iSAGE

Innovation for Sustainable Sheep and Goat Production in Europe

EAAP 2018

Implications of climate change on small ruminant systems in Europe

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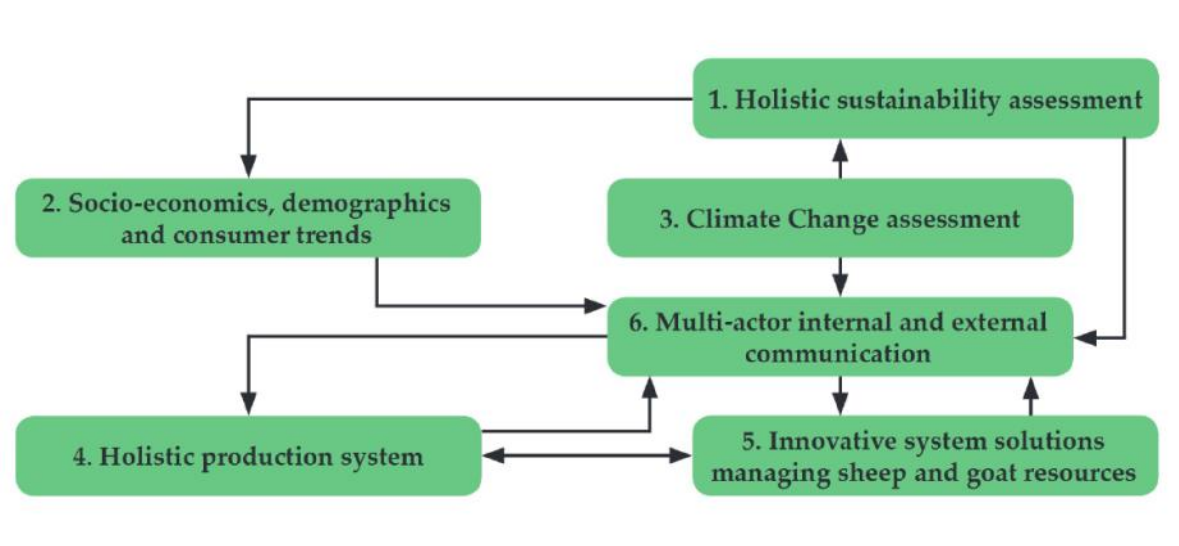
bc3
BASQUE CENTRE FOR CLIMATE CHANGE
Klima Aldaketa Ikergai

Impacts of climate change on sheep and goat systems

Innovation for Sustainable Sheep and Goat Production in Europe

Taking a holistic approach to achieve sustainable sheep & goat production across Europe



Sustainability assessments will be carried out with an adapted version of the PG tool. Interactions of economic, environmental and social outcomes and their effects on farm resilience (to climate change, market instability, etc.) will be analysed.

Consumer trends will be established in conversation with farmers, consumers and retailers to guide market direction and advise best-practice supply chains.

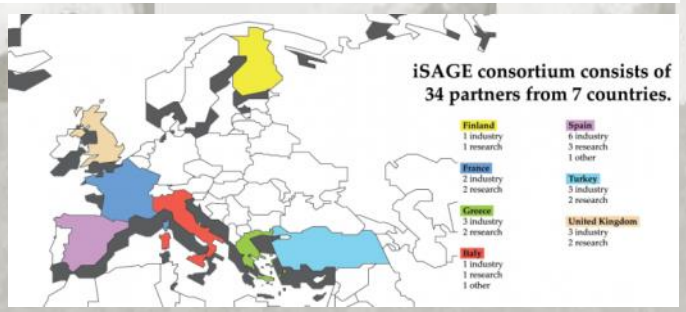
Climate change effects on pasture and livestock will be modelled, alongside different adaptation responses.

Production system innovations to tackle identified challenges will be investigated with on-farm case studies and modelling. A whole farm model will be built and used to develop user-friendly tools giving farm-specific best practice.

Sheep & goat resources will be maximized by developing breeding strategies based on phenotypes and gene profiles associated with resilience, adaptability and sustainability. Local breeds will be looked to as a valuable genetic source.

Multi-actor communications will ensure that the work of the project translates into wide-spread industry change. Workshops, demonstrations, conferences and training will be provided and a knowledge exchange network established.

http://www.isage.eu/



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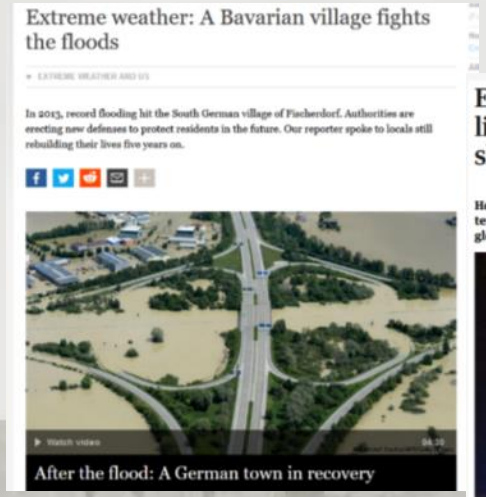
Impacts of climate change

1. Changes in temperature: Hotter
2. Changes in rainfall patterns: Extremes
   - Heatwaves
   - Droughts
   - Heavy precipitation

Increased risk of fires and floods


Extreme weather: A Bavarian village fights the floods

In 2013, record flooding hit the South German village of Fischerdorf. Authorities are erecting new defenses to protect residents in the future. Our reporter spoke to locals still rebuilding their lives five years on.

After the flood: A German town in recovery


Europe's extreme June heat clearly linked to climate change, research shows

Heatwaves that saw deadly forest fires in Portugal and soaring temperatures in England were made up to 10 times more likely by global warming, say scientists

Human-caused climate change dramatically increased the likelihood of the


British farmers fear fire as heatwave creates 'tinderbox'

Wildfire is now an over-riding concern for many farmers, who are taking extra precautions to stop fires spreading as the hot spell continues


A third of the world now faces deadly heatwaves as result of climate change

Study shows risks have climbed steadily since 1980, and the number of people in danger will grow to 48% by 2100 even if emissions are

Record hot 2015 gave us a glimpse at the future of global warming

An exceptionally hot year, 2015 shattered records, but will just be the norm in 15 years' time

This illustration obtained from NASA on January 20, 2016 shows that 2015 was the warmest year since modern by NASA's Goddard Institute for Space Studies.

by about 0.14°C. To put that into
rs (2014 and 2010) only broke the prior
Earth data. The only time the

Impacts of climate change

2017

The Observer
Spain

Grapes shrivel as Spanish farmers lament a relentless drought

Animals and plants struggle to survive as severe heat dries up the land

Sam Jones *in Malpartida de Plasencia, Extremadura*

@swajones

Sun 9 Jul 2017 00.03 BST

723 313

This article is over 1 year old

▲ Diego García de la Peña, a 65-year-old former bullfighter, has seen climate change affect his land near Malpartida de Plasencia in the western Spanish region of Extremadura. Photograph: Sam Jones for the Observer

A taunting peal of thunder rings out overhead as Diego García de la Peña studies one of his ponds and wonders whether its water will see his cattle through until October.

DE CUENCA

La sequía complica la trashumancia en su viaje a las dehesas de invierno

- Los hermanos Cardo atraviesan estos días las cañadas reales camino del Valle de Alcudia
- La incertidumbre de no saber si las 1.600 ovejas que conducen podrán beber al menos una vez al día es su mayor preocupación

C.I.P. / Las Noticias de Cuenca

15/11/2017 - 11:56h

Google ha cerrado el anuncio

Balada de auxilio de unas ovejas por la sequía

Un rebaño trashumante que no encuentra pastos en Extremadura pide asilo en Mad

ESTHER SÁNCHEZ

Comunidad de Madrid - 23 NOV 2017 - 00:04 CET

El pastor Julio de la Losa, en la finca del municipio de Majadahonda donde el rebaño trashumante espera ser reubicado. CARLOS ROSILLO

La intensa sequía que padece España ha obligado al rebaño de 1.300 ovejas que

Jazzle

APÚNTATE

TE PUEDE INTE

Trashumancia e

La Comunidad a

Impacts of climate change

2018

Heatwave forces UK farmers into desperate measures to save cattle

Water shortages cause alarm over crop yields and keeping livestock alive

▲ Farmers are struggling to water their cows in the heatwave. Photograph:

While millions of Britons are enjoying the heatwave causing problems for farmers who are concerned ab livestock, forcing some into desperate measures to

Sunscreen for cows: UK farmers struggle to cope with heatwave

Traditional farming shows its benefits as stone barns and hedgerows provide cattle with relief from the heat

▲ Cattle and ducks keep cool in the River Stour, Suffolk. Photograph: Graham Turner/Alamy Live News

Sunscreen and waiter service for cows, and a renewed appreciation for traditional countryside structures such as stone barns and hedgerows, are some of the modern and ancient ways in which

Drought

Crop failure and bankruptcy threaten farmers as drought grips Europe

Abnormally hot temperatures continue to wreak devastation across northern and central parts of the continent

Arthur Neslen

Fri 20 Jul 2018 13.11 BST

6,762

This article is over 1 month old

▲ A blighted wh

Farmers ac bankruptcy strengthen

UK farmers allowed to take more water from rivers as heatwave continues

Environment secretary holds drought summit with farmers to address series issues of crop failure and lack of fodder for animals

Suzie Horne

26 July 2018

More in

Business

Meat markets and prices

Recommended

Drought cuts beef carcass weights and leaves lambs underfinished

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Impacts of CC on sheep and goat systems

Effects of CC on small ruminants

Climate change

Effects at animal level

Increased temperature & radiation

↓

Heat stress

↓

Behavioural & metabolic changes

- Productivity & product quality
- Reproduction
- Animal health & welfare

Effects on feed supply

Increased temperature. Changes in precipitation. Extreme events

↓

Heat & water stress. Changes in growing season length & water availability

↓

Changes in crop & pasture growth

- Productivity & quality of forage
- Pests & diseases
- Availability of concentrates

Effects on small ruminant systems

Effects of CC on forage production

Regional implications for small ruminant production systems in Europe and adaptation measures

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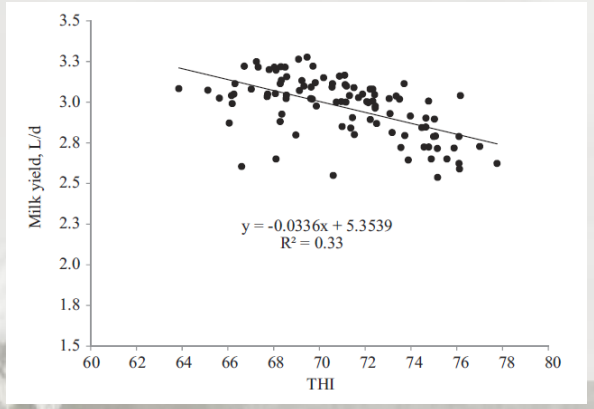
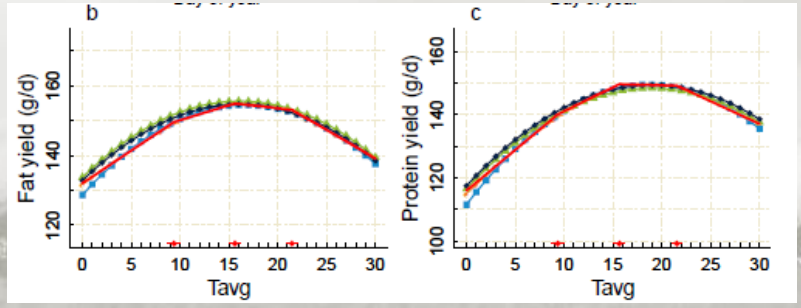
Effects of CC on small ruminants:

-Productivity and quality (milk+meat)

- Sheep and goat subject to heat stress often show reduction in feed intake and impaired productivity
  - Lamb impaired growth rate
  - Reduction milk production
  - Milk quality (e.g. reduction of protein)
  - Meat quality: abnormal odour and taste, greater water holding capacity and susceptible to spoilage by microorganism



Salama et al., 2014



Ramon et al., 2016

Effects of CC on small ruminants:

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-Reproduction (fertility)

- Females: impacts ovarian function, duration of gestation, conception rate and birth weight of lambs.
- Males: reduced quantity and quality of sperm, changes in sexual activity.

-Animal health & welfare

- Warmer conditions may increase the incidence of infectious diseases (gastrointestinal nematode, udder)

Effects of CC on forage production:

- Increase in CO_2 may promote greater production in grasslands (0-30%).

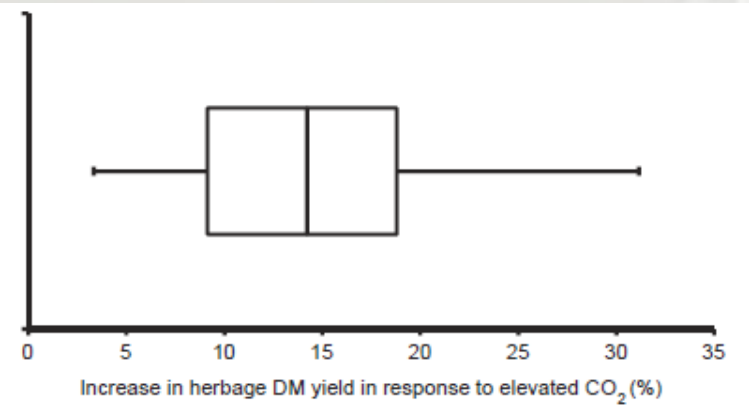


Figure 1 Variability in the annual herbage dry matter (DM) yield response of temperate pastures to elevated CO_2 (600–700 ppm) under optimal nutrient supply, displayed as ranges (whiskers), 25th percentile to the 75th percentile (boxes) and the median line. Created using 44 annual means from control and elevated CO_2 treatments from Newton *et al.* (1994), Casella *et al.* (1996), Soussana *et al.* (1996), Hebeisen *et al.* (1997) and Schneider *et al.* (2004).

Lee et al., 2013

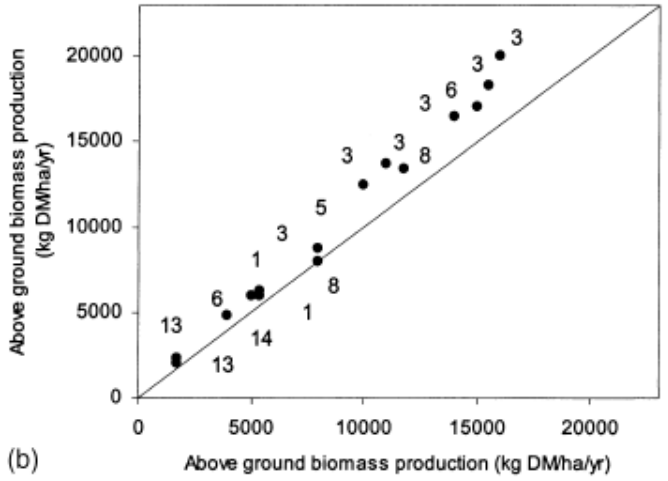


Fig. 2. Effect of doubled ambient CO_2 on above-ground biomass production plotted against above-ground biomass production at the current CO_2 concentration for different pasture and rangeland systems: (a) percentage effect; (b) absolute effect. Numbers refer to studies listed in Table 1: (1) M. Jones, unpublished; (3) Hebeisen et al. (1997); (5) Tuba et al. (1998); (6) Casella et al. (1996); (8) Newton et al. (1994), Clark et al. (1997); (13) J. Morgan, unpublished; (14) Owensby et al. (1999).

Campbell et al., 2010

Effects of CC on forage production

- Increase in CO_2 may promote greater production in grasslands (0-30%).
- Higher temperature and annual precipitation enhance plant growth of many grass species.

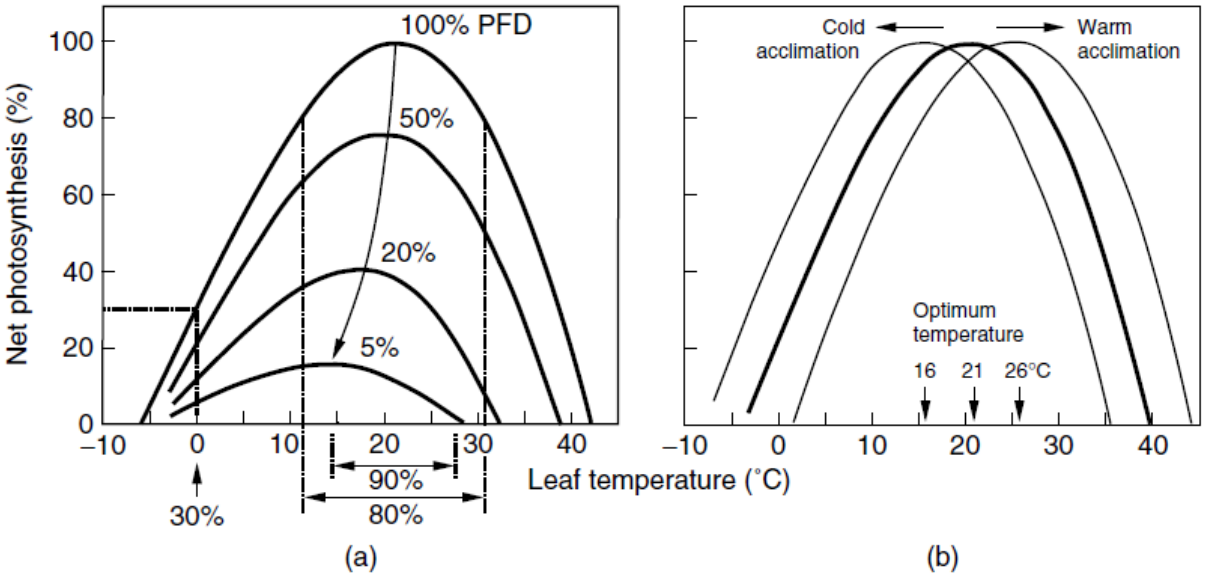
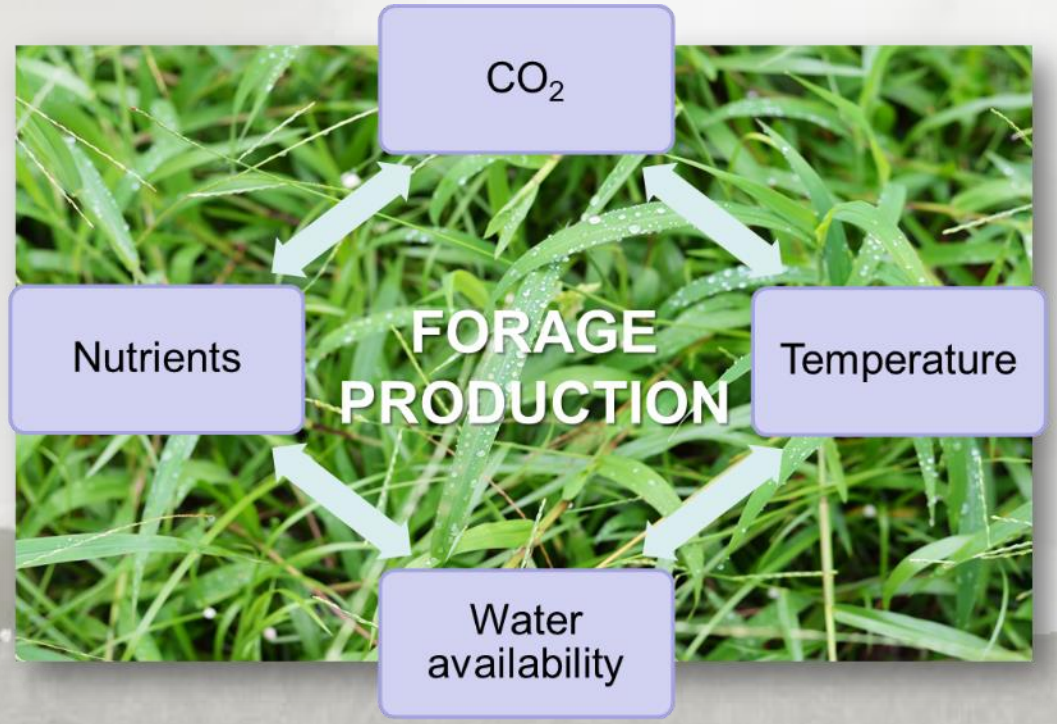


Figure 3.1 The 'classical' responses of net photosynthesis of leaves (A) to temperature (cf. Larcher, 1969, 2003). (a) Typical response curves for a temperate plant species measured at different light

Körner et al., 2006

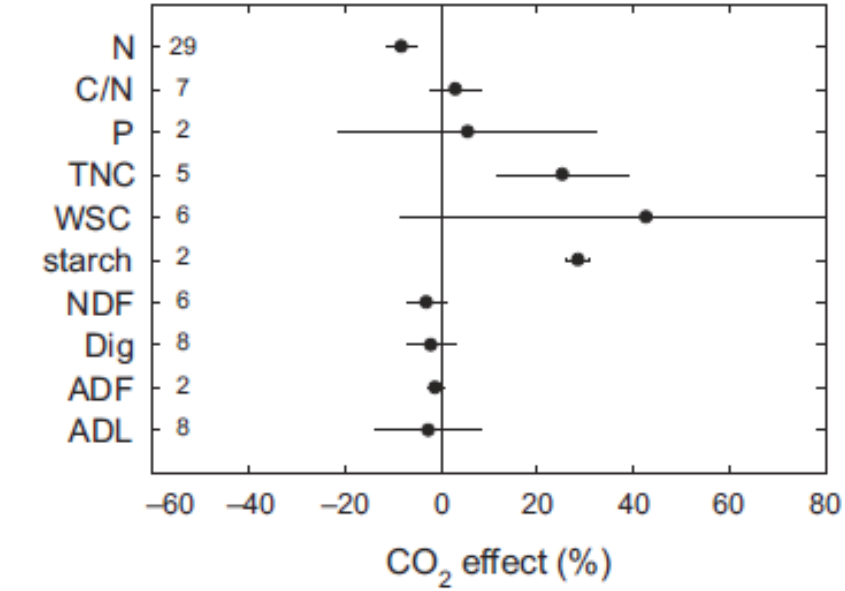
Effects of CC on forage production

- Overall effect depends on complex interacting processes between CO_2, temperature and water availability in the soil-water-plant system



Effects of CC on forage quality

- Enhanced CO_2 concentration tend to decrease forage nitrogen (N) content and increase total non-structural carbohydrates, though there does not appear to be any significant effect on forage digestibility (Dumont et al., 2015).



Dumont et al., 2015

Effects of CC on forage quality

- Enhanced CO_2 concentration tend to decrease forage nitrogen (N) content and increase total non-structural carbohydrates, though there does not appear to be any significant effect on forage digestibility (Dumont et al., 2015).
- Warming and high CO_2 levels favour species that fix N_2 (i.e. legumes) over non-fixing species.
- The protein content of C3 grasses is expected to decrease in non-leguminous plants, but this may be partially counteracted by the expected increase in the legume content of swards.

Impacts of climate change on sheep and goat systems

Regional implications for small ruminant production systems in Europe:

- Climate change impacts will vary among the different European sub-regions

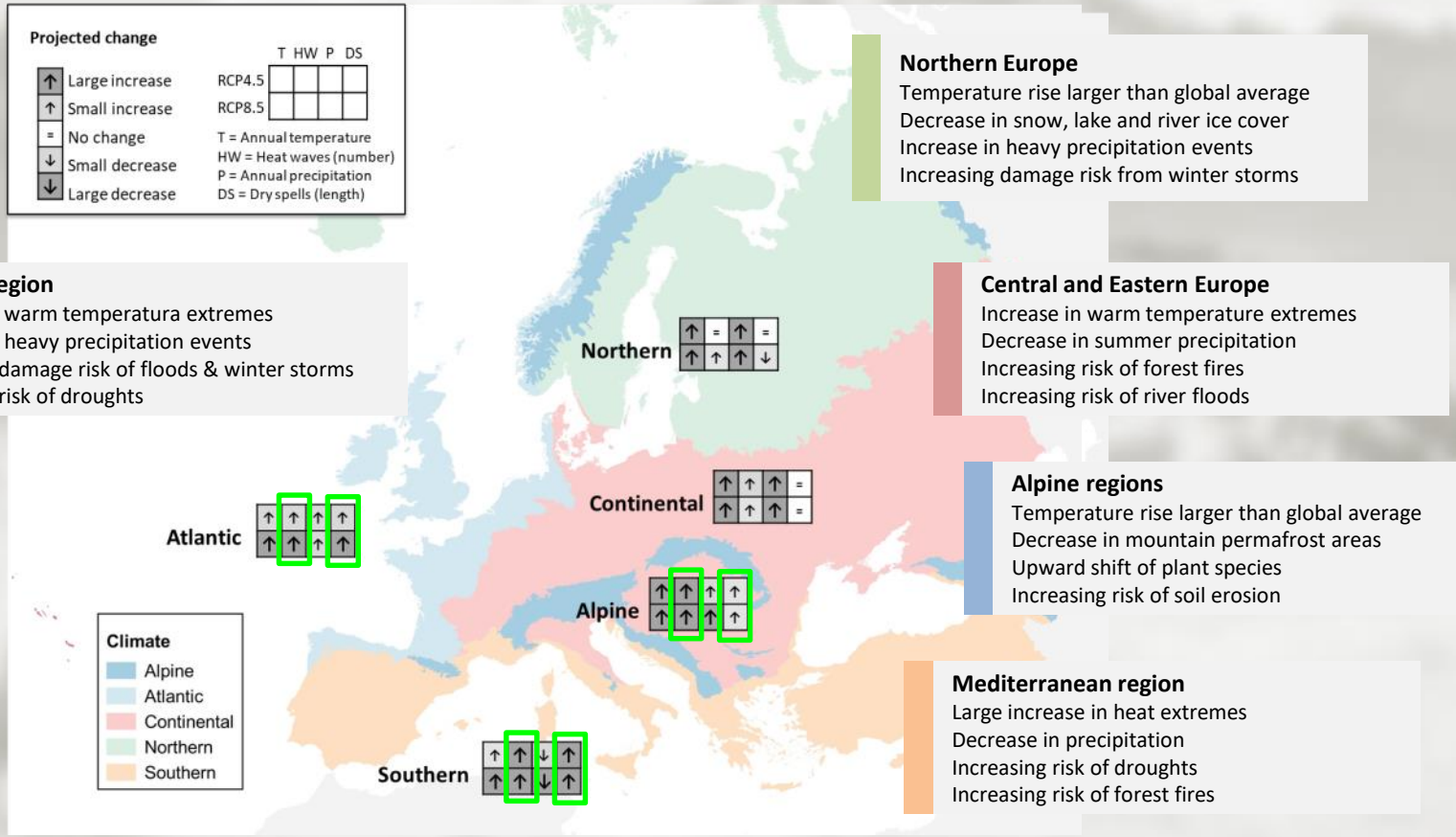


Figure - General trends of several climate variables for European sub-regions. Indices represent changes for 2071-2100 with respect to 1971-2000 based on RCP4.5 and RCP8.5 scenarios (Pardo et al 2017 based on Jacob et al, 2014).

Regional implications for small ruminant production systems in Europe:

- Climate influences distribution of vegetation and small ruminant systems across Europe

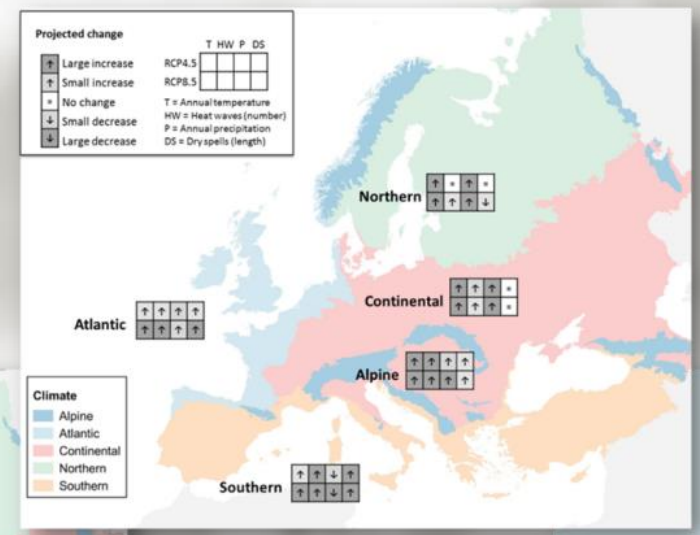


Fig.1- Climate change projections

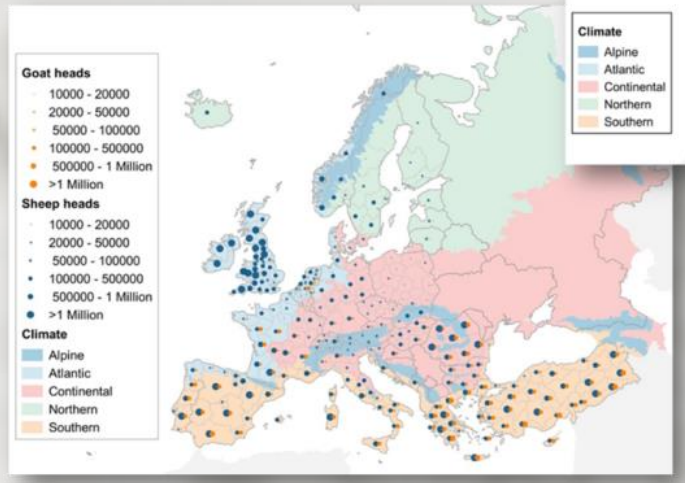


Fig.2 - Distribution of small ruminant livestock in Europe

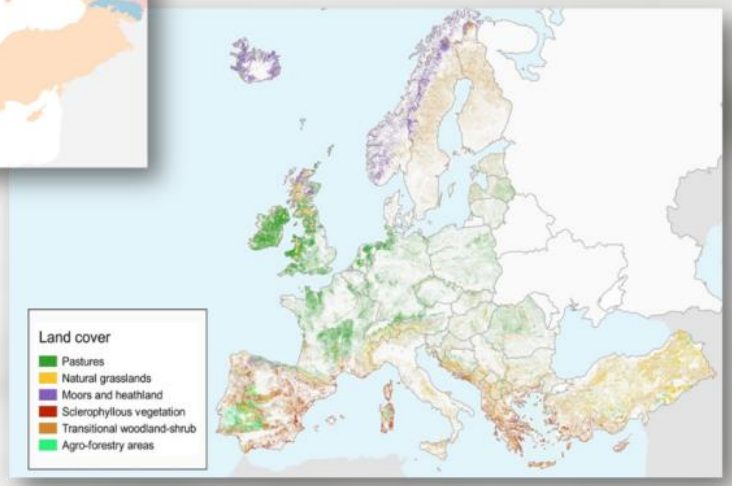


Fig.3 - Distribution of grasslands and scrublands in Europe

Regional implications:

A) Northern (Boreal) region

- Increase in forage annual yields (timothy, perennial ryegrass) due to higher temperatures, longer growing season, decreased risk of winter damage.
- Potential expansion of grass species (perennial ryegrass) to new areas.
- Ozone exposure and long photoperiod can lead to significant foliar injury and growth reductions in certain forb and grass species
- Adaptation: Changes in management due to future warming:
  -Adult ewes outside in winter
  -Ewes and offspring will come out some weeks earlier




Regional implications:
B) Atlantic region

- Potential increase annual grass productivity and growing season
- Changes in livestock management: Increased grazing season length
- Incidence of heat stress (higher temperatures + wet weather) on animal productivity, health issues and welfare
- Adaptation:
  - Presence of trees at low density (shelter & longer growing season by reducing evapotranspiration)
  - Infrequent mowing, reducing tillage, key pasture reseeding time
  - New grass breeds (Adapt+mitigation) or existing forages (e.g. maize)

Regional implications:

C) Continental region

- Potential increase in productivity in managed grasslands
- Increased variability in climate and extreme events may constrain increase in forage production under certain conditions (e.g. summer droughts)
- Adaptation:
  - Enhancing the genetic diversity within populations of species is generally recommended to cope with extreme hot and dry summer conditions
  - Dairy goat industry development may be favoured

Regional implications:

D) Alpine region

- Low biomass response to elevated CO_2, constrained by nutrient limitations.
- Warming trends may extend the growing season, enhancing grassland productivity. Projected decrease in summer rainfall may partially counteract this effect.
- Increase of heatwaves frequency: Alpine breeds are specially sensitive to extreme heat events
- Adaptation:
  - Mountainous habitats are very sensitive to anthropogenic activities and management decisions (grazing pressure)

Regional implications:

E) Southern (Mediterranean) region

- Reduction in forage yields and quality due to less rainfall and risk of drought projection
- Grazing season is expected to be shortened. Grazing will suffer from irregular patterns due to extreme events.
- Adaptation:
  - Flexible grazing and access to feed (e.g. by-products, crop residues…)
  - Nutrition for heat stress periods: e.g. high energy density, increasing number of meals, shifting meals to evening, supplements…
  - Features in barns/landscape for shelter, ventilation, spraying, shade…
  - Diverse pastures to enhance resilience. Animal and plant breeding



Thank you!

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General strategies for forage production to face CC

- Increasing mixed legume-grass pastures to adapt to potential shortages of global protein sources in Europe, or to face the expected decreased of protein content.
- Grazing/fodder management to cope with increased inter and intra-annual variability in forage quantity and quality.
- Underutilized feedstuffs from agro-industry by-products
- Reduced tillage for soil moisture conservation and increased long-term productivity
- Improved plant breeding (long-term)

General strategies to cope with heat stress:

- General management: physical protection (shading), ventilation, adequate stocking density and airspace
- Genetic selection of heat resistant breeds: breeds from tropical and arid areas are more efficient and resilient under heat stress conditions.
- Nutritional management: use of high energy density diets, reduce rumen degradability, strategic feeding, the use of supplements
- Reproductive technologies