INITIAL RESULTS REGARDING THE IDENTIFICATION OF CLIMATE CHANGE IMPACTS IN **AGRICULTURE AND FORESTRY**

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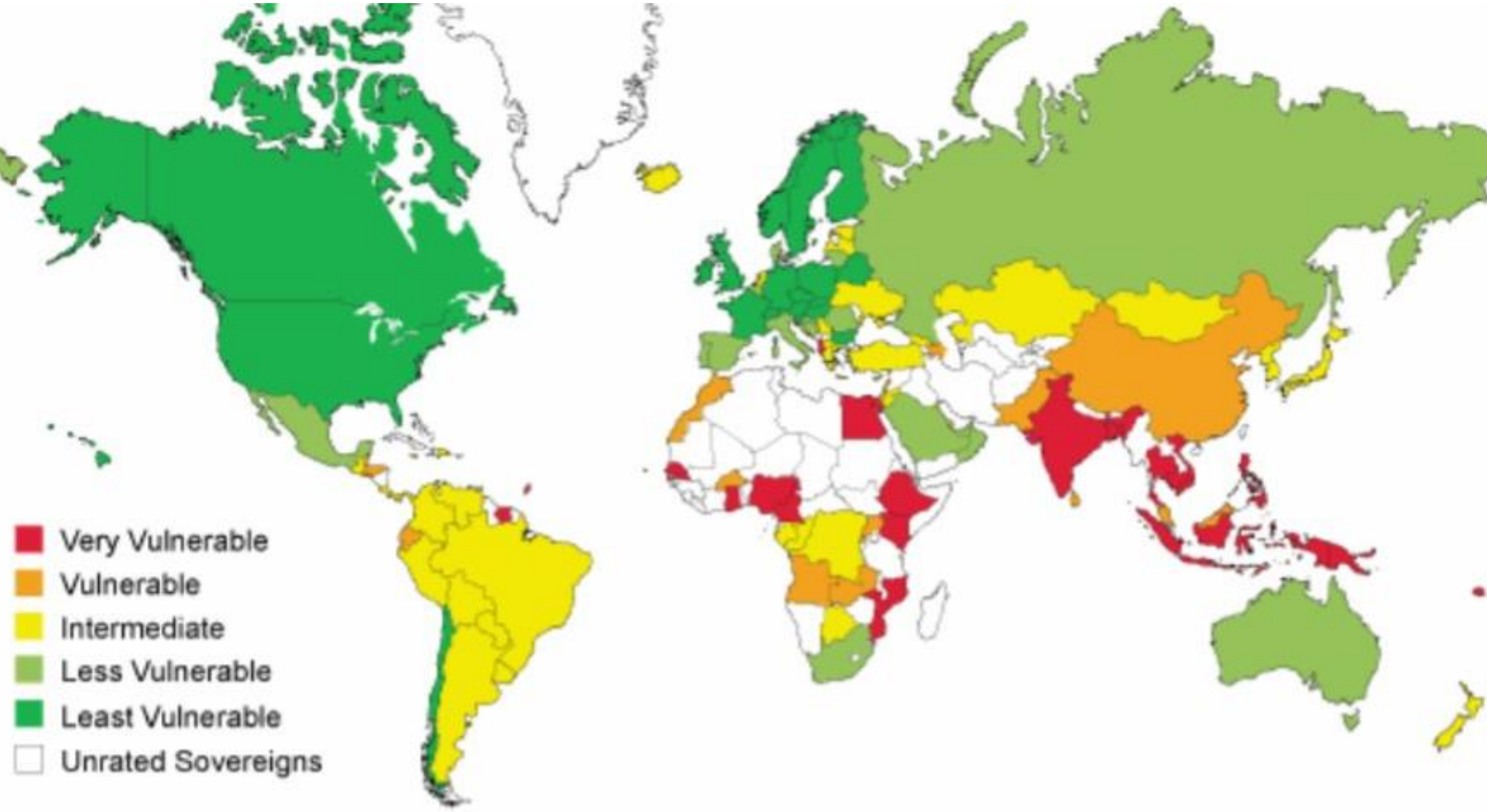
Scope of the study

- Forestry:
  - Economically significant tree spaces (pine; spruce, breach, where possible – black alder, aspen)
  - Agriculture:
    - Grain: barley, wheat
    - Rape, protein crops
    - Forage crops: forage corn, other forage crops
    - Vegetables and potatoes
    - Fruit (apple) and berries
    - Plants

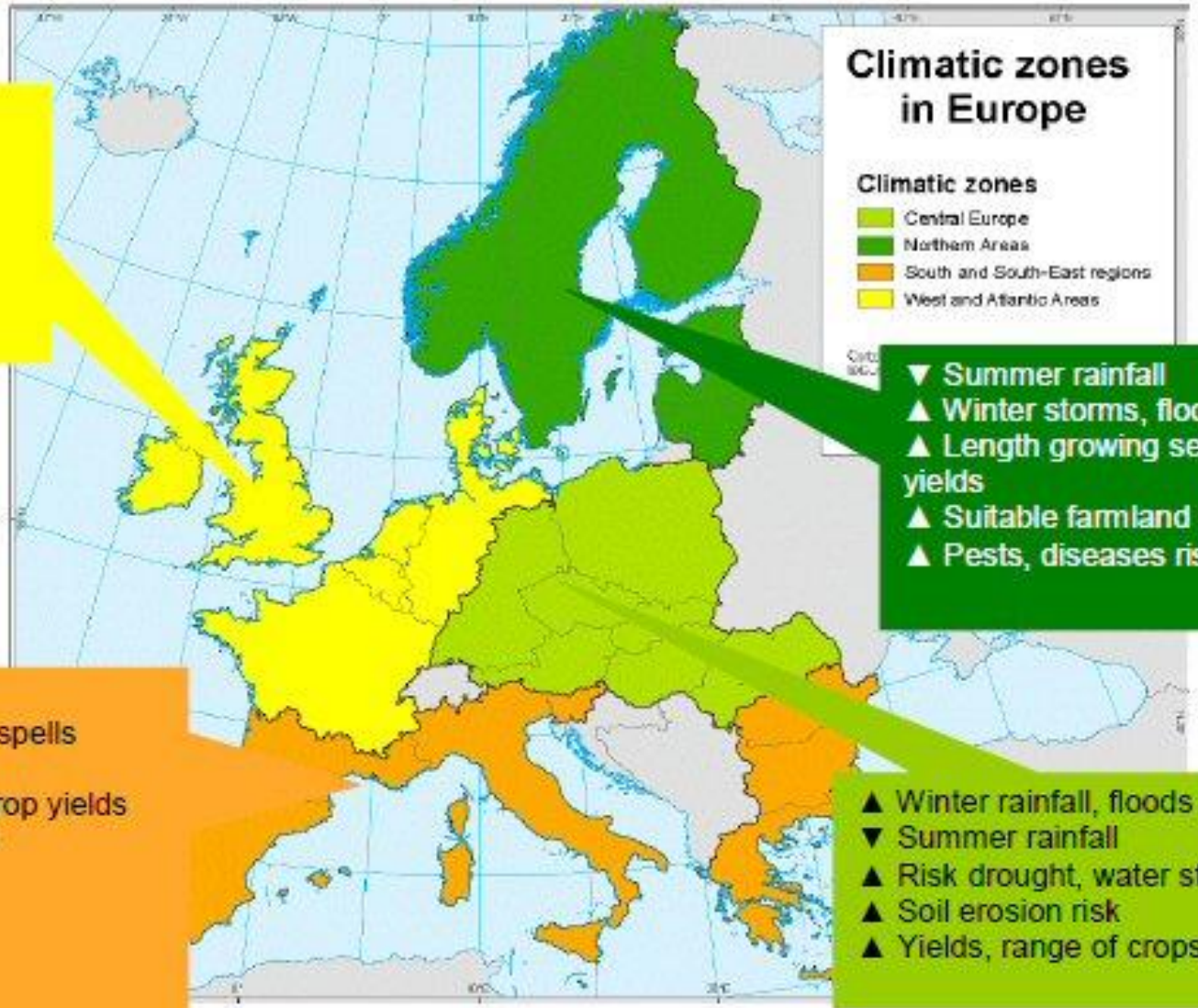
The study will also include risks affecting animal production sectors, for example, the negative effects of black-flies and animal despises. Jet, considering, that productive animals are kept in controlled circumstances, they are less exposed to climate change risks as crops.

Climate change impacts to agriculture and forestry are both negative (risks) and positive, and it is important to estimate both – potential gains and potential losses.

Potential vulnerability in the aspect of climate change



Climate change – Possible impacts on EU agriculture



▲Floods risk
▲ Hotter and drier summers
▲ Sea levels

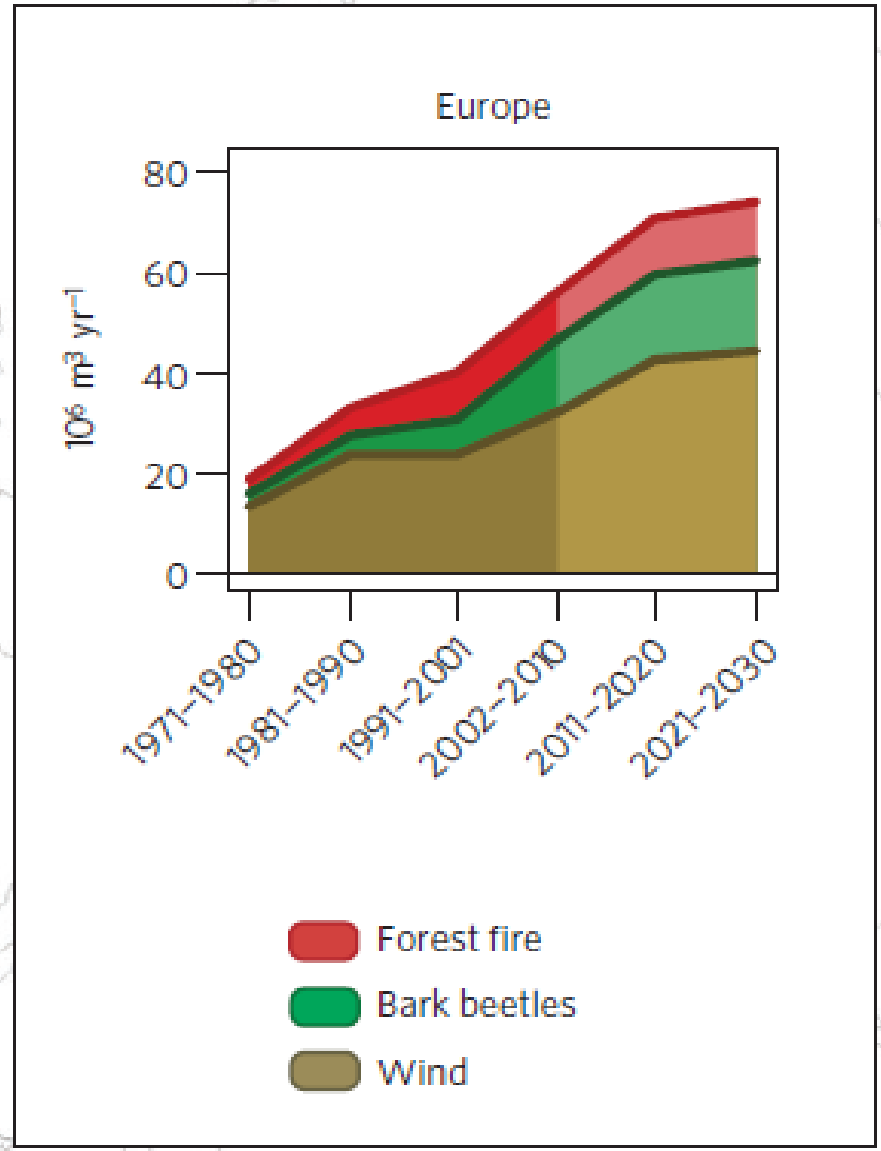
▼ Summer rainfall
▲ Winter storms, floods
▲ Length growing season, yields
▲ Suitable farmland
▲ Pests, diseases risks

▼ Water availability
▲ Risk drought, heat spells
▲ Risk soil erosion
▼ Growing season, crop yields
▼ Optimal crop areas

▲ Winter rainfall, floods
▼ Summer rainfall
▲ Risk drought, water stress
▲ Soil erosion risk
▲ Yields, range of crops

Source: DG Agriculture and Rural Development, based on EEA reports, JRC and academic studies

Major risks in forestry



Seidl et al., 2014

It is estimated, that carbon sequestration potential of forests in Europe due to changes in frequency and size of natural disturbances in 2021-2030 will be reduced by 503 Tg

Primary damages:

- Valuable timber: sawlogs, veneer logs – impact of damages and age of affected stands
- Additional planting, tending, precommercial thinning
- *In last 10 years direct losses for forest owners from storm damages in Latvia: 164 mil EUR*

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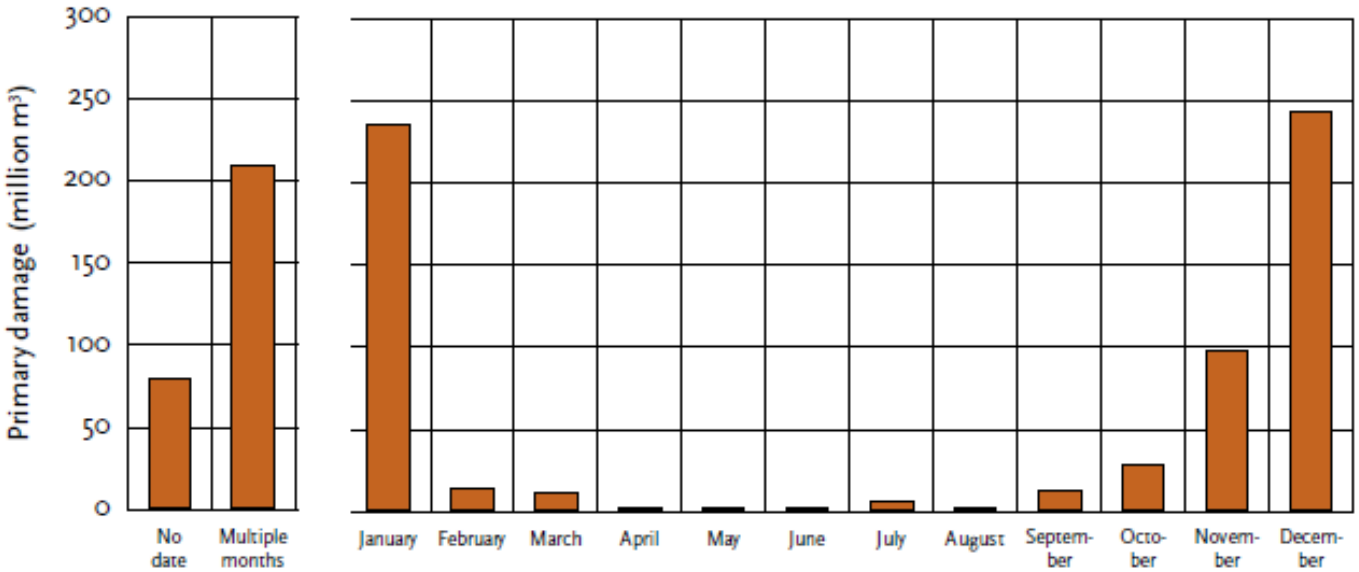
Wind storms



Gardiner et al., 2010

Prognosis: longer vegetation period, milder winters, less days with frozen soil

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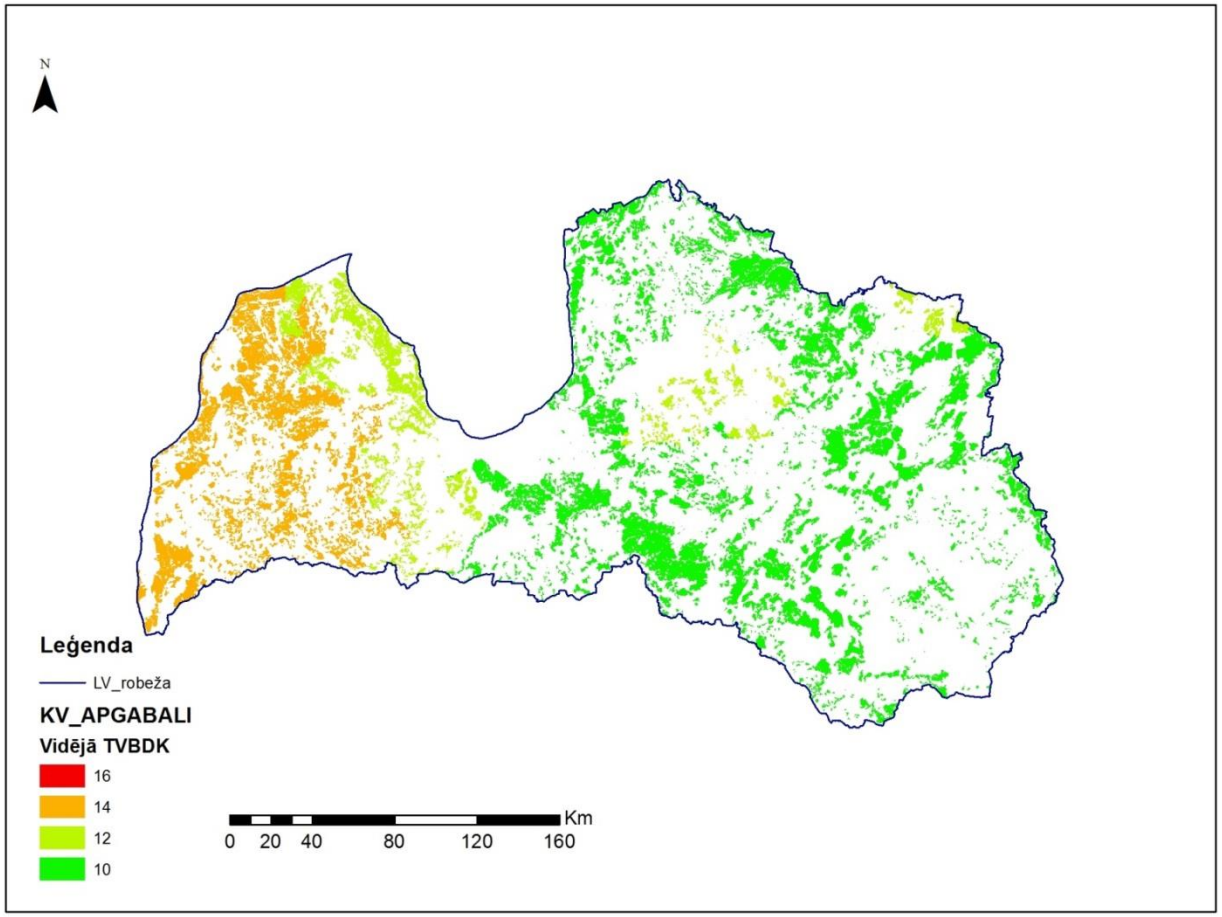
Wind storms: regional differences



Wind damage risk classes

Jansons u.c., 2015

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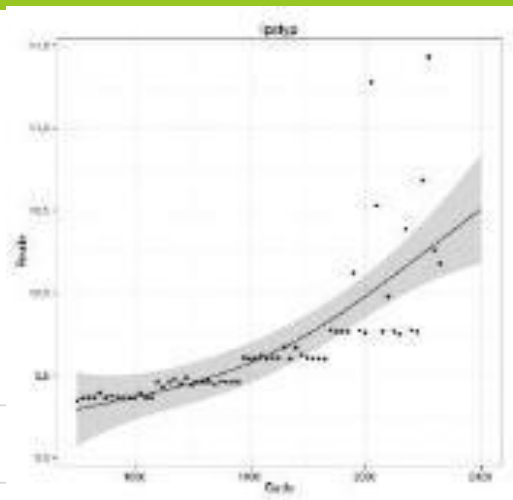
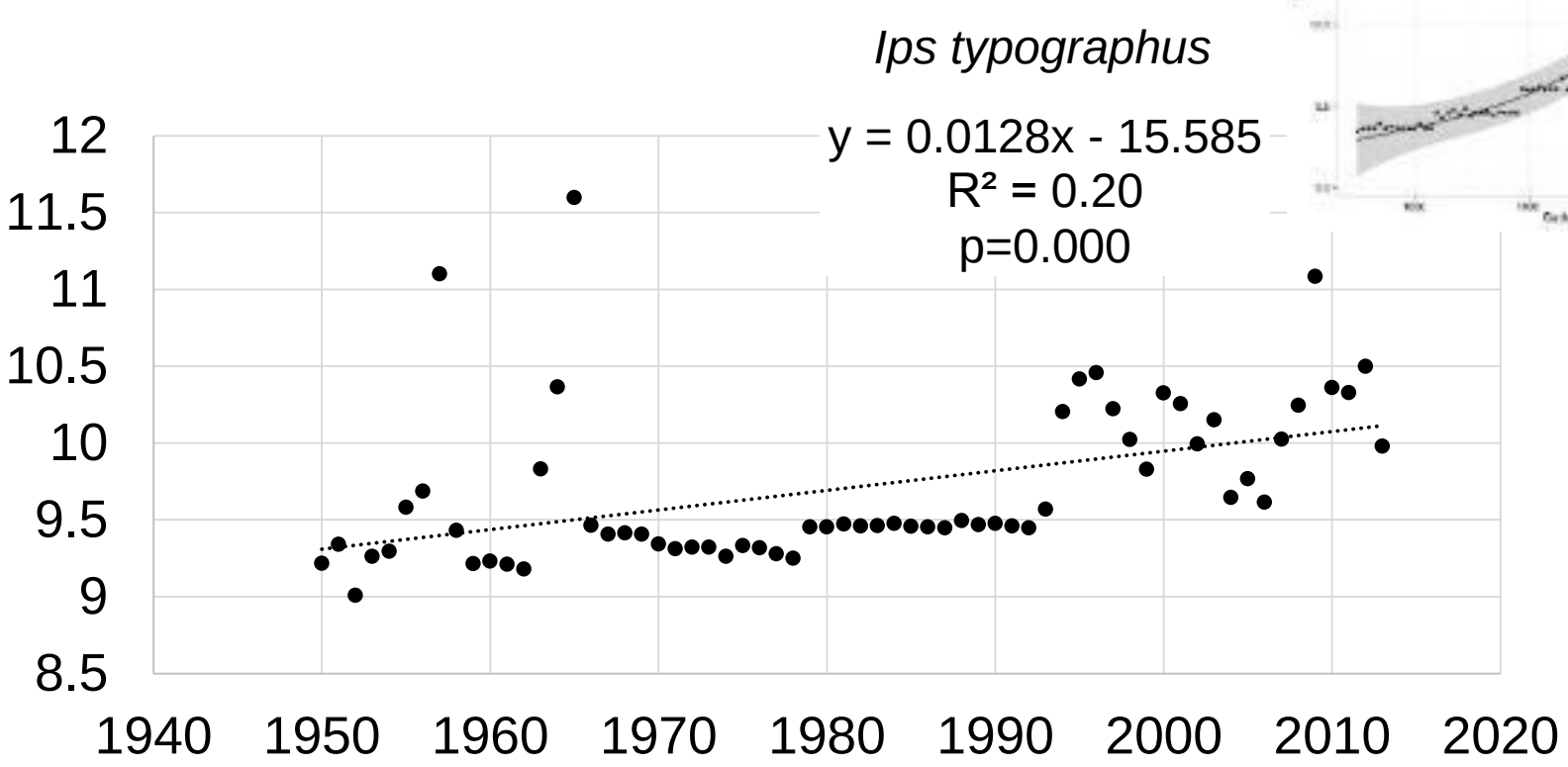
Dendrphagous insects





Logarithmic transformation of the relation between the area affected by dominant dendrophagous insect species (*L. dispar*, *B. piniarius*, *N. sertifer*, *D. pini*) and number of outbreaks

Jansons, Siliņš, u.c. 2014

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Identified risks in forestry: increasing temperature

Identified risks	The data needed for risk assessment	Data source
Faster desiccation of soil as a result of increased evapotranspiration: increasing drought stress, (important for seedlings)	Results of the experiments	LVMI Silava, scientific literature
Increase spread of diseases / appearance of new diseases	Monitoring of tree diseases	VAAD, LVMI Silava, expert assessment
Increased aggression (mass outbreaks) of dendrophagous insects / appearance of new species	Monitoring of dendrophagous insects (most significant species)	LVMI Silava, VMD, expert assessment
Reduced frost hardiness in winter followed by frost damages (linked to increased winter temperature) Reduced frost hardiness in spring (and autumn) followed by frost damages (linked to increased temperature and to early initiation of growth) Increased risk of wind damages linked to unfrozen soil	Dendroclimatic relations Areas damaged by frosts	LVMI Silava n/d, scientific literature, expert assessment VMD, LVMI Silava, expert assessment

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Identified risks in forestry: extreme weather conditions

Identified risks	The data needed for risk assessment	Data source
Wind storms Forest fires (prolonged drought) Freezing rain	Affected areas	VMD, LVĢMC, expert assessment

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Identified risks in agriculture

Identified risks	The data needed for risk assessment	Data source
Yield loss Risk of plant frost damages because of bare frost Frost damage to winter grains Risk of trunk damages of fruit trees	Crop yield data in crop farming, meteorological data	CSB, LVĢMC
Losses for cattle from mosquitos and black-flies Faster lose of water in soil and plants (evaporation, transpiration) due to higher temperature (increased drought stress risk even after a short period without precipitation)	Mosquito and black-fly attack monitoring	PVD
Risk of spreading plant diseases	Spreading of plant diseases monitoring	VAAD
Risk of spreading plant pests	Pest monitoring	N/A
Flood risk The losses of yield and yield quality due to the rain while harvesting	Compensations paid out to farmers for flood or other damage yield data in crop farming, meteorological data	LAD LAD, LVĢMC
Wind damage Frost damage Hail risk Storm risk (fruit trees) The decease of immunity of productive animals due to heat waves	Agriculture areas suffered from natural disasters	LAD, LVĢMC, expert assessment
Risk of extensive precipitation Risk of drying out	The quality of the ground water and qualitative and quantitative aspects of water (flows, levels); endangered areas	LLU VBF (data from a log-term monitoring) LVĢMC



Analysis of the current situation in agriculture and forestry


2016.06.30.

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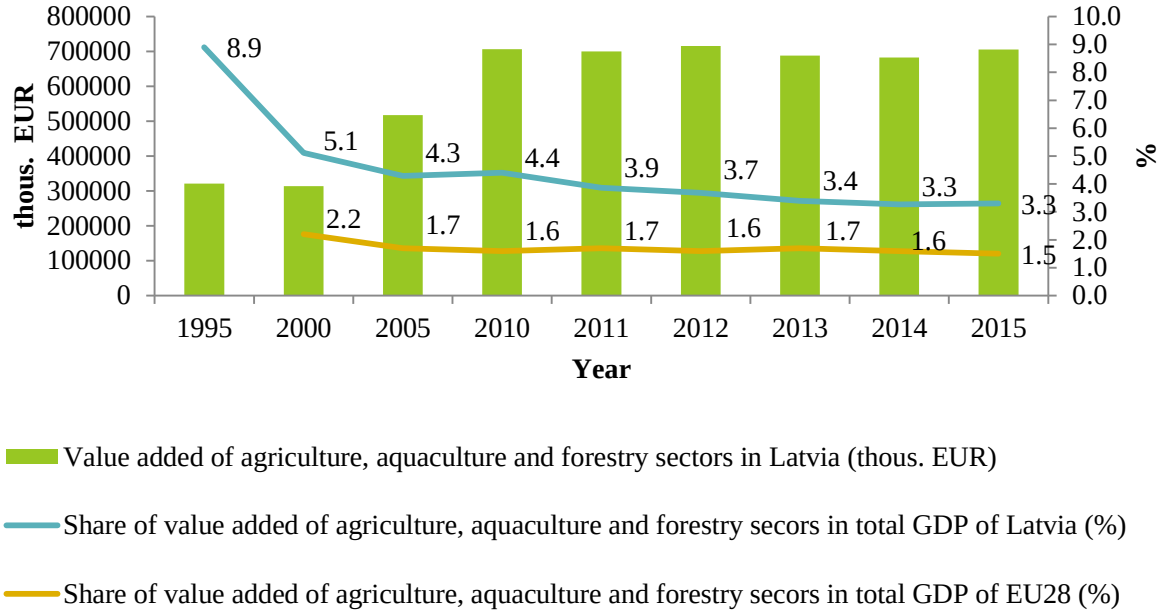
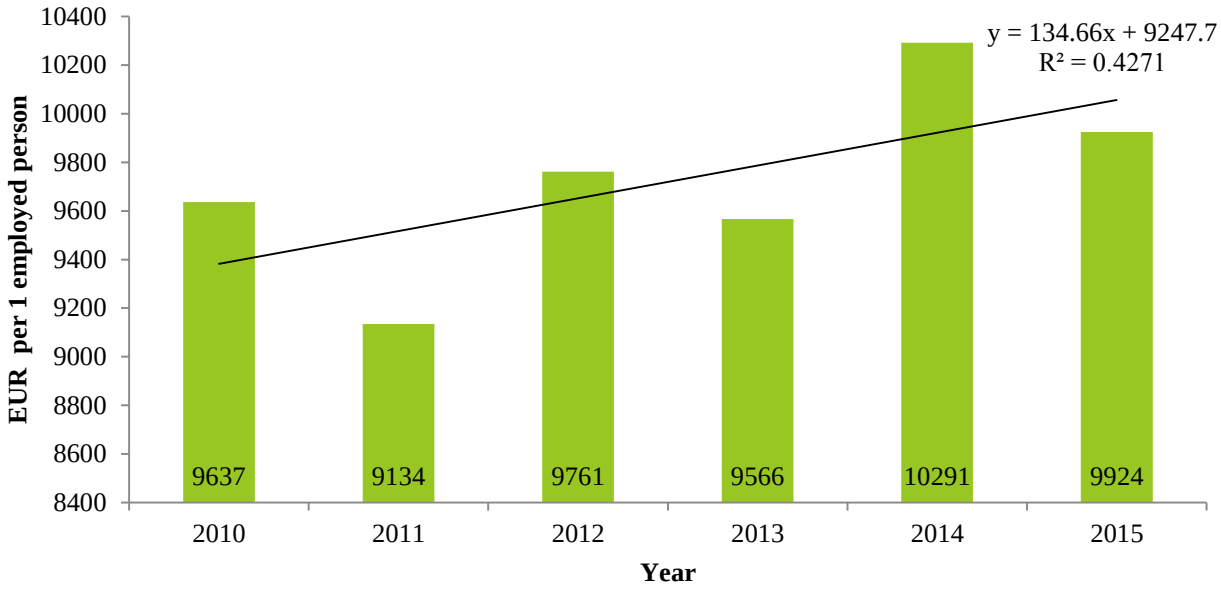
Value added of products and services produced in agriculture and forestry sectors and its share in total economy in Latvia, 1995-2015



Source: authors calculations after data from Central Statistical Bureau and EUROSTAT

- In 2015, value added of current sectors was 705.611 million euro. Compared with 2005, it has increased by 36%, however, during the last three years contribution of value added of current sectors hasn't significantly changed.

Growth of the productivity of employed person in agriculture and forestry sectors in Latvia, 2010-2015



Source: authors calculations after data from Central Statistical Bureau

- Constant increase of value added per one employed person in agriculture and forestry sectors, creates favorable conditions for further expansion and increase of productivity.

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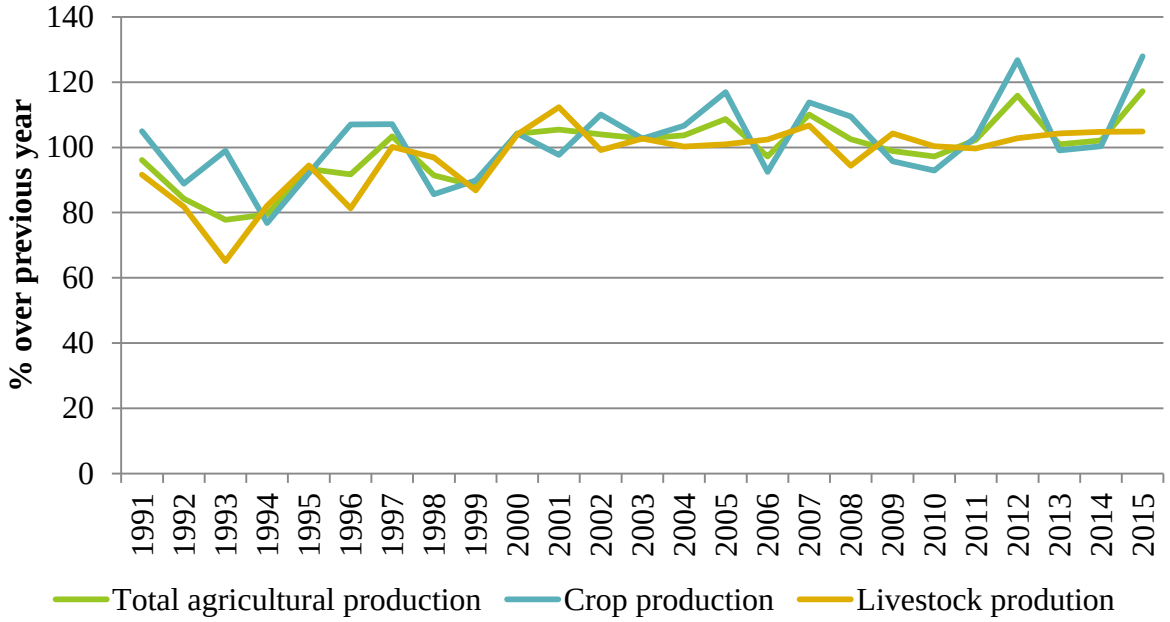
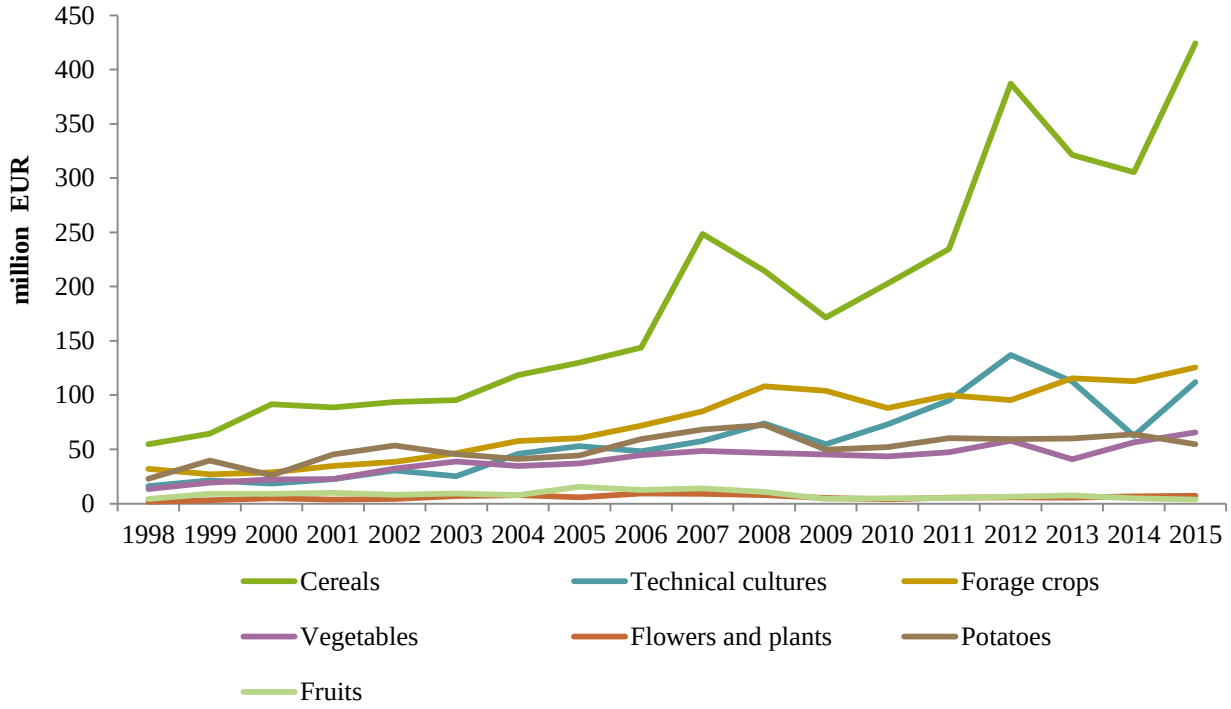
Dynamics of agricultural production in Latvia, 1991-2014 (% over the previous year)



Source: authors calculations after data from Central Statistical Bureau

- More rapid growth is characteristic for crop production, while livestock production volumes grow, but at a substantially slower rate than crop production.
- The main factor limiting crop production is weather conditions, thus crop sector is more exposed to climate risks.

Dynamics of output value of main crops in Latvia, 1998-2015 (million EUR)



Source: authors calculations after data from EUROSTAT

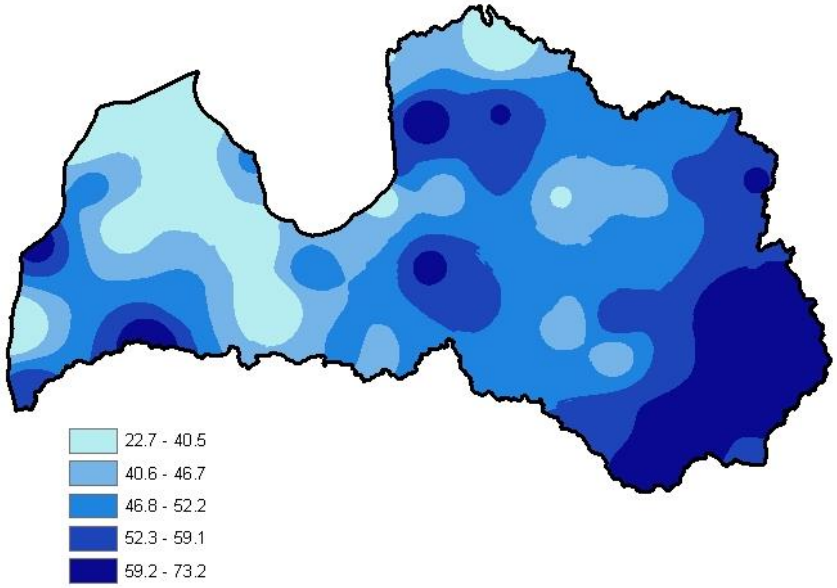
- In recent decades more important economic role has been dedicated to intensively grown crops grown for export (cereals and rape) and forage (maize), but economic importance of crops grown for local market (vegetables, potatoes) has been declining.

Methodology of risk and vulnerability analysis for the agriculture sector

- Quantitative risk analysis
  - Statistical analysis methods:
    - Multivariate regression models based on the yield and climate data
      - Relational derivation of crop production quantities (yield per hectare) and risk factors represented as climatic conditions (including temperature, rainfall, wind speed)
  - Stochastic simulation (Monte-Carlo) for representing uncertainty of yield data for climate change scenarios by using *Monte-Carlo* approach
  - Visualization (mapping) of climate data as risk factors of possible negative influence on crops yield
  - Assessment of vulnerability – the index method
  - Assessment of economic losses and gains – cost-benefit analysis
- Qualitative risk analysis
  - Risk matrix

Methodology of risk and vulnerability analysis for the agriculture sector

- Example of mapping of precipitation (mm) in September 2006 by "Latvian Environment, Geology and Meteorology Centre“ important factor for winter crop germination
- The map will be supplemented by yield data of winter crop



Thank You !

2016.07.01.

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