

Supplementary material

Linking multiple values of nature with future impacts: Value-based participatory scenario development for protected areas in the Czech Republic

Box S1. Description of the three case study areas.

Moravský kras - a “karst” PLA

Moravský kras PLA, established in 1956, is located in the southern Moravia region in the Czech Republic (49°16' N, 16°44' E), covering 98 km² with altitude ranging from 220 to 610 m. a. s. l. The mean annual temperature is around 6.5 in the northern part, 7.7 in the middle part and 8 °C in the southern part. Annual precipitation ranges from 550 to 750 mm. Moravský kras is the largest karst area in the Czech Republic consisting of Devon limestone. There are over 1100 karstic caves including Amatérská cave complex with almost 35 km, which is one of the largest cave systems in Europe. The area is covered by large forests (almost 60% of the area) consisting mainly of beech forests, oak forests and intensive coniferous forests. The area also incorporates intensive arable land in the northern and middle part with large extent of field plots (tens of hectares). Locally grown agricultural crops include primarily winter wheat, barley and rapeseed. The karst area has been affected by groundwater pollution (e.g. by pesticides) which has driven efforts to intensify local agriculture and turn local critical spots such as sinkholes to grasslands. The area is characterized by intensive tourism - particularly its cave systems attract over 350 000 visitors per year.

Kokořínsko - Máchův kraj - a “sandstone” PLA

The Kokořínsko - Máchův kraj PLA was originally established in 1976 (Kokořínsko part) and in 2014 extended by the additional area of Máchův kraj. The area of these two in fact spatially detached parts covers 410 km² in central and northern Bohemia in the Czech Republic (50° 29' N, 14°32' E). The altitude ranges from 175 to 614 m. a. s. l. The mean annual temperature is approximately 7.9 °C and annual precipitation ranges between 500 and 650 mm. The area is unique for its relief consisting of plateaus and deep terraced valleys composed of block sandstone. This specific relief creates high ecosystems variability with high levels of biodiversity in a relatively small area. Forests cover approximately 53% of the area, mostly consisting of indigenous species. Local heterogeneous landscape also includes agricultural land (41%) and large wetland areas, as well as artificial water reservoirs utilized for fisheries and water-based recreation and tourism.

Žďárské vrchy - a “highlands” PLA

The Žďárské vrchy PLA established in 1970 is located in central part in the Czech Republic (49°40' N, 16°1' E), covering 709 km² with altitude ranging from 490 to 836 m. a. s. l. The mean annual temperature is around 6.5 °C and annual precipitation between 650 and 875 mm. Žďárské vrchy PLA is unique for representing a headwater area lying on a drainage divide between North and Black Sea. The area is characterized by a local fishpond system built on a dense net of small streams. The most valuable ecosystems are peat bogs and wetlands. Local landscape is also characterized by rock formations on forested ridges and a mosaic of scattered woody vegetation in an agricultural landscape. The area consists of forest (50%), while the original fir-beech forest has been replaced by spruce monoculture in most of the area.

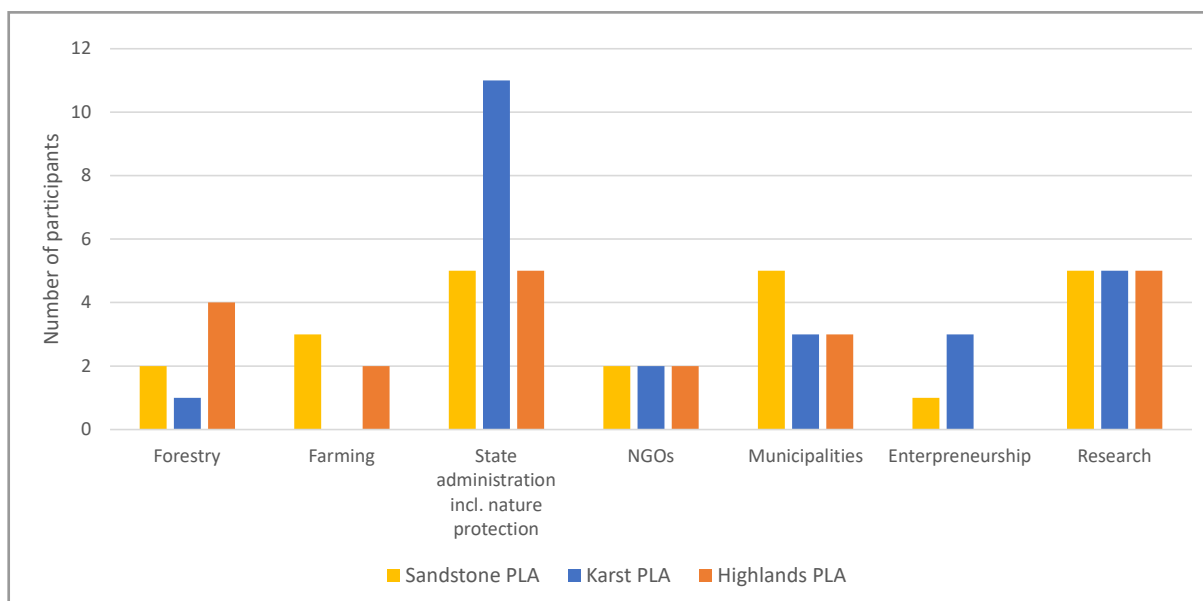


Figure S1. The number of participants from each stakeholder group attending the workshops.

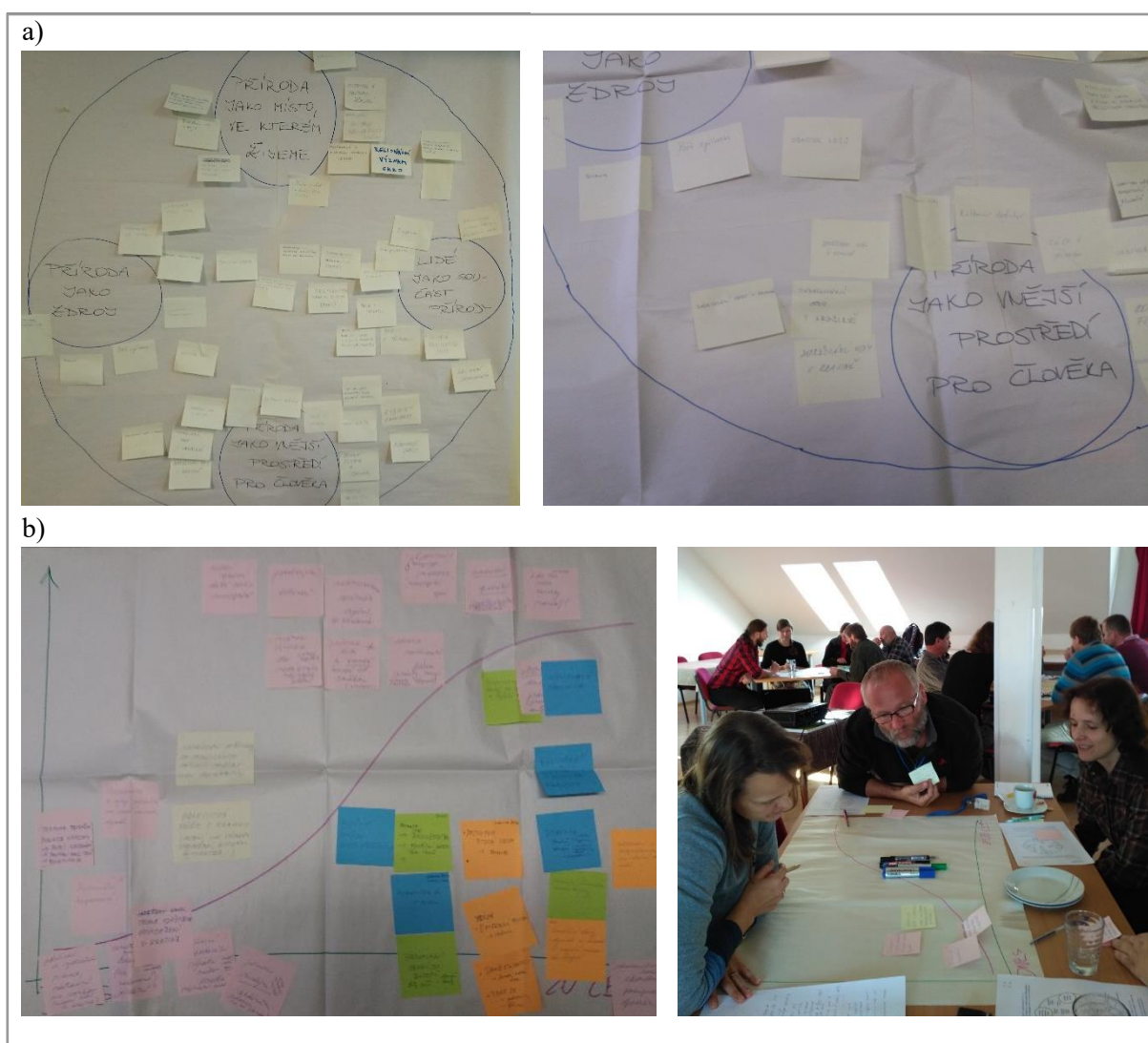


Figure S2. Illustrative photos of the participatory processes. a) The diagrams of the Life Framework of Values as used by the participants, with the value post-its. Emphasis has been placed on the absence of crisp boundaries between the four value frames. b) The diagrams of the Three Horizons framework.

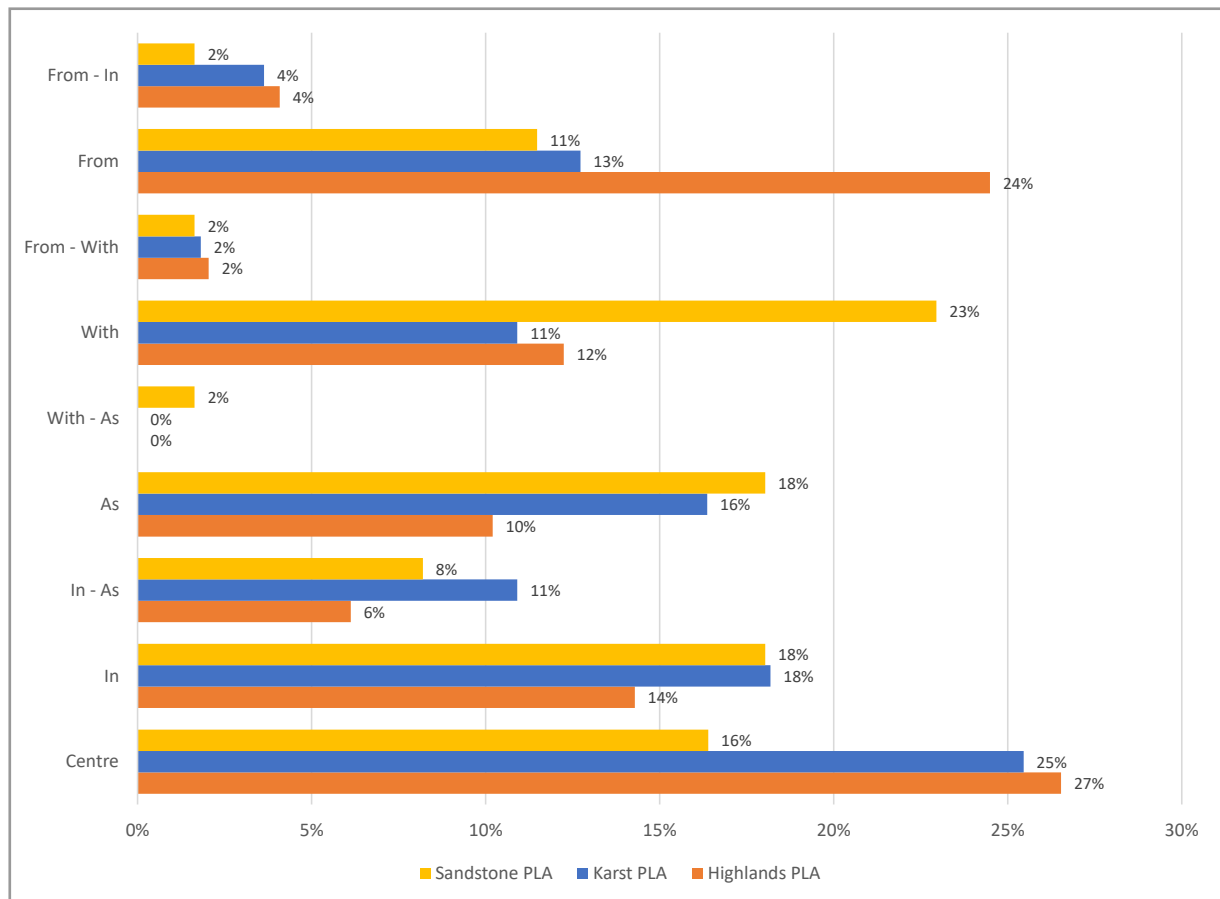


Figure S3. The proportion of participants' values allocated into different sectors of the Life Framework of Values in the three studied PLAs.

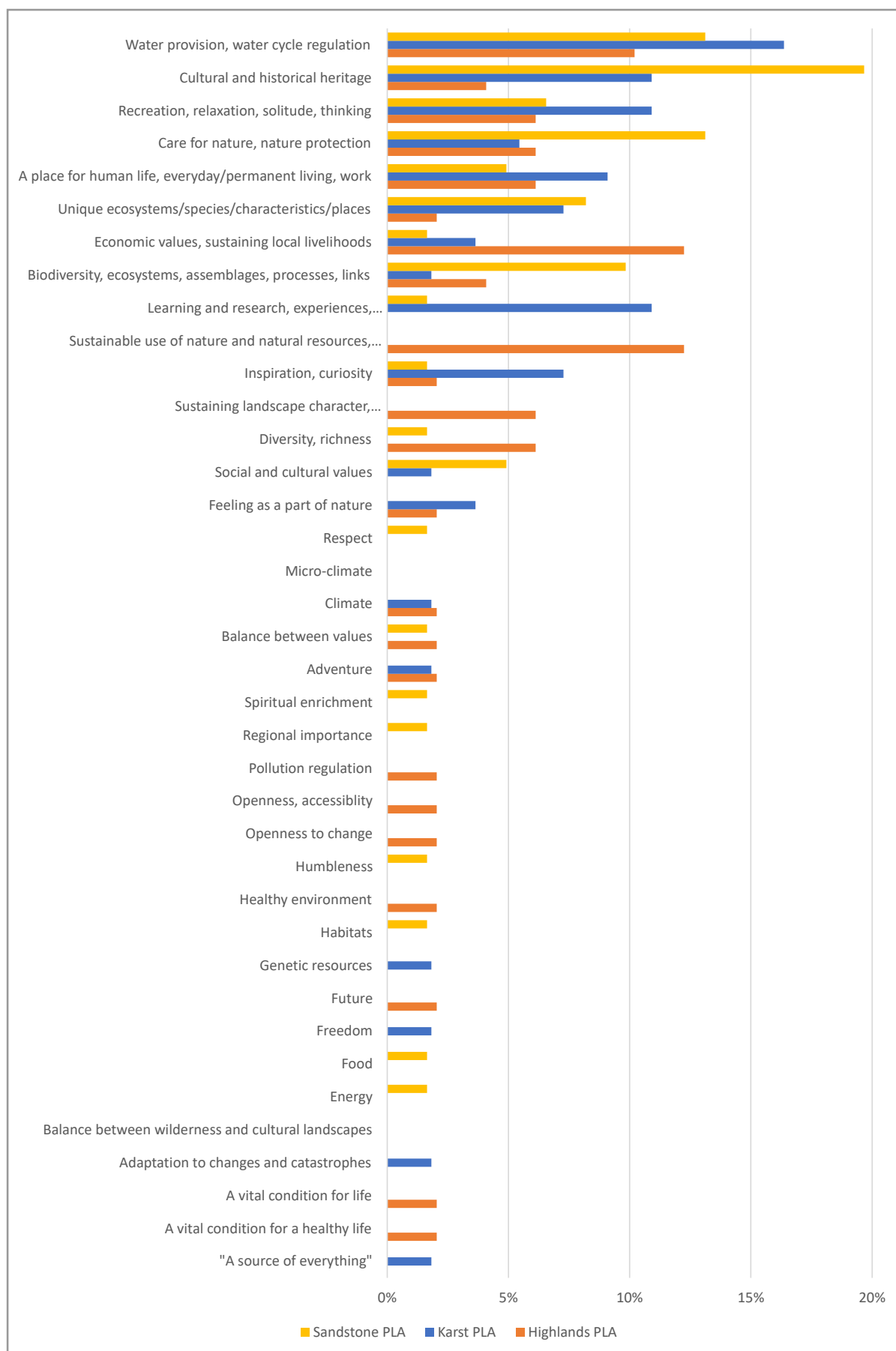


Figure S4. The proportion of participants' values categorized into themes in the three studied PLAs.

Box S2. Detailed summary of the explored future pathways, divided into six key themes of divergence among the participants.

1. Tourism

- Tourism intensifies and remains centred around few most sought areas, visited for one-day trips. It brings substantial economic profit to some parts of the PLA, but leads to increased traffic and pollution, while leaving other parts of the PLA with zero profit. Natural sites sought by tourists become overcrowded, less inhabitable for animals, and inaccessible for the locals to enjoy for everyday recreation. Prices grow and become unaffordable both for less wealthy tourists and for some locals. Local sense of place weakens and relationships erode. However, remote parts of the PLA remain unvisited and peaceful, thus safe for biodiversity and free for the locals to enjoy.
- Tourism intensifies; however, it becomes dispersed throughout the landscape as more accommodation and facilities are built and more locals transition to agritourism and related business. Multi-day stays will bring economic profit evenly dispersed in the area. No places are overvisited, but the locals lose previously entirely unvisited calm natural places to relax.

2. PLA conservation

- Nature protection and landscape conservation seeks balance between protecting local natural environment and biodiversity, and letting local population enjoy the benefits of a healthy environment for recreation and local development. Prioritizing sustainable agriculture and low-impact lifestyles improves local pollution and the state of ecosystems, soils and waters. Adaptable and flexible landscape management provides space for change and development. Nature is open to visitors and researchers, providing new knowledge and allowing to build attachment to place. However, this poses occasional risks for pristine natural areas and vulnerable species.
- Nature protection and landscape conservation is strict and leads to sealing the current state of landscape and limited access to selected areas of the PLA. This improves biodiversity richness, increases the diversity of habitats and helps sustain ecosystem processes and functions. At the same time, cultural heritage and local original landscape character is maintained. However, strong regulation and the attempts to keep local nature in a pristine state leads to a growing fatigue among the local population, negatively affected by the restrictions to construction and economic activities.

3. Landscape management

- Landscape management is responsible and prioritizes sustainable use of natural resources. Management approaches are differentiated: while some areas require stricter protection to sustain rare ecosystems and species, the general landscape is managed with an emphasis on biodiversity stewardship, functional landscape structure, sustainable agriculture and forestry. Responsible approach to decision-making processes by all involved actors and a continuous negotiation of the balance between nature conservation and human activities (agriculture, business, tourism) is key. Landscape heterogeneity and diversity is perceived as important (a "harmonic" landscape). The regulation of new construction and its character continues. Healthy and diverse landscapes provide a wide range of ecosystem services/nature's contributions to people, including provision of diverse agricultural products and fish, clean air and water, pleasant micro-climate and

opportunities for everyday recreation. Forests are managed to balance their material, regulating and non-material contributions (e.g. timber provision, regulation of the water cycle, micro-climate regulation and maintenance of habitats for rich biodiversity). Typical local architecture is maintained and restored.

- Voices calling for lower regulation and weaker nature protection to allow for development and growth of both local and extra-regional businesses prevail. This development is supported by the lack of interest in the local area and a gradually strengthening public opinion that "nature does not need to be protected by humans and will take care of itself". Regulations to construction weaken, and local villages and towns lose their typical character. This decreases the number of tourists interested in the area and property values drop. The landscape in the PLA becomes mostly unified and its heterogeneity is lost, including threatened and valuable ecosystem types and local cultural and architectonic heritage. Agriculture intensifies, the landscape loses its character and becomes more similar to other areas outside the PLA. Forests decline due to droughts and bark beetle outbreaks, with further negative impacts on local water cycle.

4. Water retention in the landscape

- Enhanced water retention due to landscape measures (small-scale natural water pools, groves, agroforestry) together with responsible and efficient water consumption secures a sufficient supply of clean water for local citizens and businesses. Water-retention measures also mitigate smaller-scale floods and help sustain local biodiversity and ecosystems. Thanks to higher water availability in the landscape, forests and agricultural land become less vulnerable to droughts. Local microclimate and opportunities for water-related recreation improve. In addition, the implementation of technological solutions such as improved waste water treatment, as well as less intensive agriculture, improve groundwater quality.
- Large-scale technological infrastructure is prioritized over local nature-based measures to retain water in the landscape. This is further supported by the prevailing public attitude that the nature will "take care of itself" and the lack of recognition of links between natural environment and human well-being. Although the technological measures secure enough drinking water for people, water for other types of uses becomes scarce. Local forests and agricultural land become highly vulnerable to droughts. Forests are severely affected by bark beetle outbreaks and dry out. Local agricultural production is severely affected.

5. Education as a precondition for sustainable governance

- Nature serves as an educational resource for all age groups. Nature-based education focusing on experiences in natural environment become a standard, increasing the understanding of nature and building attachment to place and relationships with nature. This leads to higher awareness of sustainability issues, more sustainable behaviours, responsibility in landscape management, and higher involvement in nature conservation. More people become aware of the need for balance between agricultural production and sustaining healthy ecosystems, soils and waters.
- Local society becomes increasingly individualist and self-centred, uninterested in the environment and environmental education. People become indifferent to the state of the landscape and unaware of the contributions nature brings them.

6. Community, livelihoods, well-being

- Local communities thrive due to the abundance of jobs in local agriculture, manufacturing, agritourism and services, as well as multiple initiatives by local motivated, actionable citizens. Local population becomes increasingly self-sufficient and more respected by tourists as well as larger businesses operating in the area. Sense of place, responsible ownership and community cohesion grows. People are active in protecting a safe, healthy and attractive environment for everyday living. This includes protecting natural areas for recreation and regeneration, as well as protecting cultural heritage, enhancing access to cultural events and maintaining the aesthetics of local built-up areas. Local consumption is strongly prioritized.
- Local communities become disengaged due to the lack of jobs and opportunities to make a living. Many permanent residents move out of the PLA to nearby bigger cities and are replaced by seasonal inhabitants coming for holidays only several times a year, with low local attachment and sense of place. Community cohesion crumbles and the sense of security and safety decreases. The society becomes increasingly siloed, with growing conflicts among different interest groups.