Optimalisation of the wind farm location planning with of GIS methods based on a Hungarian case study area (Csongrád county)

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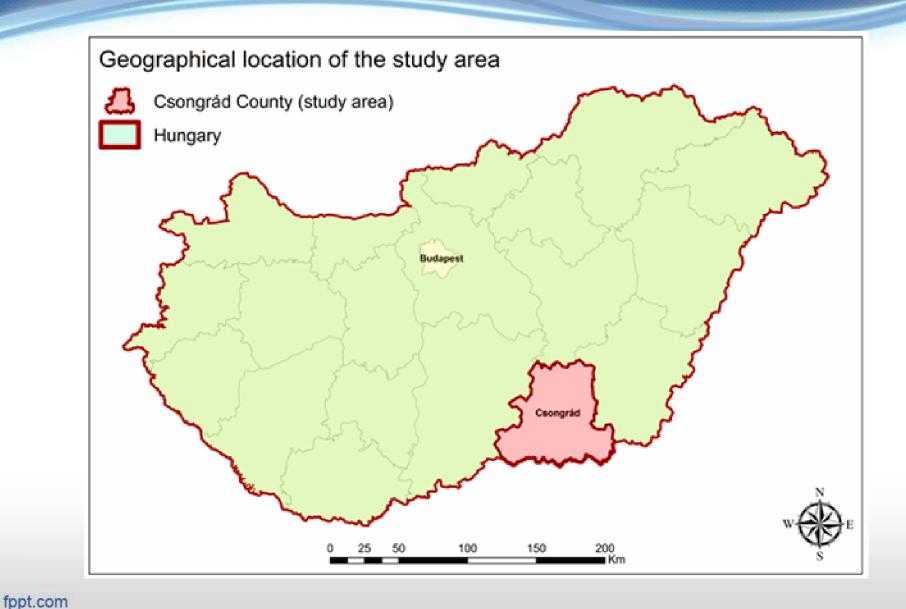




Introduction

- Growing use of the renewable energy sources
- Need for a GIS based spatial analysis of the energy potentials and limiting factors
- Our goal: a methodology which can be used for the spatial planning of wind farms

Geogrophical location of study area



Materials and Methods

The used database:

- CORINE 2006 Land Cover Map
- digital road and electricity network map
- Hungarian Digital Information
 System of Protected Areas
- Synoptic meteorological databases

GIS analysis of the limiting land use factors for wind turbine installation Protected areas

Forests and water land use units

Built-up areas

Road and energy networks

Protected areas

Protected areas

NATURA 2000

-Special Protection Areas for birds

-Special Areas of Conservation

Hungarian Environmental Authorities

800-1000 meter buffer zones

Forest and water land use units

Forests and water surfaces

Protected water surfaces

Hungarian Environmental Authorities

250, 800 and 1000 meter buffer zones

Built-up areas

Builtup areas



Residental areas

Holiday resort areas

500 – 800 m buffer zones 2 MW turbine – 105 dB

Sound calculator

500 m - 40 dB

800 m - 35 dB

Correspond to limits of Hungarian Environmental Authorities

Road and Energy networks

Road

Paved road

Road networks

Electrical

• 120 kV

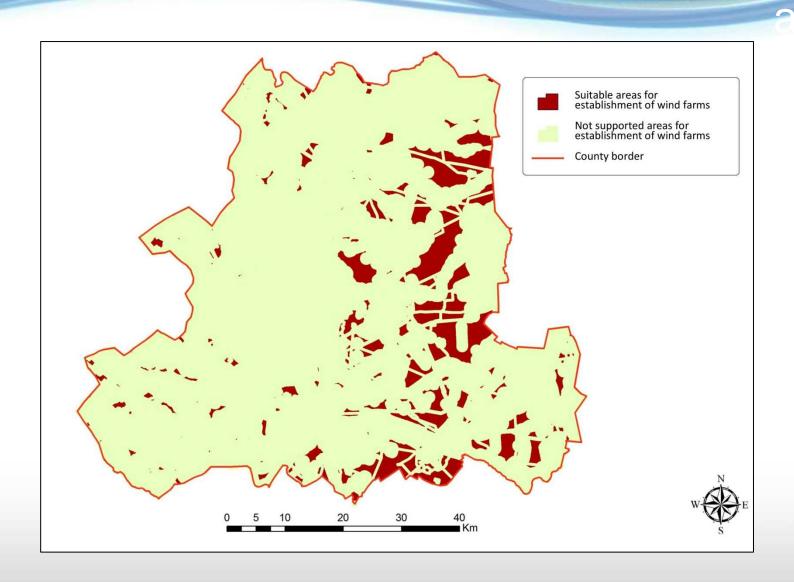
400 kV networks

Hydrocar bon

- International
- Hungarian networks

250 meter buffer zones

The limiting land use factors for wind turbine installation with buffer zones of the study



GIS analysis of supporting aspects of wind power installation

Electricity network
(120 kV and 400 kV high voltage)

Within 15 km distance

Paved road network

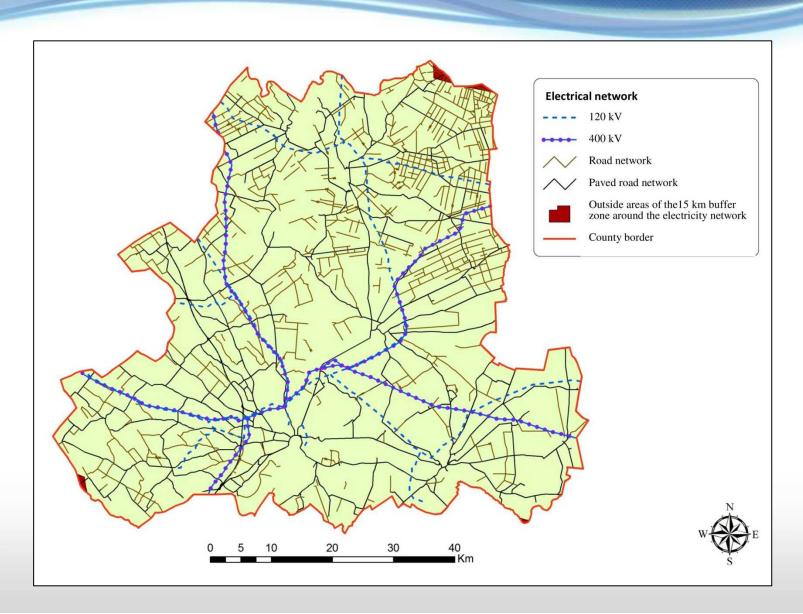
Service way

Windmill density map

Wind potential map of the study

area

Supporting aspects of wind power installation of the study area



Historical windmills as indicators of the wind energy potential

Georefered II.
Military Survey
maps



96 windmills were identified and digitalized



Every windmill with 3 km buffer zone



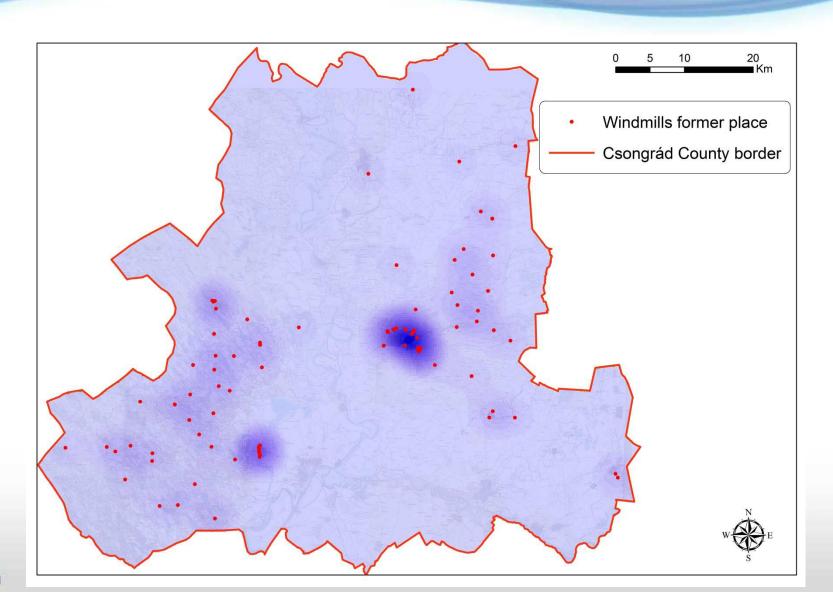


Generate density map



Counting the windmills within buffer

Windmill density map of the study area based on II. Military Survey (1870)



Wind potential map of the study area using GIS methods

Database:

- Hungarian Meteorological Service (4 stations)
- Időkép.hu (3 statinons)
- M43 motorway (4stations)
- M5 motorway (4stations)
- Ogimet.com

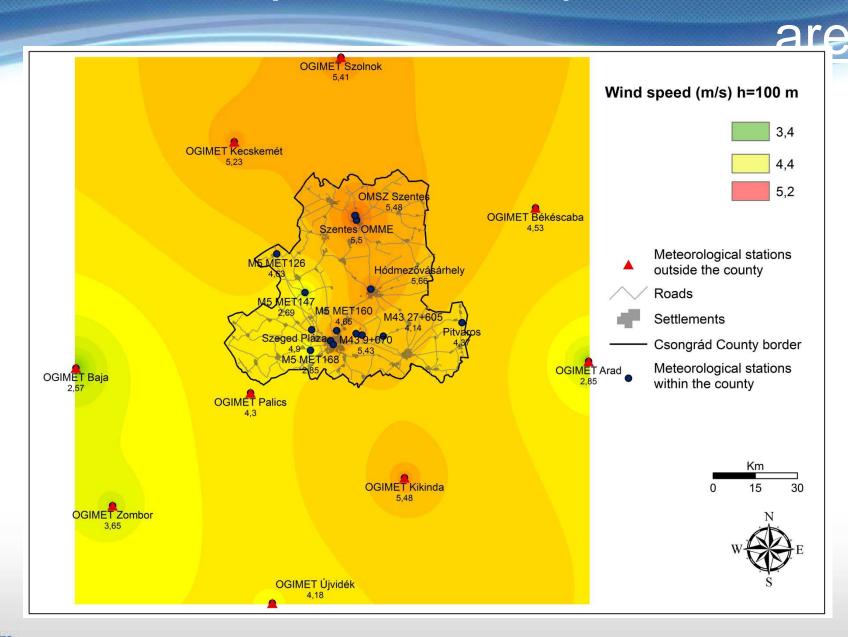
Hellman exponential function

- Hellman exponent,
- Davenport's classification $v_w(h) = v_{10} * \left(\frac{h}{h}\right)$
- Calculate data for 100 m height

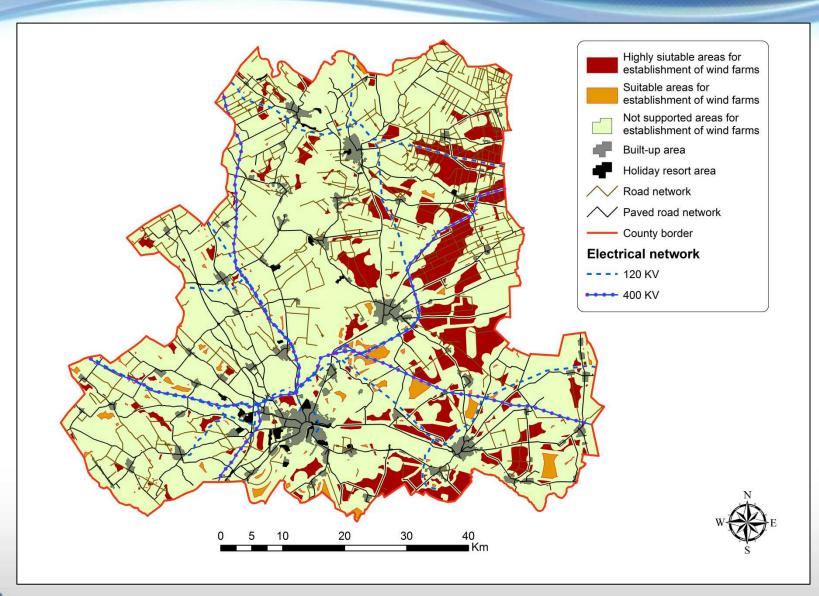
IDW interpolation

Interpolation of 100 m height data

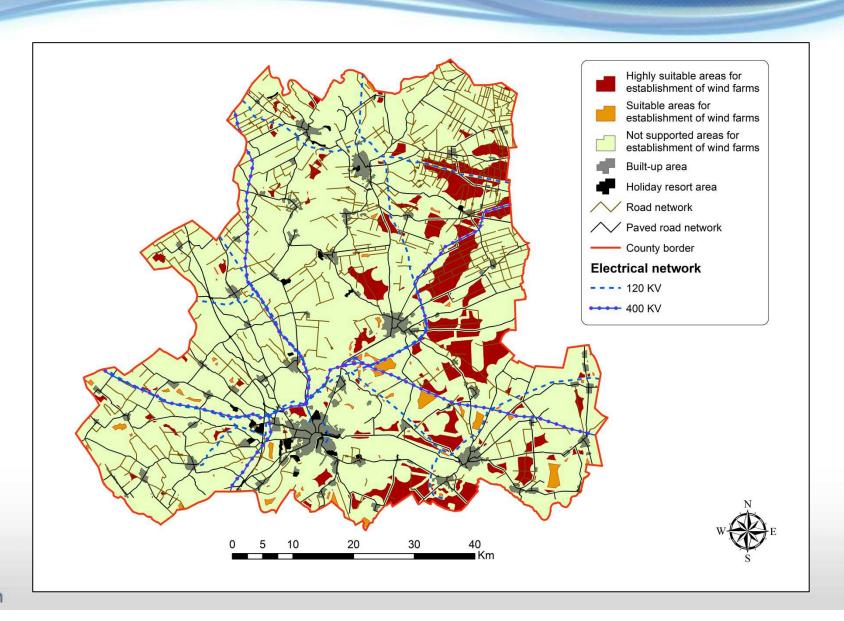
Wind potential map of the study



Suitable areas for establishment of wind farms of the study area (800 m)



Suitable areas for establishment of wind farms of the study area (1000 m)



Wind energy power potential calculations

Merging the map of the supporting and limiting factores



Fairly and highly suitable areas for wind turbine installation (9% of study area)



Prevailing wind direction 7 diameters, perpendicular 4 diameter



1744 wind turbine872 MW energy(Study area)



 $1 \text{ km}^2 = 4.4$ turbine



2 MW 90 m diameter turbines = 360 x 630 m

Results

- Windmill density map
- Wind potential map
- Delineation (2 scenarios) of the highly suitable and suitable areas for establisments of wind farms of the study area
- Wind energy power potential calculations for the suitable areas

THANK YOU VERY MUCH FOR YOUR KIND ATTENTION!