The necessity of milk and microclimate recordings on dairy cattle farms on Balkan region in the light of climate change

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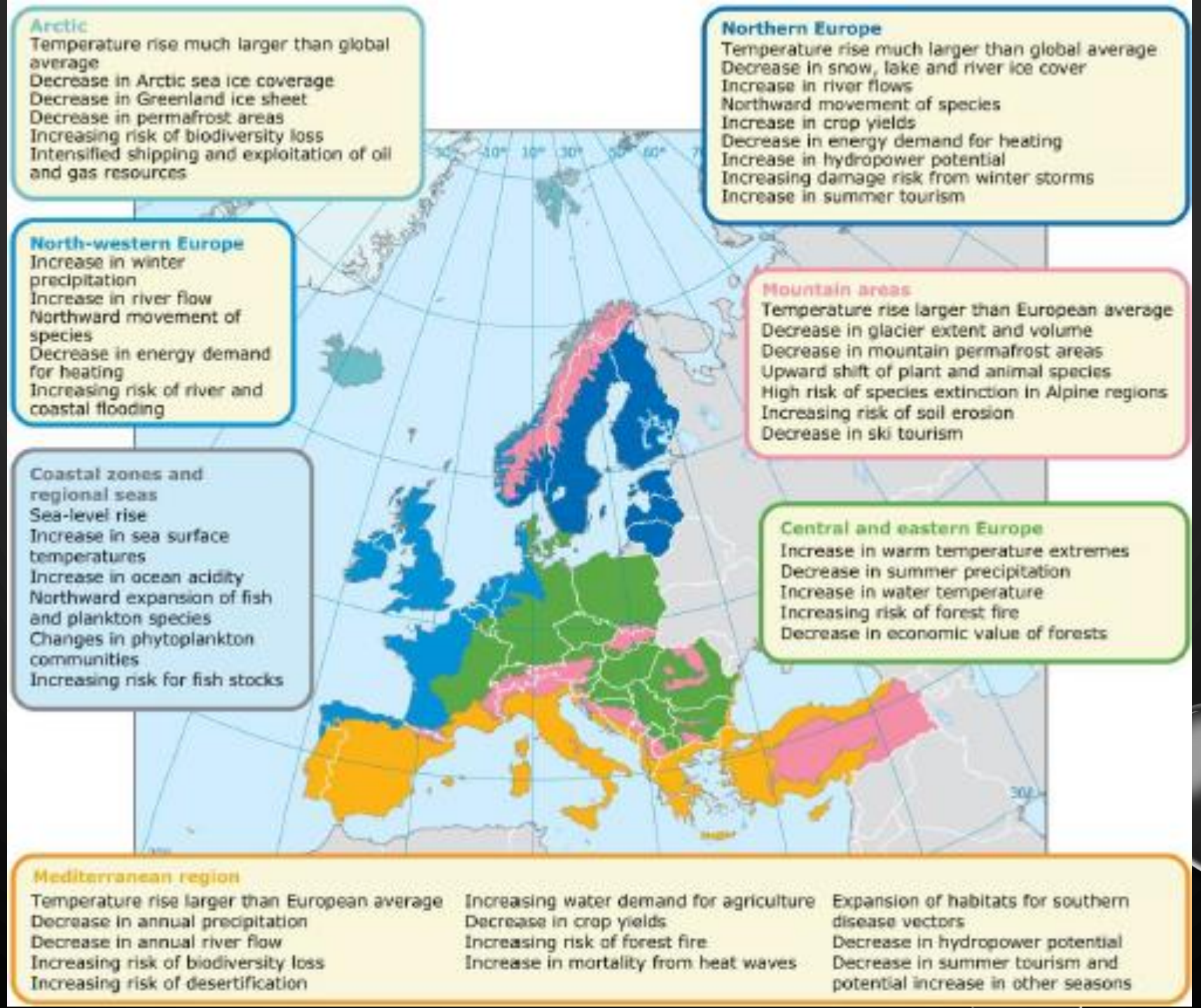
Introduction

The climate change worldwide – is no longer questionable

The question is:

How will farming in the EU be affected by climate change?

- **changing in rainfall will be a serious problem in many regions**
- **rising temperatures**
- **variability and seasonality as well as**
- **extreme events, heatwaves, droughts, storms and floods across the EU**


Arctic
Temperature rise much larger than global average
Decrease in Arctic sea ice coverage
Decrease in Greenland ice sheet
Decrease in permafrost areas
Increasing risk of biodiversity loss
Intensified shipping and exploitation of oil and gas resources
Northern Europe
Temperature rise much larger than global average
Decrease in snow, lake and river ice cover
Increase in river flows
Northward movement of species
Increase in crop yields
Decrease in energy demand for heating
Increase in hydropower potential
Increasing damage risk from winter storms
Increase in summer tourism
North-western Europe
Increase in winter precipitation
Increase in river flow
Northward movement of species
Decrease in energy demand for heating
Increasing risk of river and coastal flooding
Mountain areas
Temperature rise larger than European average
Decrease in glacier extent and volume
Decrease in mountain permafrost areas
Upward shift of plant and animal species
High risk of species extinction in Alpine regions
Increasing risk of soil erosion
Decrease in ski tourism
Coastal zones and regional seas
Sea-level rise
Increase in sea surface temperatures
Increase in ocean acidity
Northward expansion of fish and plankton species
Changes in phytoplankton communities
Increasing risk for fish stocks
Central and eastern Europe
Increase in warm temperature extremes
Decrease in summer precipitation
Increase in water temperature
Increasing risk of forest fire
Decrease in economic value of forests
Mediterranean region
Temperature rise larger than European average
Decrease in annual precipitation
Decrease in annual river flow
Increasing risk of biodiversity loss
Increasing risk of desertification
Increasing water demand for agriculture
Decrease in crop yields
Increasing risk of forest fire
Increase in mortality from heat waves
Expansion of habitats for southern disease vectors
Decrease in hydropower potential
Decrease in summer tourism and potential increase in other seasons

Mediterranean region

- Temperature rise larger than European average
- Decrease in annual precipitation
- Decrease in annual river flow
- Increasing risk of biodiversity loss
- Increasing risk of desertification
- Increasing water demand for agriculture
- Decrease in crop yields
- Increasing risk of forest fire
- Increase in mortality from heat waves
- Expansion of habitats for southern disease vectors
- Decrease in hydropower potential
- Decrease in summer tourism and potential increase in other seasons

Central and eastern Europe

- Increase in warm temperature extremes
- Decrease in summer precipitation
- Increase in water temperature
- Increasing risk of forest fire
- Decrease in economic value of forests

Mountain areas

- Temperature rise larger than European average
- Decrease in glacier extent and volume
- Decrease in mountain permafrost areas
- Upward shift of plant and animal species
- High risk of species extinction in Alpine regions
- Increasing risk of soil erosion
- Decrease in ski tourism

TEMPERATURE

INCREASE

PRECIPITATION

DECREASE

Heat stress in dairy cows reduce

dry matter intake,

milk production

reproductive performances

(West et al., 1999; Bohmanova et al., 2007; Ravagnolo et al., 2000)

Also, *heat stress is associated with changes* in

milk composition,

somatic cell counts (SCC) and

mastitis frequencies

(Bouraoui et al., 2002.; Collier et al., 2012; Correa-Calderon et al., 2004; Ravagnolo et al, 2000.; St-Pierre et al., 2003; West, 2003; Hammami et al., 2013; Smith et al., 2013)

Furthermore, *heat stress condition induces*

significant loss of profit, for example in the USA between $897 million and $1,500 million per year (St-Pierre et al., 2003)

There are many methods to decrease the impact of heat stress for example

shading,

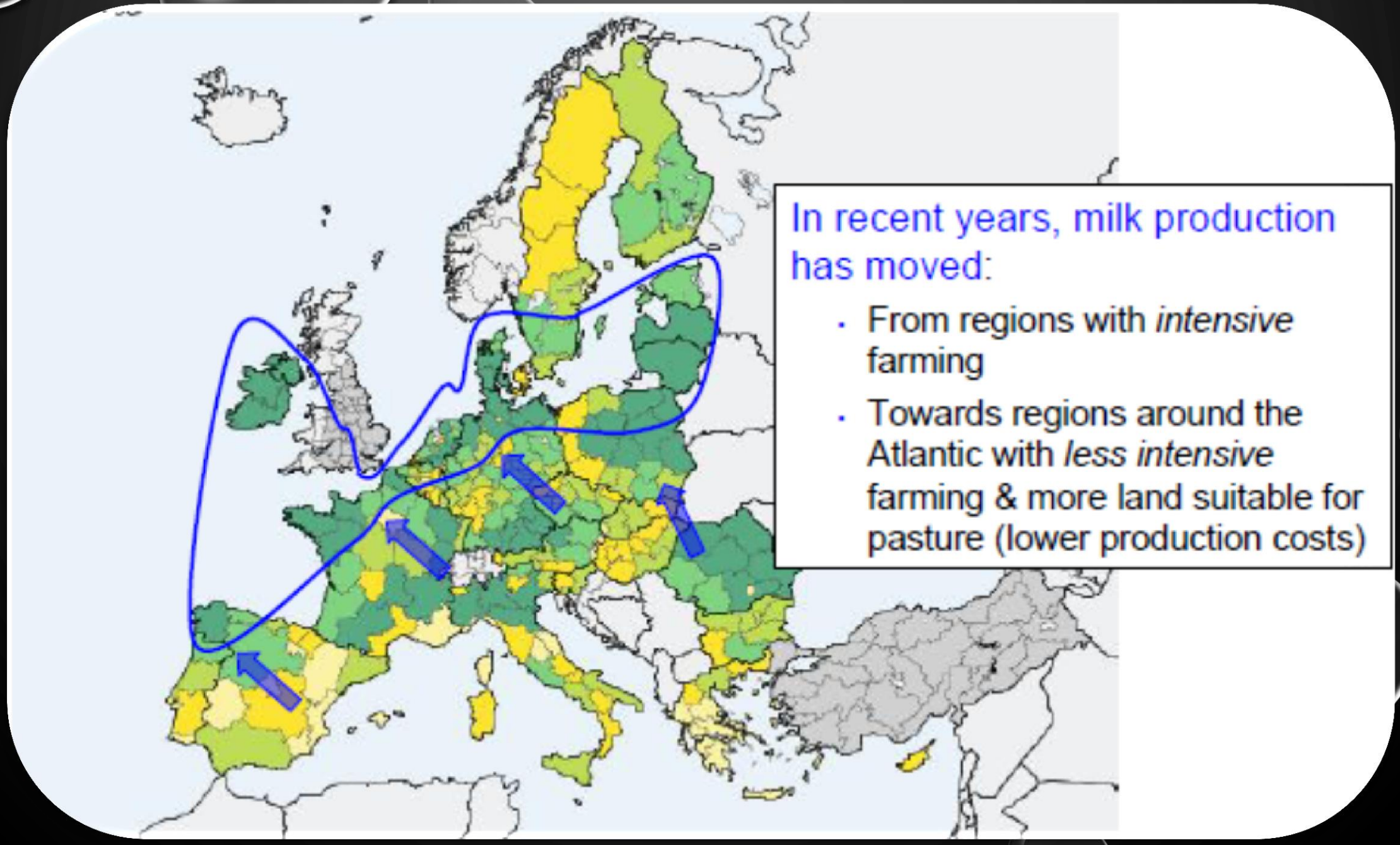
cooling and

nutrition

(Kadzere et al., 2002; West, 2003)

Also, selection for heat stress resistance could be effective, long term method

(Bohmanova, 2006)


In recent years, milk production has moved:
From regions with *intensive* farming
Towards regions around the Atlantic with *less intensive* farming & more land suitable for pasture (lower production costs)

the necessity of implementation of

breeding values for heat resistance in breeding strategies

aiming the financial losses reduction and enabling the sustainable farming

have become indisputable

The basic precondition of genetic evaluation are

1. accurate data measured on population under control

Also, determination of THI threshold value, is

the basis for setting up the genetic evaluation model

In most of the studies of the heat stress

2. climate parameters (temperature and relative humidity)

were taken from meteorological stations resulting in

possibly biased evaluation

In this research,

ambient temperature and relative humidity

were measured in the barns during the milk recording of dairy cattle population in Croatia in the period from January 2005 to December 2012

Daily temperature-humidity index was calculated accordingly to the Kibler's (1964) equation:

$$THI = 1.8 \times Ta - (1 - RH) \times (Ta - 14.3) + 32$$

Ta is average temperature in degrees of Celsius

RH is relative humidity as a fraction of the unit

After logical control performed in SAS/STAT (SAS Institute Inc., 2000)

data provided by the Croatian Agricultural Agency

consisted of

1,070,554 test-day records from 70,135 Holsteins reared on 5,679 farms

1,300,683 test-day records from 86,013 Simmentals reared on 8,827 farms

The variation in daily milk traits due to heat stress was determined by

least square analyses of variance for each given THI value (from 68 to 78) in regard to

- the breed (Holstein, Simmental) and

- production level (high, low)

- separately for each parity class (1st, 2nd, 3+) and using the PROC MIXED procedure in SAS (SAS Institute Inc., 2000)

The significance of the differences between the THI classes were tested by Scheffe's method of multiple comparisons

Following mixed model was used:

$$y_{ijklmn} = \mu + b_1(d_i / 305) + b_2(d_i / 305)^2 + b_3 \ln(305 / d_i) + b_4 \ln^2(305 / d_i) + S_j + A_k + R_l + T_m + e_{ijklmn}$$

Where y_{ijklm} = estimated daily milk trait (yield, content, somatic cell count);

μ = intercept;

b_1, b_2, b_3, b_4 = regression coefficients;

d_i = days in milk (i = 6 to 500 day);

S_j = fixed effect of calving season class j (j = 1/2005 to 12/2012);

A_k = fixed effect of age at calving class k (k = 21 to 36 month)*only for 1st parity,

R_l = fixed effect of region k (l = Croatian counties),

T_m = fixed effect of THI class (m = 0 *(normal condition – values under the given threshold)* or 1 *(heat stress condition – values equal and above the given threshold)*),

e_{ijklm} = residual.

Determination of THI threshold value for

- *daily milk traits of Holsteins and dairy Simmentals in Croatian farm*
  - *showed high variability in determined value due to*
    - *parity*
    - *production level and*
    - *breed*

Also, results showed higher resistance to the heat stress of

- *dairy Simmentals than Holsteins*

Following researches need to answer

- are Simmentals genetically more appropriate for the dairy farming in the climatic condition on the Balkan region?

With that purpose

- *accurate milk and microclimate parameters recording need to be introduced in*
  - *all countries in Balkan region on regular basis*

- *meaning*
  - *milk recording*
  - *dataloggers*
- *on each dairy farm*

THANK YOU!