

Perspectives on the study of marginal land and biotopes in intensively used Agricultural landscapes

Some principal remarks on the contribution to the collaborative program

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Forskningsseminar

Mandag d . 12 Februar

i

Geofagsalen, 192

kl. 9,30-12,00

Økonomi og økologi i landskabets udnyttelse

Vedlagt 3 papers, der skulle kunne danne udgangspunkt for diskussionen. De der kun kan finde tid til at forberede sig på de mere teseprægede sider af oplægget, kan springe siderne 5-6, 12-15 og s. 18 (midtpå) - 23 over. Men da det jo er rart, at kunne forholde det almene til det konkrete, skal det på ingen måde anbefales.

Jens Rasmussen: Økologiske og økonomiske problemer indenfor dansk landbrug, med særligt henblik på erhvervets betydning i en regionaløkonomisk sammenhæng.

Rolf Czeskleba-Dupont: Byøkologien set ud fra den natur- og arbejdsorienterede regionalforskning.

Jesper Brandt: Perspectives on the study of marginal land and biotopes in intensively used agricultural landscapes.

Paper presented at the plenary meeting of the collaborative programme on remote sensing in the management of European less favoured areas and marginal land, Ispra, Italy, Dec. 12-13 1989:

PERSPECTIVES ON THE STUDY OF MARGINAL LAND AND BIOTOPES IN INTENSIVELY USED AGRICULTURAL LANDSCAPES

Some principal remarks on the contribution to the collaborative program

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Our project-contribution is concerned with marginal land and biotopes in efficient used agricultural landscapes.

Allow me here to start with some more principal reflections on the linkage to the political purpose of the collaborative program on less-favoured areas and marginal land in a more long-termed perspective:

The concept of *Less Favoured Areas* is a complex economic category related to the lack of economic attractiveness for investments in greater regions within the community, giving rise to falling competitiveness, growing regional want of employment, emigration etc. The existence and development of such areas has to be seen in juxtaposition to the formation and development of growth-poles, where investments and economic activity seems to concentrate.

The perspective of using remote sensing in the management of LFA is based on the assumption, that remote sensing can sustain initiatives, that can stimulate the overall economic activity of such regions, for instance through

- localizing areas with environmental conditions favorable for investments in different sorts of single-purpose land-use, that will be profitable if specified conditions can be fulfilled (melioration, infrastructure, marketing organization, education etc.)
- development of complex plans for a multipurpose use of LFA, that can stimulate the general investment climate through an systematic support of the advantages of mutual cooperation between different adjacent land-users and an intelligent regulation of the conflicts between the same users.

However, since the reasons for the development of LFA very seldom can be reduced to physical conditions in the geographical environment, that can be detected by remote sensing, the role of remote sensing will in practise tend to be of much more defensive character, namely to register the influence of economic activity in LFA on the land use and the structure and function of different landscape elements, an influence, that can be twofold:

- 1) a growing pressure on the land capability to compensate for falling competitiveness and miss investments, giving rise to overexploitation, or
- 2) stagnation of the land-use-system, giving rise to a period of environmental stabilization, that however might be a transition phase towards

the emergence of real set-aside areas, until more economically extensive ways of land-use takes over.

In these different perspectives for the use of remote sensing in the management of LFA the users are of very different character, which has to be taken into consideration by the evaluation of the expected possibilities and results.

The concept of *marginal land* is related to much more specific political goals, which are at least twofold:

First the need for locating areas, which are supposed to be set aside because of overproduction and expected falling prizes of traditional agricultural products within the EEC.

Secondly the need for recommendations on alternative land-use and landscape management in such areas.

Although these goals are close related from the point of view of society, they are nevertheless for the time being linked to very opposing economic and social interest; first of all the defensive strategy of the generally contractive agricultural sector opposed to the growing claims of interests related to the expanding 'green sector' related to nature conservation, environmental protection and recreation.

So, the very comprehensive investigations on the foreseen marginalization process within the Danish agricultural landscapes was initiated by the Danish Nature Conservation Board and promoted through the Ministry of Environment, resulting in tense conflicts with agricultural interests, including the Ministry of Agriculture. Such conflicts has of course also substantial influence on the development of concepts, theory and methods related to the scientific analysis of the marginalization process, which everybody involved should be very conscious of.

Although the argument of overproduction does not seem to be so urgent as for some years ago, due to the diminished surplus stocks, the two goals will nevertheless - at least for a period - stay as relevant because of a general concentration of intensified agriculture on more favoured areas within the community.

The reason for this tendency has to be seen in a broader perspective of technological, economical, social and political trends, which are going on, and will be extended in the future:

After a long period with diminishing regional and local differences in agricultural practise due to growing technical and economic possibilities of implementing standard agricultural technologies within different environmental conditions, we are generally facing a change in direction towards a growing adoption of the land use practise to regional and local differences in natural and social conditions, giving rise to growing geographical differentiation concerning developmental conditions for agriculture and other types of land use.

Areas with less favorable natural or socioeconomic conditions will show a growing tendency towards marginalization in form of extensive land use.

More agriculturally favorable areas will meet the tendencies of general overproduction and falling prizes with an increased intensification of land use, more rational agricultural techniques, accelerated removal of small biotopes etc.

This diverging tendencies of the marginalization process will be seen on a national as well as a regional and local level, and will have a profound influence on the function of the agricultural landscape.

At the same time the withdrawal of agricultural areas for non-agricultural land use (water supply, recreation, conservation and so on) will continue regionally as well as local, especially at the urban fringe. This is to be

seen as a general intensification of the land use as a base for improving the material wealth of society - a strategy, however, that is only possible, if the single types of land use can be realized without being inconsistent to each other.

* This future demands will go hand in hand with the demands on a more environmentally orientated development, which can be summarized in the perspectives of the Brundtland commission report as a future based on *sustainable development*: Not only as a nice and optimistic vision, but much more as a necessary precondition to ensure and extend the material wealth in the future.

To meet this challenge, I would like to summarize two thesis, that I think will be of utmost importance for the practical purpose of this program:

1. *Sustainable development* means to stress the importance of separating and combining different geographical scales much more than we do today. Mapping marginal land on an EEC-scale gives quite another picture as on a national level, which again differs from the regional and local levels. To combine sustainability with development means to combine the management of the different levels much more serious than we do today.
2. *Sustainable development* means, that the question of intensification versus extensification of single purpose land-use will change towards a question of optimal or balanced multipurpose land-use, because multipurpose land-use in itself represents the combination of an overall more intensive use of the landscape (as a basic source for material wealth) and a more environmentally thoughtful way of handling the metabolism between man and nature.

Concerning the first point, there is no doubt, that for many years, there will still exist differences between the main regions of the EEC, generally between north and south, which are of utmost importance for this programme.

Here I would like to stress the importance of cooperation with the CORINE-programme: Especially the CORINE-land-cover classification system, that can be extended to more detailed levels, and the implemented coordination procedures relating to data exchange, are results, that definitely should be used in this programme; but also the CORINE projects concerning biotopes, soil, water, climate and topography are relevant on the minor overall geographical scale.

However, in the other end of the scale, we also have to make a link to the most local level, where the actual change of land-use and landscape management due to the marginalization process is going on.

One of the most ambitious works dealing with the marginalization process is the 53 volumes of reports from the Danish Marginal Area Research Project published by the National Forest and Nature Agency under the Danish Ministry of Environment.

A very important result of these investigations was a growing understanding of the fact, that marginalization tendencies can be seen not only as a problem in areas of generally less favoured natural conditions for agricultural production, but in fact also very much affects the structure and dynamics of the more efficient and intensively used agricultural areas. Everywhere local varieties in the natural conditions together with socioeconomic conditions can have important influences on the marginalization process.

The Danish landscape is generally very intensively used, which can be seen from the fact, that only 11% of the land is covered by forest. Therefore forestry has certainly been seen as a main solution to the foreseen marginalization process in Denmark.

This has, however, to be planned thoroughly, and not only to be seen as a marginalization solution: A spontaneous process of plantations on marginal areas of private farmers will work fragmented and economic inefficient: We know that after many years of experience. But to rise planned forest on bigger areas of sandy soils or wetlands might be wrong, too: It is more and more clear, that the landscape-ecological conditions have a profound influence on the forest economy; and we also have to recognize, that areas with high population density, for historical reasons, has concentrated in regions with better agricultural conditions, where the need for forest plantations for environmental, waterprotection and recreational reasons are growing fast.

In so far as the problem of overproduction is relevant, the forestation of intensively used agricultural areas certainly has a better effect than would be the case on already marginalized agricultural land.

In the Danish marginal-soil-investigations, the marginalization problems of the intensive used Weichel Morainic landscape - comprising 2/3 of the total area - was concentrated on the so-called small biotopes; That is linear biotopes and patch biotopes greater than 10 m² and lesser than 2 ha, localized in or between the fields. In average they take up between 1 and 5 % of the total agricultural land. On Fig. 1 you can see the classification, that has been used in the investigation of these biotopes.

They are very seldom of natural origin, but a result of the agricultural development, modified by physical geographical conditions and the general process of urbanization.

A study of the structure, function, and historical development was carried out during the early eighties, based on maps, air photos, field registration and interviews with farmers (AGGER and BRANDT, 1984, BRANDT 1986, AGGER and BRANDT 1988).

A general decrease in the overall density, and especially in the density of the smallest and the wet biotopes was demonstrated.

In the very intensively used agricultural landscape of western Lolland almost all the small biotopes has been removed within the last 100 years (see Fig. 2). On the Southern part of Fyn (c Fig. 3) the remaining biotopes are more and more concentrated to the boundaries between the agricultural holdings, which here seems to be a conserving factor for the small biotope structure.

Now, these biotopes form a generally unstable type of landscape elements, which nevertheless are of great importance for a variety of reasons:

From a planning and management point of view we have tried to develop different models for the incorporation of the biotope structure in the landscape planning, which represent very different points of view (BRANDT and AGGER, 1987):

The corridor model, that guides the planning of connections between all the more important wetlands, forest or pasture areas - primary guided by biological principles,

The read structure model, that gives guidance to where marginalization of fields might be given opportunity to satisfy recreational needs - guided by recreational principles, and

The boundary model, which states, that all farm-boundaries shall carry some sort of small biotopes - guided mainly by a historical-geographical principle, but in practise, the other principles are here in some way incorporated.

The dynamics of the small biotopes reflects general changes in the land-use-pattern; also for that reason they should be taken much more into consideration in the regional and local planning of agricultural areas within the next years.

A follow-up investigation after 10 years is planned to be carried out in 1991 in cooperation with the ministry of environment.

In our pilot study related to this programme, we have until now concentrated on the development of methods of integrating SGEOS-images with existing maps and field-sampled data in a GIS. This GIS should be capable of improving and actualizing mapping of land use - including biotope structure - and of complex land-capability for management-purposes.)

A test-area of 15*25 km has been selected from the northern part of the Danish island Fyn. It covers different types of the Danish Weichel morainic landscape.

Until now the following data exists and have been integrated into a GIS (MÜNIER, 1989b):

Satellite image from Landsat thematic mapper of mid May 88, with a resolution of 30 m, archived as raster data referring to the UTM coordinate system.

A soil classification derived from the Bureau of Land Data's digital soil map. It was archived as vector data and rasterized to the same map-projection and spatial resolution as the satellite image.

A digital Terrain Model based on data from the Danish geodetic Survey has been integrated. It is a raster type with 50 m. grid sells, giving information on aspect and slope, referring to the UTM-coordinates, 100. A plot showing illumination of the area at the time of the satellite passage May 15th 88 has been computed, which gives a good impression of the shape of the terrain surface, and for this reason it is suitable for *different thematic overlays*:

Themes on the marine areas, the histosol areas (relevant as potential marginal land), and drainage pattern (creeks and ditches) are examples of such overlays, that are stored as vectores in the database, so that they can be overlaid on raster-images of varying spatial resolution.

In a part of the areas the GIS has been extended with data from an *air-photo* at scale 1:60000, scanned directly from the color slide in three colors, resulting in a ground resolution of 5*5 meters-pixels, directly referring to the UTM-grid-net.

The GIS-application can be demonstrate by overlaying vectorbased themes, that shows, how the resolution of the overlay will be the same as the one of the airphoto.

For verification and quantification some ground truth covering type of land use, cover index of vegetation, soil index and soil moisture, has been sampled at about 100 selected locations in the field in May 1988 and October 1989, the first one corresponding a thematic Mapper-scene.

The test areas also include one of the test plots for small biotope studies. By edge-enhancement of the scanned airphoto it should be possible to register the location of practically all small-biotopes almost automatically, and thus giving an important part of the information necessary for a GIS-based monitoring of this theme.

The type of the biotope is however not possible to detect within this resolution. We still have to experiment with finer resolution of about 1 meter, and to find a way of compressing the data, either by vectorizing or by a quad-tree-procedure. If enhancement of 3-D-features based on adjacent photos can be obtained, there might be a possibility of a differentiating biotopes such as field divides and ditches.

The storage of these small landscape element is probably not a big problem: One have to keep in mind, that the biotope structure of the agricultural landscape can be seen as a sort of mirror or negative of the agricultural land-use, and that a detailed, digitized and vectorized survey of land-use in principle could contain data and biotope structure without adding very much geographical information.

Now some remarks on the second thesis about the need for a better basis for integrated multipurpose land-use and landscape management, which will form an important future part of our investigations.

A tendency towards multipurpose land-use as a general socioeconomic strategy for a more intensive use of the territory calls for a way of planning and management of the countryside, that can combine agricultural, conservation, recreational and other functions in a proper way.

In Denmark, this development has been followed up by a rapid growing mass of legislative initiatives concerning agricultural practise and land-use, protection of ground water and streams, and conservation and administration of habitats for wild flora and fauna within the agricultural landscape.

The implementation of these initiatives appears to be very complicated for several reasons: First of all, this change is taking place very rapid, especially seen in relation to the situation up till now, where there has been almost no restrictions on the agricultural use of the countryside. The private property of land means that measures of expropriating character can be extremely expensive. On the other hand, a general very tense economic situation for a major part of the agricultural holdings makes it very difficult to burden these with expensive arrangements.

In the long run, however, other problems connected with the transition of planning and management of agricultural landscapes will probably take over:

The integrated management of agricultural landscapes proves more and more to be a local task, very narrowly linked to local economic and social activity. The municipal authorities have seldom the expertise and resources to formulate integrated plans, and still less to secure the management. And due to the relatively small holdings, they are at the same time forced to focus on specified regulations for the single holding, instead of concentrating on the overall formation of territorial systems of ecological landscape stability, ecological infrastructure and a planned balanced multipurpose land-use structure.

This calls for the formation of local landscape administration units, which can manage for instance specified claims on vegetation cover during the winter time, or standards for combination and density of biotopes in a flexible way, that is not possible today.

The geographical bounding of such units must be based on very different and often conflicting principles concerning size, landscape structure, agricultural structure, historical-geographical structure and socioeconomic structure.

The municipality of Gundsø at Roskilde Fjord, some 30 km. west of Copenhagen, is very suited for investigating this tendencies. The municipality comprises about 6000 ha, and about 150 agricultural holdings.

There is a mixture of intensive farm land and true marginal areas, which partly has high priority for nature conservation as well as recreation. These areas are also threatened due to heavy water pollution.

13% of the total areas is build up areas, mostly residential areas for pendlers working in the metropolitan area of greater Copenhagen, and extensive colonies of summer cottages.

Gravel pit mining for greater Copenhagen is widespread in the north and west, and a planned transport corridor is supposed to be a dominating factor for the eastern part of the area.

All in all an area with tense conflicts of interest, and a growing need for multipurpose land-use (see Fig. 4).

Here we want to implement studies on

1. a suitable landscape-ecological methodology and survey technique for mapping the environmental conditions for different types of multipurpose land-use in agricultural landscapes, and
2. suitable forms of social organization for implementation and management of such multiple use of agricultural landscapes.

First we try to implement an inductive general landscape-ecological survey-method mapping ecotope-types, say 'types of smallest homogeneous landscape units', that forms the construction bricks, or 'natural pixels' of the landscape, which can be combined to typical heterogeneous, chorological units, 'nanochores', that can be described in a quantitative way, typified, and related to different kinds of land-use or combinations of land-use, different kinds of biotope structures and so on (JENSEN,1990).

But the transformation of landscape-ecological information into a technical form relevant for planning and management is not the only entrance to the problem of defining relevant local landscape management units.

We also have to take the organizational side into consideration. Here it is very important to recognize, that although many different land-use interests might be involved, the basis of such units in most cases should be cooperations of local farmers, who can combine this function with the growing economic and practical advantages of cooperation concerning an agricultural practise more adapted to the local landscape ecological conditions and potentialities, and so extend their activity from pure agriculture to a broader responsibility for the landscape management.

Here the old division into small parishes, which was abandoned in connection with the municipal reform in 1970 might be very relevant especially from an organizational point of view, has however, to be combined with other principles to secure an integrated administration of important landscape types such as valley systems, which traditionally divides the old parishes.(BRAMSNÆS and BRANDT, 1988, BRANDT 1988)

We will first of all try to develop a reproducible procedure for compiling the necessary information into a suitable GIS based on existing topographical and thematic maps, SGEOS-scenes and airphotos.

But this is not enough: The hard task will be to transform it into a form that can be a relevant tool and inspiration to the handling of the many economic, social and political problems, which we are facing during the difficult transition towards a sustainable development based on a balanced multipurpose land-use.

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