

Application of Innovative Techniques in Multi Purpose Land Development

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ABSTRACT

The Netherlands is a densely populated country with an ever-increasing urbanisation. That is why it is important to preserve the natural values of the remaining rural area and at the same time create recreational areas for the urban population and regional and national infrastructure.

The Dutch government is able to create a multipurpose rural area by applying an active land development program. The Land Consolidation Act is the legal basis of this program. All kinds of problems in the rural area can be solved by land consolidation. Recent examples are the reallocation in a rural area because of a new high speed railroad, the reorganisation of farms as a result of farming diseases like BSE and foot and claw disease and the allocation of water basins to prevent floodings.

A special division of the Dutch Cadastre takes part in land consolidation projects, mainly by designing reallocation plans. Such a plan must contribute to the realisation of the public goals in a project like railroad construction etcetera. Within these public constraints the reallocation plan must lead to a fair distribution of parcels among the private land users.

The Dutch Cadastre uses flexible instruments for the land consolidation activities, such as the MapInfo GIS and the GIS related allocation design software Transfer. The application of modern techniques has led to a great improvement in efficiency, but also to a more objective design process.

The Dutch experience will hopefully be an inspiration for others in allocation design.

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1. INTRODUCTION

The Netherlands is a densely populated country with an ever-increasing population. It is a country of 37.330 square kilometres (14.413 square miles) and more than 15 million inhabitants, what means more than 400 persons to the square kilometre. It is expected that this number will rise in the following years. The rural areas around the current towns and villages will partly be urbanised and used for new inter city infrastructure (railroads and motorways). The remaining rural area will be used for agriculture and outdoor recreation. At the same time the natural values of this area must be preserved as much as possible. To create such a multipurpose rural area, expertise and instruments are needed. The Dutch Land Registry has experience with land development as tool for realising these plans.

A special division of this Land Registry has taken part in the land development for a long time. In the past years, the Land Registry was increasingly involved in doing allocation studies prior to the start of a land development project. In these studies the Land Registry compares the pro's and the cons of a land consolidation to fulfil plans in a specified rural area. With the results of this research the local or central Government can make decisions. The use of innovative flexible instruments in allocation studies has led to a great improvement in efficiency and a more objective design process. Besides, the results of the study are more objective than ever.

2. LAND CONSOLIDATION IN THE NETHERLANDS

2.1 The Necessity of Land Consolidation

2.2.1 Developments in the Rural Area

Although the Netherlands is a densely populated country, around 65 percent of it is still rural area. The pressure on this area is enormous. Farmers are trying to survive the ever stronger rules which are made by the National and European Government. Some solutions for them are buying more land, concentration of parcels and optimising the borders.

Unfortunately, the farmers have been faced with several disasters in the past years. In 1997, there was the pig pestilence, in spring 2001 there was foot and claw-disease and till this moment there is a great fear for other diseases such as BSE. The solution for these problems is to deconcentrate the intensive farms.

But there are some other developments in the rural area. Active Landscape preservation, forestry, outdoor recreation and horticulture are important issues of the national politics. Also the large infrastructure projects have an impact on this area.

The Dutch Government wants to make the Netherlands one of the most important main ports of Europe. That is why two enormous projects of infrastructure are carried out. The first one is the “Betuwe-railroad”, which will be situated through the central part of the Netherlands.



*Figure (left): sign “No entrance, foot and claw disease!”,
figure (right): The high speed railroad in the Netherlands through the rural area.*

This railroad will be built to transport goods from the main port Rotterdam to Germany. The other project is the High Speed Railroad, situated on the western part of the Netherlands. It starts in Amsterdam, making it passengers possible to travel to the city of Paris. This new infrastructure leads through several areas with high natural values. Because of this, it is necessary to take well-known decisions.

2.2.2 Why Land Consolidation?

The rural country in the Netherlands is a multiaspect area. Agriculture, living, recreation, nature, social problems, diseases etcetera lead to a continuous transfer of land to other owners. As indicated, land development is an instrument to cover the activities that change the layout of the rural area. This instrument can be used for: fulfilling constraints in agriculture and forestry, making facilities possible for outdoor recreation, developing the values of nature and the landscape and improving living conditions in the rural area. The rules of land consolidation have been laid down in the Land Development Act.

The Land Development Act defines the procedures of land consolidation. It gives a description of the rights and obligations of all those who are involved in a land development project. The legal procedures for the actual reallocation are described. Activities in the phase of planning, by making the allocation plan, by handling the objections, till the draw up of new lease agreements, which have been submitted to the Land Tenure Board and tenants.

At this moment there are changes in this act upcoming. Most important goal is to make the process of land development shorter. Nowadays it is no exception that a project takes 25 years from start till end. This is too long and too expensive. That is why several embedded procedures in the future act are made shorter.

2.2.3 Participating Parties in Land Development in the Netherlands

Land development in the Netherlands is under supervision of the Central Government. The agencies most closely involved are the Land Development Agency (an agency of the Ministry

of Agriculture, Nature Management and Fisheries) and the Land Registry. A Land Development Commission on local level is responsible for preparing and implementing the Land Development project within the constraints of the Central Government.

Important in this article is the role of the Land Registry. The Land development Act states that the Land Registry supports the Land Development Commission. The registry is known as the expert on re-allocation in the project. Actually, the Land Registry is designing the allocation plan. It secures that the rights and interests of owners and users who are involved in the Land Development project are carefully dealt with.

3. ALLOCATION STUDY AS VALUABLE INSTRUMENT

3.1 Parts of the Allocation Study

During the phase of planning, but also during a land development program, the Land Registry is able to perform an Allocation study. This study shows possible bottlenecks that occur with the planned development measures in the consolidation situation. It also gives possible solutions for the decisions which will be taken to solve the bottlenecks. Thinking about providing access, water management and the development of the nature and countryside, an Allocation study can give insight in results of optional movements of land. At the end, if the result with land development seems to be a success, it can be used for promotion in the area. On this way, a Land Development Commission can win the support of the landowners.

The Land Registry is performing these kinds of studies more and more. An Allocation study consists of three optional parts; the land use registration, the calculation of allocation models and making a parcel design.

Depending on the phase of the specific land development project one or more of these activities will be done. If the project is in the phase of planning, only a land use registration and maybe model calculation will be chosen. After doing these activities, instructors can have more questions about some bottlenecks, for example about the allocation of farms in a certain area (sub area). In this case, a parcel design of these specific elements can be made to simulate the situation in the future.

3.1.1 Land Use Registration

First optional part of the Allocation study is performing a land use registration. Concrete results of this kind of registration are different statistical numbers. The objectives of this registration are:

- Clearness of the actual situation of the project area; for the description of the actual situation several kinds of statistical numbers are used; the average number of parcels per landowner, the use of land as a percentage of the total surface, the average surface of house parcels;
- Composing the input for the next part of an allocation study; the calculation of different allocation models.

A first step of the land use registration is collecting the information, which is needed to calculate the statistical numbers. The ownership data can be taken from the Land Registry's own registers. Information of the use can be asked to the local people or the Land Development Commission. Data of the local policy concerning the area (plans and restrictions) are also collected.

Second step is the analysis of the information. Important is to know who are using which parcels, who are having the ownership of it and which parcels are coming in touch for movement. Also important is to know which different of sort of companies have which rights of ownership of land in the researched area.

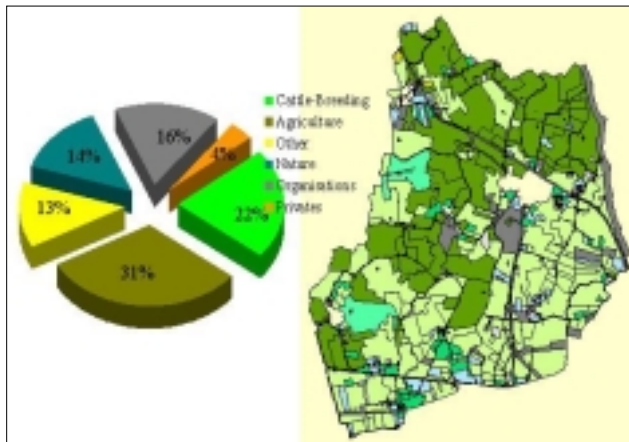


Figure: visualisation of a land use registration with diagrams and maps.

One of the products to make clearness in the actual situation of the project area is a map of usage of parcels. But also other visualisation techniques are used to give an impression, like diagrams and graphics. The Land Development Commission and the Land Registry have also to decide which parcels are taken in land development and which are not.

To compose the input for the next part of an allocation study, the calculation of different allocation models, several data

of the land use registration can be used. Examples are the user information with all their parcels, the topography and the constraints.

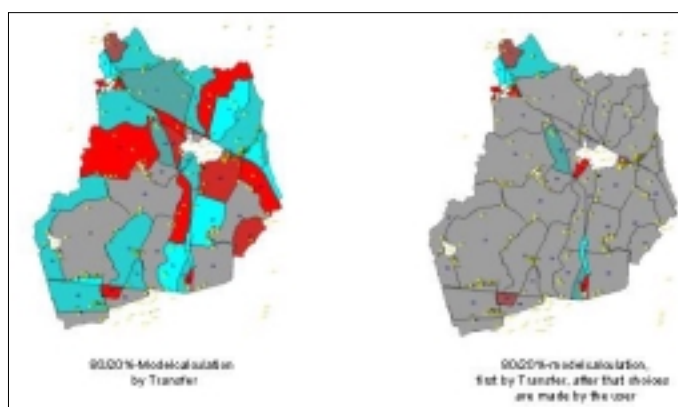
3.1.2 Calculation of Allocation Models

Instructors can have different kind of specified questions. Before making the final allocation, how much land has to be bought? On which locations? And if there is already a land development plan with guidelines, which one have the most success to be fulfilled?

The calculation of allocation models will led to an allocation on the level of sub areas.

First, you need the information from the land use registration. Second, you can decide to make an inquiry of the wishes of the land-users. This makes the allocation study more realistic. The design of a high quality allocation needs unbiased decisions.

The Land Registry uses the allocation software Transfer for this purpose. The input of Transfer consists of all users with all their parcels, infrastructure and the constraints for reallocation of parcels. The algorithm of Transfer is one which wants to make the distances between the house parcels and the others as short as possible. The algorithm is also trying to concentrate these parcels. The software calculates on sub area level. With this software, it is possible to calculate different models, for example the 100-, 60/40- and 70/30-percent versions. A model of 100 percent means Transfer calculates a model with the purpose to allocate 100% land around the farmhouse. A model of 60/40 percent means transfer calculates a model with purpose to allocate 60% of land around the farmhouse and 40% somewhere else in the area. Transfer will as a result of calculation give an impression of the over- (in red) and under asking (in blue) of land in the sub areas. Also gives it an impression which farms can get land in which sub areas. A user can get the equilibrium manually, which will be visualised in grey. More information about the Transfer software can be found in paragraph 3.3.2.



3.1.3 Parcel Design

In a later stadium of the land development project it is possible that some new bottlenecks appear. Otherwise, it is possible that after doing a calculation of different allocation models, some bottlenecks need more research. In this case it is possible to make a parcel design. For the parcel design it is possible to zoom in on a specified bottleneck in a specified sub area. For these areas a sketch plan will be designed with the already known information from the land use registration and/or the calculation of different allocation models. The new parcels are sketched in on topographical maps.

These maps also show all the elements of the delimitation plan (roads, watercourses, countryside and leisure elements) that will remain outside the allocation. The results of the research can be a basis for all the following activities done by the Land Registry.

To make these valuable allocation studies, different innovative instruments are used. To get a good overview of making Allocation studies some knowledge of the different Land Registry Systems is important.



Figure: parcel design; before (blue) and after (red) land consolidation

3.2 Innovative Instruments for Making Allocation Studies

3.2.1 Data Collection

The Land Registry's regular task is registration of ownership of land, including the surveying and mapping of the parcels. All the administrative and cartographical data of the Dutch Land Registry is digital available. The Land Registry Records System (AKR) and the Surveying and Cartographic Database (LKI) are the basis for this. Both systems "feed" the Land Registry land development systems that are used in preparing and implementing land developments. This system is the Land development Network (LIN) which is an actual copy of these AKR- and LKI-databases. A database for a land development project will be started after the phase of planning. Different in this LIN-database is the registration of the users of land besides the ownership.

In practice the information given by LIN is only useful for allocation studies for projects which have passed the planning phase. Allocation studies for projects in the planning phase AKR and LKI have to be used. Although this database give only the ownership in an area, it can be filled with usage-information by people who has the knowledge of this rights in the specified rural area. For example, these are farmers or the Land Development Commission.

3.2.2 Reallocation Algorithm

Transfer is a decision-supported system, made by the Delft University of Technology and WindowsNT/Windows95 software, build with Borland Delphi 3. It is constructed to support the Land Registry by designing the allocation plan, which is the first step to the concept- and later the final) allocation plan. With this quality, Transfer is a very good tool as input for Allocation studies.

The land use is combined in the systems with the wishes land users regarding the new land-use structure. The wishes can be obtained from an inquiry or from a simulation model. The guidelines for the allocationplan, if already laid down, for example regarding the countryside, are also taken into account. After the wishes have been obtained and entered in Transfer, calculation can be carried out using this system to establish an equilibrium between demand for land (wishes) and supply of land in each sub area. It is possible to let Transfer calculate different models of allocation. For example, the user can give the percentage of the concentration as input.

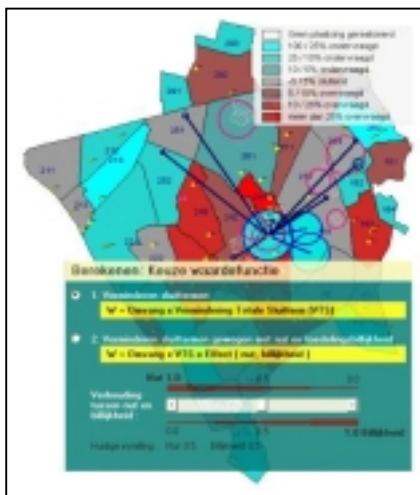


Figure: some tools in Transfer; the map and the user interface.

The system is visualising the result real-time by sub areas with red (over demand) and blue sub areas parts (under demand). Duty is then to find a solution for solving these red and blue parts into a grey colour. This means the

demand of land between of a sub area is in balance. The user can work out this equilibrium manually.

Advantage of Transfer is that it works completely graphical. Changes done by the user are real-time visualised on screen. Another important advantage of Transfer is its built in checks. For example; it is impossible to forget the allocation of a certain user.

3.3.3 GIS-Tool

The Dutch Land Registry uses the GIS-software MapInfo, which is enable to produce a wide range of professional presentations of maps. This software is used in several ways in allocation studies:

- Visualising the output of Transfer; it is possible to convert the output of Transfer to MapInfo's *.mid/mif format. Result is a cartographic presentation in MapInfo;
- MapInfo is a GIS-tool; so it is possible to ask some structured questions by SQL. This gives an optional instrument to do some useful operations as input for an allocation study. For example, if a railroad is projected through a rural area there are always landowners whose parcels will be split up. A solution is to reallocate these parcels and their borders. Here for, it is necessary to know which parcels have to be involved in the reallocation. By using the Structured Query Language these parcels can be found and visualised on screen, but also a plot of the administrative data is possible. This list can be used as input for a Allocation study;
- Making a parcel design for bottlenecks within a sub area. With these options the Land Registry is doing some pilots. It is already possible to move borders of parcels, but there are still no checks of the surface calculations in it. During 2002 parcel design by MapInfo will be optimised.

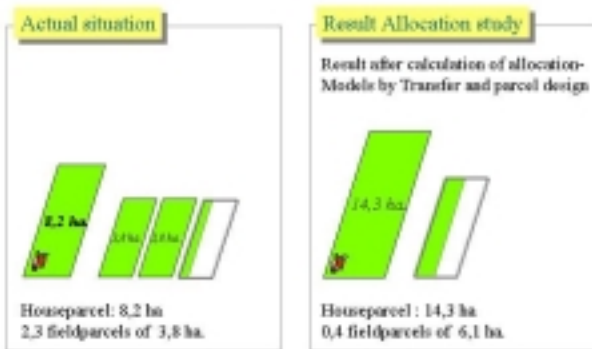
4 EXPERIENCES WITH SOME ALLOCATIONSTUDIES

4.1 Results of Allocation Studies

In this subparagraph two different allocation studies will be presented; one made for the land-development project "Stuifzand" and one for the area "Hoeksche Waard".

4.1.1. Stuifzand

The area of Stuifzand has a surface of more than 600 hectares in the northeast of the Netherlands. There are approximately 30 farms in this area. To optimise the several parcels for farming, the local people wanted concentration of parcels as one of the results of land-development. Also, they wanted to realise several nature-elements. For example water management and planting trees. Special attention was given to the zone around the river that streams through Stuifzand, the "Oude Diep"; here different kind of nature-elements have to be realised. On plans of the Central Government, there were ideas to give this land back to



the nature. To realise this, several parcels of farmers should be moved to another area in Stuifzand. But how many square kilometers have to be moved? Other important issue was the railroad Groningen-Zwolle, leading through the area of Stuifzand. There were several land users who had land on both sides of the railroad connected by private level crossings. People and cattle cross the railroad which has caused several victims over the last 10

years. Important was to end this dangerous situation. But how big was the chance to realise these goals with landdevelopment?

The allocation study aimed to find out whether Land Development could be a solution for the problems in the area.

First step of the Allocation study was to start with a land use registration. The ownership data were taken from the land Registry's database. The Land Development Commission added the data concerning land use. With Transfer different models were calculated to establish an equilibrium between demand for land (wishes) and supply of land in parts of the sub area. The calculated models were a 100% (all the land nearly the living house) and a 70/30%-model. After this, there were made experimental allocations on parcel level with MapInfo as tool. One with the agriculture-objectives as the most important factor and one with the nature-objectives as the most important factor. At the end a mixed allocation was made. For the railroad a parcel design was made to give an impression in the crossing problem.

The results were published in a report and presented to the Commission. Most relevant conclusion of the mixed model was; even if the focus would only be on the objectives of the agriculture, many nature objectives could also be fulfilled. A second conclusion was that four specific farmers needed to settle somewhere else to fulfil the plan around the "Oude Diep". Spectacular was the calculated number of the expected average surface of house parcels after land development; the number rises from 48% till 85%! At this moment the land development project "Stuifzand" has almost finished. The final allocation plan has been lying open in the beginning of 2001 and the Land Registry is busy with handling objections at this moment. The registration of the new allocation Deed –it contains the ownership of the parcels- is expected in summer 2002. A land development project takes sometimes more than 25 years. A success of Stuifzand is that the total duration of the land development has cost not more than 10 years. The performed Allocation study was an important instrument to get this result. Thanks to this instrument the parties had an impression of the intended choices of movement before the real allocation was started.

4.1.2 Hoeksche Waard

Second example is the "Hoeksche Waard", a project of 1500 hectares to the south of Rotterdam. The history of this Allocation study is very different from Stuifzand. The

Hoeksche Waard was started as project of land development in the end of the eighties, with the agriculture as priority. Mid nineties the Central Government decided to plan a high-speed railroad between Amsterdam and Paris. After a multicriteria analysis between different alternatives, the final trace was chosen through the Hoeksche Waard. Unfortunately, the real allocation plan had already been designed. Now, the Land Development Commission had to make a new one. Important was to adjust the allocation plan to the railroad with the least possible changes. To get an impression of these possibilities, the Land Registry was asked to make an Allocation study.



Figure: Selection of landowners who have at least one intersected parcel.

The Land Registry made a parcel design with the information that was already used in MapInfo. Of course there were new wishes by the farmers, but the main goal of the allocation study was to get an overall view of the possibilities. Most important objective was to get all the land of the individual farmers on one side of the railroad. A list of landowners was made by SQL who had at least one parcel which intersected the railroad. For those ones, there was constructed a new allocation by MapInfo in the Hoeksche Waard east sector.

The results of this Allocation study gave the possibilities of making a new allocation plan. With the given impression, well-known decisions could be taken of buying land on the best location. Most important conclusion was to move four specific farms to another place to make enough land free for the railroad.

The adjusted allocation plan has been already laying open for inspection and at this moment the Land Registry is handling the last objections. Expected is to make the Allocation Deed ready for registration in June 2002.

Hoeksche Waard and Stuifzand are two examples of recent Allocation studies. But there are several new possibilities for new allocation studies by the Land Registry.

4.2 Possibilities for New Allocation Studies

An important issue is the Reconstruction of farms. The Government has decided that three regions in the Netherlands have to realise these plans of Reconstruction. Different commissions are already found for making concrete objectives and parameters. After it they have to realise these with concrete plans. This Reconstruction must lead to a higher quality of the rural area. These plans all have the intention to stop foot- and mouth disease, BSE and pig pestilence. Solutions are to end farms or to move out some to other areas. Between intensive farms corridors of nature will be developed.

These plans have to lead to several new allocations in the rural area. Allocation studies supported by Transfer and MapInfo can give an impression of the possibilities to get the objectives of reconstruction. The Land Registry has started some pilots yet to import parts of the area of Reconstruction in Transfer, showing whether it is possible to move parcels to other places from especially farms with pigs.

Another project the Land Registry is participated in, is the building of the fifth runway of Schiphol, the international Airport of Amsterdam. An allocation study has been started, supported by Transfer and MapInfo to give insight in the possibilities, to make movement of parcels possible.

Other possibilities are to give an impression in the future plans of the project Waterland, where the Land development Commission is able to reconstruct a historic canal. For this several farms have to move to another place. Allocation studies can support the decisions concerning this.

Also an important issue in the future is the supporting with Allocation studies for realising areas of retention to prevent floods. This is to avoid the high river floods like those in 1997. To prevent some floods in the future it is possible to enlarge the dikes. Another solution is to create retention areas. To make this retention possible, land must be found on the right location. Landowners have to move or will be compensated for sustain damage. A structured allocation study is an optimal instrument to get insight of the number of acres which has to be bought to get the objectives and for giving alternatives to choose the right direction. The Land registry has started negotiations to participate the jurisdiction of the Waterboard in this process, for example by making Allocation studies.

From the above mentioned examples we can see that a structured allocation study with land use registration, calculation of allocation models and parcel design can give suggestions how certain problems in the rural areas can be solved by modern land development projects.

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BIOGRAPHICAL NOTES

Martijn J. Rijdsijk has studied Geodesy at the Delft University of Technology. During his study he became special interest for information technology (GIS), planalogy and land development. He supported the promotion of mrs. dr. Buijs with the practice "The Knife in the parcel" and ended his study in 1999 with his final practice "Allocation study in the pre-phase of land development". After this he came to work at the Land Registry as co-ordinator special projects.