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SPATIAL RELATION BETWEEN NATURAL RESOURCES AND LAND USE DYNAMICS IN THE AMAZON AGRICULTURAL FRONTIER

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René Pocard-Chapuis³

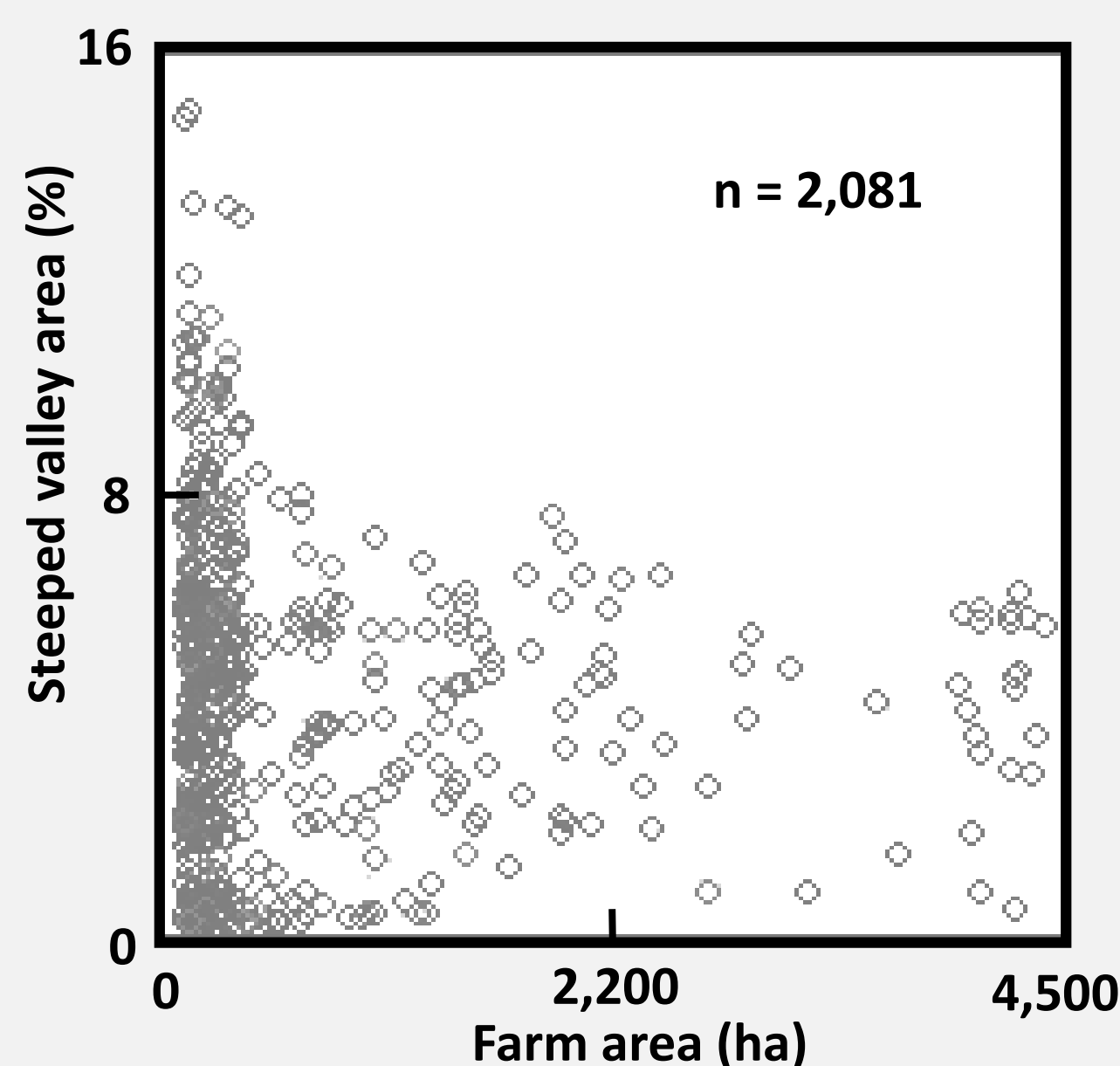
Soil properties, hydric conditions and relief are among the variables which farmers consider in decision-making process.

OBJECTIVE: UNDERSTAND THE ROLE OF NATURAL RESOURCES IN THE SPATIAL DISTRIBUTION AND TEMPORAL DYNAMICS IN CONTEXT OF LAND USE IN THE EASTERN AMAZON

1 Availability of natural resources or constraints

Depending on the farm size, the natural factors area may vary proportionately, which impacts the farm management

Data:
-Pedomorphological units [2].
-Farm borders [1].



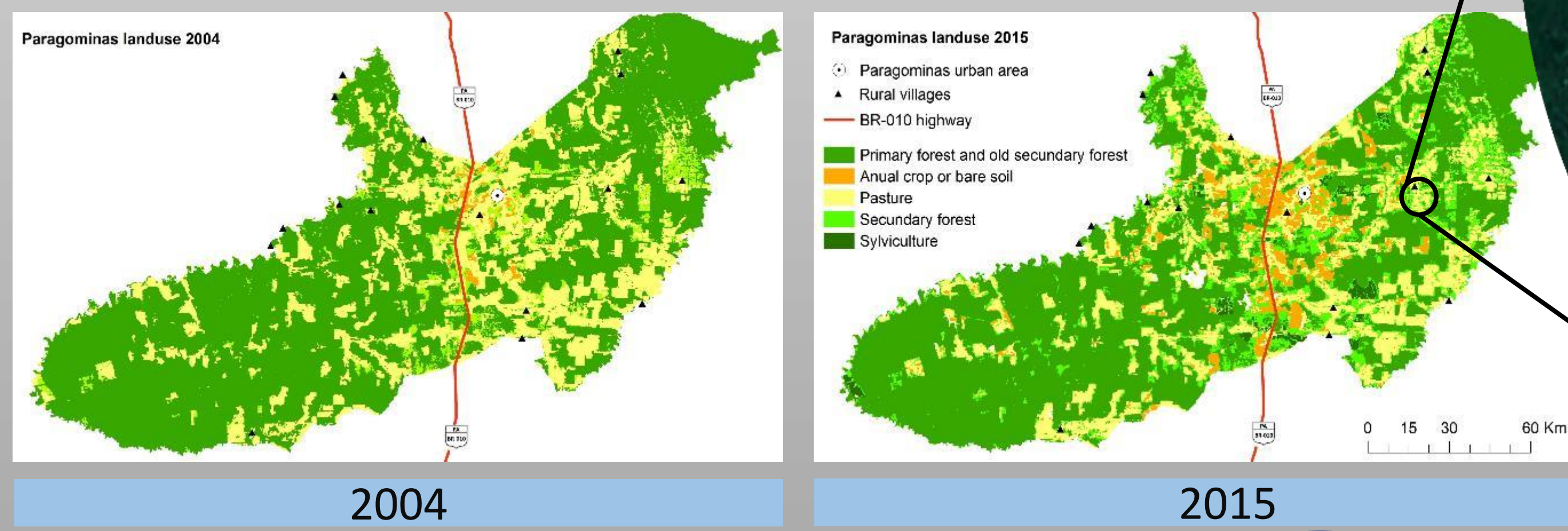
Relation between the farm size and the relative area of steeped valleys

Why? Small farms are usually located along rivers.

Consequences: the natural resources of small-sized farms differ from those of large-sized ones, which contributes to different management practices. For instance, the high proportion of steeped valleys (50-500 m wide) in small farms generates limitations such as lower proportion of mechanizable areas.



Paragominas county, Pará, Brazil
Area: 19,342 km²
Population in 2016: 108,547
Creation of the municipality: 1965
Approximately 2,200 registered properties, 84% with more than 1,000 ha
Pioneer in actions against deforestation



Soil plowing for soybean crop
Photo: Osis, R. (2016)



Slash-and-burn agriculture
Image: Landsat, 12/2015

2 Typology of dynamics of land use

Cluster analysis on farm size, land use changes and the proportion of natural resources or constraints

Definition of clusters

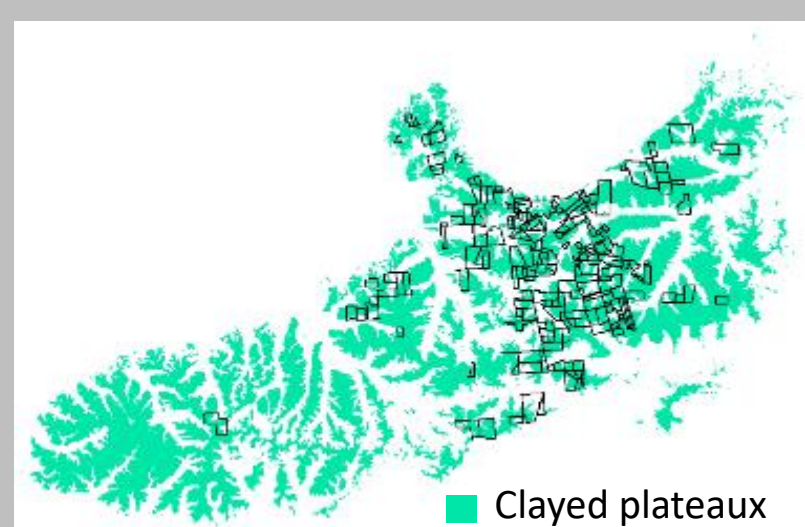
Method:
We define groups of farms with similar relative area of land use over time and natural resources/constraints. 4 clusters were defined for farms larger than 220 ha and 5 clusters for farms smaller than 220 ha (220 ha governmental threshold to define smallholders).
- Algorithm Simple EM (expectation maximisation): EM assigns a probability distribution to each instance which indicates the probability of it belonging to each of the clusters [6].

Data:
- Farm boundaries [1]
- Pedomorphological units [2]
- MODIS land use classifications between 2004 and 2015 [3]

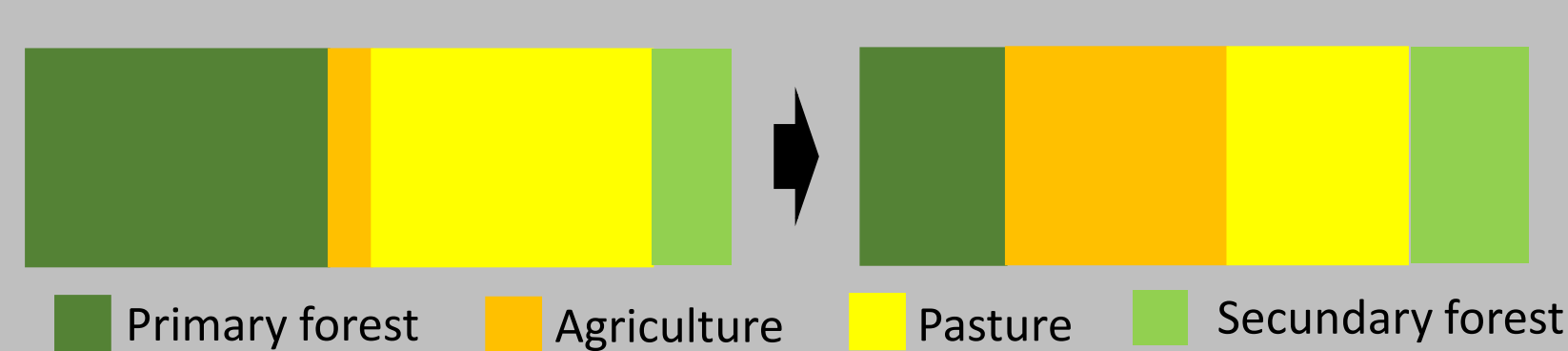
Some examples:

CLUSTER G4

-Predominance of clayed plateaux
-Farms >220 ha

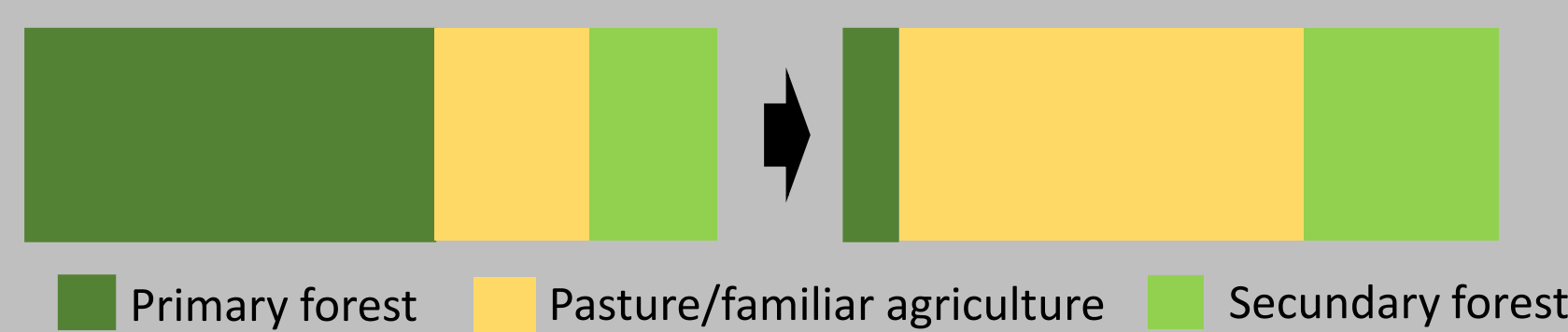
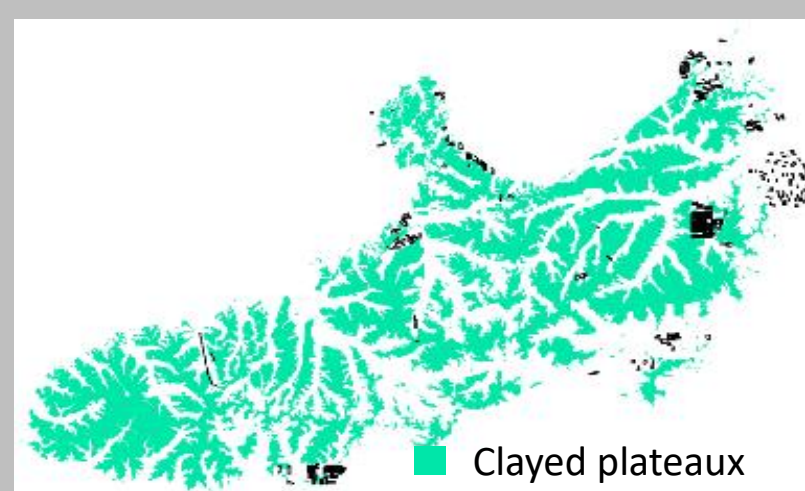


Average of relative areas of land use



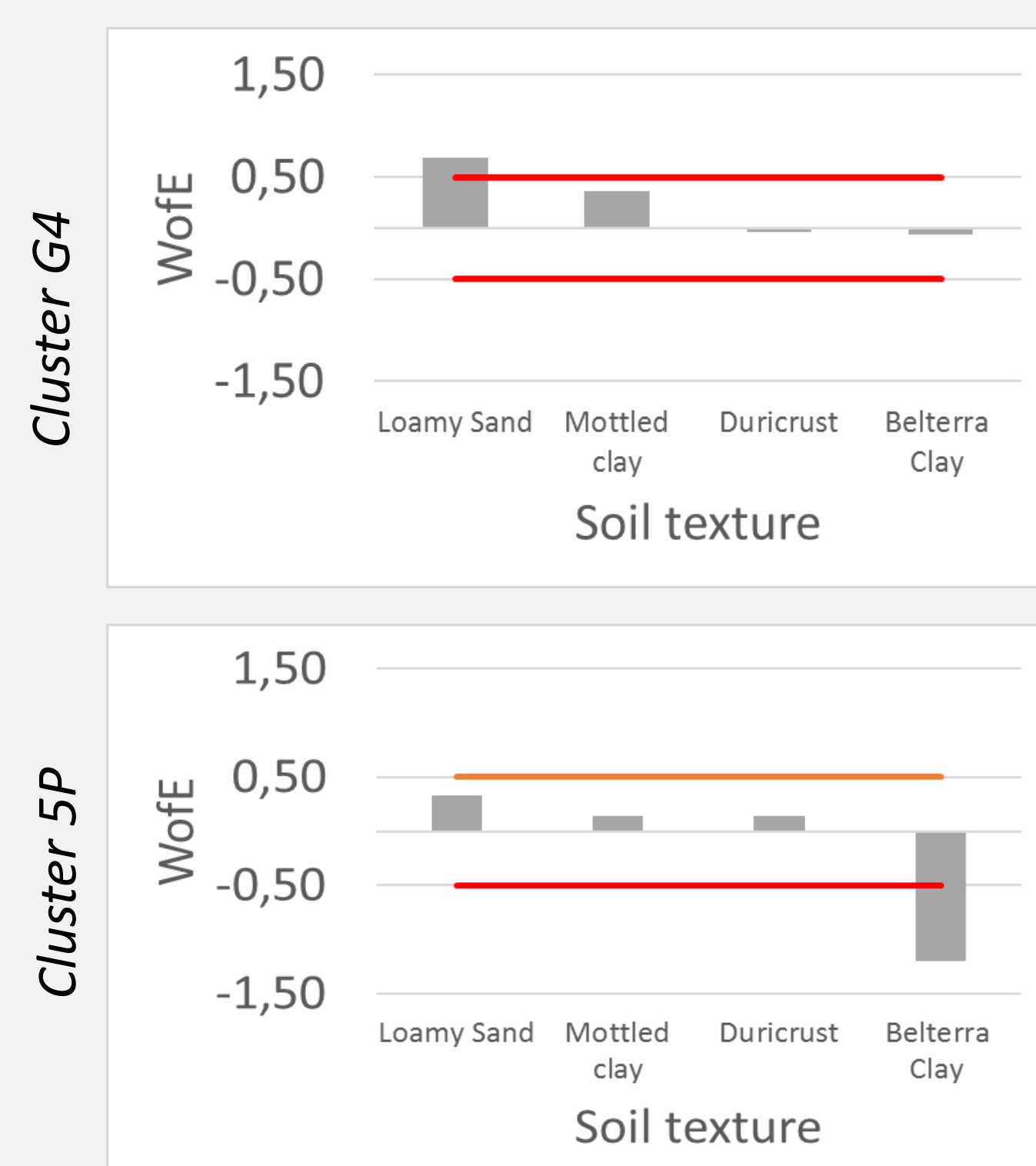
CLUSTER 5P

-Predominance of loamy sand valleys
-Farms <220 ha



Importance of the natural resources/constraints in the clusters

Method:
-Weights of Evidence (WofE) [7]: probability of occurrence of a transition from a land use to another depending on a spatial variable: processed with Dinamica EGO platform [8] Data: Soil texture [5].



Examples: WofE of the variable soil texture in the transition forest to pasture (deforestation) between 2004 and 2015

In the G4 cluster, areas with Loamy sand are preferred for deforestation.

In the P5 cluster, Loamy sand are also preferred for deforestation (but less than the cluster G4), while the Belterra clay returns to have more forest.

3 Phases

The weights of evidence vary over time, which is a reflection of the change in the logic of natural resource management

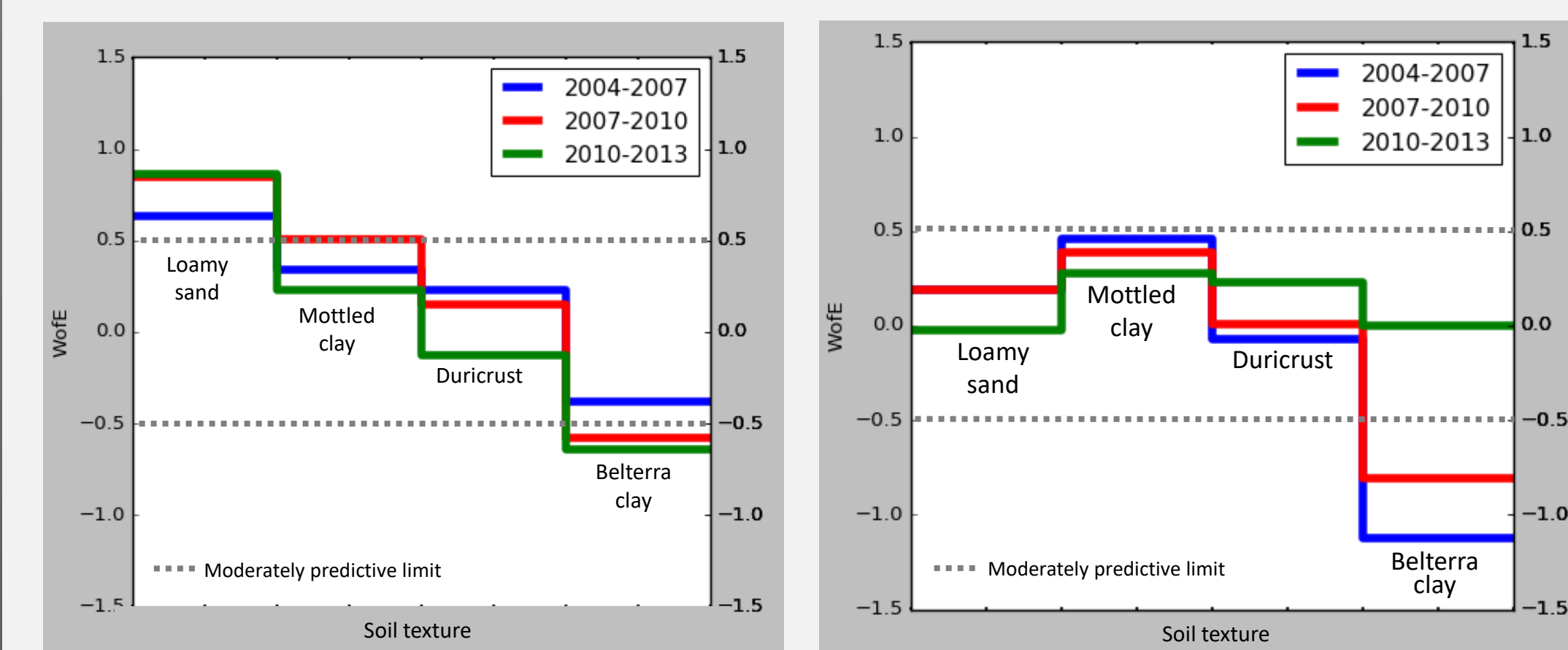
Method:
Weights of Evidence (WofE) [7].

Data:
-MODIS land use classifications between 2004 and 2013 [3].
-Farm boundaries [1].

Examples of changes in the intensity of the weights of evidence in three periods, for transition from forest to pasture

Considering the central area of the county, near the paved roads and the city, dominated by large farms with soybean crops:

Considering the eastern area dominated by smallholders:



While there was an increasing preference for deforestation to plant pasture in the loamy sand, between 2004 and 2013, the mottled clay and duricrust were less and less deforested for these purposes. In the Belterra clay, pastures were recovered by forest. In the context of the central area the soil has acquired a higher importance in decision rules.

In the smallholders area, the preference for deforestation to plant pasture in the mottled clay reduced over period. The soil texture has now lower importance in the decision rules.

4 Conclusions

- The natural resources or constraints available in the farm influence the farmer's land use decision rules.
- Groups (clusters) of farms with similar natural resources or constraints and similar land use dynamics can be identified and may reflect classes of decision rules.
- The decision rules have been changing since 2004.
- The spatialization of these groups can help in the creation of a model of land use change for the county, as a subsidy for the creation of future land-use scenarios.

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