Simlandscape, a design and research support system for local planning, based on the scenario method and Parcel-Based GIS

Better tools to enable local planning to make good and feasible plans, in an interactive way and pro-active towards realisation, are clearly a challenge for R&D. Simlandscape is such a tool. It is a design and research support system for local planning, based on the scenario method and Parcel-Based GIS. It consists of analogue and digital methods and techniques. It uses the scenario method in combination with a multi-actor transformation model to turn GIS into a research and design tool for planning. Present situation data are made available for all kinds of users, not only for retrieval and analysis, but also as a model for the development of autonomous scenarios and for the design and evaluation of plan scenarios. In this summary the backgrounds and operation of Simlandscape are described and illustrated.

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1. Introduction

A central focus of planning is decision-making in the present to influence and guide future developments for the benefit of the future community. Planning is about the future but the present planning should be improved with respect to its effectiveness; there is much attention for vision and too little for feasibility. There is a gap between strategic planning and the reality it tries to change. Planning does not deal adequately with future research (Cole, 2001; Myers and Kitsuse, 2000; Salet and Faludi, 2000).

Many authors regard it a challenge for academic research to develop and improve a toolbox with methods and techniques to enable practise planning to construct robust, intelligent and well integrated futures on a local and regional scale (WRR, 1988; Cammen, 1998; Dammers, 2000; Myers and Kitsuse, 2000; Gordijn, 2003; De Waard, 2005a). An academic attempt to develop such a tool has resulted in Simlandscape.

In this summary I will deal with; (1) challenges for scenario tools, (2) the concept behind Simlandscape, a landscape transformation model, (3) its components and (4) the construction of a digital model for the construction of scenario's. Following this I will describe and illustrate a number of applications; (1) analyses of the present situation, (2) making autonomous owner scenarios, (3) plan scenarios and (4) scenario evaluations. Also I will briefly discuss a Simlandscape game simulation. I will end with a discussion and challenges for further development.

2. Challenges for scenario tools posed by the scenario method and planning themes

The purpose of the scenario method is in essence to obtain strategic understanding of possible future developments. The scenario method can contribute to the improvement of planning in a number of ways (De Waard, 2005a,b): (1) bridging the gap between planning and realisation, (2) improving communication and collaboration of stakeholders in planning and development (planners, researchers, owners, other users), (3) facilitating and stretching thinking about the future, (4) supporting decision-making and (5) monitoring actual development compared to the developed scenarios and established policies.

The scenario method doesn't exist for a long time. Early studies, often of a military nature, were carried out in the early twentieth century (Kahn and Wiener, 1967; Clark and Xiang, 2003). Yet there is a great variety (Van Notten e.a., 2003) because of its use in many sectors and disciplines. Scenario studies vary from global environmental scenarios (Meadows e.a., 1972) and global energy scenarios (Wack, 1985ab), through local plan scenarios to scenarios for ex ante testing of legislation (Van Asselt, 2004). Another reason for the diversity is the method pluralistic character of the scenario method (Van Doorn and van Vught, 1981).

Despite this the scenario method is basically not very complicated. Van Doorn and van Vught (1981) give the following description of a scenario study; 'a description of the present situation, of one or more possible or desirable future situations and of one or more events that may connect the present and future situations'. The paths to the future describe transformations. Full scenario studies connect the present to the future.

This may seem obvious but many future studies fail to be comprehensive in this respect (Oosterveld, 1999). The difficulty of the scenario method is not in its essence but in the methodological operationalization of the different components and their mutual coherence. That is why the central challenge is in the operationalization of the scenario method into a tool in such a way that it can be used in practice planning. But there are additional challenges.

It is obvious that a tool for practice planning should not only apply to the 'academic' scenario method, but should also connect to modern planning discussion themes. All of these themes are actually related to either vision (on quality) or to strategy (for realisation) or to techniques for the support of these. Relevant themes are; (1) 'quality' as embedded in plan methodology and its effects, (2) the 'effectiveness' of planning, (3) interactive planning and (4) Information and Communication Technology (ICT). The scenario method in combination with these themes leads up to seven challenges for the development of a scenario tool for planning.

(1) Scenarios should be plausible (Clark and Xiang, 2003). That is why scenario methods should be based upon schematisations that are adequate representations of transformation processes in (spatial) reality. In the opinion of many authors (Van der Wal, 1999; Parker e.a., 2000; Groen e.a., 2004) these schematisations are not well developed. This accounts for inadequate results in simulation and in planning models. Simulations prove to be far from predictive and plans often prove to fail when it comes to implementation or quality performance; in the end in both cases because actor behaviour and interaction, especially with respect to owners and government, are ill defined. Also good schematisation is a challenge. A special aspect in this context is the connection with the real scale of spatial transformation; the parcel.

(2) Problems around digital information in planning are not primarily technical but related to definition, methodology and institutional organisation (Moudon and Hubner, 2000; Van Notten e.a., 2003). Definition problems are related to the before mentioned schematisation problems and cause integration and aggregation problems. The existing institutional organisation of planning complicates, technically and financially, exchange and use of data. Smart in practice integrated scenario methods and models that take these data pitfalls into account will therefore advance scenario studies (Clark and Xiang, 2003).

(3) Research and design are by nature and for policy exercises necessary and complementary activities (Faludi and Van Der Valk, 1994). Their combination enables an explorative approach that is essential to deal with the 'wicked problems[1]' that characterize

[1] "… in order to describe a *wicked* problem in sufficient detail, one has to develop an exhaustive inventory of all conceivable solutions ahead of time. The reason is that every question asking for additional information depends of the understanding of the problem – and its resolution – at that time …. The formulation of a wicked problem

spatial planning. This requires hybrid methods to be developed to be able to conduct full scenariostudies ‘around’ designed plan scenarios. Using hybrid methods implies combining qualitative and quantitative data (Clark and Xiang, 2003). Here there are several challenges in the field of schematisation, data modelling and methodology. Some authors doubt if it is possible to use quantitative models for a creative, participatory scenario methodology; ‘a quantitative scenario is unlikely to be developed in a participatory manner’ (Van Notten, e.a., 2003).

(4) Plan scenario evaluation with respect to policy purpose performance and effectiveness is important; this often gets little attention compared to vision development (Baer, 1997). That is why feasibility research is an important application and aspect in scenario tool development (Myers and Kitsuse, 2000), as is plan scenario performance (Stichting het Metropolitane Debat, 1998). A scenario toolbox or planning support system should facilitate the indication of effects and feasibility of plan scenarios.

(5) Several authors point out an identical cause of the communication problem between stakeholders in planning; that is the lack of an universal language. According to these authors a possible contribution to solve this problem is visualisation; in this context of information on the present and possible future spatial situations (Van Asselt, 2004; Clark and Xiang, 2003; Duany, 2002; Geertman, 2002; Al-Khodmany, 2001; WRR-RMNO-NRLO, 2001).

(6) A major pitfall of interactive methods and processes is their lack of articulated content (Edelenbos e.a., 2000). To connect the interactive process with content knowledge and method development is necessary. Improvement is wanted, not only of models but also of participative and game approaches in scenario exercises(Al-Khodmany, 2001; Dammers, 2000). In practise, participative scenarios draw more support than research scenarios. In contrast they are less robust. This is an important reason to opt for the before mentioned hybrid methodes (Dammers, 2000).

(7) In the past decade new planning concepts have been developed in the Netherlands and in the USA. In the Netherlands they are called sustainable space use and ‘multiple space use’ (Van der Valk, 2002) and in the USA Smart Growth, New Urbanism and New Regionalism (Talen, 2002; Duany, 2002; Wheeler, 2002). These concepts oppose to the functionalistic and sectoral modernism, blaming it for the loss of coherence and identity of the modern landscapes. Also apart from these concepts it seems obvious that new instruments are required; among others scenario tools that can handle multiple qualities – physical and non-physical, 2D and 3D – integrally. Scenarios that do so are called multiple themed scenarios (Clark and Xiang, 2003).

3. The landscape transformation model ‘behind’ Simlandscape

The model behind Simlandscape is the Cadastral Land Use Model. This is a schematisation of cultivated areas and their transformation and describes them as complex and dynamic phenomena. Landscapes are seen as the result of occupation of substrates. In natural landscapes, where human culture is absent, the occupation consists only of living nature. Here the dynamics are exclusively the geological, meteorological and biological processes. In cultural landscapes these are supplemented with cultural processes– functional and physical land use -, so the occupation here is the result of the interaction of:

1. Living nature and culture.

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is the problem! The process of formulating the problem and of conceiving a solution (or resolution) are identical, since every specification of the problem is a specification of the direction in which a treatment is considered … one cannot meaningfully search for information without the orientation of a solution concept; one cannot first understand, then solve” (Rittel and Webber, 1984).

2. And within culture, of property and governance.

Within culture, property is the ultimate enabling framework of change, of physical transformation. It is through private or public cadastral property that virtual concepts are transformed into actual change of use and outlay. Of course cadastral owners and their properties are not autonomous, there are influenced by economy, plans and regulations of government, by other users and by nature (Figure 1). But in the end, legally or illegally and for better and for worse the real thing happens in the context of cadastral property.

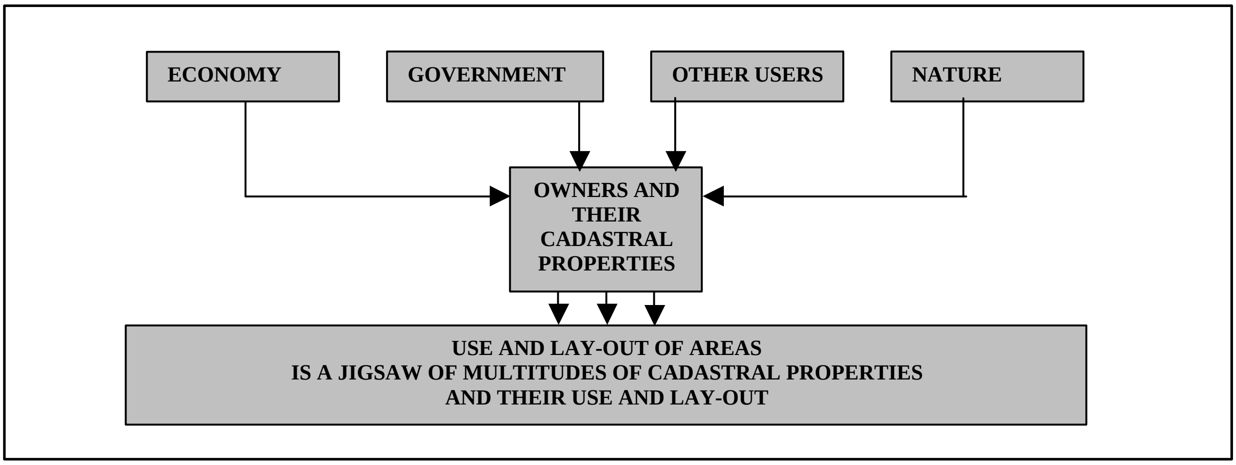

Figure 1. Actors and agents influence the transformation of cadastral properties.

This implicates that landscape can be regarded as consisting of (cadastral) *cells of change* (see Figure 2) under the influence of three actor categories; owners, government and other users[2] (Figure 2). Cadastral units play a key role in the model, because they are as well important enabling units (transformation process) as well as area covering geometrical objects.

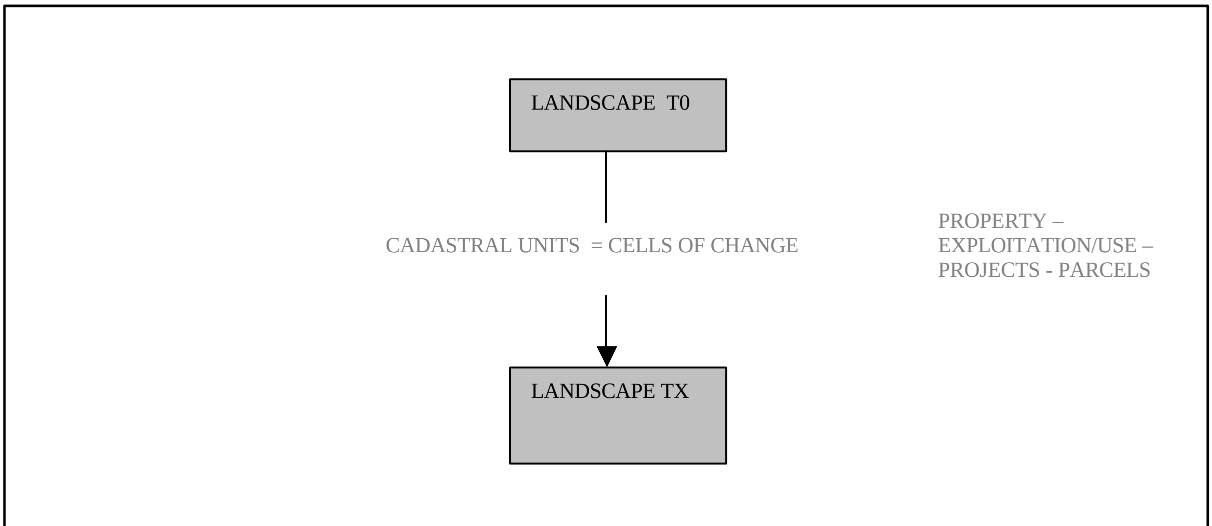

Figure 2. Cultural landscapes change, from the present (t0) to a future (tX), in units that are related to cadastral property

[2] I will not go into the actor interaction diagrams in this paper.

The model can also be represented as a spatial layer model (Figure 3) each consisting of units. Two of these layers are physical; the substrate layer (or under layer) and the cadastral layer, that represents the occupation (or upper layer). The cadastral assemblage plate represents, through property as enabling framework, the spatial organisation of the transformation of landscapes. The third layer, with the policy zones of government, is a virtual one. It represents the government's interventions, its 'rules' for land use for the landowners and their cadastral units.

The Cadastral Land Use Model can be considered to be a polycentric and integral model. Polycentric because it considers cultivated areas to be the outcome of the interaction of several enabling frameworks and forces (or actors and agents); property and government, economy and nature. Integral refers to the compilation of attributes that this polycentricism involves in this model.

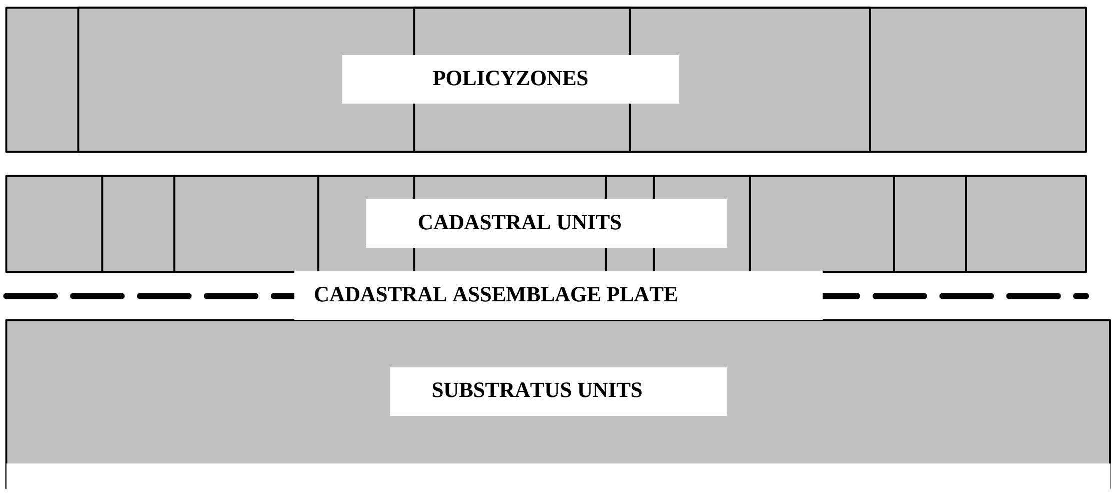

Figure 3. The polycentric and layered structure of cultural landscapes of CLSM.

An artist impression (see Figure 4) illustrates how the Cadastral Land Use Model is used to construct scenarios in Simlandscape. A landscape scenario is constructed using the cadastral assemblage plate in the middle to allocate SpaceUseForms on top of the substrate. SpaceUseForm is a cadastral unit (meta) typology of use and lay out; its typologies can be used as scenario building stones.

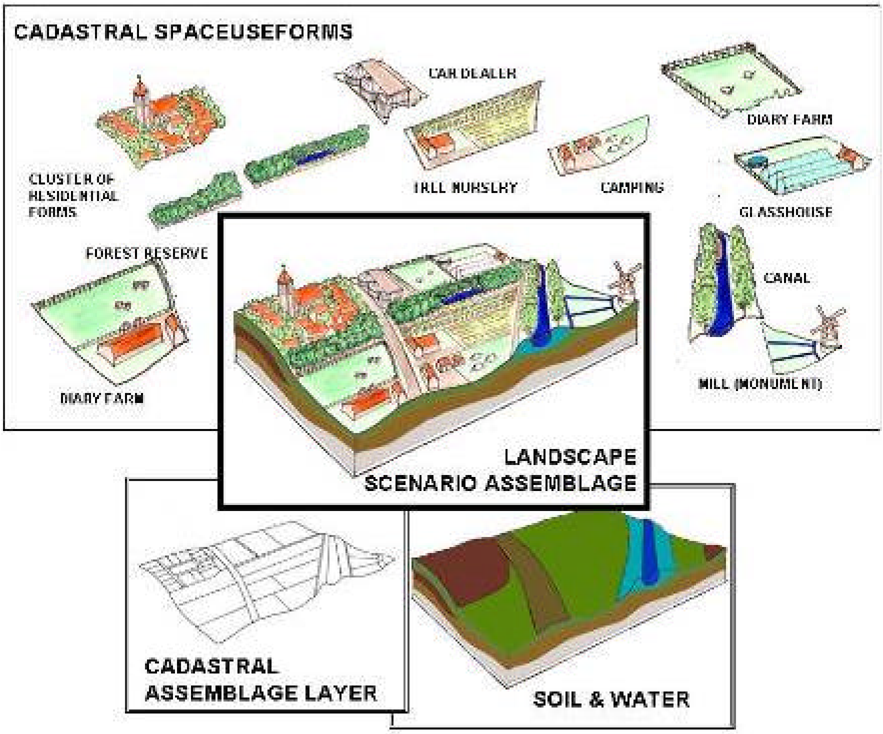

Figure 4. Artist impression of CLSM

Parcels are the building stones of the cadastral units (Figure 5). The parcels of one owner make a property. Property may consist of one or more spatial units, called lots. Lots are spatial units, belonging to one owner or to one user (f.i. tenants[3]). Scenario exercises may use one or all the types of cadastral units, depending on their purpose.

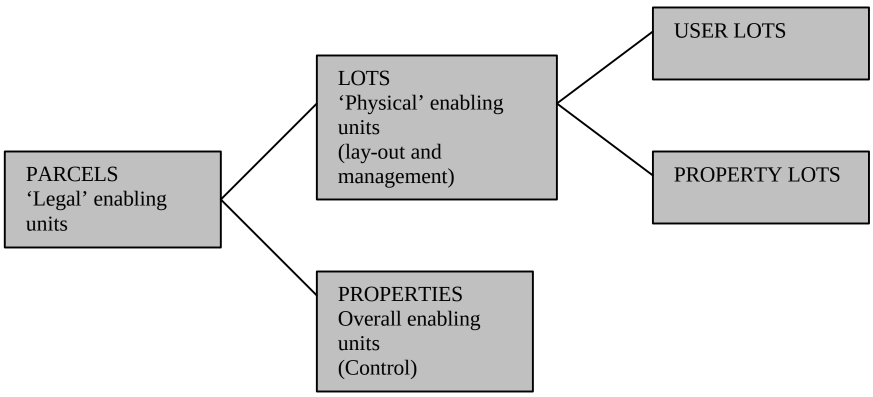

Figure 5. Cadastral enabling units in CLM.

[3] A tenant may have parcels of different owners, so his 'user' lot may overlap property lots.

The cadastral units, which are building stones of which every cultural landscape (scenario) is seamlessly composed, have attributes or sub-objects like (see Figure 6); economical function(s), physical land-use components and owners/users.Through the latter two also certain ecological and socio-economical attributes can be linked.

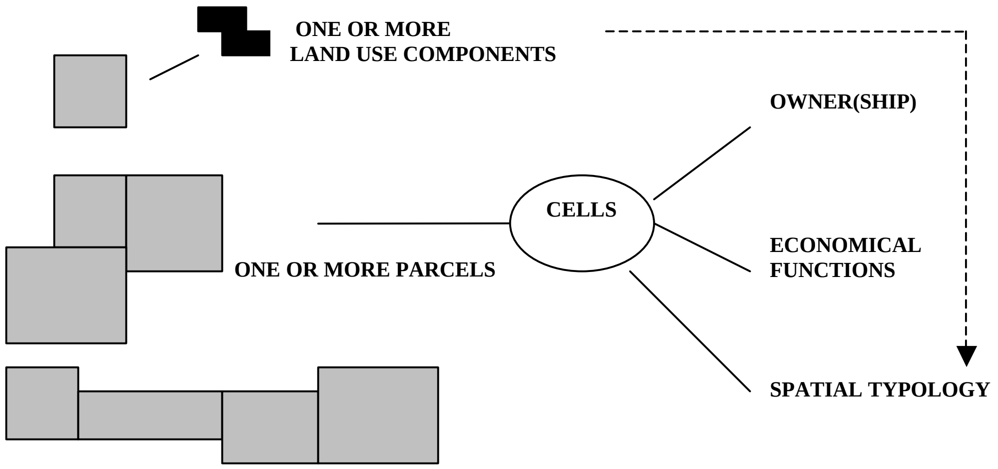

Figure 6. The composition and attributes of the cadastral units (cells of change)

To work with these units (‘cells of change’) in the context of scenario studies several methodological components are needed. I will discuss these in the next section.

4. The components of Simlandscape

Simlandscape comes in two methodological ‘forms[4]’; as an analogue game simulation and as a planning support system using GIS for research and design. The game simulation focuses on simulation, through players and an analogue area model, of plan processes and the resulting transformation of areas involved (I will discuss this in section 9). The planning support system focuses on design and evaluation of plan scenarios and the data handling and presentation.

Essentially the game simulation and the planning support system are similar. An important difference is that the analogue model that is used for simulation of transformation in the simulation game is replaced by a digital model that can handle as well present as future scenario information. The purpose of ‘ordinary’ GIS models is data retrieval and analyses, mostly of zone polygons. The Simlandscape information model differs from these in two ways; (1) It is based on a Parcel-Based GIS (Moudon and Hubner, 2000) and (2) it supports the construction of scenario’s (a design activity). It does this in such a way that scenarios can be compared and updated with monitoring data of real development[5].

For Simlandscape as a GIS based plan support system the Cadastral Land Use Model has been translated in a data model and a method has been developed to convert different source files into one consistent Simlandscape dataset. Also methods have been developed to be able to use these Simlandscape datasets to create typologies for scenario construction.

[4] At this moment they are separated, but in future they may be integrated.
[5] An important but underdeveloped aspect of scenariostudies according to Clark (2003)

Simlandscape datasets and typologies can be used to construct and evaluate different kinds of scenario's. Three categories of scenarios are used in Simlandscape; (1) t0-scenarios, (2) research scenarios and (3) plan scenarios. Research scenarios can be subdivided into owner scenarios and plan realisation scenarios.

t0-Scenarios 'are' the present situations of study areas. This name refers to the fact that the representation of the present situation is a construction just like the other future scenarios are constructions. Policy (plan) scenarios are 'global or detailed descriptions of the desired (spatial) development of areas'. They used to be made by government, but also semi-public or private bodies can undertake this in the context of the development of an area. Owner scenarios are scenarios that describe the expected spatial development in a study area based on the, by their owners, expected or desired development of lots. Plan realisation scenarios describe, through simulation of the speculative responsive owner behaviour, the effects of plan scenarios on the actual transformation of study areas. Because of that they are also feasibility studies.

Simlandscape works with cadastral typologies. Depending on the attributes that are linked to the used dataset several typologies are possible. However with two basis qualities, economic function and physical lay-out, three kinds of typologies can be made. With these already quite comprehensive scenario studies can be made, as I will discuss further on.

Funtionforms are a typology of cadastral units according to their economic function or mix of functions. Lay-out forms are 'a typology of cadastral units according to their lay-out in terms of used lay-out components[6] and their quantitative ratios[7]'. SpaceUseForms are a meta typology; a combined typology of the former two.

Simlandscape data sets can involve a great variety of physical and non-physical data. This creates possibilities to create all kinds of typologies in addition to the before mentioned. The logic of that depends on the purposes of scenario studies undertaken. Examples of possible interesting additional typologies are linked to ecological values or to real estate and production values. It is also possible to use social-economical and social-cultural typologies of actors like owners.

Theoretically it is possible to use Simlandscape analogue, without computers[8]. However, also in small areas the amount of data soon makes it not practical to do without. But also if a computer is used the amount and the variety of data can be confusing. To be able to facilitate the handling of all of these data in the explorative and creative way that is necessary in (plan) scenario studies, three methodological terms are used; catalogue, program and structure.

A Simlandscape catalogue 'contains the qualitative overview of the geo-object typology used to describe a t0-scenario (the present situation) or a future scenario'. A Simlandscape program is quantitative, it describes 'the catalogue including the amounts per type involved in a study area'. Catalogue and program are mostly represented as tables; structure refers to a more cartographic representation. It describes in Simlandscape 'the spatial distribution of the geo- object typology in scenarios'.

Apart from 'program' in Simlandscape there is also 'demand program'. A demand program is the program that 'describes the terms that are believed to be necessary to facilitate an actor, actor category or system in an area'. Demand programs are used for the design and the evaluation of scenarios.

The working procedure for Simlandscape is an iterative, explorative process of design and research and of funnelling and selection to simultaneously improve scenarios and reduce their numbers. Four steps can be discerned; (1) defining the study area, the problem

[6] Buildings, roads, green, et cetera.
[7] Or indexes; for instance floor space index.
[8] Actually this is done in the analogue simulation game Simlandscape.

perception and the policy challenges, (2) the iterative development of scenarios, (3) the evaluation of the developed plan scenarios, (4) decision-making.

Inside this working procedure different accents and shifts in the working order are possible; depending on the process approach chosen. If emphasis is put on an interactive, public-private-partnership oriented approach one may start with analyses of property dynamics and an inventory of real estate development ideas. This may than be reflected in the catalogue[9] to be used for plan scenario development[10]. Whereas in the case of more traditional policy development, a more top-down approach can be adopted. In which one may start with sketching zoning ideas that are subsequently worked out in and through catalogues.

Ultimately for plan realisation, projects are needed whose profiles reflect the plan (scenarios) catalogue cadastral typologies. So in the course of planning the catalogue may help to (1) program development projects or (2) offers clear criteria to judge developments contributions to plan purposes.

5. The construction of a digital scenario study laboratory

Generally speaking it is impossible to test planning ideas in reality. A Simlandscape t0-scenario offers a next best solution by making a kind of kind laboratory for research and planning exercises. Because it is rooted in all kind of monitoring data of the present situation Simlandscape t0-scenarios can be used for all kinds of analyses – spatial, ecological, economical – before or even without scenario studies. Apart from that all kinds of scenarios can be constructed and explored by conversion of 'traditional' plan scenarios into Simlandscape plan scenarios, by transformation of t0-scenarios through reconstructive design or through simulation. I will come to that later. First a t0-scenario has to be constructed.

A Simlandscape t0-scenario is based upon the Cadastral Land Use Model. This is a schematisation of the reality of landscape (systems); the object of planning. Without such a conceptual model it is difficult to construct semantically consistent data models. The difference between a conceptual schematisation and a data model is in the system they describe. The system that is described in the schematisation is a, be it context bound, real area; where as what a data model describes are data and the relations between those data. The latter is done by a global data model, without exactly identifying data and data sources. A there upon based concrete data model however does exactly that.

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[9] A catalogue or program, for this approach, that describes real project ideas is called a project portfolio in Simlandscape.

[10] Teisman (1997) opts for rounds rather than for 'linear' phases in interactive processes.

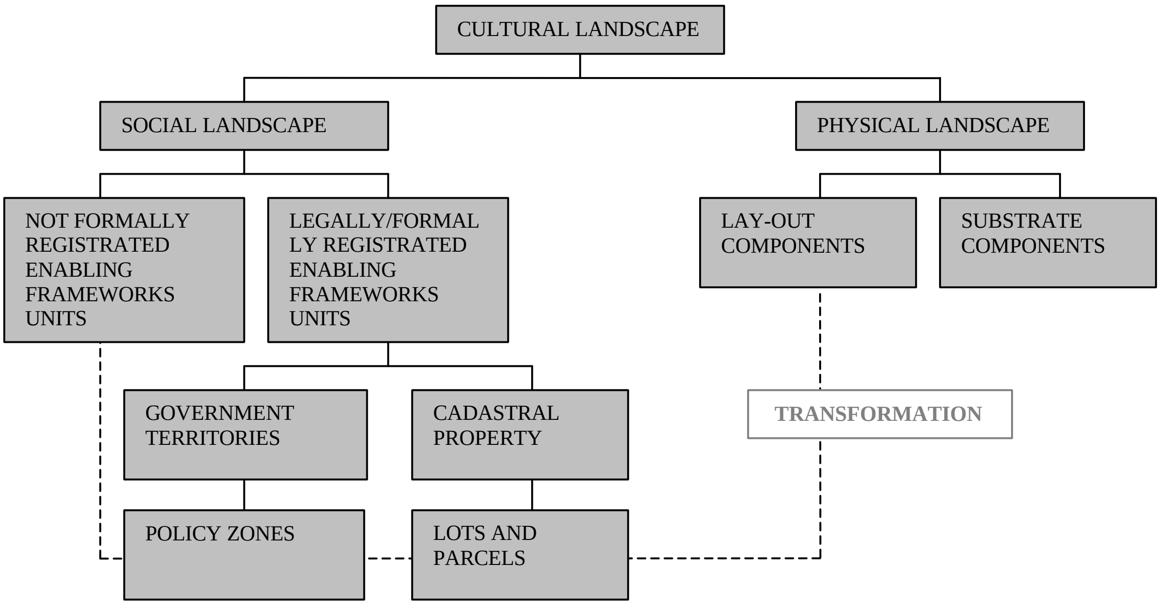

Figure 7. The cadastral Land Use Model as schematisation for global data models.

In the schematisation (see Figure 7) there are two dimensions, two kinds of landscapes ‘hidden’ as it were in the cultural landscape; a visible, physical landscape and an invisible, social landscape. The physical landscape consists of components that can be seen and touched in reality (trees, buildings, roads, et cetera and of course the soil underneath). The other social landscape consists of the units of the enabling frameworks like municipal territories or parcels. Using this schematisation a global data model can be made (see Figure 8)

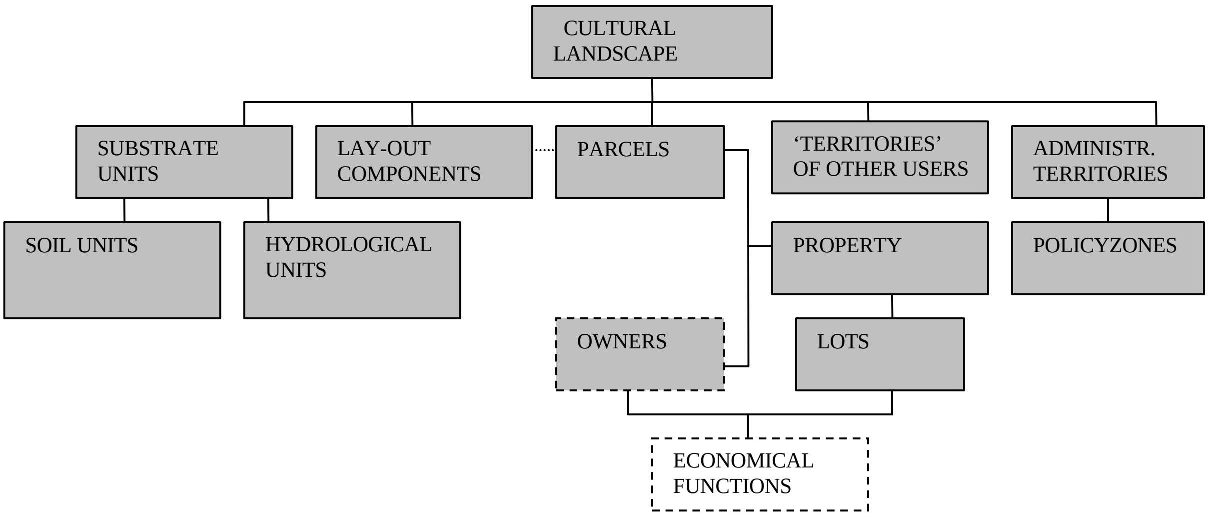

Figure 8. Simlandscape global (geo-object) datamodel.

Using the global data model and available data a Simlandscape t0-scenario was constructed for the test area Lunteren[11]. The Lunteren model consists of data of the cadastre, the topographical map, provincial employment data, the hydrological map and the soil map[12]. The Lunteren model in this stage of the procedure is not a complete Simlandscape model yet because it still lacks the lay-out forms. And this is necessary to avoid problems that are linked to traditional land use models due to ill definition of land use and land cover (Bibby and Sheperd, 2000) and to be able to conduct scenario studies. The lay-out forms in the t0-scenario are made by classifying the cadastral units through their lay-out components.

The method to do this is a flexible one; that is scenario designers can design their lay-out typology as they wish and adopt it to specific area characteristics. The method of course has a mathematical dimension and because of that also a certain complexity. Four variables are used to define a lay-out form typology of an area; (1) structure characteristics, (2) the presence of lay-out components, (3) size and (4) lay-out form ratios. A tool is developed that uses these variables to classify the cadastral units of a study areas dataset to an area covering lot typology.

About the lay-out form ratios I will give some more information. The presence and relative weight of land use components (LUC's) in the units is expressed through LUC ratios. Every imaginable spatial typology can be composed for analysis and/or design reasons. Many LUC ratios are possible[13]; some of the most important are however:

- Build Space Ratio (BSR); the buildings surface to total unit size ratio.
- Floor Space ratio (FSR); the cumulative build floor surface to total unit size ratio.
- Hard Space Ratio (HSR); meaning the pavements relative surface.
- Soft Space Ratio (SSR); meaning the non build and non paved surface.
- Tree Space Ratio (TSR); meaning the relative surface of shrubs and trees.
- Tree Foliage Ratio (TFR); meaning the relative surface of the projection of the foliage.
- Open Space Ratio (OSR); or the sum of hard and soft space[14].

For communication reasons the quantitative characteristics have to be coupled with 'names'. A purely mathematical typology is meaningful only to experts. In the Lunteren case study primarily names are used that are also used in 'normal' conversation, in the process these are better defined mathematically. However, there are not enough of such names available for a full typology. So, metaphorical names have to be invented. For instance, the normal term 'estate' can be used to describe lot sizes over 10 hectares containing 75 % forest[15]. The term 'pastorals' was used metaphorically to describe lots containing hedges; these have great visual, cultural and ecological impact, whilst containing very little shrubs and trees. In Figure 9 an example is presented of a typology that was developed for the Lunteren test area. For reasons of vividness a more visual catalogue was developed in which every lay-out form is illustrated.

[11] I will give information about the Lunteren area in the next section.

[12] Of course several problems had to be dealt with; (1) semantical problems, for instance because economic data came from different sources, (2) geometrical problems between cadastral and topographical data, (3) availability problems with respect to social economical data and (4) actuality problems with cadastral data.

[13] By introducing user numbers to these ratios additional indexes can be obtained on available space per user and denseness.

[14] These ratios are not only applicable to cadastral units but also to f.i. zones like neighborhoods.

[15] Mathematical typology can however be used to subdivide these names if necessary, without losing its communicative effectiveness (for instance small and large, over 20 hectares, estates).

<u>Cadastral units with buildings (B-units)</u>
<2ha
Buildings (SSR< 10%); Urban yards (SSR 10-20%); Yards (SSR 20-60%); Garden yards (SSR > 60%)
>2-5 ha
Buildings (SSR < 10%); Urban yards(SSR 10-20%)); Yards (20-70%); B-fields and country house estates (>70%);
Subdivision of B-fields and estates (2-5ha and SSR>70%) based upon Tree Space Ratio (TSR)
B-fields (TSR<8 %); Pastoral B-fields (t 8-25%); country house estates (t > 25%)
> 10 ha
Buildings (SSR < 20%); Campus (SSR < 20-40%); Green campus (SSR 40-80%); B-fields and estates (SSR > 80%)
Subdivision of B-fields and estates (> 10 ha and SSR>.8) based upon TSR
B-fields (TSR<3%); pastoral B-fields (t 3-15%); park estate (t >15 – 50 %);
Forest estate (t > 50%)

Soft space cadastral units (units without buildings)
The methodology for these units is identical to the above mentioned. Only the used metaphorical terms differ. For instance B-fields and estates are not used. Instead fields, park and forest is used. Single land use component (LUC) categories are named after their LUC's.

Figure 9. Example of spatial typology mathematics and metaphors in one of the Lunteren pilots.

6. The use of the t0-scenario laboratory model for analyses

Simlandscape models contain data from several sectors; they for instance always contain social and physical information. That is why Simlandscape models are, also when minimally worked out, suited for relatively integral analyses.

Apart from use for data retrieval Simlandscape t0-scenarios can be used in four ways. (1) t0-Scenarios can be used for multi-actor description, analyses and performance validation of the present situation. This use is tested in this study and shortly discussed below together with some background information about the test area (examples of this are shown in Figure 11 a+b in the end of this summary). (2) t0-Scenarios are, in Simlandscape, vital as point of departure and reference for construction and evaluation of scenario studies. This is discussed in the next sections. (3) t0-Scenarios can also be used as reference for comparison of monitoring data of the actual area development. In time achieved t0-scenarios will be valuable for historical research on areas development. (4) t0-Scenarios can be used as conversion model for the comparison of sector plans. 'Translating' the different sector plans zones into specific cadastral typologies may help to compare the cumulative effects of these plans. The latter two purposes of t0-scenarios have not been tested in this study.

I will now shortly discuss the test area Lunteren and the analyses carried out. The test area Lunteren is about 1300 hectares large. It is situated in a region that before a few decades could be considered rural, but is now becoming semi metropolitan. The planning's challenge comes down to two autonomous developments and the regional authorities vision to these.

The two autonomous developments are an ongoing process of intensification and simultaneous stagnation of agriculture and of a parallel process of urbanisation of the regions economy and culture. So there are two mutually reinforcing autonomous processes 'from green to red’. Opposite to this is the government’s vision that intends to convert this process in the direction of nature, recreation and sustainable agriculture.

These problems and challenges lead up to research questions with respect to the present distribution and extent of these autonomous processes and their effects. The ratio of ‘green and red’ is an important element in that. The following research questions were formulated; (1) What is the present structure – units and typologies – of occupation and substrate, (2) what is the ratio between ‘red’ and ‘green’ on the level of the lots or in other words within the enabling frameworks of property and use and (3) what is the effect the situation in these lots on the value of the area for the other actors (stakeholders).

Using Simlandscape the requested information is presented in two ways; (1) programmatic, through tables and diagrams, (2) cartographic, by using thematic mapping. Examples of thematic mapping in the course of Lunteren t0-scenario analysis are shown in Figure 11 a+b.

7. Describing autonomous development through making owner scenarios

Research scenarios explore expected future scenarios. For this there are different approaches and techniques. One of these is through making Simlandscape owner scenarios. Owner scenarios are ‘possible future situations constructed through using owner opinions on the expected and desired development of their property, and represented lot wise, for study areas’.

Owner scenarios have two purposes; (1) to obtain general trend data for policy evaluation and development, (2) to obtain more concrete data on supply and demand of all kinds of real estate for use in constructing (parcellation) plan scenarios and in planrealisation scenarios. Both purposes are about being able to make plan scenarios more interactive with respect to owners and through that more pro-active to realisation. This way policy efforts and instruments could possibly be used more effectively.

To obtain data for these owner scenarios the enquiry method was used. Also simulation techniques can be used[16], but simulation does not only generate information it also requires information on owners (that was not readily available). The central research question of the owner enquiry was; ‘what is the opinion of owners with regard to the future of their cadastral property, (1) what would they desire if there would be ‘no’ government restrictions and (2) what do they expect given the existing regulations’. ‘Opinion’ in this question refers to the clearly subjective character of these data. But although owners are no flawless oracles, their opinions are nevertheless of value; (1) because of their specific practise experience compared to that of specialists and (2) because adequate or not their ‘forecasts’ determine to a large extend their attitude towards policy development[17].

The distinction between ‘desired’ and ‘expected’ in the research question points to the fact that not only policy reactive data are sought but also ‘deeper’ motives (hidden dynamics) and ‘ideas’ for development. The two owner scenarios, expected and desired, give insights to the physical and non-physical transformation strategies of owners. All kinds of wishes and reflections of owners on the future of their property can be translated to physical lay-out components, size and use of lots in Simlandscape.

Some reflections – about the economy, surrounding developments or their career – may lead up to alteration of the economic purpose ‘behind’ their parcels. This could for instance be intensification of production, buying or selling of land, adding or changing to another economic function or a complete selling and moving out. In the course of all of these actions

[16] for instance the ‘what-if’ GIS technique that I used to make planrealisationscenarios.
[17] Therefore such an enquiry is also relevant in interactive planning

the lay-out may change; buildings and pavement may be constructed or removed. There can be 'red shifts' or 'green shifts'.

The average picture that results from the Lunteren owner scenarios is that of stagnation and creeping urbanisation. The ongoing policy development slows agricultural intensification and construction of buildings. At the same time it seems to discourage owners to establish 'green'. There is underhand urbanisation, just because there seems little alternative for the landowners but to shift away from agriculture to residential functions mixed with semi (illegal) urban services and industries. This way the rural character is changing to urban. At first not by the 'looks' but inside out because agricultural functions and culture are replaced by urban ones. Of course these dynamics are known for these areas. But through these scenarios this knowledge becomes much more concrete and vivid and available in an operational way. Some illustration on owner scenarios is given in the Figures 11.1 and 11.2.

8. The development of plan scenarios.

Plan scenarios are designed visions on the desired development of areas. They are 'by governments or other area wide operating organisations[18] developed global or more detailed descriptions of the desired spatial development of areas'. The core of the Simlandscape method for making plan scenarios is expressing area transformation ideas into cadastral typologies. It refers to the design of three components; global plan scenarios, cadastral typologies or plan scenario catalogues and cadastral plan scenarios.

(1) Global plan scenarios are a kind of sketches of structures or zones concerning desired futures. (2) Plan scenario catalogues describe which cadastral typologies (lots or parcels) should be used as building stones for the specified design and construction of cadastral plan scenarios. (3) Cadastral plan scenarios are plan scenarios that are described in terms of cadastral typologies. There are, depending on the level of specification, two kinds of cadastral scenarios; (a) zoned cadastral plan scenarios and (b) cadastral lot scenarios. In the latter one, to all of the lots of the cadastral assemblage plate a type, taken from the catalogue, is allocated.

Using these components Simlandscape plan scenarios can be designed and constructed that are more transparent with respect to effects and feasibility. A simple linear scheme of the working procedure consist of four steps (Figure 10).

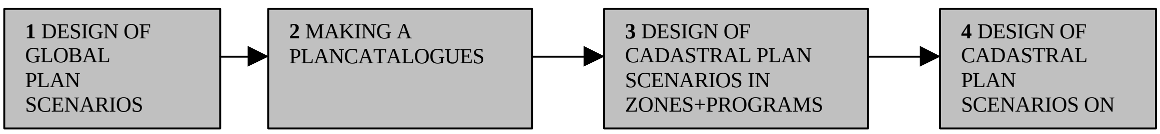

Figure 10. Plain scheme of the working procedure of making Simlandscape cadastral plan scenarios.

I will now bring more distinction in this simple scheme by elaborating on some aspects; on design versus research, on exploration and iteration, on feasibility and on participation levels and specification levels.

Plan scenarios are made by probing design and by creative research. Design and research are not limited to the scenarios only, but are also applicable to the building stones described in

[18] For instance Public Private Partnership linked development organisations.

the catalogues. Because of this layered structure the real working procedure is not linear but tentative and iterative.

A plan scenario catalogue containing cadastral typologies has to be put together through selecting existing types and designing new ones. This catalogue must facilitate realisation of the vision of the global plan scenario. The inherent effect of designing and working with cadastral typologies is that planners cannot but reflect on the relation between function, lay-out, exploitation and ownership of their creations. Because of this inevitable reflection, designers of cadastral plan scenarios – be they professionals or not – are much more aware of integral feasibility aspects of their designs than in 'traditional' approaches.

The level of participation in plan scenario development may differ widely. This of course is reflected in the working procedure. However, although their exact order and weight may differ, the kinds of steps used are more or less the same. The difference between a purely top-down policy approach and a participative development oriented approach is that in Simlandscape in the latter, area policy goals and local project development dynamics are linked from the very start. Whilst in a traditional top-down approach project development is secondary and instrumental to the designed plan.

I will now discuss the building of (1) general plan scenarios, (2) plan scenario catalogues and (3) both types of cadastral scenarios.

The global plan scenarios, the first general spatial sketches, are very much design exercises that are common in practice. They are the first exercises aimed at translating general policy objectives into a partially or entirely adjusted area structure. By drawing zones, a first spatial quantification of the general policy program becomes visible. Simlandscape does not add very much in this step, it does however in the next.

Designing cadastral typologies for plan scenario catalogues is an iterative process in which design and research are both necessary. The goal is to obtain building stones for the construction of cadastral plan scenarios that specify the global plan scenarios. To do this job different approaches are possible – that is starting with emphasis on exploitation aspects or with desired output[19] aspects - depending on the perspective of the designing stakeholders involved. These may be professional planners, owners or other users. The ultimate challenge however is to 'find' typologies that are able to accommodate simultaneously multiple demand programs of different stakeholders.

Just like the plan scenarios and the plan scenario catalogues, the making of cadastral plan scenarios requires design and research. In plan scenarios specified to zone level it involves specifying a catalogue into a program per zone; in what amounts are what typologies to be used, tolerated or rejected.

Cadastral plan scenarios that are specified to lot level serve three purposes; (1) illustrative 'simulation' of the possible implications of zone programs onto the level of lots, and (2) higher resolution allows for better evaluation possibilities with respect to performance, required transformation level, feasibility and relevance of plan scenarios. Finally, cadastral plan scenarios that are specified to lot level are the core of land reconstruction and parcellation scenario studies. This third purpose illustrates the to realisation inherent pro-active character of Simlandscape.

For the design and construction of cadastral plan scenarios specified to lot level, the cadastral assemblage plate is used. Following respective zone programs lot or parcel typologies are allocated to lots or parcels. This technique can be compared with 'painting' zone designs in which the dye colours are the typologies and the paint box is the program.

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[19] With respect to – f.i. environmental - policy goals.

The working procedure for plan scenario design depends on the process architecture and the study context; is it about participative area development or about (participative) policy development? In the first one the focus is defining projects and in the second one the focus is 'only' policy development. In participative area development the catalogue is very much the product of two perspectives; (1) project ideas of owners and other developers and investors and (2) regional development ideas of planners. The 'bottom-up ideas of the first can enrich the 'top-down' ideas of the second. Opposed to this, the catalogue in policy development is much more dominated by and instrumental to top-down thinking.

In Simlandscape, project ideas of owners and other developers and investors are filed in a so-called project portfolio. Ideas about project (real estate) development, be they initial or very concrete, are described in a way similar to cadastral typologies in the catalogue. In participative area development[20] the portfolio plays an important role, where as in policy development this role is absent or less dominant. Some illustration on plan scenarios is given in the Figures 11.1 and 11.2.

9. Evaluation of plan scenarios

Evaluating plans and plan scenarios is important because of the effects of plans, the benefits and the costs, for society in general and for related study areas in particular (Alexander and Faludi, 1989). The rationale of plan evaluation is connected to the perceptions of plans as phenomena (Baer, 1997). These perceptions are expressed methodologically in evaluation techniques and criteria. In the modernistic perception the focus is on technical, professional related criteria that are used for consistent and rational plans. Postmodernists however state that such plans do not exist. Baer in this context draws the conclusion that, although standard criteria may not be possible, it still is necessary per plan study to develop consistent criteria. The reason for that is transparency and open communication. Simlandscape is in line with this approach.

The purpose of plan scenario evaluation in Simlandscape is to obtain arguments for decision making in the process of plan scenario development. This may be connected to funnelling scenariosets to a smaller size or to establish one of the scenarios as policy line. There are four categories of evaluation in Simlandscape; with respect to (1) content, (2) stakeholder value, (3) the required transformation volume and to (4) impact on the actual development. The latter two give insights in the feasibility of plan scenarios.

Scenario content evaluation deals with the qualitative and quantitative build-up of programs of plan scenarios and other scenarios. This is a relative objective type of evaluation because it merely gives an overview of the concerned dataset. These overviews give, when compared to each other, a first impression of differences between scenarios. Part of the exercise required is making tables and diagrams.

Stakeholder value evaluation in Simlandscape deals with establishing the (relative) performance of scenarios using (user or stakeholder) demand programs. By this these evaluations are clearly and inevitably subjective, however of value in decision-making. This kind of evaluation is possible for every kind of stakeholder (value) provided it can be defined (in a quantitative way) in a demand program[21].

Evaluation of the required transformation volume describes what needs to be changed if the present situation was to be transformed into the evaluated plan scenario for hundred percent (Figures 12.1 and 12.2). In zone scenarios this evaluation has an indicative character

[20] And in parcellation scenarios.

[21] In this study the test was limited to a relatively simple demand program of 'animals of half open rural landscapes'.

but in lot scenarios this evaluation is detailed (because the lots are compared). These evaluations indicate the feasibility of plan scenarios in the sense that, in general, one may suppose a certain correlation between the feasibility and the transformation volume.

The impact of plan scenarios on the actual development of study areas depend on the cumulative effect of the behavioural response of the owners; 'will investments and transformations occur according to the envisaged vision?' This evaluation is about behaviour. Technically this can be done using enquiries or by processing speculations on behaviour through 'what-if' scenarios (Figures 11.1 and 11.2).

10. Simlandscape as game simulation of roles, processes and transformation

It is difficult if not impossible to test future planning ideas with respect to their effects on the behaviour of actors or systems in practice. However by combining different approaches and techniques there are some possibilities. Some specific possibilities are offered by Simlandscape; either through using GIS design and simulation scenarios or through using game simulation. In both approaches study areas are represented in 'laboratory' models and situations that can be safely manipulated for explorative reasons. The difference is that in GIS the focus is on simulating 2D or 3D end results. And in game simulation the focus is on behaviour and process; 'one can see the future in action' (Mayer and Veeneman, 2002; Mastik, 2002; Scalzo and Mastik, 2004).

The tested Simlandscape game simulation can be compared to an analogue role game in combination to a Simlandscape model of an game area. For a limited part it is deterministic; certain game processes and the object typology is fixed. Mostly however it is stochastic; the players interaction establishes the area transformation result. The players play the role of an actor. Each actor belongs to one three categories of stakeholders; government, owner or other user[22]. Simlandscape can be used for any kind of cultural area (landscape), although complex urban landscapes are more difficult to turn into a flexible model.

The game simulation is composed of game components and game rules. The game components are (1) the players, (2) their roles described in dossiers, (3) locations where game activities take place, (4) the model with the game pieces. The game rules determine the game process and the competences that are linked to the different roles. The physical results of the game are 3D owner and plan realisation scenarios that are constructed - physical lay-out and economic function per lot - during the game using the game area model.

One game session consists of three rounds and takes about five hours. The first round starts with the present existing situation in the area (t0-scenario) and is about making of and exchanging information about the autonomous development (owner scenarios) and global sectoral plan visions. The purpose of the first round is the introduction of the players/actors to one another and to the area and its problems.

The second round is about developing integral plan scenarios by at least two competitive coalitions of stakeholders. Negotiation is an important element in this round. The final result is the election, by a majority vote by the players, of one of these plans to the official policy plan.

In the third round the effect of the elected plan on the area development is simulated. This is done in terms of real estate development (spaceuseforms). This is the cumulative effect of (1) investors considerations and of (2) admittance (permits) connected to the elected plan and of (3) financial loans. Not all of the investment ideas developed may achieve in getting permits and loans, but only those that do can be assembled in the model as a transformation.

[22] An actor can also belong to more categories; f.i. a local government (representative) can also have property in the area. This ambiguity certainly occurs in practice.

So, the simulation shows to what extent the elected plan will be realized or in other words; the impact of plans on the actual area development.

11. Discussion and evaluation

In the context of planning and future research with scenarios a discussion is possible with respect to three questions: (1) is effective planning possible without scenario studies, (2) why are full scenario studies so little used in the local planning practice, (3) what scenario methodologies are suited.

It seems to me that the outcome of the first discussion is that through full scenario studies, that is studies that include al basic components and not only plan scenarios, local planning would at least gain feasibility and also that the participation level could be advanced. The second discussion would possibly confirm a link with lacking know-how, with inadequate data and with lacking tools and techniques. And the third discussion would probably prove that methodology is easily confused with ideology (Cole, 2001). Actually, research and design (scenario methods) are complementary because research is focused on trend analyses and effects while design focuses on the exploration of trend breaches.

An obvious conclusion for scenario tool development than is the combination of both methods through (1) integration, or (2) by advancing them separately whilst improving their 'weak' points. The second option is the approach in this research; it aims at improving the quality oriented design approach through making it more robust with an underlying quantitative model that in addition is based upon an adequate multi-actor schematisation of the transformation of cultural landscapes.

The main contribution of this thesis research is in my opinion the way in which parcels are used to operationalise the scenario method and Parcel Based GIS into a design support system for spatial planning. It facilitates interactive research and design in one hybrid, quantitative but design oriented system[23].

The fundament of Simlandscape is composed of different approaches and specifications of cadastral property; 'social' and 'physical', as agent and as building stone. By combining parcels into lots, two dimensions are integrated; 'social' enabling frameworks and 'physical' geometries. Another move is to conceive parcellation of areas as cadastral assemblage plates. These elements lead up to a system that is both multi-actor and geometrically modular; making it feasible for on the one hand, interactive planning and process simulation (research), and on the other hand for design, construction and analyses of plan scenarios (design).

Another important aspect of the operationalization of the scenario method with Simlandscape is in the way GIS is used. Especially the construction of t0-scenario models and the developed 'open' flexible method for making cadastral lay-out typologies and other typologies facilitate (digital) multi-thematic scenario construction and evaluation.

For further research and development there are challenges with respect to the infrastructure that geographic scenario techniques require in general and challenges for Simlandscape in particular.

Availability and quality of data are general challenges. At this moment it takes considerable effort and funds in the Netherlands to establish an area covering Simlandscape

[23] This way it responds to Van Nottens challenge; 'a combination of qualitative and quantitative elements can make a scenario more consistent and robust, however the fusion of these data remains a methodological challenge; a promising technique in this regard is agent-based modelling that aims to incorporate qualitative elements such as actors behavioural patterns in the otherwise quantitative realm of computer simulation'..echter ..'a quantitative scenario is unlikely to be developed in a participatory manner (Van Notten e.a., 2003).

dataset[24]. An integrated 'production' or at least better geared production would be welcomed. The present organisation of data production seems counterproductive to innovative techniques[25]. In government agencies the focus should not only be on data actualisation. For reason of historical research after spatial dynamics and policy evaluation, annual data sets should be kept to establish temporal sequences.

Further Simlandscape R&D would relate to five points. (1) Joint practice application and research for further testing and improving but also to involve practice in scenario studies and so in Simlandscape. (2) Application as a conversion model to be able to compare different sector plans and to make their cumulative effects transparent. (3) To test Simlandscape more extensively for other types of landscapes; especially urban landscapes with its high densities and public space and infrastructure. (4) To further test the application potential of (integral) Simlandscape models for social-economical, cultural-historical and ecological (scenario) research. From the perspective of possible comprehensiveness of scenario studies it would be of interest to test the combination with traffic and hydrological models. (5) The present Simlandscape ICT related performance is that of basic GIS. More advanced performances can be imagined with respect to user friendliness, ergonomics and efficiency (scenario construction and evaluation) through the development of special tools[26]. The vividness could be advanced if it were possible to obtain advanced graphics for 3D representation of the cadastral typologies on the cadastral assemblage plate[27].

These kinds of developments could create exiting perspectives. Very vivid, user-friendly and efficient Simlandscape versions may come within reach for the (local) planning practice. In a similar way the Simlandscape game simulation could be improved and integrated. In the end practice scenario studies could become merely entertainment.

[24] By consequence also 'normal' data retrieval purposes in practice are hampered.
[25] An improvement of this situation in the Netherlands may be at hand because of the recent fusion of the Land Registration Office (Cadastre) and the Topographical Service.
[26] Although the size of the planning market is said to be too small for this (Geertman, 2002).
[27] The heterogeneity of the parcels poses a complex problem.

All of the presented maps are constructed from the Simlandscape dataset of the Lunteren test area. This area can be characterized as a ‘rurbane’ area, which is a rural area transforming from an agricultural to a mixed character. The forces behind this transformation process are multiple; stagnating perspectives for ordinary agriculture in small and medium sized farms, industrialisation of agriculture, multi land use oriented policies, cultural urbanisation, settlement of urban professionals in vacant houses and farms, and physical forms of urban sprawl due to the vicinity of urban development and fringes. The first three maps show a few of the many examples for analyses of the present situation. The fourth shows a prognostic or expected scenario of owner behaviour. The fifth is a structure plan scenario and the last one is again a prognostic scenario, but this time with respect to the effect of the plan scenario on land mobility (supply and demand).

1. **Present functionforms (in t0-scenario).**

This map shows the considerable diversity in economic functions behind the cadastral units in the present situation of this area in transformation, not only in agricultural economic functions but also in urban, so non-agricultural, economic functions.

2. **Present lay-out forms (in t0-scenario).**

See for the description of the spatial typology Figure 9. Example of spatial typology mathematics and metaphors in one of the Lunteren pilots.

3. **Present user value for animals of half-open landscapes (in t0-scenario).**

This map shows the present ecologic value of the area with respect to a specific ecological (user) group. This is done by having ecologists define this user program (of demand) and than to process this on the areas dataset. In this example it was a very simple user program definition, but it can be as advanced as the researcher is able to make it.

4. **Desired owner t2008-scenario - Owners who wish to realize new land use components.**

It is of interest to have a notion of the autonomous dynamics in an area, f.i. of those related to the landowners. This can be done by conducting specific enquiries and feeding these data to a Simlandscape database. This map shows a possible scenario with respect to the physical landscape. It depicts where which new land use components could appear, because the landowners have said this would be their wish, if putting aside regulations.

5. **tX-Plan scenario Mix.**

This map shows a ‘traditional’ plan scenario that has been developed. Such plan scenarios often contain contradictory, not transparent and uncertain elements. Simlandscape offers tools to convert, analyse, evaluate, optimize and follow the realisation of such comprehensive scenarios. ‘Mix ‘ refers to a combination of zones with a variety of physical (spatial) and functional land use typologies. Two partly overlaying categories of zones are discerned; Cadastral typology related, so categories that refer to the envisaged main cadastral typology, and environmental structure related. The latter one describes the desired environmental features and the first one refers to the required enabling units.

6. **tX-Plan realisation scenario - Expected parcel availability for realisation of plan scenario Mix on the basis of expert speculation on the expected behaviour of landowner categories.**

To explore the feasibility of a plan scenario (plan alternative) plan realisation scenarios can be constructed. This is done by asking experts like sociologists and economists to speculate about the behaviour of owner and developers categories with respect to the development of economic functions, physical outlay et cetera in the context of economic development and of the interventions that belong to a plan scenario (in this case the scenario Mix). This map shows a step in this process; Which parcels will become available for the envisaged plan, because the owners want to sell or develop their property.

These examples illustrate the transdisciplinary potentials of Simlandscape databases; they enhance the multidisciplinary use and cooperation in f.i. municipalities.

Figure 11.1 Cartographic examples of Simlandscape scenarios and analysis taken from the pilot Lunteren.

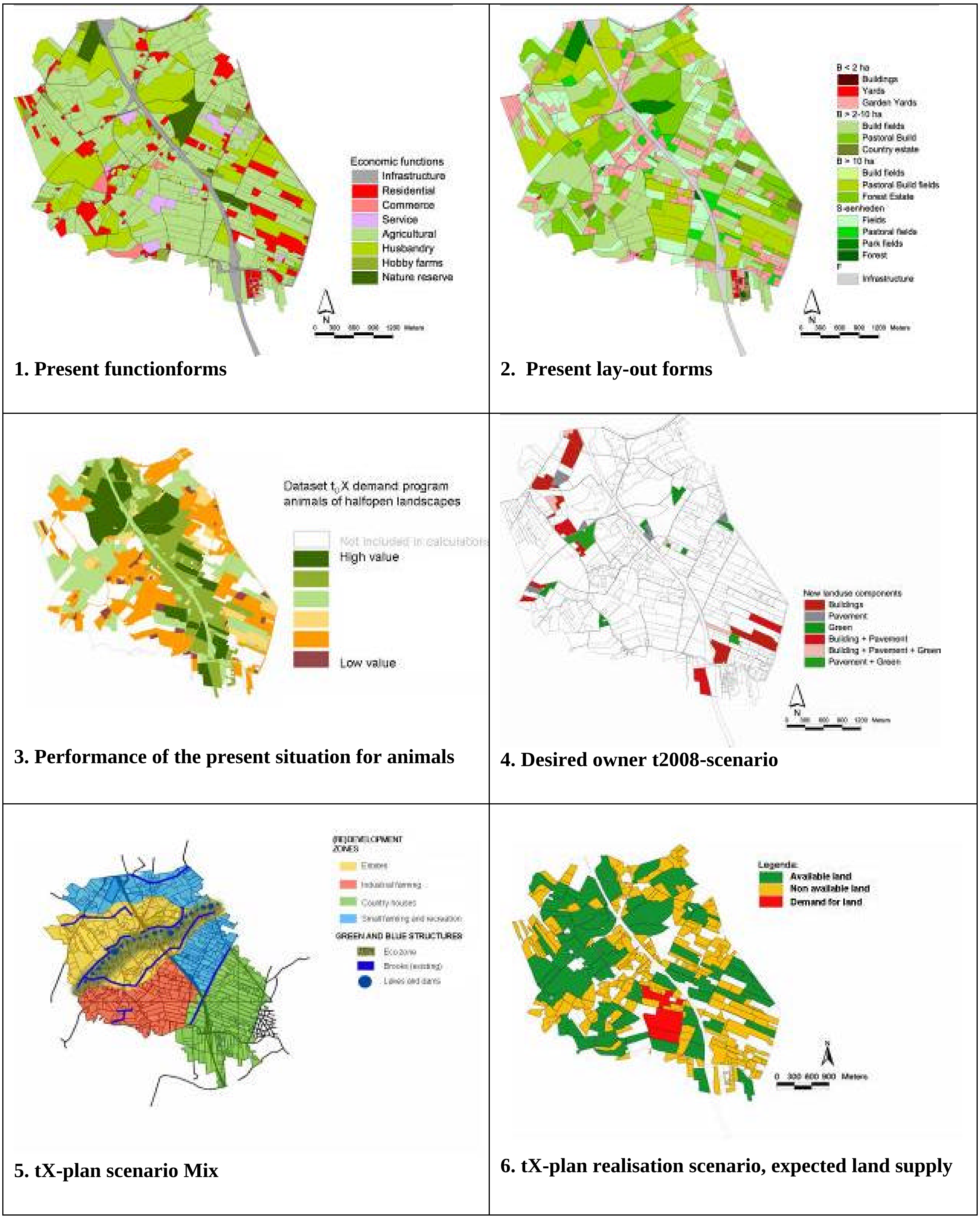

Figure 11.2. Cartographic examples of Simlandscape scenarios and analysis taken from the pilot Lunteren.

Figure 12.2 shows a transformation analysis of a plan scenario for the Lunteren test area. Shown are; (1) a t0-scenario (present situation), (2) a plan scenario and (3) a transformation analysis. Plan scenarios in Simlandscape are multi-thematic because they refer to at least economic functions *and* to physical lay-out. The shown example shows only the 'economic' part.

The typology shown is 'function forms'. This is a classification of lots after their economical function/s. The classification in this case refers to several kinds of agriculture (f.i. husbandry, horticulture), several kinds of industry and commercial services, hobby farms, residential use, nature and infrastructure.

The present situation is shown in the middle (1). It is the present situation within a polygon that corresponds with one of the zones of (2a) a zoning plan scenario for the pilot area. Each zone in a Simlandscape zoning plan scenario is defined (designed) on the level of its conceived constructive elements, the lots and their typologies. This is done in zone programs that define which typologies should occur in which numbers. On the basis of this design on the level of zone programs a design on the level of lots (2b) can be made (Of course many scenario variants can be made with respect to zone borders, zone programs and lay-out in lot typologies). A plan scenario on the level of lots may also be generated by the computer.

Its than interesting to analyze what actual transformation of the present situation is necessary (3a) to develop the situation that is described by the plan scenario. The light color indicates which lots have to be changed. Next to the map a diagram of the transformation is shown (3b). Of each lot typology is shown, from right to left; the present surface, the surface in the plan and the difference (white). A downward presented difference means 'take away' and an upward one 'add'. This information on transformation can for instance be used to asses the feasibility of a plan scenario compared to another plan scenario.

Figure 12.1. A transformation analysis of a plan scenario taken from the pilot Lunteren.

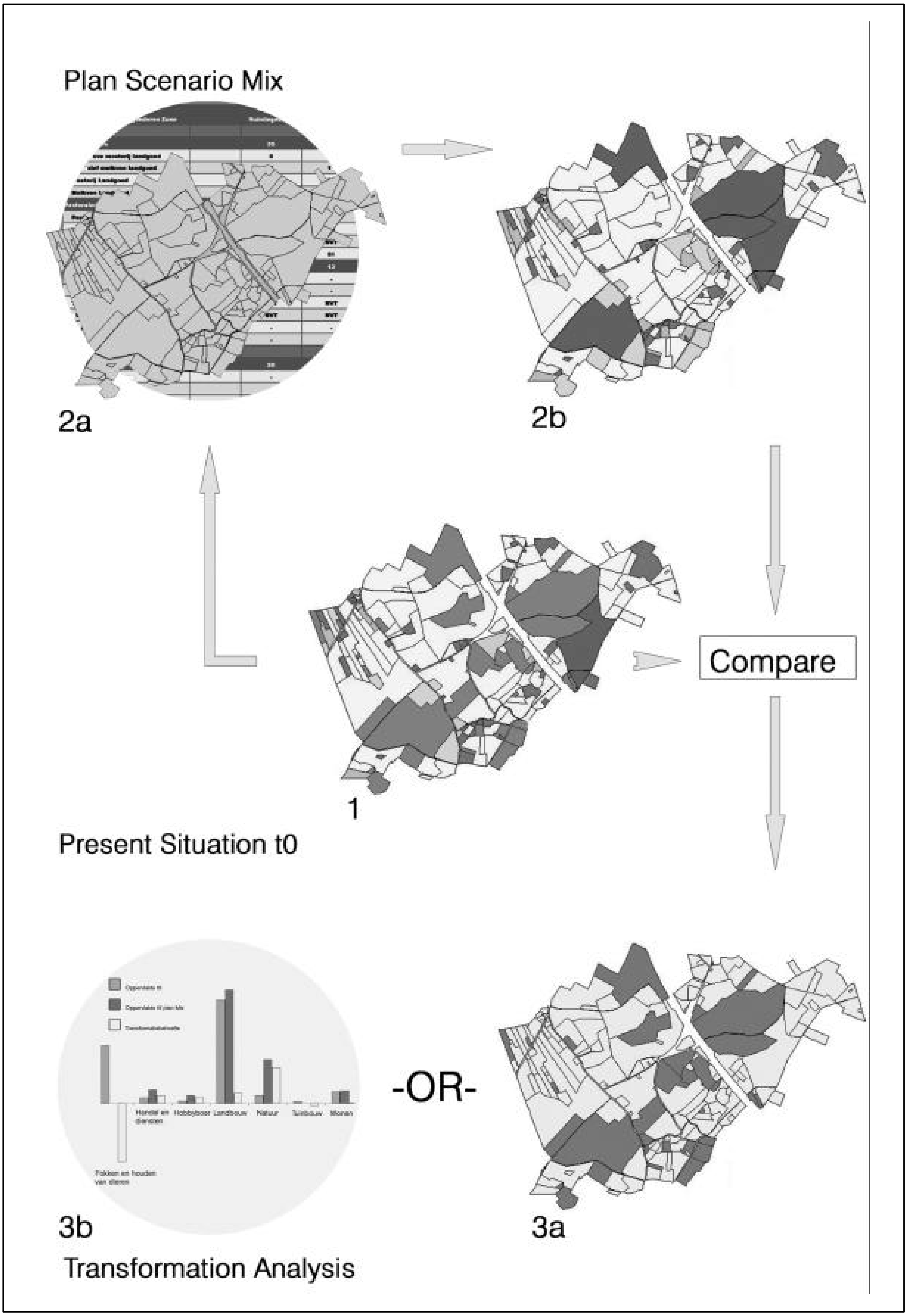

Figure 12.2 Transformation analyses of a plan scenario in a Lunteren pilot.

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