastructure

Fig. 751 The tolerance of nominal urban gross area values

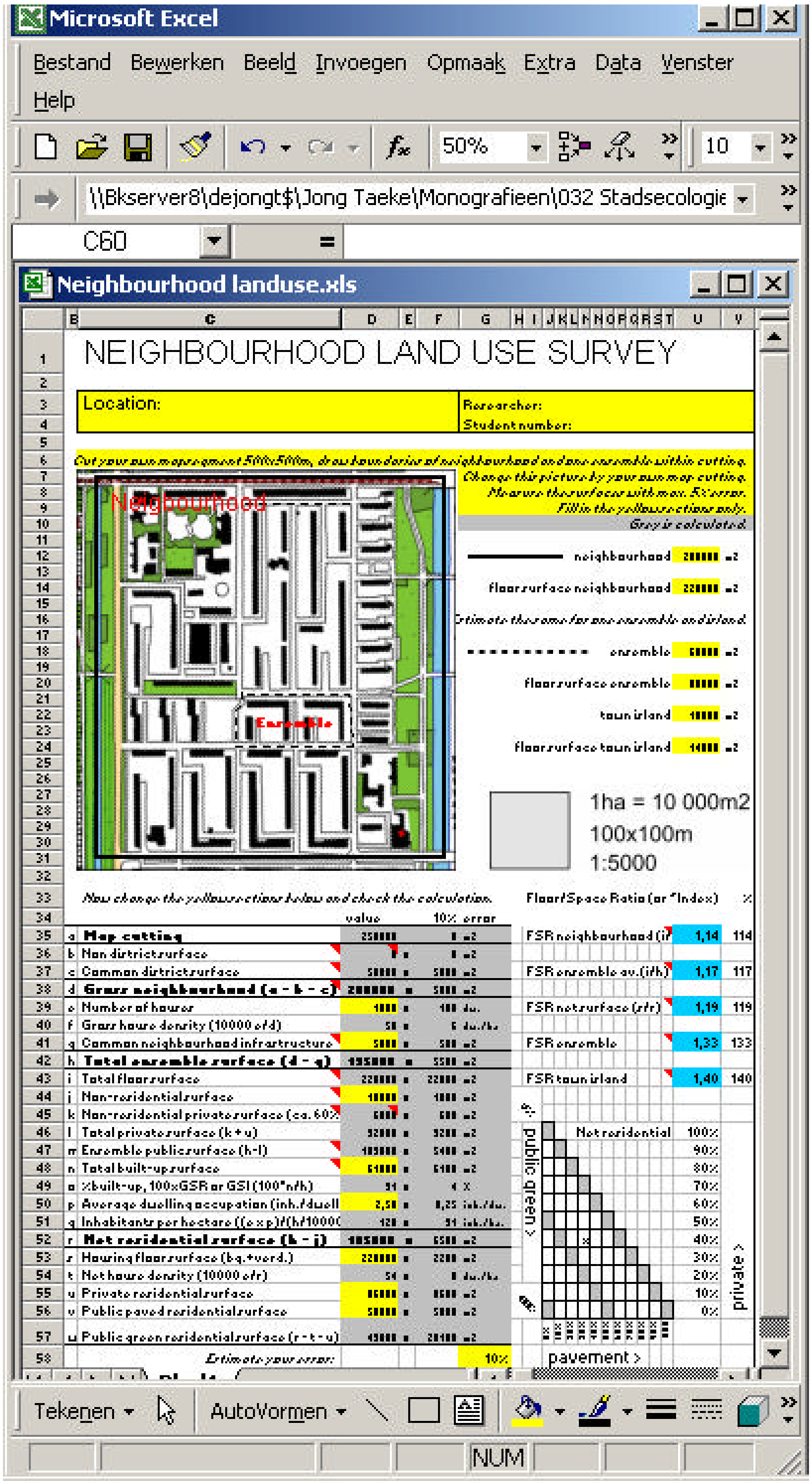
In that way we call an area restricted in surface between 10000 and 99999 m^2 (5 digits) an ensemble, or an area 'R=100m'. Even though the range of surface difference is still a factor of nearly 10, this restriction has proven to be strict enough to get comparable densities. The comparability can be improved by choosing boundaries on the axis of public pavements that open up and enclose private properties (streets), excluding tare surfaces like roads, highways, public parks and water (dry, wet and green infrastructure) for use in a larger radius. Including them would result in a lower density compared with surfaces that do not include them. They should be taken into account in a higher class of density (for example a 'neighbourhood density'). By these 'tare' surfaces the higher density class gets a systematically lower density. 'Nett residential area' is what on the preceding level was named 'gross area'.

<table>
<tr><td>higher level</td><td colspan="3">gross</td></tr>
<tr><td></td><td colspan="2">net</td><td>tare</td></tr>
<tr><td>lower level</td><td colspan="2">gross</td><td></td></tr>
<tr><td></td><td>net</td><td>tare</td><td></td></tr>
</table>

Fig. 752 Gross, Net and tare in different levels of scale

6.4.5 300m Neighbourhood density

The Excel sheet below gives some measures of urban density in their mutual relationship skinning the appropriate infrastructure per level of scale.



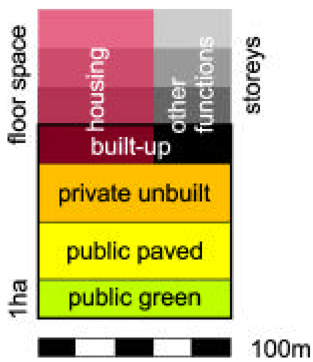


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Fig. 753 *Calculation of different kinds of density*

Fig. 754 Kinkerbuurt visualisation

The urban development office of Amsterdam study group Kinkerbuurt from the sixties of previous century found an elegant way to visualise key factors of neighbourhood land use (**Fout! Verwijzingsbron niet gevonden.**).

6.4.6 100m Ensemble density

The total area of an ensemble (set of urban islands + ensemble infrastructure) should be divided primarily in public and private surface. Both can be subdivided further. The construction and maintenance of public surface by a municipality is after all paid by selling and taxation of private surface. Moreover the boundary between both is often considered as the boundary between urban design and architecture.

PERMETA_architecten, Pont et al. (2002) (page 17) counted total and private surface of 8 ensembles in Amsterdam-West (**Fout! Verwijzingsbron niet gevonden.**).

calculation		A	P	P/A	A-P			
traditional Dutch	**oppervlak**	plan~	uitgeefbaar~	%uitgeefbaar	openbaar~	%verharding	%groen	%water
logical Dutch	**oppervlak**	**ensemble~ R=100m**	prive~	%prive	openbaar~			
Permeta	**oppervlak**	**ensemble, plan~**	kavel					
English	**area (total), surface (part)**	**ensemble area**	private surface	%private	public~	%paved area	%green area	%water area
logical English		A	P	P/A	A-P			
example		**m2**	m2	%	m2	%	%	%
1		**66486**	18413	28%	48073			
2		**34325**	5333	16%	28992			
3		**85071**	19723	23%	65348			
4		**91520**	18031	20%	73489			
5		**49395**	11036	22%	38359			
6		**97059**	25035	26%	72024			
7		**21554**	7224	34%	14330			
8		**43998**	11118	25%	32880			
ensembles R=100m		**489408**	115913	24%	373495			
neighbourhood R=300m	veld	**607246**	113078	19%	494168			
neighbourhood tarra		**117838**	-2835	-2%	120673			
			?	?				

Fig. 755 Total area and private surface of 8 ensembles counted by Permeta (dark area) and derived measures.

Permeta names the total area A of the ensemble 'plan area' (page 10) and the private surface P 'kavel' (parcel, plot or lot). A parcel however is a selling unit out of of total private area, so we will name it 'private surface' to name the sum of all parcels concerned. Giving form to the joint parcels we call 'parcelling', while 'plot division' refers to a more quantitative division of lots in different sizes in the programming phase. We will refer to the 'plan area' as to 'ensemble area' A_E to make a clear distinction as to 'neighbourhood area' A_N, 'district area' A_D, 'town area' A_T and so on, all with their own 'tare surfaces' included and consequently lower reference densities. Now we can formulate a density of private surface P/A_E varying between 20% and 34% with an average of 24% in the examples of **Fout! Verwijzingsbron niet gevonden.**.

The neighbourhood (veld) private surface density P/A_N appears to be lower indeed, because A_N=607246 m^2 is larger than ? A_E=489408 m^2. The difference is the neighbourhood tare not token into account calculating the densities of the ensembles. We suppose however that the private surface in the neighbourhood (113078 m^2) is not calculated well, because it should contain all private surface in the ensembles concerned while the table shows a negative saldo.

Public surface A-P, the area of urban design, primarily subdivided in paved, green and water area is the complement of private surface P. The water area is often given by requirements of civil engineering and sometimes by requirements of recreation. In the case of recreation it could be adjacent to green area and in case of civil engineering requirements considerable green area can be needed by sloped borders (taluds). In both cases agreements should be made about what we call ‘green area’. Sometimes water is included in this category. There should also be agreement about the amount of green area to be part of the neighbourhood tare or the ensembles. This question returns calculating the district, town, conurbation densities, because these public areas should be paid by the profits of the private area.
The same goes for the paved area as well.

Built area in the ensemble (R=100m)
The built-up area is part of the private area. Though there are constructions in the public area, they are not counted in so far they are not climatised. If there are permanent and climatised constructions in the public area the surface they occupy should be counted as private area, even if their *function* is public. Some constructions like (multi-storeyed) garage buildings are borderline cases asking closer agreements.

PERMETA_architecten, Pont et al. (2002) (page 17) counted the built-up area B and the floor surface F of the same ensembles also (**Fout! Verwijzingsbron niet gevonden.**).

calculation		B	A-B	P-B	F	F/B
classical Dutch	**oppervlak**	bebouwd~	onbebouwd~	tuin~	bvo	
logical Dutch	**oppervlak**	bebouwd~	onbebouwd~	tuin~	vloer~	gem. aantal lagen
Permeta	**oppervlak**	bebouwd	open ruimte		bvo	
English	**surface**	built-up ground~	unbuilt~	garden, unbuilt private property	floor~	average number of storeys
logical English		B	A-B	P-B	F	F/B
example		m2			m2	
1		10129	56357	8284	47587	4,70
2		3632	30693	1701	7264	2,00
3		15869	69202	3854	70229	4,43
4		13560	77960	4471	63936	4,72
5		8960	40435	2076	31912	3,56
6		19331	77728	5704	64372	3,33
7		3804	17750	3420	6498	1,71
8		5604	38394	5514	23239	4,15
ensembles R=100m		80889	408519	35024	315037	3,89
neighbourhood R=300m	veld	78054	529192	35024	294983	3,78
neighbourhood tarra		-2835	120673	0	-20054	
		?			?	

PERMETA_architecten, Pont et al. (2002)

Fig. 756 Built-up area of 8 ensembles counted by Permeta (dark area) and derived measures.

The total unbuilt surface (public and private) A-B is the complement of the built-up area B in the total area A. Here also the B_N should not be smaller than ?B_E as it is the case in the table. The density of unbuilt surface (A-B)/A is an important urban and physical characteristic for building climate, men and plantings because of sunlighting and view. Moreover it determines the possibility of future urban transformations. Gardens and other unbuilt private property (erf) P-B are part of it.

The available climatised floor surface F is an important urban characteristic as well, because it determines the average number of storeys F/B and by that the municipal profits, the future possibilities, the (lack of) sunlighting and view of the area.

Ratios to ensemble (R=100m) area

Any surface category like P (private area), its complement A-P (public area and its subdivisions paved area, green area, water area), B (built-up area), A-P (open surface area), P-B (gardens, unbuilt private property, and its subdivisions as to functions like housing, offices, industry, retailing, schools), F (floor surface, and its subdivisions as to functions) can be devided by the total area A to get meaningful urban characteristics comparing ensembles, neighbourhoods, towns, conurbations and so on.

Usually such ratio's are mutiplied by 100 and expressed in percentages. The percentage sign % draws our attention to the fact that we have to do with a ratio, a unit compared with a standarised unit. The multipication by 100 makes decimals superfluous in most of the cases. Moreover it makes short expressions like '%paved area' possible, supposing the total area as self-evident denominator.

Dividing however the last referred measure in **Fout! Verwijzingsbron niet gevonden.** the average number of storeys by the total area would produce a meaningless measure. What does (F/B)/A or F/A*B mean? F/B is already a ratio between two surfaces and the denominator is part of the total area by which we are dividing another time. The lesson shoud be, that mathematics sometimes produces meaningless measures.

PERMETA_architecten, Berghauser Pont et al. (2002) (page 17) divided P, B, F and A-B by A to get ratios for the comparison of urban areas on different characteristics (**Fout! Verwijzingsbron niet gevonden.**), hoping they would indicate something about the parcelling characteristics.[a]

[a] That is questionable because they reduce essential morphological information. See Jong, T. M. d. and H. Priemus (2002) Forecasting and Problem Spotting in: T. M. d. Jong and D. J. H. v. d. Voordt Ways to research and study urban, architectural and technical design (Delft) DUP page 255, figure 267.

calculation		P/A	B/A	(A-B)/A	F/A	(A-B)/F
classical Dutch	oppervlak	%uitgeefbaar	%bebouwd		FSI	
logical Dutch	oppervlak	%prive	%bebouwd	%onbe-bouwd	%vloeropp.	onbebouwd per vloer-oppervlak
Permeta	oppervlak	PSI	GSI		FSI	OSR
English	surface	%private	%built ground	%unbuilt	%floor	unbuilt/floor
logical English		PSR	GSR	USR	FAR	UFR
example		%	%	%	%	%
1		28%	15%	85%	72%	118%
2		16%	11%	89%	21%	423%
3		23%	19%	81%	83%	99%
4		20%	15%	85%	70%	122%
5		22%	18%	82%	65%	127%
6		26%	20%	80%	66%	121%
7		34%	18%	82%	30%	273%
8		25%	13%	87%	53%	165%
ensembles R=100m		24%	17%	83%	64%	130%
neighbourhood R=300m	veld	19%	13%	87%	49%	179%
neighbourhood tarra		-2%	-2%	102%	-17%	-602%
		?	?	?	?	?

PERMETA_architecten, Pont et al. (2002)

Fig. 757 Ratios calculated by Permeta (dark area) and (A -B)/A expressed as percentages.

The last row shows apparent shortages in the surface calculations.
A ratio is sometimes named as ‘index’ (floor area index); but that use of the term should be avoided since ‘index’ in mathematics is used as the subscript of a variable like ‘$_E$’ in ‘A_E’. Such an index is intended to distinguish different variables of the same kind. So we use ‘ratio’ as the proper numerical indication of a proportion.
The last column has a different denominater. This measure is not a density or a proportion of a part to a whole and has consequently not a self-evident denominator. It cannot be named shortly as ‘%unbuilt surface’.

The %private surface P/A or its public complement, %public surface (A-P)/A are important measures from a viewpoint of municipal ground exploitation.
The %built ground surface B/A and its unbuilt complement, %unbuilt surface (A-B)/A gives an impression of the openness of the urban area.
The floor area ratio is a more reliable substitute for the density of houses. It is not sensible for different sizes, numbers of storeys and changes in function. It encloses other functions than housing.
Permeta draws a diagram[a] plotting %floor F/A against %built B/A.
Because

F = average number of storeys * B or

F/A = average number of storeys * B/A,

the floor area appears as a straight line starting in the origin with a slope according to the average number of storeys. Any ensemble appears as a spot according to these characteristics (**Fout! Verwijzingsbron niet gevonden.**).

[a] Preceded by the graduation work of Meertens, R. (2000) Density? (Delft) DUT Faculty of Architecture.

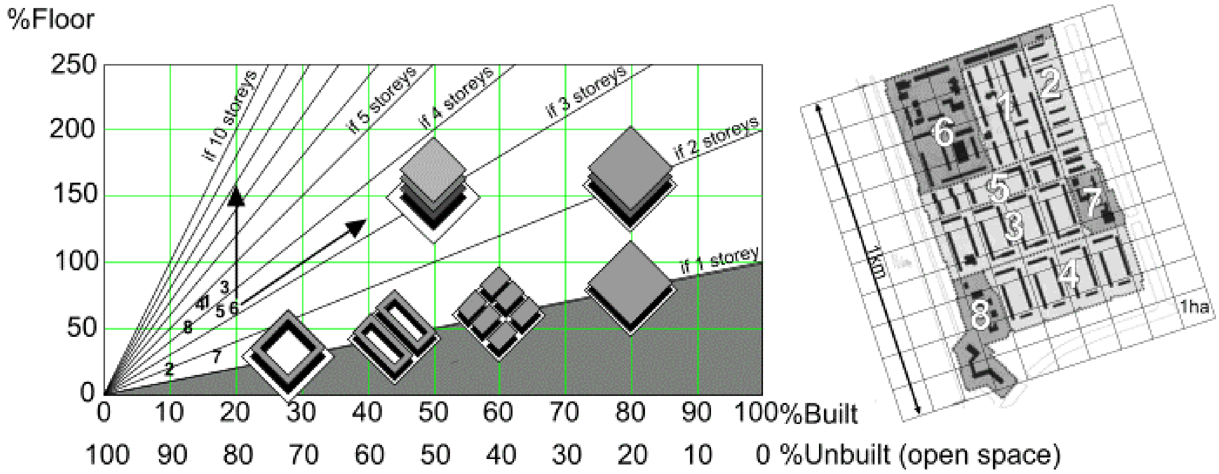
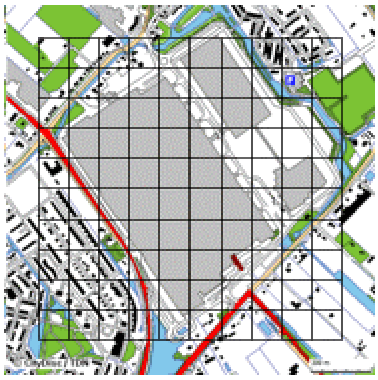


Fig. 758 Floor surface as a function of built surface F(B) according to Permeta

Within the diagram 6 theoretical parcellations are drawn on 1 hectare (approximately 1 quarter of a nominal ensemble). The 8 actual ensembles as measured by Permeta are given as numbers. They have all less than 20% built area, the theoretical parcellations have more. Parcellations with more than 50% built area have seldom courts or streets larger than 10m width.



Novelli (1989)

Fig. 759 Ensemble in Venice 1: 5000; 200x200m

Fig. 760 Auction Aalsmeer 1:25000; 1kmx1km

Such urban areas have no cars like Venice (**Fout! Verwijzingsbron niet gevonden.**) or they have internal traffic in buildings like the flower auction in Aalsmeer (**Fout! Verwijzingsbron niet gevonden.**). Ensemble 6 has the highest %built surface in the part of Amsterdam West concerned, but not the highest %floor surface. To intensify the floor density one has to increase the average number of storeys (arrow crossing lines of floor density with the same number of storeys in **Fout! Verwijzingsbron niet gevonden.**) or without increasing the number of storeys one has to increase the %built surface (arrow parallel to lines of floor density with the same number of storeys in **Fout! Verwijzingsbron niet gevonden.**). By increasing the %built surface (decreasing open surface) even more, one can cross the lines of floor density with average 3 storeys in horizontal direction decreasing the number of storeys to 2.
This elegant and useful diagram by Permeta and Meertens is complicated without necessity by introducing unbuilt/floor (OSR). To calculate these surfaces on the right level of scale the urban density measures of Permeta have to be sharpened.

6.4.7 30m Urban island density

The urban island is the best level to avoid coincidental differences that could disturb a reliable density comparison. An urban island is bordered by the axis of public infrastructure that opens up or encloses private properties in closest surrounding not intersected by other infrastructure. So it encloses no other public infrastructure than dead-end streets, opening up backyards and garages, water and green area only functional to the smallest publicly opened-up urban area. An ensemble encloses several urban islands + ensemble infrastructure, a neighbourhood encloses several ensembles + neighbourhood infrastructure and so on. The %floor surface per area of an urban island (FAR_I) is equal or higher than any other useful density measure like FAR_E, FAR_N and so on by lack of urban tare. Jong (2001) , an interactive computerprogramme shows the behaviour of an orthogonal island changing any of the determining design measures (**Fout! Verwijzingsbron niet gevonden.**).

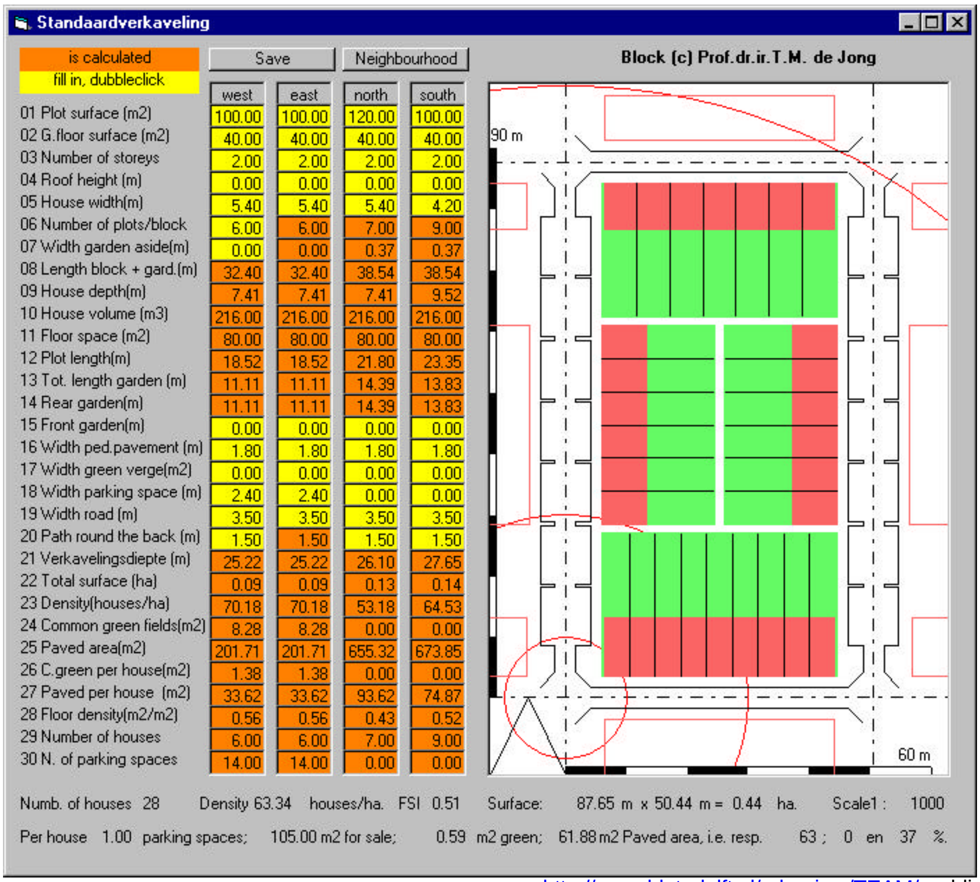


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Fig. 761 The urban island

Any higher level of scale adds its own tare decreasing the density. The programme shows in a next window the considerable surface occupied by dry and wet infrastructure on every higher level (**Fout! Verwijzingsbron niet gevonden.**).

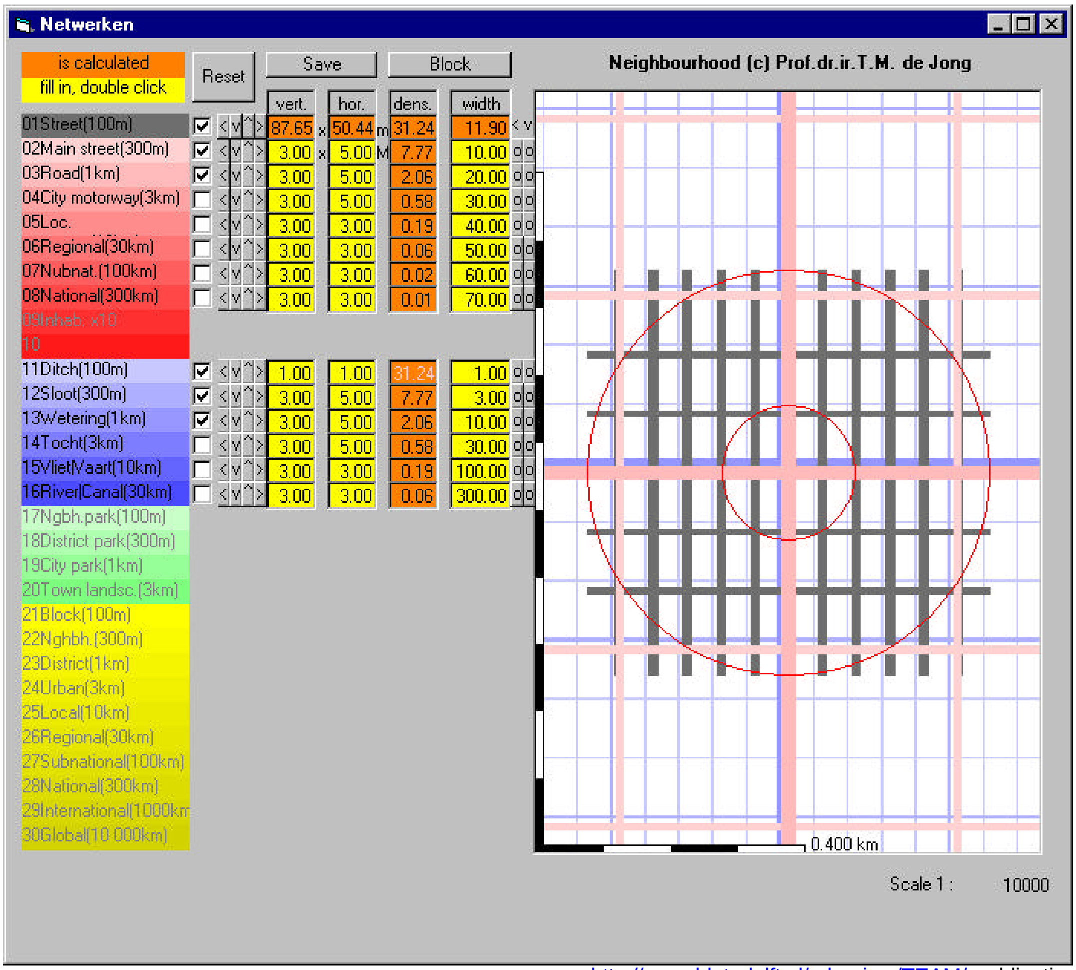

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Fig. 762 Adding E-, N- and D- dry and wet infrastructure

Green surfaces and surfaces for amenities are not yet shown in this window. It should be clear that such infrastructure of higher order should not be counted in the density of the lower order when they lack in other locations to compare. On this level of scale these surfaces are *location factors* by which the external *context* of the urban island differs, but not its *density*. They become comparable by density measures on a higher level of scale.

6.4.8 References to Densities

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