Landscape assessment methodology on a European level

Polder landscapes as an example.

(J.A.Klijn, F.Bethe, M. Wijermans and K.W. Ypma)

Referate

Klijn, J.A.,F.Bethe,M.Wijermans & K.W.Ypma, 1999. Landscape assessment methodology on a European level; polder landscapes as an example. Wageningen, DLO Staring Centre, Report xxx, yyy pages, zz maps, figs , tables.

International and national policy regarding landscape values require an adequate assessment methodology. The here proposed SWOT methodology (Strength, Weakness, Opportunities and Threats) combines geographical data, valuation procedures, insight in trends in land use, identification of threats and opportunities and eventually recommendations for policy making.The methodology is tested for polder landscapes and proved to be satisfactory. Improvements are suggested for follow up research and applications.

Key words: European Union, Landscape ecology, cultural values, scenic values, land use trends, GIS, spatial policy.

Contents

List of figures, tables and maps

Preface

This study is carried out within the framework of a larger set of projects aimed at the development of scientic tools that help to support Action Theme 4 (AT 4) from the Pan European Biodiversity and Landscape Diversity Strategy (Council of Europe). This action theme deals with landscape. The European Centre for Nature Conservation (ECNC, Tilburg), together with the DLO Winand Staring Centre, Wageningen elaborates this theme on European Landscapes in a number of projects. One neighbouring project, strongly related to the project dealt with in this study, focuses on the crucial task to classify and map European Landscapes in a systematic way. This project is still "under construction ". Classifying and mapping of landscapes however is not a purpose on its own, but should serve as a tool for a sound planning and management of European landscapes. The current study aims to contribute to the methodology of using data on landscapes, the identification of landscape values, insight in ongoing or foreseen trends, the identification of threats and opportunities seen from landscape values and recommendations for policy making, especially for spatial planning on an international level. To support the methodological developments this study takes the polder landscapes a example to test the general methodology. Explicitly it was preferred to complete the full working procedure and accept all kinds of shortcomings underway instead of being stuck halfway. Apart from the methodological goal, this study was meant to deliver insights that could give national planning an international context. The National Spatial Planning Agency (RPD= Rijksplanologische Dienst, The Hague) supported this study for the majority, additional funds came from the Ministry of Agriculture, Fisheries and Nature Management (DLO Programme 363, Programme leader Roel During). Emmy Bolsius, Gerda Roeleveld (both RPD) en Dirk Wascher (ECNC) are kindly thanked for their advice.

Summary

International and national policies in an international context dealing with landscapes and landscape values require a sound landscape assessment methodology that encompasses data on the distribution and valuation of landscapes, their specific potentials or vulnerabilities, major trends in land use and derived from these data opportunities and threats and policy options.

This study focused on the development and testing of such a policy-oriented methodology for the assessment of landscape values, elaborated as a so-called SWOT analysis (Strength/Weakness-Opportunity/Threat). The methodology applied to landscapes and land use impacts includes the following steps:

* Classification and mapping :
* Description of characteristics, properties, strengths and weaknesses
* Description of current status of landscapes
* Description of actual policies regarding the landscapes at stake
* Valuation of landscapes

* Insights in trends (and driving forces) of land use changes affecting landscape qualities.
* Confrontation of trends and landscape properties / values:
* Formulating of policy options

The above mentioned steps are elaborated for a case study dealing with the so-called polder landscapes in Europe. These, largely man-made landscapes are analyzed upon their distribution in European countries, the existence of certain subtypes, their current status, their values with respect to ecology, cultural aspects and visual qualities and – related to possible changes in land-use - upon their strengths and weaknesses. A separate analysis was done for ongoing or foreseen trends in land use change . The combined data on landscapes and landscape values on the one hand and data on trends affecting them on the other hand gave insight in possible threats or opportunities. From there policy options were formulated.

The polder case showed the applicability of digital data on landscape features stored in e.g. Corine data bases, their translation to landscape values and subsequent interpretations. Geographical data enabled us to establish whether landscapes or subtypes of landscapes are unique for a certain region or country and what landscapes are relatively unaffected. Some experiences with other landscapes were sofar less encouraging as these data were not so readily available or easily to be derived from indirect data. Generally the conclusion was that digital data (GIS, Remote Sensing data) are to be preferred when available, as these data are systematically collected and updated, easily available and manageable. Still, there is a need for additional data and further interpretation . In all cases a well chosen set of parameters that are both meaningful and available is of crucial importance. This requires additional international study ; discussion and agreement. On the whole there is a distinct need to build in an adequate check on international data from literature and national or regional experts. Insights in trends on land use and land use changes are essential to determine threats or opportunities. It was concluded that a more formal and transparant procedure to collect and interprete data is required . The methodology – though applied in a relatively "quick and dirty manner"- proved to work out satisfactory and seems to be promising for extended application for other landscapes. As this study served as a reconnaissance of possibilities and problems still to solve a number of recommendations has been formulated to improve the methodology. These are listed in the last chapter on conclusions and recommendations .It was recommended to proceed with the here applied methodology in close connection with the project dealing with the classification and mapping of European landscapes and a sufficient commitment of national expertise from various countries.

1. *Background of this study*

1.1. The importance of landscape policy and related policies on an international level.

The increasing interest in landscapes and landscape values and the concern that many landscapes loose their identity manifests itself in many European countries. On a national as well as on a European level the awareness increases that threats and opportunities ask for an international approach (EEA, 1995). Many causes of rapid changes and deterioration of landscapes can be retraced to the globalization of the world economy , changing technologies and large scale demographic factors. Additionally , the impact of international policies and regulations on the EU level intentionally or unintentionally affecting land use and landscape are of increasing importance. The awareness and attitude to cope with adverse effects and promote positive developments is officially reflected in many recent documents. Examples are The United Nations Econonomic Programme(UNEP) and the Council of Europe's joint "Pan European Biological and Landscape Diversity Strategy (PEBLDS, Unep/Council of Europe, 1995), endorsed by 55 European countries at the Ministerial Conference "Environment for Europe", held in Sofia in 1995. The Council of Europe drafted a European Landscape Convention (CLRAE) . This encourages action by governements "to evaluate, protect and enhance the quality of landscapes throughout Europe" at the local, regional, national and international level. The increasing importance of landscape as a useful concept is also reflected in some recent land-related programmes of the European Union, e.g. the European Spatial Development Perspective for regional planning in DG XVI; Agenda 2000 for agricultural reform and structural fund reforms for rural development and regeneration. Recently the Committee on Spatial Development issued a document on the European Spatial Development Perspective "Towards Balanced and Sustainable Development of the Territory of the EU" in Potsdam (ESDP, 1999) . All this forms the legitimation to invest in research and data collection that should support international policy on various terrain as well as the national approaches that want to add an international context and meaning.
Also national policies are more and more aware of their position in a larger geographical and political framework. National spatial planning in the Netherlands has been aware of the international perspective for several decades. The necessity

increased as the European integration advanced and this tendency will continue or increase (EROP, 1997, ESDP, 1999). When landscapes and landscape values are at stake questions arise how to conserve or restore their values , how to use them in a sustainable manner and how to fit in new land use types without unacceptable or unneccesary damage. An international perspective for national purposes is required for at least two reasons:

i) many planning issues are essentially transnational so that national policies can only be effective and efficient by taking into account relevant areas in neighbouring countries.
ii) national landscape policy as such needs upscaling in such a sense that protection , restoration or the acceptance of negative effects on landscape values should be based upon an international consciousness and appraisal of landscape values and the resulting international responsibility to respect them.

1.2. A methodological challenge and a case study as a test.

Some landscapes may seem abundant or seemingly trivial within a national context, but internationally they might prove to be very rare and special. This phenomenon related to the polders area within The Netherlands and other European countries, will be illustrated in this study. An international comparison might clarify their international position in terms of uniqueness, condition and expected changes in land use and give clues for national policies as well as motives for additional international support. Until now international data and methods to assess landscapes and landscape values on an international level are not yet or insufficiently available and have to be collected or developed. Landscape values are multiple: economic values, ecological values, historical values, earth-scientific and scenic values. In this study ecological, historical and scenic values are elaborated for a certain alluvial cultural landscape, the polders. Economic aspects in a broader sense are not dealt with, neither are earth-scientific aspects. The proposed approach should include a picture of autonomous or policy-driven changes that are expected to affect landscapes , and a method to identify specific strengths and weaknesses of landscapes to absorb these changes. Landscape values as such are not merely a handicap for modernization, they could also turn out to be a positive economic factor for new land use types (e.g. recreation/ tourism). The reason to undertake this study is that attempts to collect landscape data on a European level, to classify and store them, to identify landscape values and to design a method to operationalize these in spatial planning are thusfar unsatisfying when judged on criteria such as spatial resolution, the use of digital data, an explicit and transparant methodology and an adequate connection to policy - or decision making. The reason to focus on polders landscapes and elaborate this especially from the Dutch point of view is mainly a practical one: time was lacking to collect data on other landscapes or to give policy backgrounds for other countries.

The most extensive Dutch landscapes are the polder area and the (sandy) pleistocene area. In international classifications such as published in the Dobris report by J.Meeus (EEA, 1995) these are addressed as respectively the polder landscapes respectively the "Kampen" landscape in the Pleistocene sandy regions(see map 1). The polder landscapes, that were chosen as example form a relatively large area in The Netherlands. Dutch landscapes, when considered at a European scale, are typical for a large, relatively flat alluvial sedimentation area formed in the Holocene, where older and younger river deposits, marine deposits of various age and peat areas are found. The so-called pleistocene half of the Netherlands was remodelled by glaciers (moraines, ice-pushed hills) and wind-

blown coversands. Nearly all landscapes are strongly influenced by man during centuries or even millennia, so that cultural landscapes dominate almost everywhere. Many landscapes are really man made to a degree that legitimates the expression : "God created the world, but the Dutch created their own land ".
The reason to focus on one of these two major landscapes instead of taking the complete territory and heterogeneity of The Netherlands into account is to test the methodology. To choose the polder area has practical backgrounds. The Kampen area , and within this region the so-called small scale landscapes have not been elaborated sufficiently due to a lack of data and lack of time.

1.3. The purpose of this study

- To develop a methodology based upon a SWOT approach (identification of strengths, weaknesses, opportunities and threats related to the conservation or sustainable use of landscapes considering their landscape values) .The latter is meant to contribute tot methodologies applicable for international purposes in general.
- To explore where data are available, preferably in digital formats and how these data sets could be exploited for the purposes explained earlier. The challenge is to accomplish a higher resolution of geographical information and to exploit data bases that are easily available on a European level in future (e.g. CORINE/ Remote Sensing data) , compared with e.g. the maps produced by Meeus in the Dobris report (EEA,1991)
- To give a rough outline of their present condition in terms of landscape values: what regions are pristine, what regions are affected ?
- To give an overview of current and foreseen trends in land use or otherwise affecting landscape values and present insight into hinterlying driving forces..
- To test the methodology on polder-landscapes , as an important example of alluvial landscapes, in a European/ north west European context; and to present an estimate how conclusions could be interpreted for other landscapes. In other words: could the approach be extended to other landscapes ?
- Draw tentative conclusions on policy options for national or international spatial planning.
- Give recommendation for further study.

2. Brief explanation on the methodology

2.1. What is a SWOT approach ?

The term SWOT [(litterally : Strengths(S)/Weaknesses(W)/ Opportunities(O)/Threats(T) stands for an assessment technique commonly used to analyze the comparitive position in the market of commercial enterprises . A simple diagram (matrix S + W vs O + T) helps to envisage the situation, especially aimed to identify strong (S) positions in a market with threats (T :e.g. competition) or to identify where a weak (W) position in a possible good market with opportunities to expand(O) should be enforced. This helps to define a sound long term strategy and a

profitable course for the future: managers could decide to reinforce certain divisions , to reduce others or to sell less profitable parts of the enterprise.

2.2. SWOT for landscapes in Europe ?

The SWOT technique, originally a strategic marketing tool, is not simply to be used for landscape policy goals. Recent literature (Meeus, van der Ploeg and Wijermans, 1988, Bethe (Ed), 1997, Meeus 1996, EROP, 1997, Rigg et al., 1997; EEA, 1995) sofar does not always show a very strict use of the SWOT technique. Strengths and opportunities are sometimes mixed, strengths and weaknesses are replaced by characteristics and strategic choices are not always indicated. It is obviously not so simple; landscapes are always multi-dimensional (Antrop, 1989), the valuation is not simply a question of objective, quantitative aspects and last but not least, landscapes are hard to generalize; they always have their specific character due to regional circumstances .

The analogy of landscapes and particularly landscape values with commercial enterprises has evidently its limits. Landscapes, or at least landscape qualities as dealt with in this study form , are largely common goods, that normally are not considered as dispensable or for trade. Moreover, typical economic values or potentials of landscapes are not systematically identified in this study. A more or less complete and balanced assessment of strengths and weaknesses or threats and opportunities is therefore not yet accomplished.

The SWOT technique, be it in an adapted manner, can still offer comprehensive overviews of landscape characteristics or qualities in Europe set against the background of current or foreseeable trends.. The role of landscape SWOT's is to deliver short, compact and transparant descriptions of landscapes, their characteristics, trends in land use, their potentials or vulnerabilities, their threats and opportunities. This helps to assess their assumed response to changes : natural responses , mostly triggered by change in human influence. It also gives opportunities to formulate a "Leitbild" for planners and designers . From there one might conceive adequate policy responses. These could enhance i) landscape conservation as such, ii) a policy to adjust e.g. agricultural development in a desired direction, iii) the design of alternative trajectories for infrastructural and urban development or iv) the promotion of alternative land use types such as forestry of recreation to avoid deterioration of landscapes . The latter as an alternative where , for example, former agricultural use tends to marginalize or even disappear.

The assessment technique as described in this report is aimed at target groups such as international and national authorities. These are responsible for spatial planning in general or bodies on a European or national level dealing with the future and spatial aspects of major land use types in Europe such as agriculture or the conservation of nature and landscape values. Evidently the technique as such has no specific limitations in a certain scale domain and could be applied on a regional scale as well.

The application of the SWOT technique to landscapes has been visualized in a scheme (fig. 1), where strengths and weaknesses respectively threats and opportunities have been brought together, as well as indications how to translate these insights into policy options in very general terms. This landscape SWOT can be applied on several levels (see 2.2.) .In our case study on polders this approach will be elaborated .

Within this scheme (fig 1.) ***four types of possible landscape policies could be indicated***.

* ***A short term oriented action*** (*in the upper-left corner*) that uses the opportunity to maintain or built further upon a strong aspect of the landscape type and fits well with beginning trends.This asks for alertness from policy makers to develop stimuli for economic development rather than design strong conservation policies and measures.
* In the *lower-right corner* we find the most difficult policy option. Landscapes are considered to have lost their original economic carriers, current land use is considered to have strong adverse effects on landscape qualities or land use tyupes are not in tune with each other. Long term perspectives are poor for continued land use ,either in economic and ecological sense. A ***fundamental, long term re-development*** is needed as fundamental weaknesses of a landscape are here under threat.
* **The two other policy** options (upper right corner respectively the lower left corner) **take a somewhat intermediate position**.
  With a balanced policy of restrictive and stimulating instruments one could reach the long term strategic goals

A SWOT analysis should clearly distinguish between intrinsic strengths and weaknesses (of the landscape itself) and threats and opportunities being externally driven. With respect to this study, the strengths and weaknesses connected to the landscape values are not (or just partly) of direct economic importance. Most values dealt with are of general importance for society (common goods) and logically ask for interventions by governements instead of a "laissez faire policy " . Land use changes are mostly determined by economic dynamics and a sustainable land use

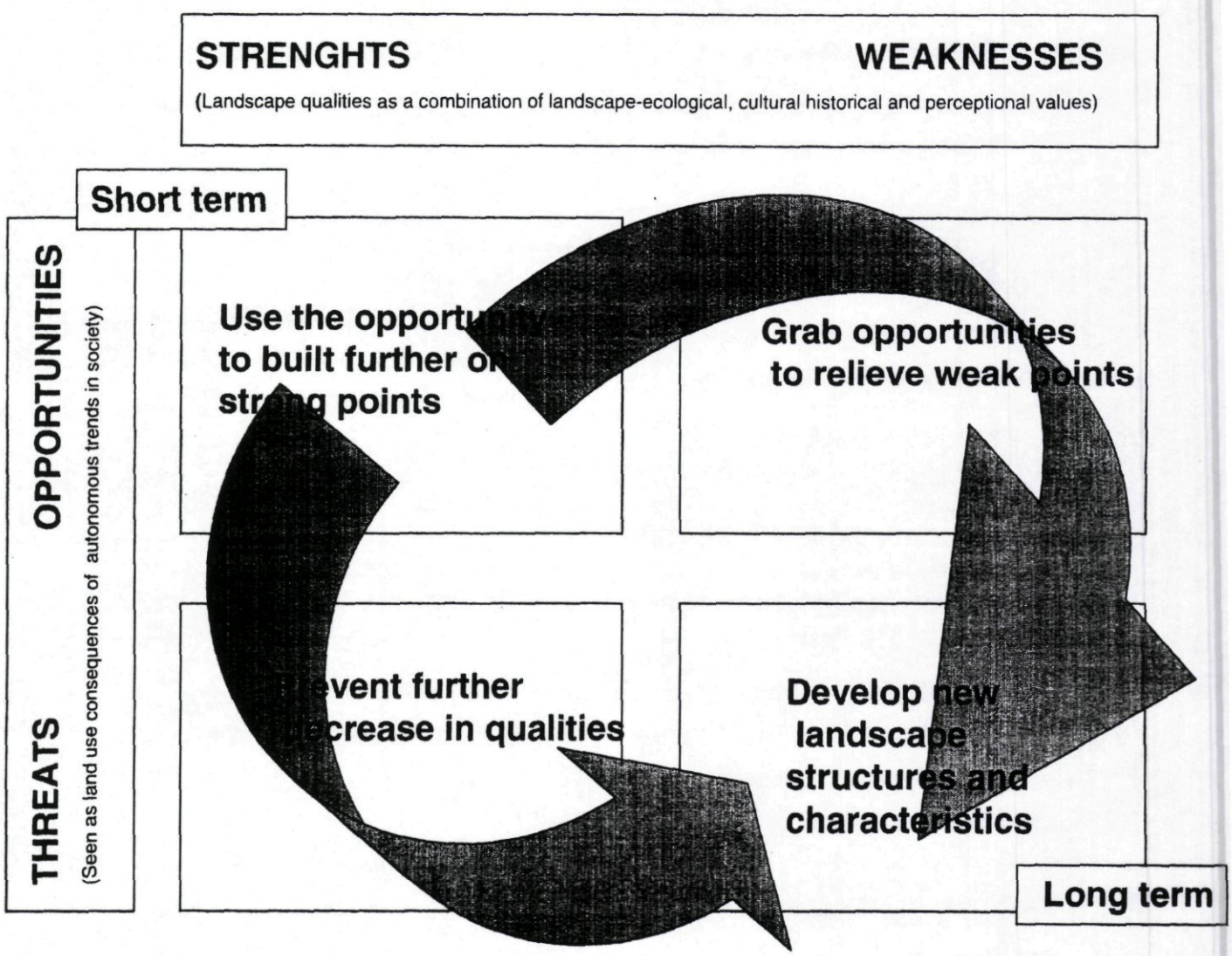
leaving landscape values intact is hard to expect from autonomous economic processes alone.

2.2. Planning levels in relationship to SWOT

For planning purposes several comparisons on different levels can be made:

1. We could *compare different landscapes* in their ability to "absorb" land use changes. So we could compare Polders with Kampen landscapes.
2. We could compare several countries on an international level as to a certain landscape, e.g. the polders in The Netherlands with comparable areas in Italy.
3. We could compare *different Polders-types, i.e. a certain specific subtype such as reclaimed lakes .*
4. Finally we could analyse *concrete landscapes on a more detailed scale in order to make more refined distinctions between parts of a certain geographical unit.*

For general policy aims on an international or national level the first three approaches seem to be useful, but analyses of real landscapes on a more detailed and concrete level seem to be necessary to support sensible decisions on a higher scale..



2.3. The methodological steps in this study

The methodology of the current study ,starting from the definition of landscapes in order to get overall picures of their distribution to eventually the formulating of policy options embraces the following (eight) steps. These represent several stages that are strongly interrelated:

* **Classification and mapping** :
  - a top down classification of landscapes
  - a method to identify them from available or easily obtainable sources
  - applying selection criteria and applying mapping techniques

* **Description of characteristics, properties, strengths and weaknesses**
  - abiotic, biotic, cultural features; suitabilities/vulnerabilities a.s.o.
* **Description of current status of landscapes**
  - the degree in which a landscape has still its original character or is negatively affected by measures or elements
* **Description of actual policies regarding the landscapes at stake**

* **Valuation of landscapes**

* **Insights in trends (and driving forces**) of land use changes affecting landscape qualities.

* **Confrontation of trends and landscape properties / values**:

  - confrontation of current and foreseen land use and landscape values
  - definition of threats and opportunities

* **Formulating of policy options**

3 *Values and valuation of landscapes*

3.1. Introduction

Landscapes and landscape values are well-recognised aspects of our surrounding and highly appreciated by most people. However to convert this awareness and commitment into a clear purposeful policy is sometimes severely handicapped by conceptual confusion . Also the scientific domain, especially on an international stage is sometimes subject to terminological confusion .To clarify several terms an appendix has been added (appendix A).

In the following we present a framework in which landscape values and underlying features are set in focus. This is done for the following domains : ***the ecological domain, the domain of historical/cultural aspects and the domain of scenic aspects***. These are generally mentioned in official documents on the need of landscape oriented policy (Dobris report; Pan European Strategy for Biodiversity and Landscape Diversity; see also Chapter 1); also on national level the same distinctions have been made (e.g. in The Netherlands the Nature Policy Plan (MLNV,1990; Nota Landschap (MLNV,1992; Structuurschema Groene Ruimte(MLNV,1995); Vierde Nota Ruimtelijke Ordening, Min.VROM,199.). Often earth- scientific aspects are mentioned separately(Natuurbeleidsplan,1990). These however are not elaborated

here for practical reasons. For each domain it is mentioned what issues are considered important and what impacts can be listed. There is extensive literature dealing with the basics of valuation of natural and cultural phenomena, starting from general classifications in four groups (carrying functions, production functions, information functions and regulation function) and each of these clusters can be subdivided in more concrete, down-to-earth items (see e.g. Van der Maarel & Dauvellier, 1978; De Groot, 1992) . A point of discussion is whether to discern a fourth domain separately containing "statutory" aspects covering the (legal) status of areas related to nature, landscape , environment, public functions and so on. This also applies to a certain European status like Habitat Directive, Bird Directive, Cultural Heritage or nmational statuses. In this report such a domain is not elaborated separately, but deserves attention in possible follow-ups.

3.2. Three domains of landscape values

3.2.1. The ecological domain :

Ecological impacts can be divided in those factors affecting I) the biotopes of species, species groups or communities, i.e. all direct losses of area and indirect decrease of living conditions for flora and fauna and II) factors directly affecting a population of a species, such as hunting, fishing etcetera, but also III) fragmentation or isolation leading to population sizes that are prone to local or temporal extinction, or even full extinction. These impacts can sometimes be regarded as separate influences, however a combination of impacts is more often encountered within the context of large scale developments. For example, agricultural land use change leads to manifold intensification and a combination of urbanization and a higher density of roads entails many impacts such as absolute biotope loss, fragmentation or isolation of populationsand indirect loss of biotope qualities by disturbance or pollution.

Biotopes : direct losses or gains (in area) due to:

Urbanization;infrastructure;land reclamation;deforestation; water management measures affecting rivers and lakes;coastal defense

loss or improvement of qualities due to ;

Eutrophication, pollution by toxics; acidification; lowering of water tables; change in forest or grassland management; disturbance respectively restoration meausures to improve qualities.

Species : losses and gains due to :

Hunting / fishing
Reintroduction schemes
Disturbance, e.g. by recreation.

Fragmentation or defragmentation due to:

Infrastructure ; building; resp. restoration of corridors ;fragmentation ;defragmentation (enlargement of biotopes);Restoration of corridors

Box 2.

From an analysis throughout Europe based upon questionnaires an intersubjective ordering and ranking of the most important threats to European biodiversity was gained. Very high scores went to agriculture (field enlargement, disappearance of field boundaries; use of fertilizers, biowater management, biocides , marginalization, land abandonment) and pollution (from various sources) ,

high scores to habitat destruction (due to various causes) , urbanisation, infrastructure,change in land use, moderate scores to tourism, industry,climate change (source : Cattizone et al. 1998; Understanding Biodiversity; European Commission)

3.2.2. The cultural domain

This domain includes those landscape phenomena with important information values including their scientific, educational or esthetic aspects, related to :

i) *historical land use or occupation patterns and man made relicts* : vestiges of cultivation, e.g. former parcellation patterns, occupation patterns, ii) historic buildings or man-made landscape elements with historical meaning a.s.o. as well as iii) archeological features, both above-ground or covered by soil. All these values can be affected by direct loss due to destruction, partial losses or slow deterioration due to a shift in management (e.g. a too intensive use of soils containig archeological archives or a lack of maintainance of old terraces)

Most important impacts result from :

Direct losses ;

Urbanisation/industrialisation : direct, irreversible loss of valuable areas

Infrastructural works : loss of areas, loss of typical patterns in landscapes

Indirect losses or deterioration

Intensification/ scale increase in agriculture : loss of small scale patterns by reallotment schemes, impact on soil archives by levelling or deep tillage. Adaptation or loss of former drainage systems.

Marginalization: Lack of maintainance of parcels,hedges, stone walls, terraces, some of these changes result in erosion of slopes.

Deterioration of farm houses and historic elements in landscapes, among which are farm roads etcetera.. Visibility and legibility (Dutch = leesbaarheid) of cultural landscapes decreases due to lack of management and resulting increase of shrubs or forest covering the traditional parcellation patterns. In other situations a conservation of historic patterns and soil archives can be seen as positive, when compared to other more destructive land use.

Reforestation : see above : most adverse effects due to lack of visibiliy, lack of maintainance of elements, sometimes due to deep tillage.

Water management; loss of historical features due to flood control; loss of typical patterns (ditches) related to former watermanagement; threats to soil archive by lowering groundwater levels.

Nature restoration : see under reforestation/ water management

3.2.3. The domain of perception values (scenic beauty)

Landscapes harbour scenic qualities, that are considered important for recreation and tourism, the quality of residential areas, but also the attractivity for business settlement. Although assessments of scenic qualities are essentially subjective there is some agreement among people

(intersubjectivity) on what has quality and what threatens or improves these qualities .
Generally there is a *communis opinio* that *fast, large scale changes in land use overriding the original landscape features are seen as negative*; slow, less rigorous changes that fit into the original landscape structure and that allow psychological adaptation are considered less serious. Still, there is a lack of easily to obtain parameters that could serve as indicators.

Scenic qualities are especially found in coastal areas, mountaineous areas, other vast natural areas where the absence of human impact is a quality, or in cultural landscapes with a high diversity in landscape elements (e.g. hedgerows, small woods, ponds, historical farmhouses) and pittoresque villages or towns gives the idea of organically grown, partially man-made landscapes that combines a lot of information on foregoing eras and current, well-balanced land use and aesthetic qualities that are determined by a large variation .In general *the absence of large, modern cities, industries, heavy and heavily used infrastructure, rational agricultural practices, large harbours, airports , so an unspoilt skyline* contribute to a high appraisal. *Absence of noise, smell and large scale illumination during the night are additional qualities*.

Impacts (negative and positive) result from :
Large scale *urbanization*
Expansion of *industries, harbours, airports*
Infrastructural works (roads, railroads, airports
Marginalization/ land abandonment in rural areas.
Artificial sea-defence works
Encroachment of (second) *houses in formerly open areas.*
Reforestation of formerly open areas.
Water management measures affecting natural drainage systems (rivers, brooks)
Large scale nature restoration(sometimes)

3.3. The use of direct or indirect data to assess landscape values

In the previous section a list of relevant ecological, cultural and scenic qualities and major impacts affecting them were listed. Ideally all these items should be analysed further , provided with relevant indicators and from there brought into an operational data base that allows mapping , monitoring , assessment of effects of measures or autonomous developments and so on. However, neither the state of the art and the required consensus to choose a limited set of indicators nor the availability of data allows such an ideal elaboration. So one is urged to fall back to less optimal procedures, especially when various European countries have to be covered in a short time frame..
To identify and valuate landscapes on a European scale one has to choose ***simple and especially operational criteria sets*** to assess current and potential values . The lack of direct, actualized and systematic data all over Europe and the complexity of the topics involved did not allow a very sophisticated , bottom-up approach. In many

cases a very limited choice of indicators is available .The only feasible way out is to use indirect or very rude indicators as a substitute provided these are sufficiently correlated to the desired indicators and sufficiently meaningful.

A short explanation on landscape values and how to address these is given below, a more elaborated version for polder areas is given in box .

***Landscape ecological values* can be related to:**

- present *species, ecosystems*
- *indirect data* on land use :conditions generally considered crucial for ecological values (especially abiotic conditions, intensity of land use; fragmentation by built-up areas and infrastructure; afforestation, ...)
- *present status of areas* related to the above (e.g. protected areas, Habitat Directive/ Ramsar areas/ Bird Directive).

***Cultural Heritage values* can likewise be approached by:**

- inventories of specific *phenomena of archeological importance, historical geography, monuments.*
- *Indirect data on land use affecting the conditions* (built –up areas, fragmentation,....)
- *present status of areas* related to a certain valuation in national or international perspective (list of National or International Cultural Heritage)
-

***Perceptional values* (attractivity for recreationists, residents)**

- to be derived from *direct sources* describing areas *in terms of attractivity* (such as road maps indicating attracive roads/ sight -seeing spots
- *indirect data* : openness/ degree of unnatural elements or land use related to built-up areas, large scale infrastructure, afforestation)

(Box. 3)

Landscape values and approaches on a European scale (case study polders)

As stated *a sophisticated way to use original, systematically gathered data on all the various aspects that allow an international comparison is hardly feasible*. A second best choice is to use several national assessments and valuations as reference for both ecological, cultural and perception values is only partly feasible: ecology and recreational attractivity score relatively well, but cultural values are generally less well known. The most simple to attain are indirect criteria, related to abiotic conditions and major land use types.

This is explained as follows for polder landscapes

Polders are originally man-made ,low-lying , flat, open, agricultural areas

characterised by the presence of dikes, ditches, watercourses, artificial devices to control waterlevels (windmills, pumping installations etc). Depending on their geographical position, physical conditions, age and way of reclamation typical differences exist, that determine their ecological, cultural or perceptional contents and values.

1. ***Ecological values*** :

Concern primarily birdlife (large birds such as geese, meadow birds), with high values for less intensively used agricultural, open areas near open water or intertidal areas (coasts). Characteristic ecological values are the higher when water levels are high, fragmentation is low and openness is high. Disturbance factors stem from urbanisation, recereational pressure.

Key factors are thus : *openness, absence of built areas or other disturbance from industrial sites and infrastructure, waterlevels, large water or intertidal ecosystems in the neigbourhood. Large forest should be absent, except in some riverine areas.From these data potential values can be derived, however not necessarily expressed in the actual situation. Confirmation of values could be based upon data from Ramsar/Bird Directive, Habitat Directive or nationally or regionally assigned statuses.*

2. Historic values:

Historic values are higher when older polders or a range of ages of polders exist; when there is an original structure of parcels, watercourses and dikes present, typical occupation patterns (along roads, dikes), intact farm houses and villages with monumental buildings, water management machinery etcetera. As data on age or originality are mostly absent the second best choice is to choose indirect parameters such as absence of large scale industry, urbane areas, infrastructure, large forest areas. It has still to be studied whether international status of polder areas could add further insights.

Key factors are thus : openness, absence of built-up areas, major infrastructure, large forests. Of course there is a strong need to add independent data on history or archeology itself s well as data on the historical or archeological values assigned by policy documents.A first step is the list of World Cultural Heritage, that however presents a very limited set of objects or areas. A broader scope is necessary. This requires fact finding on a national level.

3. Perceptional values :

These are considered to relate to an open horizon, presence of dikes, historical buildings, apprpriate land use (grasslands, crops) , water bodies, and to the absence of major urban areas, forest, infrastructure and traffic (air/road/railroad) for reasons of noise or visual disturbance

Key factors are thus :
openness, i.e. absence of built-up areas, major infrastructure, noise or visual hindrance from air or ground traffic;absence of large forestareas; added criterion : attractivity as marked on road maps (e.g. Bartholomew maps or atlases)

Overall conclusion; towards a practical way-out

All in all a coherent, multi-purpose set of parameters to give a rough impression of landscape values could be derived in a rather "quick and dirty manner " from a limited set of data : absence/presence of urban and industrial area, large scale infrastructure ; large forest areas. Large coherent polder areas have better expectations upon vareaty in age and internal diversity. Added value to be expected from variety in soils (e.g. clay, peat), geographical position close to inland water or the sea. Touristic attractivity could be derived from road maps); statuses in terms of Ramsar/ Bird Directive/ World Cultural heritage(not used in this case study !!)

.

Classes to distinguish polders *with respect to their values:*
A practical approach , followed here ,is to distinguish three classes(classes are of course open to discussion):

* *relatively intact(> 90 %% of the surface)*
* *largely intact (> 50 %%)*
* *strongly affected (< 50 %%)*

4. Trends in European landscapes

4.1 Introduction

Trends in European landscapes affecting the natural and rural area and therefore affecting landscapes are manifold and complex. It is considered useful to distinguish between *driving forces*, i.e. generic, large scale , complex and strongly generalized trends , driving the *more specific changes that directly influence landscapes* (4.3.).

Eventually these items are again grouped in larger clusters that also served as a legenda to the maps showing ongoing and foreseen trends on a European level (4.4)

4.2. Driving forces

.*Driving forces in Europe*, both within the EU and in Pan Europe, as often described in literature, are :

- An *open market within the EU, world wide trade agreements (GATT)* , almost unhampered transport at low costs and a continuous or shockwise rise in production levels based on new technologies and capital input makes that industrial activities, service industries e.g. the transport sector, and agriculture are rapidly changing. All together these changes are marked by an increasing speed, resulting in acellerated changes in land use and landscapes affected by these.
- *Polarisation of agricultural land use* is the phrase to symbolize that some parts of Europe undergo *intensification*, others *marginalization* that manifests itself by *extensification* or even *land abandonment*. In some regions this process is accellerating by *demographic factors* (urbanization, a growing demand of food in some regions or elsewhere ageing of population, net outflux to cities or other regions and consequently a decrease in population). Predictions on the future of agriculture in Europe state that a sufficient production could be gained on a considerably smaller area, so the expectation is that these trends continue (Rabbinge et al., 1992).
- In former socialistic states in Eastern and Middle Europe large , *large state-owned or cooperative farms made place for individual farming with smaller holdings , sometimes land abandonment.*In some regions a fall back in the use of fertilizers or biocides and lower production can be witnessed
- *Urbanisation /industrialisation/increase in mobility/increase in transport of goods and men*: in certain areas the spreading of cities and industrialised areas is fast. Increased transport requires extension of motorways, air traffic and water transport capacity.

- *Increase/ decrease of population; cultural changes*; changes in demography related to age distribution: certain areas witness rather rapid increase of population density, other areas a net loss of inhabitants. In other regions the age distribution of people can embody problems on the long term. Partly connected to demographical changes and interwoven with changes in agriculture or urbanisation is a socio-cultural change among people in their relationship with landscapes. Two major currents can be recognized: an ongoing alienation towards landscapes and as a countercurrent a rediscovery of the landscape in all respects. The latter is marked by increased attention for regional identity as the context for social or personal identity of people.

- *Increase in recreation and tourism*: due to a higher economic standard of inhabitants ad a sometimes extremely rapid increase of incoming (international) tourists in attractive regions the pressure in some regions, such as coasts, lakes and mountains has increased rapidly.

- *Climatic change and change in sea level*: evidence builds up that climatic change will influence most parts of Europe whereas some regions will change into warmer and drier areas, other areas undergo major changes in precipitation and evaporation. Hydrological systems , either groundwater or surface water are subject to major changes. Sea level is predicted to rise or rise at a faster rate and affect or threaten coastal areas, sometimes indirectly (salt intrusion) . Most land use types will have to adapt.Response of the society could imply the construction of artificial sea defense structures.

4.3. Changes in land use elaborated

The above driving forces can be considered to lead to more doown-to-earth and recognizable land use changes(affecting landscape values) listed below. This list serves as a check list rather than as a operational list of items that has been handled systematically in our study. Themes and items within a certain theme are not systematically covered by existing geographical or monitoring data:

(A) AGRICULTURE:

* Intensification and increase of scale (higher input of capital,labour(sometimes) fertilizers, biocides, energy, rationalization of holdings, adapting drainage, field size, road improvements etc.)
* Marginalization : as a reaction on less favourable conditions a lower level of input of labour , capital, energy, fertilizer etcetara helps to reduce costs. This may result in a new balance on a more extensive level or a further decline in agricultural use, eventually even leading to land abandonment. Related changes are the turnover from arable land into grassland and changes into "wasteland" or forest or recreational area, depending on the situation.
* Land reclamation : transition of formerly natural areas into farmland (e..g. wetlands along rivers or coasts)

(F) FORESTRY.

* Changes in area due to cutting forest areas (deforestation); planting of new forests (afforestation)
* increase due to natural causes (land abandonment of arable land or grazing areas resulting in natural shrub- and forest growth)
* effect of major forest fires.

(H) HUNTING/FISHING

* Major changes in nature or intensity in hunting and/or fishing affecting landscapes

(M) MINING

* Extraction of raw material by surface mining (coal, iron, gravel, sand, limestone); side effects such as lowering groundwatertables.
* Large scale dumping of residues of mining

(G) EXTRACTION OF GROUNDWATER

* Large scale extraction of groundwater leading to lowering of water tables

(W) MEASURES IN WATERMANAGEMENT (SURFACE WATERS)

* regulation in rivers for water discharge, shipping, flood control
  canalization (by dikes, sluices)
* formation of water reservoir for hydroelectric energy, public water supply
  damming of river outlets/sea entrances.
  measures for coastal defence (dikes or otherwise)

(U) URBANISATION ;INDUSTRIALISATION

* loss of biotope/landscape by built-up areas, infrastructure etc.;fragmentation
* Unwanted side-effects on ecosystems due to pollution (acidification, emission of nutrients, emission of toxics)

(I) EXTENSION INFRASTRUCTURE

* Construction of motorways, railroads, waterways, airports

(R) RECREATION/ TOURISM

* Destination of areas for tourism/recreation: building of second houses; intensive use of natural areas for sports etcetera.

(N) NATURE RESTORATION

* Purposedly change into natural area (e.g. formerly arable or grazing land)

(D) DUMPING OF INDUSTRIAL OR OTHER WASTE

* Large scale dumping of waste from households or industries on land or in water.

These long lists of impacts have been simplified aand aggregated into a set of processes that can be recognised as trends in certain regions on a European level. This led to the distinction of seven very broad categories, that have served as legenda to the two maps as presented : one map (fig. ~~4a~~3) covering the EU unions and a second map (fig. ~~4b~~4) with a somewhat higher level of resolution covering a large circle of NW Europe.
Both maps can be regarded as strictly indicative

3)
4)

4.4.. A short explication to the legenda and maps (ref. Bethe, 1997):

Urbanization/ industrialization and formation of agro-industrial complexes:
Expanding cities, industrial complexes, denser network of infrastructure.

Agriculture gets an industrial/ urbane character, high production per unit; high building density, tendency towards uniformity in agricultural activities.

Intensification and scale enlargement
In areas with favourable conditions for agricultural development , support from governement and the availability of capital a tendency to intensification and upscaling can be observed. This leads to high-tech enterprises in e.g. horticulture and glasshouses or enlargement of farms in arable land or dairy farming.

Stand – still
Areas without a distinct tendency to either intensification/ scale enlargement or extensification

Extensification / shift to other sources in income
Lower input of production means per unit. In semi-urbane areas alternative sources of income outside agriculture and exploitation of other markets (recreation, typical regional products). Scale of landscape hardly subject to change, lan use somewhat more differentiated, possibly a slightly higher density of built-up areas. Extensification especially in periferous areas, often accompanied by enlargement of farms.

Afforestation
In areas where marginalization prevails and where less favoured conditions for (extensive) agriculture. Areas indicated are suitable for forestry based on soil, climate and the size of available areas. Next to forest other land use is possible : water conservation, receation and tourism. Commercial forestry could lead to uniformity. Generally large scale forest affects the original open character of rural areas. Increase in built up areas and road density is hardly expected.

Marginalization
No possibilities for alternative forms of extensive land use that could compensate for former agricultural use. The resulting process could lead to spontaneous natural succession into shrub or forest, but also to land degradation and erosion. Depending upon boundary conditions the openness of landscapes can decrease, biodiversity can increase but in other cases where a larger uniformity will result a decrease is possible as well. New economic carriers can be expected in some areas, e.g. mountaineous areas that could offer possibilities for ecotourism.

New economic carriers
In a limited number of locations, rather than covering large areas alternative new economic carriers can be seen that replace earlier agricultural land use. Examples are recreational centres , new estates, tourism.

4.5. . Some comments on maps, map legenda's and the underlying information

The maps have been produced in a relatively short time frame, starting from existing information in literature and aditionally based on personal interpretation of several other data. Consequently, also because of the lack of geographical precision , the resulting maps are best characterized as indicative or tentative. Sources that primarily served to design the maps were found in the report "Land Use in Rural Europe "(ref.). Additional information was derived from regional studies for parts of France and Germany in "Back to the Future "(Klundert et al.,1994) , the report "Marginalisation of agricultural land in Europe (Bethe & Bolsius,1995) and eventually descriptions in "Mirabel "(see literature) . In general , personal knowledge and interpretation of the author of this section (F.Bethe) has been decisive .It is beyond dispute that a more verifiable procedure based upon solid monitoring data is required if any policy were based upon the results. Improvements could be achieved after investment in better data collection and the consultation of regional or national experts that could fill in lacking knowledge. Furthermore the general trends have to be translated again to factual or possible impacts on landscape characteristics that can be affected. In a tentative way this has been done in the case study on polders.

5. The polders as a case study

5.1. Introduction

The general methodology as explained in earlier chapters has been applied to the Polder landscapes to test its operational value and to identify pitfalls or alternatives .Due to the lack of time to gather all relevant data and expertise from other countries we were forced to limit this excercize mainly to the situation in The Netherlands. Readers should keep this bias in mind.

5.2. Classification and mapping : what are polders ?

Box.

Few Dutch words have been introduced in all foreign languages of neighbouring countries in both their original spelling and meaning. Polder is such a word and in French, German, and English it's spelling and meaning has not been changed. Not only the word as such has been exported, also the know-how and techniques have been exported over European countries. Fig. 2 (after Haartsen et al.,1990) shows where Dutch expertise has been used to endike riverine areas, marine deposits or reclaim low lying peat areas, using well designed plans, drainage techniques, dike constructions, artificial devices to get rid of surplus water (windmills,sluices, pumping stations) and hard labour, often organised under feodale regimes.

Polders are flat, low lying areas with an artificial water level, most often partly or fully surrounded by dikes. Without dikes and artificial drainage these areas are subject to temporary or permanent inundations by sea, lakes or rivers. Originally these areas were too wet or too risky to be used as permannent or intensive agricultural land. By introducing a protection against flooding and water management system the area was reclaimed and made useful for agriculture. Polders are considered to be one of the most man-made landscapes, together with huertas and delta-landscapes in the Mediterranean they form the artificial landscapes of Europe, as indicated on the map of Johan Meeus (1991).

Although polders are man-made landscapes and therefore a more cultural then natural landscape, polders are a typical landscape with specific characteristics, properties, functions and values in both the ecological, cultural and scenic domain... To show the present distribution and condition of polders landscapes the first step is to select geographical data that can help to show their distribution

5.3. Selecting the polders

To select polders of Europe two methods can be used: I) the first one uses existing landscape maps on an international scale and/or maps on a national scale and compile from there the distribution or properties of the polder landscapes . The most recent and well-known landscape map of Europe is the Meeus-map (Meeus et al., 1992, also published in EEA,1995). The map consists of 30 types landscapes at a scale of 1 : 6 000 000 and is compiled from various sources (map 2). Another relevant source in literature is the description of polders in 'The polders of the World' (Van Dam et al.,1982) .This information resulted in a general map indicating larger polder areas in Europe (Map 6) . Both sources identified polder areas in a qualitative and indicative way; the maps have a low resolution and polder landscapes do not have strict boundaries. II) A more quantitative, but initially time consuming method is to define strict criteria which could help to discern and characterise polders and apply these to digital data. Essential data relate to soil, topography, water management or land use present in CORINE data or comparable sources. This second method is chosen to select the polders (see Appendix B for further explanation). Reasons are that the study tries to to exploit large , authorized , updated data bases for a variety of landscapes with a higher spatial resolution . Alternative sources are either incomplete, inadequate or coarse grained or too time-consuming to bring them into a systematic framework.

Criteria to select polders in Europe relate to the definition presented earlier.

The primary characteristics of polders are :
i)an artificial water management system, ii) flat, and adjacent to water bodies (sea, lakes, rivers) , iii) reclaimed by endiking intertidal area or inland lakes, iv) the presence of devices (pumps, windmills, sluices) to get and keep the water out of the area.

Map 7 shoows the result of selecting polders with these characteristics from digital data at a scale of 1 : 1.000.000. We restricted ourselves to the polders areas of Northwesten Europe because of data availability. only European digital data sets are used. Land cover data were used (See for more detail :Appendix A). The outcome is comparable with 'the Polders of the world' and the Meeus map, but offers a higher resolution and was achieved by a more traceable method. It has to be kept in mind that the map should be considered as an overview of "potential polder distribution" using selection criteria . A check on these data is necessary to conclude that all indicated areas are polders in the real sense.

5.4. Variety of polders

The polder landscapes presented in map 7 have comparable characteristics but reflect also many relevant differences Using specific or additional so-called *differentiating criteria* these differences can be shown and explained.
Differentiating criteria can be used to select different *types of polder-landscapes* whereby descriptive criteria can be used to give more information within each type.

Determining polder types

To reach this level and distinguish the major types of polders, three distinctive criteria are needed. The first distinction is based upon three major soil types,i.e. *river clay, sea clay and peat*. These properties are important as other properties are correlated . For example : occupation patterns, drainage density, water levels and dynamics, and the actual or potential ecological situation. Furthermore the polder types can be subdivided by the dominant kind of water management system (ditches, pumping, overhead sprinklers, or pipe underdrainage, indicating the intensity of agricultural use). Within the river polders an extra distinction is made between upland and lowland rivers based on elevation (height) of the polders above sea level. Within this group a relevant subdivision should imply river-forelands (frequently flooded) and land protected by dikes (not separately indicated for cartographic reasons).

The result is six types of polders and these polders are presented in Map 8 .In table 1 are their destinctive characteristics presented.

Table 1 Distinctive characteristics for defining polder types

Polder type	**Distinctive characteristics**		
	Soil	**Water management system**	***Maximum height***
Lowland riverpolder	River clay soil	ditches & pipe underdrainage	Between 0-20 meter
Upland riverpolder	River clay soil (tertiary)	No info	Between 20-450 meter
Peat polders	Peat soil	ditches and pipe underdrainage	Between –10 – 0 meter
Sea clay polder 1	Sea clay soil	*Pumping*	Between 0-20 meter
Sea clay polder 2	Sea clay soil	*Pipe underdrainage/drained*	Between 0-20 meter
(Dry) Sea polder 3	Sea clay soil	Overhead sprinklers	Between 0-450 meter

Description of the polder types

Hereafter *descriptive criteria* can be collected to give more information about these six types of polders. This information is useful for the SWOT analysis and gives insight to what degree a polder could be considered intact or spoilt by all kinds of impacts that affected the original state.

The land cover of a polder is originally characterised by a very high percentage of pasture or arable land and a low percentage of urban area or forest. Table 2 gives the percentages of the main land cover per polder type. From this table can be concluded that peat polders are currently most urbanised and the dry sea clay polders have the biggest area of forest.The degree of urbanization of peat polders is of course remarkable or even unlogical but can be explained as a result of their position near agglomerations in the western part of The Netherlands. So this is a result of a concentration of peat polders in the western parts of Netherlands and their historical vicinity to urban activities rather than a predestination by physical conditions. Another conclusion is that the upland river polders and the peat polders are chiefly grassland and the other types (river polders and sea clay polders) are predominantly used as arable land. These phenomena can easily be explained by soil and water conditions respectively the flooding risks determining land use potentials.

Table 2 Percentage urban, arable, pasture, forest, and water per polder type

	Urban %	Arable %	Pasture %	Forest %	Water %
Lowland river polder	5	74	16	5	0
Upland river polder	6	37	53	2	2
Peat polder	9	15	72	2	2
Dry sea clay polder	3	75	2	13	7
Pipe drained sea clay polder	7	70	14	2	6
Pumped sea clay polder	1	96	0	0	2

Map 9 (a,b,c,d) shows the percentages of urban, forest, pasture, and arable land cover for polders on the more detailed level of the soil unit. This shows the variety within each polder types in land cover.
Whether all pastures are used for agriculture is uncertain. At least for the peat polders in The Netherlands it's known that large parts serve as (semi) natural area and to a lesser degree as recreation area.

Other descriptive information can be found in literature: 'Polders of the world'(Van Dam et al., 1982) and the Dobris report (EEA, 1991).

5. 5. SWOT-analyses on polder landscape types in (NW) Europe

Following earlier distinctions in polder types, the SWOT analysis , following the various steps explained in chapter 2, is applied to the major polder types in sea clay

(Marine sediments) , river clays (Fluviatile sediments) and peat polders. The analysis focuses on the Northwestern part of Europe (shown in the circular window in map 4 and in other maps)

5.5.1. SEA CLAY POLDERS

Distribution

In North-western Europe, the sea clay polders are mainly found in the Netherlands, Flanders, France and England. (A further distinction is made between the common sea clay polders, reclaimed from silted-up areas from 1000 AD onwards and drained inland lakes, as found in former peat areas, where peat has been mined for fuel or other purposes and remaining lakes expanded due to subsequent wave erosion until these lakes were reclaimed again, resulting in mostly low lying marine clay areas.. These areas form generally a younger landscape, since the 16 th Century).

Strengths and weaknesses

Description of landscape characteristics and properties

- water management system: ditches and larger water courses, pipe underdrainage/drained/pumping
- elevation/ topography :slightly below (drained lakes) or just above sea-level (up to 20 meters, often lower than 5 meters above sea level))
- land use : mainly arable and pasture and horticulture (glasshouses)
- less than 8% urban and less than 2% forest(?)
- medium to large scale open landscapes
- concentrated settlements and scattered farms often with planted yards
- canals, dykes (old ones sometimes planted), dwelling mounds (in the northern polders), (former) creeks, sometimes planted roads (drained lakes)
- irregular (older ones) or regular block parcelation with ditches as boundaries
- fertile sea clay soil, mostly modern(ized) land division and management give high agricultural outputs.

Valuation of landscape qualities

As explained earlier, landscape qualities could be specified into ecological, historical and scenic qualities.

Polders could be valued from "largely intact" to "strongly affected", depending on the percentage of the area affected by uncharacteristic land use. Drained lakes are generally more affected by urbanisation than the other clay polders as the former are close to major urban conurbations. The landscape of the younger drained lakes is generally less attractive in terms of ecological values, cultural heritage and landscape diversity. This refers especially to 19th and 20 th century reclamations. Nevertheless recent reclamations like the Noordoostpolder gain appreciation (as recently was the

outcome of the Belvédère-project in The Netherlands, that indicated areas of historic importance).

- Ecological values: habitats mainly connected with dikes, creeks and salty or brackish environments giving specific opportunities for special species (Ramsar and Natura 2000 sites), meadows as forage areas for geese and other waterfowl. In general the more intensively used polders are more polluted or otherwise influenced (levelled).
- Cultural heritage values: the pattern of individual polders linked together, planted dikes, individual dwelling mounds, farms and villages and the overall monumental spatial lay out of some drained lakes, like the Beemster and the Noordoostpolder. Typical features relate to drainage systems, like some pumping stations and the structure of canals.
- Scenic values: mainly the openness in connection with the small scale, rural settlements, historic farmland and the abundant appearance of water in canals and ditches.

Actual landscape policy

For the sea clay polders there is no specific policy within The Netherlands although polder areas or parts of these often belong to a certain category of landscape policy. Characteristics of distinguished landscape types have to be taken into account in sectoral or spatial plans. The Zak van Zuid-Beveland in SW Netherlands is designated as "valuable cultural landscape". Some polder areas, mainly in the western part of the country and Flevoland are marked for their "characteristic openness" and should be retained as such. Others fall under the category "Preserve and recover landscape quality". (Nota Landschap , 1992 , Structuurschema Groene Ruimte,1995) Landscape policies from other countries are not yet analyzed, so that comparisons are not possible.

Strengths and weaknesses

- The overall lay-out of the sea clay polders in the western part of the Netherlands (mainly the drained lakes) and the Fens in East Anglia, is very rational and well equipped for modern agriculture. The landscape of the drained lakes is flexible and suitable for multiple land use types; it seems to be easy to adapt to new types of land use. Landscape quality was often qualified as poor or even "boring"., but reconsideration is evidently going on. A good example is the appraisal of modern polders such as the Noordoostpolder as mentioned earlier. There are some fine examples of well designed older and newer polders as exemplified by the Beemster and the Noordoostpolder.
- The sea clay polders in the northern provinces are extensive, less affected by urnabization and well maintained so that cultural heritage and natural values are relatively high. These landscapes also support different types of modern agriculture. Here the large scale and openness is generally regarded as a quality.
- The sea clay polders of the south western part of the Netherlands are generally intact, except for certain areas.

- The Marais de l'Ouest in western France are mainly cultivated or cattle rearing marshes or other ancient salt marshes. For agriculture they do not seem to be very interesting. Ecologically they are however important wetlands.

Opportunities and threats

Driving forces
- An ongoing liberalisation of international trade and the agricultural markets
- Ungoing urbanisation, industrialisation and transport of goods and persons
- Continuing demand for time and space for recreation and tourism
- Climatic change and sea-level rising

Land use consequences
- Urbanisation
- Agriculture (from industrialisation to extensification)
- Diversification and new functions
- Marginalisation
- Forest and nature development
- Pollution

Opportunities and threats
- The sea clay polders in the western part of the Netherlands (mainly drained lakes) are under strong pressure from urbanisation. Both room for residential areas, industrial estates and office sites and ever expanding infrastructure are a threat to the openness and rural character of the polders. Developments in agriculture work into the same direction: industrial forms of agriculture, concentration of intensive forms of agriculture (glasshouses, horticulture) dominate. There are abundant claims for forest and nature development or leisure facilities. The nearness to urban centres offers a change for (regional) specialities for direct delivery in the towns. The national policy still favours agricultural development and also a a diversified development, by executing a restrictive policy towards urbanisation. Finally a major threat are the increasing costs to fight salinization of agricultural land, a feature that will increase in importance when sea level rise continues. An opportunity for alternative destinations for some of these polders might be fresh water storage combined with watersport and nature restoration.
- Agriculture in the polders of the Fens is characterized as "stand-still". That could turn into a vulnarable situation in the future. This is a major threat for a monofunctional agricultural area, with cereals as main crop.
- The sea clay polders in the northern provinces of the Netherlands are not threatened by strong urbanisation. Rural land use seems to dominate. The general trend in agriculture is intensification and scale increase and in some parts concentration. Claims from , respectively opportunities for, leisure activities are limited; claims for other functions do not exist, except for nature. In some parts

there are extensive claims for nature development.
- The sea clay polders in Zeeland are more subject to extensification and diversification. Urban pressure at the moment is not so strong. The coast attracts tourists from the Randstad, Flanders and the Ruhr-area. More and more the hinterland of the coast will be used to enhance and diversify the leisure possibilities for tourists.
- The (former) marshes of the Marais, along the French westcoast are subject to agricultural marginalisation. The nearby urban agglomerations might be able to trigger new developments.

Confrontation of strengths and weaknesses with opportunities and threats

A strategy for the relatively unspoilt sea clay polders in the northern and south-western part of the Netherlands could be directed to an overall preservation of the landscape characteristics. For the south-western part a more offensive or anticipative strategy might be necessary as this area could, due to its geographical position, very well be subject to major urban developments in the coming decades.

For the polders of the drained lakes in the Western Netherlands , the most precious examples might be selected for preservation. For the remaining parts a clear choice has to be made between a landscape-sensitive urban development or an open space policy, based on large scale agriculture, leisure developments, afforestation and nature development. In both cases the openness will disappear and original polder characteristics will be transformed. Perhaps water-storage and water conservation are options for new functions that would best respect the quality of openness and add ecological values related to wetland environments. Of course, historical values are certainly affected negatively by such measures.

5. 5. PEAT POLDERS

Distribution

Peat polders are mainly to be found in the western part of the Netherlands and in the province of Friesland and Overijssel. In other countries the areas are much smaller, although peat deposits also occur elsewhere. Overall a concentration in The Netherlands on a European level is emerging from geographical data.

Strengths and weaknesses

Description of landscape characteristics and properties
- water management system: maintain the water level by pumping

- slightly below or above sea-level)
- dominant land use is grassland; recreation and tourism come second.
- medium to large scale open landscapes
- concentrated but ribbon-like occupation pattern
- canals, dykes, relict of tree rows (willows) and peat-streams, strip-like parcelling with ditches as boundaries
- they are characterized by peat soils, and large amounts of surface water
- mostly not very modern(ized) land division and management
- low to medium agricultural outputs; zoned: more intensive near the farm buildings, to very extensive in remote parts, or parts with physical handicaps, small parcelling or isolated by water.
- Vulnerable to ongoing deep drainage

Valuation of landscape qualities

With respect to the amount of openness and the absence of urban and industrial areas, large infrastructure and major forest areas, these peat polders could be valued as "largely intact". Though sometimes closely situated to urban conurbations, the natural circumstances have prevented these polders from being developed for other goals than e.g. dairy farming. These polders may be considered (together with or perhaps even more than the sea clay polders and river polders), the archetype of the Dutch landscape in a historical sense as often reflected in older and newer generations of paintings.

- Ecological values: due to the relatively extensive use as grasslands, these polders contain major values for meadowbirds, marsh communities
- Cultural heritage values: the medieval occupation pattern. These resulted in strip-like parcellation, the so-called cope reclamations. Also relicts of former defence lines, individual buildings are of interest.
- Scenic values: the openness, the long, small strips with broad canals; the combination op openness with enclosed and again cosy settlements, with often historic farmhouses.

Actual landscape policy

There is a general policy for areas of peat meadows, concerning the relation between agriculture and nature and pointing out the most important areas for geese and small swans. Part of the Holland/Utrecht peat district fall under the National Landscape Green Heart, so that urbanisation is formally restricted.
Several marsh-development areas have been indicated in relation to the EHS in both areas. De Weerribben is getting protection as being appointed a National Park.
Large parts of the peat polders fall under policy categories as "Preserve characteristic openness" and "Preserve and recover landscape quality".
Waterland is mentioned as a "Valuable cultural landscape"

Strengths and weaknesses

- The Holland/Utrecht peat district is severely fragmentated by infrastructure and

urban developments. On the other hand the marshy environment with large lakes offers an ideal environment for watersport for nearby urban populations. Historic estate development has provided a rich and diversified landscape along the river Vecht.

- The Frysian/Overijssel peat district is a more coherent area with major ecological qualities and an extensive system of waterways. The area is not well accessible by road. Specific semi-agricultural practices have developed like cutting reed

Opportunities and threats

Driving forces

- An ongoing liberalisation of international trade and the agricultural markets
- Ungoing urbanisation, industrialisation and transport of goods and persons
- Continuing demand for time and space for recreation and tourism
- Climatic change and sea-level rising
- Pressure from recreation (recreational building; watersport)

Consequences for land use

- Urbanisation
- Agriculture (from industrialisation to extensification)
- Diversification and new functions
- Marginalisation
- Forest and nature development

Opportunities ands threats

- The Holland/Utrecht peat district both suffers and profits from the urban pressure. The scenic quality, being so important for tourists, is seriously hindered by expanding urbanisation. But the city also provides possibilities for farmers for supplementary activities in leisure related activities. Agriculture itself will be economically of diminishing importance and further extensifying. Long term continuation of drainage practices implies ongoing lowering of the land surface caused by oxydation and compaction .The high costs to maintain the water management will cause a threat in the future.
- Some of the values are based on the specific combination of agriculture practices and natural values, but economic and ecological demands do not always coincide.
- The Frysian/Overijssel peat district can develop in a less hectic environment. Extensification and where possible diversification of agriculture are likely developments. This can be regarded as a change for the ecological potentials for the region. The economic basis however, either by agriculture or by tourism, is less obvious than in a more urbanised environment.

Confrontation of strengths and weaknesses with opportunities and threats

The Peat polders in the western part of the Netherlands, especially in the

Utrecht/Holland district, will profit most by a clear orientation on the demands of the urban environment. Traditional agriculture practices will diminish and make room for rural/leisure entrepreneurship.

For the polders where agriculture land use is still dominating, the future is less clear. Water management problems will further erode agricultural profits, but the alternative economical structure is not yet available. Maybe a co-operative effort to develop a really urban-oriented food production could provide a solution. No more world market-oriented, but region-oriented based upon regional specialities and brands.

In the Frysian/Overijssel peat district a further development towards enhancing the landscape-ecological qualities by development of marshes and habitats for meadowbirds seems to be logical.

5.4.3. LOWLAND RIVER POLDERS

Classification and mapping

River clay polders are divided into upland and lowland ones. Lowland river polders in North-western Europe are mainly found in the Netherlands and Germany. There are three area's distinguished: The Lowland Rhine river polders and the two Northern German Lowland river polders.
Upland river polders are found in Germany and England.

Strengths and weaknesses

Description of landscape characteristics and properties

- water management system: ditches (and pipe underdrainage)
- between 0 and 20 meters above sea level
- dominant land use is pasture and arable land, gravel and clay pits
- medium to large scale open landscapes
- zoning from river forelands, more sandy or silty riverbanks to clay polders
- occupation mainly concentrated in villages, with some dispersion
- irregular to large regular parcelling, small plots of poplar and willow, dikes, avenues of trees and ditches, river dunes, former streams and relicts of breaches in dikes ("wielen")
- mostly modern(ized) land division and management
- medium agricultural outputs

Valuation of landscape qualities

With respect to the amount of openness and the absence of urban and industrial areas, large infrastructure and major forest areas, these lowland river polders could be valued as "largely intact".

- Ecological values: dynamic habitats (pioneers) in the river forelands of major imoportance for migration of species, further these landscapes provide major values for meadowbirds...
- Cultural heritage values: archeologically rich in frmer levees , medieval reclamation history, former brick factories in the forelands, specific sites like "draaiakkers", "donken". Beside characteristic farms also castles and fortresses.
- Scenic values: the openness, the long linear landscape structure connected to the river; the contrast between small settlements and diversified land use on the river banks with the monofunctional halfopen coulissen of mainly grassland polders.

Actual landscape policy

There is no general policy for the lowland river polders, exept that landscape characteristics should be taken into account by sectoral developments and spatial plans. In the Netherlands a number of nature development projects in river forelands are initiated in the recent decade, aiming at a more spontaneous river. (Blauwe Kamer, Gelderse Poort). Large parts of the river forelands are incorporated as core-areas in the Nature Policy Plan. The lowland river polder are designated as important areas for geese, small swans and meadowbirds.

Strengths and weaknesses

- The Lowland Rhine river polders in the Netherlands and Germany have to be subdivided in river forelands and endiked areas.
- River forelands : less suitable for urbanization and permanent agriculture; essential for water storage and discharge; suitable for nature restoration ; gravel, sand or clay mining. Recreational values relatively high.
- Endiked areas : suitable for intensive agriculture, horticulture, orchards on higher grounds. Lower parts suitable for dairy farming, limited silviculture, nature restoration. Lower parts run risks of river flood disasters or precipitation surplus, so they are less suitable for building
- Character of the area relatively vulnerable to larger scale urbanization and heavy infrastructure.

Opportunities and threats

Driving forces

- An ongoing liberalisation of international trade and the agricultural markets
- Ungoing urbanisation, industrialisation and transport of goods and persons
- Continuing demand for time and space for recreation and tourism
- Climatic change and sea-level rising

Consequences for land use

- Urbanisation
- Agriculture (from industrialisation to extensification)
- Diversification and new functions
- Marginalisation
- Forest and nature development

Opportunities ands threats

- In river forelands a combination of river discharge and flood control, mining of raw material, nature development and recreation.
- Endiked areas : Higher grounds are attractive for intensification in agriculture, transport, housing, industry but vulnerable to loose their character.
- Lower areas are due to their elevation vulnerable for moderate or severe flooding and have less agricultural potential. Water storage, recreation and partly forestry couild offer some perspectives.

	MARINE POLDERS	**PEAT POLDERS**	**DRAINED LAKES**	**LOWLAND RIVER POLDERS**
INTERNATIONAL UNIQUENESS	+/-	+	+	-
INTERNATIONAL SIGNIFICANCE	+	+	+/-	+
PRESERVATION BY NATIONAL POLICY	-	+	+/-	+/-
LANDSCAPE DEVELOPMENT BY NATIONAL POLICY	-	+/-	-	+

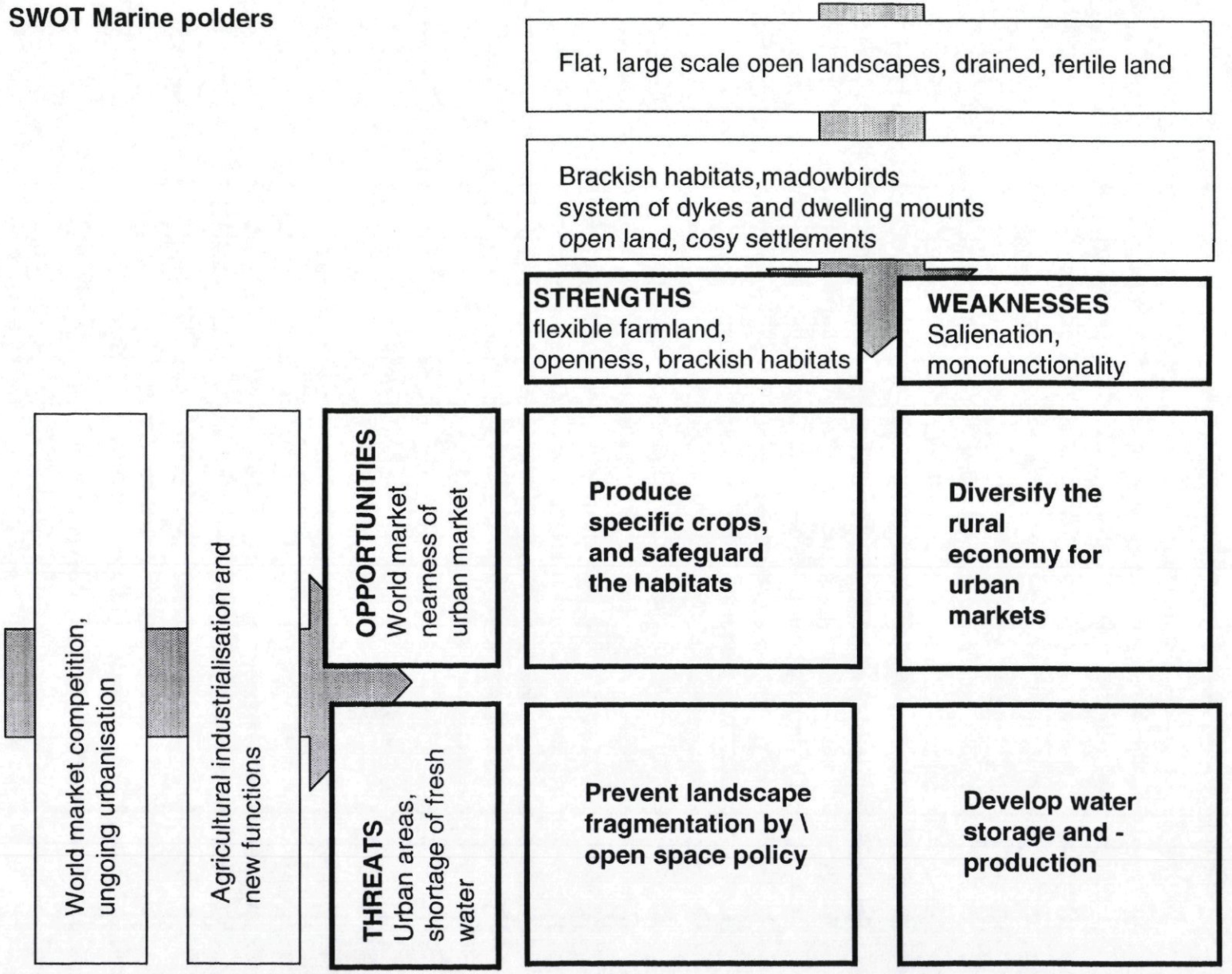
5.5. General conclusions related to the polders

Polders can be found everywhere around the world (Van Dam et al. ,1982). Millions of hectares of land below or just above sea level in deltas and estuaria and stretches of fertile land along rivers are artificially drained to get rid of excess water and reclimed for agriculture. Not all these areas are so strictly and so completely under human or technological control as (we believe) the Dutch polders are. The latter are composed from different types of polders on a relatively small area.
There is good reason to compare the status, qualities and potentials of the Dutch polders with polders abroad. Especially when landscape policy gradually becomes an international point of discussion.
On a European scale, and the same picture emerges from the smaller window on North-West Europe , a concentration of polders and a high variety of types of polder landscapes is found in the Lowlands. In North-western Europe major areas of sea-clay polders are largely restricted to the Netherlands, Belgium and France and some smaller areas in other countries . A special subcategory, drained lakes seems to be bound to the Lowlands .Larger peat polders are liberally found in The Netherlands, smaller areas however are present in Germay and the Fens in East Anglia.
The last type of polders are related to rivers. River polders are related to major rivers and found in many countries.
All in all both the extent and the variety of polder landscapes in The Netherlands emerges from the data as presented before. A qualitative manner to assess the values of various polder types in The Netherlands seen from an international point of view is presented in Table 3. The main four types are scored upon their uniqueness, international significance, preservation by national policy or theiir presence as landscapoes that will receive poluicy attention in an other way, e.g. by active landscape development plans.
The current condition of polders as well as the analysis of ongoing and foreseen pressure from changing land use leads to the conclusions that most areas will undergo a trend towards a higher pressure from agriculture, urbanization or other potential land use types.
If we benchmark the four Dutch types of polder landscapes with respect to their uniqueness and significance aand current status we can roughly conclude that:

- with respect to sea clay polders there is no general preservation policy, nor a major landscape development policy. Reconsideration of policy from an international context seems to be logical.
- Drained lakes and peat polders seem to have their centre of gravity even more within the Netherlands. Current policy seems to give better conditionsfor the preservation of peat polders than for drained lakes.
- The lowland river polders are not unique, but the vast area and still coherent appearance make them internationally important. Protection by policy measures are – at least partly , i.e. for river forelands - present
- Good opportunities seems to exist in combining existing and new functions that help to safeguard landscape values.

Fig 3

SWOT Marine polders



In the following scheme (Fig.3)the main points are recapped.

6. Conclusions and recommendations for further study

In this study a SWOT approach was developed and tested for landscape assessment on a European level .The method includes the identification and mapping of landscape features, the formulation of landscape values, an analysis of ongoing or foreseen trends in land use change and the assessment of threats and opportunities as well as suggestions for policy making. The experiences in this study reveal generally that:

- *the methodology in general is quite promising and effective, but needs refinement in several respects*
- *the success of the methodology strongly depends on the availability of reliable, consistent and full-cover data.*

Several aspects of the above can be explained and discussed in more detail :

a. The case study on polders proved to work out reasonably well thanks to a relatively well equipped data bank and additional data from literature. Experiences with features of the so-called Kampen Landscape, focused on typical small-scale landscapes revealed that existing data from international data bases did not yet offer enough firm ground.
b. The SWOT approach should preferably pay more attention to the several economic potentials of areas. This helps to identify the strengths of areas and the probabilities of continued trends in land use change . It helps to underpin expectations on realistic opportunities of alternative use of landscapes. A well tested land evaluation procedure as for agriculture has proven its ability , but requires a broader scope for other activities.
c. The choice of parameters or indicators for landscapes features (characteristics, properties, values) is of paramount importance and should be developed explicitly in international context
d. Data and insights in land use change need to be refined and collected from authorised and regularly updated statistical sources providing sufficient geographical detail.
e. An essential information layer should be added concerning the official (actual or foreseen) statuses of areas, e.g. areas falling under international agreements (Habitat Directive, Bird Directive a.s.o.) or under national policies (Nature Policy Plans, National Parks a.s.o.).This helps to verify data from other sources or to identify remaining valuable areas.
f. A reliable, consistent geographical data base for various applications based upon an adequate landscape classification and a GIS with geographical data is urgently needed.
f. A top down approach using central data bases like Corine has proven to be very useful. Expansion or geographical completion of these data in a systematic way deserves full support. In addition however, national or regional data and expertise (including expert judgement) are necessary to check, refine or

complete these sources. This requires cooperation from national or regional organizations and experts and should be based upon sufficient consensus on goals, concept, classifications, indicators a.s.o. It also needs organizational and logistic support and leadership.

g. The translation of the several analytical steps to the part dealing with threats, opportunities or policy options needs to be realized in an interactive discussion between researchers and people dealing with the policy making process.

h. An extended study to improve several points listed above should be undertaken , well geared to the project on classification and mapping of landscapes. Priority should be given to the formulating of a meaningful set of indicators for all domains (ecology, cultural aspects, scenery, economy, possibly earth-scientific aspects) that could easily be derived from existing data.

7. Literature and other sources.

Antrop, M.1989. Het landschap meervoudig bekeken. Monogr. Stichting Leefmilieu, kapellen/België

Baldock,D., G.Beaufoy, F.Brouwer & F. Godeschalk / 1996. Farming at the Margins; abandonment or redevelopment of agricultural land in Europe. London/The Hague

Bethe,F.H.(Ed.).1997. Land use in rural Europe/ rural areas and Europe; processes in Rural land use and the effects on Nature and Landscape. Min. Housing, Spatial Planning and The Environment, The Hague

Bethe,F. & E.C.A.Bolsius , 1995.Marginalisation of agricultural land in The Netherlands, Denmark and Germany. National Spatial Planning agency, The Hague

Cattizone et al.,1998. Understanding Biodiversity., European Commission.

Centre for Ecology and Hydrology, 1998. MIRABEL; Models for Integrated Review and Assessment of Biodiversity in European Landscape

Council of Europe/Unep/ECNC.1996. The pan-European Biological and Landscape Diversity strategy

Dam, J.C.van (Ed.),1982. Polders of the world; papers of an international symposium: 6 Volumes, Ijsselmeer Polders development Authority, Lelystad.

Delbaere, B. (ED.)1999. Facts and figures on Europe's biodiversity. State and trends. ECNC, Tilburg

EEA, (Eds. D.Stanners & Ph.Bourdeau) 1995. Europe's Environment, The Dobris Assessment.

ESDP, 1999. European Spatial Development Perspective; Towards a balanced and sustainable development of the territory of the EU. Potsdam, May 1999-06-22

European Commission ,199 / .The perspective development of the central and capital cities and regions.

EU Commission, 1998. Agricultural Landscape. OECD workshop on Agri-environmental indicators 2nd meeting of the steering group for the workshop

Groen,J. / National Physical Planning Agency, 1995. De toekomst van het landelijke gebied; discussienota Eurokompas '95.

Groot, R.S.de ,1992. Functions of nature. Diss. Wageningen

Haartsen, A.J., A.P.de Klerk & J.A.J. Vervloet. 1989 Levend verleden, een verkenning van de cultuurhistorische betekenis van het Nederlandse lanmdschap.. achtergrondreeks Natuurbeleidsplan 3, Staatsuitgeverij.

Klundert, A.F.van de , A.G.J.Dietvorst & J.van Os.1994. Back to the future. New functions for rural areas in Europe. National Physical Planning Agency, 1994.

Maarel, E.van der & P.L.Dauvellier,1978 .Naar een Globaal Ecologisch Model. Rijkjspolanologische Dienst, Den Haag

Maarel, E.van der & P.L.Dauvellier,1978 . Naar een Globaal Ecologisch Model. Rijksplanologische Dienst, Den Haag

Meeus,J., M.Weijermans and M.Vroom,1990. Agricultural landscapes in Europe and their transformation. Landscape and urban planning 18 (3/4):289-352.

MLNV(Ministry for Agriculture, Nature Management and Fisheries), 1990. Natuurbeleidsplan

MLNV,1992. Nota landschap.

MLNV, 1995. Structuurschema Groene Ruimte.
National Physical Planning Agency, 1996. Landelijke gebieden en Europa. LG&E project.

Regt, A.L. de / National Physical Planning Agency, 1989. Small-scale Landscape in a large-scale Europe, In : Spatial reconnaissances 1989, National Spatial Planning Agency, The Hague.

Rigg,K., A.Salman, D.Zanen, M.Taal.J.Kuperus & J.Lourens.1997. Threats and opportunities in the coastal areas of the European Union. Ministry of housing, Spatial Planning and Environment, The Hague.

National Physical Planning Agency, 1997. Land Use in Rural Europe.

Lebeau, 1991 Les Grands types de structures agraires dans le monde

Mücher,C.A.,K.Steinnocher, J.L.Champeaux,S.Griguolo,K.Wester and P.Loudjani,1999. Land Cover Characterization for environmental monitoring of pan

Europe. In: Proc. 18 th Earsel Symp.on Operational Remote Sensing for Sustainable Development , ITC Enschede, 11-13 May, 1998: pp.107-113.

Rabbinge, R. et al.1992. Ground for choices: four perspectives for the rural areas in the European Community. Netherlands Scientific Council for Governement Policy, The Hague.

Wascher,D.M., H.P.Pior & A.Kreisel-Fonck, 1998. Agri-environmental indicators for agricultural landcsapes. Tilburg/Final Draft.

Wolff,W.(Ed.).1990. De internationale betekenis van de Nederlandse Natuur. Achtergronddoc. Natuurbeleidsplan

Digital data

Corine soil erosion, This report describes the CORINE Project on Soil Erosion Risk and Important Land Resources in the Southern Regions of the European Community. It includes sections dealing with the framework, procedures, methodolgy and results of the project. It goes on to describe the applications of the results of the project, the lessons learnt and to discuss the needs for future development and research.

Corine land cover, This report describes CORINE Land Cover project. It consists of two parts: the first describing the framework, objectives and methodology; and the second specifying the nomenclature used in the project. For each item of the nomenclature, Part II of the guide includes a satellite image, delineation of a unit on the image and an example of a document (ancilliary or additional documentation) that will help delineate and identify the unit, and a short commentary on the three illustrations.

Pelcom (see Mücher et al., 1999)

Appendix A : Some definitions

Landscape : a recognisable region , i.e. distinctly differing from neighbouring regions, showing a characteristic set of abiotic, biotic and man-made landscape features including its historic developments.

Landscapes consist always of smaller units that together form a typical mosaic (e.g. hills, valleys, lakes, agriculture, forest, road patterns, building) . Landscapes in Europe are only partly natural landscapes, such as high Alpine mountain ridges or marine sand flats, but predominantly cultural landscapes, where bio-physical properties (rock, topography, soil, water, vegetation, fauna) are remodelled by and interwoven with antropic features, such as parcellation, built-up areas, infrastructure a.s.o. In view of a long history of landuse that changed in place, intensity , technology European landscapes harbour a rich cultural history next to abiotic and biotic phenomena.

In this report landscapes and landscape features are especially seen from the angle of view of ecological, cultural and scenic values that deserve positive attention from policy makers in view of major developments in land use in the European rural and urban areas. This explicitly within the context of human use and the consciousness that land use and land use changes are of paramount importance for either positive or negative effects on landscape values.

Landscape characteristics : specific , well recognisable abiotic, biotic and antropic features in landscapes.

Characteristics are neutral features (high, low, wet, forested) without reference to properties in terms of suitability/ vulnerability or values in an economic or ecological sense.

Landscape properties : those features of landscapes or combinations that possess a certain meaning for all kinds of land use by man or organisms(e.g. fauna) . Examples : possibilities for certain crops, water extraction; biotopes/corridors for large animals etc.

Landscape functions: in a strict sense :those land use types found in a defined landscape ; in a broader sense : all actual or potential services (carrier function, production function, regulation function, information function) accomplished bij landscapes

Landscape values : Values are attributed by man from a certain context of appraisal, e.g historic or cultural values of old, unspoilt landscapes dating back to the middle ages, ecological values related to botanical richness or the presence of rare animals or scenic qualities in coastal areas or mountains. The way values are attributed to landscapes mostly differ from country to country and from time to time, depending on the socio-cultural context.. Specification of criteria is utterly necessary as well as the distinction between neutral, objective data and values.

Trends : current or foreseeble changes driving forces and resulting dynamics in land use directly or indirectly affecting landscapes.

A subdivision can be made in so-called *"driving forces"*, that generally are large scale ,indirect trends that for instance relate to globalisation of the economy, demographic trends (strong growth or decline of number of inhabitants) or important changes in technology (e.g. infromation technology). Mostly these driving forces cause a host of dependent developments that affect landscapes more directly, such as intensification in agriculture, land abandonment, growth of cities and infrastructure a.s.o.

Therefore, these trends generally represent multiple influences on the landscape, that sometimes require a further breakdown in specific points of primary impact. For example intensification of agriculture is usually connected to reallotment, the formation of larger fields, the loss of hedgerows or other field boundaries, a higher input of fertilizers and biocides, artificial drainage, irrigation and sprinkling techniques

Appendix B

Method of selection and description of polder areas

A *stepwise approach is followed to i) select and ii) describe polder*s:
On this *first level* river clay, sea clay and peat soils are selected from the soil map. These soils find their origin in marine or fluvial sedimentation or peat growth. The minimum height of the area is used to distinguish the higher rainfed peat areas (blanket bogs) from the peat areas influenced by groundwater or surface water. Only the last areas can be polders. Because polders are characterised by a horizontal water level these areas are flat which means a slope nearby 0 %. Information on the water management system (yes or no) has completed the selection of polders on the first level.

On the *second level* the selected polders can be subdivided to distinguish the major types of polders. This distinction is based on soil types, such as river clay, sea clay and peat. These properties are often important as other properties are correlated: occupation patterns, drainage density, water levels, ecological situation. Furthermore the polder types are subdivided by the kind of water management system (ditches, pumping, overhead sprinklers, or pipe underdrainage). Overhead sprinklers is not a

typical polder water management systems, but if it is in dominant use in a potential polder area (level 1) some other characteristics could be derived from that information. Within the river polders an extra distinction is made between upland and lowland rivers based on maximum height of the polders.

On the third level characteristics of polders are found which further describe the types of polders related to their present use and degree of loss of original character. Because originally the polders have no high percentage of urban land use or forest this percentage is used for this description.

Selection	*sub selection*	*Description*
level 1	*level 2*	*Level 3*
• Climate/altitude class • Soil (1) • Minimum height • Slope • Water management System	1. Soil (2) 2. Kind of water management system 3. Maximum height	• % urban • % forest • % pastures • % arable • 1st dominant land use • 2nd dominant land use • info out of polders of the world • info out of Meeus report

Discussion

At the second level (level 2) three characteristics are used to define sub types of polders, soil (river clay, sea clay, peat), water management system (ditches, pumping, pipe underdrainage, sprinklers) and Maximum height (-10 – 0, 0 – 20, >20 meter above sea level). After these three steps, six sub types of polders are 'created'. We think this is adequate on a European level.

But there are different possibilities to create sub type polders. Besides the selection described above it is also possible to:

1. finish level 2 after step 1 (soil). This means only three types of polders are distinct (sea clay polders, river clay polders and peat polders). The kind of management system and the maximum height can be used at level 3.
2. use a fourth step 'water system' (Rhine, Maas etc) in which the above drawn types of polders are divided into 14 sub types (peat 1, river upland 6, river lowland 3, sea clay 4)
3. replace step 3 'maximum height' by 'water system' (Rhine, Maas etc) and you get 13 sub types (not upland and lowland river polder but only Rhine river polder)
4. use a fourth step 'united', in which each polygon is a type of polder. In this way about eighteen type of polders appear.

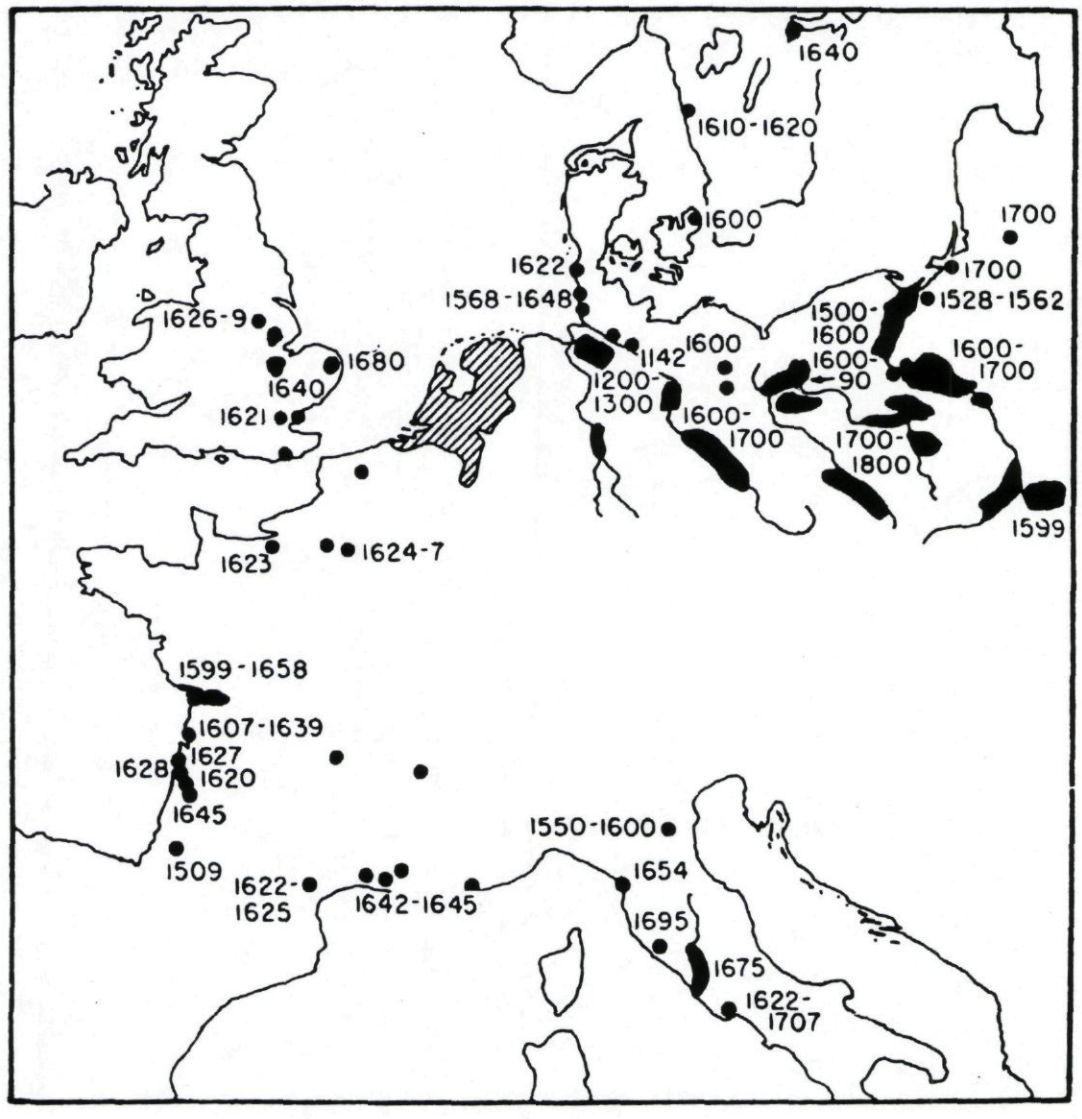
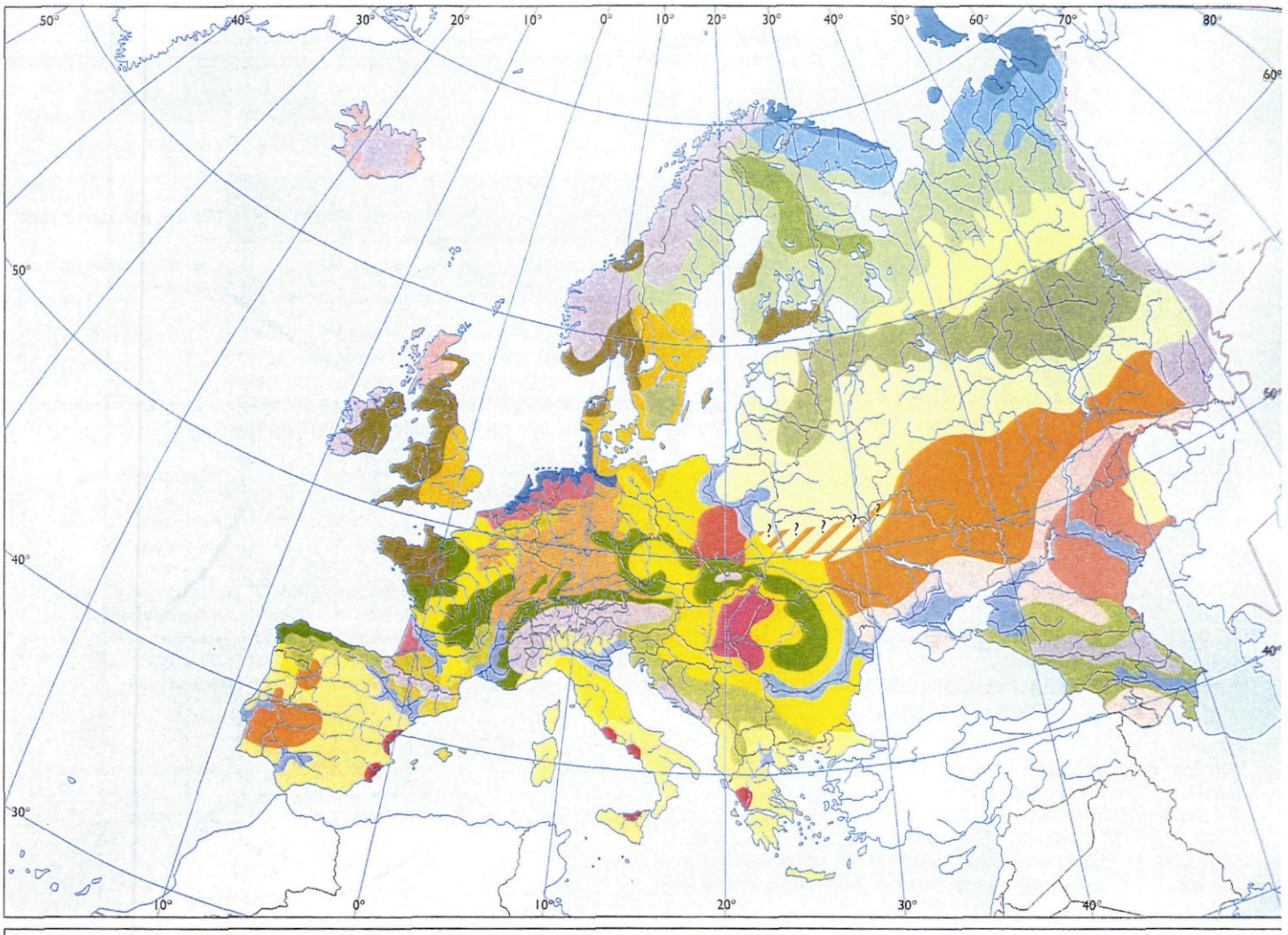


Fig 2. Dutch Polder making techniques exported to adjacent countries (years of construction indicated)
From: Haartsen et al., 1988)



European landscapes

TUNDRAS
- arctic tundra
- forest tundra

TAIGAS OR FOREST LANDSCAPES
- boreal swamp
- northern taiga
- middle taiga
- southern taiga
- subtaiga

UPLANDS
- northern highlands
- mountains

BOCAGES OR ENCLOSED LANDSCAPES
- Atlantic bocage
- semi-bocage
- Mediterranean semi-bocage

ARTIFICIAL LANDSCAPES
- polder
- delta (artificial forms)
- huerta

REGIONAL SPECIFIC LANDSCAPES
- kampen
- Poland's strip fields
- coltura promiscua
- dehesa or montados

OPENFIELDS
- Atlantic openfields
- continental openfields
- Aquitaine openfields
- former openfields
- central collective openfields
- eastern collective openfields
- Mediterranean open land

STEPPIC AND ARID LANDSCAPES
- puszta
- steppe
- semi-desert
- sandy desert

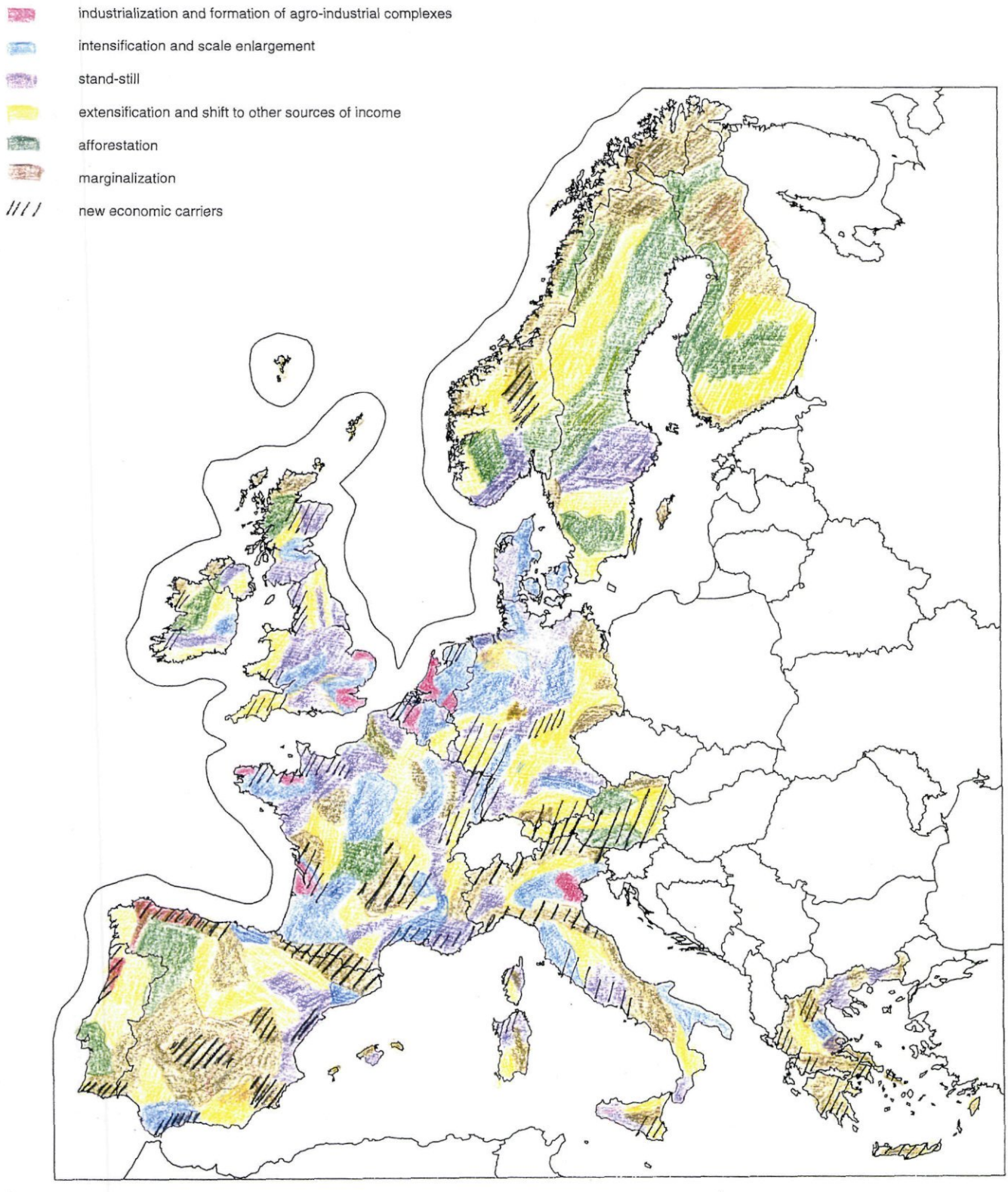
- no data collected

0 km 1000

Map 1
European landscapes, (composed by J. Meeus (from EEA, 1995

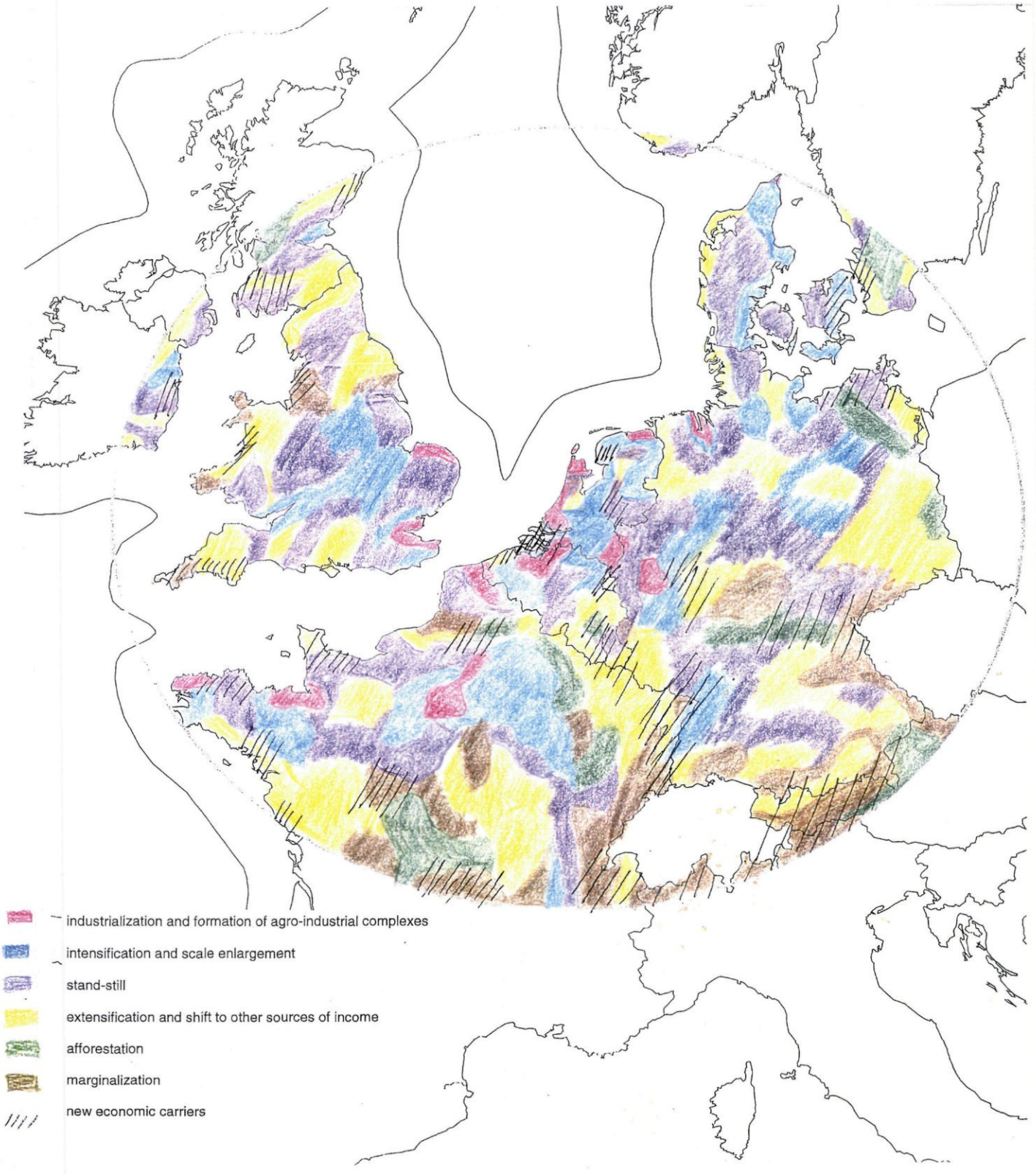
Map 3

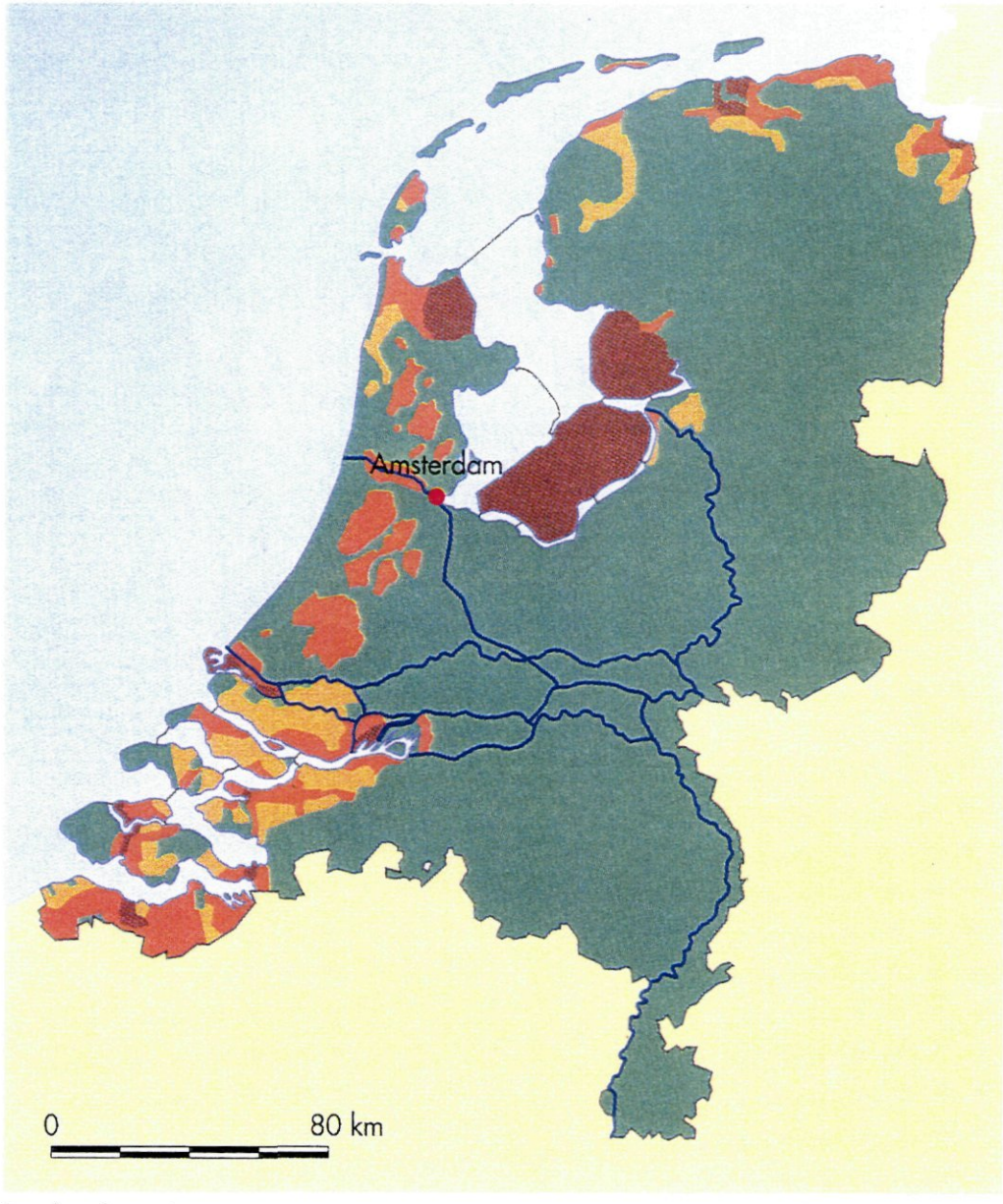
Map of regions with potentials for the appearance of several processes within the EU.



Map 4

Map of regions with potentials for the appearance of several processes within a circle covering NW Europe.

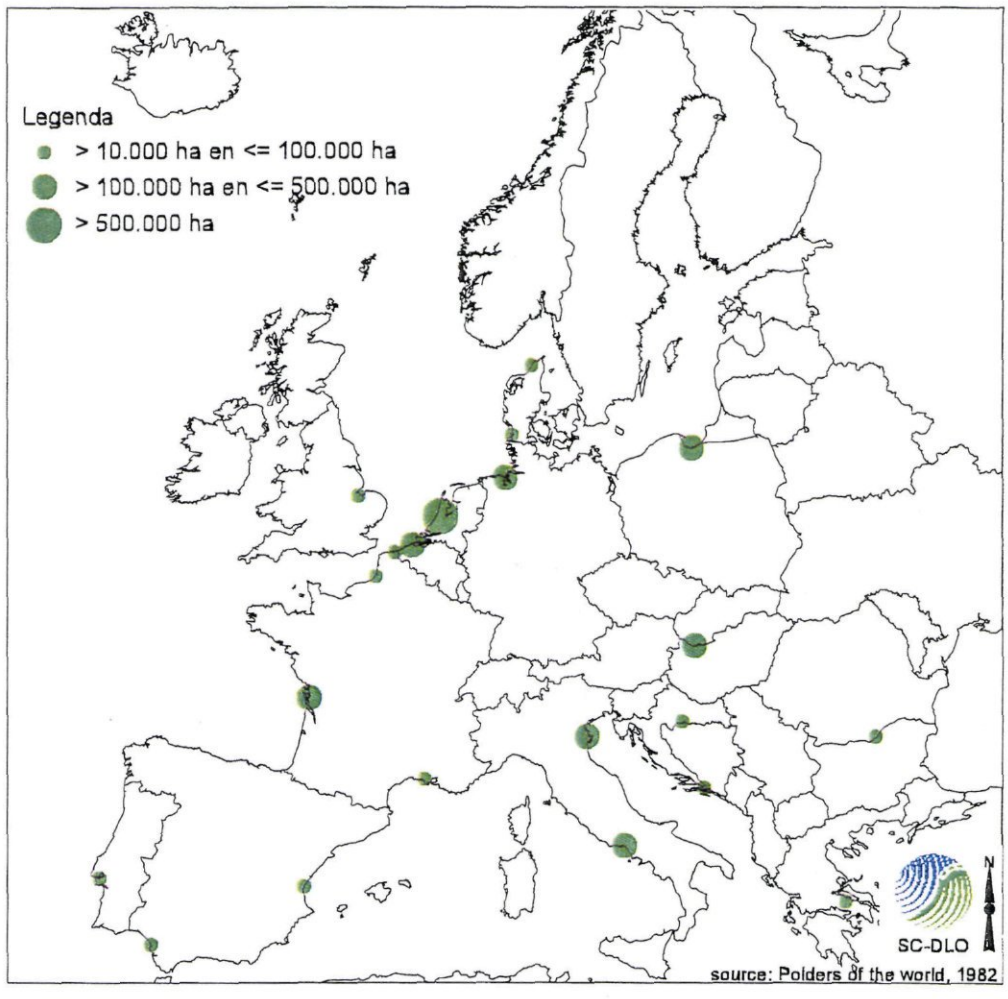




Land reclamation
1200 - 1600 A.D.
1600 - 1900 A.D.
1900 - 1970 A.D.

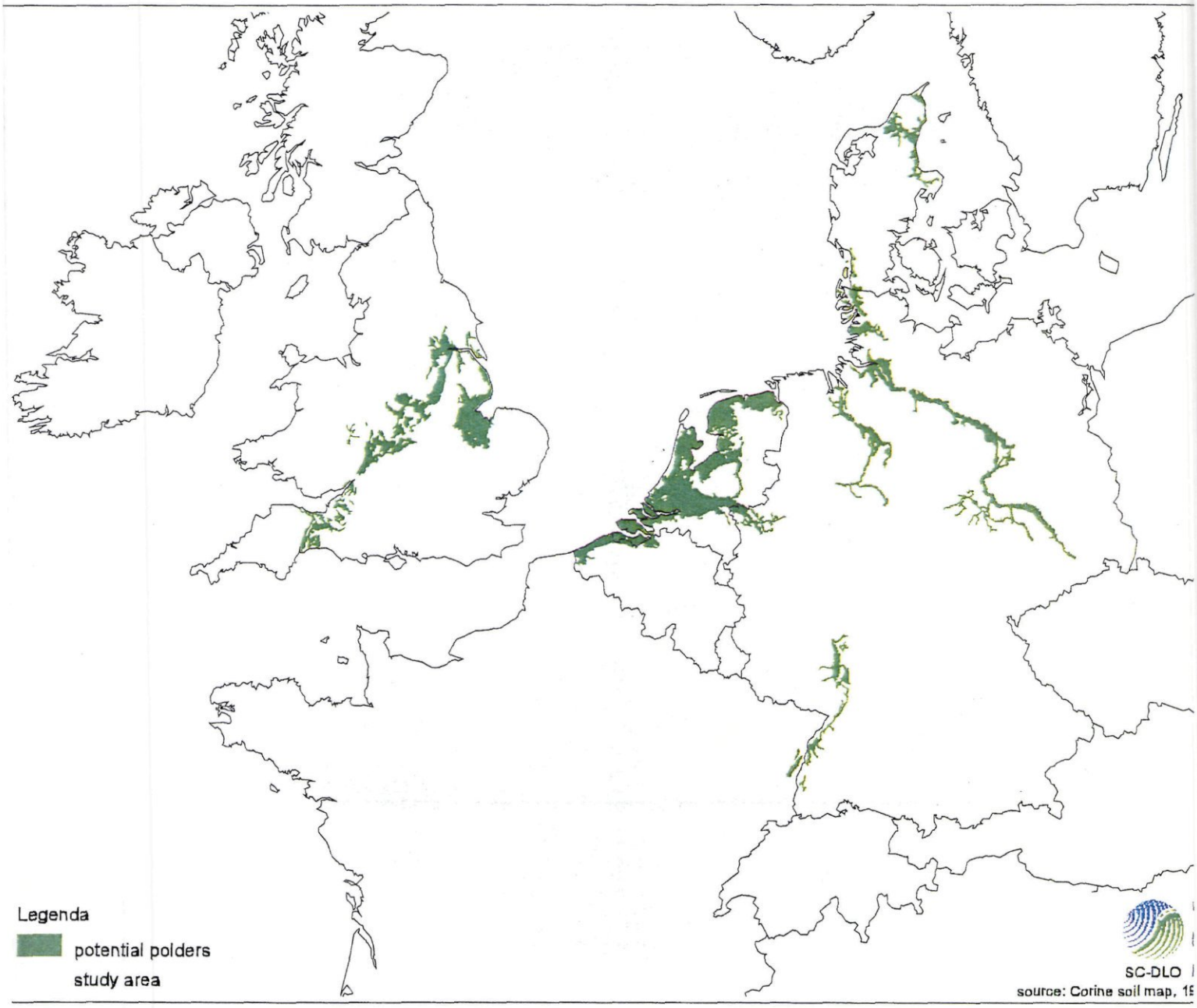
Map 6.

Figure 3 Major polders in Europe derived from literature



Map 7

~~Figure 4~~ Potential polder landscape derived from digital data (level 1)



Map 8)

Figure 5 Major polder types within the polder landscape derived from digital data (level 2)