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SCIENCE FOR A SUSTAINABLE DEVELOPMENT

LANDSCAPE CAPACITY AND SOCIAL ATTITUDES TOWARDS WIND ENERGY PROJECTS IN BELGIUM

"LACSAWEP"

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FINAL REPORT

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"LACSAWEP"

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0.1. Objectives of the research project LACSAWEP

The recent increase of the price of energy and the awareness of the global warming stimulated the development of on wind energy parks in many parts of the world. In Belgium the wind power capacity increased significantly over the last 5 years from a capacity of 35 MW in 2002 to 287 MW at the end of 2007. It may be expected that the number of wind turbines will continue to increase in the coming decade.

Nevertheless experiences with various wind energy projects in Belgium and other European countries showed that the development of new on-shore wind energy project is not unanimously perceived as positive. The way a wind energy project is perceived by the surrounding inhabitants in strongly dependent on the landscape characteristics of the surrounding environment and the pathway of the development of a social attitude towards the wind energy project.

Hitherto however, very little was known about the factors that determine the 'landscape capacity' for wind energy parks. Especially in the Belgian context with a very high variability of landscapes a relative ranking of landscapes according to their suitability for wind energy projects may be useful for site selection. Moreover, at present it is not clear how social attitudes towards wind energy parks in Belgium are formed and which actions can be taken to develop positive attitudes towards wind energy farms.

The research project LACSAWEP had therefore a double objective:
1. To develop a tool for the evaluation of the landscape suitability for wind energy development in Belgium
2. To get a better understanding of the development of social attitudes and their controlling factors in Belgium

0.2. Development of a tool for assessment of the landscape suitability for wind energy development

In order to tackle the first objective the following methodology was adopted:
- A set of Belgian landscapes was photographed in order to compile a representative but sufficiently diverse sample. The original photographs were manipulated by adding simulated wind turbines in the panoramas.
- Each photographed landscape was described by means of a set of categorical and quantitative indicators.
- The visual quality of each photographed landscape was measured by means of photo-questionnaires.
- Finally, the regression model was applied to quantify the impact of a wind turbine on the visual landscape quality.
- A multivariate regression model was developed that allows predicting visual landscape quality based on the available landscape indicators.

An extensive photo survey was carried out during which 250 panoramic photographs of rural landscapes in different regions of Belgium were constructed. Each panoramic photograph covers a horizontal observation angle of around 120°. Out of the total database of 250 panoramas, 54 photographs were selected for the photo questionnaire.

The selected photographs cover a large variety of landscape types in the Belgian lowlands, the Belgian Loess Plateau and the Belgian Ardennes including forested, suburbanized, traditional, open and 'bocage' landscapes with or without disturbing elements.
Next, by means of photo manipulation techniques wind turbines were simulated on each of the 54 selected landscape photos using advanced photo editing software. Various spatial configurations of simulated wind turbines (solitary, line, arc) were simulated.
Finally, a database of 108 panoramic photographs (54 with and 54 without wind turbines) was created.

Each photographed landscape was described by means of a set of categorical and quantitative parameters. The quantitative parameters that were used in this study are the area percentages of the different land use types. For each selected photograph the area of the following land use types was assessed by means of digitalisation: woods, green elements (non-wood and non-agricultural), urbanised area, water surface and agricultural land. For each land use type a relative area proportion was calculated. For reasons of comparison the area on the photographs that was covered by sky was not taken into account. The categorical parameters that were derived for each selected photograph were the following: vista type, topography type, weather type, the presence of historical-cultural elements and the presence of anthropogenic point elements.

In the next step People were asked to score the visual quality of a set of 18 photographed landscapes on a 7-point Likert scale (1 = very low visual quality, 4 = neutral, 7 = very high visual quality) attractive). In total 1542 respondents evenly distributed over Belgium were interviewed door by door, at market places or in front of shops. Respondents were not explicitly informed about the possible presence of wind turbines on the landscape photographs. In order to make the scoring of the respondents comparable the scores of each individual respondent were standardized by calculating z-scores. In this way the mean of scores of each respondent is 0 and the standard deviation is 1.

The results of the questionnaire were used to calculate an average visual quality score for each of the selected 108 photographs (54 original and 54 simulated). This resulted in an average visual quality score (VQ-score) for each of the landscapes.
Next, the impact of wind turbines on the visual quality of the selected landscapes (VQ) was quantified by calculating for each photo-pair a D-VQ-value. A D-VQ-value is the difference in visual quality between the original landscape and the landscape with simulated wind turbines. A positive D-VQ-value implies that the visual quality of a landscape decreases after the installation the wind turbines. A negative D-VQ-value implies that the visual quality of a landscape increases after the installation the wind turbines.
Finally, the relation between VQ-values and the calculated D-VQ-values were explored by means of regression analysis. The relation between VQ and D-VQ can be use to assess D-VQ if VQ is known.
In order to assess VQ-values (i.e. the visual quality of a landscape without wind turbines) a predictive model was calibrated. Univariate regression analysis was used to identify quantitative landscape parameters that are significantly correlated with visual landscape quality. By means of T-tests significant categorical landscape parameters were identified.

Next, a multivariate linear regression model was calibrated in order to predict the mean visual landscape quality by means of a linear combination of the assessed landscape parameters (both categorical and quantitative). The developed model was validated using a Jackknife validation procedure.

The model fitting resulted in the following equations:

$$VQ = -0.1183 + 0.9427\ Wo - 1.6817\ U - 0.1847\ T1 + 0.0002\ T2 + 0.2386\ APE0$$

and

$$D\text{-}VQ = 0.32 + 0.19 * VQ$$

Where: VQ = visual quality of the original landscape; D-VQ= Delta Visual Quality = $VQ_{original\ landscape} - VQ_{simulated\ landscape}$, Wo = area percentage of forest in the landscape, U = area percentage of built-up area in the landscape, T1 = rolling topography, T2= flat topography, T2= rolling topography, APE0= absence of anthropogenic point elements.

0.3 Analysis of the social attitudes towards wind energy parks in Belgium

In order to get a deeper insight in the formation of social attitudes towards wind energy parks in Belgium qualitative discourse analyses were carried out for a 5 selected wind energy projects in Belgium: Houyet and Mettet-Fosses in Wallonia and Kruibeke-Beveren, Kortrijk and Lombardszijde-Middelkerke.

For each selected case, the project leaders or the developer(s) have been interviewed; together with the responsible officials and politicians possibly involved at the local level, primarily on the process and the discourse they produced. Of course they were also considered as prime sources to find crucial respondents, as it is expected that they – together with the developer of the project – have the best knowledge about who has been involved in the process (possibly even lists of participants in information sessions or petition signatories).
Secondly, about 15 residents have been interviewed per case as 'discourse receivers and/or producers'. In the case of protest, both activists who joined the protest and 'regular' residents (randomly chosen) have been interviewed.
In the case of cooperatives, residents who became shareholders alongside 'regular' residents were interviewed, but also opponents were searched for. In the case of projects across different municipalities, or at the municipal border, residents from both sides of the border have been interviewed to assess the influence of local discourse production by the municipal governments.
Thirdly, the media were covered in order to get an insight on how they interact with other actors, and how they reflect the different discourses from relevant actors in the project.
In a first round, the analysis of the discourses and their influences on shaping and developing attitudes was organized around the following questions:

- Who are discourse producers?
- At what scale level do they produce it?
- In which stage of the process do they produce it?
- What are their arguments and motivations?

In a second round, the questions were:

- How were these discourses perceived?
- What were people's fears?

The development of attitudes and the reasons behind it were analyzed in the respondents' interviews and summarized in attitude formation diagrams. Based on the discourse analysis the following influencing arguments on attitude formation could be identified:

- **Physical disadvantages** such as: visual landscape disturbance, flickering shadows, noise, the possibility of braking rotor blades and the possible negative impact on bird migration areas and routes.
- **Economic factors** such as: the devaluation of property, the amount of economic gain one can have on behalf of the project and the economic efficiency of wind turbines
- **Symbolic arguments**: wind turbines are often seen as energy for the future generation and as a way to pay 'the ecological sin' of mankind
- **Type of decision making process**: the discourse analysis pointed out that there is a great need for more collaboration in the planning system of local wind projects. Residents and other stakeholders need to be involved, by which means there can be created institutional trust, a feeling of equity and fairness, and a lower degree of dissatisfaction towards the project.

0.4. Conclusions and recommendations for developers and policy makers

A perception-based approach was used to construct a subjective landscape appreciation model of non-urban Belgian landscapes. A questionnaire among the 1542 inhabitants of Belgium resulted in a model of rural landscape preference and information about the change in landscape appreciation after the implantation of a single wind turbine or wind turbine park. The main concern of the study was to provide a tool for spatial planners in order to evaluate future wind power landscapes.

A first finding is that landscape appreciation can be predicted using a set of quantifiable landscape indicators. In this study the following landscape parameters were found to be significant: the percentage of forest, the percentage of built-up area, the topography type and the presence of anthropogenic point features. The methodology used to create the landscape model can be extended to other types of landscapes, if a sufficient number of new respondents are interviewed with photographs from new landscapes. The landscape model parameters presented in this study are only valid for rural and semi-rural landscapes in Belgium.

A second finding is that after the installation of a wind farm the appreciation of high-quality landscapes decreases and the appreciation of low-quality landscapes increases.

This implies that the change in landscape appreciation after the installation of wind turbines can be quantified. The results of the LACSAWEP project suggest that **quantitative landscape modeling should be included in the site selection process** in order to minimize the (perceived) degradation of landscape quality.

Qualitative research methods revealed 4 different categories of arguments that may have a negative impact on the formation of social attitudes towards wind energy parks in Belgium: physical disadvantages, economic factors, symbolic factors and the type of decision making process. In depth discourse analysis in 5 case studies suggested that here is a **great need for more collaboration in the planning system** of local wind projects. Residents and other stakeholders need to be involved, by which means there can be created institutional trust, a feeling of equity and fairness, and a lower degree of dissatisfaction towards the project. Three different systems to increase the involvement of surrounding residents could be adopted:

- Offer residents **the possibility of becoming a shareholder** in the wind turbines: In the interviews, No example of shareholders who opposed the wind turbines could be found, and in this perspective, it is a good mechanism to overcome protest. Nevertheless, the system creates in some cases an in-group/out-group effect, with the risk of a group of non-participators dissatisfied who could become opponents just because of their out-group status.
- Installation of a more direct distributive system where **people who live close to the turbines get a reduction** for the energy they buy. A wind project – which is by its private character based on profit-making – creates opponents when it produces direct economic profit for the developer and only long-term ecological profit in combination with certain direct annoyances for the surrounding residents.
- **Avoidance of the negative annoyances** for the residents by collaboration and consultation between all local stakeholders, including the local residents implemented in a bottom-up planning process. The interviews show clearly that the minimal collaboration through an information gathering for residents is not enough. The information gathering in most of the cases is organized after the real planning has been made, and is therefore too late for residents to collaborate. In most of the cases, the only option residents have is to accept totally or to protest, while collaboration from the beginning of the process could create intermediary results that make both parties satisfied.