

ILTER Ecosystem Service Initiative for LTSER Region Eisenwurzen (Austria)

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Narrative

Introduction

The LTSER region Eisenwurzen stretches over an area of 5784 km² and heights from 210m to 2496m. It includes parts of the pre-alps, parts of the Northern Limestone Alps and of the large inner-alpine valley of the Mur River. Most of the area except the most southern parts belongs to the water basin of the Enns River.

Today forests are the dominating land-cover and land-use form in the region. Although nowadays largely dominated by rural and agricultural settings the region also harbours some important industry. The existence of these industries in the region, the current distribution and state of natural landscape patterns and also the identity of the region can only be understood through consideration of the historic development path which was also shaped by the availability and transformation of past ecosystem services of this region.

The LTSER region Eisenwurzen has been influenced by large scale economic developments since centuries. Building on its natural iron deposits and its vast timber resources Eisenwurzen was once one of Europe's iron producing centres. In the 16th century 15% of the European iron was produced in this region. At this time a complex system of mining, transport, agriculture and forestry developed enabling extensive deforestation and high population densities. After the decline of the iron producing industry the wood industry remained important for the regional economy and for shaping the landscapes – although it never reached the significance of the iron industries. Nowadays the wood industry has also lost much of its economic importance. Pockets of enduring industries around the urban centres of Styer and Leoben are still an important part for the dynamics and identity of the region. Through the decline of active farmers and total population the forests are increasingly reclaiming the land in the central parts of the Eisenwurzen. Many inhabitants of the region perceive this development negative as being “overgrown by forest” is seen to indicate loss of importance and increasing marginality.

Building on the beauty of the landscape tourism is growing in importance. Anyway the competition between tourist regions is high in Austria and only in some of the municipalities favourable conditions for skiing are found which enable more intensive and year-round tourism. Most regions are opting for “eco-tourism” i.e. in connection with one of the two national parks, holidays on farm, or family holidays and are mostly restricted to the summer season.

Regions & Scales

The LTSER Eisenwurzen can be divided into two main parts: the lower lying parts of the pre-alps and the Mur River valley, which also contain the urban centres of the region and the higher alpine parts which are more rural, characterized by small scale farming, and population decline.

Another characteristic of the region is that single landowners own large stretches of forest. In the case of Eisenwurzen these are the Austrian State Forest (ÖBF), the Styrian State Forest and the Monastery of Admont. These companies which are also operating on the global markets have different management approaches than smaller landowners i.e. farmers.

Ecosystem Services and Natural Resource Management

Forest

Forests are the dominant landcover and landuse type in the LTSER region. They were already heavily used as energy carrier and construction material in the early industrialisation phase of the region. Next to these provisioning services they also provide important regulating and cultural services. The dominant species in the region is spruce as it was favoured for its faster growth and the resulting economic advantages. The natural forest cover would be a mixed broadleaf forest in the lower and a mixed coniferous forest in the higher parts.

A domination of spruce can affect the capability of the forest to withstand strong winds. It also leads to a higher yearly uptake of nitrogen from the air as spruce do not drop their needles in the winter and therefore remain effective “air-filters” all year round.

Hunting is a culturally but also economically important activity. Renting hunting grounds can contribute more to the income of a forest owner than the harvested wood. Hunting aiming for the biggest trophies (males with big antlers) has led to unsustainable high populations of deer (chamoix, roe- and red-deer) as animals are fed through the winter or hunting is performed without consideration of population structure. These high densities of deer can hinder natural regeneration of mixed forests. Conflicts between forest owners and hunters occur as well as conflicts between hunters and non-hunters how want to use forest for other out-door activities. Hunting clubs have a very strong lobby and it is quite difficult to change this system as it is deeply rooted in tradition.

Big carnivores like lynx and bear have also returned to the region attracted by the large remote forest areas. However the populations are still so small that there is a high risk of extinction. (To which hunting seems to contribute).

For a region dominated by forestry bark-beetle management is an important topic. The huge monoculture spruce forests have a lower resilience against bark-beetle outbreaks than the mixed broadleaf forests. Some management measures are prescribed by the national laws. Others depend on the initiative of the forest owner. In the national park management of game and also against bark beetle is reduced as far as possible and usually restricted to the “puffer-zone”.

Alpine Agricultural Systems

Beside some larger farms in the pre-alps specialising on the production of pigs the region is dominated by cow keeping either for milk or meat. Milk cows require a more intensive form of farming both in terms of land-use and working time. Suckle cow holding for meat production requires less work input and is also less intensive in terms of landuse. The transition from milk-cows to suckler-cows is commonly observed in the region.

A specific feature of alpine agriculture is the alms, which are used for transhumance. During the summer the cows are brought to high lying meadows. Without the maintenance of these meadows through regular grassing the tree-border would reach higher.

Economic conditions, like agricultural prices, changes in life-style, and a lack of infrastructure in remote areas are forcing more and more farmers to look for other occupations. Extensification, renting a-way land and finally forestation are the usual steps in a process leading to the loss of open agricultural land. The loss of cultural landscape in the area – which basically means loss of open meadows – has also impacts on the biodiversity. Several species depend on traditionally managed extensive meadows. Unfortunately these are often the meadows abandoned first due to their low gains. Another loss of “cultural” biodiversity directly connected to agriculture is the loss of traditional cultural species i.e. old fruit tree

varieties. In recent time farmers have started to explore alternatives to cow-livestock. Framing with sheep or with deer as livestock can now also be observed in the region.

Water

With a high annual precipitation the region has large water resources. Large springs in the calcareous stocks of the “Hochschwab” are used for the drinking water supply of cities like Vienna and Graz. Along the Enns River power stations produce electricity some with negative affects on the biodiversity of the streams.

The zones along the rivers and streams are regularly threatened by flooding. The role of river regulation and electric power stations in this context is not well studied. Both a restoration of river-banks and the new installation of small scale power stations, which are currently subsidised by the government, can be observed. The region still harbours some smaller streams, which are still mostly unregulated and therefore valuable for conservation.

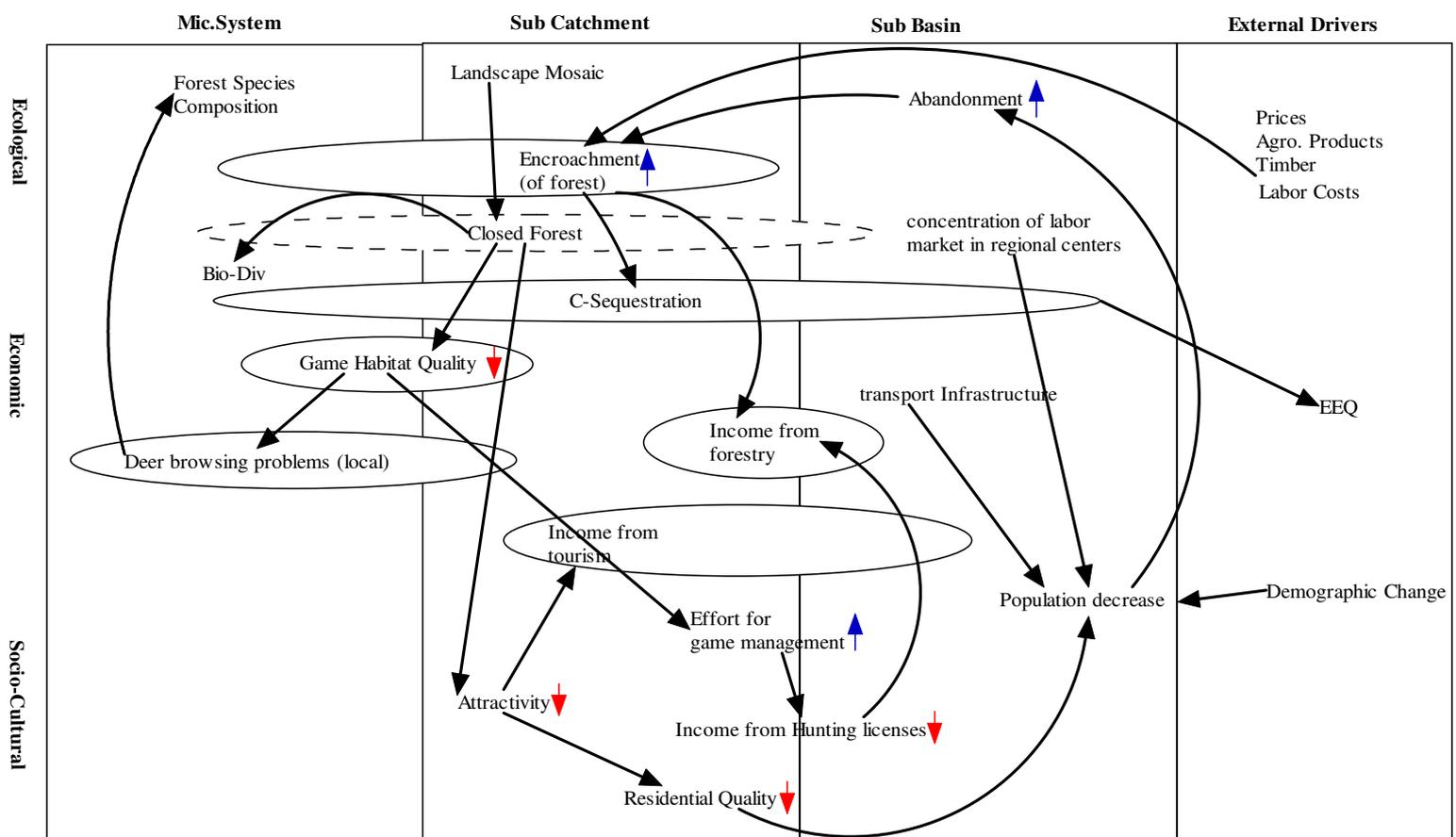


Figure 2: Interactions of important components of the SES in the LTSER region Eisenwurzen over several scales. Blue arrows indicate an increase, red arrows a decrease of the factor. Afforestation is one of the main trends in the region. Through an abandonment of agricultural areas and an overall population decrease in rural areas caused by a mix of economic conditions, lacking infrastructure and demographic development the landscape pattern is changing from a mosaic towards a more homogeneous landscape. This affects the overall biodiversity of the region negatively as whole habitats disappear. Through a lack of open meadows and borderlines the game habitat quality can also decline, leading to local deer browsing problems (for a detailed view on deer – forest interaction see figure 3) and a higher effort for game management, which will reduce the income from hunting licenses. In turn it can be expected that the contribution of forestry to the regional income will increase, as well

as the C-sequestration. A negative affect is expected on the attractiveness of the landscape reducing the residential quality and therefore contributing to population decrease.

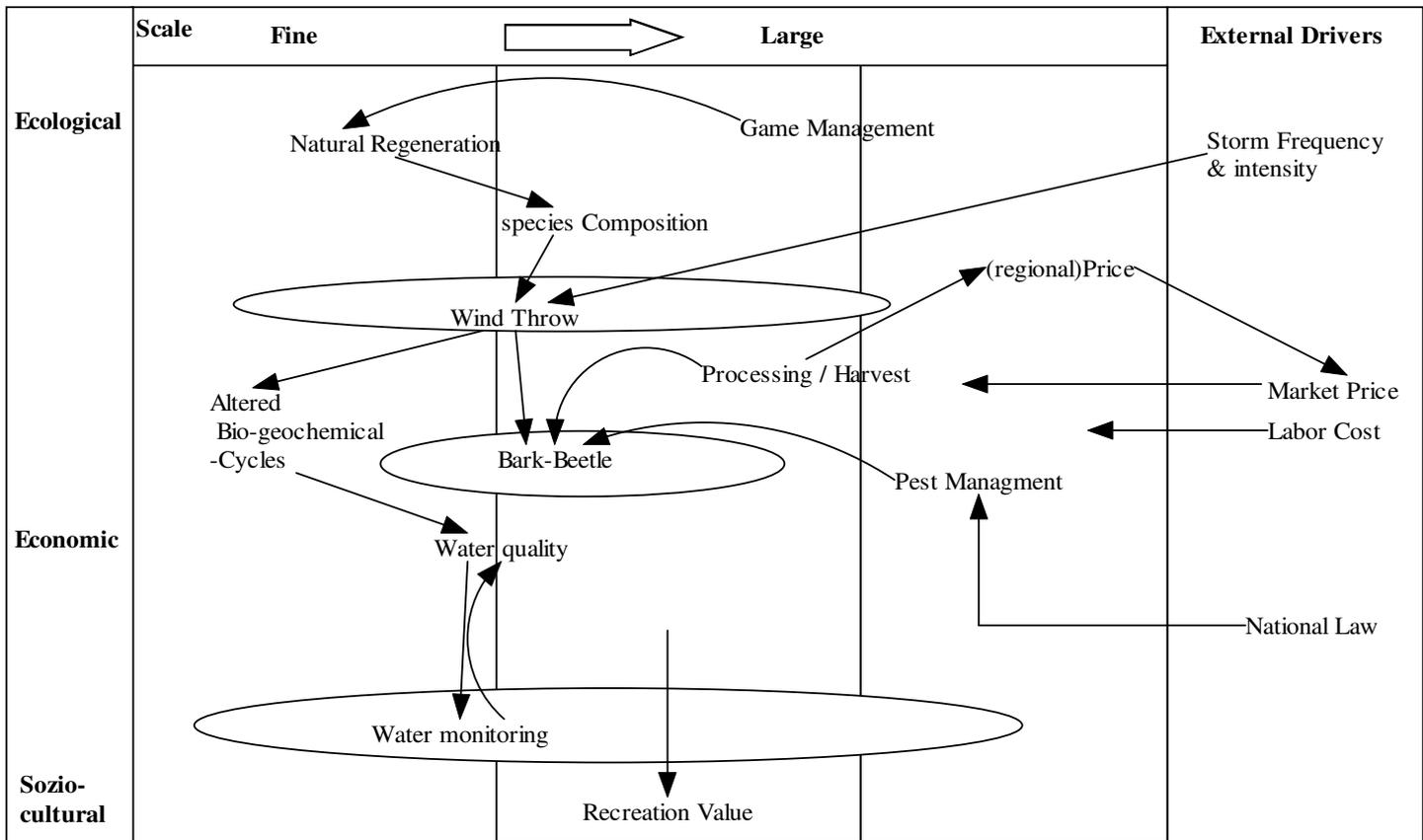
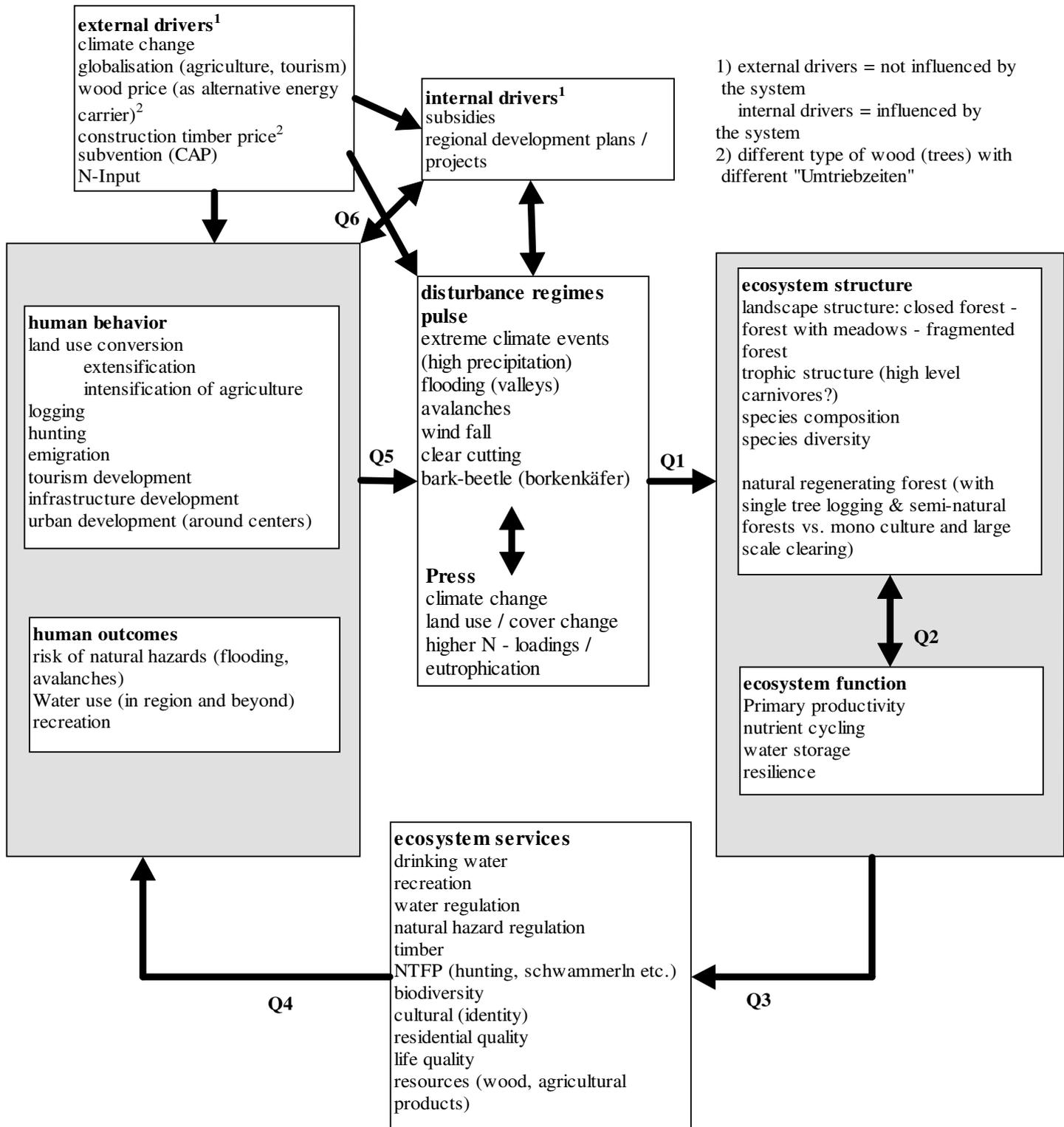


Figure 3: Interactions between different factors contributing to or influenced by wind throw. The resilience of forest stands against wind throw is determined by their species composition. Due to their shallow roots spruces are especially prone. The capacity of a forest to regenerate towards a mixed species forest is largely influenced by the density of deer, how selectively browse trees in the recruitment stage and tend to avoid spruce. Increasing wind throw also elevates the risk of bark-beetle outbreaks. This requires either harvesting and processing of the wood or other management measures like decortication. If and what measures are taken depends on the market price for wood, the accessibility and national regulations. Large wind throws can also affect the water quality (releasing nitrogen etc.) and the aesthetic value of a landscape.

ISSE Feedback Loop Model



1) external drivers = not influenced by the system
 internal drivers = influenced by the system
 2) different type of wood (trees) with different "Umtriebszeiten"

Q1: How do long-term press and short-term pulse disturbances interact to alter ecosystem and function?

How will long term changes like changing species compositions through climate change and management decisions interact with short presses like extreme weather events?

Q2: How can biotic structure be both a cause and consequence of fluxes of energy and matter?

How will changes in landscape patterns influence biodiversity in the LTSER region? How do changes on different scales interact?

Q3: How do altered ecosystem dynamics affect ecosystem services?

How do changes in landcover patterns influence cultural and regulating ecosystem services? How will slowly changing variables i.e. N-load influence the system once the threshold is reached?

Q4: How do changes in vital ecosystem services feed back to alter human behaviour?

How will the human population respond to changes in the ecosystem services i.e. caused by changes in landscape?

Q5: Which human actions influence the frequency, magnitude, and form of press and pulse disturbance regimes within and across ecosystems?

Which ecosystem services are important for local people? How strong is the willingness to conserve them?

How will conflicts over management goals and uses of ecosystem services (i.e. hunting – conservation – tourism) influence human behaviour towards ecosystems?

How does human behaviour esp. changes in population number influence different regions in the Eisenwurzen LTSER? Are there negative or positive feedback loops in place determining if a region will depopulate or not?

Q6: How do external drivers influence the system?

How do the changes introduced through external disturbances influence ecosystem structure and function and how do these effect the “human outcomes” and “behaviour” via ecosystem services. Are mitigation efforts on local regional or national scale applied which take into account the interactions in the SES? How is the relation between external and internal drivers? Is the system largely external driven or influenced by internal decisions?

LTSER Region Eisenwurzen Ecosystem Services

Ecosystem services per Ecosystem:

Ecosystem	Ecosystem Service	Pre-alps	Alps
Temperate Broadleaf & Conifer Forest:	Water regulation	yes	yes
	Drinking water	yes	yes
	Natural hazard regulation	yes	yes
	Non Timber Forest Products (NTFP) (hunting, mushrooms etc.)	yes	yes
	Timber	yes	yes
	Cultural identity	yes	yes

Rivers & Streams:	Fishing	yes	yes
	Recreation	yes	yes
	Electricity	yes	yes
Alpine Grasslands	NTFP	no	yes
	Recreation	no	yes
	Cultural identity	no	yes
	Biodiversity	no	yes
	Resources for agriculture	no	yes
Rocks	Recreation	no	yes
	Identity	no	yes
	Biodiversity	no	yes
Meadows & Alpine pastures	Biodiversity	no	yes
	Cultural identity	no	yes
	Recreation	no	yes
	Resources (for stock)	no	yes
Urban and industrial systems	Quality of life	yes	yes
	Historic local advantages	yes	yes

LTSER region Eisenwurzen: Temperate Coniferous Forest and Mixed Broadleaf Forest; represents the Northern Limestone Alps and pre-alps

The six most important ecosystem services are marked green in the table.

Ecosystem Service	Specific services that are important at your site	Direction of change (improving, degrading, about the same, unknown)	Primary drivers of change, if known	Public awareness of service (high, medium, low)	Institutions that manage this service
<i>Provisioning Services</i>					
Food	Milk	Degrading	Economic situation (agri-prices), infrastructure, lifestyle changes,	high	farmer
	Meat (Cows)	Slightly improving	extensification	high	farmer
	Meat (Pigs)	?	?	medium	farmer
	Game (hunting)	About the same	Changes in regulations	high	Landowner regulated by state law
	NTFP like mushrooms, berries, etc.				Regulation by national law, landowner
Construction	Yes timber	About the	Increased	Medium?	owner

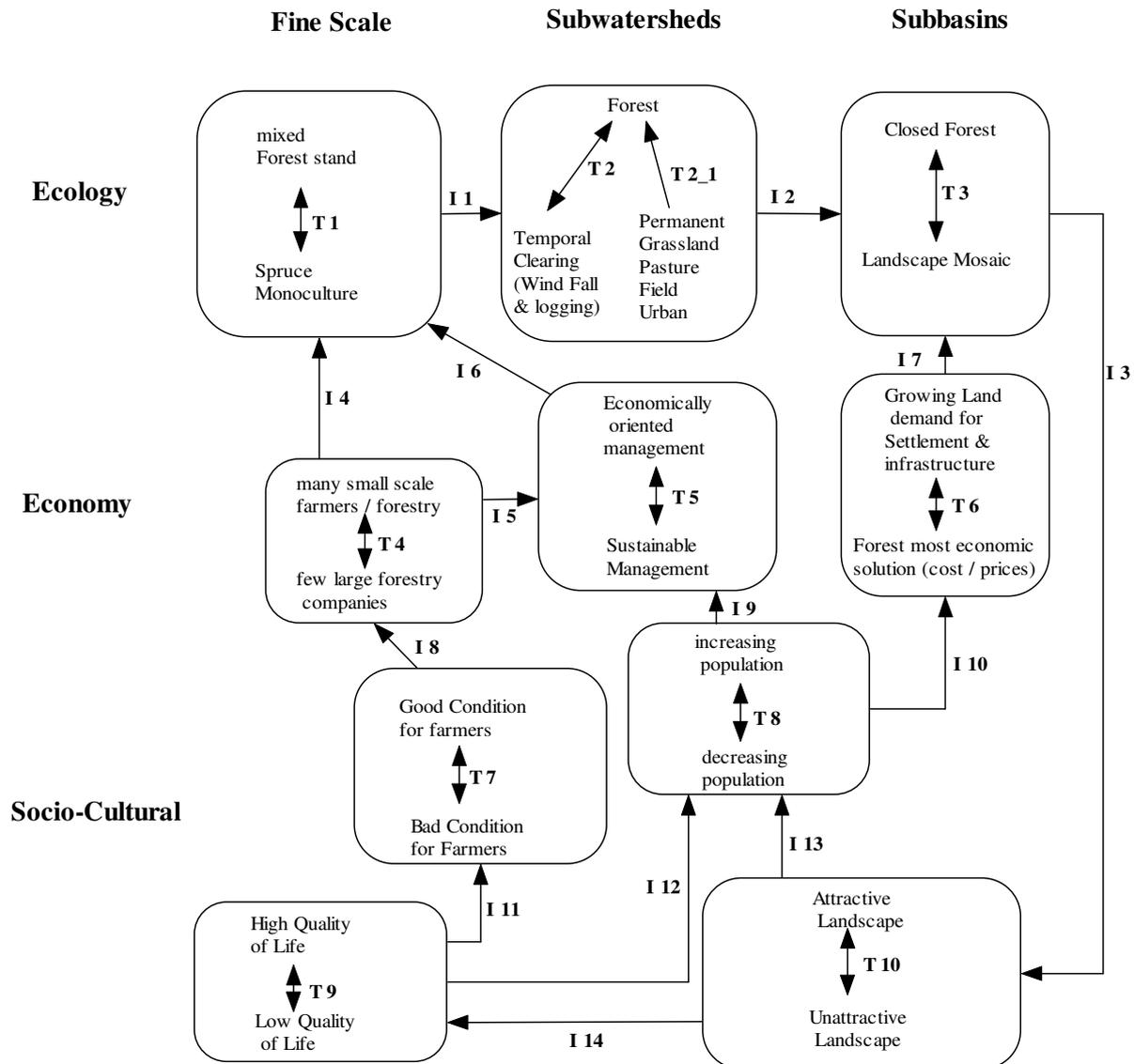
material and Fiber		same	demand		
Fuel	Yes (wood)	About the same	Increased demand	Medium?	owner
Energy	Waterpower	About the same	?	medium	Owner
Genetic Resources	Varieties of fruit trees ?	declining	unknown	Low?	owner
Fresh Water	Yes	degrading ?	Nitrogen	low	Regulated by national law
Biochemicals & pharmaceuticals	None	-----	-----	-----	-----
Ornamental resources	None	-----	-----	-----	-----
Other service					
Regulating Services					
Air quality regulation	Yes		Emissions	Low?	National and state laws
Climate regulation	Yes	About the same	Climate change Landcover changes	low	
Water regulation	Yes	About same	Climate change Landcover changes	High	Owner – regulations from state and national laws
Erosion regulation	Yes	About same	Landcover changes	Medium	
Water purification and waste treatment	Yes	Degrading	Climate change; emissions Landcover /use changes	medium	Municipality administration
Pollination	Yes	Degrading	Climate change	Low	
Natural hazard regulation	Yes	Degrading	Extrem events (climate change) Landcover / use change	High (floods, avalanches)	Federal state
Disease regulation	Non				
Pest regulation	Yes	degrading	Changes in species composition (landuse changes)	low	Landowner national laws
Other service					
Cultural Services					

Cultural diversity	Yes	degrading	Economic situation (multiple reasons)	High	NGOs, local initiatives
	Hunting?				
Educational values	Yes	Improving	National parks etc.	Medium	National and nature parks
Inspiration	Yes	Improving	No directional drivers	medium	?
Aesthetic values	Yes	Degrading	Landuse change	Medium	Municipality, federal state
Social relations	Yes	?	Landuse change	High	?
Sense of place	Yes	Degrading?	Land use change	Medium	?
Cultural heritage values	Yes	Degrading	Landuse change	High	Federal state, national state
Recreation and ecotourism	Yes (action & sport)	Slowly improving	Lack of other options	High	Tourism clubs, alpine clubs
	Yes (family & education)	Slowly improving	Lack of other options	High	
Other service					
Supporting Services					
Soil formation	Yes	?	Landuse change, climate change? Emissions?	Low	
Photosynthesis	Yes	About the same	Landuse change	Low	
Primary production	Yes	About the same	Landuse change	Medium	
Nutrient cycling	Yes	?	Climate change	Low	
Water cycling	Yes	Degrading ?	Overuse?	High	
Other service					

Six most important ecosystem services:

1. Construction material, fiber and fuel from wood
2. Natural hazard regulation
3. Sense of place
4. Recreation and tourism
5. Water regulation
6. Fresh water

Identification of threshold interactions between environmental and socio-economic dynamics at multiple scales



T1 - Mixed Forest – Spruce Monoculture

A mixed conifer-broadleaf forest would be the natural climax society in most of the LTSER
 Spruce monoculture is cultivated because of its quick growth (= economic reasons)
 Two factors influence if a plot will naturally regenerate either with mixed species or with spruce domination:

- Proportion of spruce vs. other trees (available seeds...)
- Amount of game in the area (selective browsing)

In most of the Eisenwurzen active management (in forestry & hunting) would be required to reduce domination by spruce. This would require a management with goals other than maximising profit.

Consequences of spruce monoculture on ecosystem services:

- Less resistance against windfall
- Higher susceptible against bark-beetle
- Less attractive
- More N input

Interaction with other states:

I1: influences the likelihood of wind throw.

T2 & T2_1 Forest – Open land

Two types of open land can be distinguished:

T2: Temporal clearings:

Forest clearings, which will be re-grown (either through natural regeneration or planting)

- 1.1) Through logging operations
- 1.2) Through wind fall

Consequences of clearings on ecosystem services

- Short term mobilisation of nitrogen etc. effecting water quality
- Loss of erosion control
- Depending on size and frequency: positive affect on biodiversity
- Positive for game density

T2_1: Permanent clearings

As it is easy to turn a piece of land into forest but rather difficult to turn a piece of forest into open lands this is a one-way development. If permanent open land is not maintained (through use) it will be encroached by forest (either mixed or spruce).

- 2.1.) Pastures and other agricultural land
- 2.2.) Urban & infrastructure

Consequences of permanent clearings on ecosystem services

- Needed for agriculture (provisioning services)
- Depending on extend and use they can have positive or negative affects on biodiversity

Interaction with other states:

I2: influences the landscape composition

T3 – Closed Forest – Landscape Mosaic

Similar to T2 but on a landscape scale. The current development in most of the LTSER region is towards decreasing landscape diversity – except around some urban centres where an increasing urbanisation is leading to fragmentation.

Consequences of closed Forest on ecosystem services:

- Less attractive
- Less biodiversity

Interaction with other states:

I3: Landscape mosaics are usually perceived as more attractive then closed forest.

T4 - Small scale – large scale landowners

If the conditions for agriculture (including forestry) are bad small farms tend to quite whereas a few farmers grow by buying / renting the land of the others.

Consequences of bigger landowners on ecosystem services:

- Difference in management style?
- Connection to international companies (esp. forestry)
- Regional value creation vs. outflow of value / money?
- Cultural / traditional management vs. economic oriented management

Interaction with other states:

I4: large scale forestry operates with equipment and on scales favouring mono-culture.

I5: small scale management i.e. family run businesses also value tradition, etc. they feel a responsibility towards their land.

T5 - Economically oriented management vs. Sustainable management

Sustainable management should rather promote mixed forests and game management oriented towards natural stock sizes whereas economic management is oriented towards profit maximisation.

Consequences of Economically oriented management on ecosystem services:

- Fast growing, easy to harvest monocultures
- Large game stock sizes oriented towards trophy hunting

Interaction with other states:

I6: Economically oriented forestry operates with equipment and on scales favouring mono-culture

T6 - Growing land demand vs. Forest most economic solution

This also reflects the current differences between the two major regions in Eisenwurzen: In the lower lying parts agriculture is still a viable occupation. Around centres urbanisation / settlements together with necessary infrastructure are growing.

In the central parts agriculture is often gain less, and Population decreasing (due to lack of economic opportunities). Forestry is one of the few remaining viable landuse types.

The transition in this state is highly depending on external factors i.e. prices, infrastructure development – but also on local incentives.

Consequences on ecosystem services::

- Landuse changes

Interaction with other states:

I7: Influences landuse decisions, which either lead to more fragmentation or more forestation.

T 7 - Good vs. bad conditions for farms

Good conditions for farms depend on the characteristics of the land (i.e. flat – steep, soil quality etc.) and on the general quality of life in the region and on a bunch of external factors like available subsidies and prices

Consequences of bad conditions for farmers:

- Decreasing population

Interaction with other states:

I8: If the conditions for farmers are bad small farms tend to quite whereas bigger farms often can expend on the abandoned land.

T8 Increasing population – Decreasing population

In Eisenwurzen we find regions with growing and with decreasing population. The availability of jobs is the main criterion which attracts people to the urban centres. The attractiveness of the landscape and the quality of life is the main reason for “urban sprawl” around those centres.

Interaction with other states:

I9: an higher population density can put pressure on land use activities which are considered as not aesthetically i.e. large clearings

I10: an increasing population influences the land demand for settlements and infrastructure.

T9 High vs. Low Quality of life

What is seen as contributing to high / low quality of life, is largely depending on the individual perception. Despite personal situation being able to fulfil income and leisure time demand together with an attractive surrounding is likely to contribute to a feeling of high quality of life.

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Interaction with other states:

I11: A good quality of life for the household also influences farm households.

I12: Areas with a high life quality attract people.

T10 – Attractive Landscape

Attractive landscape is often seen to have following characteristics:

Diverse landscape (mixed forest with open fields)

Not too intensive agriculture

Diverse Forest (No spruce monoculture)

Interaction with other states:

I13: Attractive landscapes attract people

I14: an attractive landscape contributes to the quality of life

Figure 5: Current states – Future states

