Assessment of the connection between drought and agricultural land use changes in Hungary

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MAGYARORSZÁG KORMÁNYA

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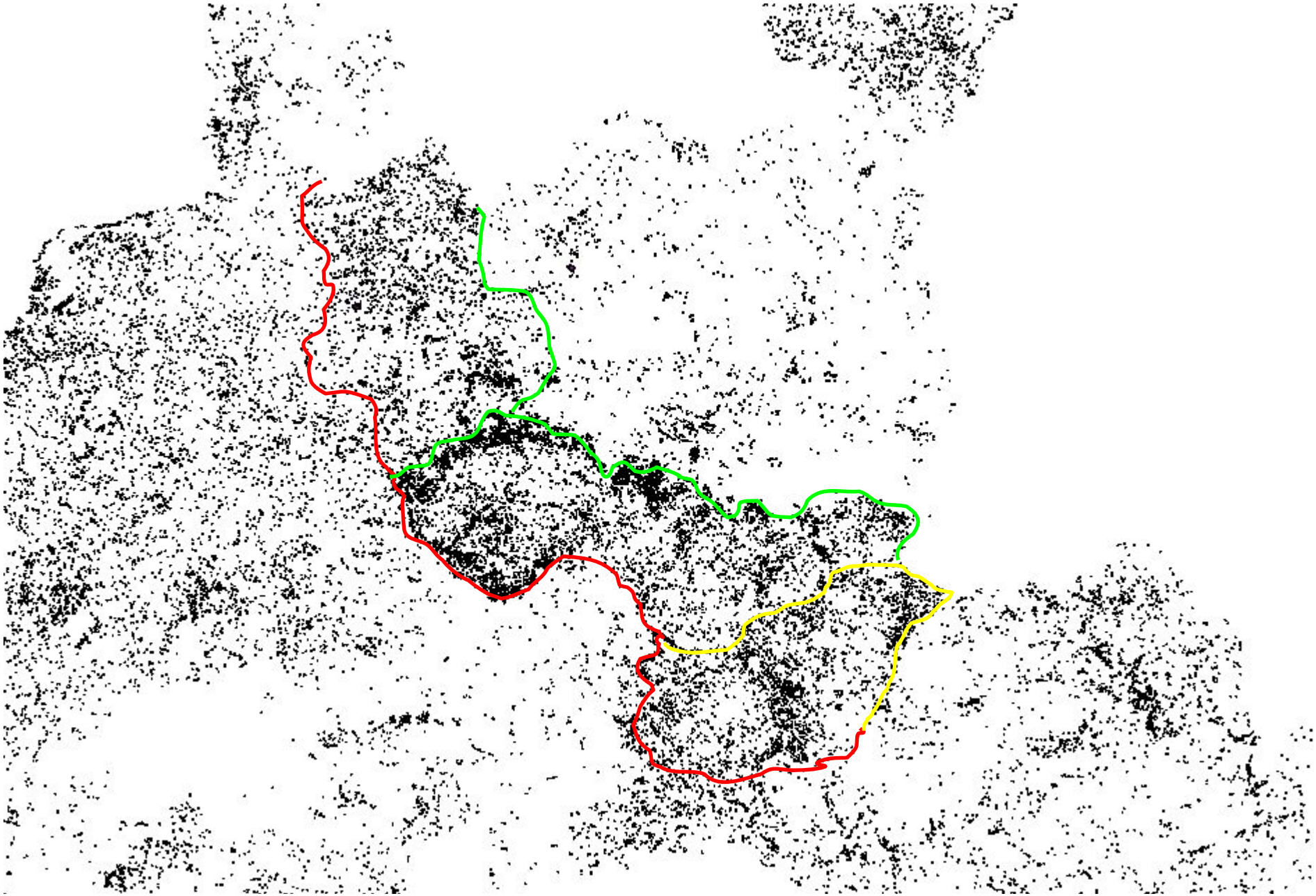
BEFEKTETÉS A JÖVŐBE

Tha main driving forces of the land use, and land cover changes:

- Global driving forces:
  - Changes of the World economy, (food prices, markets),
  - Political changes in Global scale
  - Agrarian politics of EU etc.
- Local driving forces:
  - Local economical, political Social, demographical features
  - Road network
  - Agroecological conditions (quality of soils, water availability etc.)
  - Environmental changes (water level, hydrological network, soils, **climate change** etc.)

Global driving forces: changed land cover areas in Central - Europe between 1990-2000



Structure of this presentation:

INTRODUCTION:

- The effects of droughts on Hungarian agriculture
- The land use change, and the changes of the types of cultivation, as a key factors of adaptation for drought risk.

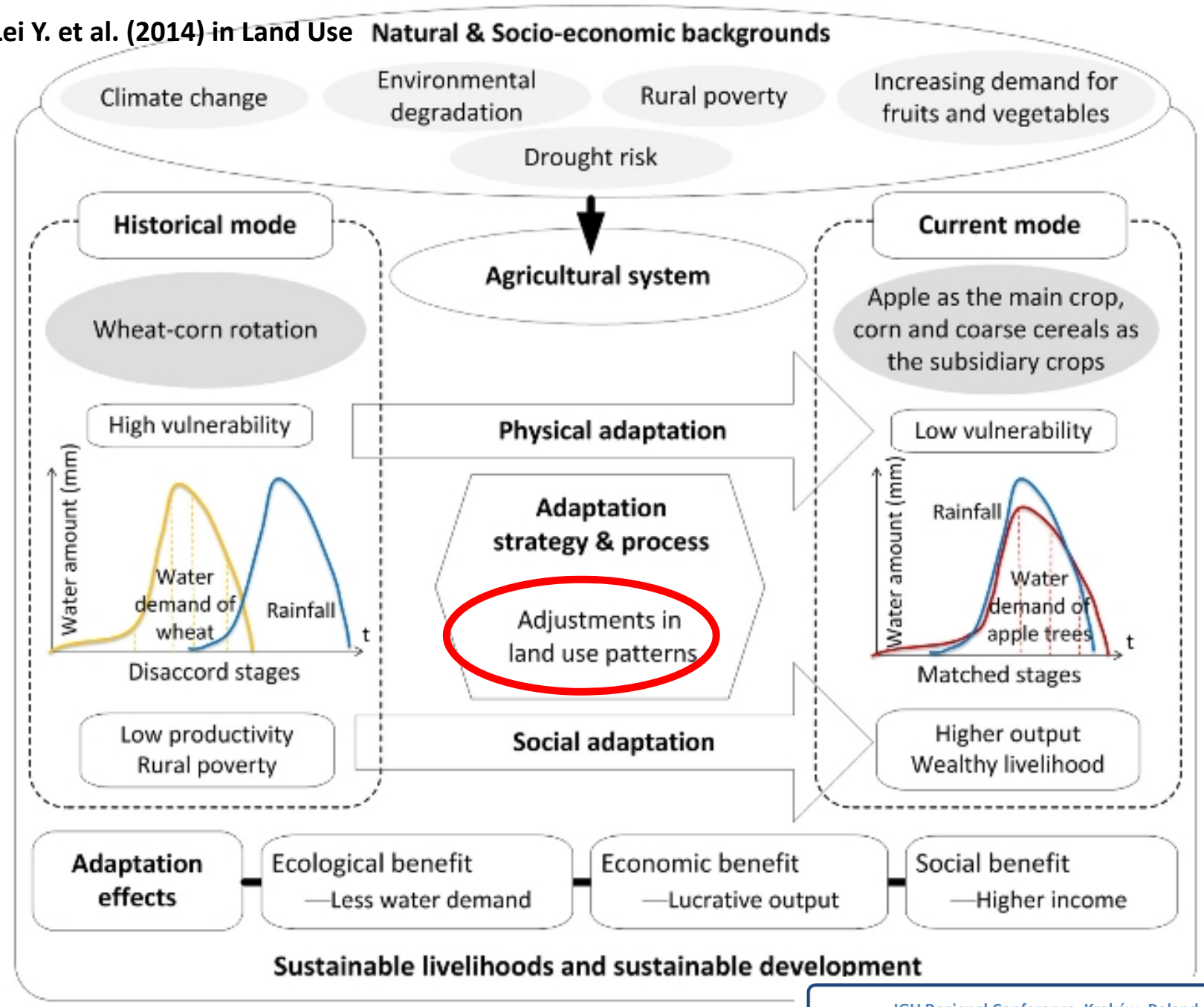
RESEARCH:

- Analyses of the connection between the recent change of agricultural lands and it’s drought related soil properties.
- Analyses of the connection between the recent change of agricultural lands and climatically conditions (Palfai Drought Index).

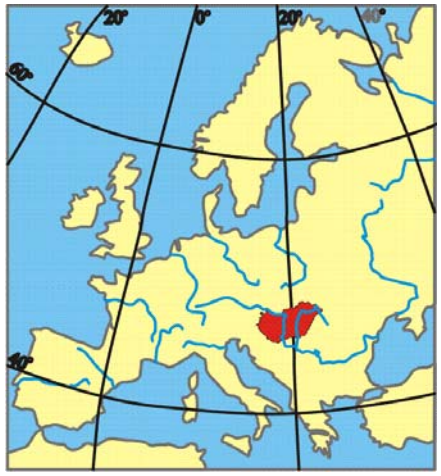
Definition of droughts

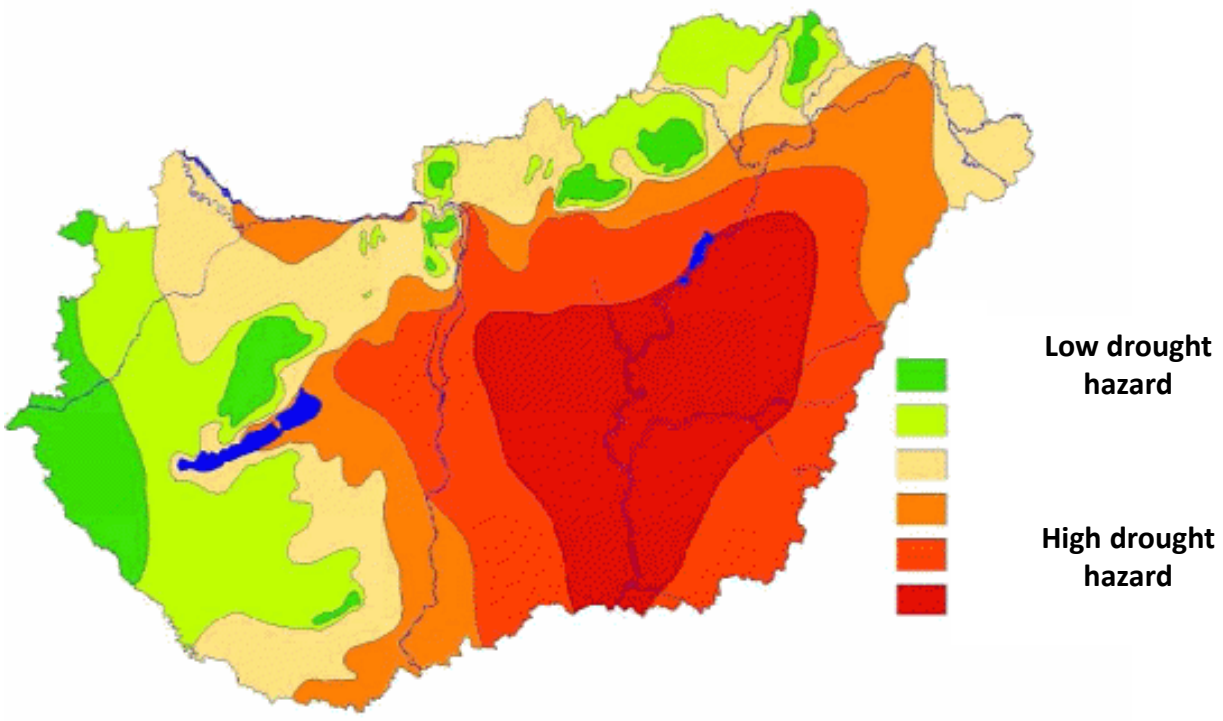
- **Agricultural drought**—This type of drought occurs when there isn't enough moisture to support average crop production on farms or average grass production on range land. Although **agricultural drought** often occurs during dry, hot periods of low precipitation, it can also occur during periods of average precipitation when soil conditions or agricultural techniques require extra water.

Based on Lei Y. et al. (2014) in Land Use Policy:



Study area





Drought severity map of Hungary (Pálfai 2002)

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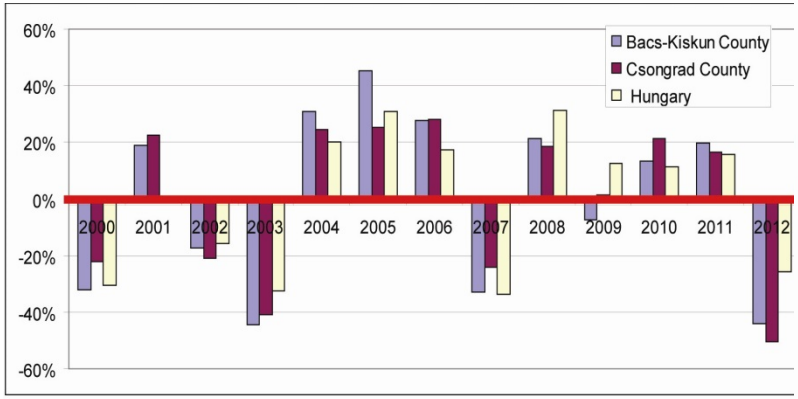
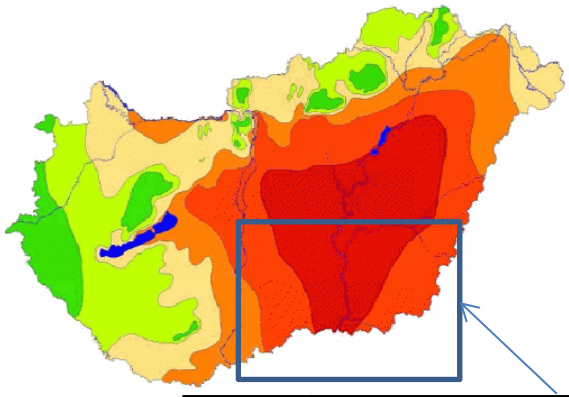
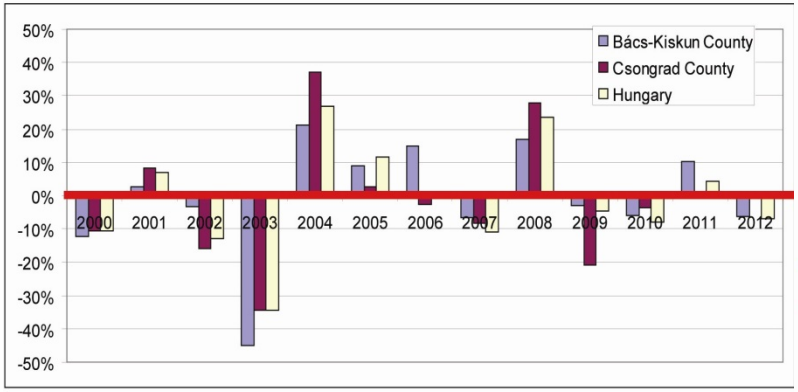


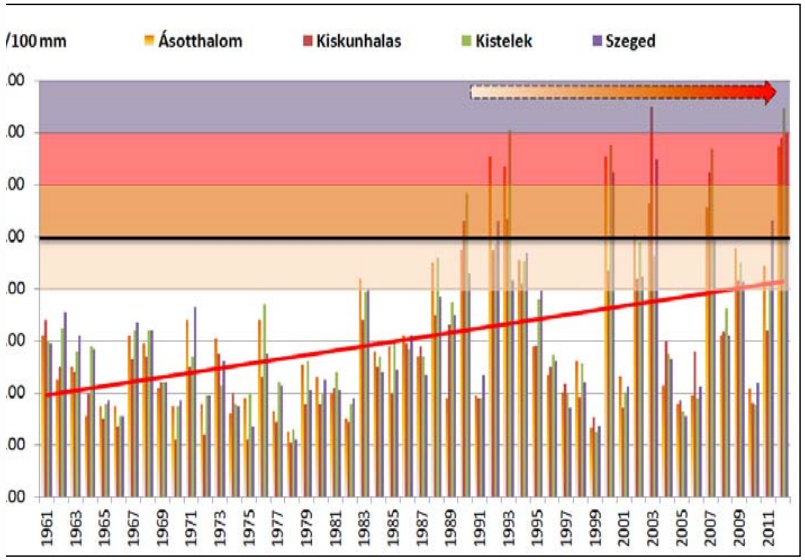
average maize production 2000-2012



Csongrad and Bacs-Kiskun Counties



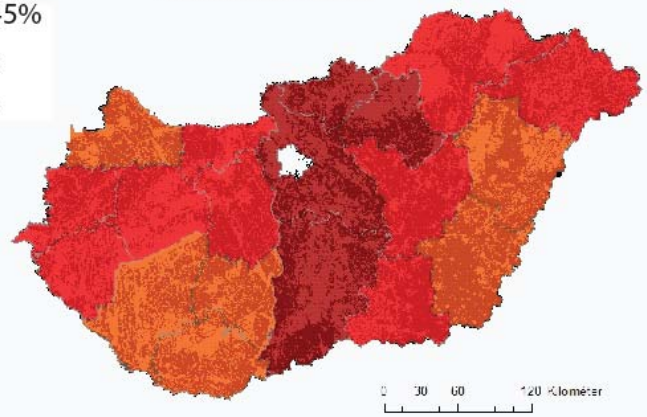
average wheat production 2000-2012



Palfai Drought Index on different stationts in Hungary (Fiala et al. 2014)

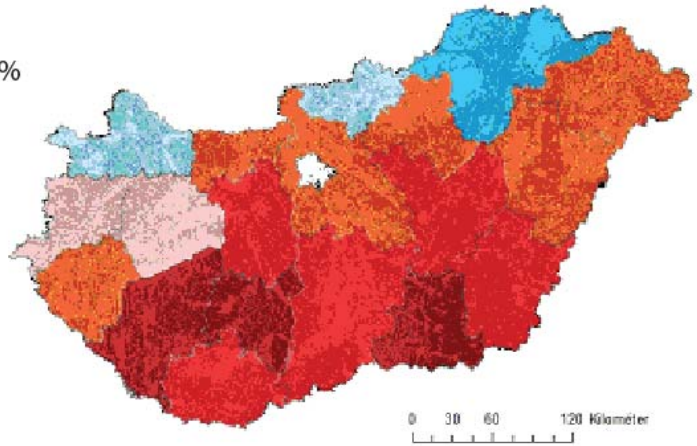
Wheat production change in 2003
from the average between
2000 and 2012

-more than - 45%
-30% to -45%
-15% to -30%



more than - 45%
-30% to -45%
-15% to -30%
0% to -15%
0% to +15%
+15 % to +30%

Maize production change in 2012
from the average between
2000 and 2012



Aims:

Generally: Analyses the **main environmental, and agroecological factors of the recent land abandonment** in Hungary:

1, To investigate the connection between the **land abandonment** and (especially the drought related) **soil properties.**

2, To investigate the connection between the **climate conditions** (Palfai Drought Index), and recent **land abandonment.**

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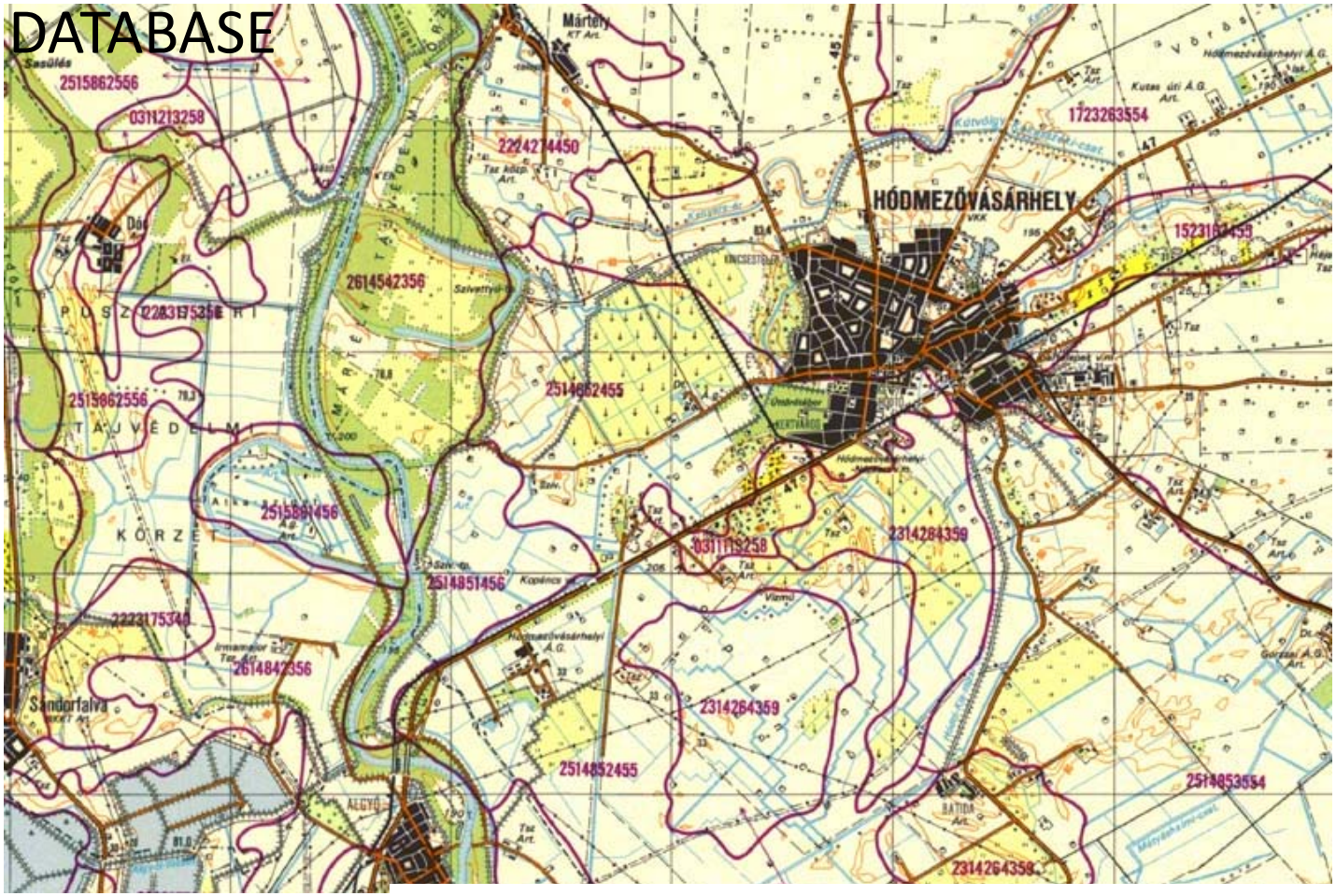
Used databases II.:

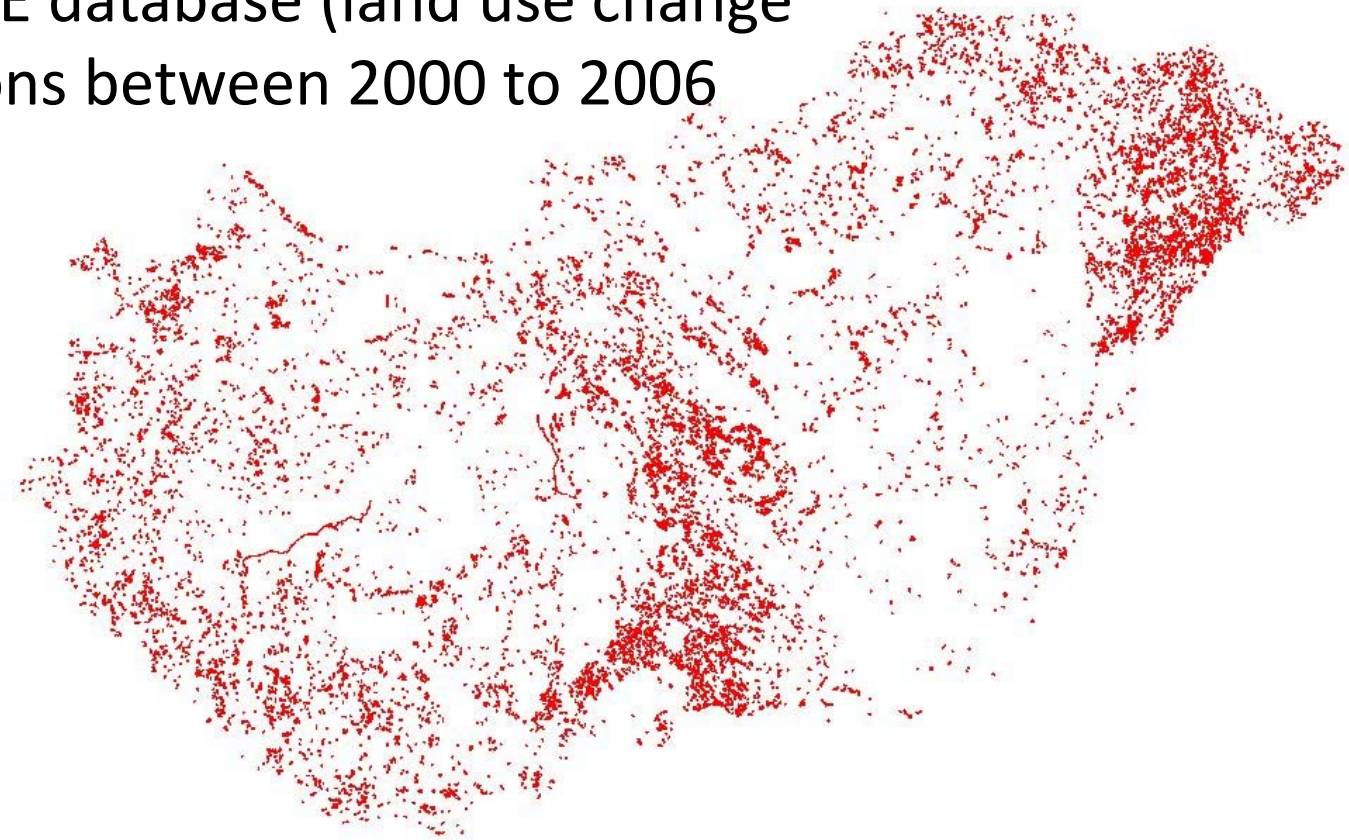
„AGROTOPO” DIGITAL SOIL DATABASE



soil properties of the AGROTOPO polygons	**Number of soil property categories (values)**	**Units of the values**
1. Soil types	31	Text description for each categories
2. Geological structure	9	Text description for each categories
3. Soil texture	**7**	Text description for each categories
4. Main clay minerals of soils	10	Text description for each categories
5. The hydrological conditions of soils	**9**	Text description for each categories
6. Chemical characteristics of soils	5	Text description for each categories
7. Organic matter content	6	t/ha
8. Thickness of productive layer of soils	5	cm
9. Soil productivity number	10	A number from 1- to 100
	Total: 92	

Used databases I.:

CORINE database (land use change polygons between 2000 to 2006



Land abandonment: land use transformation from arable lands into pasture, meadow, or forest

Method:

$$SPV_i = \left[\sum_{j=1}^{AP} \left(\frac{ALA_{(i,j)}}{TALA} - \frac{CHA_{(i,j)}}{TCHA} \right) * 100 \right]$$

Where:

SPV_i = i times Soil Properties Value (where the i=1,2,3…92)

AP= Number of the AGROTOPO soil polygons

$ALA_{(i,j)}$ = Abandoned arable land areas inside j. AGROTOPO soil polygons

TALA = Total abandoned arable lands of Hungary

$CHA_{(i,j)}$= Changed land cover surfaces inside j. AGROTOPO soil polygons

SP= Soil Polygons (AGROTOPO Polygons)

TCHA = Total Changed Land areas of Hungary

Results: Total ranking list of the soil properties classes

(Where the difference is positive between the abandoned land and the total changed land cover areas):

Difference	AGROTOPO soil properties	AGROTOPO soil category values
+8,1%	**Soiltexture:**	**sand**
+6,5%	Main clay minerals of soils	Montmorillonit, illit
+6,0%	**The hydrological conditions of soils**	**Soils with huge water permeability, middle water storage capacity, and weak water keeping capacity**
+5,2%	Soil productivity number	between: 0-10
+4,1%	Type of soils	

Results 1: **Total ranking list of the soil properties subclasses**

(Where the difference is negative between the abandoned land and the total changed land cover areas):

- 4,4%	**Type of soils**	Soils with high carbonate content on the top layer
- 4,5%	**Type of soils**	Braun forest soils with high clay content
- 5,7%	**The hydrological conditions of soils**	**Soils with middle infiltration ratio, big water storage capacity, and good water keeping capacity**
-7,6%	**Soil texture**	**Loam**

Results 2:

Connection between climate (Palfai Drought Index), and recent land abandonment:

- Based on meteorological datasets the average Palfai Drought Index were calculated for every AGROTOPO Polygons for each year between 2001 and 2006

- The statistical connection was investigated with Spearman correlation between the Palfai Drought Index. And the land abandonment between 2000 and 2006.

Results:

Spearman correlation coefficients between the percentage of the abandoned areas from the total changed areas, and the average PADI Drought Index in AGROTOPO soil Polygons (N=773) in Hungary:

N=779	2001	2002	2003	2004	2005	2006	Average PADI between 2001 and 2006
Spearman's	0.029**	0.042**	0.00	0.069**	0.041**	0.037**	0.053**
	**. Correlation is significant at the 0.01 level (2-tailed).						

Conclusions:

- The recent cultivation structure of the arable lands is very sensitive for drought (mainly the maize production).
- Reduction of the size of the maize areas, and increase of the wheat areas could be preferable.
- The soil properties have a relevant effect on recent land use transformation
- Soil texture and hydrological conditions of soils are the most important agroecological factors of the recent land use change of Hungary.
- There is an significant correlation between the recent climatically conditions and the land abandonment of Hungary.

Thank you for your kind attention!

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