

Improving basin micro-climate:

How and to what extent



What is microclimate?

- Micro-climate is the climate of a small area which may be different from that of the general region
- Microclimates are the wonderful local interplays between factors such as soil temperature, air temperature, wind directions, soil moisture and air humidity – affected by day-night effects and seasonal effects

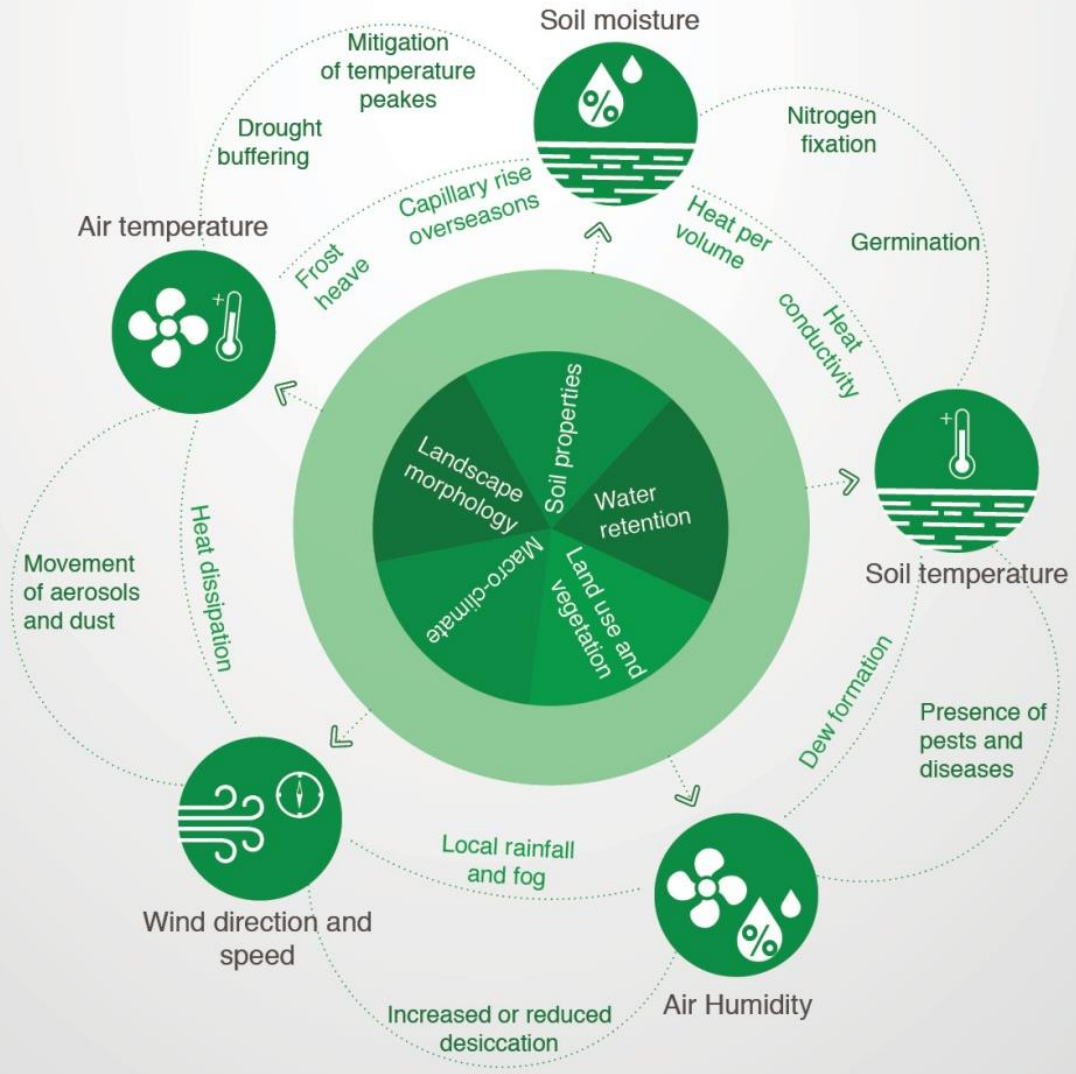
Spatial and temporal scales of climate defined by Geiger (1961)

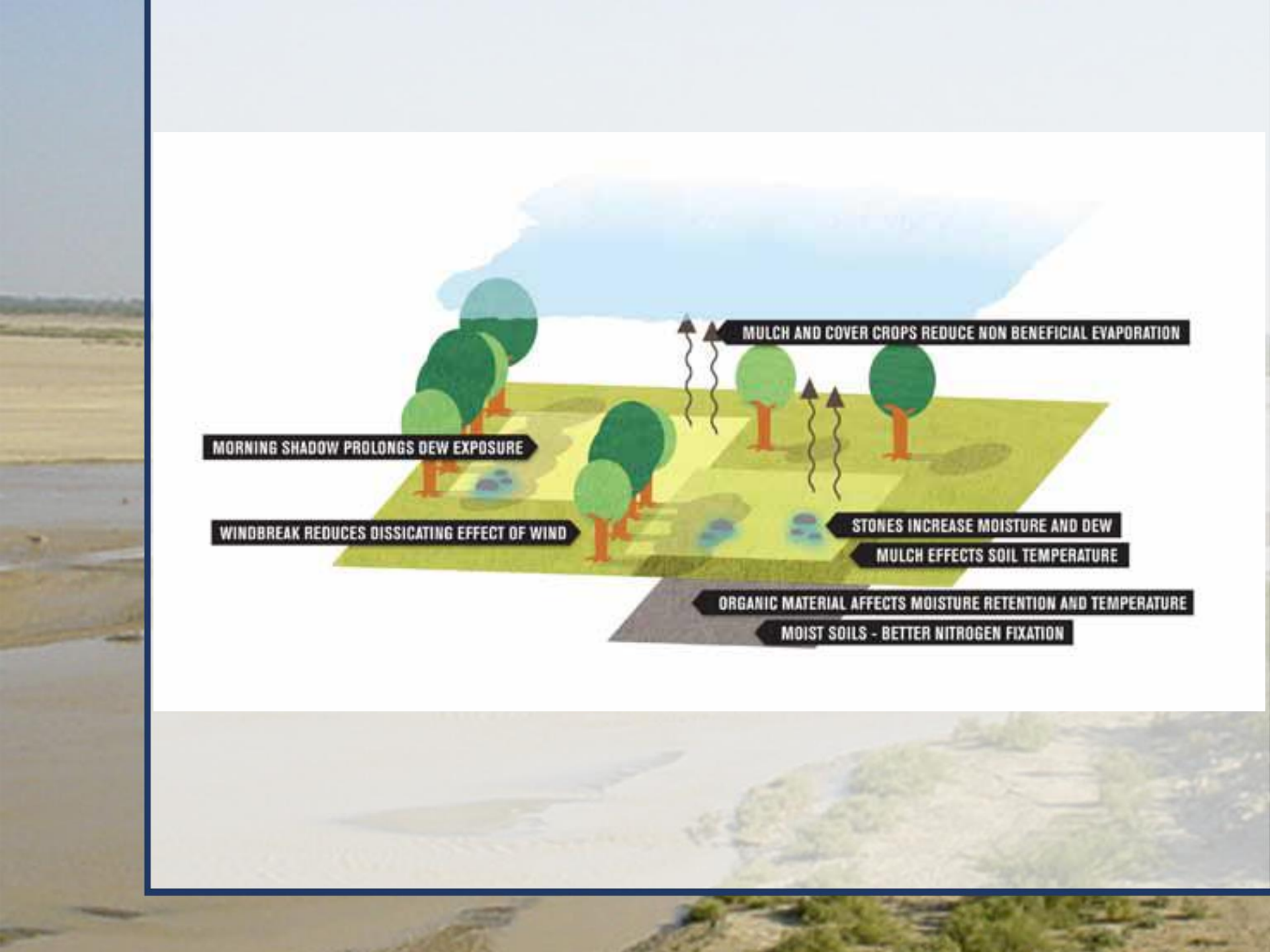
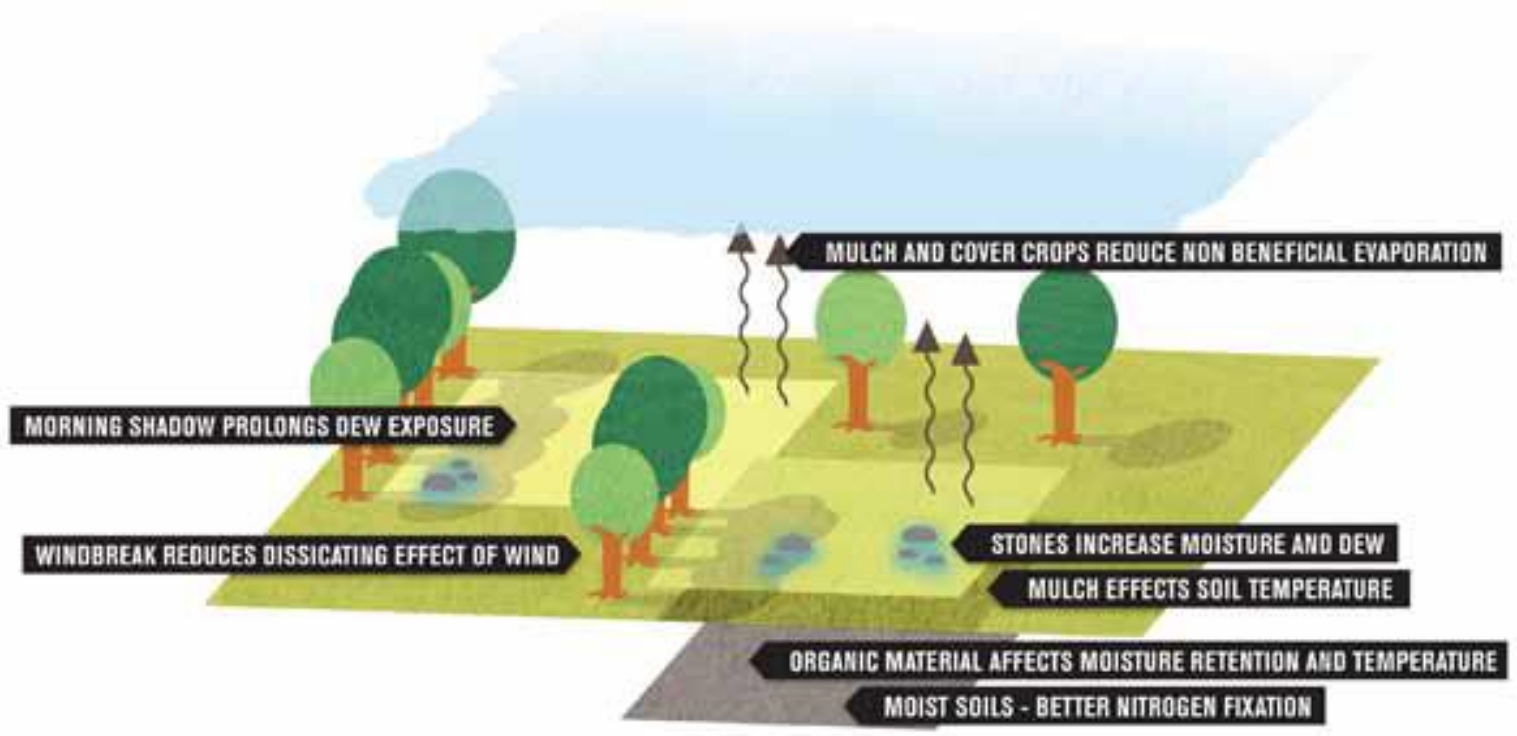
Table 1-1. Spatial and temporal scales of climate. (After M. M. Yoshino [111])

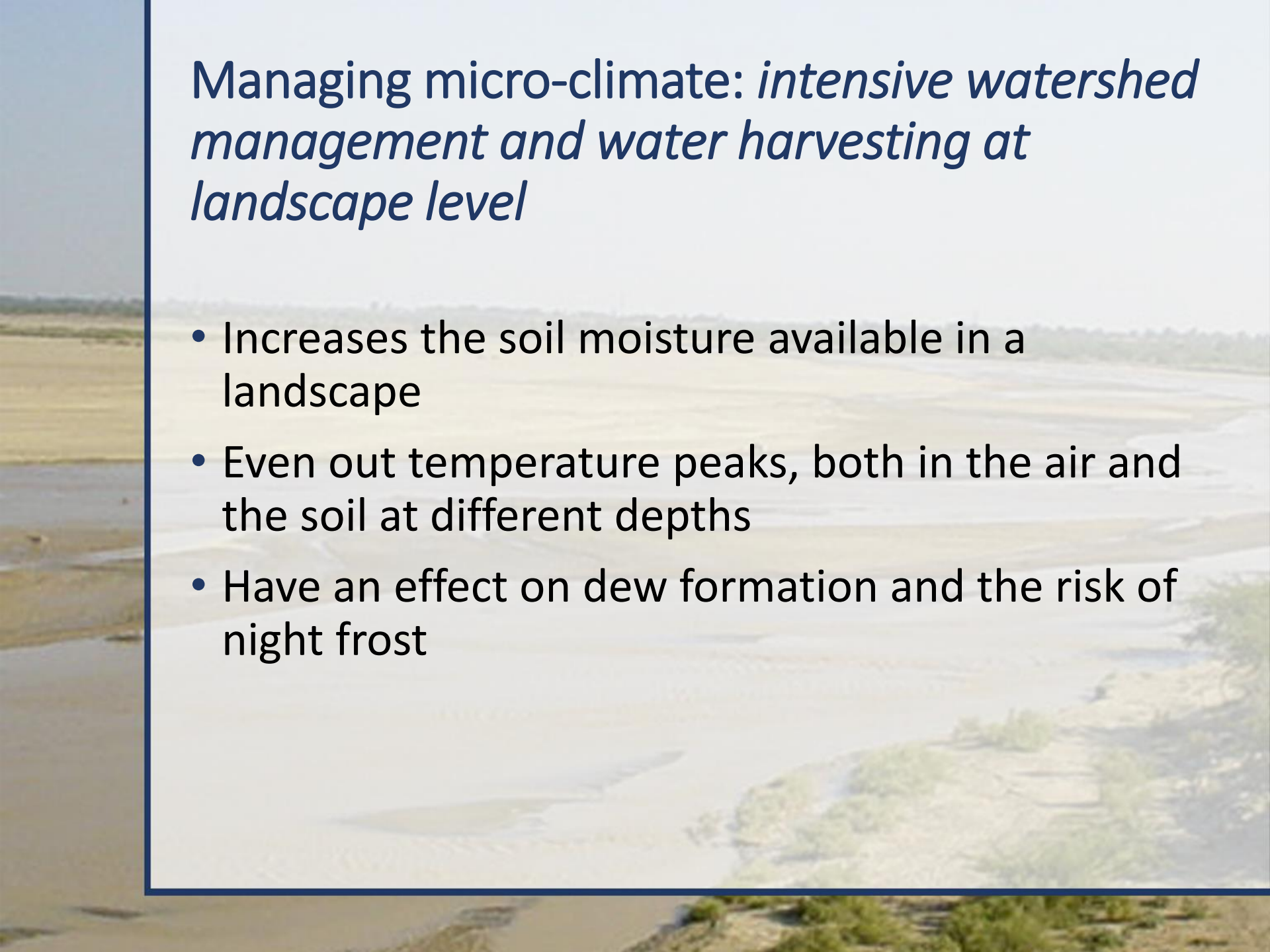
Scale	Horizontal range (m)	Vertical range (m)	Primary time scale (sec)
Microclimate	$10^{-3} - 10^2$	$- 10 - 10^1$	$< 10^1$
Local climate	$10^2 - 10^4$	$5 \cdot 10^0 - 10^3$	$10^1 - 10^4$
Mesoclimate	$10^3 - 2 \cdot 10^5$	$5 \cdot 10^2 - 4 \cdot 10^3$	$10^4 - 10^5$
Macroclimate	$> 2 \cdot 10^5$	$10^3 - 10^4$	$10^5 - 10^6$

Why is understanding micro-climate important?

- The management of microclimate is a powerful, but not well understood frontier to smoothen out the impacts of climate change.
- Much priority is given to predictions and trends of meso and macro-climate. However, how this translates in weather in time and space at a locality is poorly understood.
- Microclimates for instance help to explain the differences in vegetation and crop yields that occurs on local scale due to the amount of sunlight, nutrients and water that plants receive.







Managing micro-climate: *intensive watershed management and water harvesting at landscape level*

- Increases the soil moisture available in a landscape
- Even out temperature peaks, both in the air and the soil at different depths
- Have an effect on dew formation and the risk of night frost





Managing micro-climate: *Regreening the landscape*

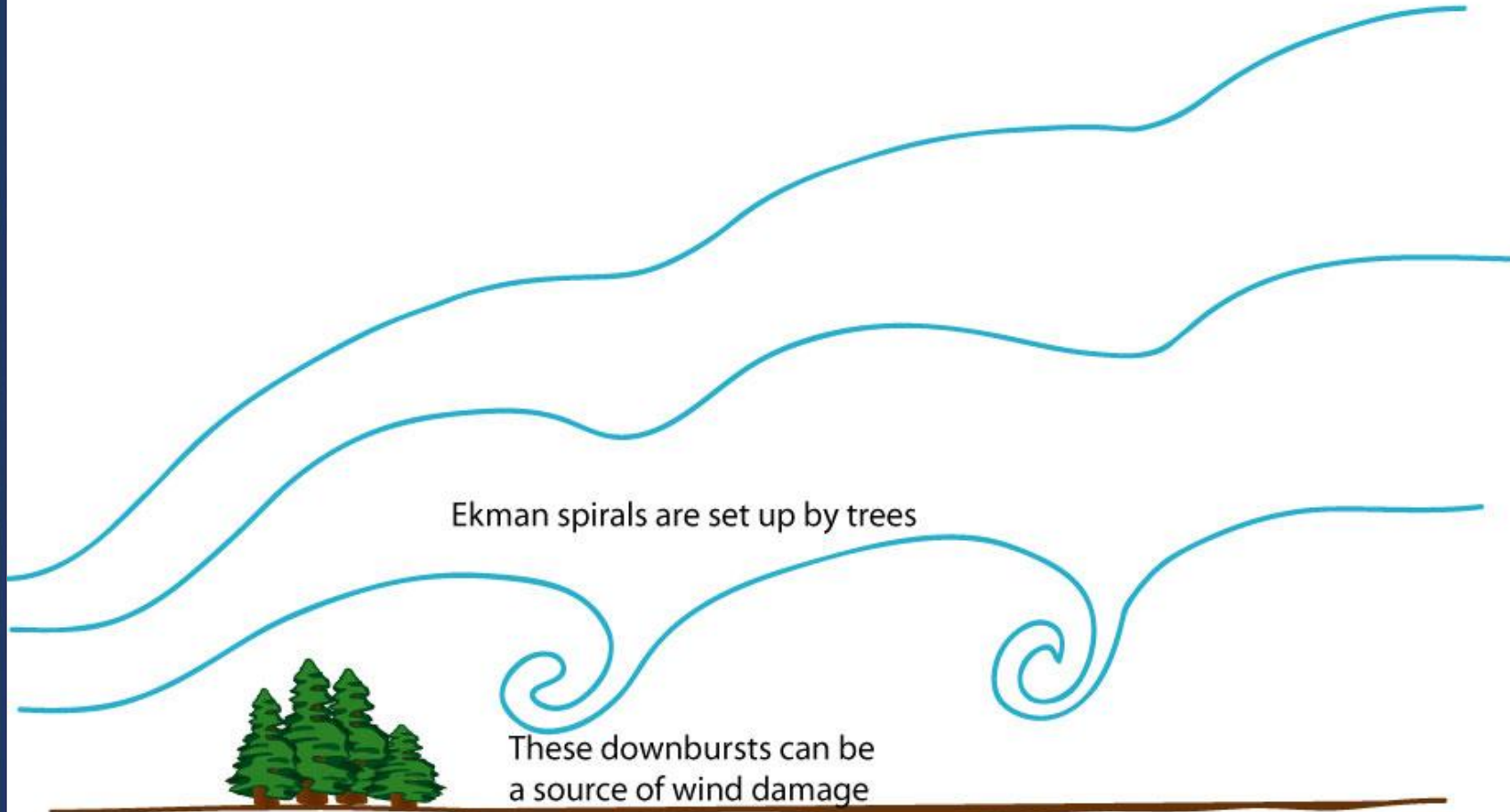
- Vegetation influences the amount of heat absorbed and the amount of radiation
- The circulation of air temperatures at different elevations, wind speed directions and the transportation of dust particles are influenced.
- Vegetation canopy can retain moisture.



Trees can compress the streamline 20 to 40 times the height of the tree

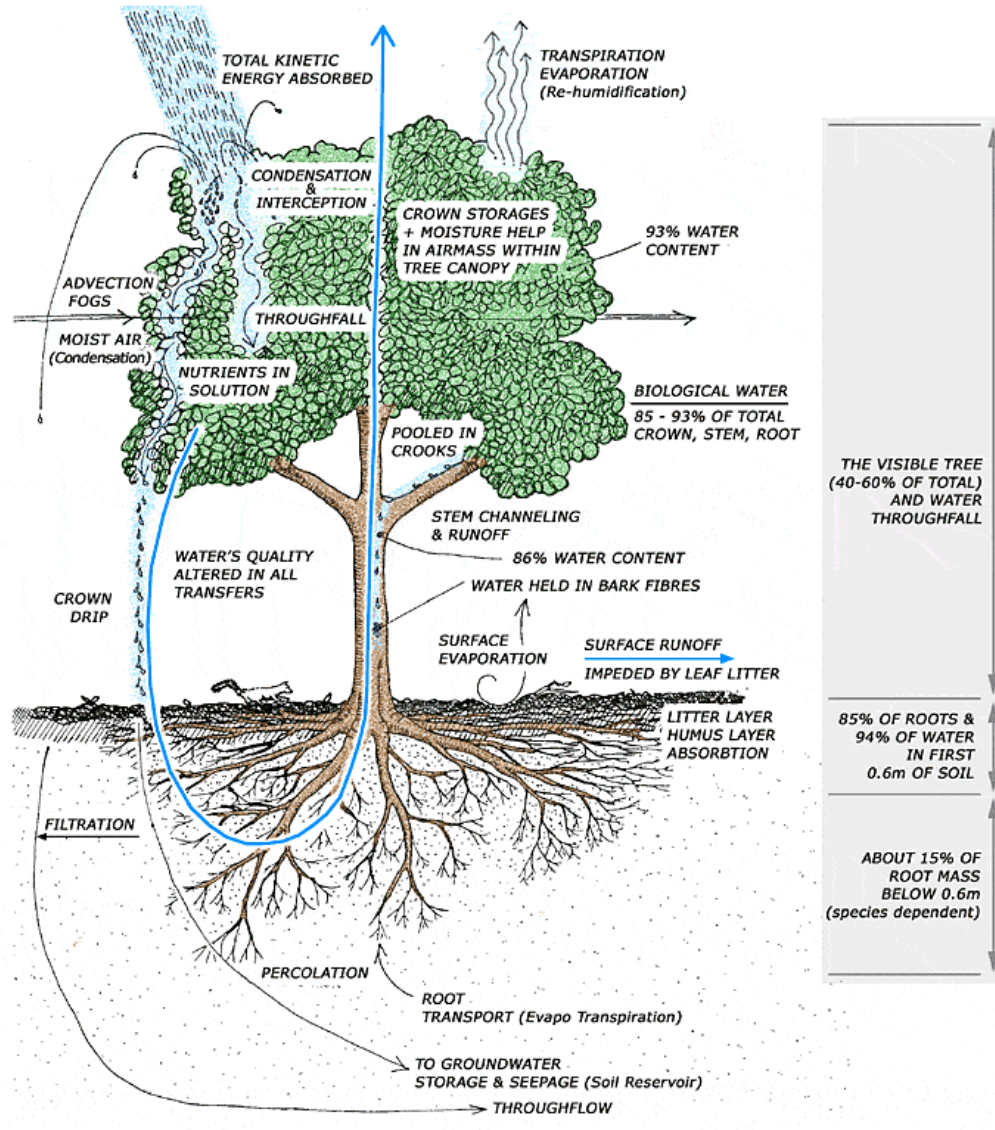
Ekman spirals are set up by trees

These downbursts can be a source of wind damage



HOW A TREE INTERACTS WITH RAIN IN AN UNDISTURBED FOREST

EVERY TREE, EVERY PLANT SPECIES, INTERCEDES IN RAIN TO CHANGE THE COMPOSITION, ENERGY AND DISTRIBUTION OF WATER, THE OVERALL EFFECT OF TREES IS TO **MODERATE AND CONSERVE** INCOMING ENERGY.



Capillary rise in soils

- In soil, there are many vertical channels - called micro pores.
- When it rains, the water goes down through these micro pores. When it is dry, these same pores transport water up, due to the phenomena of capillarity during periods without precipitation or irrigation.
- This can contribute a significant volume of water to the root zone of the crop

Project: *Harnessing floods to enhance livelihoods and ecosystem services*

- This research explores how to optimize the use of floods for agriculture and ecosystem services to support livelihoods in different landscapes and socio-economic settings in Sudan and Ethiopia.



RESEARCH
PROGRAM ON
Water, Land and
Ecosystems

Objective microclimate Ethiopia

- Understanding key microclimate interactions in 2 FBFS areas, Guguf and Oda sub-catchment of the Raya Basin.
- Capturing the perceptions of the local communities as well as the government and non government institutions actively implementing the watershed management practices on the impact of interventions on microclimate.

Research Questions

- How significant is the impact of the intensive re-greening, watershed management interventions as well as agricultural activities on the microclimate in the Raya Basin?
- How has this change in microclimate affected the ecosystem services that are usually overlooked:
1) increase in biodiversity of the natural vegetation
2) revitalization of grass and bush land for livestock,
3) groundwater recharge and the birth of springs,
4) reducing the occurrence of damaging flood events?

Examples of SWC interventions in the areas

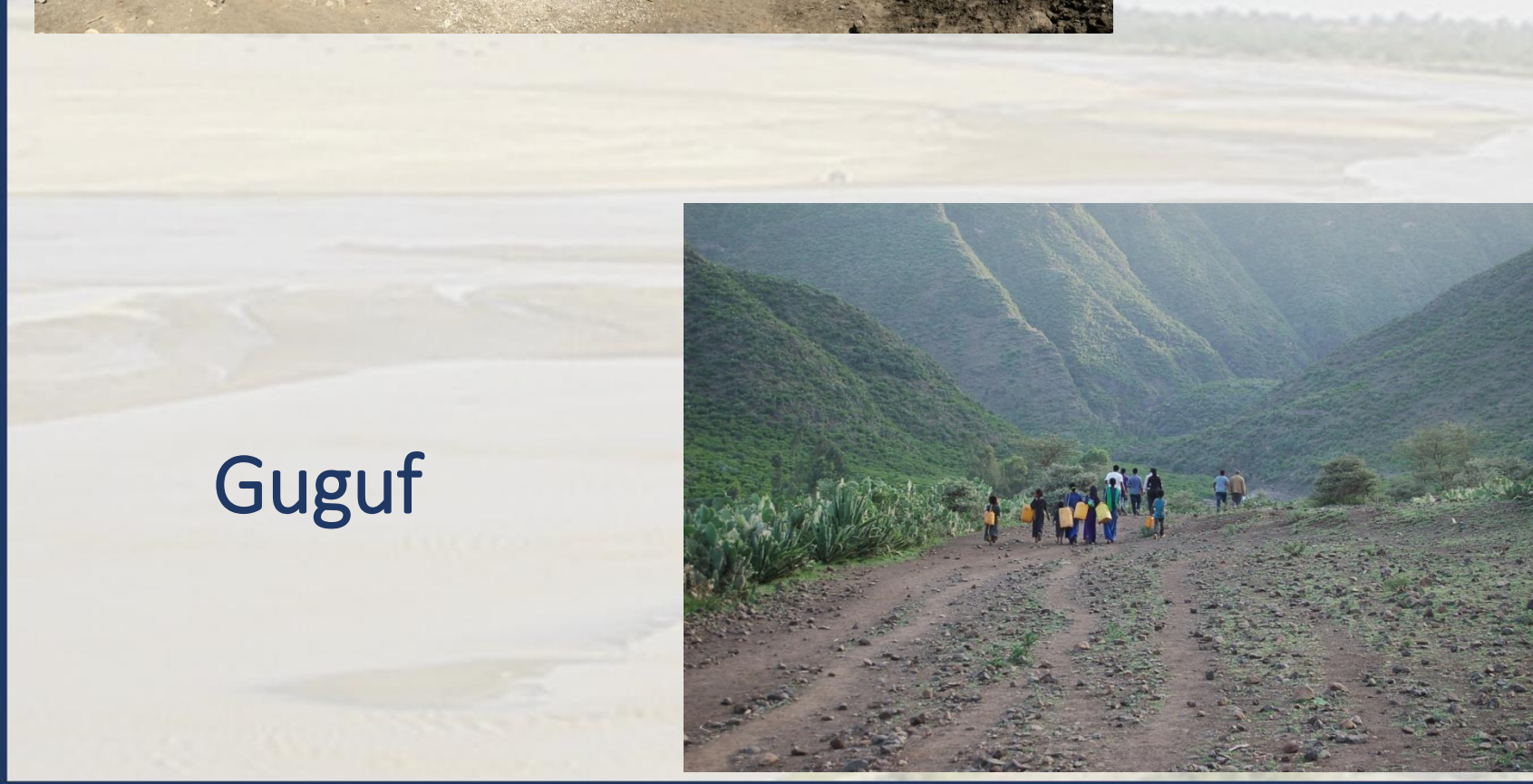


Focus group discussions and expert interviews





Oda



Guguf



Guguf and Oda Upstream

Microclimate and Guguf ecosystem benefits		Oda
Microclimate	Well regulated, conducive	Less mitigated
Residual soil moisture	Good, longer availability	Poor, shorter availability
Rainfall/runoff	Less runoff and erosion, high nutrient retention	High runoff and erosion, low nutrient retention
Base flow	Good and serves for two irrigation, water supply	Insignificant and used for drinking only
Vegetation cover	Good and used for fodder, fuel, construction and commercial purposes	Poor and used for fodder and fuel
Groundwater use	Good availability	Poor availability

Guguf and Oda Downstream


Microclimate and ecosystem benefits	Guguf	Oda
Microclimate	Conducive	Conducive
Rainfall/runoff	Moderate flood and less erosion, sedimentation and flood risk	Large flood and high erosion, sedimentation and flood risk
Base flow	Good, stays till April and serves two irrigations	Low, stays till January and serves one irrigation
Vegetation cover	Bare	Bare
Groundwater use	Good availability	Poor availability

Ecosystem services

- SWC and intensive re-greening has lead to more springs in Guguf.
- There are more trees that are used for fuel wood (regulated) and beekeeping in both catchments
- The damage of floods are still high in Oda. In Guguf the intensity of floods is much lower.
- Increase in grass and bush land in both areas. However also an increase in livestock Guguf upstream!

Conclusion

- Understanding the microclimate is an essential part of managing ecosystem.
- Micro-climate affects soil moisture, temperature, wind direction and humidity of an area
- This has a direct impact on agricultural production, (ground)water availability of an area
- It is therefore important to make not isolated interventions but having a critical sum of measures that creates a systematic change of microclimates at landscape level.

A wide, shallow river with many channels and sandbars, illustrating a microclimate. The river is brownish, likely due to sediment. The surrounding landscape is flat and appears to be a floodplain or delta. The sky is overcast and grey.

Do you have any example from your experience of microclimate and its impact on agriculture?