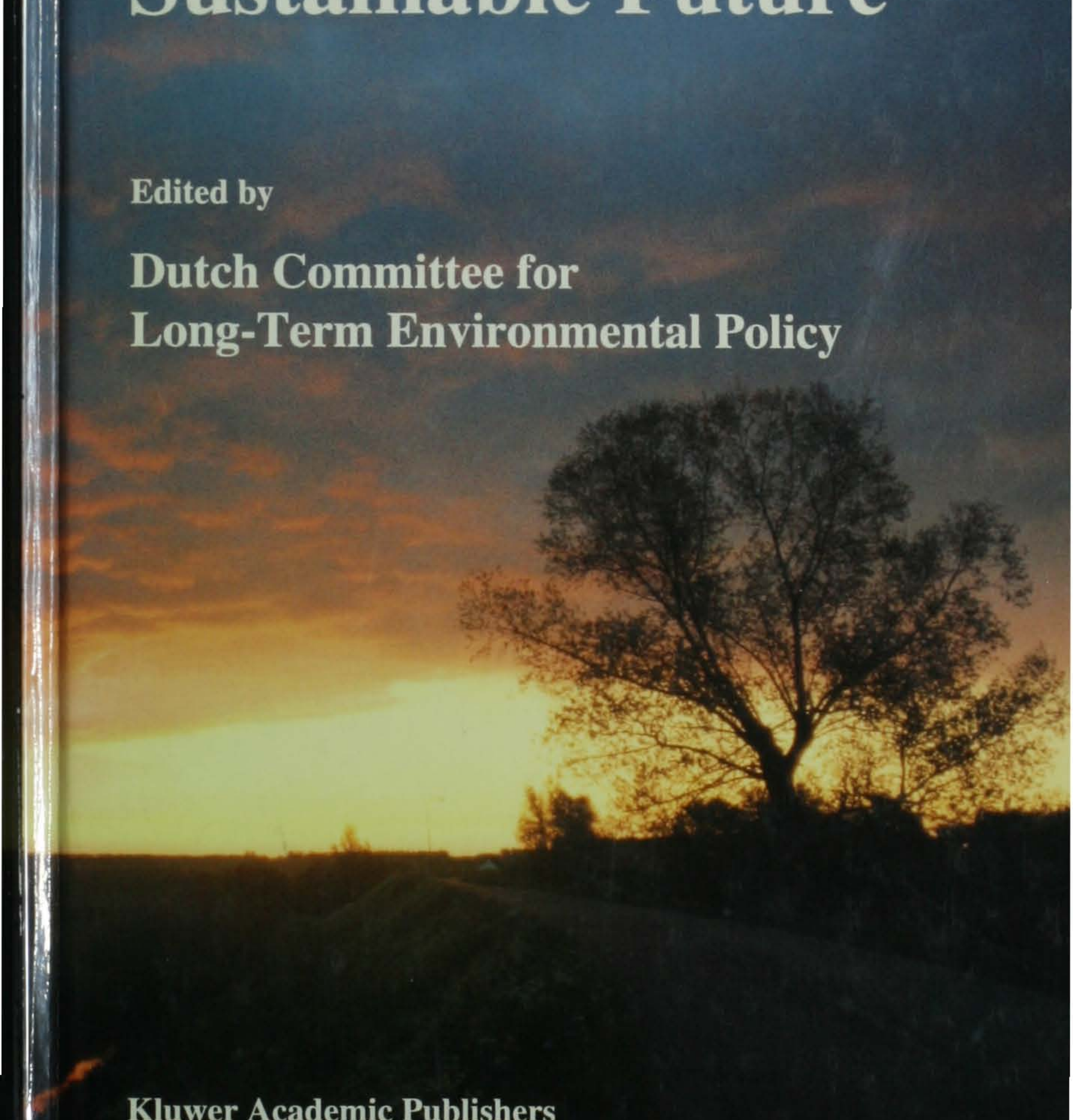
ENVIRONMENT & POLICY

The Environment: Towards a Sustainable Future

Edited by

Dutch Committee for Long-Term Environmental Policy



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The Environment: Towards a Sustainable Future

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20. Indicative spatial picture: a Dutch perspective

Taeke M. de Jong and Dirk Frieling

No single human understands
two things about the Netherlands.
(Leo Vroman)

20.1 Introduction

The object of this study

A sound long-term spatial picture of the future for the Netherlands usually requires the efforts of hundreds of people for many years. In the Netherlands this task has been legally assigned to the Rijksplanologische Dienst[1] (National Service for Town and Country Planning), which, under the terms of this assignment, published its latest national plans for 2015 in 1988 and 1992 under the names *VINO* and *VINEX*, respectively. However, such a political picture of the future cannot take shape before various sectors of environmental policy have stated their preconditions. In such a case the picture will be an applied one right from the start rather than being fundamental.

Nederland Nu Als Ontwerp (NNAO) (Design of the Netherlands Now) was a private enterprise[2] aiming at designing pictures of the Netherlands. These had to be extreme and had to explore the limits of what is possible in order to promote the future-oriented imaginative powers of citizens, administrators, researchers and designers, but without the obligation to reach compromises. To be able to be objective about short-term interests and problems, as well as for other reasons, the horizon of the plan with respect to the legal national plan was shifted to 2050. This study, too, took many years and over one hundred people were involved. In principle the scenarios – *the Critical Scenario (socialist), the Caring Scenario (Christian-democratic), the Dynamic Scenario (liberal) and the Relaxed Scenario (optimistic)* – were those laid down in the *Beleidgerichte Toekomstverkenning van de WRR* (1983) (Policy-oriented investigation into the Future by the Scientific Council for Government Policies) extended to 2050 by the Geographic Institute of the Amsterdam University and developed into demographically and economically founded spatial programmes for each political opinion (van Engelsdorp Gastelaars et al., 1987), together with their own scenario (de Jong, 1985; Koppert and van Dijk, 1986). This resulted in four draft designs. Only then were complementary scenarios made by various sectors and interest groups such as agriculture, conservation, inland waterways, drinking-water, energy, traffic and the environment, resulting in their respective space claims as corrections of the first design.[3]

In 1990 the Committee for Long-Term Environmental Policy (CLTM) published ideas for the 21st century (inter alia in the fields of agriculture, conservation, atmosphere, energy, economy and traffic) from the point of view of the environment. In addi-

tion to pointing out potentially positive trends, in its new publication CLTM also wanted to consider the influences of other sectors and to make a first attempt to evoke a spatially integrated image of these influences on society in 2050.

In this chapter such an image is given; it is restricted to and looked at from the situation in the Netherlands. In this context in particular, the idea of "region" relates to one of a smaller size than elsewhere. As an international background to the national options described, the scenarios of the Dutch Central Planning Bureau can be used, although they only go as far as the year 2015 (CPB, 1992a). However, should these scenarios be worked out on a national level (CPB, 1992b), the difference in the horizon of time will become insurmountable. In the pictures presented in this study much larger differences in the population resulting from ageing (especially after 2010) and from immigration due to environmental flight (especially after 2020) will be taken into account. As a result the scenarios have become incomparable with the spatial picture developed here.

This indicative spatial picture is not only developed by prediction and programming, but also by means of designs. Its scientific pretensions do not exceed those of an "educated guess". In order not to use utopian images only, it will be necessary to bear in mind what is probable, desirable and in the long term possible and feasible from the point of view of the various Dutch sectors, in addition to what is desirable for environmental groups. The various ways of looking to the future are described in the following section with respect to each other; they are, so to speak, "different futures".

Exploration of the possibilities by means of research through designs

A society that is sustainable in the long term has various potential spatial solutions of which only one is explored in this section (de Jong, 1992). It is an improbable future and therefore it cannot be predicted, but has to be designed. For the *probable* future is so gloomy from an ecological point of view that we can only take courage from improbable, but indeed *possible* and in any case more *desirable* developments. Designs of different and sometimes extreme, improbable, but all the same, possible solutions may help to explore the extent of the possible in a conditional, restricting series that is mainly based on the available means.

Consequently, the space programme of the solution developed here has not been derived from a prediction of the most probable or from a proclamation of the most desir-

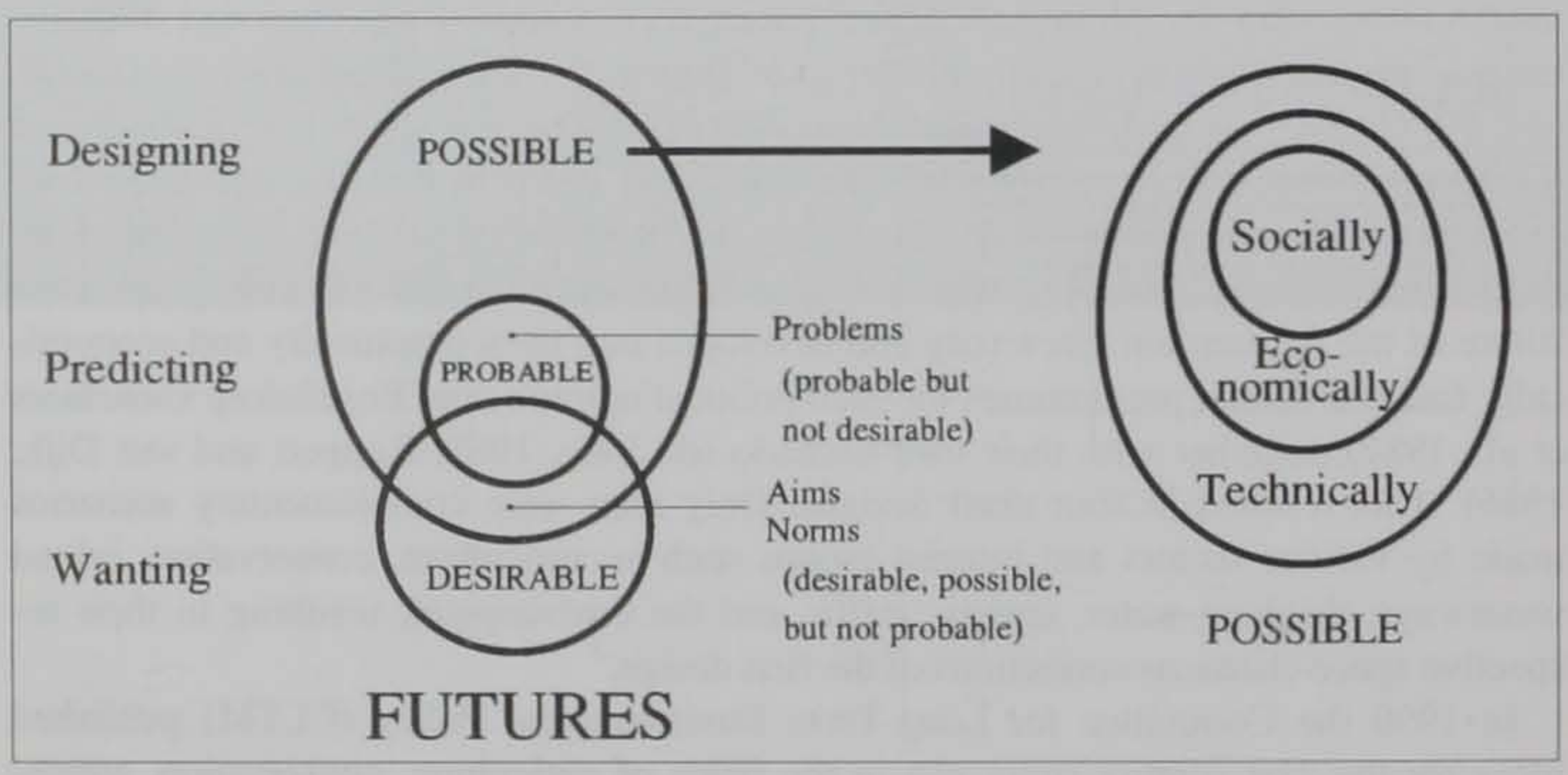

Fig. 1. Different futures and their modality.[4]

able, sustainable social development, but from the limits of what is possible in the field of sustainable technical, economic and cultural developments. Within all these possibilities we have confined ourselves to one that, within the framework of this project and its monographs, seemed to be most appropriate. Within these limitations we found, however (as befits a good house that does not enforce one behaviour but permits various forms of behaviour), that the possible variants of social developments are infinitely great, favourable or otherwise with regard to nature and environment. The spatial solution selected provides good conditions for numerous imaginable sustainable social alternatives and restricts the possibilities of other solutions. However, it leaves the ultimate choice of the way in which people want to live in this house to the people themselves.

This does not mean that all visions developed as part of the studies initiated by CLTM must have direct spatial consequences.[5] In the previous CLTM publication (1990), it is especially the studies by Vermeersch, Reijnders, Mansholt and van Witsen which proved to be of importance for the spatial picture described here. On the other hand it also means that the spatial picture developed is not always of consequence for the developments indicated in these visions.

Of all possible futures the utmost and hardest precondition is formed by what is *ecologically possible* (the really available space, the total amount of sunlight available together with time, water, minerals, the maximum number of inhabitants, the temperature to be expected and the ecological space actually available). Of all possibilities that are conceivable physically within this condition only a limited number is *technically feasible* (for instance, with the optimal rate of efficient use of space, sunlight, and biological resources). Of all possibilities that are conceivable technically within this condition again only a number is *economically feasible.* Here, too, there is a world of possibilities that are conceivable culturally, socially and from an organizational point of view, although excluding certain technically economic developments. Of the remaining possibilities within what is culturally *possible*, only a number can be influenced managerially.

Designs that are not probable but certainly possible can be made on each of these *conditional levels.* On the inner level, where most of the conditions apply, the design is

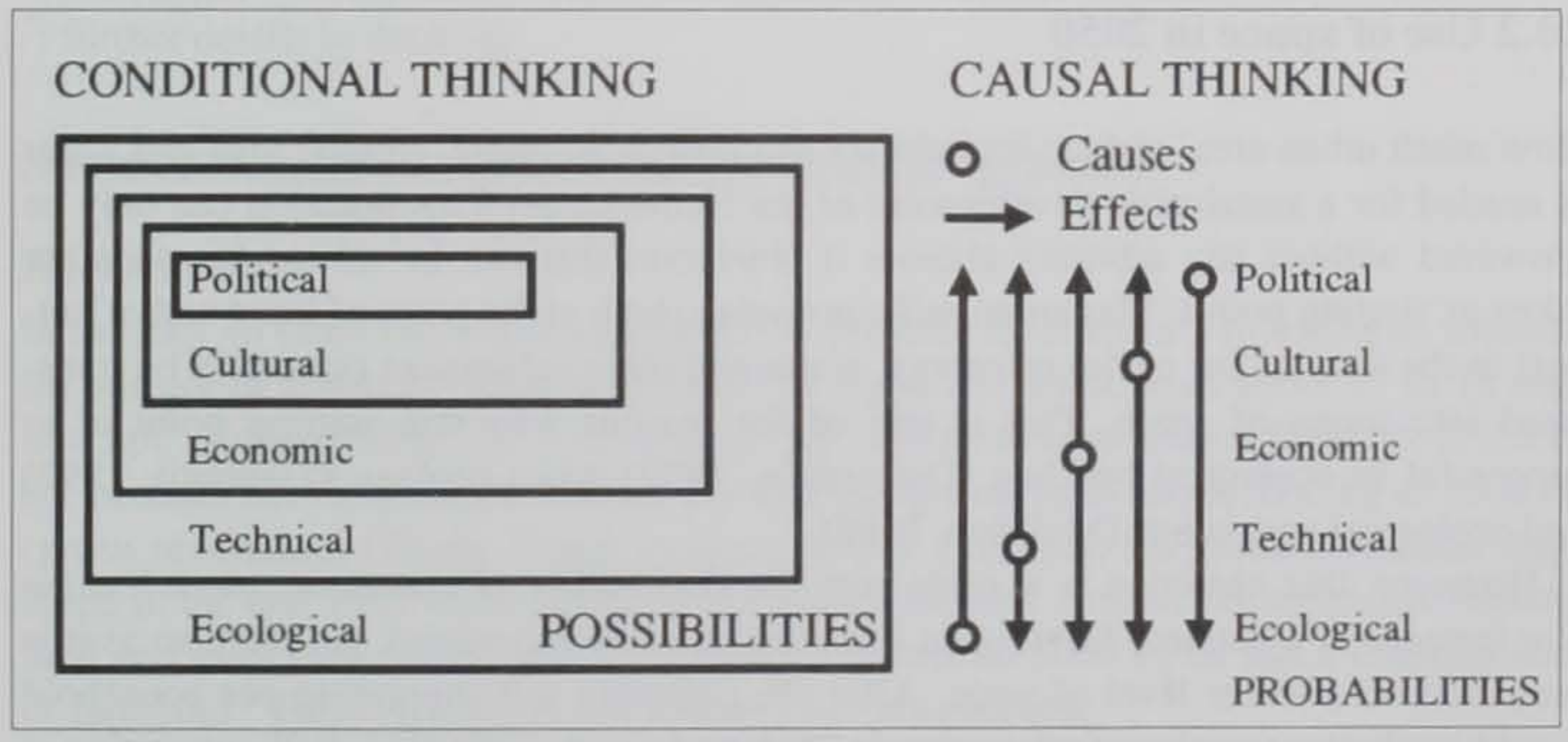

Fig. 2. Causes and their effects within the limits of what is possible.

the most restricted and consequently it is concrete. Still, it is here that the designer experiences Deelder's (1991) truth: "Within the limits the possibilities are just as unlimited as they are beyond the limits." Within these limits and on the basis of a design, *effects* can be analysed on various causal grounds.

In the reversed course that is determined more socially, it is decisive for the implicitly presumed feasibility of the spatial picture to what extent:

- an imperious or, on the contrary, a cooperative administration could initiate social developments in the direction proposed;
- social entities generally, such as administrative bodies, cultural institutes or companies could reach an adequate consensus about what is probable, desirable, possible and feasible for a narrow escape from the ecological crisis;
- these concepts, standards, values and expectations will actually lead to consumer and investor behaviour enabling us to bear the cost of the spatial picture, to develop and to accept it and to have it implemented in daily life;
- the technical concepts presupposed in the spatial picture will be realized in time;
- the picture will really lead to a sustainable future.

The two courses may be summarized in the formulation of an adaptation of society to its territory ("adaptation") and, conversely, the adaptation of the territory to society ("accommodation"). The interaction between adaptation and accommodation results in a dynamic equilibrium, which becomes "sustainable" if this interaction leads to conditions enabling permanent habitation of these territories.

Ecosystem, technology, economy, culture, politics and administration are first involved in the research through design in a conditional order (not a causal one) in order to arrive at a statement of affairs of the programme. In reverse order we should then have to take the practical route in order to test the feasibility and effectiveness of the picture of the future. According to the usual *planning cycle* a new round of programming stock-taking, conceptualization and prognostication of effects should now follow. However, such research is outside the scope of this study.

20.2 Use of space in 2050

How much urban area, surface for industry and traffic, farmland, wildlife area and water is needed for a sustainable development of the Netherlands? This question can only be answered without any arbitrary choices if objectives that can be related to space are taken as starting points. Maximum *self-supporting* (both at the point of input and of output) in the field of the cycles of energy, water and other substances can easily be translated into terms of space. This is one of the reasons why this starting point is so successful in ecological building (Duijvestein, 1992), town ecology (Tjallingii, 1992) and ecological agriculture (Mollison, 1988).

However, this objective is at odds with the desirability of economic *specialization* (for instance at a national level: open frontiers versus isolationism), the more so as it is projected on a lower level of scale. After all, complete self-supporting per household would imply the negation of all economic life based on specialization. Self-supporting at a global level, however, does not impede the possibility of economic specialization at all

lower levels of scale. At a global level self-supporting is equivalent to "sustainable development". For self-supporting should not only be interpreted in terms of space but also in terms of time (prevention of shifting to other places as well as to later periods). In such cases not every place, but every period should be able to be self-supporting.

The principle of local self-supporting may sometimes give rise to interesting technological challenges and solutions. A good example is self-supporting in the field of local management of water (rejecting water that is foreign to the region and draining purified water only) (Tjallingii and Dubbeling, 1989). However, if this principle of self-supporting is generally bound to a local level of scale, it will lead to meaningless notions such as, for example, the proposal for a project with the aim at developing an urban renewal area that is "CO_2-neutral". Each cycle has a *scale* of its own. In order to determine this scale chains may be distinguished in great detail as to place, nature[6] and phase of treatment[7]. However, we confine ourselves to the spatial and most relevant cycles on the scale of the Netherlands as a whole (water, food, energy and raw materials).

On this scale self-supporting is the zero value of international specialization. The ultimate ecological possibilities of self-supporting and specialization are globally explored below. Furthermore, in this section attention is paid to the biological potential of the Netherlands. Against this background the technical possibilities of housing 10, 20 or 30 million inhabitants are investigated; they are further split into three variants: economic (shortage and surplus), cultural (tradition- or chance-oriented culture) and politico-governmental (directing or managing on a national level). In this way a series of increasingly specific programmes will arise (Table 1).

Table 1. Survey of variants in the use of the land.

Ecological	Self-supporting				Specialization			
Technical	10 mln inhabitants		20 mln inhabitants*		30 mln inhabitants*			
Economic	–*		+*		–		+	
Cultural	<	>	<	>	<	>	<*	>*	<	>	<	>
Governmental	Managing / directing							

- = shortage; + = surplus; < = tradition-oriented; > = chance-oriented.
*: further details in drawing

Some ecological conditions for the space programme

International

In the past 40 years the world population has doubled from about 3 to 6 billion, whereas the surface of arable land has diminished by about one tenth, from about 17 to 15 million km^2. Consequently, the corn acreage per capita has been halved from about 0.2 to 0.1 hectare, but the yield per hectare per year has grown from about 1000 kg to 2500 kg (green revolution) (World Watch Institute, 1990). However, the green revolution stagnated in the late 1980's and is one of the causes for new erosion. Nevertheless Brundtland and associates (1987) assume continued growth to 5000 kg/ha and a constant area of farmland.[8] This is desirable and possible, but not probable.

According to Mansholt (1990) 11 billion people can be fed at an average food consumption of 300 W/person.[9] At the moment this consumption varies from 150 in poor

countries (5 billion people) to 750 in rich countries (1.2 billion); the difference is mainly caused by the difference in meat consumption. In this view the population may double only once more at the most, but from then meat will have to be rationed. Extrapolation indicates that this limit will be reached around 2030. In the meantime death rates should exceed birth rates. The moral implication of such a statement is out of all proportion.

Almost three times the surface of the Netherlands in farmland somewhere else in the world is now needed to supply our livestock with high-protein fodder.[10] This surface will soon be used more directly to feed the people living there. Looked at in this light our manure problem is a problem of luxury and, except for nitrogen poisoning of deeper groundwater and woods lost through acidification, it is of a temporary nature. Even without our manure problem a shift will have to be made from livestock farming to agriculture. This may happen within the Netherlands or within Europe. In the latter case the Netherlands may keep its meat production, if necessary even for the purpose of the nitrogen supply for agriculture.

An effect on global agriculture that is difficult to assess and that is consequently often neglected, is the greenhouse effect. The Sahara will cross the Mediterranean. IIASA has localized the dehydration to be expected in southern Europe (Brouwer, 1988). The flow of foreign labour from the Mediterranean area is a forerunner of an even greater environmental flight in a northern direction in the next century.[11] Reijnders and Kroeze (1990) reckon with an increase in temperature of about 2 degrees centigrade at the latitude of the Netherlands. This will cause much more rain in winter and less in summer. The driest summer now occurring once every ten years may then become normative.

In principle a rise in temperature will be favourable for the agriculture at Scandinavian latitudes (including Russia!) as well as in this country, provided the river water collected in winter (meanwhile probably clean) is kept for the summer. According to estimates by NNAO this will require flooding about 5% of land of the dry, high grounds in the Netherlands[12] or a national freshwater supply system from lake IJsselmeer and the freshwater basins of very large capacity in the province of Zeeland[13] as well as a diversion of water from the river Rhine to these basins via the rivers IJssel and Meuse.

National

The surface of the Netherlands takes up approximately 41,600 km^2, of which 7600 is inland water and sea and 34,000 km^2 is land. On land we have at our disposal per person about 1600 m^2 of agrarian area, 350 m^2 of wildlife area, forests and recreation, 120 m^2 of industrial and traffic area and 170 m^2 of urban area. Within this urban area the residential area, including basic facilities, varies from about 100 m^2 in the West to 300 m^2 in the North-East.

Figure 3a shows the map of the Netherlands stylized per category of land use in units of 100 km^2, roughly localized as to their centre of gravity. The space programme content is shown separately for the higher and lower part of the Netherlands and on the same scale. For this distinction the altitude of 1 m + NAP has been used. Figure 3b shows the development of these categories since 1900. In Fig. 3b the dotted line shows a scenario for the development of farmland in the case of an increase in productivity of 1% and a reduction of sales of 1% per year (Mentink, 1986). Such a considerable reduction of agrarian surface has been used in the NNAO scenarios for 2050 for conservation especially. We consider increase in productivity as an autonomous process in the sense

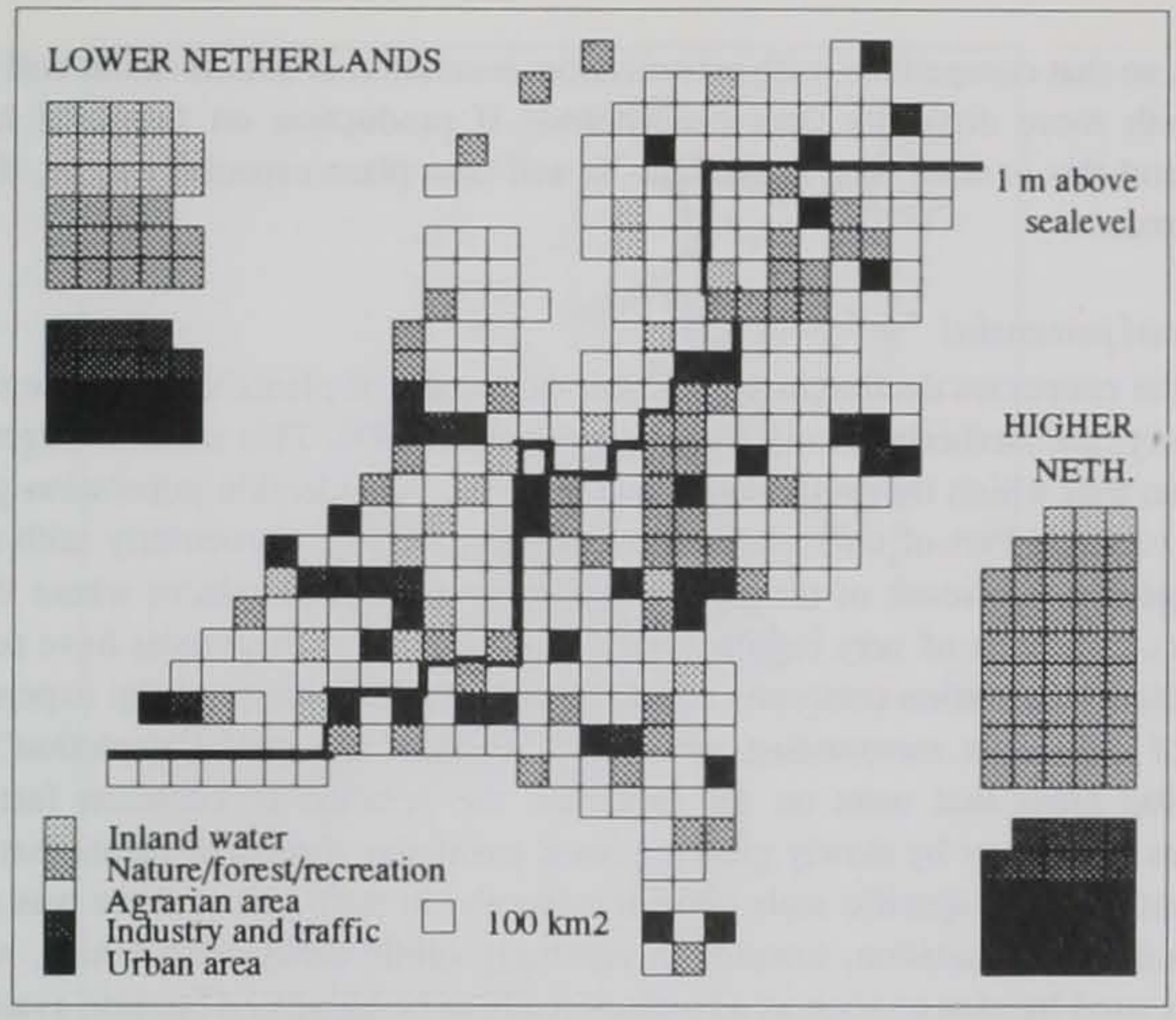

Fig. 3a. Categories of land use (based on Soil statistics CBS, 1985).

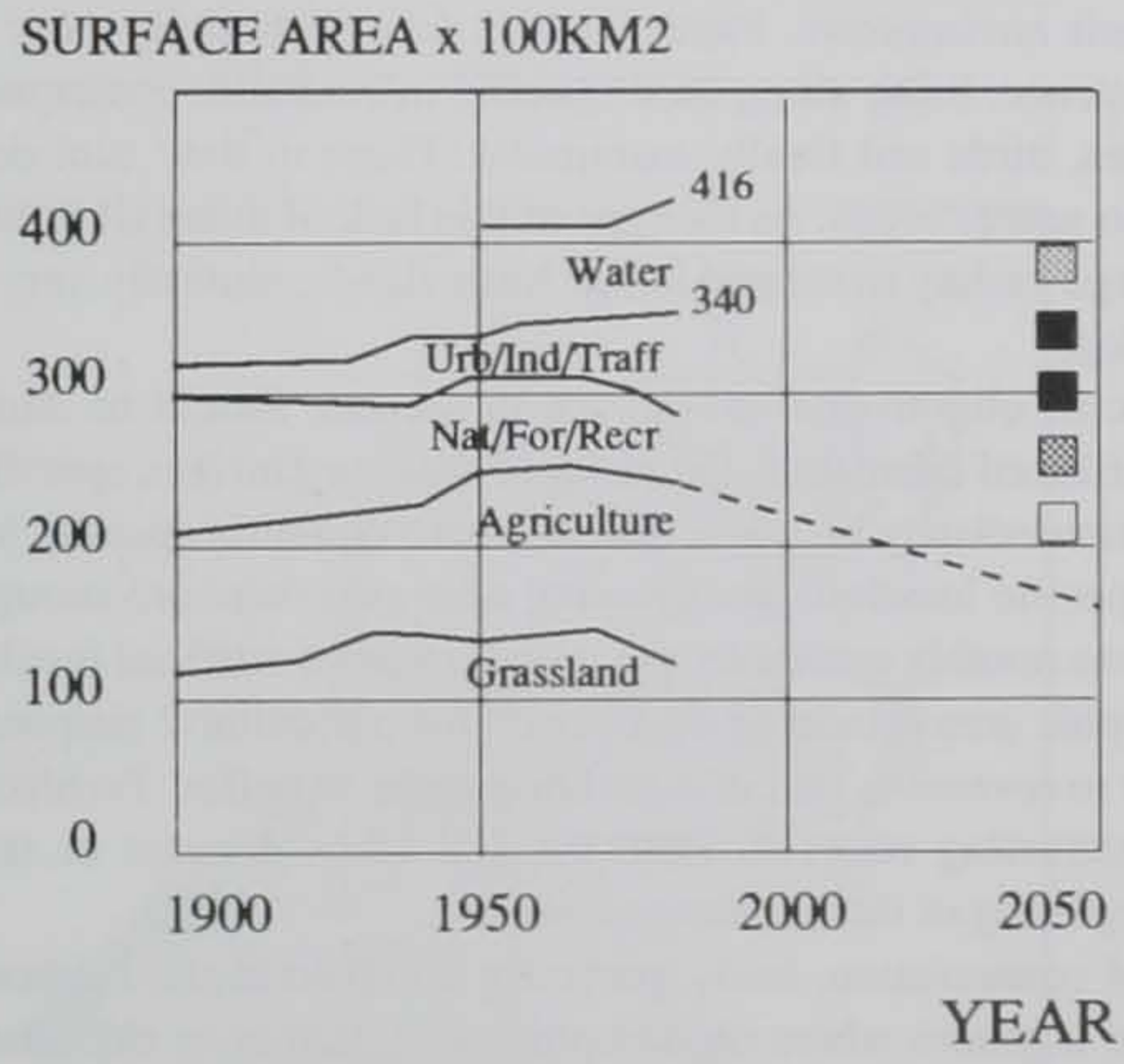

Fig. 3b. Development since 1900 (85 years statistics in time series CBS, 1987).

of the WTK-complex (Vermeersch, 1990), but in the light of the development of the world population as outlined above a sustainable reduction of sales is not probable or desirable.

A rise in sea level of up to a few metres can be solved by means of civil engineering; it offsets economically the "value of the *Randstad*",[14] but will have great natural technical consequences. According to Reijnders and Kroeze (1990) the lower part of the Netherlands will have to face an increasing degree of brackishness caused by this rise in

sea level, so that competition with urbanization, recreation or conservation will be maintained with more difficulty than elsewhere.[15] If production on farmland has to be stopped and this is done on a large scale, it will take place especially there, if only for these reasons.

Biological potential

Despite the enormous decline in the number of species of plants since the beginning of this century, the Netherlands still has approximately 1500. This number might well be larger than that which the Netherlands had after the considerable population growth in the 11th century. Part of this relatively recent biodiversity, particularly with regard to special species, is a result of the differentiation by man of the places where they grow (biotopes). Centuries of very regular, traditional agrarian management have resulted in concentrated fertilization (eutrophication) in and around villages at the expense of the fertility of the soil in surrounding areas. As a result of the stable "depletion" of these surrounding areas that went on for centuries, the position of common fast-growing plants was taken over by slowly growing ones, particular species of plants that were especially suitable for specific soils poor in minerals. In such places there was a succession, specific as to location, towards increasingly subtle ecosystems which, moreover, were only used by man as soon as a biomass ready to be harvested became available.

In its turn this development towards special oligotrophic biotopes leads to a large variety of plants specialized for specific forms of lack of minerals and for specific forms of dynamics of their environment. Plants such as these, especially those specimens having a marginal existence, bring along their specific insects and, consequently, insect-eating animals (reptiles, birds and finally mammals). These in their turn do not only prevent plagues but also scatter seeds. As the type of this lack of minerals differs everywhere because of the large variety in subsoil in the Netherlands, mutually very different biotopes may also develop.

If these special, oligotrophic areas, rich in species, should be situated in the downflow area of fertilized farmlands, the place of these organisms, specific for soils poor in minerals, will immediately be taken over by more common species, highly competitive, not bound to specific locations and growing wherever there are enough nutrients (grass, nettles). This was notably caused by the introduction of artificial fertilizers, as a result of which oligotrophic areas could again be used for agricultural purposes. This process is just as difficult to reverse as that of dissolving sugar in coffee. Fertilization is a matter of seconds, but extracting minerals from the soil takes decades or requires continuous mowing and depleting of the soil for centuries.

This form of conservation, fairly generally accepted in the Netherlands, is probably most successful at places where oligotrophic, acid, humus or dry areas drain into basic, mineral or wet areas or areas that are rich in nutrients (gradient areas). In the reverse case the chance of success is zero (disturbance areas). The gradient areas have been listed by van Leeuwen (Rijksplanologische dienst, 1966) and later by Baaijens (1985) (see Fig. 4a) for the *Tweede Nota Ruimtelijke Ordening* (Second Bill on Environmental Planning). These pictures are too detailed for a national plan, however.

Besides these oligotrophic areas, which are indispensable for their staple food, birds and mammals also need areas rich in nutrients. However, these areas are fragmented as a consequence of the expansion of the area of land used for agriculture and the construction of roads. In the *Nationaal Natuurbeleidsplan* (National Conservation Policy Plan)

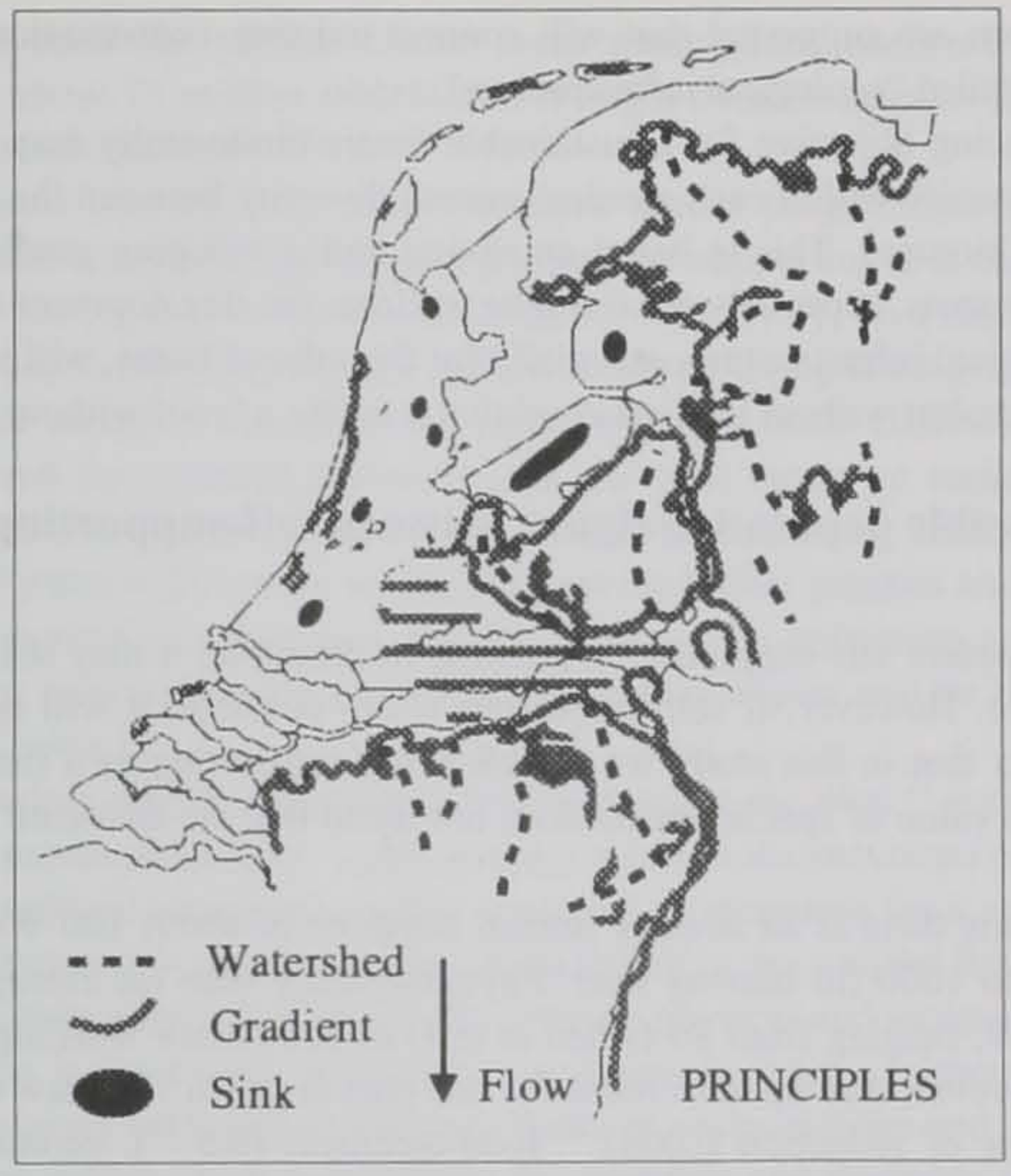

Fig. 4a. Gradients. Source: Baaijens (1985) (strongly reduced).

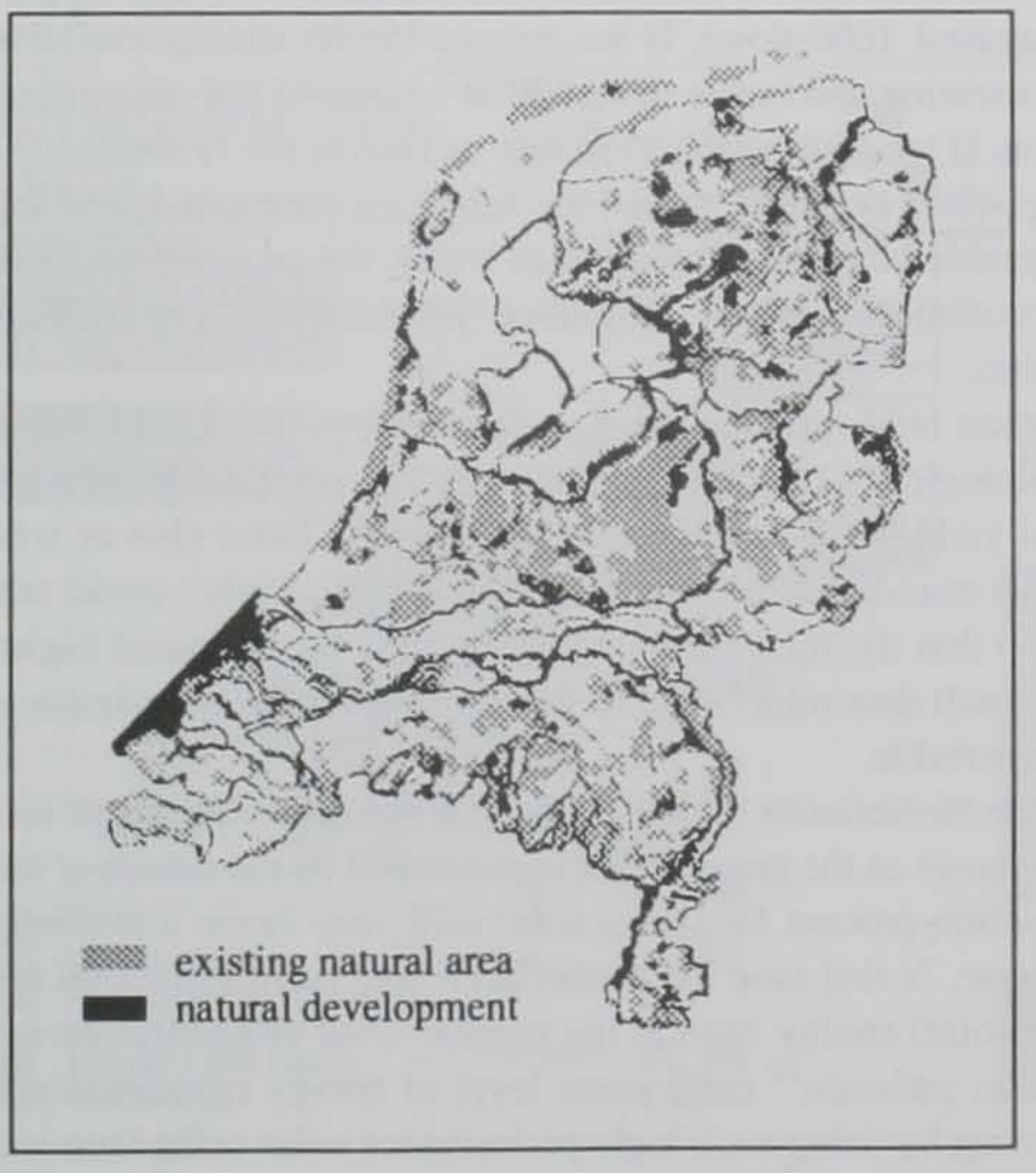

Fig. 4b. Ecological infrastructure. Source: National Conservation Policy Plan (1992).

(Fig. 4b) expansions are suggested that will connect existing conservation areas with each other, the so-called "ecological infrastructure".

As an all-embracing objective for a sustainable future biodiversity may be aimed at on three levels: diversity within each species, mutual diversity between the species, and diversity between biotopes. This is based on saving and developing gradients, also in small conservation areas, especially for the sake of flora; the development of larger entities and an ecological infrastructure, especially for the sake of fauna, will subsequently offer a surplus value, but without the first condition it is like a "roof without a house".

Technically possible population figure between self-supporting and specialization

If in a country complete self-supporting is possible in principle, it may still, of its own free will, specialize. However, if self-supporting is not possible, it will be obliged to specialize. The fact that in this study we establish self-supporting as a theoretical and spatially clear zero value of specialization does not mean that we advocate self-supporting.

In the Netherlands there is an average annual sunshine of about 100 W/m^2, ranging from 0 (at night) to 1000 (in blazing sun). Physiologically man on average also consumes about 100 W, ranging from 80 (when at rest) to 600 (when working hard). This does not mean, however, that we have room for one person per m^2. In view of agricultural-energetic (factor of reduction 0.008),[16] food-technical (0.5[17a]), economic-cultural (0.5[17b]) and planning reductions (0.5[17c]) on these 100 W/m^2, the effective rest for the supply of food in the Dutch gastronomic culture is only about 0.1 W/m^2. In the case of these presuppositions 1000 m^2 of farmland will be needed for the supply of food per person (100 W) (against 1600 now). If we assume the remaining available surface for living, working, recreation and traffic to be 400 m^2, agrarian self-supporting will require 1400 m^2 per person. If we assume the available surface in the Netherlands to be 35,400 km^2, including the water available within the functions mentioned, and leave aside the potentially considerable biomass production in water, the programme for agrarian self-supporting can accommodate about 25 million inhabitants.[18] Let us assume the safe number of 20 million.

This argumentation holds good as long as solar energy can better be converted into organic material biologically (theoretic yield about 2%, practical yield 0.8%) than technically (theoretical yield photo-voltaic cells 35%). In the latter case or when clean and cheap fusion energy could be obtained, "industrial food supply" could take over tasks from agriculture, so that the maximum population may be estimated higher. Economic and cultural factors will determine whether this is experienced as desirable and will consequently become probable.

The surface of the Netherlands including the Dutch Continental Shelf receives almost as much energetic power as the amount that is consumed by the whole of mankind. Consequently, a production process for cheap solar cells may cause a revolution in energy supply and spatial use. In that case the Netherlands will be in a position to supply itself permanently with (solar) energy even at the present level of energy consumption. Suppose that we want to maintain[19] the present level of energy consumption and be completely self-supporting by using such high-performance solar cells; then we would have to earmark[20] another 1000 m^2 for the remaining energy supply, in addition to the

1400 m^2 we need per person. Under these assumptions *energetic self-supporting* is possible for about 15 million inhabitants. It might even be safer to assume a number of inhabitants of 10 million.

We will now provisionally work out three spatial programmes: potential complete (energetic) self-supporting, potential agrarian self-supporting and compulsory specialization, with 10, 20 and 30 million inhabitants, respectively, on a surface of 35,400 km^2. In the first case at least 20,000 km^2 will be reserved for agrarian production and for the production of energy, whereas in the other two cases these 20,000 km^2 will be exclusively reserved for agrarian production. In all these cases we make a provisional assumption that the surface reserved for industries remains[21] 1800 km^2, that another 1000 km^2 of water will have to be provided on the higher grounds and that an average of 170 m^2 per person of urban area will be needed. The remaining surface intended for conservation, recreation and/or specialized agrarian export will be the margin in these three cases (Table 2).

The new urban surface, *completely concentrated in the West*,[22] is considered in one of the variants mentioned below. Subsequently, we have *decentralized* on various levels on the basis of cultural variations. In this sense the programmes for a considerable and for an extreme increase in population have been drawn in the stylized figures 5a and 5b.

These are only rough sketches of the extreme physical and technical possibilities and should not be looked upon as probable or desirable futures (although on that subject some suppositions are taken as ultimate limits of undesirability and improbability). For the restriction within these possibilities for probable and desirable futures depends on technical, economic, cultural and governmental conditions for the space programmes to be discussed in the following sections.

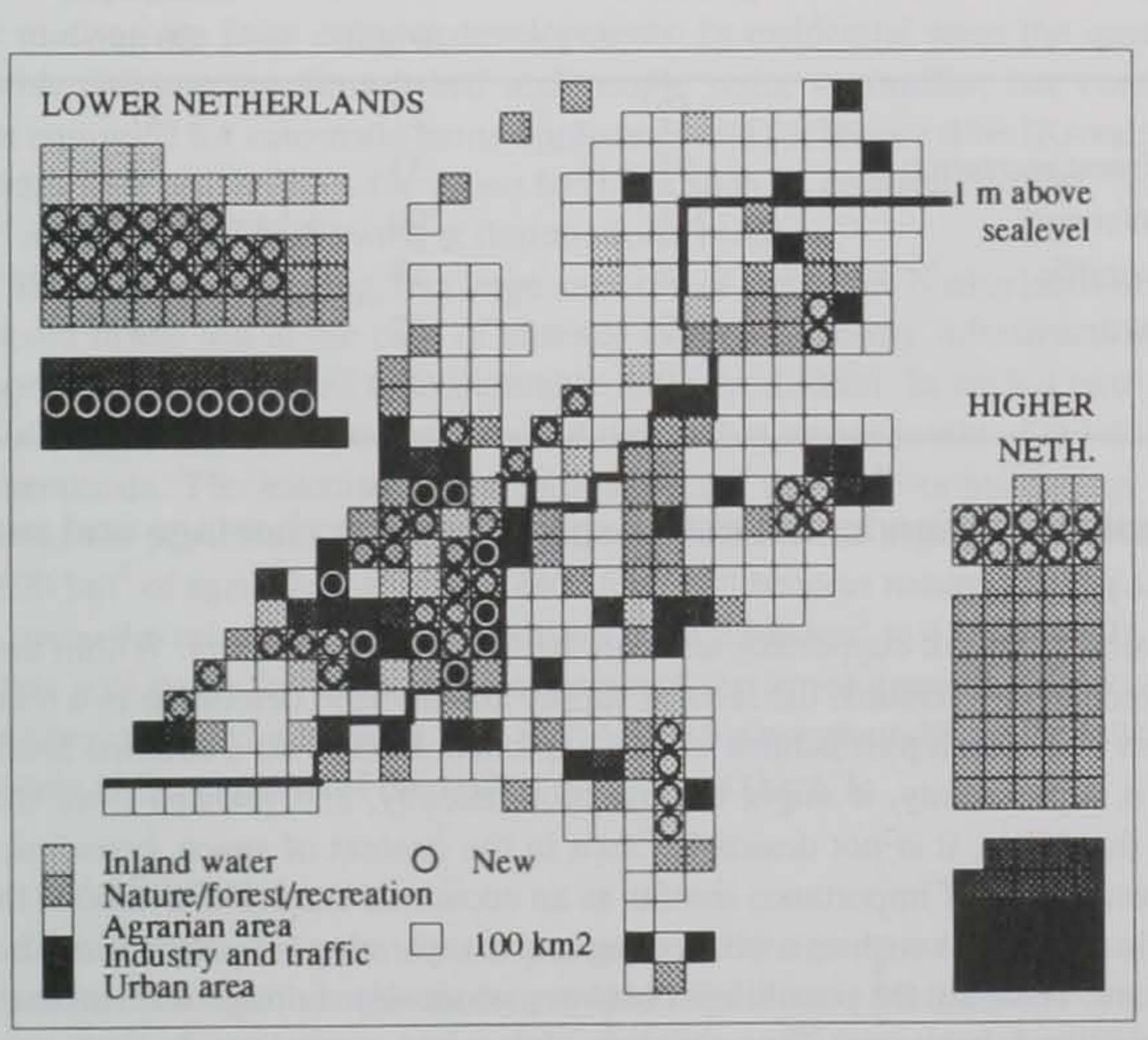

Fig. 5a. 20 mln inhabitants.

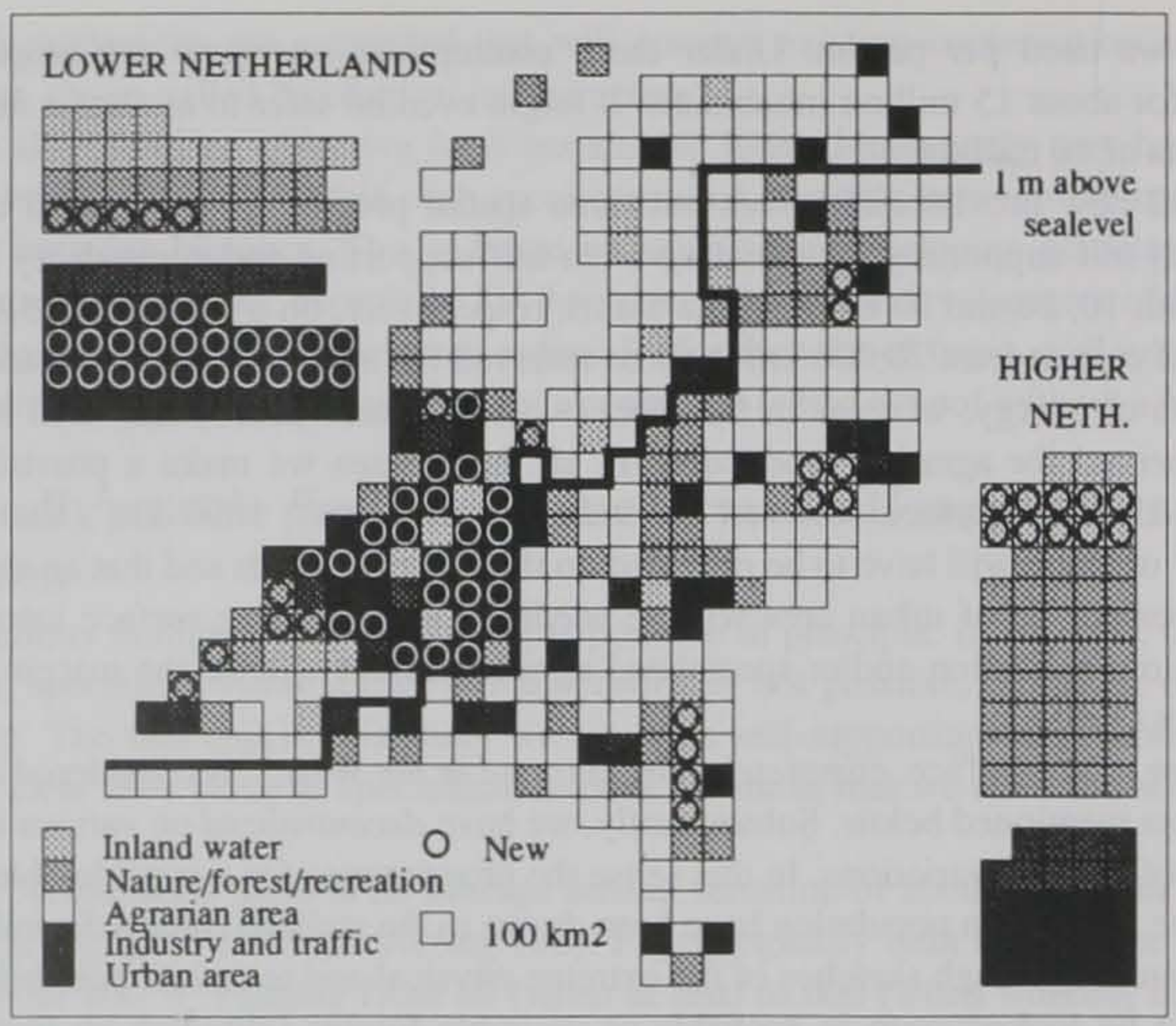

Fig. 5b. 30 mln inhabitants.

Table 2. Three programmes for the use of land in units of 100 km^2.

Destination	1985	inhabitants		
		10 mln	20 mln	30 mln
Water	17	27	27	27
Nature/forest/recreation	53	53	53	53
Agrarian/energy	241	200	200	200
Industry/traffic	18	18	18	18
Urban area	25	17	34	51
Margin	0	39	22	5

Economic variation in the use of space between shortage and surplus (- and +)

The possibility of self-supporting need not be utilized by economy. Within the world of what is technically possible the laws of supply and demand determine in a relatively autonomous way which possibilities will be exploited. Even if on a national level self-supporting is a possibility, it might be that economically, and perhaps from the point of view of durability, it is not desirable. Seen in the context of space, economic development is especially of importance insofar as an economic surplus is available that is used for public provisions such as a connecting and a separating infrastructure. The question is therefore: What are the possibilities between economic shortage and surplus for 10, 20 and 30 million inhabitants? The economic circumstances and mechanisms under which this spatially relevant shortage or surplus is probable (for instance shrinkage or growth)

will largely be left aside. The variants mentioned here apply to the level of scale of the Netherlands. "Surplus" on one level of scale and in one sector will leave unimpeded "Shortage" on another level of scale and in another sector or social category.

10 million inhabitants

For a diminishing and greying population there are great technical-economic problems regarding protection of the coast, management of water and nature, urban provisions, employment policies and provisions for old age. If we want to prevent pensioned-off people from moving to the quiet eastern part of the country (retirement migration), the *Randstad* from losing its international economic significance, agriculture and urbanization from not having sufficient capacity for infrastructural projects (the economic "Shortage" variant), we must suppose that a surplus will result from the introduction of telematics, automation and robots in every sector of consumption, traffic and production, which all replace man.

In the "Surplus" variant (Fig. 6b) a highly automated agrarian surface of 20,000 km^2 will have a task that is mainly devoted to export. From the point of view of productivity it would be appropriate to have a complete separation of agrarian use of the soil and nature, and a very concentrated and automated export-oriented agriculture with its own management of water and energy supply (see also Forester, 1988). However, if international developments require energetic self-supporting, half of this has to be reserved for a more direct production of energy. If solar and/or fusion energy are going to replace fossil fuels as from 2050, large-scale electrified self-supporting in the field of energy will be possible, although it may be advantageous to import solar energy from the Sahara.[23] The urban population will concentrate in the West, unless there is decentralization caused by motivations from cultural developments. In residential areas the quarters for families with children are demolished and people retire to smaller, but comfortable apartments equipped for automatic home appliances and for leisure time (Kroner, 1989). This provides new possibilities for urban facilities such as computerization, "cared-for travelling" and a public life directed at (international) culture.

In the "Shortage" variant (Fig. 6a) large surfaces of the lower Netherlands are left to nature or even to the sea in the case of absence of a solar energy infrastructure, of agrarian export possibilities or of a considerable meat production. In such a case there is the threat of degradation if there is no careful decreasing management of the old, eutrophicated farmlands. The international significance as "wetland" is increasing. An important part of the population of the *Randstad* will move to the high grounds where, out of the 12,800 km^2 of agricultural surface 2800 km^2 will become nature.

In both cases the urban area will be reduced from 2500 km^2 to 1700 km^2. In the former case this will partly be done at the expense of the lower grounds (300 km^2 in the *Randstad* to be converted into parks; 500 km^2 on the higher grounds); in the latter case it will be entirely at the expense of the higher grounds (800 km^2).

20 million inhabitants

There are sufficient people to pay for the pensions of the ageing autochthonous population. As there is not so much emphasis on productivity, there is more room for a (labour-intensive) mixture of agriculture and nature, wildlife and urban area, horticulture and urban area. In addition there is a larger basis for large-scale infrastructural projects that

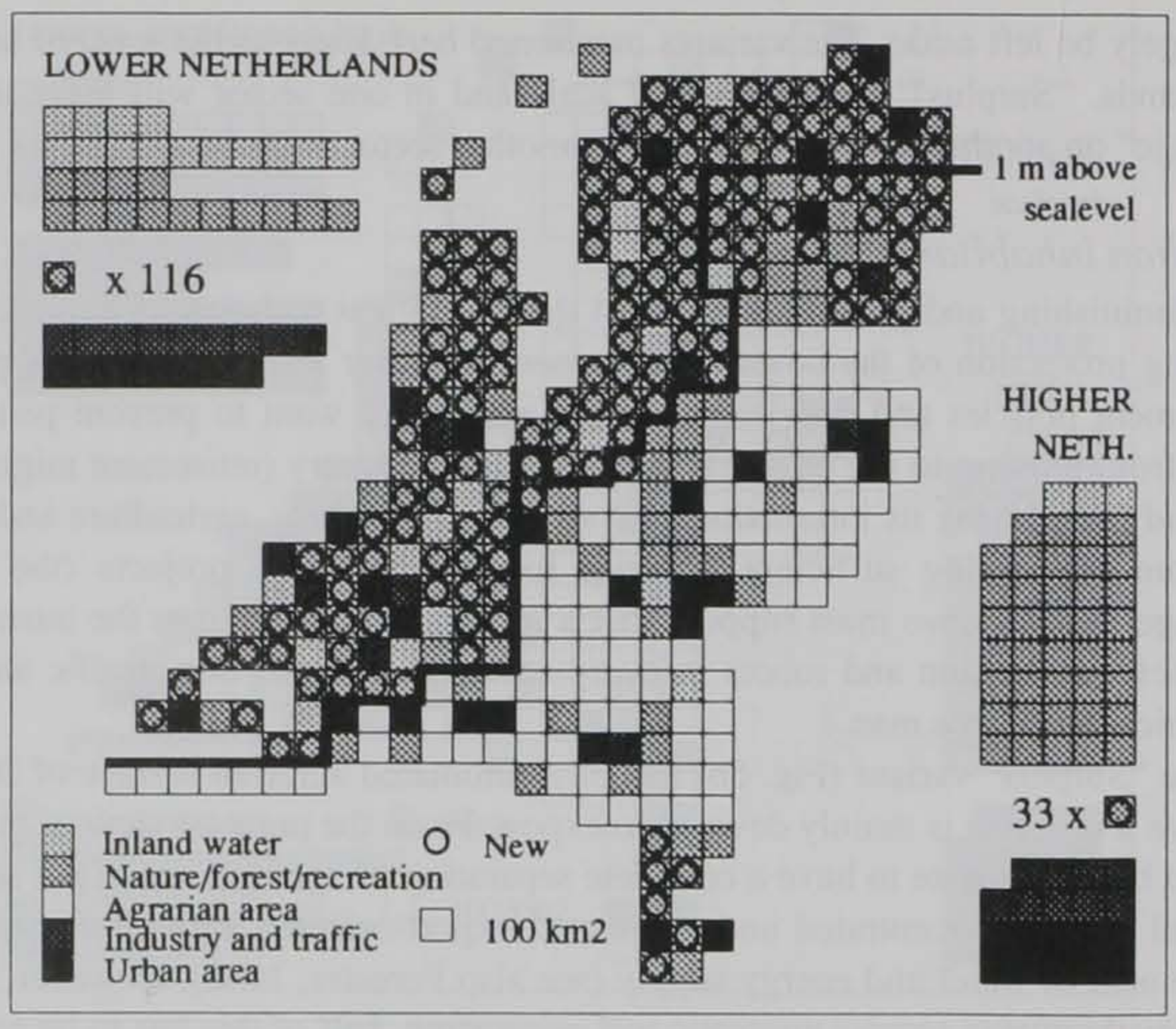

Fig. 6a. 10 mln inhabitants "Shortage".

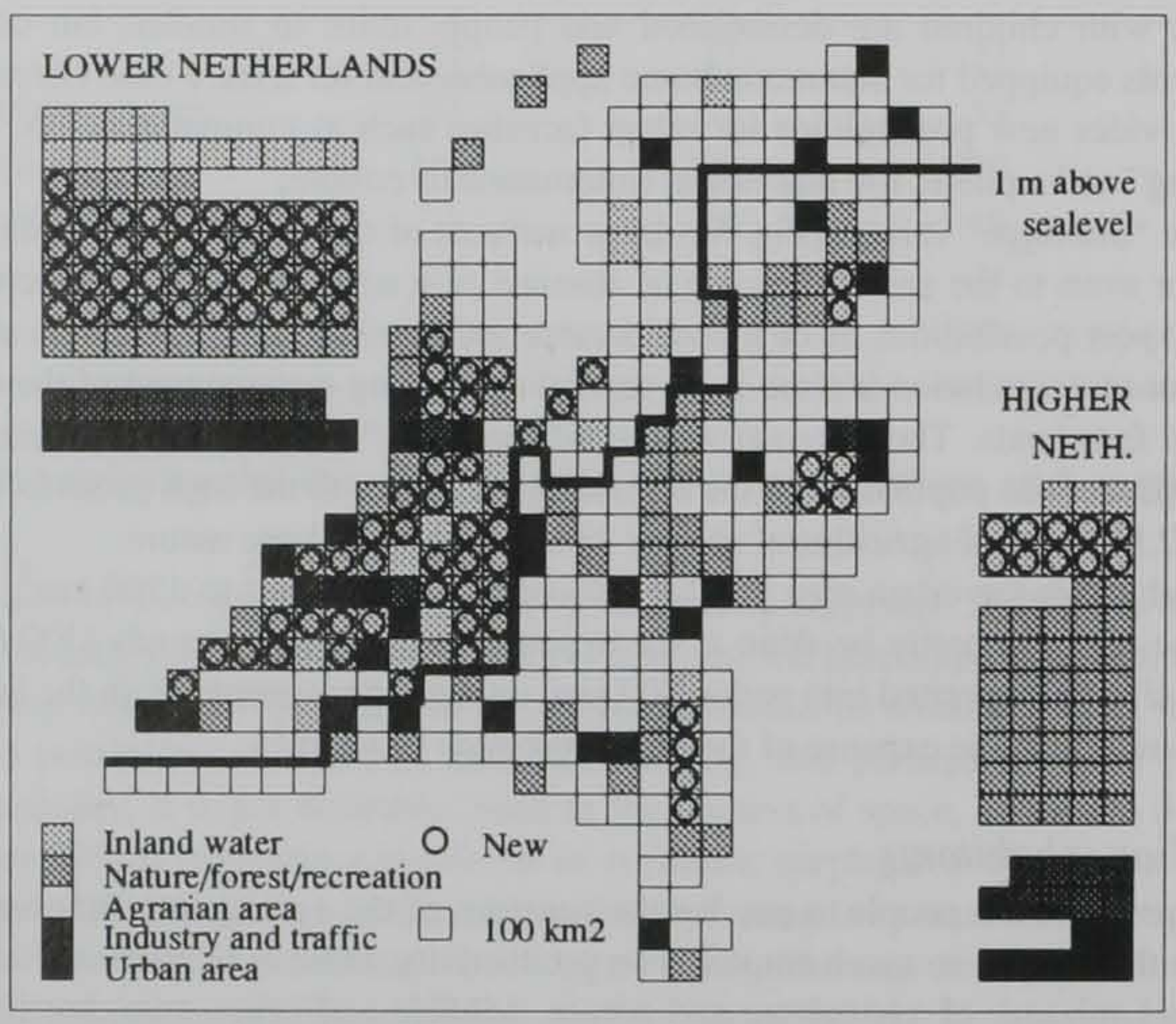

Fig. 6b. 10 mln inhabitants "Surplus".

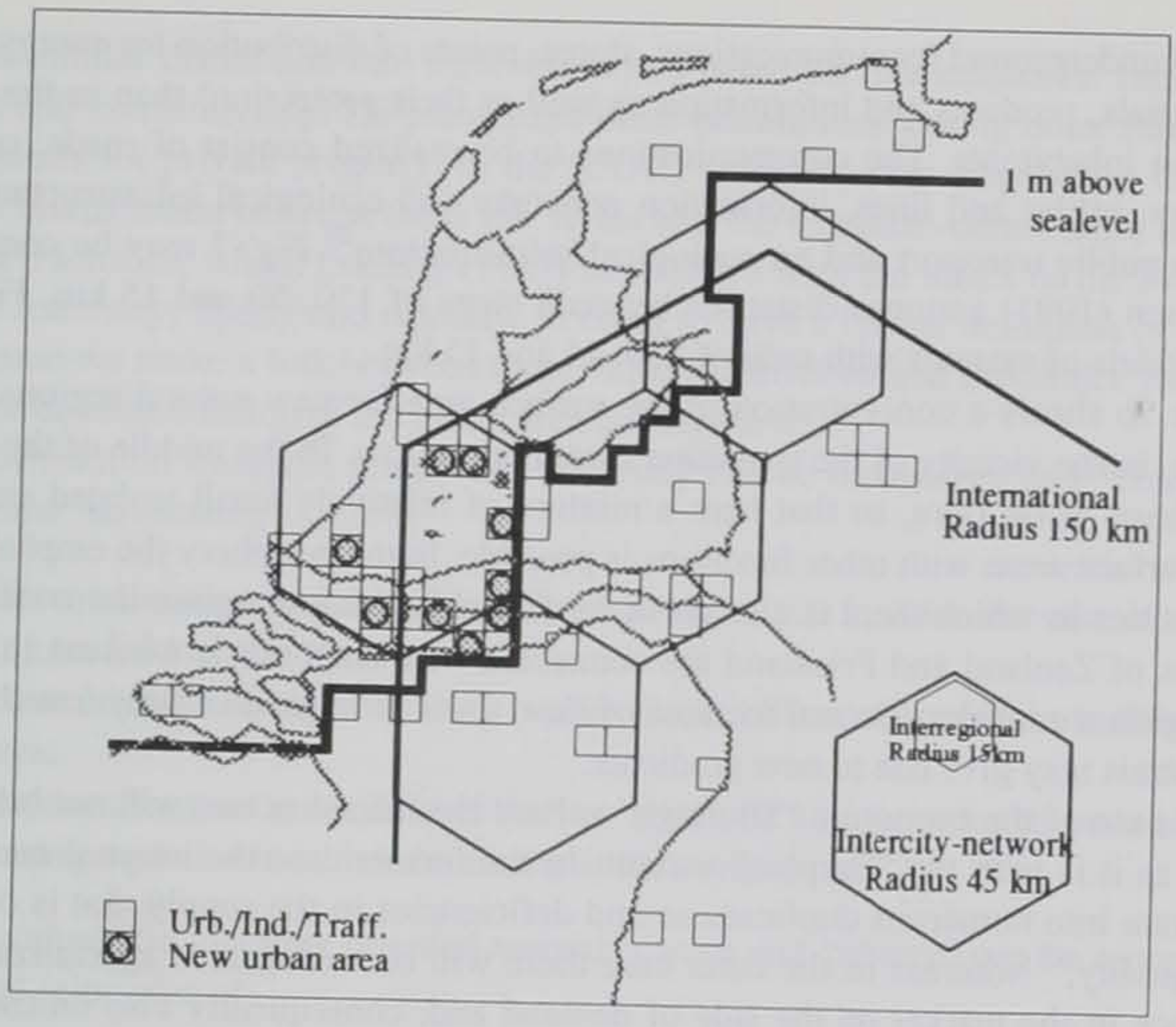

Fig. 7a. 20 mln "Surplus". Public transport.

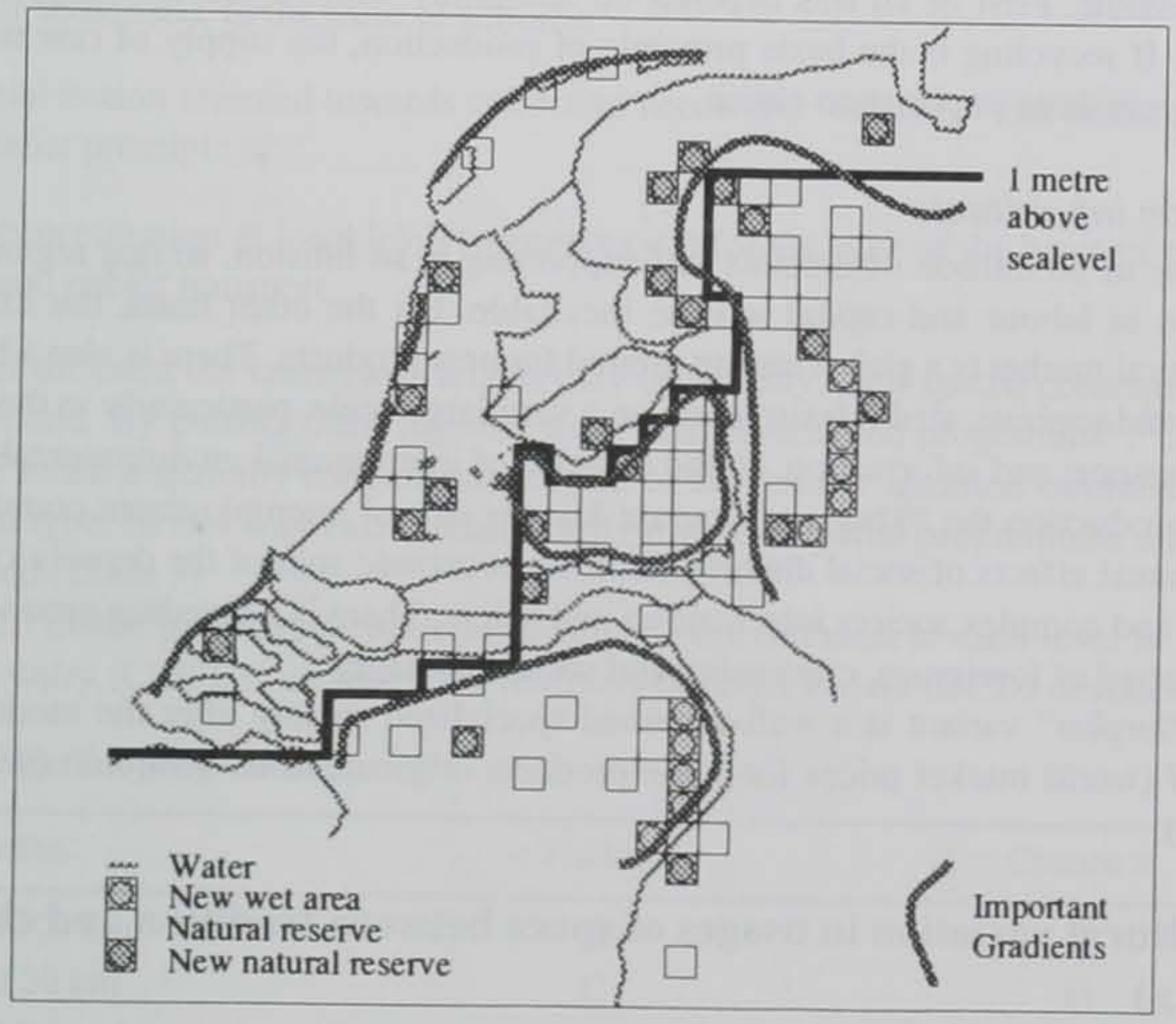

Fig. 7b. 20 mln "Surplus". Ecological infrastructure.

are partly underground (communications, stores, points of distribution for energy, water, raw materials, products and information as well as their protection) than in the case of 10 million inhabitants. The communications to be realized consist of roads, railways, waterways, cables and lines, information networks and ecological infrastructure. With regard to public transport and an ecological infrastructure[24] Fig. 7 may be considered. Van Witsen (1991) assumes distances between stops of 150, 50 and 15 km. Figure 7a shows models of systems with radii of 150, 45 and 15 km.

Figure 7b shows a concentration of the surface area for new natural regions, rich in gradients, in the vicinity of the transition from high to low. In the middle of the country the emphasis is on flora, so that here a mixture of relatively small isolated entities of natural surface areas with other functions is possible. In the periphery the emphasis is on larger entities in which there is also room for fauna. In the low region the waters in the provinces of Zeeland and Friesland are connected with each other, whereas in the elevated region a considerable surface area of new water is located in dehydrated centres. This contrast may give rise to new gradients.

In the case of the economic "Shortage" variant the infrastructure will not be realized in time, as it is with the "Surplus" variant. In the former case the internal market will disintegrate into numerous duplications and deficiencies in the supply that is otherwise of low quality,[25] whereas in the latter case there will be well-geared specialization and confidence in the market on the side of demand and, consequently also on the side of supply.

The population figure provides the possibility of a supply of labour that is differentiated in such a way that also in sectors other than agrarian ones economic self-supporting is possible. First of all this depends on autonomy with regard to energy and raw materials. If recycling is the basic principle of production, the supply of raw materials will not necessitate importation either.

30 million inhabitants

In the case of 30 million inhabitants self-supporting is an illusion, so that regional specialization in labour and capital will be inevitable. On the other hand, the extremely multicultural market is a global testing ground for new products. There is also a basis for a further and sophisticated infrastructure on a very large scale, particularly in the field of public transport and information. In the absence of international environmental legislation for production the "Shortage" variant has the risk of unemployment coupled with the additional effects of social disintegration, an economic split of the densely crowded, dynamic and complex society into winners and losers. There is a breeding ground for rumours, hatred of foreigners, criminality and social sabotage.

The "Surplus" variant is a well-informed specialized society after the model of the *Westland* (world market prices for some products originate at its auctions) (de Jong et al., 1987).

The cultural variation in usages of space between tradition and chance (< and >)

Riesman (1950) distinguishes three value orientations in historical order: tradition-directed, inner-directed and other-directed. He claims that the latter type, broadly speaking, dominates the fashionable, contemporary (American) society. Michelson (1970)

makes a similar distinction into three life styles based on role emphasis: familism, careerism and consumership. He recognizes these orientations among other things in advertisements for private property. In the NNAO scenarios (van Engelsdorp Gastelaars, 1987) a link is made between these life styles and the Christian-democratic, liberal and socialist traditions, which Frieling (1987) interrelates with the ideals of the French revolution: fraternity, liberty and equality. In order to have a further definition of the space programme we make a link between these value orientations and the choice for concentration or decentralization of the urban area on three levels.

The orientation tradition, family and fraternity can be recognized in a "conventional programme" advocating:

- decentralization at national level (radius about 100 km) for the sake of maintaining traditional regions;
- concentration at regional level (radius about 30 km) to maintain traditional centres;
- decentralization at local level (radius about 10 km) in order to maintain small, caring societies in which the family is the cornerstone.

The individualistic ideology oriented towards career and "liberty" can be recognized in the liberal principles of:

- concentration at national level for the sake of the competitiveness of the *Randstad*;
- decentralization at regional level because of free settlement to live and to work, if so desired, in the form of suburbs.

The social notion oriented towards collective needs and "equality" can be recognized in the socialist principle of:

- concentration at local level (compact city) for the sake of the basis of provisions and public transport.

However different the latter two variants may be socially, their spatial consequences can be combined. By putting them together as a "chance-oriented programme",[26], this programme forms a spatially relevant counterpart of the former "tradition-oriented" cultural idealized type. In this way two fundamentally different spatial programmes may be distinguished (Table 3).

In each of the previous pictures we assumed concentration at each level in the West of the country (CCC), from which the tradition-oriented variant (DCD) deviates most. In

Table 3. Spatial programmes.

Level/radius	< Tradition	Chance >
National 100 km	D	C
Regional 30 km	C	D
Local 10 km	D	C

C: Concentration of urban area
D: Decentralization of urban area

Fig. 8a the new urban area is spread across the regions (D) and within those regions it is concentrated around the existing central areas (C). As a result each of these concentra-

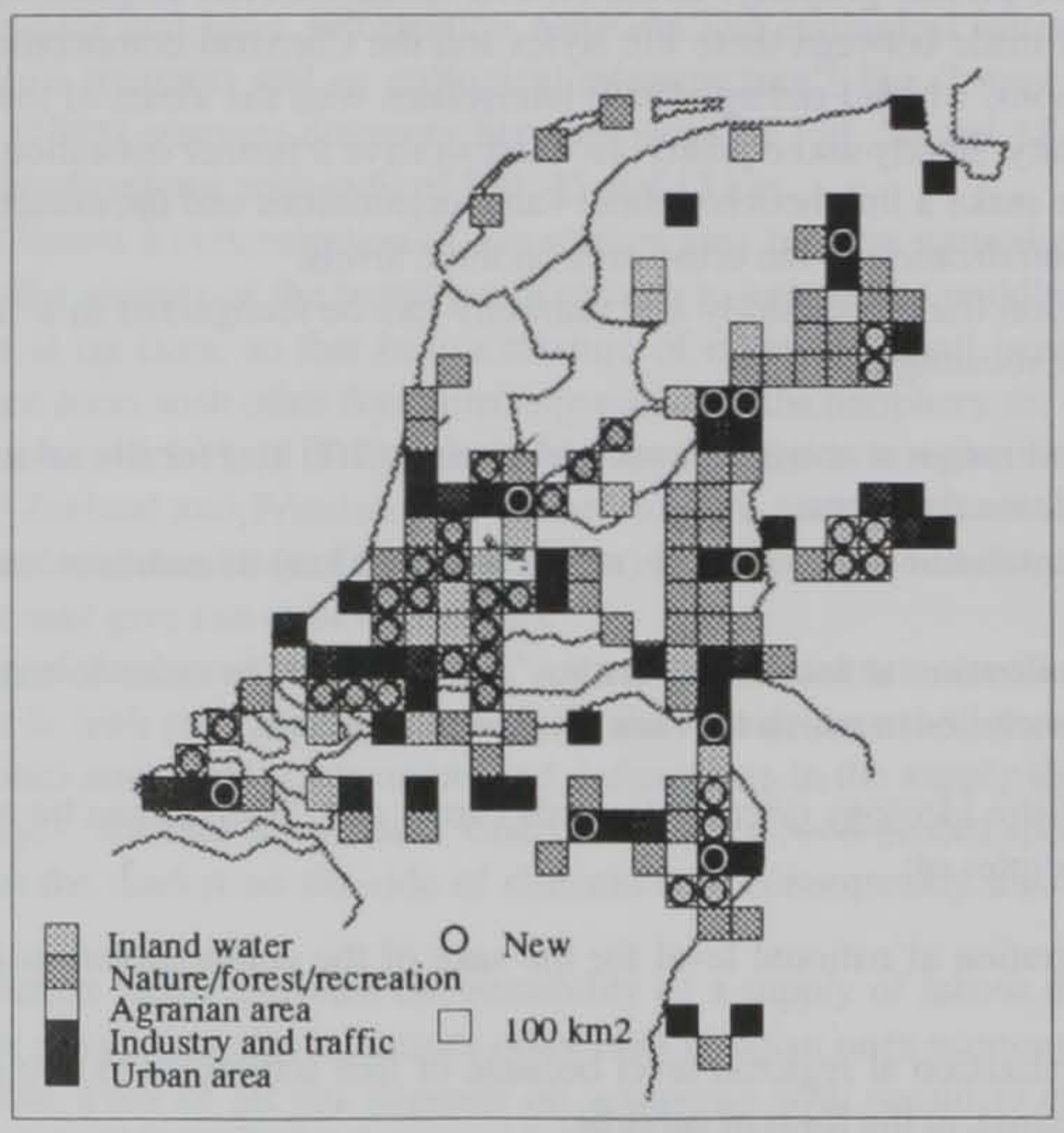

Fig. 8a. 20 million inhabitants < DCD.

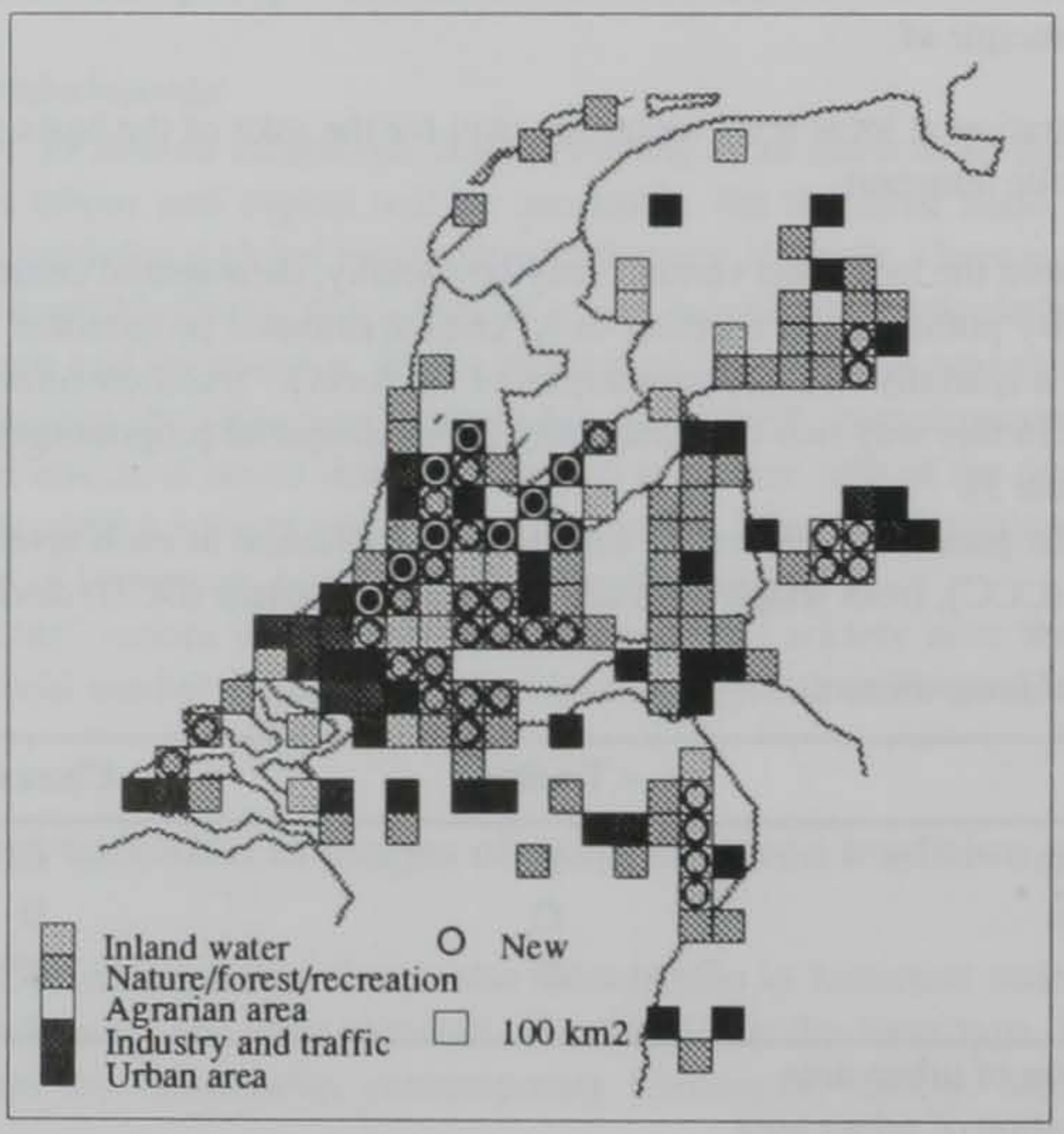

Fig. 8b. 20 million inhabitants > CDC.

tions has at least one million inhabitants, who now have a considerable level of provisions, whereas in their own region they will not lose contact with nature and agriculture, which enables them to maintain their feeling for regional responsibility.

In accordance with the chance-oriented programme Fig. 8b shows the new urban area to be mainly concentrated around Amsterdam, flowing out to the provinces of North Holland, Flevoland, Utrecht and the city of The Hague (CDC). The industrial area, offering few jobs and by now extensively automated, is concentrated in Rotterdam. Its petrochemical industry has been replaced by agricultural chemistry. The Ruhr area is no longer the most important hinterland, and consequently Rotterdam has not expanded any further. The Dutch metropolis around Amsterdam is orientating at Europe through high-speed railway lines and at the world through Schiphol airport. In this picture the peripheral urban areas are only outposts and the peripheral rural sectors lying in between are sanctuaries.

The "Shortage" and "Surplus" variants can again be distinguished in the extent to which provisions and infrastructure are realized. The conventional programme tends towards a proportional, regional distribution of accessibility. In Fig. 9a the high-speed railway network has been extended to a loop line with side tracks to the north, east and south. As a result of the national concentration the "chance-oriented programme" (Fig. 9b) provides a broader basis for large-scale national provisions and infrastructure. The unequal distribution of accessibility makes it possible to have large-scale peripheral sanctuaries.

The "Shortage" variants are characterized by failing concentration around missing communications: the "grey economy" will look for and find cheap space for living and establishment in the country where self-supporting is imaginable on the level of the local societies. On the other hand, the "conventional programme" can withstand this bet-

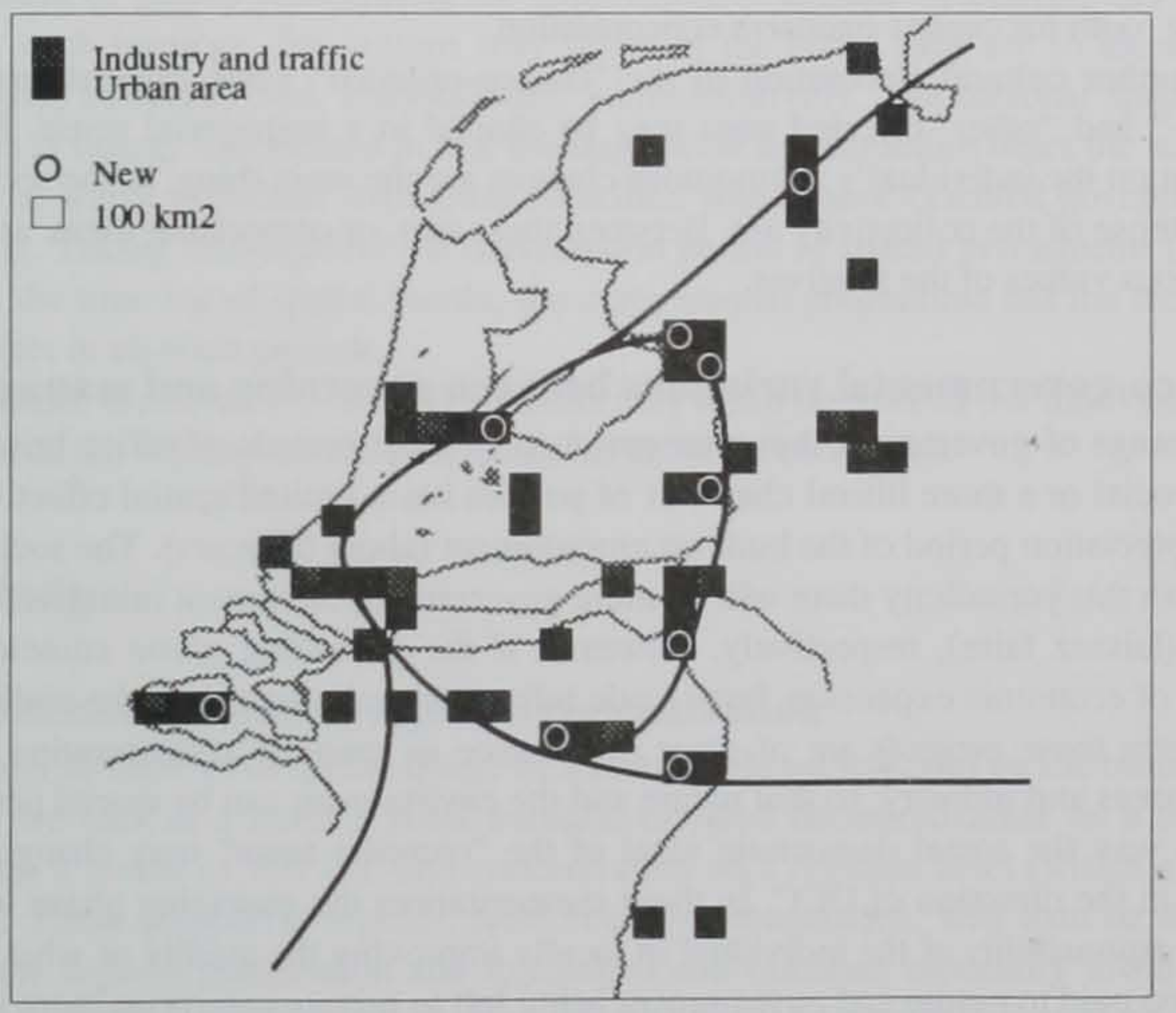

Fig. 9a. 20 million + < DCD.

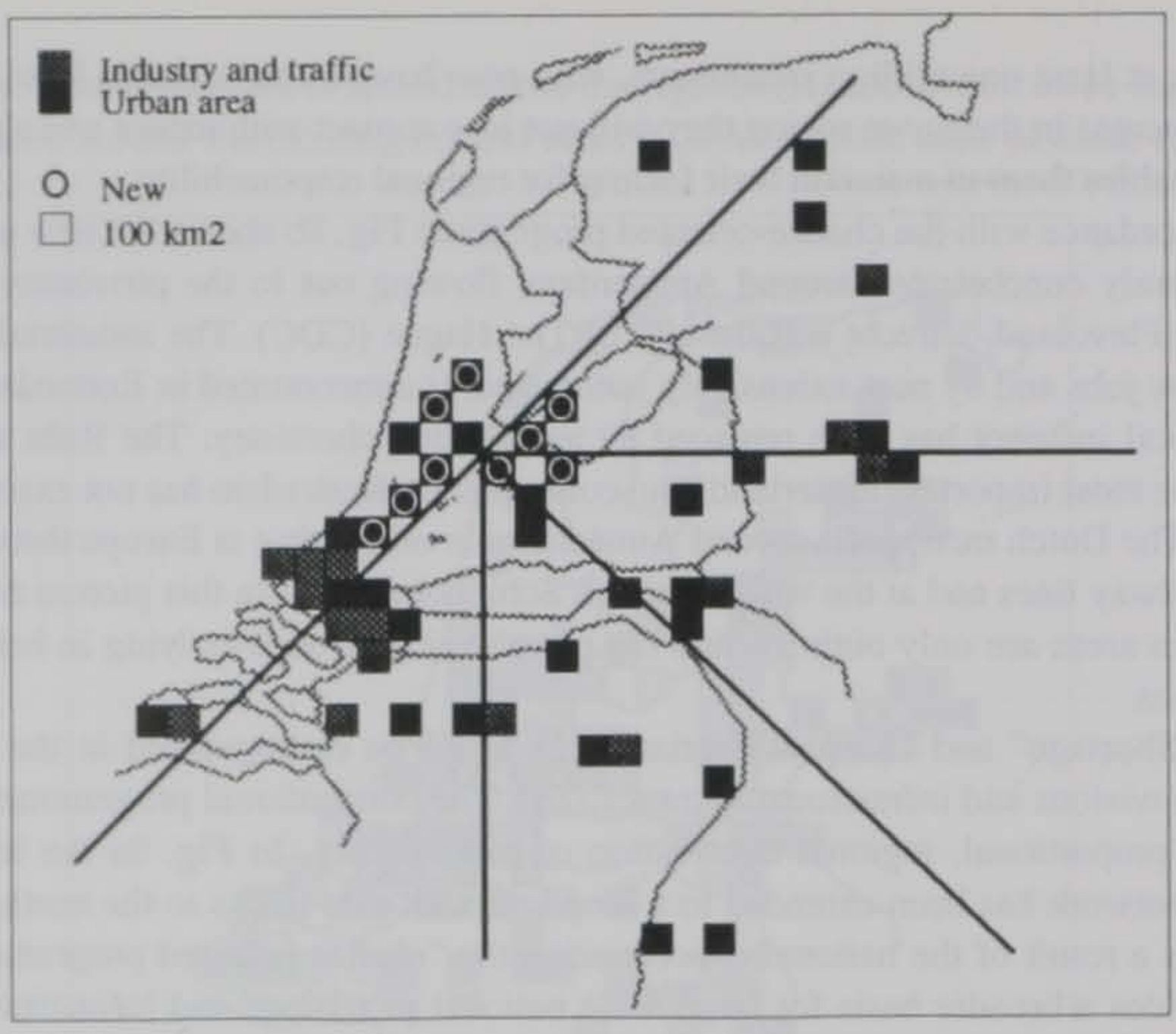

Fig. 9b. 20 million + > CDC.

ter than the "chance-oriented" programme. If we consider the variants of the 30 million inhabitants in this perspective, they provide a broader basis in both cases for advanced communications and urban concentration on the regional or the national level, respectively. In this case shortage will lead to a lot of pressure on wildlife areas, "Surplus" permitting room for capital-intensive concentration.

A further cultural elaboration of the "chance-oriented" value orientations based on "inner-" and "other"-directed ones may be shaped in a managerial sense. In the first orientation the individual's autonomous chances are the main thing; in the second orientation those of the collectivity are. Between these two, or comprising them, are the heteronomous values of the relatives.

Politico-governmental variations between governing and managing

The change of government that after one, two or three periods of office brings about a more social or a more liberal character of politics has a limited spatial effect because of the depreciation period of the built-up environment (about 50 years). The social effect is that with this periodicity there will be more governing (government initiative) than managing (laissez faire), respectively. However, if the governing *phase* coincides with a period of economic expansion, large-scale infrastructural projects can be realized. In the long term these projects are of great importance as spatially concentrating forces for urban areas and industry, so that nature and the environment can be spared permanently. In this way the social democratic ideal of the "compact town" may change the DCD model in the direction of DCC. In these circumstances the managing phase will lead to more *responsibility* of the individual in locally improving the quality of what exists, the attention paid to nature and environment being left to private enterprise more frequently. Under favourable economic conditions the liberal principle of freely choosing one's

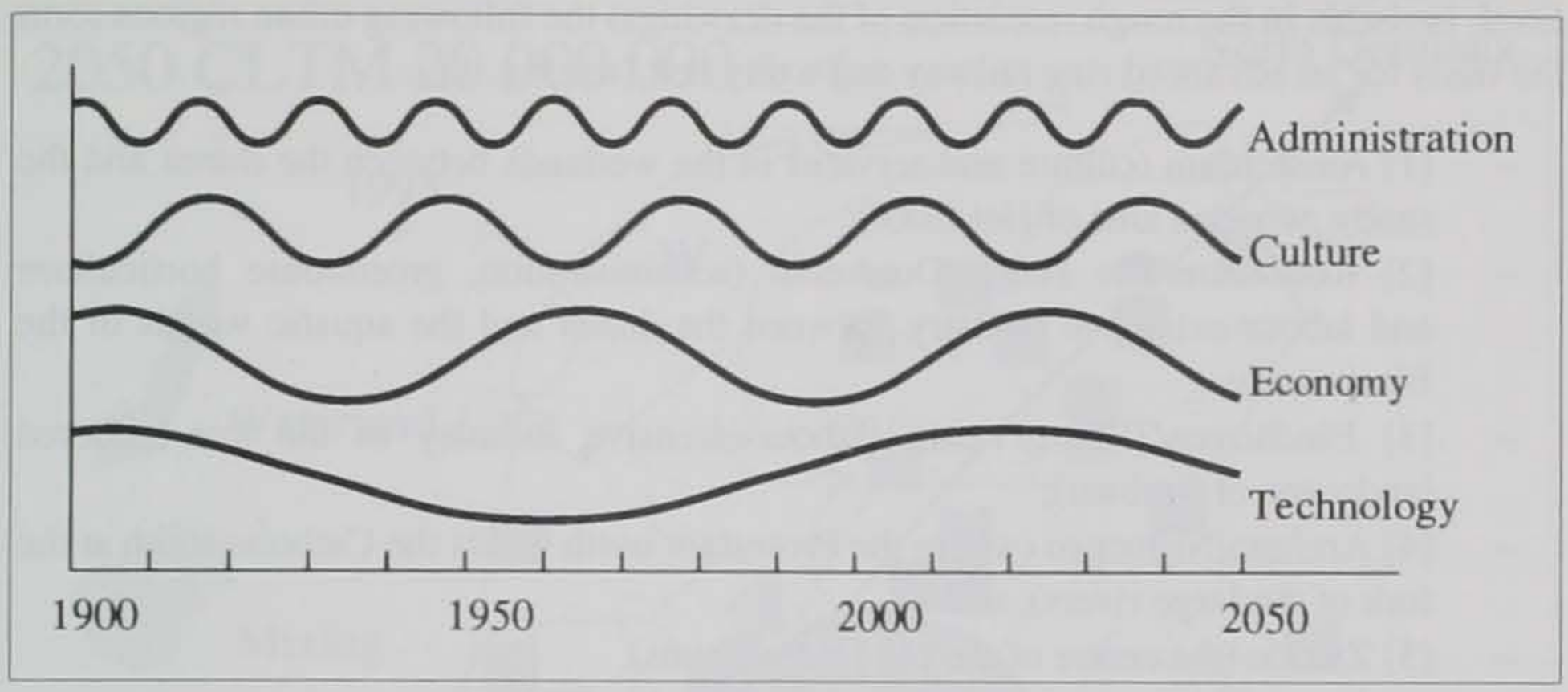

Fig. 10. Coherence of long- and short-term variations (arbitrary and tentative).

place to live and to settle while maintaining a strong control on the *Randstad* could change the DCD model into the direction of CDD.

In Fig. 10 the interaction between technical, economic, cultural and governmental variations in time is tentatively shown, starting from the arbitrary supposition that this time will take a period of 120, 60, 30 and 15 years, respectively. A change from governing to managing or the other way round will then take place every 7.5 years. In this figure the administration oscillates between governing and managing (7.5 years); culture in longer phases of a generation between tradition- and chance-oriented (15 years); the economy between rich in initiative and consolidating (30 years); and technology between innovation and implementation (60 years) (Simmie, 1986). Each time has its own unique system of phases determining the administrative agenda. Moreover, this system differs for each territory, for regions may differ in the phase they are in technically, economically, culturally and, consequently, administratively. The national spatial differentiation is mainly determined in that the large-scale infrastructure bears the stamp of the period in which economic expansion coincided with chance-oriented governing administration. Taking into account the depreciation period of spatial investments (say 50 years) and the time lag of spatial inertia, the conventional programme has the most permanent effect in all other periods.

On this basic theme all preceding variations may again be worked out into variants in order to check the solidity of this concept under different conditions.

20.3 A design

National decentralization, regional concentration

In the case of an indicative spatial image of a sustainable society, and on the basis of the foregoing, we take as a starting point tradition-oriented decentralization on a national level (within a radius of 100 km) and concentration on a regional level (within a radius of 30 km). These peripheral regions, reinforced by urbanization, will then be more in line with the regions Amsterdam and Rotterdam and orientate especially towards Europe. Because of the density of their populations (despite a possible sprawl on a local

level, invisible in the rough resolution of the drawings) the following urban regions form the basis for an advanced ring railway and a city belt (see Fig. 11).

- [1] Amsterdam (culture and services in the wetlands between the dunes and the sandy, wooded area of Het Gooi);
- [2] Rotterdam/The Hague/Dordrecht (administration, greenhouse horticulture and labour-extensive industry between the dunes and the aquatic woods of the Biesbosch);
- [3] Eindhoven/Tilburg/Venlo (labour-intensive industry in the tree-bordered landscape of Brabant);
- [4] Arnhem/Nijmegen (where the Protestant north meets the Catholic south at the fork of the large rivers); and
- [5] Zwolle (the centre of the old Hansa towns).

Within these regions four essential natural Dutch landscapes (wooded and sandy areas of the elevated Veluwe [V]; the River district [R], rich in clay, with its flowing rivers; the cut peat bog Lowland [L] with cattle and villages with ribbon development, as well as the new Polders [P] reclaimed from the sea) form an enlarged green heart. The aim is to achieve the largest possible variety on a small surface area by combining natural entities of a minimum size of 1 km^2 with forestry, (organic) agriculture and recreation.

Outside the city belt the objective is larger entities of natural areas: within a radius of 30 km around the large regional centres entities having a minimum size of 10 km^2; outside this radius entities with a minimum size of 100 km^2. The largest entities lie in quiet rural regions. In the lowlands these are: Zeeland [Z], criss-crossed with wide stretches of water; Noord-Holland [N] with its old towns and polders; Friesland/Groningen [F] with their stately farms, boats and waters; the Wadden [W] with its islands in the low country; Drente [D] with its "esdorpen" (villages surrounded by fields); Twente/Graafschap [T] with its trees and fields; Limburg [L] with its gravel pits along the Meuse. These areas comprise the following peripheral urban concentrations: Groningen-Assen-Delfzijl [6] along the "Scanlink", orientated towards Scandinavia, North and East Germany and the former Eastern bloc; Maastricht-Aken-Luik [7] related to South Germany; the Twente Euro-region [8], and the Schelde Euro-region [9]. Within the city belt Utrecht [10] forms a regional urban centre closely interwoven with natural values.

In this design the Netherlands is decentralized into ten urban and ten rural regions. Each urban region has a concentrated centre with at least one million inhabitants and is situated in an "ommeland" (environment) that has a typically Dutch and highly varied landscape.

The five regions along the ring railway are situated in an "ommeland" that will be developed within the ring, with the emphasis on a mix of nature, agriculture, recreation and urban areas; outside the ring the emphasis is on segregation. As a result each region will show differentiation in experience with and responsibility for its landscape, while the surroundings will provide environmental bases for urban differentiation of the city itself. Industrial activities are kept outside the ring, and inside the ring the emphasis is on services and small-scale industrial activities. Economy-related connections such as roads, waterways, railways, networks for telephone as well as mains for gas, electricity and water, and telecommunication infrastructure will be concentrated on the ring as much as possible, while an ecological and recreational infrastructure connects the inner area – a varied and ecological laboratory – with the more homogeneous outer area.

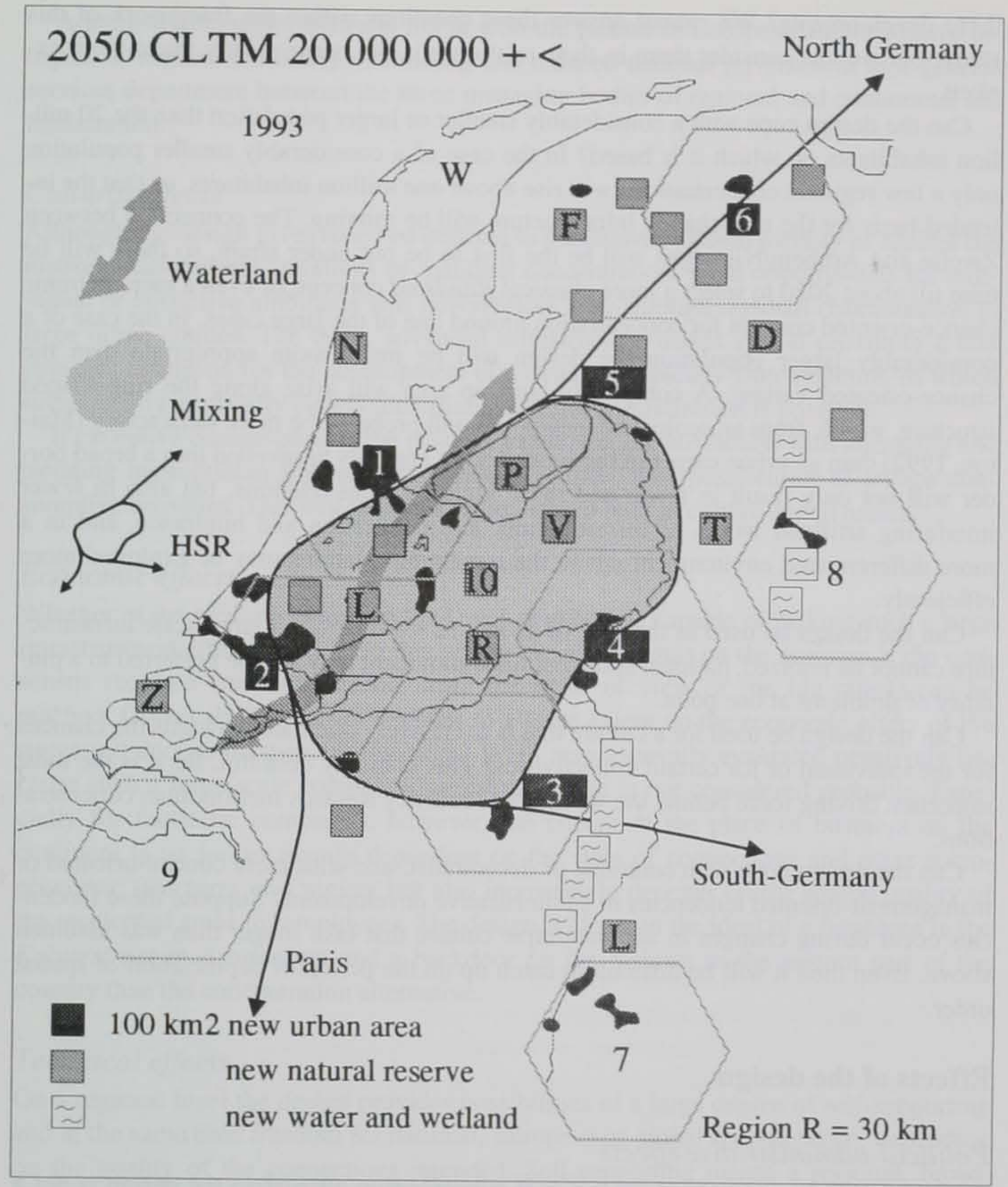

Fig. 11. A design (see text for explanation).

The most important ecological and recreational axis is the "water" line, connecting Zeeland via the lake districts of Zuid-Holland and Utrecht as well as the IJsselmeer with the Frisian lake district. The axis passes the ring east of Amsterdam and Rotterdam via large ecological and infrastructural projects. As a result these cities will also have an eastern "soft" dockland for pleasure cruising around the "water gateway" through which the axis visibly crosses the ring. This axis will turn the Netherlands into a country for water sports just as Switzerland is for winter sports.

The solidity of the design

How solid is the design against the background of all possible administrative, cultural, technical and ecological developments outlined here and how does it, in its turn, affect

these developments? We cannot answer these questions within the framework of this study, but we can consider them in their relationship and consequently make them explicit.

Can the design cope with a considerably smaller or larger population than the 20 million inhabitants on which it is based? In the case of a considerably smaller population only a few regional concentrations will rise above one million inhabitants, so that the intended basis for the ring-shaped infrastructure will be missing. The connection between Zwolle and Arnhem/Nijmegen will be the first to be put under strain, so there will be time till about 2020 to select a more classical *Randstad* concept, or even a more extreme chance-oriented concept for concentration around one of the large cities. In the case of a considerably larger population the design will be much more appropriate than the chance-oriented variant. A completely built-up area will arise along the ring-shaped structure, which, from an ecological viewpoint, will probably be more satisfactory (Matton, 1992) than an urban carpet in the west. A knot spatially unravelled into a broad border will not only result in fewer and more logical spatial relations, but also in fewer interfering artificial works of infrastructure, less congestion and hindrance, and in a more differentiated environment where the remaining relations may be exploited more efficiently.

Can the design be used in the case of economic shortage? If a large-scale infrastructure cannot be realized, national spread of unemployment may still be preferred to a plurality of problems at one point.

Can the design be used for a culture that is exclusively orientated towards the chances for the individual or for certain collectivities? This is highly doubtful, for it is the most important driving force behind the worldwide tendency towards metropolitan concentrations.

Can the design cope with centralist or decentralist, and with more control-oriented or management-oriented tendencies in administrative development? Suppose these tendencies occur during changes in administrative culture that take longer than was assumed above. Even then it will be difficult to catch up on the period of depreciation of spatial order.

Effects of the design

Political-administrative effects

Against the "urban carpet" of the national concentration alternative the design is not a spatial condition but as "round table" a clear image of administration decentralization. From the point of view of nature and environment this is a large step towards the much desired regional integration of ecological responsibility and recovery of the crumbling national and political involvement in a regional context. Paradoxically, however, in the medium long term this will mean an enormous and improbable infrastructural effort on a central level to guarantee and channel mutual coherence as well as coherence with the rest of the world. Its effect on the regional political agenda may be a prolonged shift of economic items to more ecological ones. In the long term administrative energy will be spent on characteristic identity and differentiating complementarity rather than on senseless mutual competition. In the latter case there will certainly be losers; not in the former.

Administrative regionalization fits in with the picture of European administrative integration with an ultimately controlling and reduced national government as a general services department between the more managing bodies of regional and continental administration.

Cultural effects

Although the design gives renewed impetus to traditional regional identity as against the metropolitan-cultural ambitions of national concentration, good opportunities for individual or collective ambitions will nevertheless arise through regional concentration in large urban entities. The large, advanced infrastructure makes spatial proximity a less stringent condition for the development of a dynamic typically Dutch culture, in which subsequently a spatially clearly identifiable cultural specialization is possible.

If excessive consumption is the result of existential dissatisfaction with alienating and isolating metropolitan life, regionalization will offer new possibilities to reduce consumptive activities. This will require a region varied both in culture and in nature.

Economic effects

Whether in the medium long term the Dutch economy is capable of making such a large infrastructural effort proposed in this design largely depends on the question if the consensus required (now improbable from the point of view of the big cities) can be reached. Obviously the answer depends to a large extent on the economic effect of the suggested decentralization on a national level, now generally evaluated negatively because such a large-scale compensating infrastructure is not considered probable. Especially for footloose companies, however, the choice of the place of business on the continent is no longer mainly dependent on the state of connections and other socio-economic structures of a region, but also increasingly depends on the spatial quality of the residential areas for employees. The design is closer to the ideal of a frontdoor in the *Kalverstraat* in Amsterdam and a backdoor on the Veluwe in the eastern part of the country than the concentration alternative.

Technical effects

On a regional level the design provides possibilities of a large degree of self-supporting and at the same time freedom for national, European or global specialization, depending on the quality of the connections intended. Self-supporting means a regional, broad, technological spectrum with a small degree of capital-intensive innovation: development of local techniques is based on improvements of what already exists. Specialization means making a better product than others and, consequently, requires capital-intensive local innovation in order to remain ahead of the world, the *Westland* forming a clear example. There is some reason to assume that in peripheral, somewhat identifiably specialized regions, innovations spread faster than in metropolitan regions where a plurality of innovative attempts usually meets with more scepticism (Drewe, 1988). Established economic interests in metropolitan regions may be a drag on the innovative climate in the same way as the rigid and unwieldy structure of large companies is a drag on their flexibility as compared with that of small and medium-sized businesses. The combination of different kinds of large-scale infrastructure as presented in the design naturally

raises numerous questions of transport technology which will not be dealt with in the scope of this study.

Ecological effects

The final and most relevant question within the framework of this study is, of course, whether the suggested spatial picture offers a good representation of a sustainable environment in the long term. We think it important to state, first of all, that the spatial order of an administrative/cultural/economic/technological complex does not cause good or bad, sustainable or nonsustainable ecosystems, but merely offers more or fewer conditions.

National decentralization as worked out in the design and compared with national concentration, provides favourable conditions for sustainable administrative developments (e.g. ecological standards specific to a region), for cultural developments (e.g. involvement in the ecosystem where one lives), for economic developments (with possibilities of high-quality residential environment, self-supporting and ecologically justified, channelled specialization), as well as for technical developments (local innovation). The variety brought about by this decentralization reduces the overall ecological risk in all these sectors. National decentralization, however, also leads to the spread of potentially harmful effects, depletion and pollution, and to decreased possibilities of control. Regional concentration as worked out in the design compensates this effect. However, the basis of this design is formed by potentially large administrative, cultural, economic and technical *varieties* in the ways of habitation, brought about by decentralization. As a result an ecological variety in biotopes may evolve, offering identity to each region and, within the region, to each individual.

Identity is a condition for responsibility. Only an individual who knows that he is placed in a recognizable variety understands his position in this world and can feel responsible for a sustainable future.

20.4 Summary and conclusions

The Netherlands is far from full. If in the next century considerable streams of environmental refugees will have to be housed, a growth to 20 million inhabitants of the existing urban density can be fully realized within the circle of the *Randstad*, in which case present technology will even permit agrarian self-supporting within the surface area of the Netherlands. This does not mean that in view of the effects this would be desirable or probable. In the case of 10 million inhabitants and an economically feasible technology capable of collecting sunshine with a yield of 5% even energetic self-supporting will be possible. In the case of 30 million inhabitants energetic or agrarian self-supporting is no longer conceivable, but with the present urban density housing within the *Randstad* still remains possible. The *Green Heart* will then be lost, however, which might turn out to be an irreparable deficiency for a sustainable society in a remote future.

Although concentration of urban areas is desirable from the point of view of practically every environmental aspect, the question remains whether this goes for every level of scale. The environmental advantages of concentration are demonstrable on the level

of a neighbourhood (radius 300 m), a city (3 km) and a region (30 km). However, if one also considers social and cultural aspects, such as permanent responsibility for environment, nature and landscape, it may be desirable to see to it that nature and landscape will remain recognizable within areas of habitation and the political sphere of influence of those areas. This would be another argument for decentralization on a national level. Within the framework of this study a design has been made that, in the case of a considerable increase of population through immigration, divides the *Randstad* into ten regions, within which the urban area will be concentrated. These regions have an average of over one million inhabitants. Each urban area is surrounded by its own recognizable and varied landscape. The urban areas are mutually connected via an advanced high-speed ring railway line. This design seems to be an alternative to today's aim for national concentration, providing the possibility to have a society that is sustainable for several reasons.

Notes

1. Wet op de Ruimtelijke Ordening (Act on Environmental Planning), art. 2 en 52, Besluit op de Ruimtelijke Ordening art. 30.
2. H. van der Cammen (ed.), Nieuw Nederland, onderwerp van ontwerp (The New Netherlands, a design), boek 1, Achtergronden (Backgrounds) en boek 2, Beeldverhalen, Stichting Nederland Nu Als Ontwerp, Staatsuitgeverij 's-Gravenhage 1987.
3. The "additional" but unpublished scenarios written in 1986 and 1987 for NNAO deal with the following subjects: *Agriculture* (Mentink), *Nature* (Gelderblom and Stortenbeker), *Water* (Bulten, Kop and de Lange), *Energy* (Boswinkel, ESC), *Traffic* (de Rooy), *Environment* (Clarenburg).
4. The various modalities mentioned here roughly fit in with the classical philosophical modalities and those of modal logic. Here, however, they are further determined in a Venndiagram, resulting in a more practice-oriented shift in their definition. Within the framework of investigations into the future this distinction comes up again and again in a more or less hidden form, for instance in P. Hall, 1977, Europe 2000, Duckworth, London; and in Beleidgerichte Toekomstverkenning van de WRR (Policy-oriented investigation into the future by WRR), mentioned before.
5. At a meeting in Delft in November 1992, however, the majority of research workers expressed their preference for the decentralization of the urban area on a national level and called for attention to possibly increasing immigration.
6. For example, various types of energy may be distinguished: the use of passive solar energy means a very local chain; the use of electricity from coal-fired power stations means a continental chain in the Netherlands.
7. Production, selection, transformation, assembling and consumption are all concentrated or spread in space in a different way. They find their optimal progress of process on a different scale. Taken together these phases form the "technological-logistical course" of the chain to be plotted against the optimum spatial scale.
8. The 5000 kg/ha* year of Brundtland corresponds to 0.16 W/m^2.
9. In the case of 300 W per person the calculation probably includes many economic and cultural reductions (meat consumption). C.T. de Wit once made a much more optimistic estimate of 126 billion people, applying disputable suppositions such as

150 W/person and optimum irrigation all over the world. However, even in the Netherlands water is the most important factor that is physically limiting agricultural production, let alone in drier regions.

10. Surface areas for the cultivation of concentrates (rich in proteins) for 80 million chickens, 16 million pigs and 8 million head of cattle.
11. The comparable illegal immigration from Mexico to the US already shows characteristics of environmental flight.
12. This offers perspectives for fish-farming or recreation based on treating agricultural waste.
13. The amount of water needed for agriculture and nature-based culture is now already approximately 3 times the quantity required for drinking-water consumption (T. de Jong, 1992, Technische ecologie, deel land (Technical ecology: land).
14. In the 1960's this "value of the *Randstad*" was once calculated within the framework of State Expenditure and at that time it was already higher beyond compare than any conceivable price of coastal protection.
15. Footloose agriculture, too, (especially greenhouse horticulture) in the western parts, where water is becoming brackish, requires water supplies (with a lower chloride content than is necessary for people and animals!) and, will therefore be inclined to move along the rivers together with the salt limit to other European markets despite coastal climatic advantages.
16. The agriculture energetic yield is set at 0.8% (0.8 W/m^2 in this case), but it has by no means reached this point in the Netherlands. This yield is, for example, proportional to the on-site quantity of irrigation water available for plants. In the Netherlands, too, the agricultural yield could be doubled if the amount of water needed for agricultural purposes could be increased by 50%. However, such an increase in productivity per m^2 is still more expensive in the current economic situation than an extra square metre.
17. a) The edible part; b) the part that can be sold in the future, also in view of the need for meat after deduction of production energy; c) the part of the national agrarian surface actually available for production.
18. This figure is highly relative; if a change of 10% is made in the factors of reduction assumed, this will result in a difference of 6 million inhabitants!
19. For example, for the sake of an environmental technology enabling the recycling of all waste materials; in such a case it would no longer be necessary to import any raw materials.
20. If 50% of the urban area including areas for recreation, business and traffic (200 m^2 per inhabitant) could be covered with solar cells on roofs and roads giving a return of 5%, the result would be approximately 10* 100 W per inhabitant (10 times the physiological capacity). This would cover 10 "energy slaves" of the 60 currently in use. The remaining 5000 W require an additional 1000 m^2 completely covered with solar cells for an output of 5 W/m^2.
21. Also because of the disappearance of the petrochemical industry.
22. In his main subject Matton (1992) states that urban concentration on regional, urban and neighbourhood levels scores favourably on environmental factors such as energy and water consumption, living environment, green areas, traffic and waste.
23. Loss through transport can be solved technologically, for instance by means of high voltage, super conduction or electrolytic storage in hydrogen.

24. Ministerie van Landbouw, Natuurbeheer en Visserij, 1990, Natuurbeleidsplan (Natural Environmental Policy Plan), regeringsbeslissing (government decision), Tweede kamer Staten Generaal, Den Haag.
25. Such a scenario was once outlined by Alfred Dernison, 1986, Long-term perspectives for human settlements, *Futures*, February.
26. The difference between the two becomes clear when one wonders whose chance one has in mind: that of the individual (liberal) or the chance of a collectivity. This difference shows up in the following section.

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Reflection

1. Relevance

One of the most obvious aspects of the environmental problems is the relation to space: someone once said that "environmental degradation is because of matter being in the wrong place". If one travels through Europe large differences can be seen: densely populated areas obviously are the most polluted as they attract not only people but also all the activities associated with modern life. So environmental planning activities often are closely associated to spatial planning efforts. In the Brundtland report one does not find a separate reference to the burden of spatial planning, except for a special section on "the urban challenge". The world's economic system, the report claims, is increasingly an urban one with overlapping networks of communications production and trade. What the Brundtland commission considers the "urban revolution" might be written mainly for the situation in the Third World, but is in many ways what the Dutch have been living through in the last 50 years. Holland, originally an agricultural country, grew in two generations into one man-made network of cities and industries with hardly any original nature in between. Ever since the Second World War the Dutch, living in the most densely populated country in Europe, have built up a considerable track record in spatial planning. The government agency responsible for most of the work in that field is also directly linked to the same ministry where environmental policy is developed. The Dutch situation is also special since the relative small space is used for economic activities that have a considerable environmental burden such as chemical industry, concentrated agriculture and a large transportation sector, including several main ports. One should also realize that the Dutch live in a vulnerable delta, so careful planning of all these activities is essential, both from the standpoint of nature conservation and of ecological load. When CLTM was considering this report, it immediately realized that some of the studies should be linked to the spatial dimension, but we also realized that the Dutch spatial situation has considerable peculiarities because of the issues mentioned above. We decided to challenge a group of independent experts that earlier developed several spatial scenarios for 2050 to use their imagination again on the issues of a sustainable society for the 21st century. We especially hoped that they could integrate some of the other studies written for this report into their spatial analysis.

2. Comments

CLTM thinks this chapter shows a remarkable ingenuity and is of great interest to our work. In many ways the authors have succeeded in giving a fascinating insight in different "possible futures" for this small country. The authors have lived up to their reputation as spatial "designers" and have made an interesting use of the earlier work of both themselves and CLTM's earlier report. They have also tried to include as much as possible the work of some of the other studies done for this report. They have also succeeded in explaining their "design method" to other authors and have given a lucid de-

scription of their approach in this chapter. The results of their work are equally interesting: contrary to common belief they conclude that this small country is far from full: 20 million inhabitants (from the present 15 million) is quite feasible and even 30 million, although it may lead to certain problems, might become acceptable under certain circumstances. From their analysis it is quite obvious that the authors use scientific approaches that some people consider technocratic. There are very few qualitative considerations in their "three spatial programmes", which feature 10, 20 or 30 million inhabitants respectively. In the typical way of designers they even translate value orientations into quantitative parameters, but we must admit the results are interesting. What it does is structure preferences of social scientists into attractively manageable inputs for their "design tool kit". The end result is equally striking: different designs for our spatial future which can easily be used for discussions on the sensitivity of our own plausibility. This work clearly shows that Dutch planners have a long tradition in integrating causal and conditional thinking into workable concepts – in many ways one could say we have realized in our own way the urban revolution that the Brundtland Commission refers to.

3. Suggestions

In this chapter there are no suggestions for solutions in the common sense, but there are some striking inputs for discussions on the interaction between space and sustainability. It shows that the challenge of a sustainable society may bring the Dutch to seriously reconsider their present spatial policies for national concentration and emphasis on some main ports and growth centres. The alternative is an interesting mix of adaptation of society to its territory and accommodation, which means adaptation of territory to society. According to the usual planning cycle, the authors conclude, a new round of programmed stock-taking, conceptualization and effect forecasting should follow. They have given us an interesting argument for this new round, as they show that the Dutch territory could develop into a sustainable one even with a growing population, if we take their design approach seriously. They have developed a design based on a decentralization on a national level into 10 regions with 1 million inhabitants in an urban area which is surrounded by its own recognizable and varied landscape. CLTM finds these suggestions interesting and would like to have them included into the present planning, which often is more geared toward the European dimension (see the recent Scanning the Future scenarios by Central Planning Bureau, 1992). CLTM therefore proposes that more work to be done in this field, as the link between long-term spatial planning and the environmental/conservational consequences has been neglected recently in most debates on sustainability at all levels (even NGO's). In line with some of the other chapters we suggest to have some policy exercises on this subject with some of the planning agencies using the input of this chapter.