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Monitoring Success of Measures

	Explanation	Measurement/necessary data	expressiveness	Measuring frequency*	DIY?
Floor			in terms of indicators		
Carbon storage	How does the organic carbon content (=TOC) change in the soil?	TOC from soil samples, possibly different soil layers	Soil health indicator	with regular soil analysis; approx. every 1-3 years	in the soil laboratory
Water holding ability	How well can the soil hold water?	Soil laboratory	Resilience in the event of prolonged absence of		
Water infiltration	How quickly does water infiltrate the soil surface?	Infiltration test (see instructions in Farm Survey)	Erosion risk indicator	can be repeated several times per year (e.g. at different stages of vegetation, before and after plowing); at least once per year	x
evaporation	How much water evaporates from the surface?	Evaporation measurement (see agroforestry monitoring document)	Loss of water from the area	can be repeated several times per year (e.g. at different stages of vegetation, before and after plowing); at least once per year	
Structural stability	How many stable aggregates are there? How big are these? What shape are they?	Aggregate stability test (see instructions in Farm Survey)	Indicator of soil health, carbon storage, soil management (e.g. compaction)	can be repeated several times per year (e.g. at different stages of vegetation, before and after plowing); at least once per year	x
Edaphone activity	How many soil creatures are there?	Earthworms as a proxy?	Mixing, mineralization, formation of aggregates higher soil health	Once a year at a similar time	x
Ground cover	What level of ground cover was achieved by the measures (e.g. catch crops)?	% ground cover calculated over the year (i.e. not just in full vegetation); alternatively: Duration of fallow land/when the ground is not covered		document continuously throughout the year	x
Temperature on the surfaces	What is the temperature at the ground surface? Higher temperature = higher evapotranspiration, risk of drought	Surface temperature measuring device	Cooling effect of vegetation, especially shading from trees/shrubs	document continuously throughout the year and during special events	x
Nitrogen losses	Where are there losses in the system, for example due to erosion?	?? Possibly calculation of fertilization, nutrient analyzes of plants and soil	Can the nutrients be retained in the soil?	document continuously throughout the year and during special events	
Erosion by leaching	Can the top layer of soil be kept on the area?	?? through observation	Removal of the top layer of soil = loss of fertility	document continuously throughout the year and during special events	x
Erosion by drifting	Can the top layer of soil be kept on the area?	e.g. MWAC masts, see agroforestry monitoring	Removal of the top layer of soil = loss of fertility	document continuously throughout the year and during special events	x
soil moisture	How high is the soil moisture? When during the day/year is it particularly low?	Soil moisture meter	Covering soil can hold more water; However, too high soil moisture can also be	document continuously throughout the year and during special events	x

Crop production					
weeds	Are there new or more/fewer weeds? How many compared to previous years?	Records, documentation	Does the system promote the “right” organisms?	document continuously throughout the year	
Perspiration rate	How much water do plants lose to the environment? (Water use efficiency)	??	?		
camp	How often does the crop go into storage? When/at what events?	Records, documentation	Low stability of the culture, e.g. due to too high a nitrogen content	document continuously throughout the year and during special events	
Water consumption	If irrigated: How much water is needed? When? On which areas?	Records, documentation		document continuously throughout the year	x
Failure rate	What proportion of the harvest failed due to stress factors, external influences, etc.?	Records, documentation	Influence of factors that cannot be controlled: weather, climate change, pests, infrastructure, etc.	at harvest	x
Development of the pest population	How high is the pest pressure compared to before the measures? Are there new parasites or other diseases?	Records, documentation	Does the system promote the “right” organisms?	document continuously throughout the year and during special events	x
Development of the beneficial insect population	How high is the population of beneficial insects (species, quantity) compared to before the measures?	Records, documentation	Does the system promote the “right” organisms?	document continuously throughout the year and during special events	x
Monitoring of malicious images	What does damage to plants look like?	Records, documentation		document continuously throughout the year and during special events	x
ower nutrient absorption due to drought and stress	Is nutrient absorption prevented by stress factors? Are nutrients present but not mobilized/in the wrong form?	Documentation of stress symptoms, nutrient content of the plant sap	Does the plant's nutrient absorption function properly?	document continuously throughout the year and during special events	(x)
Nitrous oxide emissions	When are fertilizers applied? How much per hectare? Which product?	documentation	Where do greenhouse gas emissions arise that could be prevented?	document continuously throughout the year and during special events	(x)
livestock farming					
sunburn	Do the animals get sunburned? How many? When? How often?	Observation of symptoms, documentation	Indicator of heat stress, general herd health	document continuously throughout the year and during special events	
Parasites	Do the animals have parasites? How many? When? How often?	Observation of symptoms, documentation	Herd health indicator, pasture management	document continuously throughout the year and during special events	
Movement patterns	Are the animals acting more restless than usual? When?	Observation of symptoms, documentation	Indicator of stress, e.g. due to heat or high humidity	document continuously throughout the year and during special events	x
Water consumption	Are the animals drinking more than usual? When?	Document water intake	Indicator of heat stress	document continuously throughout the year and during special events	x

Feed intake	Are the animals eating less than usual? When?	Document feed intake	Decreasing feed intake (up to -25%) is an indicator of heat stress	document continuously throughout the year and during special events	x
Departures diseases	How many sick animals are there? Where do the diseases come from? Were the animals already weakened beforehand? If yes why?	Recording, documentation	General herd health	document continuously throughout the year and during special events	x
Purchase	How much feed must be purchased? What? What quality does it have?	Recording, documentation	Indicator of self-sufficiency, availability of high-quality feed	document continuously throughout the year and during special events	x
Nitrous oxide emissions	How is the herd managed? How is the manure stored and applied?	Recording, documentation	Proper livestock/grazing/manure management	document continuously throughout the year and during special events	
Biodiversity fauna	How high is the diversity of animals in the area? e.g. species of birds, bats, insects (ground beetles, wild bees, grasshoppers, etc.), small animals	Recording, documentation	Higher biodiversity = better use of ecological niches -> higher resilience	document continuously throughout the year	(x)
Biodiversity flora	How high is the diversity of plants on the area?	Recording, documentation	Higher biodiversity = better use of ecological niches -> higher resilience	document continuously throughout the year	(x)
Soil biodiversity	How high is the biodiversity in the soil (micro and macro fauna)	Recording, documentation	ecosystem function; Nutrient cycles, utilization of organic material, carbon storage, greenhouse gas emissions, etc. higher biodiversity = higher resilience against pests and diseases	document continuously throughout the year	(x)
Economy/Logistics/Transportation					
Number of irrigation days	How many days a year is watered? How much water is needed?	Recording, documentation	Dependence on irrigation, level of water consumption	document continuously throughout the year	x
Drone operations monitoring number	How often per year is monitoring carried out with a drone? What is recorded?	Recording, documentation	Density of data points for monitoring	document continuously throughout the year	x
Fuel consumption	How much fuel is used per year? What are the costs for this?	Recording, documentation	Costs, dependence on external resources	document continuously throughout the year	x
Fertilizer consumption	When are fertilizers applied? How much per hectare? Which product?	Recording, documentation	Costs, dependence on external resources	document continuously throughout the year	x
Use of pesticides	When are pesticides discharged? How much per hectare? Which product?	Recording, documentation	Costs, dependence on external resources	document continuously throughout the year	x
Water & energy supply					
natural surface water	How high is the water level on lakes/rivers in the area at certain times? Is the water clear/cloudy/algay?	Recording, documentation or research/inquiries with authorities	Availability and quality of water	document continuously throughout the year and during special events	(x)

artificial water reservoirs	How full are water reservoirs in the area? When will they be fed?	Recording, documentation	Availability of water	document continuously throughout the year	(x)
PV yield	How high is the annual yield of photovoltaic systems? To what extent does it cover the needs?	Recording, documentation	Independent energy supply, effectiveness	document continuously throughout the year	x
Wind yield	How high is the annual yield from your own wind turbines? To what extent do they cover the need?	Recording, documentation	Independent energy supply, effectiveness	document continuously throughout the year	x
Bioenergy yield	How high is the electricity yield of bioenergy systems per year? To what extent do they cover the need?	Recording, documentation	Independent energy supply, effectiveness	document continuously throughout the year	x
fossil energy use	How much energy from fossil fuels is needed per year? What proportion is obtained from fossil energy sources? What are the costs	Recording, documentation	Energy supply, dependence on external resources	document continuously throughout the year	x
Hydropower?	How high is the annual yield from your own hydropower plants? To what extent does it cover the	Recording, documentation	Independent energy supply, effectiveness	document continuously throughout the year	x
Other					
Employee satisfaction	How satisfied are employees with the working environment/workload/distribution of tasks? Do you support new measures and implement them conscientiously?	Regular employee discussions, questionnaires, feedback sessions, failure/change rate	Satisfied and happy employees create a pleasant working environment, are more productive and usually stay with the company longer	continuously throughout the year and fixed regular appointments for employee discussions, feedback, etc.	x
CO2 balance	What do the greenhouse gas flows look like on the farm? (Energy, machines, materials, etc.) How have they changed compared to previous years?	Recording, documentation, possibly also external help/special programs/apps; important: define system boundaries!	Reducing greenhouse gas emissions on the farm directly contributes to curbing climate change and thus its consequences	Keep records throughout the year and calculate a balance sheet once a year	(x)
* Depends heavily on the context and what you want to achieve with the measures. Therefore, determine the appropriate frequency yourself					
Climate change consequences					
Categories/Indicators	Explanation	Measurement	expressiveness	Measurement frequency	
Crop production					
sunburn	Was there sunburn? What value has been lost as a result? Were there measures taken to contain the damage?	Records, documentation	Assess the effects of climate change at the location and any expected worsening of the problem	at special events	
Symptoms of heat stress	Do the plants show symptoms of stress at high temperatures?	Records, documentation: folded/rolled leaves, brown/dry spots, hanging plant parts	Assess the effects of climate change at the location and any expected worsening of the problem	In the event of special events, check regularly (approximately every 2 years) whether there are new climate models	

sowing date	Has the sowing date changed in recent years? How?	Records; Possibly also documentation of trafficability, soil moisture, frost, etc. depending on the individual crop	Assess the effects of climate change at the location and any expected worsening of the problem	continuously, regularly (approximately every 2 years) check whether there are new climate models	
Hail damage	Was there hail damage? What percentage of the area did they affect? Possibly what value was lost as a result?	Records, documentation	Assess the effects of climate change at the location and any expected worsening of the problem; Check regularly (approximately every 2 years) whether there are new climate models	In the event of special events, check regularly (approximately every 2 years) whether there are new climate models	
Frost damage	Was there frost damage? What value has been lost as a result? Were there measures taken to contain the damage?	Records, documentation	Assess the effects of climate change at the location and any expected worsening of the problem; Check regularly (approximately every 2 years) whether there are new climate models	In the event of special events, check regularly (approximately every 2 years) whether there are new climate models	
Heavy rain	How often/how early were heavy rain events? What damage did they result in?	Documentation of events and damage, e.g. soil erosion -> brown, cloudy rivers (topsoil was washed away), washing away of seeds and small plants	Assess the effects of climate change at the location and any expected worsening of the problem; Check regularly (approximately every 2 years) whether there are new climate models	In the event of special events, check regularly (approximately every 2 years) whether there are new climate models	
Ecosystems					
Beginning of the growing season	When do certain plants start to grow/bloom?	Recording, documentation	Estimate how the growing season may shift	continuously, regularly (approximately every 2 years) check whether there are new climate models	
meteorology					
humidity	How does air humidity change on a daily/annual basis? Is there a change compared to long-term averages? When is it particularly high?	recording, documentation; Research into long-term average values and climate forecasts	Assess the effects of climate change at the location and any expected worsening of the problem; Check regularly (approximately every 2 years) whether there are new climate models	continuously, regularly (approximately every 2 years) check whether there are new climate models	
wind speed	How does the wind speed change on a daily/annual basis? Is there a change compared to long-term averages?	recording, documentation; Research into long-term average values and climate forecasts	Assess the effects of climate change at the location and any expected worsening of the problem; Check regularly (approximately every 2 years) whether there are new climate models	continuously, regularly (approximately every 2 years) check whether there are new climate models	

Temperature ø, >30°, <0°	How does the temperature change daily/yearly? Is there a change compared to long-term averages? When do temperatures >30°C or <0°C occur?	recording, documentation; Research into long-term average values and climate forecasts	Assess the effects of climate change at the location and any expected worsening of the problem; Check regularly (approximately every 2 years) whether there are new climate models	continuously, regularly (approximately every 2 years) check whether there are new climate models	
Precipitation values	How does precipitation change on a daily/annual basis? Is there a change compared to long-term averages? When is there particularly much/little rain?	recording, documentation; Research into long-term average values and climate forecasts	Assess the effects of climate change at the location and any expected worsening of the problem; Check regularly (approximately every 2 years) whether there are new climate models	continuously, regularly (approximately every 2 years) check whether there are new climate models	
Heat periods, heat waves	When do heat waves occur? Will these be longer compared to previous years?	recording, documentation; Research into long-term average values and climate forecasts	Assess the effects of climate change at the location and any expected worsening of the problem; Check regularly (approximately every 2 years) whether there are new climate models	In the event of special events, check regularly (approximately every 2 years) whether there are new climate models	
Economy/Logistics/Transportation					
Frost protection days number	How many days a year are frost protection measures required? When? Which?	Recording, documentation	Assess the effects of climate change at the location and any expected worsening of the problem; Check regularly (approximately every 2 years) whether there are new climate models	continuously, regularly (approximately every 2 years) check whether there are new climate models	
Water & energy supply					
Groundwater supply/level	How high is the groundwater level? Can groundwater be used without restrictions?	Research/inquiries with authorities (regional measurement of groundwater levels); If you are more interested, you can also install a pipe that is inserted into the ground until the groundwater is reached, then measure the distance from the ground surface to the groundwater surface; can remain installed at the edge of the field for years	Availability of water, supply of groundwater through infiltration	1x per year and during special events (e.g. long droughts, heavy rain events)	

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