

Appendix 1. Trade-offs made by local farmers in order to define the appropriate time of mowing. Ps: time periods studied (P1: 1950-1990, P2: 1990-2007, P3: 2007-2020). Colors of driver categories help the overview of the most important driver categories (green: climate change-related driver; brown: land-use change; blue: direct exploitation; yellow: all the indirect drivers).

Trade-off	Ps	Driver-categories	Explanations
1.) Labor logistics # 1: harvesting (mowing) of cereals OR haymaking P1	P1	• A4. Climate change – increasing frequency of extreme weather events	Starting in the 1970s, heavy rainfalls became increasingly frequent. Intensive rain and wind can blow down tall grass vegetation, hindering mowing or advancing the time of mowing.
	P1	• A5. Land-use change – transformation of natural habitats into agricultural areas or vice versa	The labor demand of cereal harvesting delayed mowing of hay. Due to the abandonment of cereal production labor logistics, the area of arable land halved – changes in the labor logistics on family-owned farms.
	P1	• B1. Economic processes, goods and services (e.g. processing, manufacturing, distributing, consuming)	Cereal production was abandoned due to improved trading conditions – this situation created the chance of better labor logistics and optimized the time of mowing on family-owned farms.
2.) Labor logistics # 2: Migration of younger generations and less well-tended hay meadows OR youth remain – right time of haymaking, but lack of financial capital P3	P3	B2. Demographic – human population development (size, age structure)	Migration among younger generations is more common, hampering labor logistics during mowing seasons and preventing mowing from taking place at the optimal time.
	P3	• B5. Cultural drivers – social processes shaping attitudes, behaviour, values, beliefs, norms	The loosening of traditions means that mowing at the right time is less important, with an increasing proportion of youngsters working abroad.
3.) Hand mowing: More financial support from CAP OR greater risk of hay damage in rainy weather P3	P3	• A1. Climate change – increasing average temperature	Increases in average temperatures make the hay ripen earlier, and it is increasingly difficult to manage the optimal stage of vegetation using hand mowing (it is physically more strenuous as well in increasingly hot summer weather).
	P3	• A2. Climate change – precipitation patterns	Precipitation patterns are increasingly unpredictable, making it harder to define a sufficiently long period when the weather permits mowing by scythe.
	(P2), P3	• B1. Economic processes, goods and services (e.g. processing, manufacturing, distributing, consuming)	Thanks to growing financial capital and the consequent mechanization (mowers, raking machines), fewer farmers are willing to do hand mowing, despite increased subsidies for hand mowing.
	P3	• B2. Demographic – human population development (size, age structure)	There are increasingly fewer able-bodied people available who are in the proper physical condition to carry out hand mowing.
	(P2), P3	• B3. Technological innovations	With machinery capable of performing ever more tasks, it is not worth mowing by hand, despite greater financial support for it.
	P3	• B4. Governance – formal or informal multi-stakeholder processes	The CAP subsidy system provides a package of increased support to those who mow registered meadows by hand, but prescribed late mowing makes it more difficult to maintain hay of adequate quality.
	P3	• B5. Cultural drivers – social processes shaping attitudes, behaviour, values, beliefs, norms	The simplicity and especially the speed of mechanical mowing is judged increasingly favourably. Time is of growing importance, and a good farmer mows at the right time, regardless of the method.
	4.) Mower machines # 1: dusty hay OR slower, harder haymaking by scythe P2–P3	P2, P3	• A1. Climate change – increasing average temperature
P2, P3		• A2. Climate change – precipitation patterns	Haymaking must be done rapidly due to the unpredictability of precipitation patterns – machine mowing aids this, but at the cost of poorer hay quality.
P2, P3		• A3. Climate change – earlier start of	Due to the early onset of spring, on grasslands included in the

	seasons	CAP subsidy system, where mowing cannot be started before 1 st of July, it is an important priority to mow the “overripe” hay quickly after that date, before it turns to “straw”.	
P2, P3	• A4. Climate change – increasing frequency of extreme weather events	Speed is increasingly important because of the growing frequency of heavy rains, which blow down the hay that grows tall on manured grasslands.	
P2, P3	• A5. Land-use change - transformation of natural habitats into agricultural areas or vice versa	Due to the abandonment of hay meadows at higher altitudes far from the settlement, the increased proportion of managed grasslands to be mowed earlier at lower altitudes, closer to the village, necessitates the expansion of mechanization.	
P2, P3	• A7. Direct exploitation / extraction – overexploitation	With mower machines, work progresses more quickly, so late-mown grasslands can be dealt with sooner.	
P2, P3	• B1. Economic processes, goods and services (e.g. processing, manufacturing, distributing, consuming)	Those who cannot afford machinery either have to hire help or mow by hand. This economic situation affects the time of mowing.	
P2, P3	• B2. Demographic – human population development (size, age structure)	Due to the migration of younger generations, the middle generations can make faster progress with haymaking if they can rely on the help of mower machines.	
P2, P3	• B3. Technological innovations	Mower machines speed up mowing, so some of the meadows are mowed earlier, although the hay suffers from poorer quality (dusty) and reduced quantities, as the remaining stubble is longer.	
P3	• B4. Governance – formal or informal multi-stakeholder processes	After the date of 1 st of July specified by the CAP subsidy system, the ripeness of the vegetation means that mowing must be done quickly, and in this case the large-scale use of mower machines is of great benefit.	
P2, P3	• B5. Cultural drivers – social processes shaping attitudes, behaviour, values, beliefs, norms	In parallel with the loosening of traditions, the spread of machinery and reshaping of grassland management created the opportunity for earlier mowing in large areas of outer (i.e. outlying) hay meadows, and alterations in social institutions.	
5.) Mower machines # 2: longer stubble (greater loss) OR slower, harder haymaking by scythe P2–P3	• B1. Economic processes, goods and services (e.g. processing, manufacturing, distributing, consuming)	Due to reductions in livestock numbers, the losses resulting from longer stubble are of decreasing significance, which helps to spread the use of mower machines and to advance the time of mowing.	
6.) Time of mowing # 1: early mowing - short-term benefit of hay quality and long-term loss hampering completion of reproductive cycle OR vice versa P1–P2–P3	P2, P3	• A1. Climate change – increasing average temperature	Due to the increasing average temperature in the different seasons (especially in winter and summer), the vegetation ripens increasingly earlier, so mowing can be carried out sooner.
	P3	• A2. Climate change – precipitation patterns	As the time of mowing shifts ever earlier in the season, it clashes with the end of the period of maximum precipitation in early summer, but the decreasing predictability of rainfall makes it hard to decide on the right time of mowing.
	P3	• A3. Climate change – earlier start of seasons	Earlier springs mean the vegetation grows earlier, which also shifts the optimal time of mowing to earlier in the season.
	P2, P3	• A6. Land-use change – intensification or abandonment of agriculture	In manured grasslands, the vegetation ripens more quickly, so these grasslands need to be mowed increasingly earlier.
	P3	• A7. Direct exploitation / extraction – overexploitation	The changing preferences of local farmers often result in them mowing too early in the season. This is a phenomenon that is increasingly prevalent in the landscape.
	P2, P3	• B1. Economic processes, goods and services (e.g. processing, manufacturing, distributing, consuming)	Investment in the purchase of mower machines allows for earlier mowing than before, even on outer meadows, so more areas can be mowed earlier in the season.
	P2, P3	• B3. Technological innovations	As mower machines become increasingly widely used, outer meadows can also be mowed earlier in the season, so a lot of areas are mowed sooner than before.
7.) Time of mowing # 2: late mowing - long-term stability of the yield and loss of quality OR vice versa P1–P2–P3	P3	• A1. Climate change – increasing average temperature	Increasing average temperatures have a powerful effect on the early ripening of vegetation, and therefore on the time of mowing.
	P3	• A2. Climate change – precipitation	Increasing periods of drought accelerate the over-ripening and drying-out of vegetation, so more hay turns to “straw” in

		patterns	the case of late mowing.	
	P3	• A3. Climate change – earlier start of seasons	The early start of spring means that the hay ripens sooner, so late mowing may result in decreased quality.	
	P3	• A6. Land-use change – intensification or abandonment of agriculture	Manuring (also) accelerates the ripening of vegetation, so hay must be mown earlier, otherwise the quality deteriorates rapidly.	
	P3	• A7. Direct exploitation / extraction – overexploitation	Mowing too early in the season (compared to the traditional time) is increasingly prevalent as the quality of the hay takes precedence, so late mowing is no longer as common as it was.	
	P3	• B2. Demographic – human population development (size, age structure)	Late mowing may take place owing to outward migration among the youth, not for management reasons, but because of other work carried out in other sectors (difficulties in labor logistics).	
	P3	• B4. Governance – formal or informal multi-stakeholder processes	The rules of the subsidy system promote late mowing, but this often damages the interests of the farms.	
	P3	• B5. Cultural drivers – social processes shaping attitudes, behaviour, values, beliefs, norms	Late mowing is less common due to both the loosening of traditions and the changing preferences of local farmers - increased importance of hay quality compared to seed ripening.	
8.) Aftermath: harvesting the hay earlier in order to ensure time to grow aftermath OR allowing completion of reproductive cycle (P1)–P2–P3	P3	• A1. Climate change – increasing average temperature	Mowing can be done earlier because of the warming climate, which is beneficial to aftermath mowing.	
	P3	• A3. Climate change – earlier start of seasons	Mowing can begin earlier because of the early onset of spring, which is beneficial to aftermath mowing.	
	P1, P2, P3	• A6. Land-use change – intensification or abandonment of agriculture	Manuring accelerates the ripening of vegetation, which is beneficial to earlier mowing and aftermath mowing.	
	P2, P3	• B3. Technological innovations	Machine mowing promotes faster mowing and is beneficial to aftermath mowing.	
	P3	• B4. Governance – formal or informal multi-stakeholder processes	The subsidy system hinders aftermath mowing, because permitting mowing only after 1 st of July leaves little time for vegetation to re-grow on inner meadows.	
	P3	• B5. Cultural drivers – social processes shaping attitudes, behaviour, values, beliefs, norms	The loosening of traditions and the increasing tendency to follow the behaviour of one's neighbours promote early mowing, which is beneficial to aftermath mowing.	
9.) Species-specific haymaking: considered species are Poaceae species and some selected Fabaceae species OR Forbs P1–P2–P3	P2, P3	• A1. Climate change – increasing average temperature	The increasing average temperature has heterogeneous effects on the prevalence of plant functional groups (e.g., Poaceae species, forbs), making the decision on the time of mowing more difficult.	
	P3	• A2. Climate change – precipitation patterns	The unpredictability of precipitation patterns and the more frequent periods of drought are detrimental to a significant proportion of forb species making the decision on the time of mowing more difficult.	
	P3	• A3. Climate change – earlier start of seasons	Increasingly early mowing because of the earlier spring and the consequent greening of the vegetation has different effects on local key species, so local farmers have to rethink the time of mowing.	
	P3	• A5. Land-use change - transformation of natural habitats into agricultural areas or vice versa	As mountain meadows dominated by forbs were increasingly abandoned, the proportion of manured inner grasslands dominated by the Poaceae functional group increased – farmers have to consider the time of mowing to maintain the abundance of important plant functional groups.	
	P3	• A6. Land-use change – intensification or abandonment of agriculture	Manuring results in the dominance of Poaceae species – the time of mowing plays an important role in shaping the relative abundance of plant functional types.	
	P3	• A7. Direct exploitation / extraction – overexploitation	Mowing too early in the season is beneficial to species that reproduce vegetatively, e.g. Poaceae species.	
	P3	• B2. Demographic – human population development (size, age structure)	Paid jobs in other sectors among the younger generation make early mowing increasingly frequent, which benefits vegetatively reproducing species, e.g. Poaceae.	
	P3	• B5. Cultural drivers – social processes shaping attitudes, behaviour, values, beliefs, norms	Loosening traditions often cause mowing to be carried out too early in the season, which benefits vegetatively reproducing species, e.g. Poaceae.	
	10.) Key species: <i>Onobrychis viciifolia</i> : early mowing harvesting good <i>Onobrychis</i> hay OR delayed	P3	• A1. Climate change – increasing average temperature	<i>Onobrychis</i> , a species of Mediterranean origin, is flowering ever earlier thanks to increasing temperatures, so it also has to be mowed increasingly early.
		P3	• A3. Climate change – earlier start of	An early spring means early flowering <i>Onobrychis</i> – this

mowing supporting completion of the reproductive cycle P1–P2–P3		seasons	influences the time of mowing.
	P3	• A7. Direct exploitation / extraction – overexploitation	Due to changes that do not follow the ripening of vegetation, <i>Onobrychis</i> is mowed too early (in flower), reducing the dispersal of seeds and leading to declining yields.
	P3	• B4. Governance – formal or informal multi-stakeholder processes	Due to the rules of the subsidy (first date of mowing is 1 st of July), <i>Onobrychis</i> can disperse seeds by the time it is mown, but it has no value as hay in this case, its leaves break off, and only the stem remains, although the seeds have been dispersed.
11.) Livestock condition: early cut of good quality hay (milk production) OR later mowing and seed ripening P1–P2–P3	P3	• B5. Cultural drivers – social processes shaping attitudes, behaviour, values, beliefs, norms	Younger generations regard <i>Onobrychis</i> as of declining importance – many mention that it is disappearing.
	P3	• A1. Climate change – increasing average temperature	The faster development of vegetation due to increasing average temperatures contributes to early mowing.
	P3	• A2. Climate change – precipitation patterns	Periods of drought caused by changing precipitation patterns accelerate the ripening of vegetation and lead to lower hay quality.
	P2, P3	• A3. Climate change – earlier start of seasons	Early springs mean that the ideal phenological stage of the vegetation also comes earlier, which affects the time of mowing.
	P2, P3	• A5. Land-use change - transformation of natural habitats into agricultural areas or vice versa	As outer meadows are abandoned, a greater proportion of the hay is produced on inner meadows.
	P1, P2, P3	• A6. Land-use change – intensification or abandonment of agriculture	Manuring accelerates the ripening of vegetation and influences the quality and quantity of the mown hay.
	P3	• A7. Direct exploitation / extraction – overexploitation	Early mowing improves the quality of the hay, but is unfavourable to long-term yields.
	P3	• B4. Governance – formal or informal multi-stakeholder processes	As hay quality grows in importance, mowing is carried out ever earlier. This process is rendered impossible by the strict, inflexible rules of the subsidy system.
	P3	• B5. Cultural drivers – social processes shaping attitudes, behaviour, values, beliefs, norms	Due to changes in social capital (traditions, preferences), there is a preference for good-quality hay, and therefore mowing is carried out earlier.
	12.) Springtime grazing of hay meadow: improving the quality of hay and increasing yield security but trampling of carefully managed grasslands OR vice versa P1–P2	P1, P2	• A2. Climate change – precipitation patterns
P1, P2		• A3. Climate change – earlier start of seasons	Spring comes early so vegetation develops sooner; livestock can thus be driven earlier to the pastures instead of grazing hay meadows.
P1, P2		• A4. Climate change – increasing frequency of extreme weather events	Heavy storms that blow down the hay in June have become more frequent since the 1970s – if there is no grazing, storms damage the increasingly tall-stemmed vegetation, which advances the time of mowing.
P1, P2		• A7. Direct exploitation / extraction – overexploitation	When precipitation is insufficient or at the wrong time, grazing represents overexploitation of the hay meadows and delays the time of mowing.
P1, P2		• B1. Economic processes, goods and services (e.g. processing, manufacturing, distributing, consuming)	Farmers do not like to graze livestock on hay meadows that are increasingly treated with manure, which brings forward the time of mowing.
13.) Manure: manuring of arable fields OR hay meadows P1	P1	• B1. Economic processes, goods and services (e.g. processing, manufacturing, distributing, consuming)	The volume of cereal production influences the amount of manure that remains available for the grasslands, which influences the ripening of the vegetation.
	P1, P2, P3	• A6. Land-use change – intensification or abandonment of agriculture	The abandonment of cereal production means there is more manure available for the grasslands, which also encourages secondary growth (aftermath).
14.) Manuring: Increased quantity of hay (aftermath) OR lower quality (Poaceae dominance) P1–P2–P3	P2, P3	• B1. Economic processes, goods and services (e.g. processing, manufacturing, distributing, consuming)	Declining livestock numbers lead to a decrease in the available manure, so greater care must be taken when deciding which areas need to be manured.
	P3	• B4. Governance – formal or informal multi-stakeholder processes	Manuring brings forward the optimal time of haymaking, but this is prevented by the rules of the subsidies. In most years this is bad for hay quality.
15.) Weather:	P3	• A1. Climate change –	Increasing average temperature brings mowing forward.

waiting for a longer dry period to dry the hay OR mowing at the right time P1–P2–P3		<ul style="list-style-type: none"> • increasing average temperature 	
	P3	<ul style="list-style-type: none"> • A2. Climate change – precipitation patterns 	Due to the decreasing predictability of precipitation patterns, it is difficult to decide when to mow and when there will be enough time for the hay to dry out.
16.) Social institutions: Collaborative, communal haymaking (<i>kaláka</i>) OR haymaking at the right time individually P3	P3	<ul style="list-style-type: none"> • A1. Climate change – increasing average temperature 	The increasing average temperature accelerates the ripening of vegetation, which encourages farmers to carry out the mowing individually.
	P3	<ul style="list-style-type: none"> • A3. Climate change – earlier start of seasons 	Early springs accelerate the ripening of vegetation, which encourages individual mowing.
	P3	<ul style="list-style-type: none"> • A6. Land-use change – intensification or abandonment of agriculture 	Manuring accelerates the ripening of vegetation, which encourages individual mowing.
	P3	<ul style="list-style-type: none"> • B1. Economic processes, goods and services (e.g. processing, manufacturing, distributing, consuming) 	Purchasing a mower machine allows a farmer to do the mowing alone, without the help of the community.
	P3	<ul style="list-style-type: none"> • B3. Technological innovations 	With a mower machine, even one person working alone can progress quickly without communal assistance.
	P3	<ul style="list-style-type: none"> • B4. Governance – formal or informal multi-stakeholder processes 	Due to the strict date set by the CAP (1 st of July), there is no time for farmers to help each other.
	P3	<ul style="list-style-type: none"> • B5. Cultural drivers – social processes shaping attitudes, behaviour, values, beliefs, norms 	The loosening of traditions also contributes to the decline of collaborative, communal haymaking (<i>kaláka</i>), and farmers are increasingly reluctant to help each other.
	P3	<ul style="list-style-type: none"> • A1. Climate change – increasing average temperature 	Increasing average temperatures accelerate the ripening of vegetation, which conflicts with CAP rules on the time of mowing.
17.) Subsidies: Support from CAP OR haymaking at the right time P3	P3	<ul style="list-style-type: none"> • A3. Climate change – earlier start of seasons 	Early spring accelerates the ripening of vegetation, which conflicts with CAP rules on the time of mowing.
	P3	<ul style="list-style-type: none"> • A6. Land-use change – intensification or abandonment of agriculture 	Manuring accelerates the ripening of vegetation, which conflicts with CAP rules on the time of mowing.
	P3	<ul style="list-style-type: none"> • A7. Direct exploitation / extraction – overexploitation 	Mowing too early (based on the views of the local farmers) in the season is increasingly prevalent as the quality of hay becomes more important, which makes it harder to take account of the date set by the subsidy system.
	P3	<ul style="list-style-type: none"> • B2. Demographic – human population development (size, age structure) 	Due to migration, the traditional labor logistics of family-owned farms no longer apply, and younger generations frequently do the mowing when their other jobs allow, with grassland management aspects playing a secondary role.
	P3	<ul style="list-style-type: none"> • B4. Governance – formal or informal multi-stakeholder processes 	The CAP subsidy system regulates the time of mowing, and farmers only receive financial support if they meet the requirements of the regulations.
	P3	<ul style="list-style-type: none"> • B5. Cultural drivers – social processes shaping attitudes, behaviour, values, beliefs, norms 	The increasingly early start date of mowing, resulting from the loosening and changing of traditions, conflicts with the compulsory date of 1 st of July.