



HOLISTIC RESOURCE MANAGEMENT FOR
CLIMATE RESILIENCE OF FARMING

Farm Analysis Report Hof Tolle, Germany ClimateFarming

Provided by: Nils Tolle
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Introduction:

The Farm Analysis Report is based on Step 1 (Farm Survey) and Step 2 (Farm Vulnerability) of the Climate Farming Cycle. It should consist of:

Step 1: Farm Survey and Soil- and Site-Assessment

see Annex 1 and 2

Farm Survey of the partner farm Hof Tolle

See Annex 1

Soil- and Site-Assessment of the partner farm Hof Tolle

See Annex 2

Farm Objectives of the partner farm Hof Tolle

Qualitative Farm Objectives

1. Economic Objectives:
 - . Hof Tolle want to make the step from part-time farm to full-time farm
2. Ecological Objectives
 - . Be as environmentally friendly as possible (low GHG-emissions; beneficial for biodiversity; no/minimal negative impacts on water and air quality)
2. Social Objectives
 - . Improve quality of live on the farm
 - . Help to improve quality of live in the rural area of Kassel
2. Other Objectives
 - . Have a high degree of autonomy and low dependence on external inputs and services (incl. production of food and energy which can be consumed on-farm)

Quantitative Farm Objectives

1. Economic Objectives
 - . The five-year average net margin should be 60,000 € annually
 - . Time-horizon: This objective should be achieved in 2028
2. Ecological Objectives
 - . GHG-emissions should be reduced by 30% compared to the CO₂-Footprint of 2021
 - . Time-horizon: This objective should be achieved in 2030
 - . Continuously improve the biodiversity protection and support performance of the farm - progress is assessed by discussion during regular review event
 - . Time-horizon: Improvement should be achieved every year
2. Social Objectives
 - . Improve quality of live on the farm
 - . Average weekly working hours should not exceed 45-50 hours
 - . Every farm member must take 15 obligatory holidays
 1. Time-horizon: This objective should be achieved in 2030
 - . Help to improve quality of live in the rural area of Kassel
 - . Provide two employments in the scope of the farm
 1. Time-horizon: This objective should be achieved in 2028



Conduct >30 events with schools and other groups on the farm per year

1. Time-horizon: This objective should be achieved in 2025

Other Objectives

Have a high degree of autonomy and low dependence on external inputs and services (incl. production of food and energy which can be consumed on-farm)

The self-sufficiency concerning heat and electricity should reach 80%

1. Time-horizon: This objective should be achieved in 2030

Step 2 of the ClimateFraming Cycle

SWOT-Analysis results of the partner farm Hof Tolle

Strengths

- Various production branches and income sources
- Off-farm income
- Family workforce
- Advanced environmental protection methods
- Appealing farm environment
- Good financial situation
- High degree of mechanization and capacity
- Well connected (other farmers, associations, advisory services etc.)
- High level of animal welfare
- Well established direct-marketing of premium beef products
- Experience with 'new' crops (soy)

Weaknesses

- High workload
- Poor, heavy soil qualities
- Low N-availability
- Low crop-product quality, e.g. wheat cannot be sold for human consumption
- High weed pressure
- Relatively small amount of land
- Low product variety (only beef)

Opportunities

- Increasing share of environmentally concerned consumers
- Low level of direct competitors
- High level of pedestrian and cyclist tourism
- Many potential partners
- Eco-schemes (GAP reform)
- No regional soy or chickpea products
- High number of horses in the area
- Demand for beef products is higher than supply
- Additional workforce available

Threats

- Lack of forage and low yields/qualities
- Low quality and high prices of bought forage
- Spring droughts restrict crop variety usage
- Higher costs for water (animal usage)



- Falling producer prices due to more organic farms
- More farms doing direct marketing, increasing competition
- Disapproval of new buildings due to farm location in protected landscape
- Meat tax

BONUS: TOWS-Analysis

Strengths/Opportunities

- Increase share of cattle farming
- Create agrotourism and/or gastronomy branch
- On-farm processing of crop products (e.g. soy)
- Diversify direct-marketing offer (e.g. vegetable production, on-farm processing)
- Expand landscape conservation services

Strengths/Threats

- Establish forage cooperation
- Expand rainwater harvesting
- Good communication of USP (environmental benefits)
- Expand direct-marketing

Weaknesses/Opportunities

- Hire another employee
- Focus on high value legume crops (e.g soy and chickpea)
- Shift to hoeing as weed control
- Increase value derived from available land
- Diversify direct-marketing offer (market gardening/on-farm processing)
- Create weather independent income sources
- Expand horse husbandry

Weaknesses/Threats

- Improve planning of farm activities to reduce workload
- Increase income derived from scarce land (diversify direct-marketing)
- Improve soil health, nutrient availability and water holding capacity (E.g. composting)
- Utilize more drought resistant cultivars
- Utilize more land for forage production
- Improve grazing management

Climate Impact Exploration and/or Regional Climate Projections and Interpretation

Past Climate Events

1. Flooding event (Spring 1998)
 - Minor damages to building infrastructure
 - Flooding of certain pastures and fields
0. Drought years (2002/2003)
 - Very low grassland and clover-grass productivity, low forage yields → caused the farm to cease cattle farming
0. Drought since 2018

Increasing variability of yields

- Higher dependency on timely rainfall due to lack of soil water
- Low grassland productivity → need for bought-in forage (hay)
- Increasing frequency of spring droughts



- Less summer crops in the rotation → higher weed pressure, Reduced grassland productivity

Future Climate Impact

Temperature

- Higher temperatures in spring
 - Could enable earlier sowing of heat-adapted crops (e.g. soy, chickpea)
 - Grazing period can potentially be extended
 - If enough water (and other factors) is available, higher average temperatures could cause better growing conditions

Hot Days

- . Hot days during sensible growing phase
 - .Could reduce yields and qualities in crops
- . Increasing heat stress for livestock
 - .Could make additional weather protection necessary
- . Increasing heat stress during work
 - .Could lower productivity; probably shift in working hours necessary

Dry periods

- . Dry periods in spring
 - limit crop choice (summer crops are hard to establish)
 - reduced mineralisation → worse plant development
- . Lower yields in arable crop production
 - Lower forage yields (silage and hay)
- . Higher prices for hay (horses)
 - Worse development of legume stands cause less N-fixation → worse development of following crop
 - Overall economic performance of the farm is endangered

Precipitation

- Wet periods
 - Limited field accessibility could increase weed pressure
 - Probably higher energy costs for drying
- Heavy precipitation
 - Not many fields with slopes → low risk concerning water erosion
 - Vulnerable infrastructure: cow shed can be flooded during heavy precipitation

Frost

- Earlier sowing of crops susceptible to frost could entail risk
- Lack of frost (winter) could negatively impact soil conditions
- Lack of frost (winter) could negatively impact winter crops dependent on vernalization

Hail, Wind and Storm

- More severe and frequent storms/hail events could cause higher maintenance cost on infrastructure
- More severe and frequent storms/hail events could make more weather protection on pasture necessary

Sun hours

- More sun hours pose a health risk to working outdoors
- Beneficial for PV electricity production



Prioritization of adaptation needs

- Vulnerability towards drought and dry conditions
- Improvement of soils and nutrient availability
- Improvement of income through expansion of direct marketing
- Grassland and forage management
- Improve farm management and processes to reduce workload

Comments:

SWOT-Analysis

The group decision room method was applied in order to collect aspects for the SWOT-Analysis

- Explanation: In order to collect many different opinions and perspectives about the current situation of the farm without a hierarchical order or the influence of opinion leaders, all farm members had to conduct a first SWOT analysis on their own. This includes writing strengths, weaknesses, opportunities and threats on separate pieces of paper and collect all written bullet points according to the individual categories. Afterwards, the analyst writes down the bullet points in random order, so that a SWOT matrix is produced. The individual categories were discussed afterwards.

Bonus: TOWS-Analysis

The TOWS-Analysis (see ClimateFarming Trainer Handbook) was applied for Hof Tolle due to the complexity of the farm (various production branches) and the various aspects which were identified in the SWOT-Analysis and the complexity of the farm. The goal was to make prioritization of adaptation needs easier.



ClimateFarming

Farm Survey

Documentation form

Alena Holzknecht¹, Nils Tolle¹, Janos Wack¹

Contact

Name	Hof Tolle
Address	Richardwegs 1, 34379, Calden-Fürstenwald
E-Mail	info@hof-tolle.de
Telephone	-

1. General farm information 🌱

Total farm area [ha]	60
Production branches	Mixed-farm: <ul style="list-style-type: none">• arable crop production• cattle farming (suckler cows)• boarding horse husbandry
Certifications (EU-organic, other organic, etc.)	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no if yes, please specify:

¹ kontakt@triebwerk-landwirtschaft.de

TRIEBWERK - Regenerative Land- und Agroforstwirtschaft UG

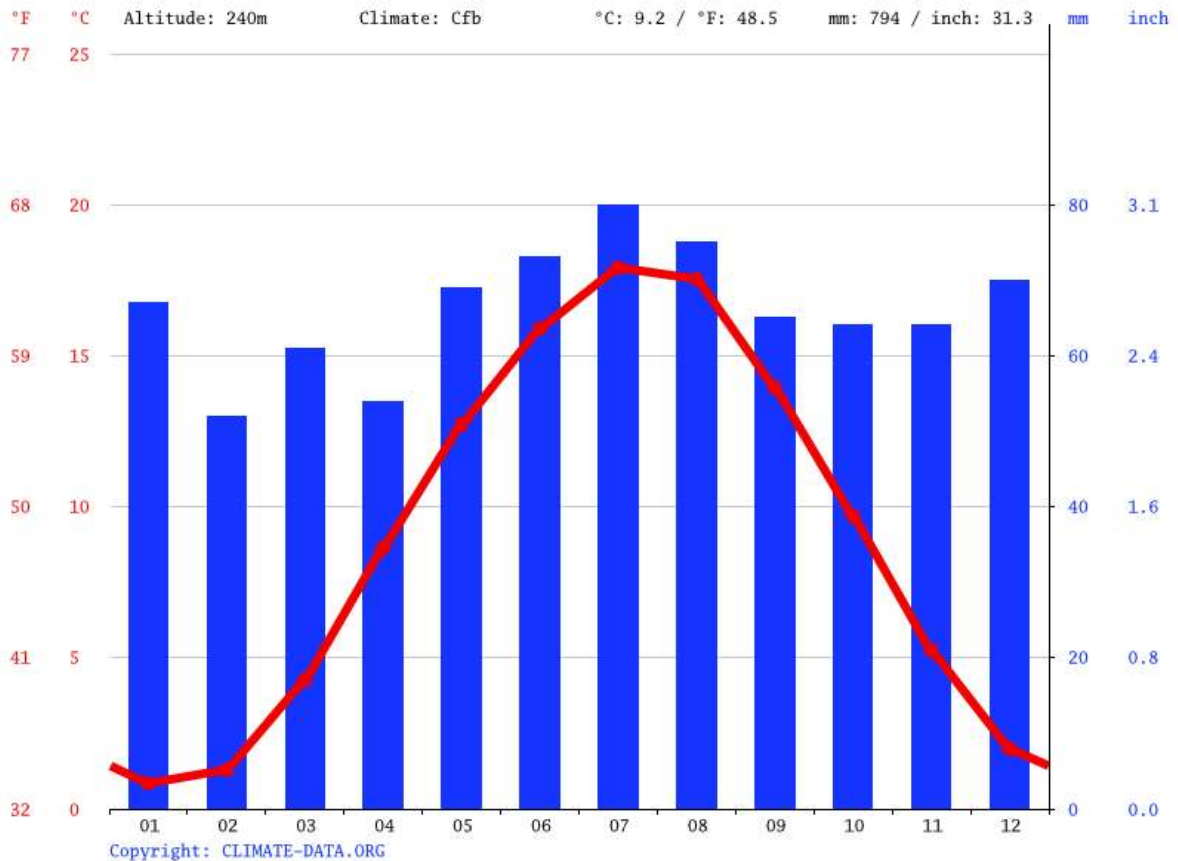
Im Rothenbach 49, D-37290 Meißner

<https://www.triebwerk-landwirtschaft.de/>

	Gäa Association
Marketing / sales channels	<ul style="list-style-type: none"> • arable crops: conventional selling channels (organic bulk buyer) • cattle: direct marketing of beef products
Other on-farm establishments	<ul style="list-style-type: none"> • landscape conversation (cattles) • PV-installation (40 kWp) • part-time farm

Farm location within region	Located in a small village (~1.000 inhabitants); in proximity to a larger city (200.000 inhabitants; 15 km distance)
Main soil type & texture	Farming site A: Tu4 (~70%); Farming site B: Ut3 (~30%)

Wind (direction, peak velocities)	
Precipitation [mm] (mean, min, max, per season, peaks)	750 mm/y (theoretically); since 2018 ≤ 500 mm/y
Temperature [°C] (mean, min, max, per season)	9,5 - 10°C
Average amount of days < 0°C per year	40 - 60 d/y
Experienced/ historic extreme weather events	<input type="checkbox"/> yes <input type="checkbox"/> no if yes, please specify: 1998: Heavy precipitation and flooding event 2002/2003: Drought event since 2018: Agricultural drought
Vulnerable sites within farm	Farming site A (70% of land): Leeward site of mountain range - especially prone to drought



Source: [Klima Calden: Temperatur, Klimatabelle & Klimadiagramm für Calden + Wetter - Climate-Data.org](https://www.climate-data.org)

1.1. Farm overview ★

Farm areas	Own property [ha]/ leased [ha]	Total [ha]	Number of fields	Remarks
Arable land	Owned: 25 ha / leased: 20 ha	45	22	Primarily production of organic livestock feed due to low qualities; stronger focus on pulses (e.g. soy) due to low nitrogen availability; high share of legumes (up to 50%)
Grassland	Owned: 15 ha	15	7	Extensive grassland; annual change

				between grazing and hay production; rotational grazing; 1-2 cuts per year
Vegetables		0,01	5 beds à 20m ²	Small scale test trail of two farming newcomers - no economic utilisation yet
Orchards		0,9	2	Existing structures in grassland (~80-100y); mostly apples and pears; no economic utilisation
Other perennials				
Forestry				

Cropping

Culture(s)/ Rotation	Area [ha]	Yield [t/ha]	Marketing/ Use
Culture(s)/ Rotation	Area [ha]	Yield [t/ha]	Marketing/ Use
Arable crops			
Spring barley	7,54	5-6	Brewing barley
Winter spelt	6,73	5,5	Baking spelt
Oats	3,31	3,2	Horse feed
Maslin (Wintermenggetreide)	8,75	5-6	Dairy cow feed
Fodder legumes			
Clover-grass	11,68	7,5	Winter fodder
Other legumes			

Soy	5,88		Partly fodder, partly for tofu production
Other crops			

Animals

Species	Amount	Husbandry system	Output	Marketing/ Use
Cattle - Rotes Höhenvieh (endangered species); Scottish Highland Cattle	25	Extensive grassland throughout the year; separate winter-shed and pastures for yearlings	23-25 calves per year	8-12 cattle per year sold via direct marketing; 8-12 cattle per year sold to breeders or regional organic beef programmes
Horses (boarded horses)	20	Group A (14an): Group system Group B (6an): individual boxes with pasture access	Monthly payment per horse	

Source of animal feed:	Forage is produced on-farm; in bad years, hay must be bought-in
If applicable, grazing system:	Cattle: Rotational grazing with 5 pastures; partly on field with clover-grass Horses: Two fix pastures, pasture are changed after 6 Month

1.2. Ownership structure & decision making 🌱

Legal owners	Patch work farm; operated and owned by two successors (one from farm-family, one external); supported by predecessor generation
Lease agreements, generation changes or farm transfers	Generation change is not discussed yet; still ~30 years of active management of the farm is planned
Other involved parties for decision making	Landscape conservation site is managed together with another farm - collaboration is organized in a GbR

1.3. Workforce, facilities and machinery 🌱

Staff per production branch	0,5 Ak arable production 0,5 Ak animal husbandry
Training and education of persons involved at the farm	B.Sc. Organic Agriculture + M.Sc. Food Systems
Special knowledge and skills	<ul style="list-style-type: none"> • Large workshop and comprehensive knowledge concerning (agricultural) machinery maintenance and construction • Education in construction engineering
Additional workforce	Two newcomers experimenting with small scale vegetable production in the scope on one field of Hof Tolle
Facilities	<ul style="list-style-type: none"> • Main hall: Meeting room, large workshop and storage, straw and hay storage, tractor and machinery garage, cattle shed (20GV), horse shed (6 an) • Machinery hall: Crop storage, machinery storage, transition cattle/horse shed

	<p>during winter</p> <ul style="list-style-type: none"> • Farming site B: hall for machinery • Farming site B: group shed horses (14 an)
Machinery	<ul style="list-style-type: none"> • Plow, (deep) chisel plow, harrow, combined seeder, rotary cultivator, disc harrow • 80% of field work is conducted with own machinery, including combined harvester
Agricultural contractors	Dependence on external service provider for forage (silage/hay/straw) production, precision seeding and hoeing

1.4. Economic background 🌱

Economic situation	Cost-covering with high shares for re-investment; in extreme years partly financed by off-farm income
Average farm investment sum (5-year period)	80.000 - 100.000€
Planned/ necessary expenditures	no major expenditures planned
Relative contribution of branches to income	<ul style="list-style-type: none"> • Arable production: 30% • Cattle farming: 30% • Horse husbandry: 40%

1.5. Climate change ★

Farm climate balance	<input checked="" type="checkbox"/> available <input type="checkbox"/> planned <input type="checkbox"/> neither
Observed climatic changes	<p>Drought and heat events aggravated and constitute the main challenges</p> <ul style="list-style-type: none"> • extended spring drought • early heat waves (April/May) • probably elongated growing period

	(till November/December)
Climate mitigation measures	<ul style="list-style-type: none"> • owner-occupation of PV-electricity • improvement of grassland and related animal performance
Climate adaptation measures	<ul style="list-style-type: none"> • shift towards more drought resistant cultivars and crops • further income diversification • intensifying cover- and mixed cropping • usage of alternative crops (soy, chickpeas, sudan grass, etc.)



1.6. Formulation of goals and priorities

How important are...	Very Important	Important	Positive side effect	Not important
Economic performance		x		
Providing a livelihood for yourself/ family/ employees		x		
Diverse product range			x	
Self-sufficiency		x		
Higher yields	x			
Local/ heritage varieties				x
Processing			x	
Biodiversity	x			
Biotope connectivity	x			
Promoting beneficial insects/ animals	x			
Wind protection			x	
Improving soil health/ soil quality	x			

Preventing soil compaction	x			
Improving water balance (on landscape level)	x			
Preventing nutrient leaching			x	
Reducing greenhouse gas emissions / climate mitigation	x			
Carbon storage	x			
Climate adaptation	x			
Shade for animals		x		
Fodder quality		x		
Scenery/ landscape design			x	
Independence from external inputs	x			
Other:				


2. Site Assessment

2.1. General information 🌱

Site name	
Lot number / Site ID	
Site location	
GPS coordinates	
Site area [ha]	
Land manager	
Current land use 	
Vegetation/ crops 	

Distance from main production facilities [km]	
Means of transport & time needed	
Relevance of site within farm	
Reasonable intervals for management/ observations	
Reasons for choosing this site	
Zonation short explanation: (Please attach sketch with GPS coordinates of zones)	

Per zone:

GPS coordinates/ Zone map:	
Characterize zone: 	Zone ID:

Sample IDs:

2.2. Management history 🌱

Previous farm manager(s)	
Crops /-rotations	
Amendments, incl. crop residues	
Tillage regime	
Machinery use	
Other practices	

2.3. Protection status 🌱

Any/ which protection status?	
Influence on farming decisions	

2.4. Climate/weather 🌱

Wind (direction, peak velocities)	
Precipitation [mm] (mean, min, max, per season, peaks)	
Temperature [°C] (mean, min, max, per season)	
Average hours of sunlight per year	
Average amount of days < 0°C	
Local climate projections	
Experienced/ historic extreme weather events	
Personal estimation of future climatic tendencies	

Vulnerable sites within farm	
------------------------------	--

2.5. Topography & terrain 🌱 (★)

Altitude [m a.s.l.]	
Slope inclination, exposition	
Sunlight, shade, rain	
Surface runoff, erosion areas	

2.6. Landscape elements, compaction, drainage & surrounding vegetation 🌱 (★)

Waterlogging / Infiltration	
Compacted areas	
Drainage structures	
Water table [m]	

Trees, shrubs, other perennials	
Wetland areas, ponds	
Depressions, hills	
Power lines, pipes, underground cables	

★ Phenological indicators	
★ Species composition	
★ Plant communities	
★ Growth rate, yield	






2.7. Existing cultures 🌱 (★)

Field journal	<input type="checkbox"/> yes <input type="checkbox"/> no
Diseases, pests	
Root or harvest residues	
Height & uniformity of cultures	
Yield	
Deficiencies, excess	
★ Phenological development stages	
★ Grasses: tillering rates	
★ Brix level of leafsap	
★ Micro-, macronutrients of leafsap	
★ Indicator plants: <ul style="list-style-type: none"> - nitrogen - water - compaction - salt 	

2.8. Issues & optimisation 🌱


Microclimate (e.g. late frosts)	
Weeds or pests	
Erosion (water/ wind)	
Water balance/ management	
Biodiversity	
Wildlife	
Others	

3. Soil Assessment

Date:
Authors:
Weather:     
Air temperature: _____ °C

3.1. Visual Soil Assessment and Extended Spade Test 🌱




3.1.1. Surface analysis

<input type="checkbox"/> wheel tracks <input type="checkbox"/> wind erosion <input type="checkbox"/> water erosion (rills/gullies) <input type="checkbox"/> surface ponding <input type="checkbox"/> crusting <input type="checkbox"/> cracks 
Ground cover: <input type="checkbox"/> <30% <input type="checkbox"/> 30-70% <input type="checkbox"/> >70%



Organic matter, root and harvest residues

<input type="checkbox"/> none <input type="checkbox"/> little <input type="checkbox"/> moderate <input type="checkbox"/> many
Describe: _____

3.1.3. Soil structure assessment

Horizon	Score	Notes
Surface (0-2) cm		
Topsoil (0-15 cm)		
Subsoil (15-30 cm)		

3.1.4. Root assessment:

Horizon	Score	Notes
Topsoil (0-15 cm)		
Subsoil (15-30 cm)		

3.1.6. Aggregate stability test / Slaking test

Horizon	# stable aggregates	# completely slaked aggregates	% stable aggregates	Notes
Topsoil (0-15 cm)				
Subsoil (15-30 cm)				

3.1.7. Assessment Score

Soil structure index

$$= \left(\frac{\text{Root score}_{\text{topsoil}} \times \text{Soil structure score}_{\text{topsoil}}}{2} \right) + \left(\frac{\text{soil score}_{\text{subsoil}} \times \text{aggregate stability}_{\text{subsoil}}}{2} \right)$$

Zone ID	Horizon	Root score	Soil structure score	% stable aggregates	Overall soil structure index
	Surface (0-1 cm)				
	Topsoil (0-15 cm)				
	Subsoil (15-30 cm)				
	Total (=Topsoil + Subsoil)				

3.2. Root indicators

- **White root tips:** none few moderate many all



- **Soil attached to roots:** none little moderate a lot

- **Smell:** pleasant/earthy foul/putrid/rotten eggs fungal/ fresh forest soil like the plantation (e.g. carrots) no smell (also not earthy) other, describe:

- **Root nodules on legumes (per plant):** none few moderate many on every root

→ **nodule colour on the inside:** reddish/pink greyish green or brown other, describe: _____

- **Root orientation/ root barriers (mechanical/ chemical)::**

- **Root depth:** most roots: _____ cm, deepest root: _____ cm


- **Visible Mycorrhizae:** none few moderate many

Space for additional notes:

Remember to:

- draw a map of zones within every field
- take pictures of the soil pits with a measuring tape
- take soil samples and note sample IDs

 **Time needed to assess this zone:** _____

 **If you are doing the base case scenario, you are done with the Soil Assessment. Well done!**

 **For best-case scenario, continue:**

3.3. Soil texture (Soil Ribbon Test) ☆

Coarse: sand loamy sand clayey sand

Medium: sandy loam* silt or silt loam loam

Fine: sandy clay loam silty clay loam clay loam

sandy clay silty clay clay

*moderately coarse

3.4. Other Soil indicators ☆

- **Carbonate testing:** no bubbling only audible slight bubbling strong bubbling

- **Moisture:** dry slightly moist moist very moist wet

- **Smell:** pleasant/earthy foul/putrid/rotten eggs fungal/ fresh forest soil like the plantation (e.g. carrots) no smell (also not earthy) other, describe:

- **Colour:** dark brown light brown grey/blue/greenish white reddish/orange
 other, describe:

- **Mottles:** none gray/blue/greenish orange/red; **if present, how many?**
----- %

- **Soil pit:** describe and sketch:

depth of A-horizon:----- cm

- **Compaction:** yes no; if yes, at which depth: ----- cm/ ----- cm/ ----- cm

- **Soil depth:** ----- cm, **Bedrock depth:** ----- cm,

Groundwater depth: ----- cm

- Volumetric stone content: %

Space for additional notes:

3.5. Earthworms ☆

Earthworm number in 20cm x 20cm x 20cm of soil:

3.6. Infiltration test ☆

Infiltration time #1:

Infiltration time #2:

Infiltration time #3:

Infiltration rate:

 Time needed to assess this zone (base+best-case scenario): + min.