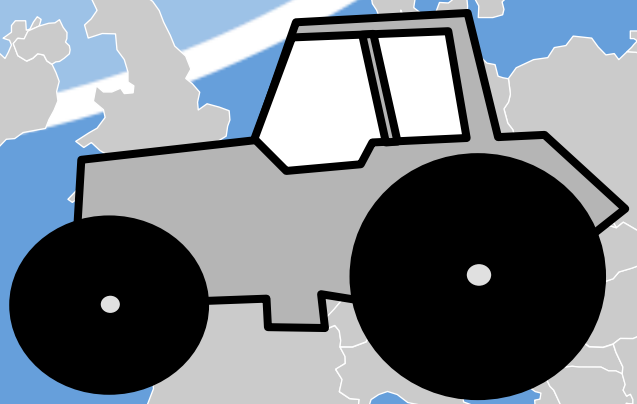
Europe's agriculture in a changing climate

Part 4: Adaptation in 21 sheets



www.climatechangepost.com

Latest update: 29 April 2019

Adaptation potential European agriculture

Contribution agriculture to GDP – Situation 2018

Contribution to GDP (%):
(UNECE and World Bank)

- 0 – 1%
- 1 – 2%
- 2 – 3%
- 3 – 5%
- 5 – 10%
- 10 – 20%
- > 20%

2040 relative to 1975:

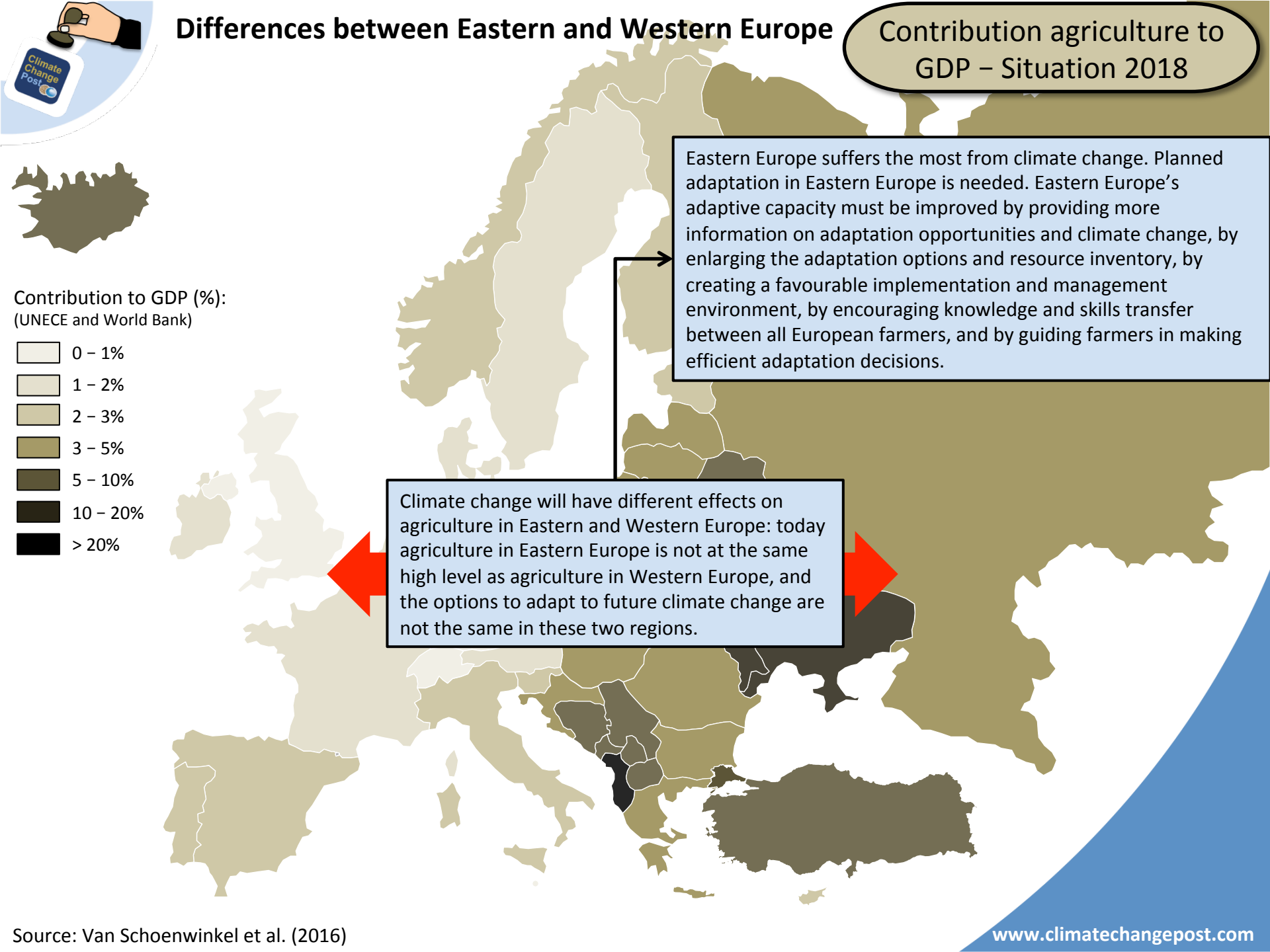
- Without adaptation: average farm profits across Europe could decline by 2.3%. Even cooler regions in central France and Germany could see declines in profitability. Projected temperature changes are more important than precipitation changes in determining the impacts of climate change over the next few decades.
- With adaptation: average farm profits across Europe would increase modestly (1.5%). However, decline could be over 10% even after adaptation in warmer regions in southern France, Spain, Italy, Greece and Portugal.

Climate changes will happen gradually, giving farmers time to adapt. In the next 50 years, climate change is probably of lower importance than the impacts of globalisation, technology and policy.

Source: Moore and Lobell (2014)

Differences between Eastern and Western Europe

Contribution agriculture to GDP – Situation 2018



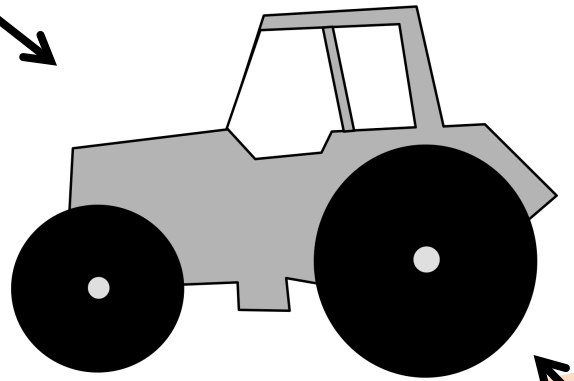
Eastern Europe suffers the most from climate change. Planned adaptation in Eastern Europe is needed. Eastern Europe's adaptive capacity must be improved by providing more information on adaptation opportunities and climate change, by enlarging the adaptation options and resource inventory, by creating a favourable implementation and management environment, by encouraging knowledge and skills transfer between all European farmers, and by guiding farmers in making efficient adaptation decisions.

Climate change will have different effects on agriculture in Eastern and Western Europe: today agriculture in Eastern Europe is not at the same high level as agriculture in Western Europe, and the options to adapt to future climate change are not the same in these two regions.

Source: Van Schoenwinkel et al. (2016)

Adaptation measures

Adaptation



Irrigation, water storage and drainage

- Expansion irrigation
- Deficit irrigation
- Capture runoff
- Capture melt water
- Drainage

Soil-related measures

- Soil improvement
- Protection against erosion
- Conserva-tion tillage
- Reduction evapo-transpiration

Policy and organization

- Financial incentives
- Institu-tional change
- Monitoring and detection
- Education and training
- Awareness raising

Crop-related measures

- Adaptation crop species
- Biomass production

Fires and floods

- Wildfires
- Floods

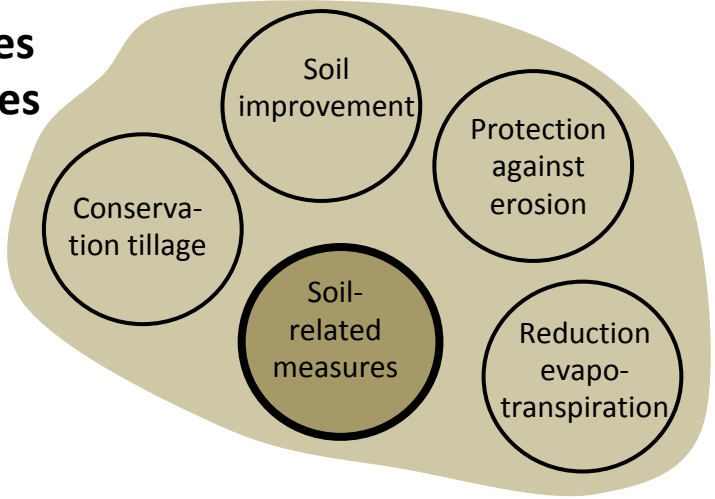
Increase financial resilience

- Insurance
- Income diversification

Farm management

- Fertilization management
- Move to higher altitudes
- Move to other areas
- Green-houses
- Management pests and diseases
- Change sowing date

Adaptation measures
Soil-related measures



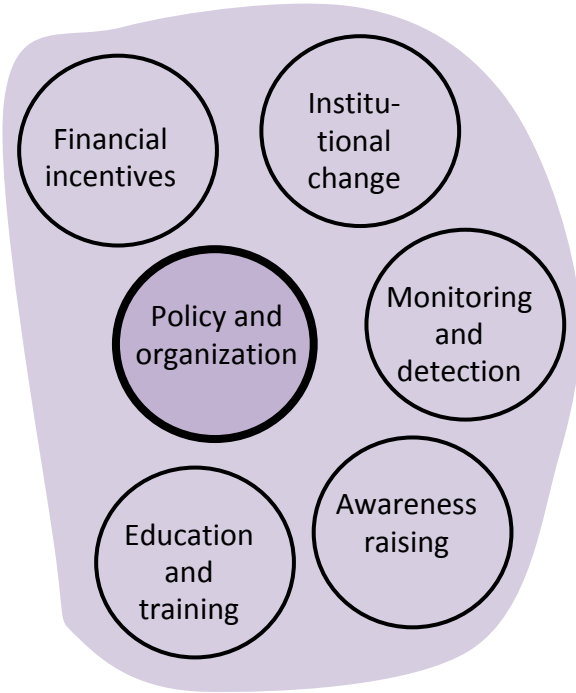
Conservation tillage: The establishment of permanent soil cover through an increase in perennial forage cultivation and the application of cover cropping techniques such as living mulch and/or intercropping; sowing winter cereals earlier, i.e. in October, would achieve effective cover and root system development already in November; crop residue retention at the soil surface and reduced or no-tillage systems (plough-less soil treatment) would also be valuable techniques. These practices lower water losses through transpiration, and decrease the release of carbon and the risk of erosion.

Soil improvement: Employment of soil improvement techniques, such as the addition of compost, to control salinity and to improve water retention

Protection against erosion: Soil erosion may be prevented by specific agricultural measures, better selection of crops and better use of efficient irrigation, by using proper growing and harvesting techniques, slope forestation, and slope water collection. Anti-erosion measures may include grassing over of cropland, cultivation of intermediate crops and the establishment of grass strips on sloped land.

Reduction evapotranspiration: A reduction in evapotranspiration can be achieved by a reduction in wind speed (using hedgerows and windbreaks); an increase in soil conductivity (mulching); and a reduction in available energy (shading). Effective shading can be achieved by anti-hail nets (where possible), which are, at the same time, an effective method of protection against hail.

Adaptation measures
Policy and organization



Financial incentives to adopt technological innovations; access to modern inputs; reformed farm subsidies; risk insurance; tax incentives for private investments; social safety nets.
The most important reason for not adopting soil fertility options is that farmers lack capital, and credit systems are poorly developed and relatively inaccessible.

Institutional change: Support for institutions offers countries win-win opportunities for reducing vulnerability to climate risk and promoting development. Key institutions include: hydrometeorology centres, advisory services, irrigation directorates, agricultural research services, veterinary institutions, producer associations, water-user associations, agro processing facilities, and financial institutions. These measures hold the greatest promise for Eastern European countries.

Monitoring and detection: Targeted weather forecasts for farmers by meteorological services; monitoring and detection of new pests and diseases for the crop, livestock and forestry sectors; improved drought monitoring in the South.

Awareness raising: Especially in the South, awareness about droughts must be raised.

Education and training: Farmers have to learn how to integrate new practices into their systems. The main reason for farmers and communities not to implement appropriate soil moisture management is lack of information, education, and training. Know-how transfer is also relevant with regard to animal husbandry, animal nutrition and animal health. Links between research and practice (that is, between scientists, advisors and teachers) must be improved.

Adaptation measures
Farm management

Fertilisation management: The use of fertilisers needs to be adapted to an increased demand for nitrogen with increasing CO_2-content. On the other hand, increased nitrogen fertilisation increases water use, so that a suitable balance needs to be achieved. Water quality may be polluted by fertilizers through increased point-source and diffusive pollution (more runoff). Fertilizer efficiency and application methods need to be improved and farmers should be made aware of best practices regarding the application of manures and fertilizers and the control of soil erosion. The use of buffer strips (hedgerows, vegetative rows) beside watercourses can be effective in reducing nutrient leaching.

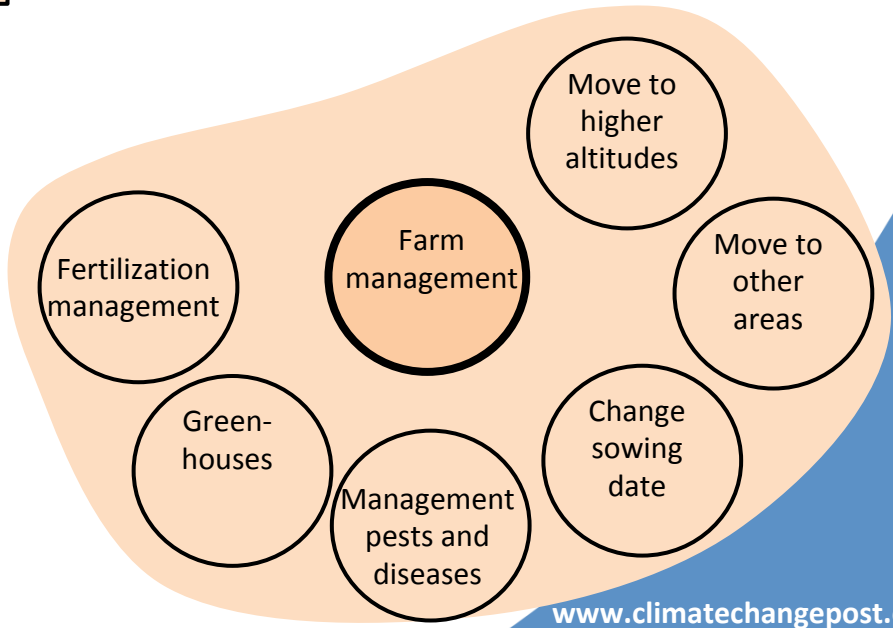
Management pests and diseases: The introduction of resistant or less-susceptible varieties is one approach. To deal with new crop pests a sustainable integrated pesticides strategy should be developed. The use of new pesticides needs to be carefully evaluated with respect to the potential impacts on water quality. Livestock disease adaptation measures include vaccination of both the domestic and wild populations. An increased use of pesticides is expected due to climate change.

Greenhouses: Making wider use of greenhouse controlled cultivation

Change sowing date: Summer cereals can be sowed earlier due to increasing temperatures. This brings the advantages of higher soil moisture levels in the early year, potentially increased yield through longer growth phase, and decreased risk from heat waves and water stress. On the other hand, the risk of damages through late frosts increases.

Move to other areas: Crops may be shifted to areas where the climate is more suitable for their cultivation.

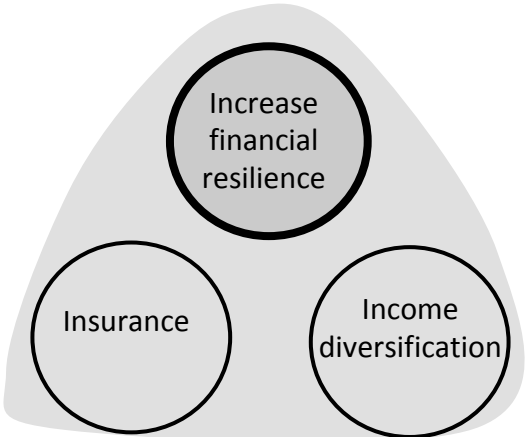
Move to higher altitudes: In the Alps, cultivation of higher altitudes to sustain livestock will likely become more lucrative.



Adaptation measures
Increase financial resilience

Financial insurance for extreme events can play an important role in hedging against the implications of climate change. Farmers that have more crop diversity less likely adopt an insurance scheme that buffers against the implications of crop failure: crop diversification may act as a substitute strategy for adopting disaster insurance.

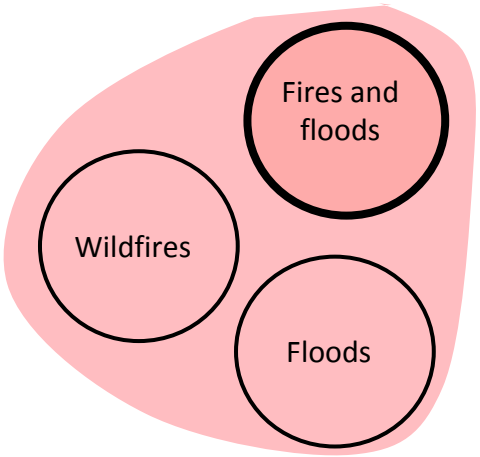
Income diversification: In many regions of Europe, farms have become highly specialized enterprises. Farms can adapt to climate change by replacing part of their production activities by alternative, income generating activities like nature management and development, biological farming in water extraction areas, processing and sale of products on the farm, agro-tourism, health care. Besides income diversification, move to biomass production or crop diversification are farm level strategies that could increase resilience and reduce vulnerability to external shocks.



Adaptation measures
Fires and floods

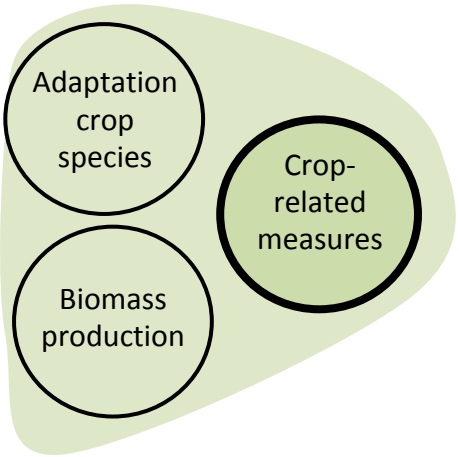
Wildfires: In response to forest fires during summer drought, the introduction and maintenance of firebreaks (where areas are cleared or burnt under controlled conditions) with access to water for fire fighting, will limit fire spread and damage.

Floods: Improved drainage increases water transfer from soils to watercourses, thus increases flooding probability. This can be balanced by providing 'breaks' such as hedges and increasing the area of undrained farm woodlands to buffer peak rainfall events, slowing the movement of water from soil to watercourse.



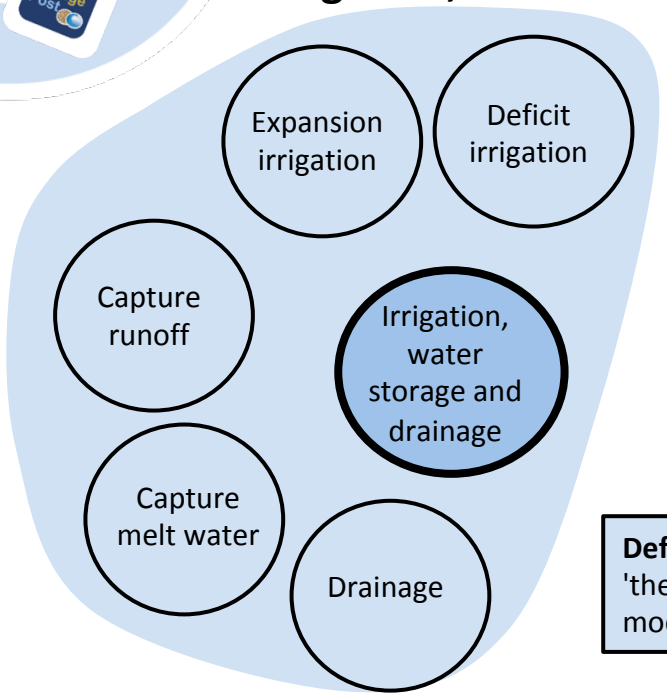
Adaptation measures
Crop-related measures

Adaptation and diversification of crop species: The choice of crop variety and genotype which better resist saline conditions, wetness, drought, pests, diseases, frost and a shorter growing season is considered the most important adaptation strategy to climate change in the agricultural sector.
Soil water use can be improved by reducing area of spring crops and increasing area of winter crops. In France, for instance, winter barley seems to be more resistant to warming than spring barley. As such, a possible pathway of adaptation could be shifting from spring to winter varieties. In fact, the share of winter barley in total barley acreage in France has already increased from 21% in the period 1951-1960 to about 70% in the period 2006-2015, indicating that crop choice may be moving toward more robust varieties.



Biomass production: Cultivation of renewable primary resources for energy generation, especially interesting for agricultural areas that will no longer be needed for food and fodder production in the long term.

Adaptation measures
Irrigation, water storage and drainage



Expansion of irrigation: switching irrigations technologies from gravity to drip or sprinkler feed system; irrigating at night; increasing storage capacity for surface water (construction of retention reservoirs and dams), and groundwater (aquifer recharge); rainwater harvesting and storage; use of 'grey' water (treated effluent); water transfer; desalination of sea water; deep well pumping.
If the agriculture industry aims to adapt by increasing irrigation, the water resources necessary may need to be supplied from within the farm. This may be achieved by on-farm rainwater harvesting and establishing small-scale water reservoirs on farmland.
Farm ponds that catch precipitation runoff could be used against fire and for irrigation.

Deficit irrigation is a technique that aims to reduce the amount of water applied to below the 'theoretical irrigation need' on the basis that the substantial water savings realised outweigh the modest reduction in crop yield.

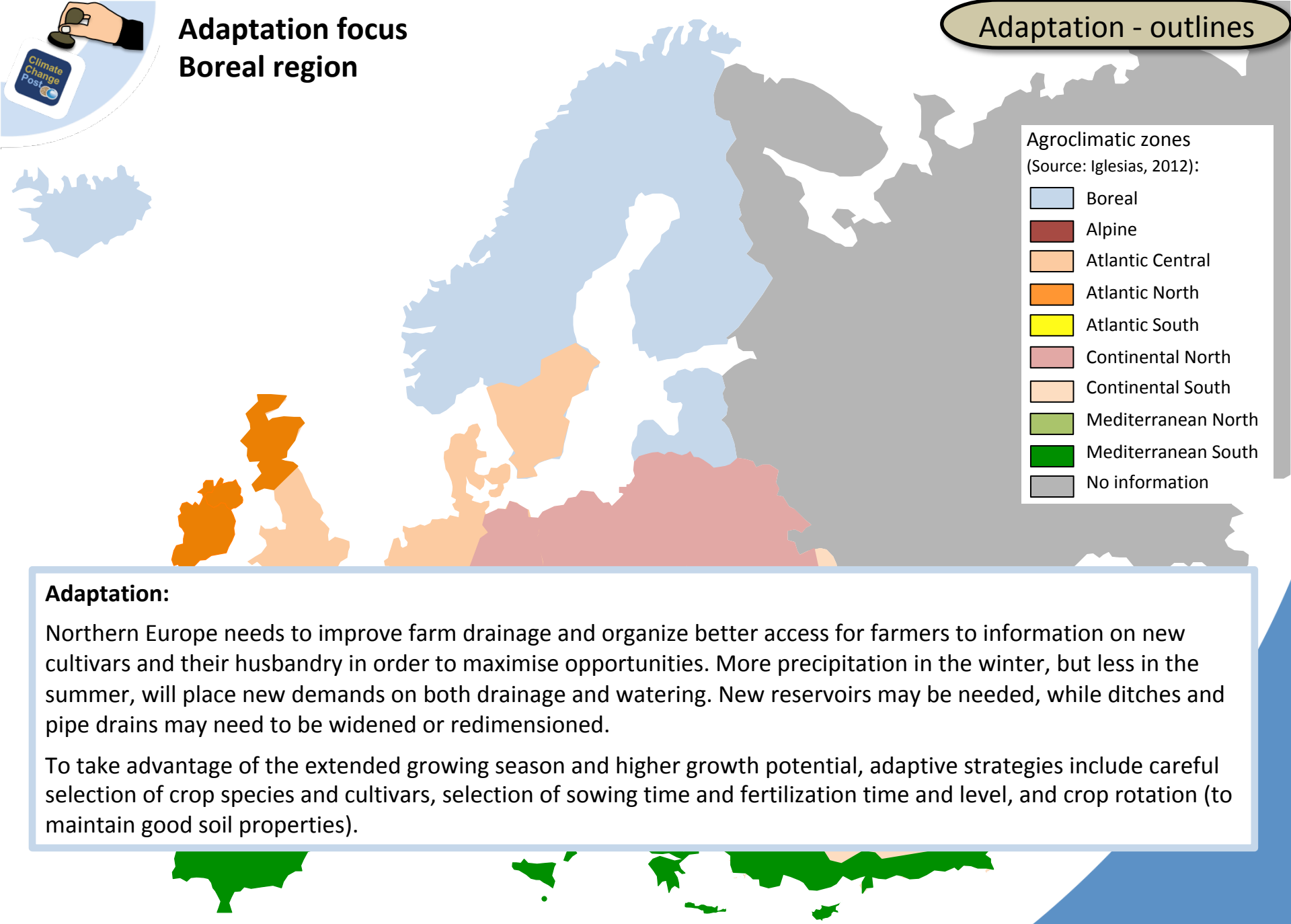
Drainage: More precipitation in the winter, but less in the summer, will place new demands as regards both drainage and watering. New reservoirs may be needed, while ditches and pipe drains may need to be widened or redimensioned.
Drainage, especially of heavy soils, could have an important role in drought mitigation; it is known that drained soils allow field labour in the spring earlier than undrained soils; earlier planting in spring enables earlier plant growth and root development to take up the water from deeper parts of soil during dry period; in addition, drained soils increase infiltration and decrease runoff.

Capture runoff: Provision of obstacles to runoff water, keeping precipitation where it falls in a growing season, with various tillage techniques and soil formations (ridges and protective strips formed with stubble worked into the soil).

Capture melt water: Mountain communities that depend upon melt waters for their domestic and agricultural supply will need to invest in water capture and storage systems to compensate for the projected changes in seasonal water availability (low summer discharge from glaciers) that will affect these regions.

Adaptation focus
Boreal region

Adaptation - outlines



Adaptation:

Northern Europe needs to improve farm drainage and organize better access for farmers to information on new cultivars and their husbandry in order to maximise opportunities. More precipitation in the winter, but less in the summer, will place new demands on both drainage and watering. New reservoirs may be needed, while ditches and pipe drains may need to be widened or redimensioned.

To take advantage of the extended growing season and higher growth potential, adaptive strategies include careful selection of crop species and cultivars, selection of sowing time and fertilization time and level, and crop rotation (to maintain good soil properties).

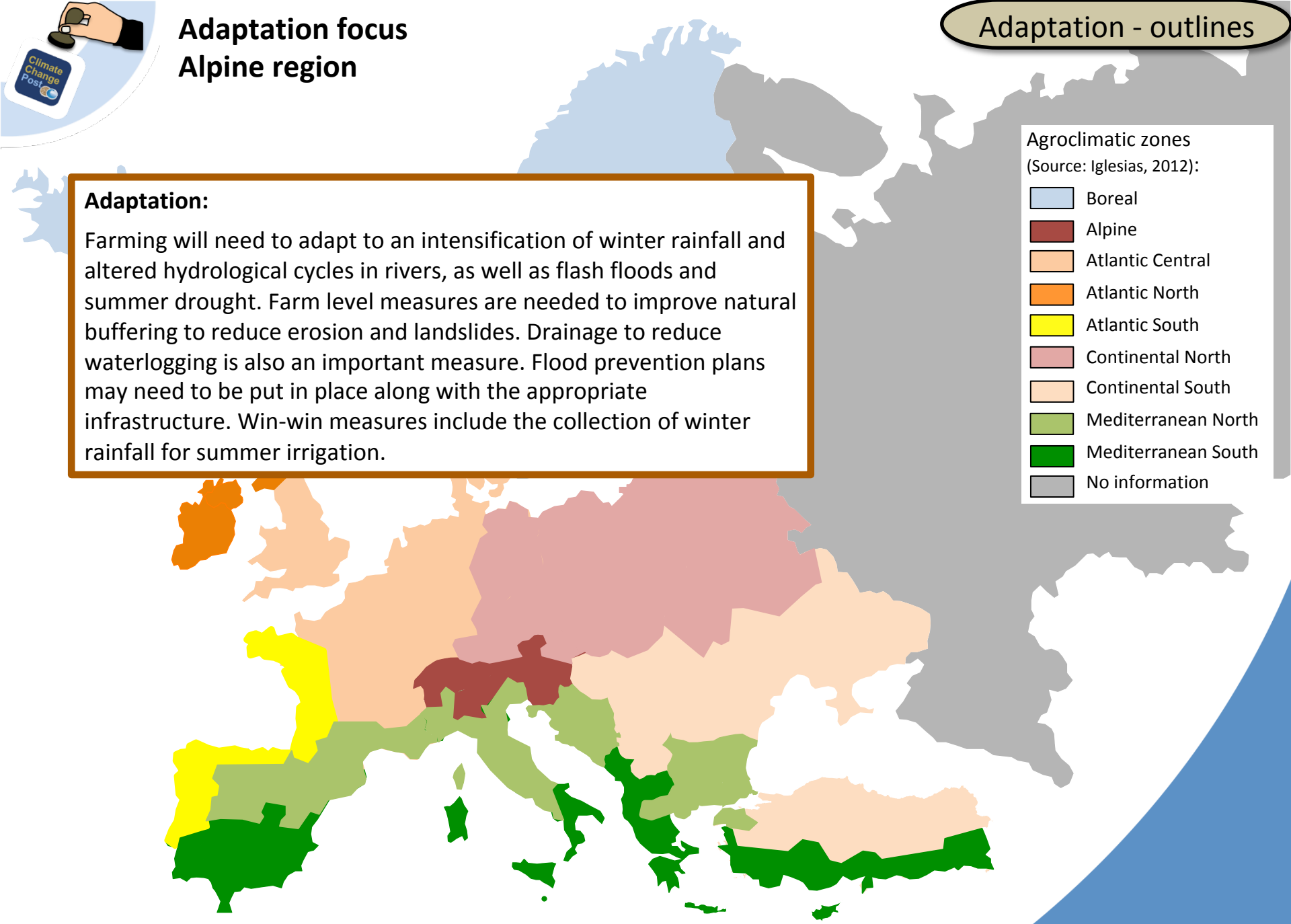
Sources: Swedish Commission on Climate and Vulnerability (2007); Iglesias (2012); Uleberg et al. (2014)

Adaptation focus
Alpine region

Adaptation - outlines

Adaptation:

Farming will need to adapt to an intensification of winter rainfall and altered hydrological cycles in rivers, as well as flash floods and summer drought. Farm level measures are needed to improve natural buffering to reduce erosion and landslides. Drainage to reduce waterlogging is also an important measure. Flood prevention plans may need to be put in place along with the appropriate infrastructure. Win-win measures include the collection of winter rainfall for summer irrigation.

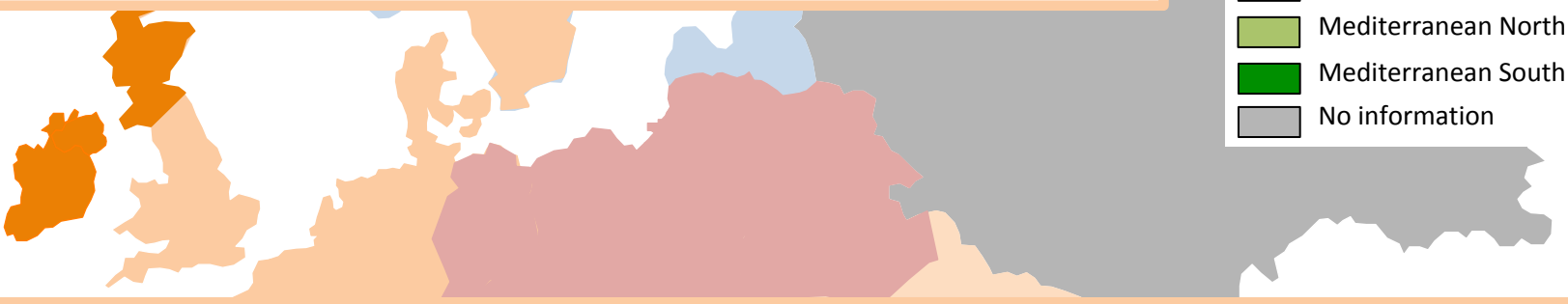


Source: Iglesias (2012)

Adaptation focus
Atlantic Central and Atlantic North regions

Adaptation:

Farmers will need access to information on new farming techniques and species to benefit from opportunities. Farming will have to adapt to the risks of intensification of winter rainfall as well as reduced summer rainfall and, under warmer conditions, the likely introduction of new pests and diseases. Farm-level measures are needed to allow rainwater harvesting and improve drainage to reduce waterlogging while improving crop growth and stock health and reducing the risk of pollution from run-off and fertilizer leaching. Also, measures will be needed to protect land from salt water intrusion.



In the Netherlands, tailor-made adaptation strategies have been advised:

- Subsoil drainage of peatlands is a way to combat subsidence and oxidation of peat related to lowering of groundwater tables during periods of drought. Drainage tubes are laid out in the field perpendicularly to ditches, below the water level in the ditches. This way, the water from ditches infiltrates into the subsoil to increase the groundwater level.
- Floating greenhouses are greenhouses on the water surface, which move up and down with the water level, while offering space for water storage in low-lying polders.
- Salinization of agricultural land calls for measures such as: the retention and storage of rain water, a better separation of fresh and salt water, and the increase of surface water levels to suppress salt water seepage; the growing of halophyte cultures; the conversion of salted arable land to grassland, nature or sea culture parks; irrigation using brackish water; use or design of salt tolerant crops; changing land use.

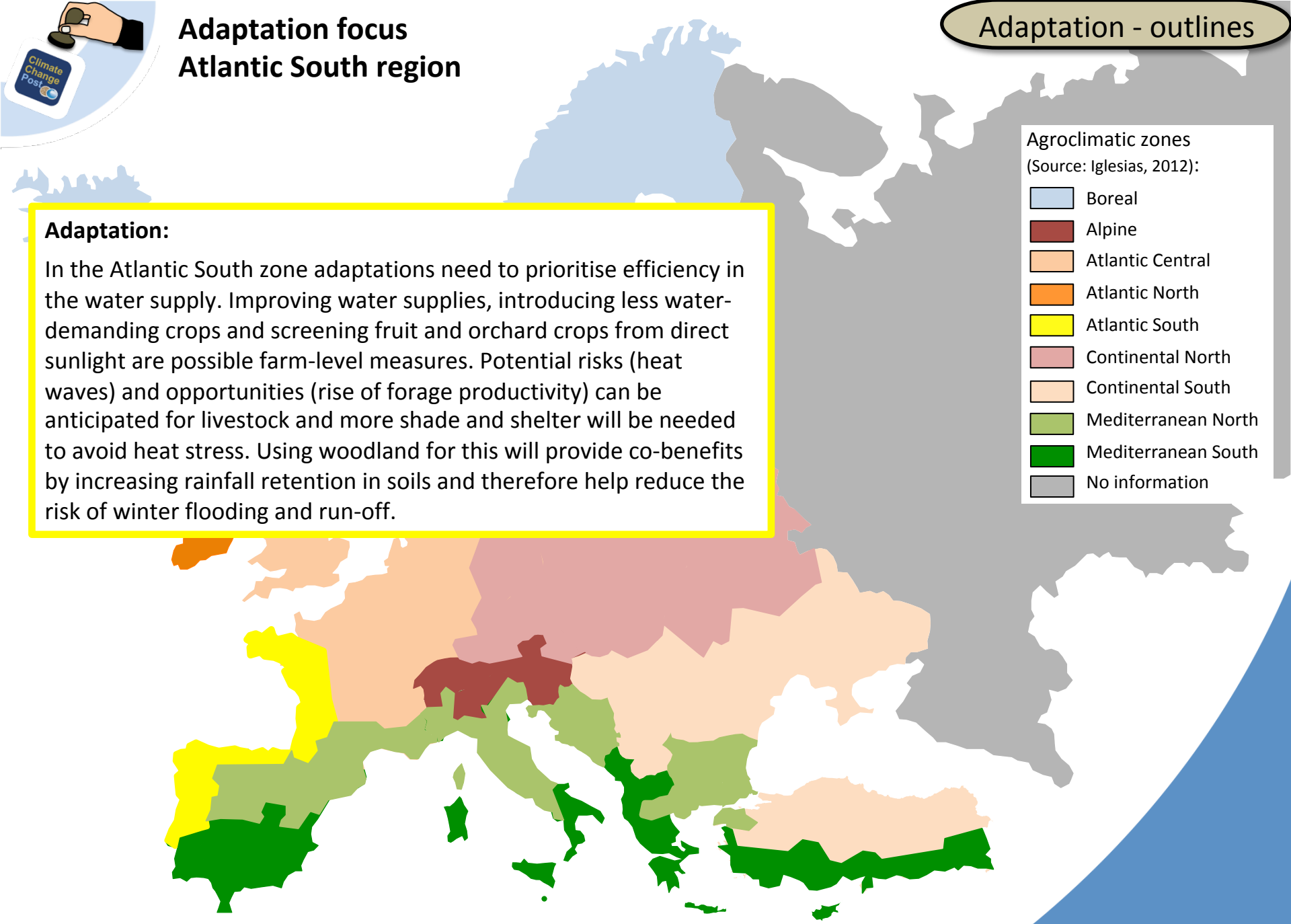
Source: Sources in Nillesen and Van Ierland (2006); Iglesias (2012)

Adaptation focus
Atlantic South region

Adaptation - outlines

Adaptation:

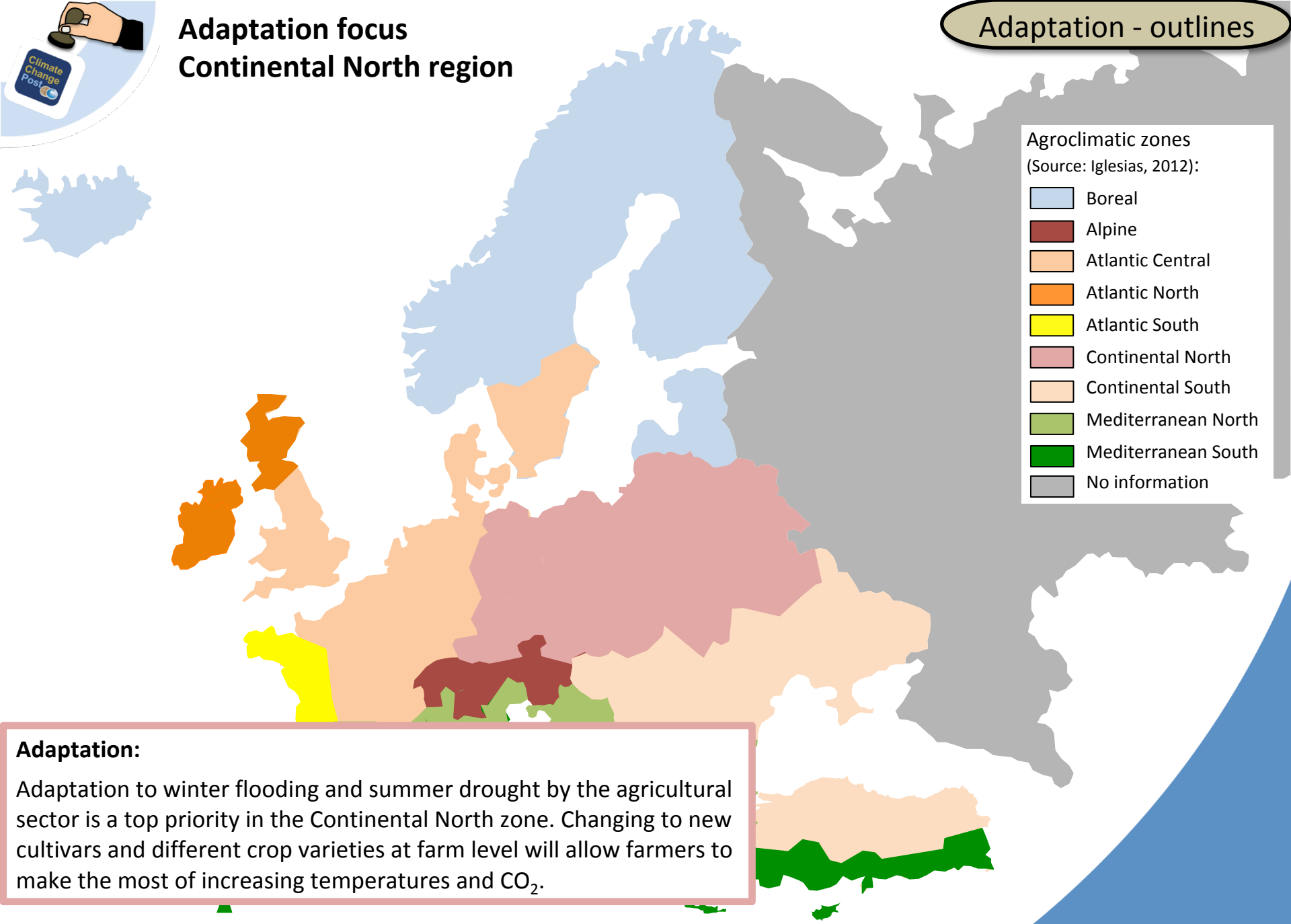
In the Atlantic South zone adaptations need to prioritise efficiency in the water supply. Improving water supplies, introducing less water-demanding crops and screening fruit and orchard crops from direct sunlight are possible farm-level measures. Potential risks (heat waves) and opportunities (rise of forage productivity) can be anticipated for livestock and more shade and shelter will be needed to avoid heat stress. Using woodland for this will provide co-benefits by increasing rainfall retention in soils and therefore help reduce the risk of winter flooding and run-off.



Source: Iglesias (2012)

Adaptation focus
Continental North region

Adaptation - outlines



Adaptation:

Adaptation to winter flooding and summer drought by the agricultural sector is a top priority in the Continental North zone. Changing to new cultivars and different crop varieties at farm level will allow farmers to make the most of increasing temperatures and CO_2.

Source: Iglesias (2012)

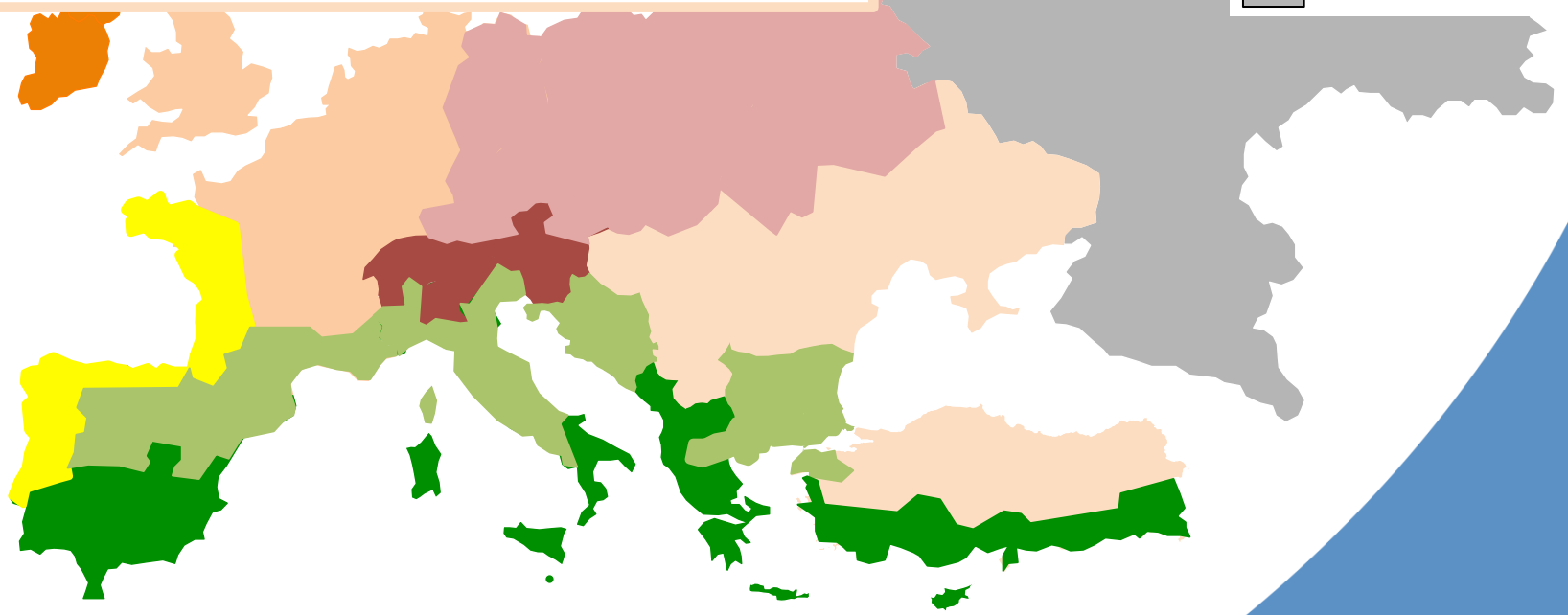
Adaptation focus
Continental South region

Adaptation - outlines

Adaptation:

The priorities for adaptation measures will be to identify suitable new crops and new cultivars that can be grown in place, or in combination with, those currently cultivated. Priority should be given, by farmers, to conserving water on their farms to provide a source for irrigation and to apply efficient irrigation schemes.

Climate change may increase soil erosion: in Hungary, erosion occurs on about 25% of the country's territory. Protection against erosion enhances the preservation of the quality and quantity of the soil.



Sources: Farago et al. (2010); Iglesias (2012)

Adaptation focus
Mediterranean North and South regions

Adaptation - outlines

Adaptation:

The efficiency of the irrigation systems needs to be improved substantially in order to continue satisfying the region's future food demand with irrigated crops. Water withdrawal for irrigation most likely needs to be reduced, because the availability of water resources will reduce under climate change whilst water stress is already a major issue in this region. In fact, the share of irrigated cropland in future crop production needs to be considerably lower, despite improvements in irrigation efficiency. In addition, the productivity of existing rain-fed cropland systems needs to be improved.

Other options include changing crop types and management practices to one which are less water demanding and better adapted to climate conditions under water scarcity. In the south of Europe, short season cultivars that are planted earlier are more likely to reach maturity in advance of the arrival of extreme high summer temperatures, thus avoiding injury from heat and water stress.

Crop species diversification should focus on drought tolerant and salt tolerant varieties. Wider use can be made of greenhouse controlled cultivation.

Sources: Giannakopoulos et al. (2005); Moriondo et al. (2010); Iglesias (2012)

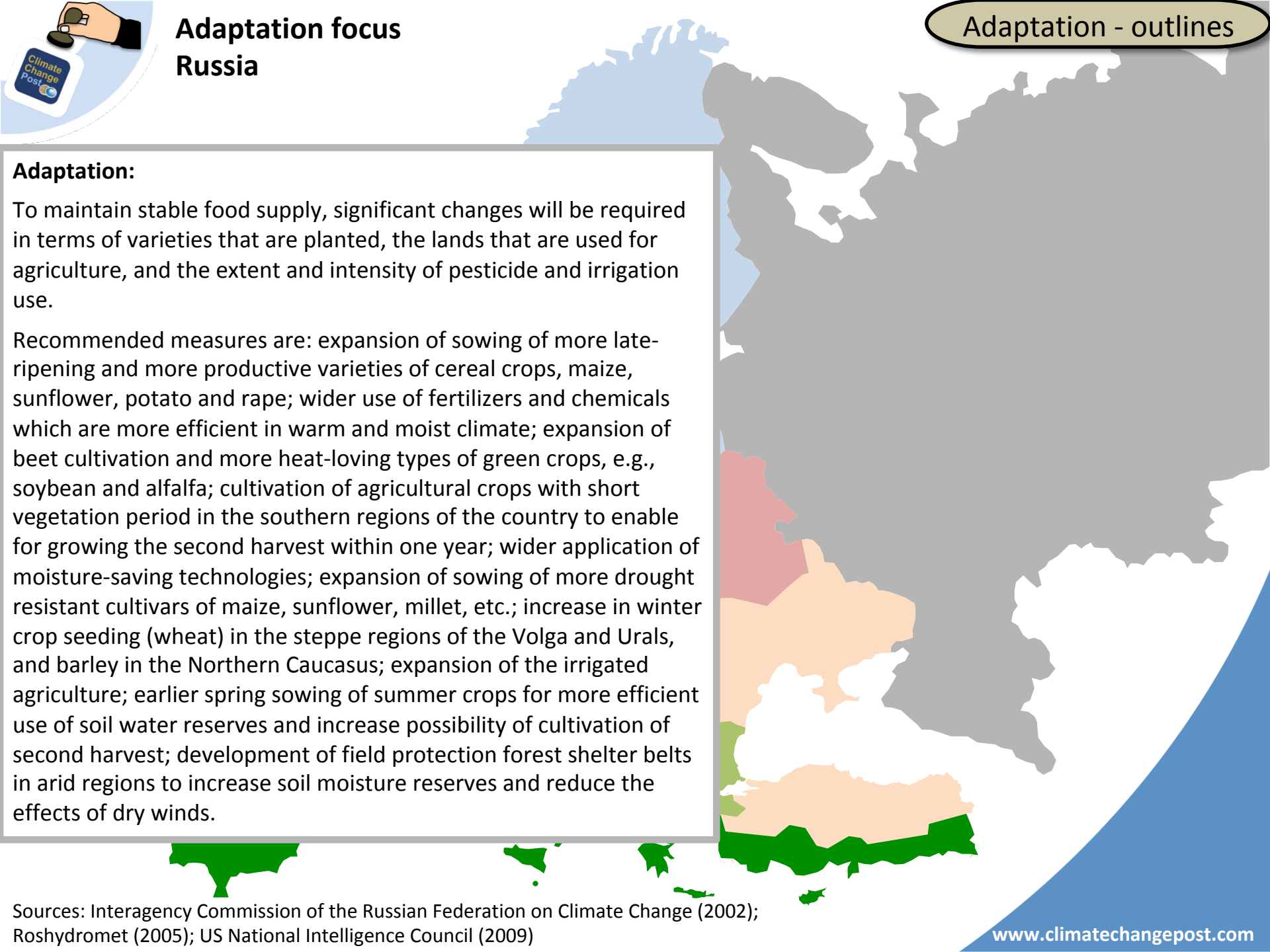
Adaptation focus
Russia

Adaptation - outlines

Adaptation:

To maintain stable food supply, significant changes will be required in terms of varieties that are planted, the lands that are used for agriculture, and the extent and intensity of pesticide and irrigation use.

Recommended measures are: expansion of sowing of more late-ripening and more productive varieties of cereal crops, maize, sunflower, potato and rape; wider use of fertilizers and chemicals which are more efficient in warm and moist climate; expansion of beet cultivation and more heat-loving types of green crops, e.g., soybean and alfalfa; cultivation of agricultural crops with short vegetation period in the southern regions of the country to enable for growing the second harvest within one year; wider application of moisture-saving technologies; expansion of sowing of more drought resistant cultivars of maize, sunflower, millet, etc.; increase in winter crop seeding (wheat) in the steppe regions of the Volga and Urals, and barley in the Northern Caucasus; expansion of the irrigated agriculture; earlier spring sowing of summer crops for more efficient use of soil water reserves and increase possibility of cultivation of second harvest; development of field protection forest shelter belts in arid regions to increase soil moisture reserves and reduce the effects of dry winds.



Sources: Interagency Commission of the Russian Federation on Climate Change (2002); Roshydromet (2005); US National Intelligence Council (2009)

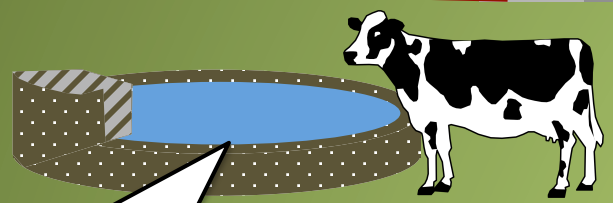
Adaptation strategies livestock husbandry

Adaptation - outlines

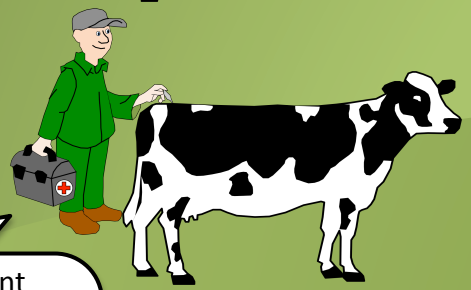
Improve farmhouse micro-climate management through the use of thermal insulating construction materials and modern ventilation systems (including wetting of cattle surface) to protect livestock from extreme conditions and increase productivity.

For grazing animals, provision of shaded areas in pasture, and trees for shade can improve the resilience to extremes.

Introduce more heat-tolerant and drought-resistant breeds of cattle and sheep.



Special emphasis should be given to efficient and secure water supply.



A new range of forage crops, such as soya, can be grown, and current forage crops can be grown during early spring and late autumn. Reduced yields of current forages could also be compensated for by the introduction of more drought and heat resistant forage varieties.

Veterinary services can be improved for efficient handling (controlling) of epidemics and the condition of livestock. Services include use of antibiotics (but limited by increasing resistance); new medical interventions, including use of feeds and supplements; monitoring of health status; genetic approaches for resilient breeds.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