FOOD SECURITY IN THE MEDITERRANEAN BASIN WITH AN ANALYSIS IN MACHINE LEARNING Which are the variables best representative for the crops production in Mediterranean ? : Case of WHEAT

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FOOD SECURITY IN THE MEDITERRANEAN BASIN WITH AN ANALYSIS IN MACHINE LEARNING

Which are the variables best representative for the crops production in Mediterranean ? : Case of WHEAT

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- CONTEXT

- THE DIVERCROP DATABASE

- MEDITERRANEAN BORDERS

- MACHINE LEARNING

- RESULTS

- Mediterranean agricultural systems are heterogeneous (from single-species industrial production to traditional small farms)

- Market conjunctures, national and international policies of regulation of uses or production standards (Smith, 2009; Lambin and Meyfroidt, 2011).

- Today, urban policies need to incorporate food security considerations and focus on building cities that are more resilient crises. There is a growing recognition of intra and peri urban agriculture and forestry as an important strategy for climate change adaptation and disaster-risk reduction (Lwasa, Dubbeling,2015).

CASE OF THE WHEAT

Morocco has imported **9.3%** of MENA's wheat since 2007

Algeria has imported **16.6%** of MENA's wheat since 2007

Egypt has imported **25.9%** of MENA's wheat since 2007
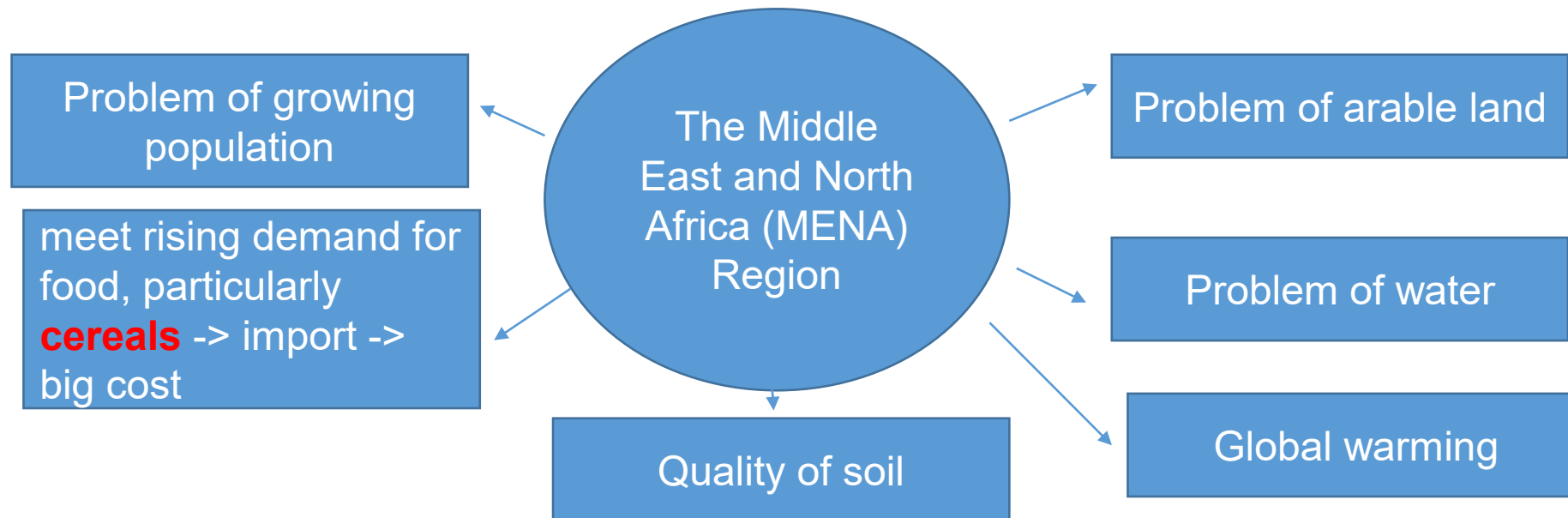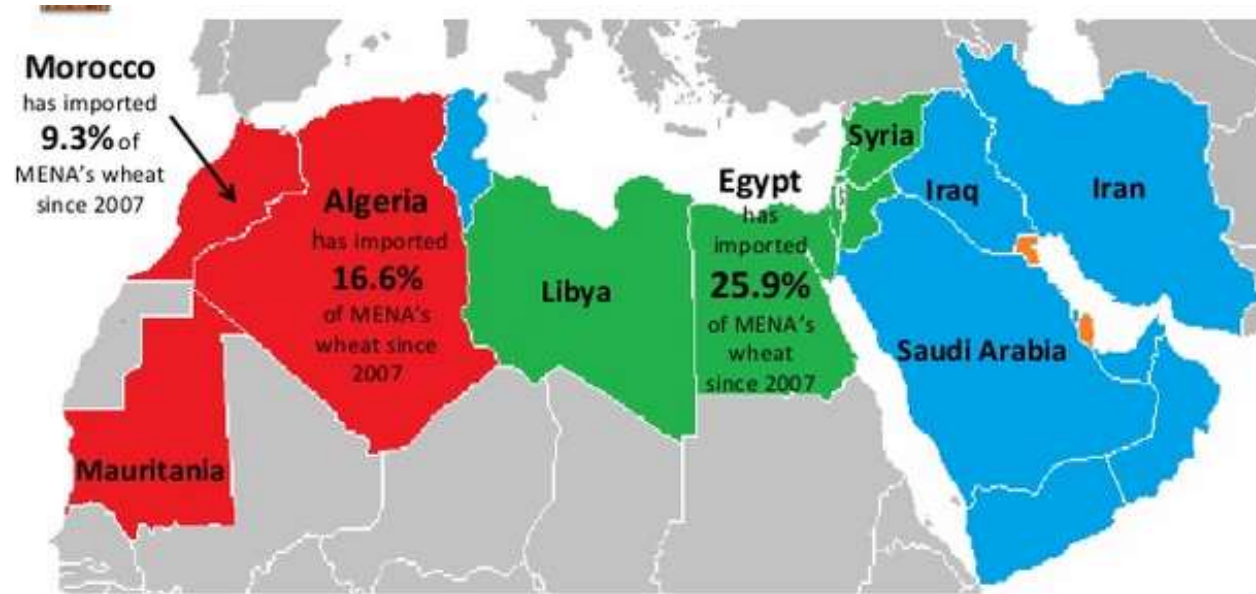
Different regions within MENA rely on different countries as their leading source of imported wheat. Depending on the country, these relationships have persisted since 2007

Russia | France | No stickiness | Australia

SOURCE: FAO, total tonnage of wheat exported

➤ France , Germany exports a lot (**C**ommon **A**gricultural **P**olicy) -> Primes -> intensive agriculture

➤ MENA : Import wheat to fill the gap

➤ Marroco (Green Plan) -> export (arboriculture, onion) → good profitability
Case of wheat , (large surface), less profitability and problem of climate , soil

➤ Algeria : **zone « ADRAR »**
The purchase price of cereals has not made it possible to amortize charges and other production …
See https://journals.openedition.org/cybergeo/25732

EXCLUSION OF SMALL SCALE-FARMING

Divercrop database

HYDE Database (2005)
(MODEL)
Number of Population
% urban population
%rural population
(text file)

And other data (temperatures , soils...)

**MAPSPAM MODEL - 42 CROPS (2005) – Raster images**
Area , production , yield , crop suitability , irrigation , rainfield
Pixels 5 min ~ 10Km resolution checked with FAO / country regional scale with (FAO/IFPRI,SAGE)

SPATIAL

DATABASE

Postgres

Peter Horsboll Moller

World Database on Protected Areas (vector)

Land Cover – CCI - ESA (Louvain) – 300 m résolution (2005) – raster images (MODEL)
natural vegetation
Tree cover
Scrubland
Urban areas
Bare areas
Water bodies

Résolution 8 – 10 km2

DTM: Global 30 Arc-Second Elevation (GTOPO30) USGS
(slope) – raster image

5

Sources : Debolini M, Napoléone C, Fusco J , Mouléry M

Limit of the mediterranean : change according to disciplines

Discipline : "Ecology" (Metzger et al)

Environmental Stratification of Europe (Metzger et al. 2005)
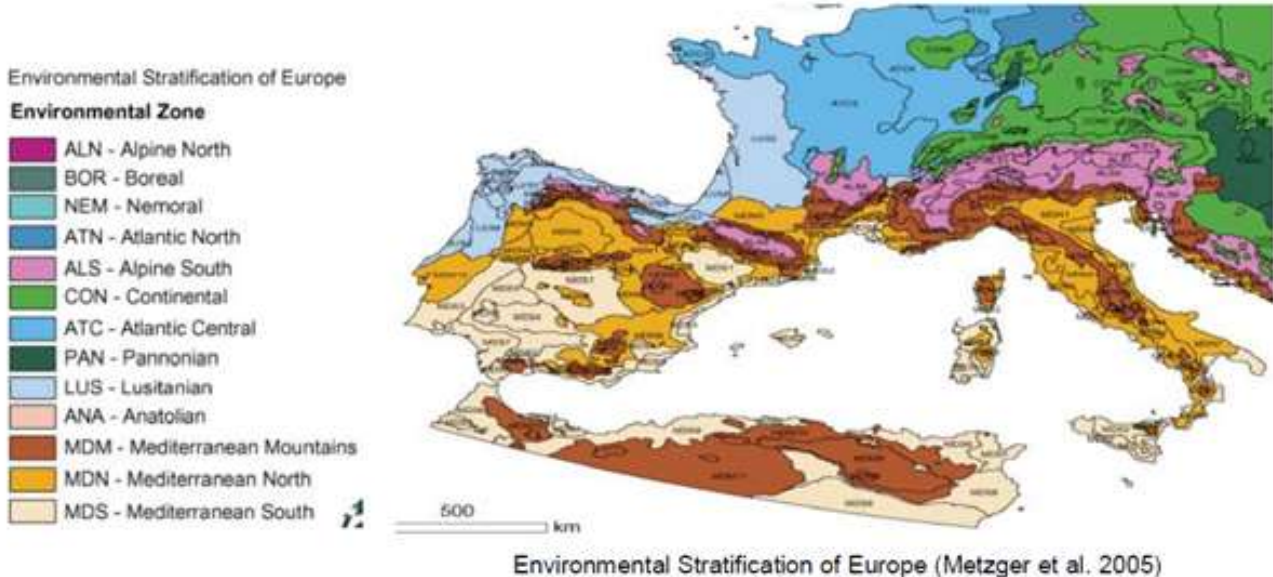
Discipline : "Geography" (Malek, Verburg)

Ž. Malek, P. Verburg

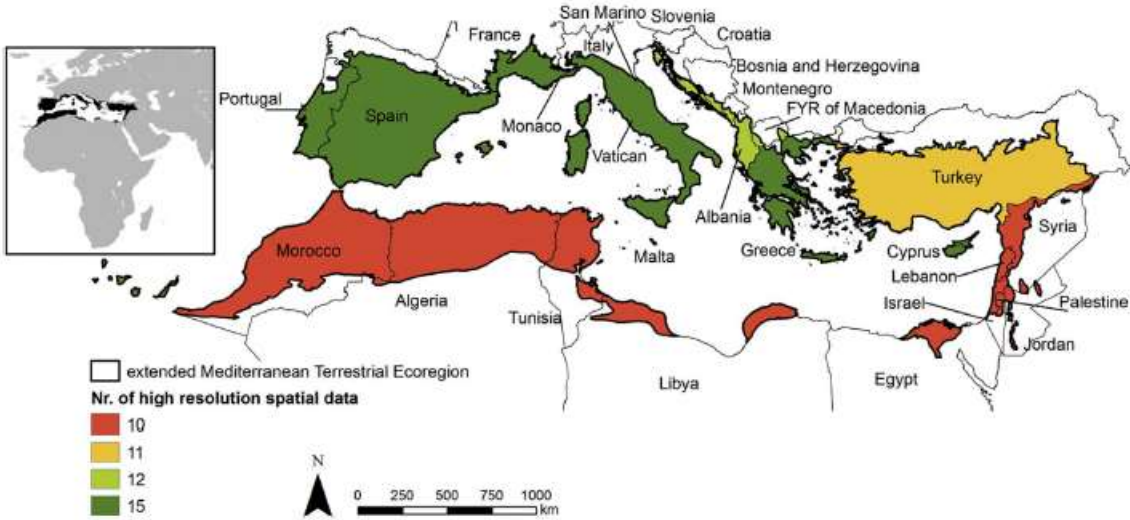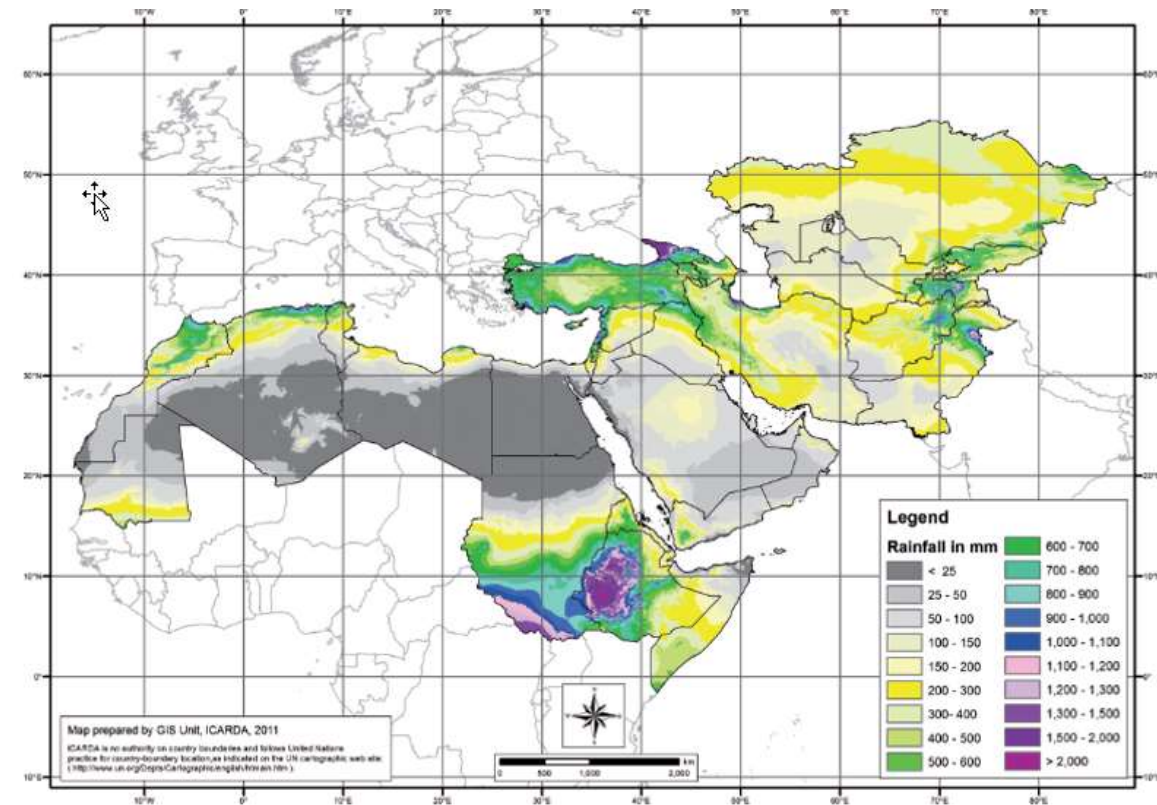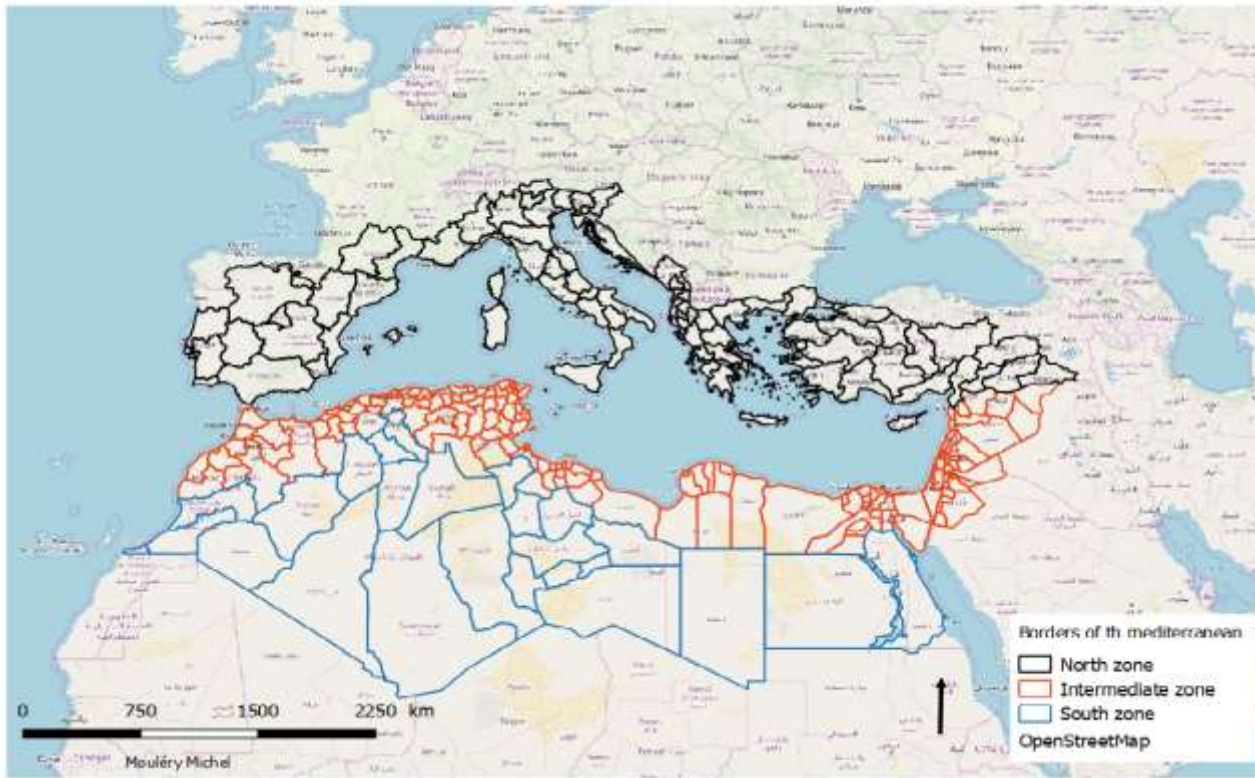Landscape and Urban Planning 165 (2017) 102–116

Fig. 1. Study area with the distribution of available high resolution (min. 1 km) spatial data layers (max. 15 data layers).
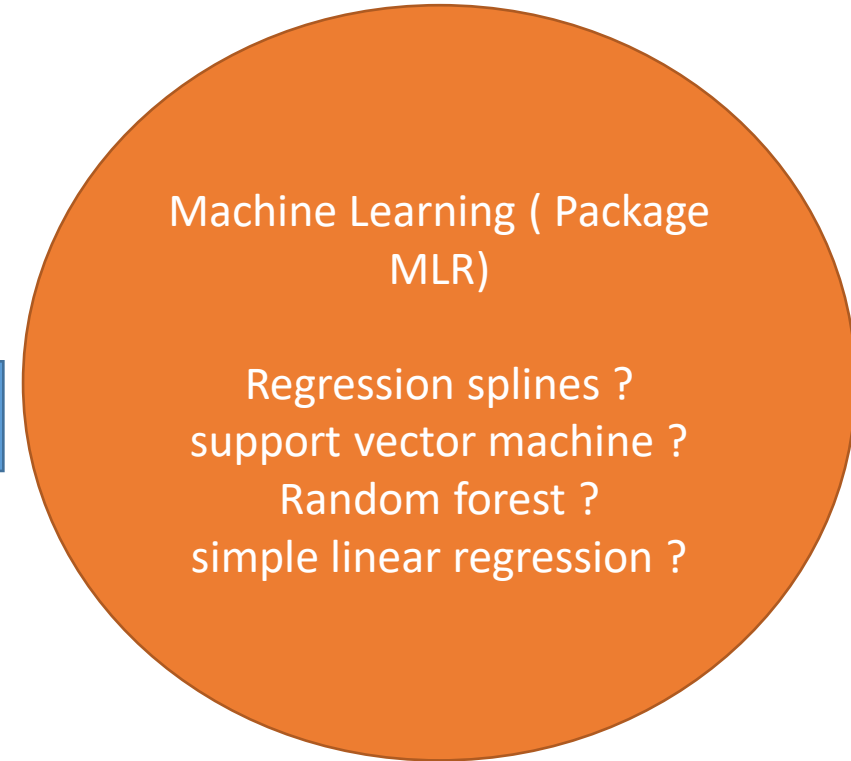
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■ Border based on the recent work of the research project « Divercrop » , by using the definition of the European environmental zones made by Metzger et al including the Southern Alpine zones located in continuity of the Mediterranean zones except the Carpathian Mountains.

■ On the South, **approximately,** we have focused on the arid zones using the map of rainfall (zones < 25 mm (Icarda,2011))

■ Intermediate zone » between North and South on the southern and eastern edge of the Mediterranean, with slightly more favourable rainfall than in desert areas

FIRST STEP : FIND THE BEST STATISTICAL MODEL FOR EACH BORDER THAT EXPLAIN WHEAT PRODUCTION

HYDE Database (2005)
(MODEL)
Number of Population
% urban population
%rural population
(text file)

And other data
(temperatures ,
soils...)

MAPSPAM MODEL - 42 CROPS (2005) – Raster images
Area , production , yield , crop suitability , irrigation , rainfield
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SPATIAL
DATABASE
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Résolution 8 – 10 km2

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DTM: Global 30 Arc-Second Elevation (GTOPO30) USGS
(slope) – raster image

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Bare areas
Water bodies

Machine Learning (Package MLR)

Regression splines ?
support vector machine ?
Random forest ?
simple linear regression ?

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Find the best model that explain the wheat production with package MLR (Machine Learning)
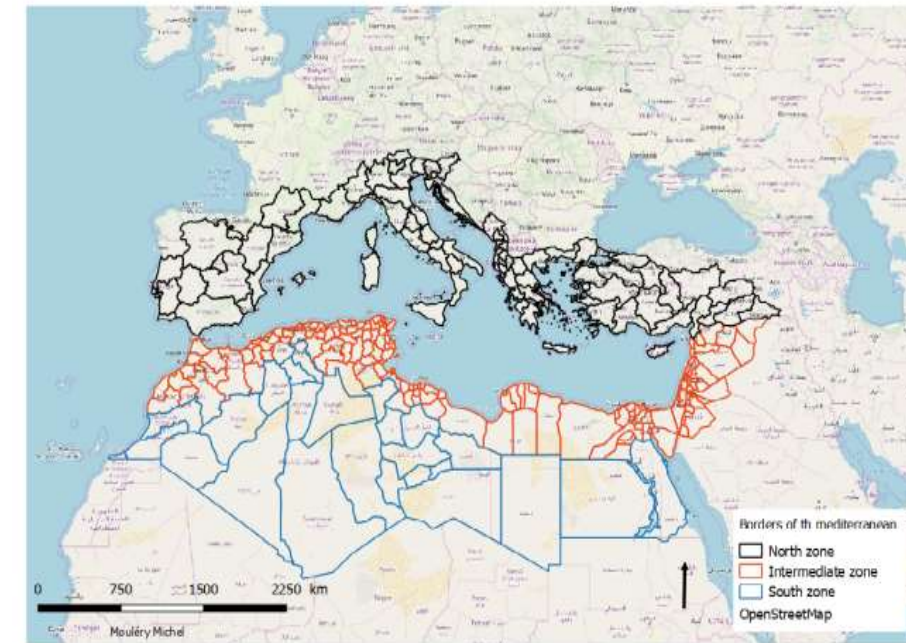
Database Divercrop

North Europ

North Africa

Desert

The function benchmark (Package MLR) determinate the best model (variable bmr)

Grid = (North Border or North Africa or Desert)

task_train_subset <- makeRegrTask(id = "best model", data = grid, target = "p_ta_whea") rdesc=makeResampleDesc("CV", iters = 5 , stratify = FALSE) lrns2=list(makeLearner("regr.earth"),makeLearner("regr.ksvm"),makeLearner("regr.randomForest"),makeLearner("regr.lm")) bmr = benchmark(lrns2, task_train_subset, rdesc,show.info = FALSE)

BEST MODEL (MSE)
1- Random Forest
2- Linear Regression
3 - Regression by splines
4 – SVM

BEST MODEL
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BEST MODEL
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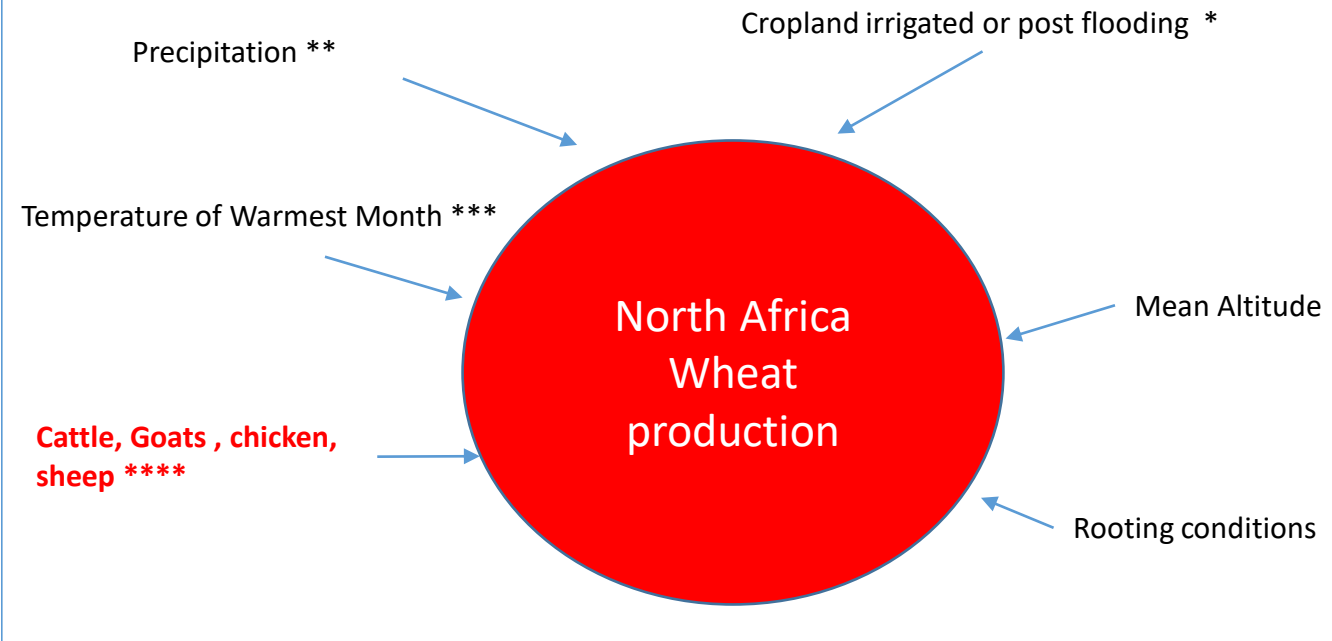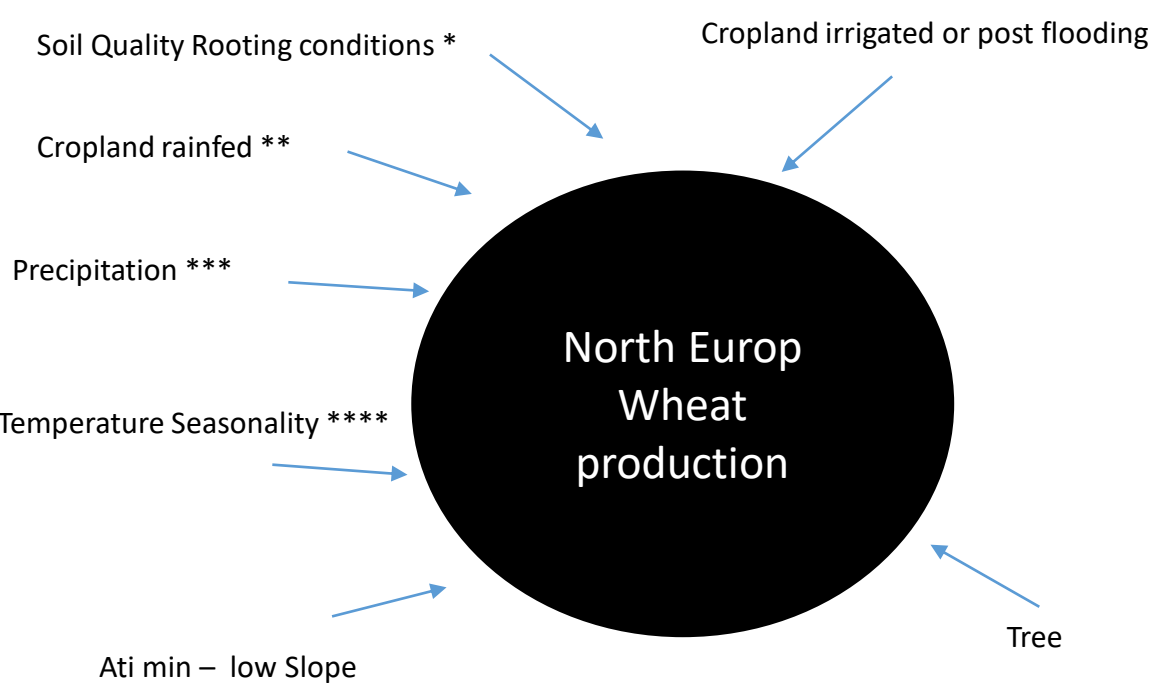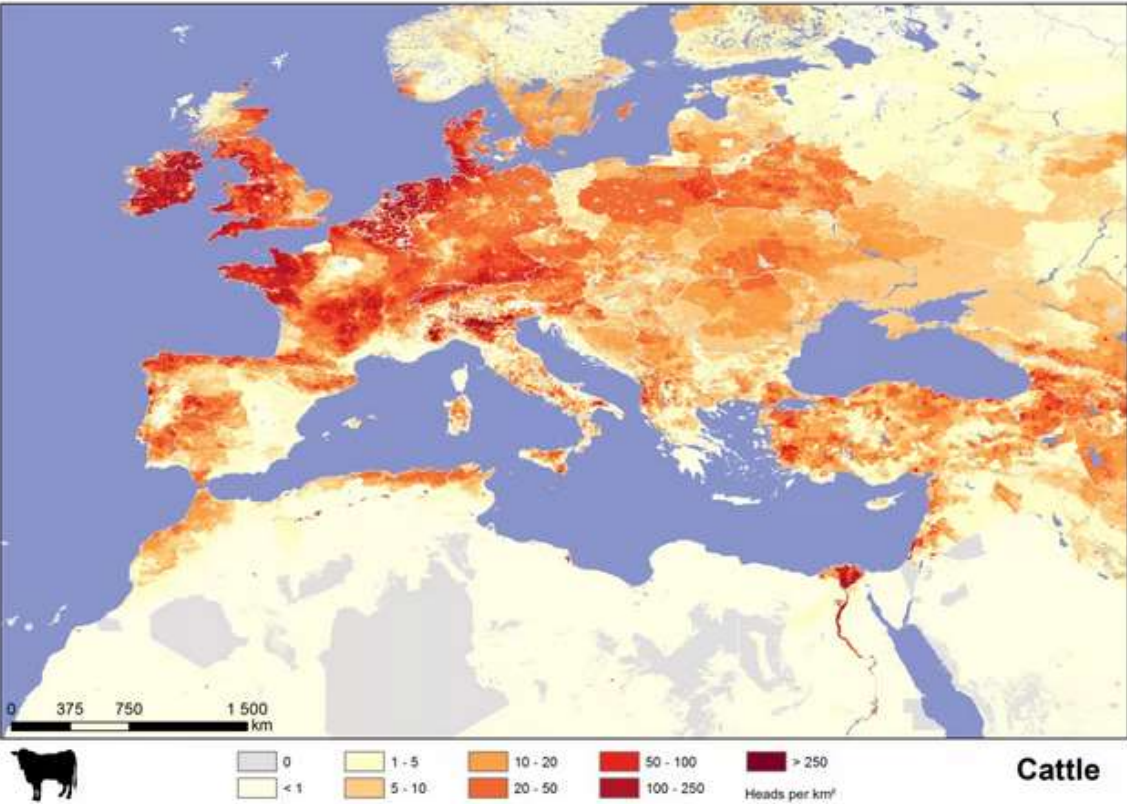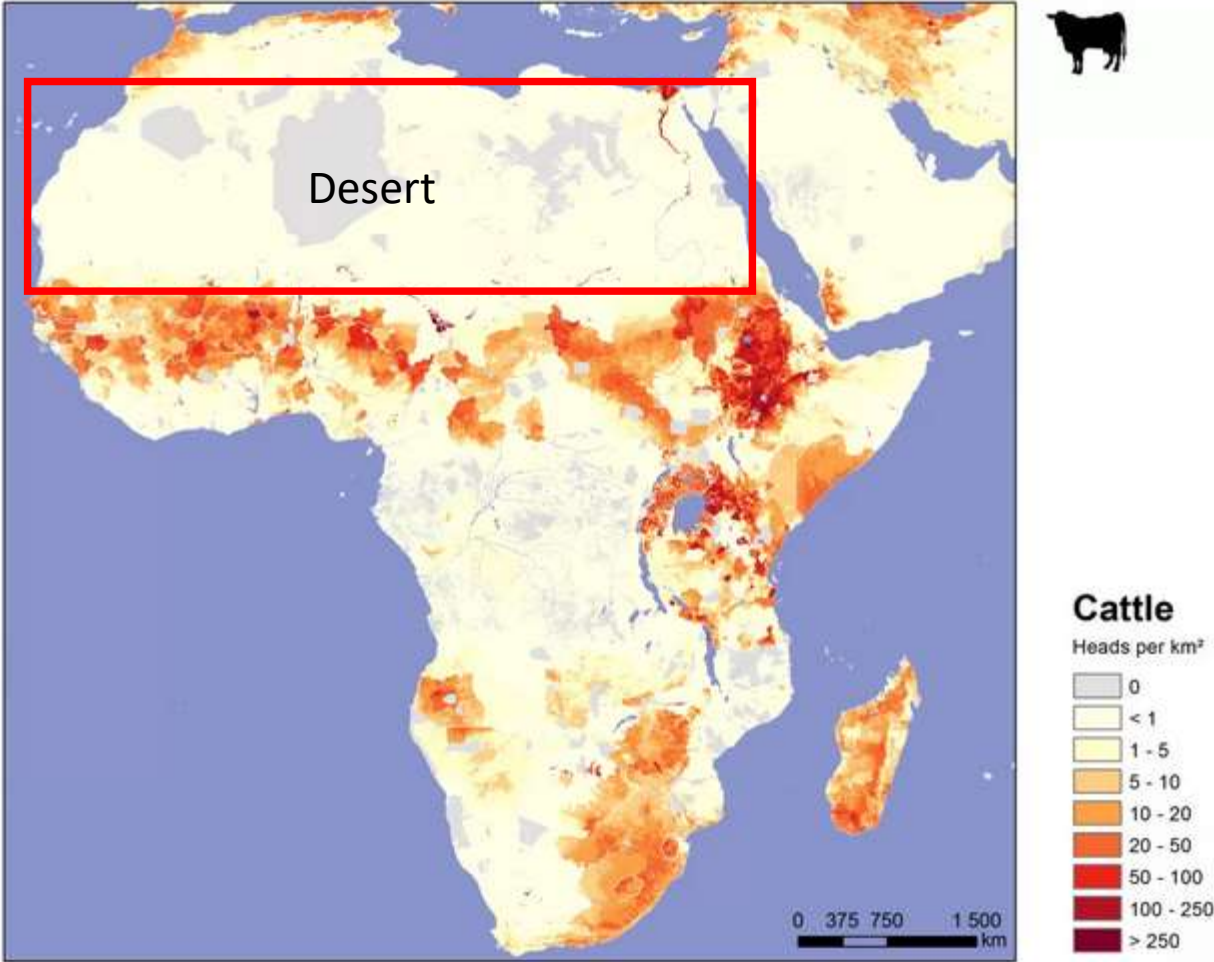3 – Linear Regression
4 - SVM

SECOND STEP (BEST VARIABLES FOR EACH BORDER / WHEAT PRODUCTION WITH RANDOM FOREST - Relationships)

Cattle farms in Europ and North Africa

Cattle farms in Africa

Desert

Cattle
Heads per km²

https://www.consoglobe.com/betail-du-monde-en-coup-doeil-cg

Density of Population *

Goats, chicken, poultry ***

Desert Wheat production

Cropland irrigated or post flooding

Alti min **

Precipitation ****

Small-scale « family » farming , autonomous close to the city and the local market

Wheat feed livestock (no pesticide -> cost)

Organic agriculture
Access to the Market

Own consumption, no waste

Wheat = security = medium of exchange (Market) , -> store case of starvation

-> Irrigation .

Photos of ABDELMAJID SAIDI
And https://www.sudmaroc-hotel-terrassedesdelices.com/irrigation-patrimoine-oasien

Figure 32 : jnâan sur le territoire de la Saïdia (photographié le 04-10-07). Deux strates de cultures : palmiers dattiers et cultures basses.

Palmier dattier

Maïs

Semis de blé

Luzerne

Chou fourrager repiqué sur les diguettes

Figure 22 : ayant droit d'une khettara de Monkara préparant le passage de l'eau en ouvrant les barrages en terre d'un canal tertiaire (photographié le 22-05-07)

Photo of Spoerry Sylvie

This has been exploratory work

Population is a good incentive in the Sahara (wheat may be a production close to the city) contrary to the north (Africa and Europ) , where there is no effect (production areas and cities are not in the same location)

➢ Statistical function can be improved and other models can be notified (choice of model !) and parameters in the function of machine learning

➢ Large resolution 8 – 10 km2 but mediterranean area

➢ Spatially detect the wheat production with the Help of GIS

➢ But result validated by expert on Sahara by abdelmajid saidi (PHD in food security in Sahara)

➢ **Think another model on wheat crops (more small surfaces, less pesticides -> biodiversity) in europ (covid , war ..) -> food security -> make cities or regions or countries more autonomous (less import when possible?).**

THANK YOU

https://www.grain.org/article/entries/93-seized-the-2008-landgrab-for-food-and-financial-security