

Climate adaptation pilot project – Daia

‘a reflection on challenges and scoping for opportunities for the common grazing lands of Daia village’



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Contents

Climate adaptation pilot project – Daia	1
Introduction	4
Topography	5
3D mapping and overland flow	9
Soils	12
Erosion.....	12
Landcover and landuse.....	14
Grazing (land) observations	16
Grazing Land Management	17
Water resources and land management.....	19
Climate	19
Water resources	22
Run off and groundwater recharge	24
Tackling the road side gullies	28
Deepening the understanding of water resources	31
Water supply for grazing livestock.....	31
Summary of action points – Strategy.....	33
Community Engagement	35
Engaging Youth and Children	35
Inhabitants of Daia.....	35
References	36

Figure 1: Topographical map including the village of Daia and neighbouring village of Ighiu (scale 1:5000).	6
Figure 2: Daia C4C project area (plot boundaries in green) and the neighbouring village of Ighiu (to the top) and village of Daia to the right (/east).....	7
Figure 3: Daia C4C project area (plot outlined in green) and contour lines at 2.5 metre interval	7
Figure 4: Former clay pits/burrows for brick making	8
Figure 5: Scouring of sides and foundation of dilapidated concrete channel	9
Figure 6: Earthen bund and pond (left) and concrete weir (right)	9
Figure 7: ‘Overland flow’ patterns in the project area	10
Figure 8: 3D map of the Daia C4C project area (green boundaries) overlying a DTM is google earth imagery and contour lines at 2.5 metre intervals	11
Figure 9: Intervention areas for soil and water conservation.....	13
Figure 10: Gully formation adjacent to the road leading up to the ridge	14
Figure 11: Daia project area from above, looking down-slope eastward (photo credit: Both Gabor)	15
Figure 12: Daia common grazing land, interspersed with privately owned forests (boundaries in yellow)	16
Figure 13: Cow-touring (encircled in brown) and logging and vehicle tracks (encircled in red) at the lower end of the grazing land	17
Figure 14: monthly temperature and rainfall average, Harghita county, Romania (1991-2023)(World Bank, 2024).....	20
Figure 15: Rainfall, Evapotranspiration and Reference Evapotranspiration in Daia (2018-2023)	21
Figure 16: Water points in Daia communal grazing lands and C4C project area (in yellow)	23
Figure 17: Example of contour bunds, capturing runoff inducing recharge and reducing erosion.	26
Figure 18: Regreening options along contour lines (bund and treelines at an elevation difference of 10 meters)	27
Figure 19: Road-drainage system as an asset for road protection, watershed management, and water harvesting	29
Figure 20: Sketch of roadside ponds and miter drains to capture roadside drainage	30
Figure 21: Mobile water point - a water tanker and trough in land adjacent to the project area.....	33

Introduction

This report is compiled by Szilvia Bencze (project coordinator of the C4C project in Daia) and Simon Chevalking (Water Management expert, MetaMeta) for the purpose of finding short (coming year) and medium term (2-5 years) opportunities to improve the management of the communal grazing land of Daia village and thereby also the livelihood of the villagers. The report builds the work (field visits; discussions/meetings; mapping) carried out by Szilvia and the field visit of Simon Chevalking in December 2024. Besides drawing invaluable input from the people of Daia, the commons manager, the mayor and topographer of Ulies municipality; and secondary data from reports, maps, satellite imagery and online databases.

The report is structured as such that by describing the project area in detail a more thorough understanding is developed for the opportunities to be identified and best tailored to the context of the area. The chapters are now organized into:

- Topography, describing the landscape in terms of elevation and particular elements to be found within the boundaries of the project area;
- Land cover and landuse, more detail is given as to what can be found and observed on the surface. Diving into its use (ie. grazing) and also highlighting some of the challenges and opportunities that relate to the use of the land;
- Water and Land Management. As these two elements cannot go separately it is chosen to dive into the water resources and relate these to how the land is and can be managed;
- A small section on community engagement as we realise that nothing will become successful if it is not supported from the ground.

Finally, we realise that this report is not an end but hope it can be a means and resource for other/further investigations and development in Daia and other similar areas.

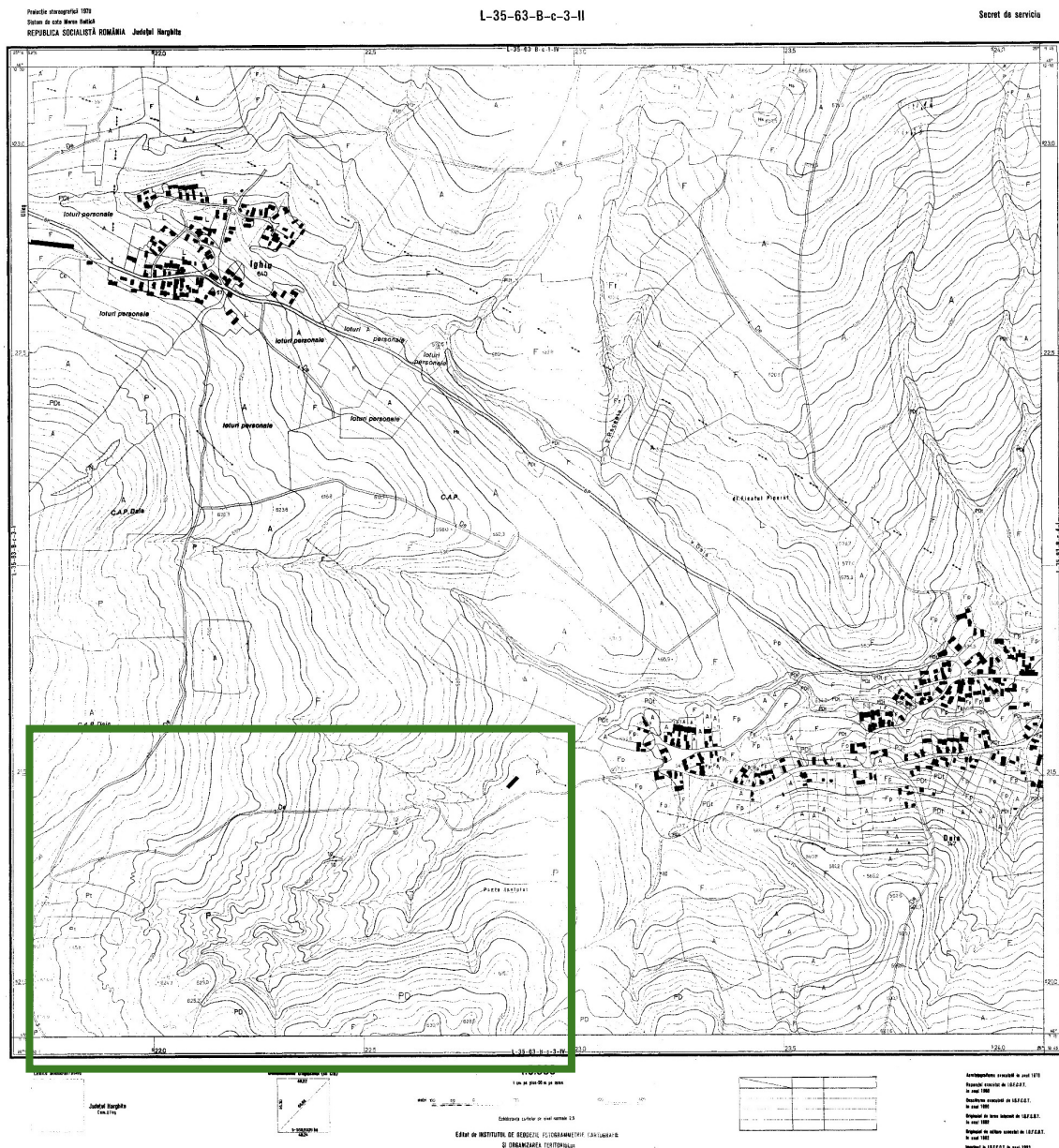
Topography

The village of Daia lies at the start of a valley through which the creek flows (since the last 4-5 years this flow has been seasonal) into the Homorodul Mare towards the east. The houses of the village are located around the creek and on the adjacent north and south slopes (village elevations ranging between 570 meters and 520 meters). The horizon to the north, south and west of the village consists of hills reaching elevations of around 790, 680 and 720 respectively and slopes ranging from 1 – 15%, with scarce short stretches of steep slopes that not immediately visible as they are either covered by trees and shrubbery.

As part of a country wide exercise the topography of Daia village was also carefully mapped using among other aerial photography in 1979¹. Featuring in Figure 1 is the topographical map of the village of Daia and the neighbouring village of Ighui to the northwest and its surrounding, including an indication of the location of the project area, ie. the communal grazing lands.

¹ Made by the 'Institutul de Geodezie, Fotogrammetrie, Cartografie si Organizarea teritoriului' (IGFCOT), made available for this report by the Municipality of Ighiu.

Figure 1: Topographical map including the village of Daia and neighbouring village of Ighiu (scale 1:5000).

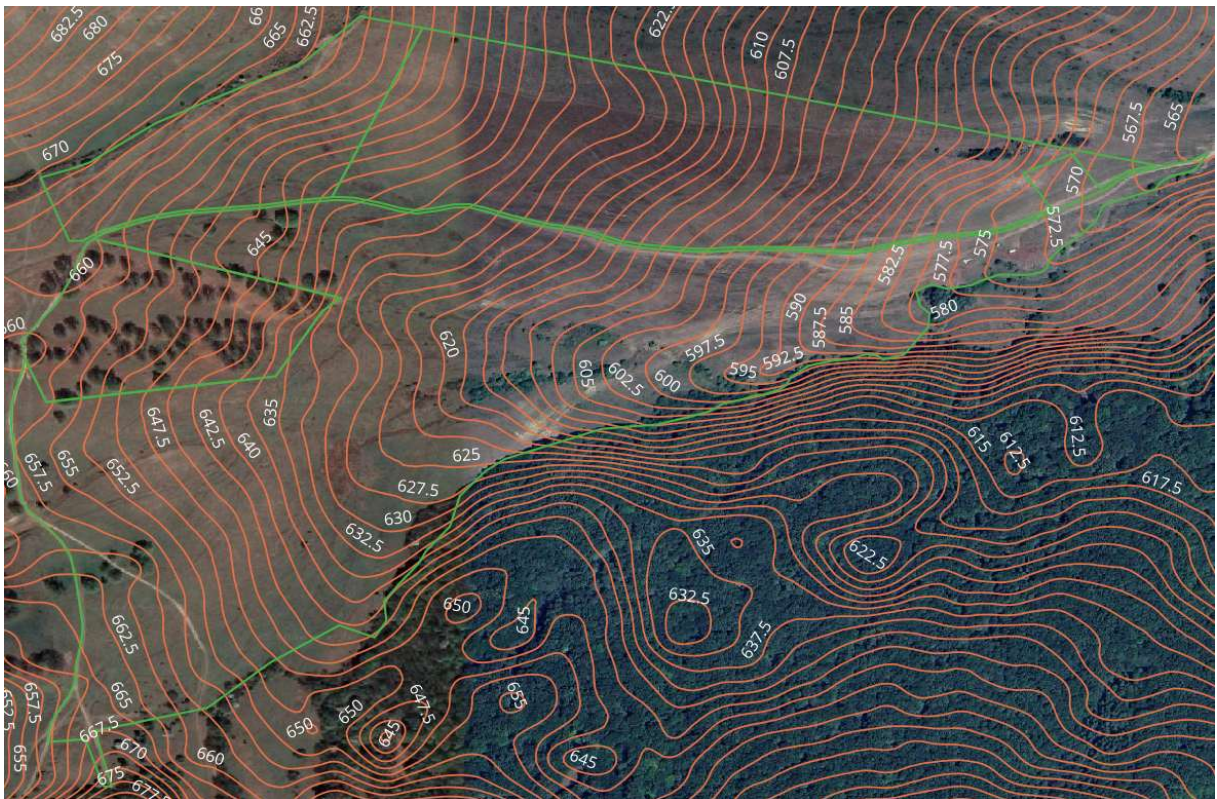


The project area itself stretches from the edge of the village (lowest point 560) to the ridge further to the west (highest point 660 meters) and has a surface area of 43.44 hectares. The following figures show the project within its surrounding area including the places of Daia and Ighiu (as above); and the project area only including contour lines at 2.5 metres interval (see Figure 3)

Figure 2: Daia C4C project area (plot boundaries in green) and the neighbouring village of Ighiu (to the top) and village of Daia to the right (east)



Figure 3: Daia C4C project area (plot outlined in green) and contour lines at 2.5 metre interval



From Figure 3 we can observe that the project area has a fairly gradual slope from right to left (east to west) with a slightly more steeper edge on the top side (northern edge) and steeper slopes at the southern side (bottom) where the project area is bordered by a creek

and the forest. Important to note is that the communal lands of Daia stretch beyond the ridge (featuring in Figure 3 as the most left boundary) down the west side of ridge and sloping down to the border of Harghita county (see also Figure 12).

Besides the above maps, the field visit provided detailed insight into topographical and manmade feature that determine the landscape. The project area is slopy, with slopes ranging from 0 to 10 to 15%, several old clay pits stretch (see Figure 4) along the southern side of the project area and some sharp edges cut the terrain where former surface water channels (amelioration' works²) (concrete triangular channels) are dilapidated and water has scoured the sides and foundations resulting in erosion. At the lowest point in the project area a pond is found (earthen bund and small weir with concrete sides and wooden raising beams), into which water (previously channelled) drains from various sides. At at least one the drainage points around the pond signs of erosion can be found.

These mentioned constructed features in the project area, including the pond have however already been overgrown by some shrubbery and small trees, see Figure 5 and Figure 6.

Figure 4: Former clay pits/burrows for brick making



² Although it is known that so called 'amelioration' works have taken place in the surrounding area (hillsides) of Daia village, their exact extent is unknown. The works took place in 1985/86 and were meant (as of hearsay) to improve the water management for arable farming. They include surface structures as well as subsurface drainage systems.

Figure 5: Scouring of sides and foundation of dilapidated concrete channel



Figure 6: Earthen bund and pond (left) and concrete weir (right)



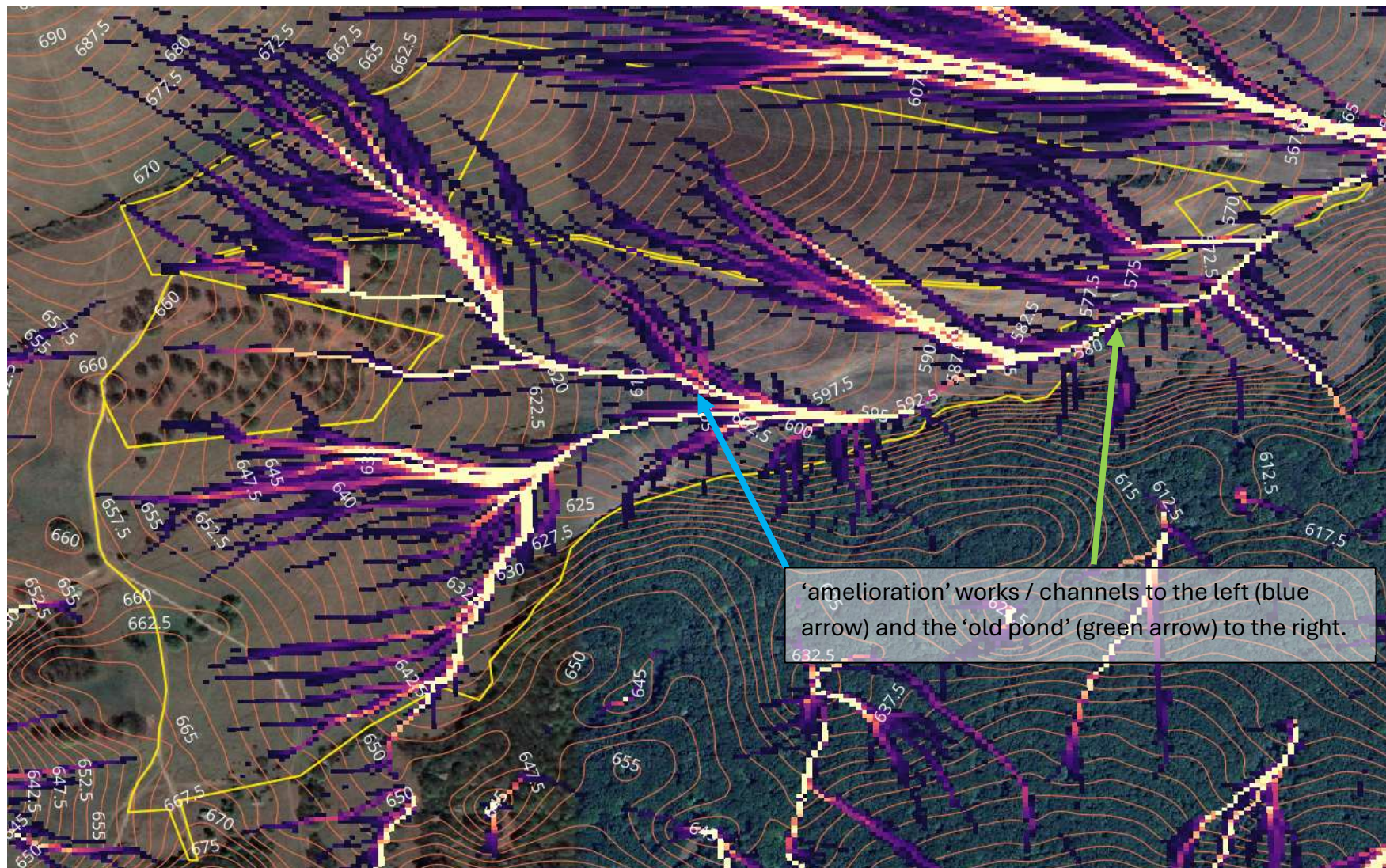
In the section on water management the locations of the features mentioned above will be located on a map (see Figure 16).

3D mapping and overland flow

Using the digital terrain model³, with which the contour lines in the previous section were generated, we can generate a ‘estimated’ overland flow map and a 3D model. The overland flow map is generated by estimating the contribution of each pixel upon the next, ie. based on slope and slope direction the ‘overland flow’ (or runoff) is visualised in drainage patterns. This does not represent actual runoff (as it does not combine, soil properties or rainfall events) but give an indication where runoff may potentially concentrate. Figure 7 shows the map of the project area underlayed with google earth imagery and overlayed with ‘overland flow’ patterns coloured in high (yellow) and moderate (purple) ‘potential overland flow’.

³ a NEXTMap® Elevation Data Digital Terrain Model

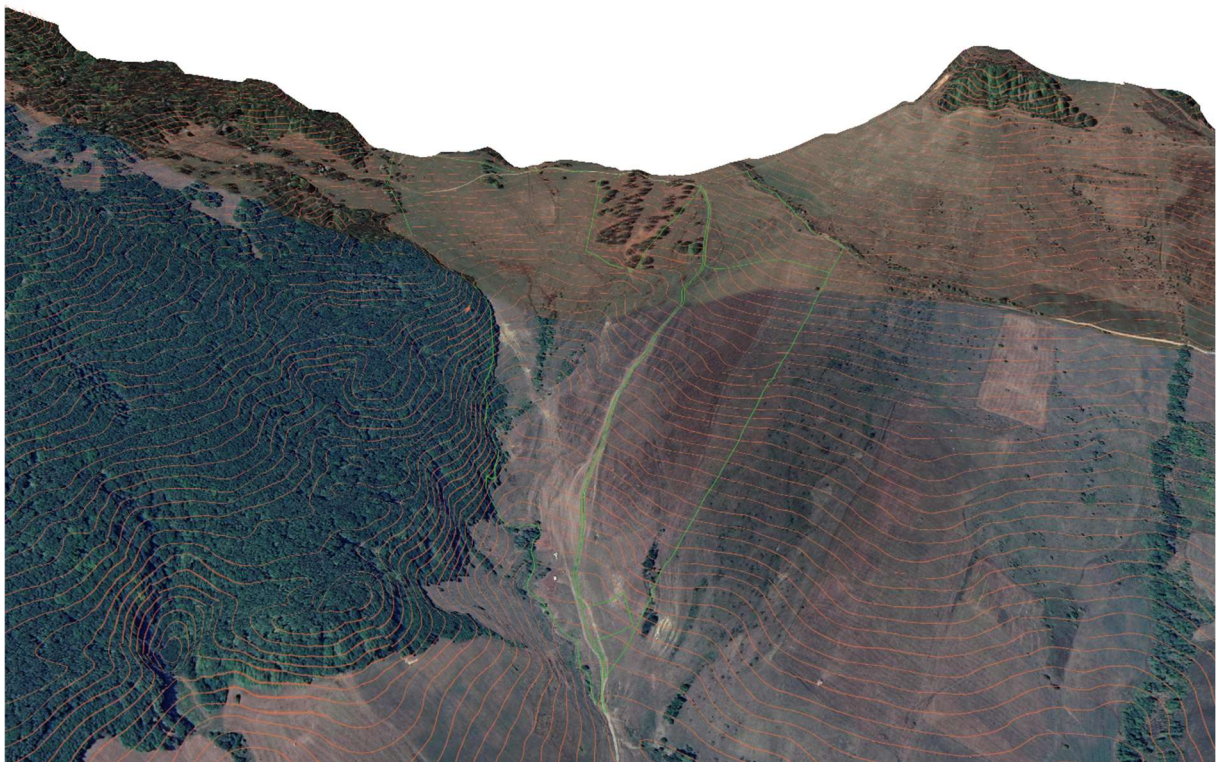
Figure 7: 'Overland flow' patterns in the project area



The analysis using the elevation model provides interesting insight into the drainage patterns in the project land scape. From the north-west downwards a pattern transverses the road going up to the ridge, this could imply (if runoff takes place) that water collects on the north side of the road. Not coincidentally this is also what was observed during the field visit as water was particularly draining along the northern side of the road. Also not coincidentally are the locations of the ‘amelioration works’ referred to earlier, ie. the dilapidated channels (Figure 5) and the ‘old pond’. Clearly the works in the past were meant to concentrate the drainage of the area towards the ‘old pond’.

Finally, the 3D map provided in Figure 8 basically shows google earth satellite imagery draped over the elevation map (/model). It helps support the observations from the field and understand the contour lines. Further reference will be made in the section on hydro(geo)logy. Note that in the underneath representation the elevation has been exaggerated 5 times merely to highlight angles and slopes, raises and crevice’s/ and or creeks.

Figure 8: 3D map of the Daia C4C project area (green boundaries) overlying a DTM is google earth imagery and contour lines at 2.5 metre intervals



Soils

The soil layers in the project area are considered to be similar to those found by Studio Geotehnic whom extensively studies a neighbouring area⁴. The top soil layers are summarized (in metres depth) as follows:

0.00 - 0.30, Sol vegetal (top/organic layer)

0.80 - 2.50, Argilă cafenie vârtoasă (Turbid brown clay)

2.50 - 5.50, Pietriș cu nisip prăfos (Gravel with dusty sand)

5.50 - 6.00, Marnă (Marl layer, mix of clay and calcium carbonate)

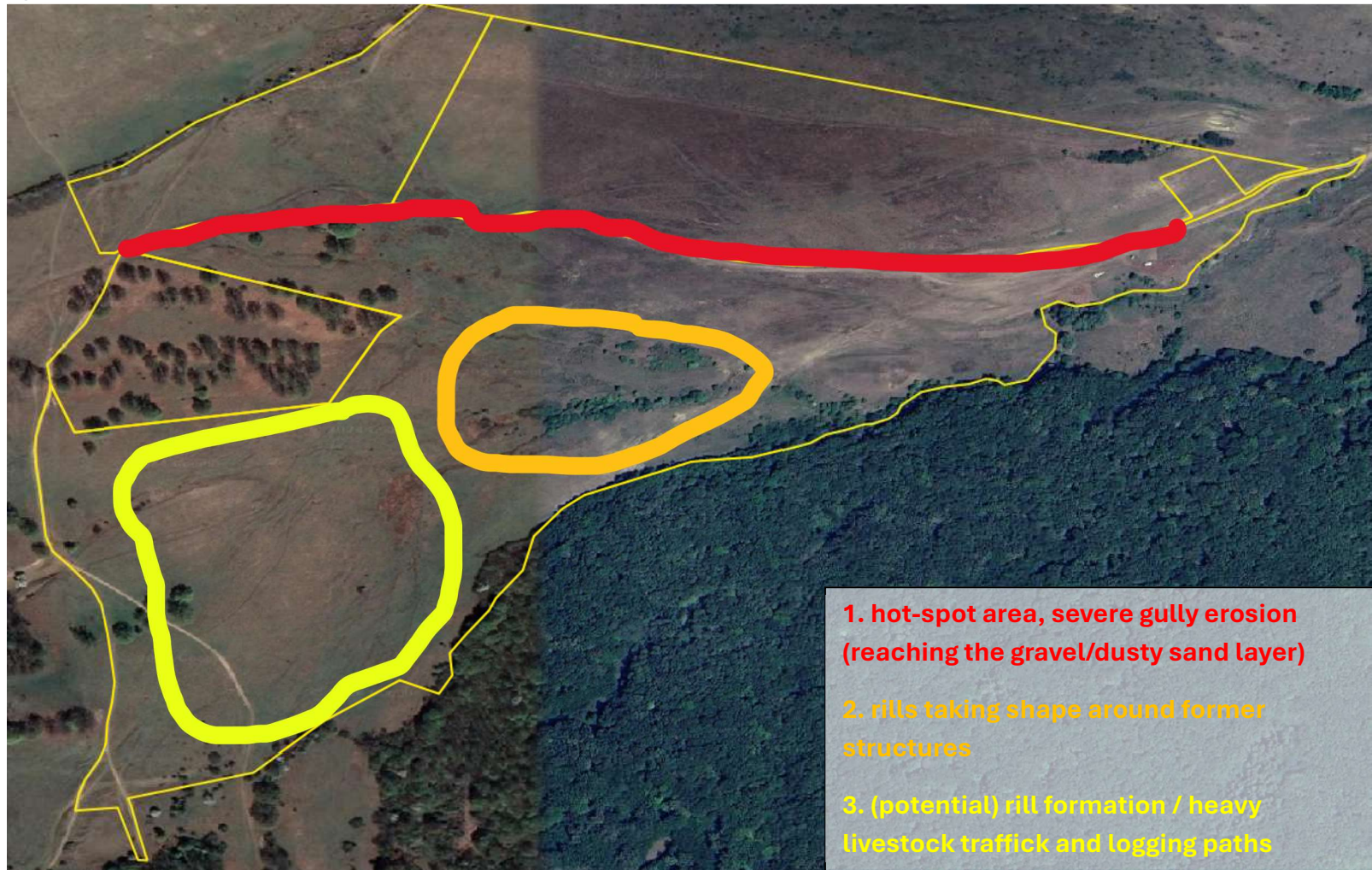
During the field visit the organic layer was not observed as such; the turbid brown clays and gravel and dusty sands were. The latter particularly in eroded gullies.

Erosion

Overall erosion does not seem to be the biggest challenge, although from field and areal observations it can certainly be identified. Where in Figure 7 on the southern slopes (bottom left) clear drainage patterns are shown first indications of rill erosion can be seen. More distinct rills can be seen close to the broken-down channels. Finally, the most severe erosion can be seen along the road particularly on the northern side and to a lesser extent on the southern side of the road. Along the road as well as at other parts in the landscape it seems that also car or machinery tracks contribute to compaction and heavy spores that also collect water and at sloping parts start to show rill/gully formation. In Figure 9 the areas encircled, it is strongly suggested that action is undertaken in the hotspot (red) area along the road, besides also in the less severe areas (read suggestions in the chapter Water resources and land management).

⁴ Studio Geotehnic carried geological surveys for the purpose of developing water supply for Daia village. Source: GEO GUIDE SERVICES S.R.L., ODORHEIU SECUIESC, STUDIU GEOTEHNIC. 2021. STUDIU GEOTEHNIC: ELABORARE DALI PENTRU PODEȚE AVARIATE DUPĂ INUNDAȚII ÎN SATUL DAIA, COMUNA ULIEȘ, JUD. HARGHITA

Figure 9: Intervention areas for soil and water conservation



The three highlighted areas are also clearly seen in Figure 5, Figure 11 and Figure 10.

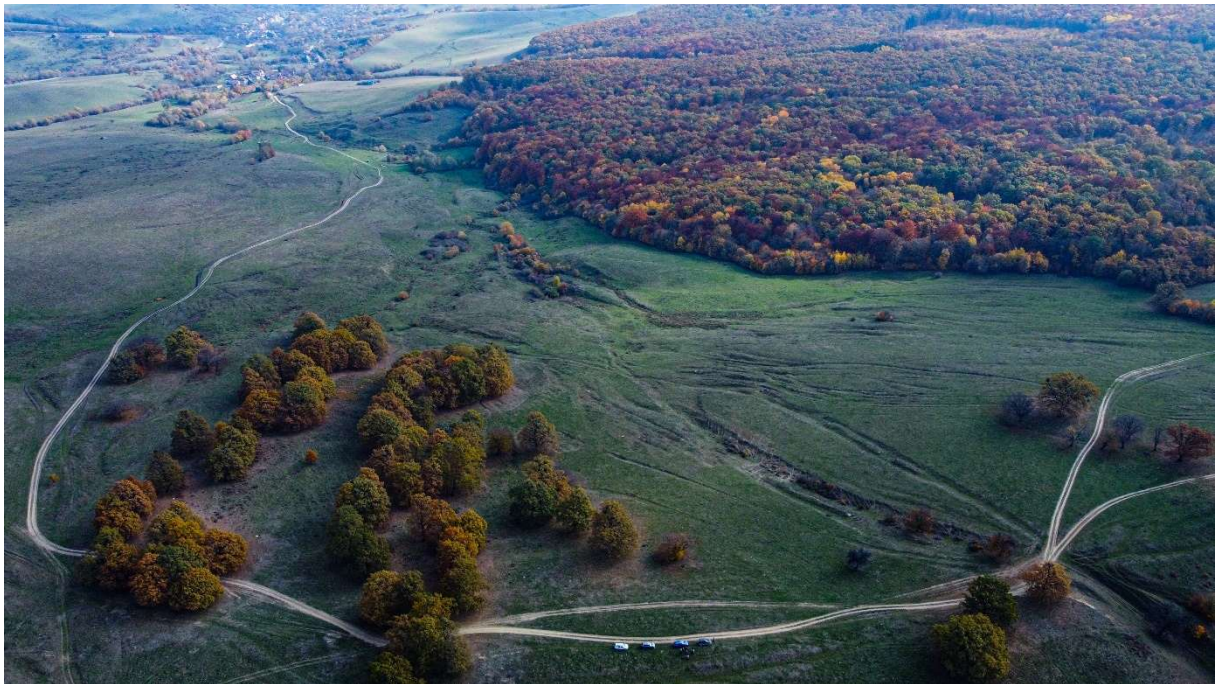
Figure 10: Gully formation adjacent to the road leading up to the ridge



Landcover and landuse

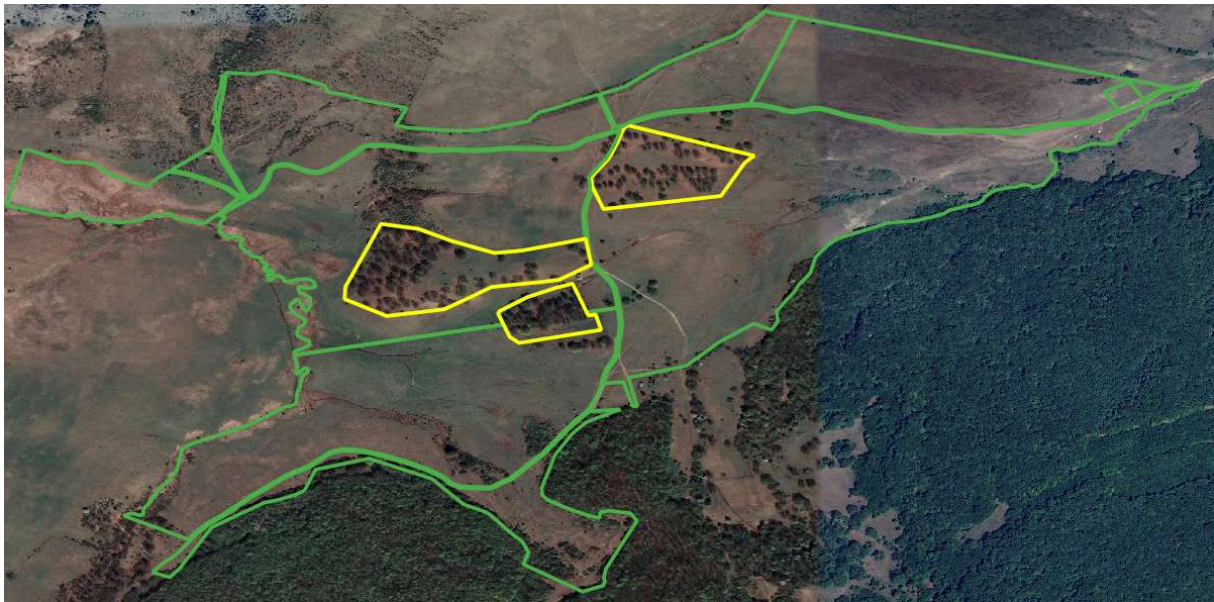
The area (hillsides) around Daia is predominantly covered by grassland, forest (Reed, Alder, Beech and Oak observed) and to a minor extent arable farming lands. Creeks and their slopes are covered with trees and shrubbery. The landcover in the project area is primarily grassland with patches of oak trees, these reportedly privately owned areas surrounded by the common grazing lands. Figure 11, allows a birds-eye view of the project area looking eastwards, with the privately owned but community regulated forest on the southern (right) side and patches of oak in the centre.

Figure 11: Daia project area from above, looking down-slope eastward (photo credit: Both Gabor)



As alluded to above landownership around Daia including the project area is principally either privately owned (privately managed/controlled), privately owned but regulated by the commons (particularly the forests) or community owned /or commons lands. The common grazing area for the villagers of Daia is shown in Figure 12 show, sections in yellow are identified as private. A like a lot of other common grazing lands in Romania, those of Daia constitute a valuable and important asset for villagers of Daia. Although in numbers limited, 5-10 cows per household, they play an essential livelihood role in terms of home consumption and small-scale sale of milk. Besides also Eco-Ruralis put it in a paper in 2017, ‘the Commons’ (or communal grazing lands in Romania) ‘are home to extraordinary biodiversity because they are mostly untouched, except by livestock’ (Eco-Ruralis, 2017).

Figure 12: Daia common grazing land, interspersed with privately owned forests (boundaries in yellow)



Every day in the months between May and November an approximate of 100 the cattle of the villagers in Daia are herded onto the communal pastures. The commons manager upholds a grazing management plan that determines the cattle/ livestock load on the land and organises for the herding (that is outsourced).

Besides grazing on the project area the impact of logging in the forest can also clearly be seen. A common practice is that the trees that are being cut in the adjacent forest and are drawn (behind vehicles) diagonally across the grazing fields. This displacement of logs leaves deep tracks in the top soil see Figure 11. Not only is grass growth impeded, the track soils are compacted and in effect reduces the infiltration capacity and enhances runoff and hence vulnerability to erosion.

Grazing (land) observations

- From field observations the impression is raised that the grazing load may be too high for the area and that grazing is not only limited to cattle but also sheep. This impression is based on the rather short and stubbled grass and small shrubs; considerable presence of 'grazing animals trails' that run parallel to the slope (sometimes also called "cowtouring") this besides the logging and vehicle tracks running straight across the grazing land (see Figure 13);
- Besides the tracks in the area that damage (/compact) the grazing area referred to above there is the distinct impression that there is a lot of livestock traffic, ranging on the grassland area and seeking to get to the springs and troughs on the other side of the ridge which lead to paths formed, compaction and enhanced vulnerability to erosion;

Figure 13: Cow-touring (encircled in brown) and logging and vehicle tracks (encircled in red) at the lower end of the grazing land



Grazing Land Management

The key to a sustainable future for the Daia project area will be the management of grazing. The grazing of the area plays an important role for: the livelihoods of the villagers; the unique ecology of the grazing land; and the preservation of the culture(d) landscape. Besides that grazing also (in)directly plays a role in soil and water conservation, considering: soil moisture retention; water infiltration capacity (and possibly recharge of groundwater); runoff; and susceptibility to erosion.

Following from the field inventory and the considerations above, the following actions could be considered in the short term (2025-2026).

What	How	With/ by whom
1. (2025) Review of the Grazing Management Plan, considering: intensity (amount of livestock/ha/grazing season); grazing patterns (see below); guidance/awareness raising of herders.	The management plan is provided by the local government ⁵ ; Engagement of the community in meetings to increase understanding and collective commitment Training of commons manager and herders;	the commons manager; herders (if possible); grazing land specialist; community engagers; NGOs/ advisors

⁵ Insight into the grazing plan and practices could give a better understanding of the agreements there are in place; to what extent these are adhered to; and how grazing takes place in practice

- | | | |
|--|--|---|
| 2. (2025-2026) Assessment of the grazing land ecology/biodiversity | Field investigations / determination | University student assignment led by a lecturer (perhaps University Brasov / Cluj)
Or a relevant public administration |
| 3. (2025-2026) upgrading of access road (improving of grazing land accessibility) and awareness raising on the impact of livestock and logging movements | (re)grading of the road tilting to either side, ie. north or south side; application of gravel/other materials, etc. ⁶ ; community meetings | Municipality; the commons manager; and involvement of community and herders. |
| 4. (2026) Trials with Rotation Grazing | Division of grazing land into sections, depending on livestock load
Purchase of mobile electric fencing (does not have to be very expensive)
Small trials to experiment
Note: start by testing (ie. Trying both rotation grazing on a section of the grazing land and common grazing on the other; also the implementation would need external expert advice | the commons manager; herders (if possible); support by municipality; NGOs; and possibly expertise from universities |

For the medium and long term the following could be thought of:

1. Assessment of the productivity of the grazing land, by means of remote sensing a productivity analysis could be done looking at rates of evaporation, transpiration, and biomass accumulation. This considering past pasture productivity and various climatic forecasts, including wetter and dryer years as well as effects of adaptations in the landscape such as greening by means of treelines or hedges.
2. Looking into reseeding of the grazing land to increase the diversity, and improving the ecology. Thereby also considering if certain patches of the land need to be (temporarily) protected.

⁶ Green Roads for Water Guidelines could provide insights into how good road design such as for cut-off drains (these drains that cut-off water preventing it from flowing further and cutting into road embankments without restriction, they can also be called miter drains). Also other protective works such as depicted in Figure 19 can prolong the lifetime and reduce maintenance efforts and costs of roads (see <https://documents1.worldbank.org/curated/en/102951623742853259/pdf/Green-Roads-for-Water-Guidelines-for-Road-Infrastructure-in-Support-of-Water-Management-and-Climate-Resilience.pdf>).

3. Determining the future of livestock rearing in Daia village. Open community discussions the long-term vision for the area as well as potential challenges/opportunities. It is not unimaginable that in the context of Daia the livelihoods dependency on livestock rearing in the long-term decreases. This could feature as households figure other sources of income, or decreasing interest of successors in the family for example

There are many resources available online to give further information and inspiration on grazing land management (e.g. [The Regrarians Handbook](#)⁷). The above opportunities are not exhaustive but meant to encourage direct adaptation as well as provide food for further action research. Furthermore, these cannot be seen separate from the observations and suggestions concerning water management in the next chapter.

Water resources and land management

The management of the available water in the project area, as for the whole of Romania is set to become ever more challenging as changes in climate, particularly temperature and precipitation (/rainfall) are expected⁸. More frequent and extreme weather events like storms, floods and droughts can be expected. Maybe the most important for the project area is the possible modification of vegetation periods and shifting ecosystems as prolonged droughts (high temperatures) draw out all of the water that may have replenished the soils, groundwater and particularly the vegetation.

In this section we look into:

- the climate of the project area (variations and change);
- beneficial and non-beneficial water consumption in the project landscape (this being evaporation and transpiration);
- and the water resources, either available as runoff and as groundwater.

As securing water for livestock is one of the main challenges, the water resources management suggestions are compiled to secure water supply for livestock in the long run.

Climate

Romania has a temperate-continental climate of a transitional type, specific to Central Europe. The transition is particular in the direction north-south and west east with temperate continental climates classified in the north and west and wet and warmer climates classified in the south and east (at the Black Sea). Most land land elevating

⁷ <https://www.regrarians.org/regrarians-handbook/>

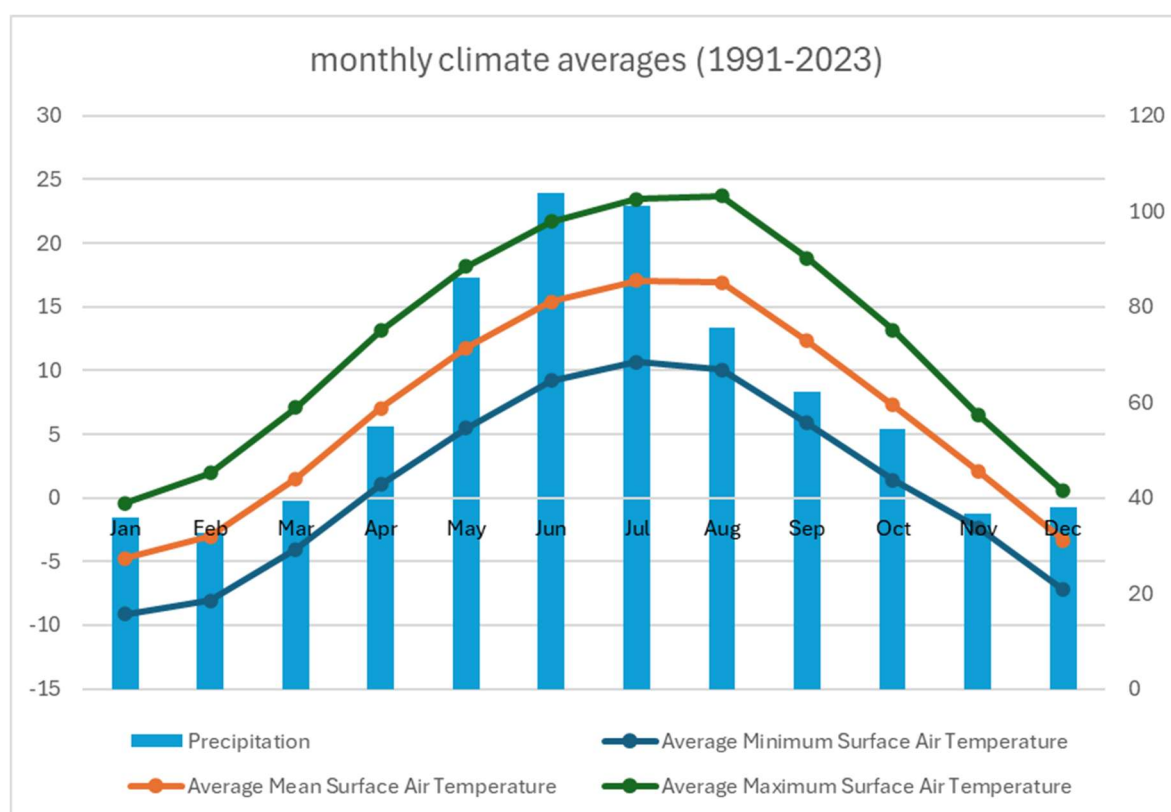
⁸ This stated in multiple sources among other 'Romania's Fourth National Communication 4 November 2006 and the Progress Report 31 January 2006.'

above 500 metres above sea level classifies as cool continental and beyond 1200 metres as Alpine.

As we zoom in to the Harghita county two (Koppen) climate classes are predominant, the ‘wet temperate’ and the ‘cool continental’. The latter also the one which Daia can be characterised by. The average annual precipitation is 720 and average temperatures throughout the year is a mere 8 degrees with average minimum and maximum of 2 and 13 respectively for Harghita county (World Bank, 2024). Figure 14 provides the mentioned data in graph format.

Important to mention here is that this is an average spanning the last 30 years. If looking at long-term development of temperatures in Harghita county (1901-2023⁹) it is clear to see that, as for many other parts in Europe, the temperatures show a clear rise in the last two decades. This rise does not feature in the averages presented in Figure 14.

Figure 14: monthly temperature and rainfall average, Harghita county, Romania (1991-2023)(World Bank, 2024)



Studies and data that are more detailed to the project area are scarce, however FAO-WaPOR data and a study carried out by Studio Geotehnic in mention annual precipitation of around 650mm with ranges the last 6 years from 547-755mm¹⁰.

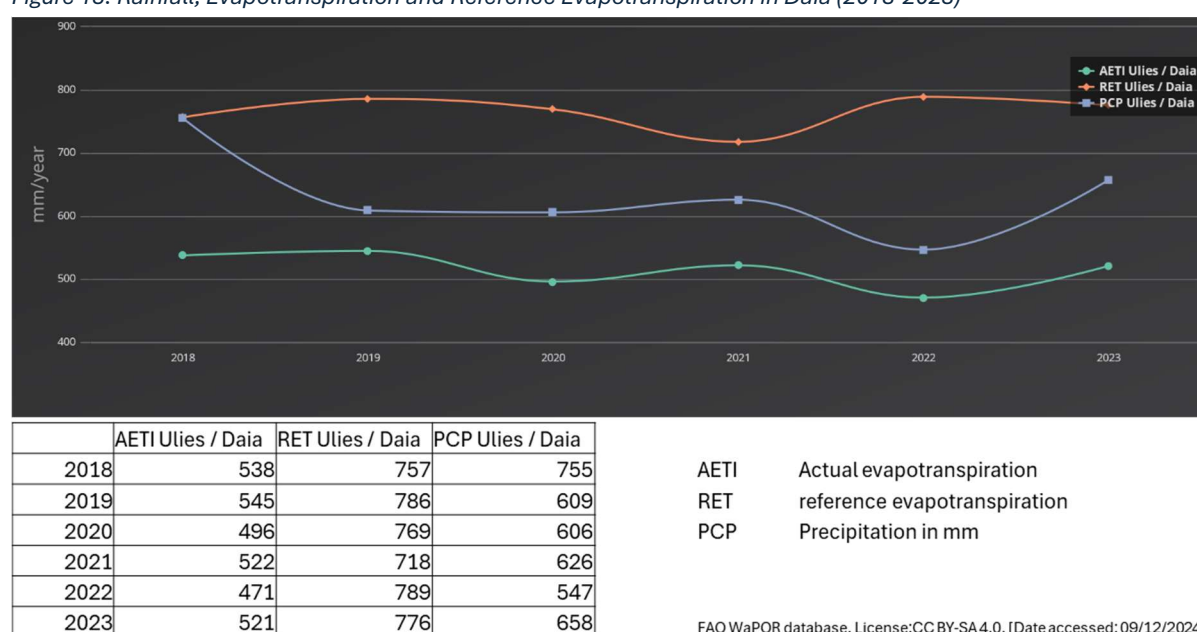
⁹ <https://climateknowledgeportal.worldbank.org/country/romania>

¹⁰ Studio Geotechnic reports and annual average of 600-650mm rainfall with 94.5mm average in June and a monthly average of 25.2mm in February. (besides also mentioning snow coverage of 60days and seasonally-frozen soil up to a depth of 1.10 meters, this however is not supported by local observations).

Temperature and rainfall provide an indication of the climatic conditions in the project area. It is important however to also look at a broader range of climatic indicators if we want to understand what landcover and landuse practices can be sustained in the landscape. A quick data scrape from FAO’s WaPOR portal allows a bit more insight.

Figure 15 shows the fluctuations in rainfall (blue), actual evapotranspiration¹¹ in green and reference evapotranspiration in orange¹². As it shows there is quite some fluctuations particularly in terms of rainfall throughout the years, and clearly the evapotranspiration from vegetation and soils correlate. Considering the high reference evapotranspiration in 2022 and dip in rainfall you can imagine that this year was more drought stressed than in other years.

Figure 15: Rainfall, Evapotranspiration and Reference Evapotranspiration in Daia (2018-2023)



The difference in millimetres between rainfall and actual evapotranspiration above are the most interesting and relevant. The difference implies that at a given spot in the project area there is more rainfall than that water is ‘actually’ either evaporating or being transpired by the vegetation. This ‘surplus’ of rain will replenish soils and groundwater (contributing to aquifer recharge – baseflow of creeks and rivers) or runoff over the ground surface.

¹¹ Actual evapotranspiration (or AETI) is simply said sum of water that is evaporated from the earth’s surface and water that is transpired by vegetation expressed in millimetres depth

¹² Reference evapotranspiration is purely climatic indicator, combining parameters such as relative humidity, windspeed, sunshine, temperatures it expresses the amount of evaporation and transpiration that could take place in a given grassland if the grass has full access to water. The indicator can be used to give an indication whether or not a climate is changing. From this very short time series this cannot be concluded.

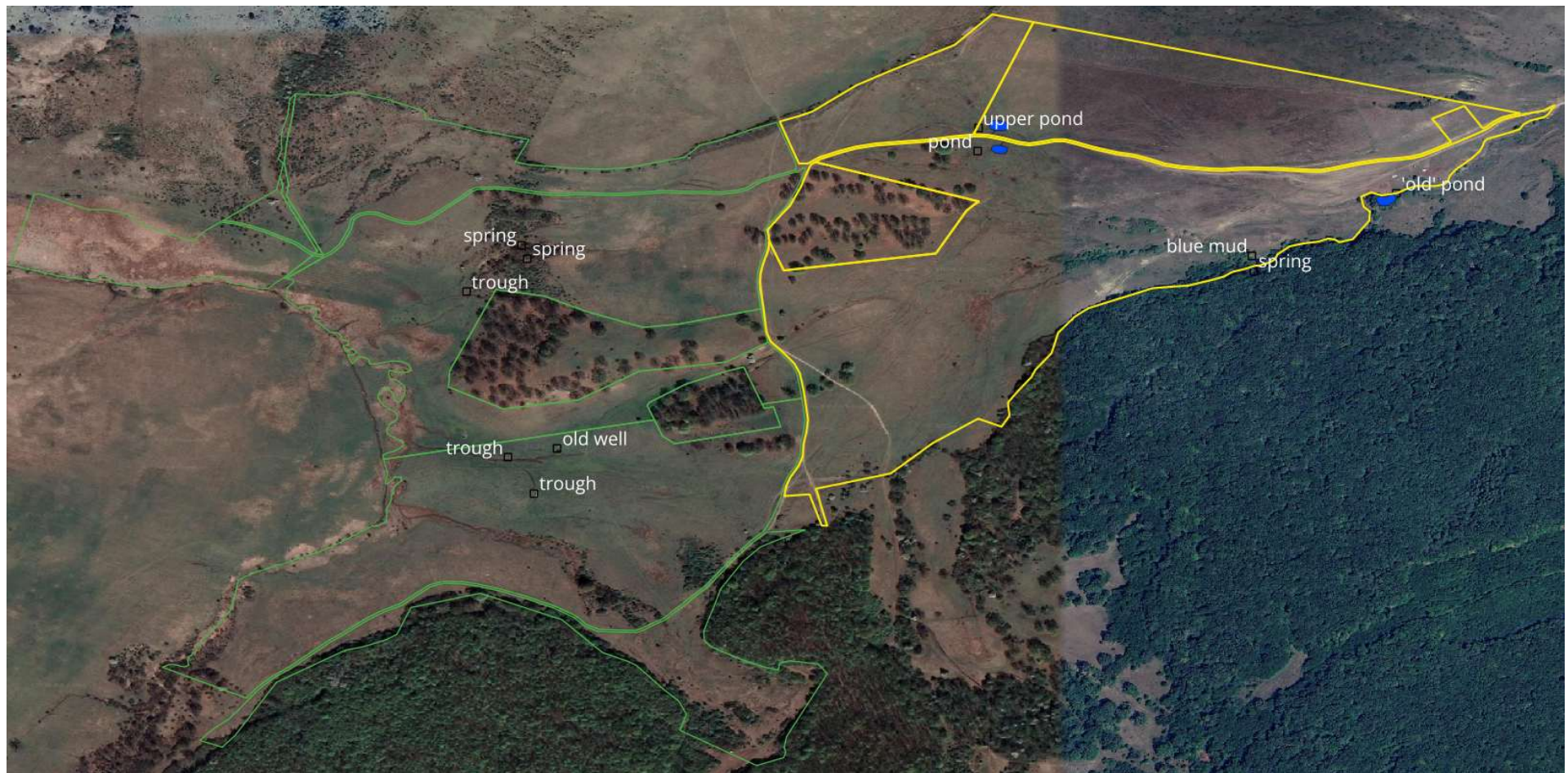
Water resources

As the dynamics of water movements are explained above, following from climate data on rainfall and evapotranspiration, we will try to combine this with the observations from the field (and narratives from municipal/ Daia village members). Noting that this study report however is not providing quantitative figures on amounts of water, in terms of total rainfall amounts, total evapotranspiration, runoff, groundwater replenishment, or discharges from springs and creeks.

Figure 16 provides an overview of the entire communal lands that are part of Daia village (in yellow highlighted the project area) and the points that have been known to bear water. Either as surface water (ponds) or as springs. Underneath key observations and narratives with regards to Daia's water resources are summarised supported by Figure 16 on the following page:

- the 'old' pond on the right used to be water bearing throughout the year. Typically, the springs alongside the creek running alongside the forest would have fed the pond it however unknown to what extent these are still water bearing (timing and volume of water). The old depicted in Figure 5 may also contribute to water collecting in the old pond, although its contribution has not been verified. The storage capacity in the pond has also reduced as during the field visit it was observed that the weir was damaged, and that considerable amount of vegetation has claimed the pond bedding.
- The upper ponds are located at either side of the road. It is not known to what extent these have been water bearing; however these are ideally located to capture the road runoff (using miter drains) as explained further below
- The springs and troughs on the left side of figure Figure 16 still bear water and are mentioned to currently provide the grazing livestock with water;
- The main creek that drains down from the town of Ulies to Daia is recalled to have water flowing from December to March. Also the creek from the project area that leads to Daia village is known to have water flowing from December to February. However in the last years discharge has reduced and it is thought that the high temperatures and wind are the main culprits.
- With regards to surface runoff directly from the grazing lands no other visible traces, besides the roadside gullies, the logging tracks and the heavily trafficked livestock paths leading to the ridge, can be seen. These gullies, tracks and livestock paths however are considered to make the landscape susceptible to increased runoff and erosion.

Figure 16: Water points in Daia communal grazing lands and C4C project area (in yellow)



Run off and groundwater recharge

In considering water resources availability for the project area and Daia village in the long run it is important to take all contextual observations into consideration. This including the landscape, landuse, soils, the incidence of erosion and the agro-climatic conditions and forecasts referred to above.

It is thought that for the conservation of water resources in the project landscape as well as the potential to change and improve the local climate that the following landscape measures are most suited (this besides the capturing of road run off as further described in Tackling the road side gullies). This is also in line with the 'Communal Development Strategy' in which 'water retention' is one of the objectives as part of sustainable landscape management.

For the purpose of ensuring that both soil and water are retained in the vulnerable areas identified in Figure 9 (area in yellow), suggested are two measures.

1. 'Contour bunds': these are (slightly) elevated longitudinal mounds that follow contour lines (ie. lines of equal elevation). In the Daia area it is suggested that these should not be higher than 30cm (preferably even lower) from the soil surface and are constructed with as little soil disturbance as possible. This can be done for example with a scraper board minimally scraping the soil 2 metres from the uphill side of line. A slight compaction should take place and both scraped area and the bunds can be resown immediately with good mixture of pasture seed.
2. 'Tree lines': the trees could be set in the bunds (described above) or could be separately made. Suggested is that local varieties are chosen, preferable saplings that are taller than 2 meters. It will be important to protect the saplings, a very natural way to do that could be using logs that are firmly triangulated around each sapling. Cuttings (from shrubs/ trees) could be used to further fill the gaps between the logs and saplings¹³.

The placing of the above suggested bunds and/or tree lines is shown see Figure 18. The placing is chosen such that sightline from the ridge into the valley remains the same, ie. considering the final height of the trees. The four pictures show tree and bund lines that start at an elevation of 645 the first/highest line of trees and are replicated down slope at every 10 meters elevation difference (except the privately owned section of trees). The green dots representing trees are spaced at 5 meters distance, this however could be varied with, also considering the four different options shown (from top left and going clock wise):

- (top left) shows trees and bunds along five different contour lines

¹³ Further reading among other from the internet: [The Grazier's Guide to Trees - Trees For Graziers](#)

- (top right) trees highlighted in yellow the section that could first be focused on as also suggested in Figure 9, an area that seems heavily trafficked and show rill formation
- (bottom right) trees highlighted in yellow trees at random intervals along the contour lines, an option perhaps more appropriate considering the grazing and maintaining a more open landscape
- (bottom left) highlighted in yellow tree lines on the most barren and also steeper section of the pasture.

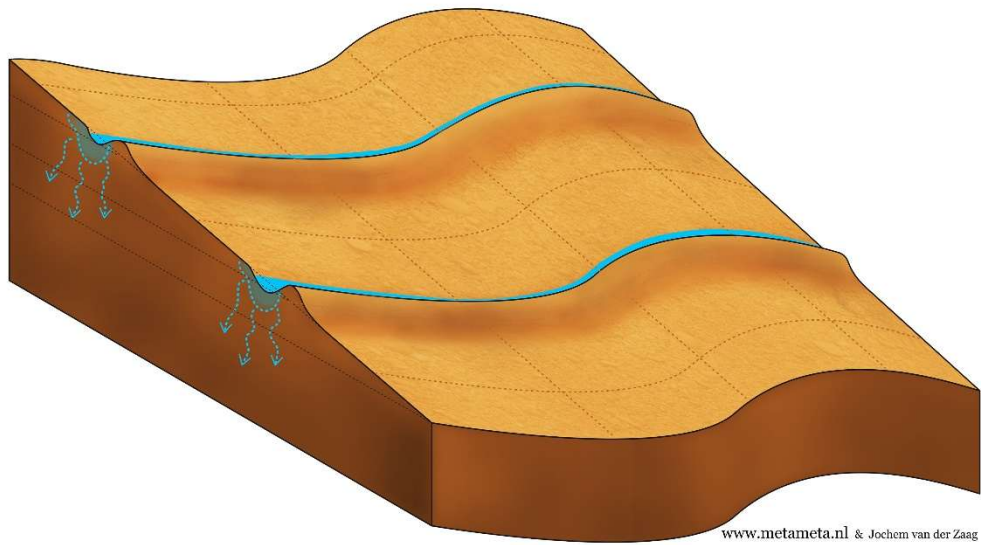
Using the contours to separate the land however may help the herders in moving around the pastures using the road rather than the pasture for livestock movement. And for the piloting of rotational grazing temporary/electric fences can be set along the contour lines indicated by the tree lines or bunds.

These different options are open for discussion and reflection, however regreening is highly suggested, particularly in the potentially vulnerable areas (indicated in top right and bottom left). The trees could be spaced at a larger distance, or in groups (woodlots with plenty of space in between) such as often seen in pastures in Romania. Choosing the varieties will require research ie. investigating common practice in Romania. A combination of locally present species, such as oak, alder and beech and possibly also fruit trees¹⁴ could be thought of.

Finally, trees in pasture not only contribute to improving the local climate (cooling) it is also known that trees and tree lines have a beneficial effect on the quality of pastures (shading and the so called biotic pumping). The positive effect of having trees in pastures was also mentioned by Atilla Sárig during the field visits, as he combines pastures with trees on his farm in the Carpathian Mountains.

¹⁴ Fruit trees were mentioned by the mayor as this might also have positive implications considering the subsidies available for common land management.

Figure 17: Example of contour bunds, capturing runoff inducing recharge and reducing erosion.



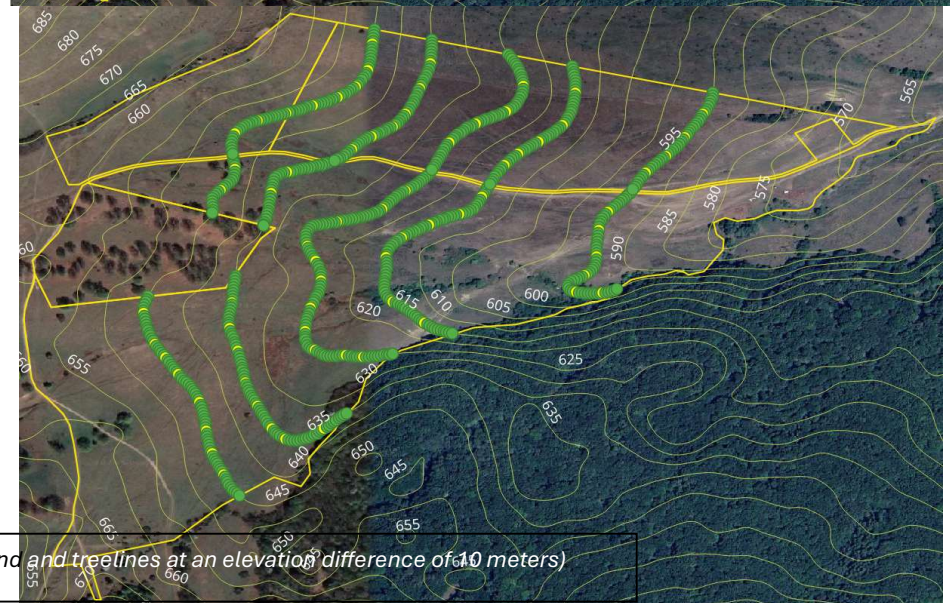
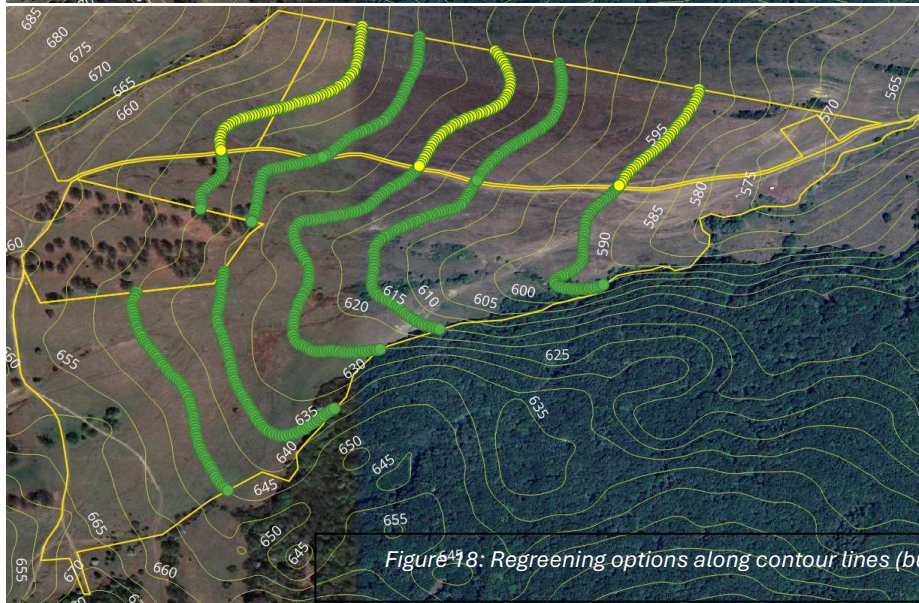
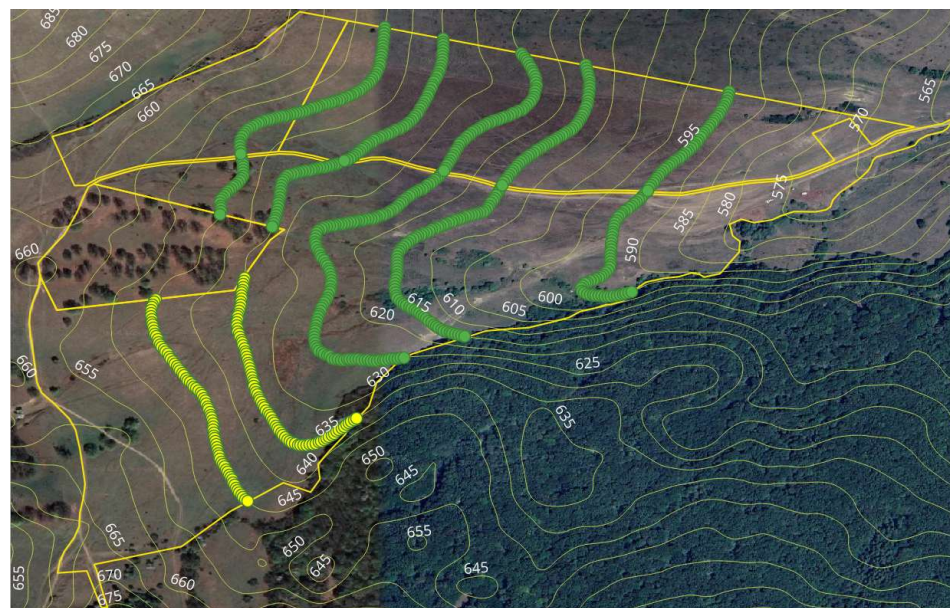
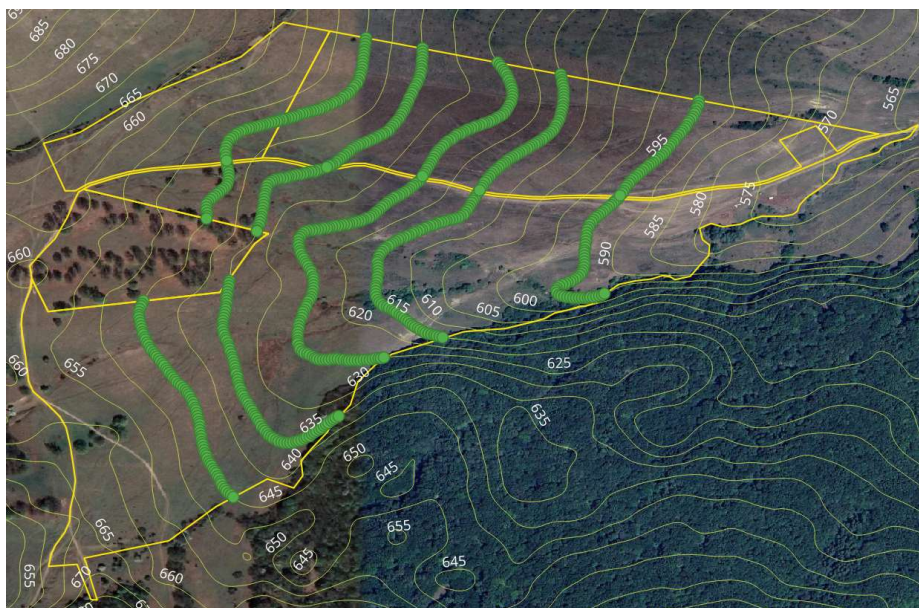


Figure 18: Regreening options along contour lines (bunch and treelines at an elevation difference of 10 meters)

Tackling the road side gullies

The severe erosion taking place alongside the gravel road leading to the top of the ridge (as shown in Figure 9 and Figure 10) requires top priority. Not only does it endanger the path of the road (bearing increasing costs of repair) but the gully is also eating away at the valuable pastures lying adjacent. Besides requiring repair of the road and filling of the gully (scour checks at regular interval could already help here), the water could be diverted to the ponds also shown in figure using so called miter or turnout drains (see Figure 19). These miter drain could be excavated with a small excavator, taking note that the longitudinal slopes of the drains towards the ponds is between 2 and 5%. This to avoid siltation on the one hand and erosion of the drains on the other. The excavated material could be use to make the scour checks and/or for the bunds mentioned earlier.

A sketch is provided for the ponds next to the road in Figure 20 including the miter drains with a slope of around 3%. The surface area of the ponds are 420 m² and 275 m² and could retain considerable amount of water. For example, if considering a depth of 30 centimetre on average a total storage of 125 m³ and 80 m³ could be achieved (considering a maximum depth of around 1 meter and sloping sides). However this is a very tentative estimate, it depends on whether or not the ponds are sealed (with impermeable clay), how much water actually accumulates, rate of evaporation or infiltration through the pond.

Whereas the drains and ponds are seen as an important measure to retain water and reduce further erosion of the gullies along the road, the development of the ponds would need thorough further investigation (exact location, soil condition). Besides that it is believed that these retention ponds should not and most likely also cannot be used as option for water supply for the livestock.

Figure 19: Road-drainage system as an asset for road protection, watershed management, and water harvesting

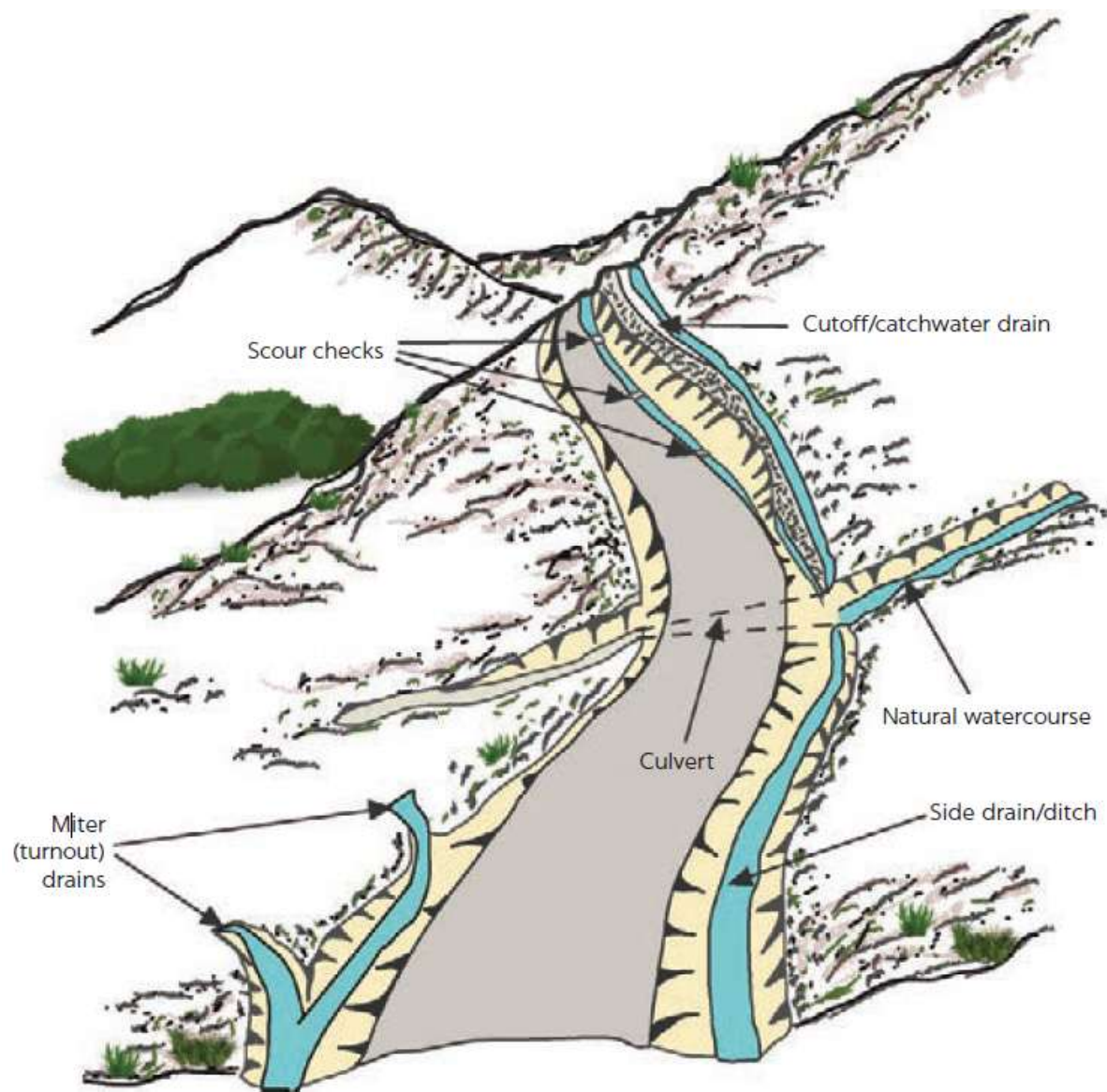
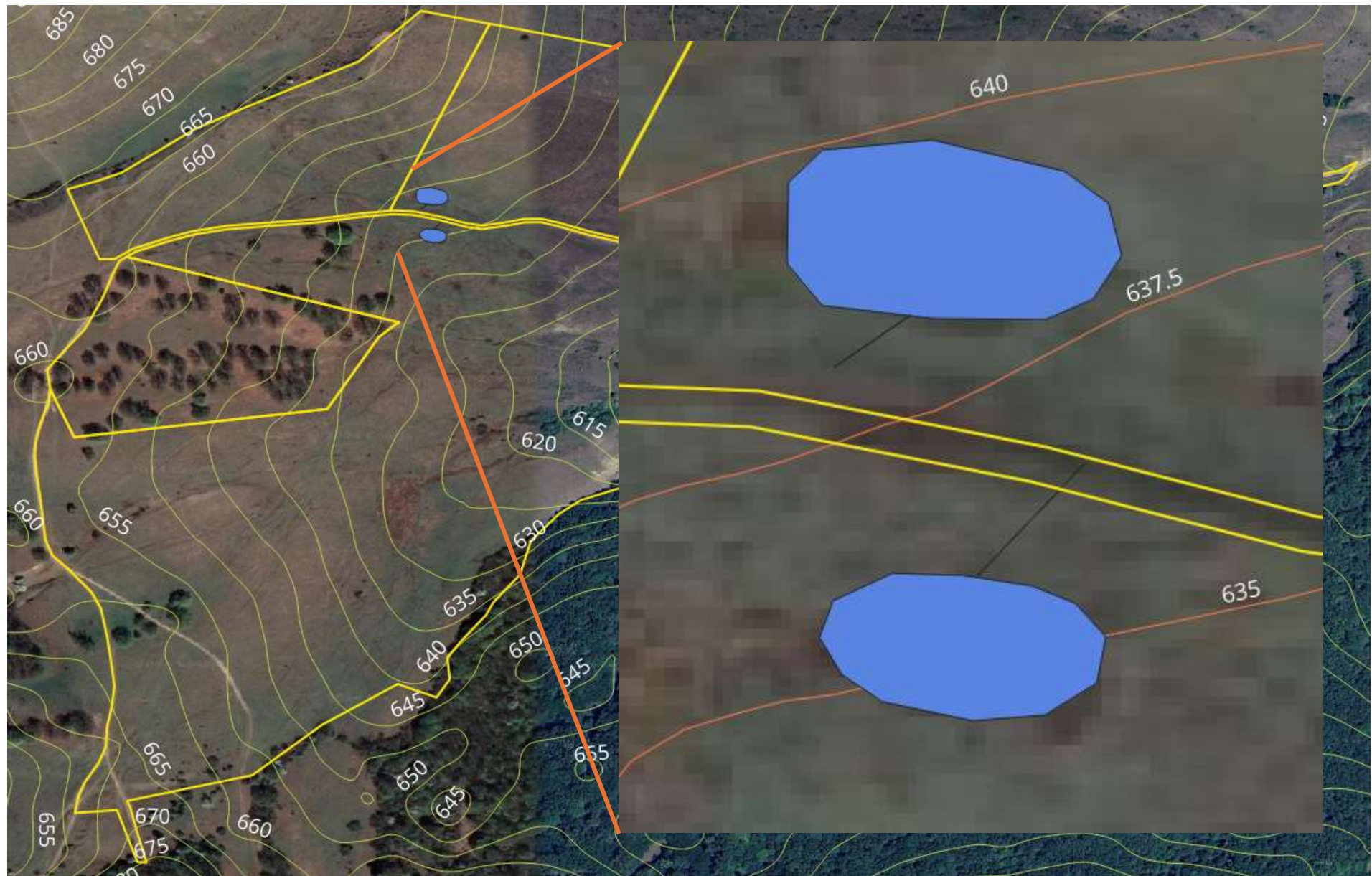


Figure 20: Sketch of roadside ponds and miter drains to capture roadside drainage



Deepening the understanding of water resources

Besides the measures suggested it is also important to continue gaining a better understanding of the local hydrology and hydrogeology. Looking at: how groundwater is replenished (among other the recharge zones of springs), the occurrence and impact of runoff, the further understanding of the drainage patterns (natural and man made) and the occurrence and flow of the springs will be important in 2025. The following is suggested:

- Delving the plans of the 'amelioration'¹⁵ works to understand if subsurface drainage has been put into place and what the purpose/function of the triangular surface drains and 'old pond' was (if subsurface drains are placed the best option might be to remove these);
- Spring observations at all the springs that have been located to observe if / and when water is flowing. These observations will help in determining if and to a certain extent where recharge zones can be protected (observations suggested twice per month)
- Further discussions with the hydrogeologist that carried out the studies for the Daia water supply (Studio Geotechnik, see references) to have their expert opinion
- A (simple) field monitoring exercise into surface runoff, in which you could either compare 'soil infiltration capacity and rainfall intensity time series' which 'allows detecting the occurrence of surface runoff by infiltration-excess'. Or the 'comparison of surface soil water content with saturated water content values allowing detecting the occurrence of surface runoff by saturation of the soil surface horizon'¹⁶.

Water supply for grazing livestock

Besides the conservation of the landscape, the water resources (and local climate) and the improvement of the quality of the grazing land the main priority for the pastures in the project area is the supply of water for the grazing livestock.

Whereas the ponds have been known to bear water the amounts that can be expected from runoff are 'too much of an unknown' to depend on for the coming grazing season. It is also believed that for the number of livestock currently visiting the project area the (re)development of ponds will not provide enough water for the entire season. The current

¹⁵ The amelioration works constituting surface and subsurface drainage works are visible to a certain extent. If the plans and designs can be found these can help in: gaining a better understanding of the hydro(geo)logy of the project area; the purpose of the works and their past and present impacts on the area in terms of water availability

¹⁶ Citation from: Judicaël Dehotin, Pascal Breil, Isabelle Braud, Alban de Lavenne, Mickaël Lagouy, Benoît Sarrazin, Detecting surface runoff location in a small catchment using distributed and simple observation method, Journal of Hydrology, Volume 525, 2015, Pages 113-129, ISSN 0022-1694, <https://doi.org/10.1016/j.jhydrol.2015.02.051>.

pond and the two ponds that are envisions to retain water from the road will certainly help in the provision of water but may also not be sufficient.

For the provision of water for livestock in the coming season(s) It is therefore suggested to focus on mobile water points that are placed as close as possible to the gravel road leading up to the ridge. The reason for this is that we cannot assume (knowing what we know) that if the 'old pond' is restored or any other ponds are developed that these will sufficiently fill to provide sufficient water. These mobile water points such as observed on the private land adjacent to the project area (see Figure 21) are suggested to assure that there is sufficient water for the livestock during the grazing months. The mobile watering points might also facilitate the rotational grazing trials. The old pond may contain water and could be used for watering the livestock this could also be the case for the roadside ponds although these are not suggested to be lined but to allow for recharge of the soil.

Whether in 2025 or 2026 it will be good to see if the springs adjacent to the pastures can be developed. This could be trialled by means of installing check dams in the creek and installing pipes to troughs situated at different points in the grazing lands. By means of pipes lined at an angle along the pastures to allow for enough pressure water can be draws water from the pond upstream of the check dams. The pipes could be fitted with a float valve installed behind the check dam in the water to allow water to be drawn. Air bleed valves could be fitted along the pipes (at the highest point) to draw out air that enters into the piped system.

Finally, as source for water for the livestock the rehabilitation of the 'old' pond could be considered. Rehabilitation should consider the potential multiple purposes, besides that it can become a biodiverse hotspot and attractive feature along the Via Transylvanica. Rehabilitation could be low cost, by means clearing the pond area; dredging/shovelling out the sediments and enabling a vegetative contour to stabilise the slope sides.

Figure 21: Mobile water point - a water tanker and trough in land adjacent to the project area



Summary of action points – Strategy

The below provides a summary of the actions described in the previous chapter. Content should form a basis for focussed discussion around the key points for development. The timing, the how and with or by whom are indicative.

What	How	With/ by whom
(2025-2026) Access Road improvement	Quick assessment of options and materials (by a road engineer, guidance could be the guidelines provided); development terms of reference; tendering (if needed); guidance of contractor	Municipality; Commons manager;
(2026) Bunds	Excavation (with excavator or grader)	Municipality; Commons manager; Community of Daia; Landscape expert
(2025-2026) Trees in grazing land	Either in lines (following contours) or in groups (as is common practice); possibly including fruit trees	Municipality; Commons manager; Community of Daia; Ecologist/ farmers in Romania practicing this

(2026) (re)development of ponds: the roadside and 'old pond'	Excavation (as described); Clearing of shrubbery; creating a vegetative perimeter around the ponds.	Municipality; Commons manager; Community of Daia; Ecologist; Water engineer
(2025) Deeping the understanding of water resources	Development of short assignments for universities/ local schools; facilitating on-site research	Project coordinator; commons manager; universities/ technical schools; water engineer / hydrologist
Livestock watering		
(2025) Mobile water points	Tractor and water cart/wagon	Commons manager; community of Daia
(2025 – 2026) Trials in capturing spring water with check dams and connecting to troughs with piped systems (considering float and air bleed valves where necessary	These trials could/should follow a learning and observing approach. First, choosing the sites at strategic points in the creek considering: the presence of springs along the creek bed and taluds (/side slopes); and the ease of water access / piping the water to troughs (sufficient gravitational head). Second: installing simple check dams first (vertical / horizontal log dams); and observing the amounts of water that collect. If sufficient water (depth and volume) collects then direct access / or piping can be trialled.	Project coordinator; commons manager; universities/ technical schools; water engineer / hydrologist

Community Engagement

As the meetings held to support this writing did not involve meeting (all) members of the Daia community, the underneath pointers are merely meant as food for thought.

Engaging Youth and Children

- Field work: the local school (Ulies) and kindergarten in Daia could be involved when bunds are built and trees are planted. Besides explaining the purpose of activities the children can help in the field in gathering cuttings, and perhaps even setting out the contour lines (A-Frame exercise¹⁷). They could also be involved in the gathering of observations of the springs.
- Educational materials such as the 'soil and water tubes', or simplified 'hydrological' cycles can help in understanding the movement of water in the environment as well as the influence of soil type and soil cover on infiltration and erosion. Infographics in which data, map, picture or other visualizations are combined to give easier access to complex information can also be developed. A 'real' 3D model of the area might be too ambitious, although with paper mache and printing of a topographical map (as much times as there are contour lines on the map) they could come a long way
- Linkage could be sought within Romania with schools and or NGOs that are active with the Green Week 'Education for Nature' in schools. Their outdoor ideas could be linked with the activities in the project area

Inhabitants of Daia

In meetings with the commons manager held before it was mentioned that the community is very willing to contribute to the sustainable development of the project area. Their involvement should not only start at the implementation but also at design and planning stage. It will be important to capture a community vision for the future of the project areas as well as the rest of the village. A vision that includes the local economy, the environment and local climate and the landscapes. The vision should then also inform the 'Communal Development Strategy' and be considered in the future planning.

With regards to the environment, local climate and landscapes this document has provided some inspiration. However most important for the people in Daia is sustaining their livelihoods and the developing of the local economy. There are many examples in Europe of remote areas and villages that have by means of collective action been able to (re)develop and sustain their living together and really develop rural economies. Some ideas to foster the opportunities in Daia could be: a community owned and run bed and

¹⁷ [Making and Using an A-frame Level \(https://www.youtube.com/watch?v=c90LEjR4Y3E\)](https://www.youtube.com/watch?v=c90LEjR4Y3E) or A Complete Guide to A-Frame Levelling (<https://www.permalogica.com/post/a-complete-guide-to-a-frame-leveling>)

breakfast for passersby of the Via Transylvanica; community cheese making and /or other typical produce (clay soaps); guided tours of the ‘ancient church’

Finally this document and the presentation could be used (after translation) to kick start a first meeting with all inhabitants of Daia so that everybody is on the same page in terms of understanding of the challenges as well as discussing and thinking out the opportunities for the future.

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