



Collective Action and Ecosystem Services: Balancing Livestock Grazing and Biodiversity in the Baiboosun Micro-Reserve

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ABSTRACT

This study explored the establishment and governance of Baiboosun, the first community-led micro-reserve in Kyrgyzstan integrating biodiversity conservation and sustainable pasture management in mountain ecosystems. Using a qualitative case study approach, the research was co-designed by a geographer and staff of local NGOs drawing on the data collected via interviews, participatory workshops, and 2019-2025 internal reports. The study utilized the conceptual framework on social interdependencies and ecosystem services (ESs) to examine stakeholder dynamics and multi-functional land use. The creation of the micro-reserve was driven by local actors, notably hunters and pasture committees (PCs), and supported by a national-level NGO, as well as state agencies. The reserve's management plan aims to balance biodiversity conservation with agropastoral use, avoiding exclusionary practices. It also emphasizes grassroots engagement, knowledge generation, and ecosystem integrity. The key enabling factors included stakeholder cognitive framing shifts, cross-scale institutional levels, and legal innovations supporting community governance of protected areas (PAs). Further research, however, is required to investigate the ecological outcomes and connectivity of such reserves at the landscape scale. This research provides empirical insight into multi-functional land management and community-based conservation, thus offering an innovative framework to integrate ES and governance in post-Soviet agro-pastoral landscapes.

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1. Introduction

With approximately 20% of the world's species at risk of extinction according to the International Union for Conservation of Nature (IUCN), biodiversity preservation is becoming an increasingly salient issue (Bradshaw et al., 2021). Conversion of natural environments into anthropogenic ones as well as climate change were deemed the main factors driving biodiversity decline (Bauduin et al., 2020), and in the Central Asian Region *inter alia* land use changes negatively impact the capacity of ecosystems to provide water and food, as well as sustain communities (Lioubimtseva, 2015).

Amidst the growing criticism of exclusion of local communities from protected areas (PAs), novel models of co-management and partnership aim to account for the values and interactions between people and nature. This paper investigates the capacity of local stakeholders to forge alliances both locally and *vis-à-vis* national agencies to foster mutualism between pasture management and nature conservation.

The meadows of Ton District are extensively exploited as agri-land and pastures. In this rural area on the southern shore of Issyk-kul Lake in the Kyrgyz Republic, the growing livestock population adversely affects the overall condition of the habitats of wild ungulates (e.g., ibex, roe deer), the main prey species of snow leopard. These fragile mountain ecosystems also suffer from poaching, predatory cutting of trees and shrubs, contamination, as well as illegal digging of medicinal herb roots.

Recognizing that in the vast majority of cases the challenges in preserving local biodiversity persist due to the anthropogenic destruction of natural ecosystems, the local association of hunters and fishermen initiated nature conservation actions that triggered the creation of the first community-led micro-reserve of the country.

The Kyrgyz Republic (KR) is small in terms of surface area (0.13% of the world's land). Yet, it is one of the 200 Earth's priority eco-regions because of the high concentration of flora and fauna (Olson & Dinerstein, 2002). The Kyrgyz Republic is home to over 12,300 animal and 7,723 plant species, including 3,780 higher plants, 3,676 lower plants, and 261 microorganisms (viruses, bacteria, elementary organisms). Approximately 3,500 plant species grow on its pastures, and according to A.G. Golovkova (1959), including more than 200 medicinal herbs, nectar source plants, as well as 630 palatable plant species forming the basis of high-nutrient pasture forage. The pastureland vegetation cover renders cheap forage for livestock and constitutes the primary source of income and subsistence for rural communities *i.e.*, 58% of the total country's population (NSC of the KR, 2025). Through trade, rural livestock provides meat and dairy products to urban centres.

In 2009, pasture management was delegated to local communities via the creation of Pasture Committees (PCs) with the primary function of ensuring sustainable use of pasture resources.

Biodiversity conservation arose as a complementary dimension of the targeted actions in the field of pasture management, although in the Kyrgyz Republic conservation is mostly managed by the State, as per the inherited Soviet model of exclusionary conservation (Weiner, 1999). This approach, also in other regions of the world, has been criticized for its injustice. Besides, the participation of local communities has demonstrated positive effects on the compliance of rural residents with conservation measures (Andrade & Rhodes, 2012). The new model, described in this article, aims at vesting local communities with PA management and governance obligations, and underwent testing in the Kyrgyz Republic when a local community self-mobilized to create the pilot micro-reserve.

Building on the conceptual framework devised by Barnaud et al. (2018), the study team examined the links between the establishment of a community-based PA and social interdependencies (SI) emerging around provisioning, regulating, and cultural ecosystem services (ESs) related to pastures. This framework is rooted in the field of socio-ecological system (SES) research steered towards analysing the institutions regulating interactions between social and ecological systems. It is based on a definition of institutions resulting from and influencing social interactions, and takes full account of the complexity of relations between ecosystems and society, as illustrated by the mismatches between the spatial and temporal scales of biophysical processes and institutions (McGinnis & Ostrom, 2014).

The SIs bridge collective action and power relations with the field of ESs. They draw a conceptual line between ESs providers and beneficiaries, while also recognizing that stakeholders can play different roles - contribute to ESs provision simultaneously benefitting from them, or one stakeholder can provide an ESs which benefits another. For instance, when local inhabitants graze livestock, they contribute to the production of recreational ESs, whose beneficiaries include outside tourists but also local residents. Intermediaries such as law- and policy-makers, administrations, and private actors likewise impact decisions regarding ESs and are included in the overall system. SIs exist between intermediaries, providers, and beneficiaries, but also among various categories of beneficiaries and providers. The analysis of SIs includes four dimensions:

Cognitive framing relates to the way stakeholders perceive their environment, and how they are linked with other stakeholders through biophysical processes or biodiversity;

Levels of organizations referring to different scales (and potential mismatches) between administrative and organizational tiers of natural resources use and ESs;

Institutions possessing sets of formal and informal rules shaping SIs and ESs management;

Power relations.

These interactions are examined over a specific question (action arena, in the SES vocabulary) and do not aim to be exhaustive. Most often, ecosystems provide a bundle of ESs, which implies choices regarding supporting synergies between ESs and agreeing on trade-offs (Raudsepp-Hearne et al., 2010). This approach has been applied to different case studies to investigate the dynamics underlying the multi-functionality of agro-ecosystems and interactions with natural resource management (Barnaud & Couix, 2020; Moreau et al., 2019; Salliou et al., 2019).

The case study of the Baiboosun micro-reserve allowed the research team to explore how communities roll out strategies to partake in the governance and management of a bundle of ecosystem services related to biodiversity and pastures, using the conceptual framework of social interdependencies (Barnaud et al., 2018).

International literature investigates engagement of communities in conservation from different angles. The field of ecosystem services has been quickly evolving since the seminal paper of Costanza et al. and Millennium Ecosystem Assessment (1997; 2005). Similar evaluations are getting increasingly popular and include local people perspectives (Ament et al., 2017; Maestre-Andrés et al., 2016).

Protection of an ES bundle in alpine ecosystems (grassland for livestock, patrimonial landscape, recreational activities, heritage, and identity) highlights the ability of different stakeholders to preserve natural infrastructure. The latter is key to maintaining fauna and flora biodiversity, as well as ensuring the provision of key regulatory ESs like water regulation and landslide protection. Cultural ecosystem services are defined as the nonmaterial benefits that people obtain from nature (Millennium Ecosystem Assessment, 2005). In the Kyrgyz Republic, pastureland and mountain ecosystems are vital in terms of cultural heritage and identity (Féaux de la Croix, 2011). Providing ESs such as livestock production, honey-making, and tourism create monetary but also relational values rarely incorporated in target assessments (Arias-Arévalo et al., 2018; IPBES, 2018).

2. Methods and materials

The interplay among the shifts in agri-systems, public policy alterations, and global change can be defined as ‘wicked problems’ (Rittel & Webber, 1973). There are no optimal solutions to respond to the associated challenges due to the interdependencies they entail and variety of social groups and interests involved. Especially when investigating sustainability matters, tackling the issues above requires academic and non-academic partners synergizing in a reflective and action-oriented approach (Popa et al., 2015) for knowledge co-production (Norström et al., 2020).

This research builds upon a qualitative case study, which also accommodates the dynamics occurring at the national level (Yin & Campbell, 2018). The idea of this paper emerged from the persons involved in independently establishing PAs, i.e. members and supporters of the CAMP Alatau Public Foundation (PF) and Baiboosun Jaratylysh Korugu PF, eager to contribute to a reflective effort on the actions they have been carrying out. Together with a geographer, they engaged in co-designing this study to deepen comprehension of governance in a setting where stakeholders with different backgrounds come together to protect mountain ecosystems.

The data were harvested via collaboration with both of the aforementioned entities by means of interviews and workshops for local farmers (involved in livestock, fruit and crop production), hunters, local authorities (municipalities, district, and oblast), as well as administrative bodies (agricultural production, water management, pasture management, and PAs) during the period spanning 2019 through 2025. The data were assembled in the form of unpublished reports and completed by interviews. The qualitative analysis was conducted by the geographer, and the results were cross-checked with the rest of the team at different stages of the research.

3. Results and discussion

3.1. Community action as a conservation lever

Ton District (Fig. 1) is mostly composed of alpine meadows and sub-alpine ecosystems. Its territory has been historically renowned among hunters for its rich biodiversity, including large mammals. Snow leopards play the role of an umbrella species, as they rely on a variety of prey occupying various habitats at different altitudes in mountain ecosystems. In the 2000s, however, hunters became increasingly aware of the decline of game due to proliferating poaching and land use changes. In response, in 2016, endorsed by the Department of Biodiversity Conservation and Protected Areas (DoBCPA) under Ministry of Nature, Ecology and Technical Supervision (MoNETS) of the KR, the Ton District Hunter and Fisher Association (Ton District HFA) launched a series of efforts. The agreement signed with the Department for Rational Natural Resource Use (DRNRU) of the State Agency for Environmental Protection and Forestry under the Government of the KR aimed to ensure year-round protection of wild animals and their habitats on the hunting-reserve area of 156,000 ha (of the 723,000 ha of the total district's area). In 2019, scientists from the Academy of Sciences of the Kyrgyz Republic conducted the inventory of fauna and vascular plants, as well as identified those listed in the national Red Book; they also zoned the area according to the present ecosystems and elaborated preliminary conservation recommendations.

This initial stage in creating the PA in question was supported by a change in cognitive framing. The first shift took place among the Ton District HFA membership - they started diverting from game extraction to focus on ecosystem conservation. The engagement of the scientific community likewise contributed to permitting different stakeholders to find a common ground by assessing the status quo and showing potential conservation prospects (Fig. 2). An ES bundle was identified around alpine ecosystems: pastures utilized for animal grazing, landscape features attracting tourists and bearing patrimonial and historical value as well as providing habitat for biodiversity. These ESs were compatible and reinforced each other.

The PA's title - Baiboosun - as well as its location are deeply rooted in the history of imperial violence. The locals refer to the popular story of a man named 'Baiboosun' that lived in the area back in the time when the Russian Imperial Army forcibly conscribed Central Asian males to fight on the frontlines of the First World War and violently suppressed the uprising that followed. As many other residents of Issyk-Kul Region, Baiboosun decided to flee to China (Drieu et al., 2020) to avoid that. As he couldn't take all his horses with him, he left them in a hard-to-access high valley. After some years, as he decided to come back, he was anxious if his livestock would still be where he had left them. To his surprise, not only were the horses still there, but they thrived in his absence.

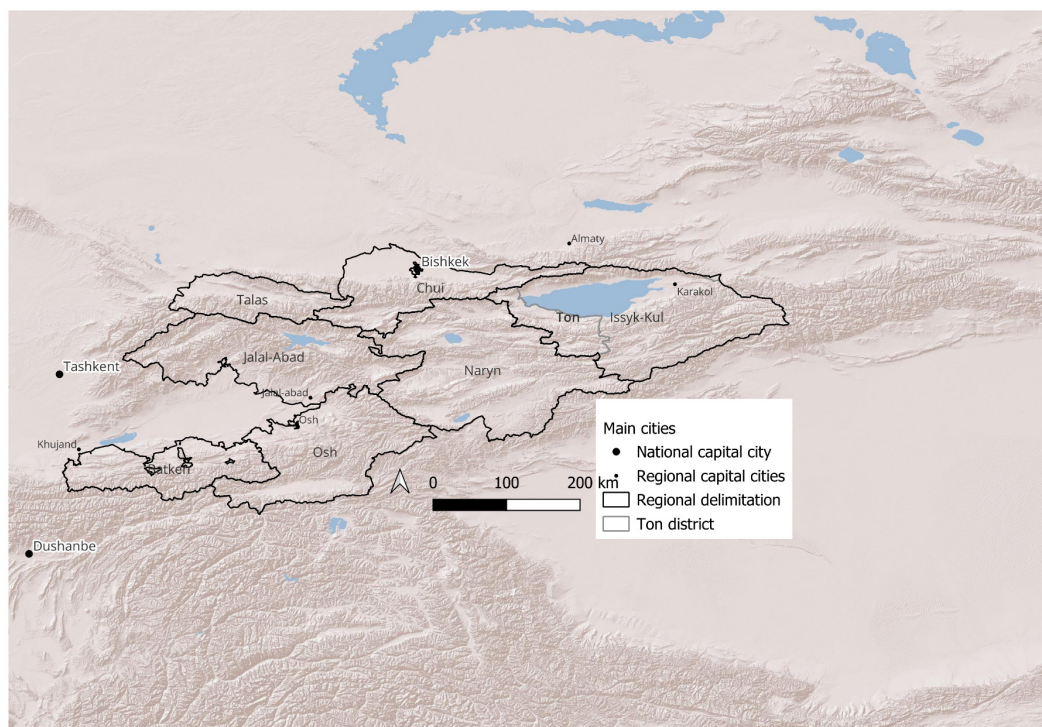


Figure 1. Map of Ton District and Oblast of the Kyrgyz Republic (source: I. Mestre based on data of OCHA and ESRI).

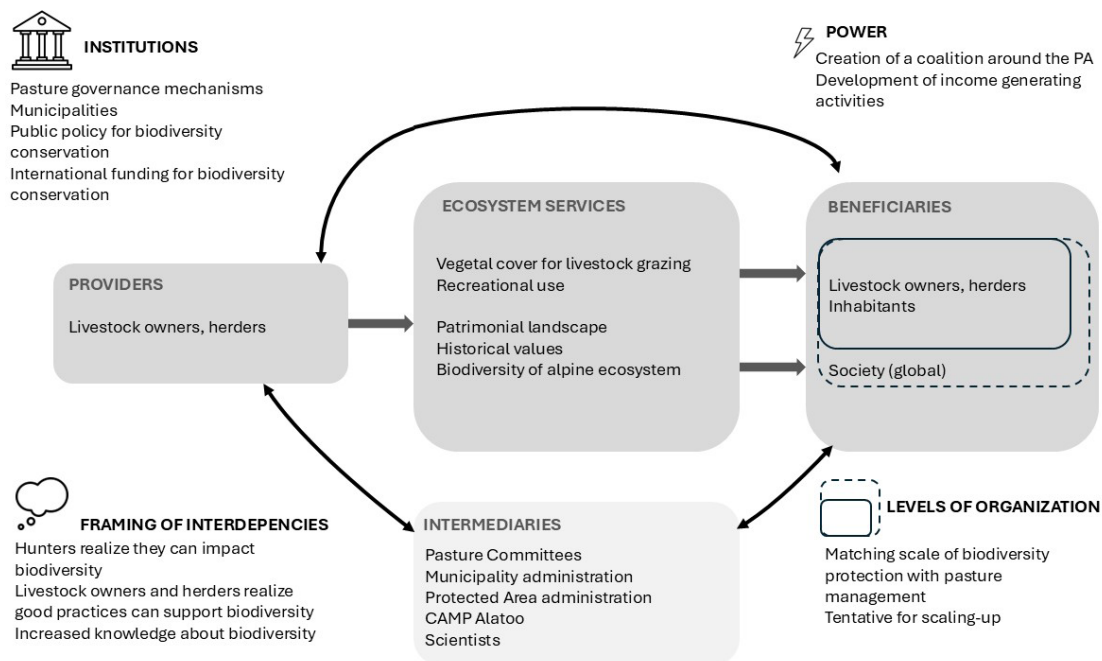


Figure 2. Main social interdependencies in the action arena in a newly created protected area, balancing agro-pastoralism and biodiversity (adapted from Barnaud et al., 2018).

3.2. Creation of a local alliance with pasture managers

It is acknowledged that the majority of biodiversity challenges in the region are attributable to the anthropogenic impacts on natural ecosystems, more specifically, of pasturelands. In early 2019, the Ton District HFA initiated the establishment of a PA, and following the endorsement of this proposal by the CAMP Alatoo PF, the inaugural pilot micro-reserve was created the same summer. Its status - much more protective than the 2016 agreements - aimed to regulate poaching but did not entail a conservationist approach.

With the support of CAMP Alatoo, a pilot area of 10,000 ha was identified jointly with pasture committees, municipalities, and HFAs to establish a micro-reserve. Located in the southern part of Ton District and under the jurisdiction of various Ton District municipalities, the area encompasses meadows falling under the status of state reserve lands and pasture lands administered by the municipalities of Tort-Kul, Bolot Mambetov, and Kol-Tor. At the outset of the process, four municipalities were included: Kun-Chygysh, Ton, Tort-Kul, and Bolot Mambetov. However, due to low involvement, Kun-Chygysh and Ton ceased their participation. Later on, the municipality of Toguz-Bulak showed interest in stepping in and subsequently engaged in the process.

The establishment of this PA was facilitated by the Memorandum of Cooperation signed by the heads of the DoBCPA of the MoNETS of the KR, Administration of Ton

District, three municipalities (Toguz-Bulak, Tort-Kul, and B. Mambetov) and their PCs, as well as CAMP Alatoo and Ton District HFA. At first, the idea was that biodiversity would be supported through a set of measures to enhance pasture management: less livestock grazing on pastures, better balancing of the carrying capacity, and later use of summer alpine pastures.

The area designated for conservation has been historically utilized as seasonal pastures by the local population, predominantly reliant on agropastoralism for sustenance and revenue generation. Pasture management has undergone substantial transformation since the country's independence in 1991. In 2009, the pasture management authority was entrusted to local communities through the establishment of pasture committees, that became responsible for collecting pasture user fees, drafting and implementing grazing plans, and facilitating sustainable pasture resource use. The fees collected by PCs were intended for the enhancement of pasture conditions and rehabilitation of degraded pasture ecosystems. The collection of fees was of critical importance to PCs, as they served as the primary source of financial support for infrastructure efforts at pastures as well as remunerating PC employees. Concurrently, the sustained growth in livestock populations since 1991 has likely contributed to pasture degradation, although this issue remains contentious (Isakov & Thorsson, 2015; Robinson, 2016). Nevertheless, the actions aimed at restoring pasture ecosystems and their biodiversity, i.e. the central tenets of the Pasture Reform, continue to be neglected due to various factors. Firstly, the government has utilized budget size as the primary metric for evaluating PC performance. Secondly, there was a lack of national-level monitoring to assess the condition of pastureland and biodiversity, overall impact of pasture management, and grazing plans. Consequently, the issue of biodiversity conservation emerged as a complementary dimension of pasture management efforts. Pasture management has been inherently associated with resource utilization, in contrast to nature conservation (Mestre, 2017).

At the local level, the Baiboosun PA and PC entered into a partnership to collaboratively define pasture management actions strengthening biodiversity. This approach was preferred over the exclusion of livestock from the PA territory, perceived by managers as detrimental for two main reasons. First, it could lead to human-wildlife conflicts with local herders limited in their alternative livelihood options (Anarbaev, 2022). Second, the efficacy of such micro-reserves was contingent on the absence of coercion against the backdrop of inadequate control mechanisms. The financial constraints associated with fencing and patrolling the territory to avoid herding appeared prohibitive. In this context, conservation is understood as regulated and collectively managed use rather than strict exclusion, aligning biodiversity objectives with continued agropastoral activity.

The coalition supporting the PA's creation comprised a range of stakeholders and managers with jurisdiction over the territory and influence over local natural

resource use. By adjusting and integrating the most active and involved municipalities, the initiators ensured strong commitment to biodiversity conservation with the risk of creating a divide with the wider area.

3.3. Development of a management plan to foster participation and scaling up prospects

In 2020, as per the recommendation of the DoBCPA of MoNETS, the area of the Baiboosun micro-reserve was expanded to approximately 14,000 ha. In 2023, after an additional functional zoning study to better understand the ongoing biophysical processes and assess biodiversity, more land was added, and the PA reached 38,000 ha (CAMP Alatoo, 2023) based on the principle of ecosystem integrity.

The management plan for the Baiboosun micro-reserve aims to:

- Protect local biodiversity from poaching,
- Ensure a balanced use of vegetation cover for grazing,
- Generate and disseminate knowledge.

These actions are carried out with a strong focus on community engagement in the PA management. For instance, local rangers underwent training on reserve patrolling, monitoring biodiversity, and enforcing anti-poaching measures. Most of them were former professional hunters who could mobilize their competencies and knowledge for conservation after the hunting ban.

The actions included in the management plan can be divided into awareness-raising and management activities (Table I.). The plan's execution is mainly hindered by the lack of administrative resources at the local level, making it difficult to report in the formats required by NGOs, international actors and local administrations.

Elaborating an economic model to ensure financial sustainability - with no or extremely limited state subsidies as the source of PAs income in the Kyrgyz Republic - manifests a crucial issue for promoting similar community-led initiatives in the future. Tourism and high-value local product value chains look promising, but their creation requires time and investment. In addition, potential local suppliers/vendors need thematic knowledge and skills, including on starting local commercial partnerships and, above all, on building their communication strategies. Tourism revenues are often used to support conservation efforts, albeit the trade-offs between the two objectives (Spenceley et al., 2019). This potential tension highlights the need for carefully designed economic instruments capable of reinforcing conservation objectives without generating new ecological pressures.

Table I. The Baiboosun Micro-Reserve Management Plan: Main objectives and activities.

Objectives	Awareness raising	Management
Protection of local biodiversity from poaching	Informing local residents about the ecological consequences of activities like root digging.	Equipped with tools like camera traps and GPS devices, community rangers conduct regular patrols to deter illegal activity.
Balanced use of vegetation cover for grazing	Workshops on sustainable pasture use for pasture users.	Drafting grazing management plans based on the Grazing Response Index (GRI) methodology. GRI is a tool devised to assess grazing impacts on pastures (Reed et al., 1999) adapted for the Kyrgyz Republic. Coordination efforts to harmonize the management plans amongst different pasture managers. Infrastructure efforts to enhance access to remote pasture and lower pressure near settlements.
Knowledge generation and dissemination	Environmental education courses in local schools on fauna and flora with exercises and games. Participatory Monitoring via designing a mobile app to enable community members and tourists to record wildlife sightings. These data contribute to the centralized biodiversity database.	Creating a core zone (75% of the PA territory) where only research activity is allowed.

With the government announcing a 10% expansion of the PA area by 2040, the Baiboosun initiative could serve as a pilot for future scaling up (Government of the KR, 2018). Since the launch of the PA, CAMP Alatau took part in the working group drafting resolutions to foster the legal framework updating, which is essential to streamline community-based PAs in legislation. The Chairperson of the Cabinet of Ministers of the KR signed the Procedures for Establishing and Operating PAs of Local Significance and Micro-Reserves on October 7, 2022. The document forges the legal basis for active and full-fledged involvement of local communities in biodiversity conservation. However, certain limitations still remain in the sphere of nature conservation. The categorization of PAs is a complex process further exacerbated by the absence of clear criteria. In terms of management, there is no unified methodology on assessing anthropogenic pressures and monitoring PA performance.

The Baiboosun PA Administration has been actively sharing its experience with other groups striving to establish protected areas on the southern shore of Lake Issyk-Kul (Chong-Jargylchak District) and north-west of the lake (Chong Kemin District). The PA Administration, CAMP Alatoo, and the municipalities perceive economic activities as a way to ensure adherence to the PA requirements and limit injustice. The livestock owners and herders who need to adapt their grazing practices to allow biodiversity regeneration would be more likely to do so with the economic incentive of gaining new revenues through tourism.

3.4. Multifunctionality and community-based management: a synergy?

The PA supporters integrate a bundle of ESs in their management: vegetation cover for livestock grazing, cultural and historical values, recreational use, as well as biodiversity. However, it is still necessary to identify conflicting and mutually supporting ESs (Conrad et al., 2023).

Quite interestingly, they were capable of achieving coordination with the diversity of stakeholders and managers involved in a single territory. The involvement of HFA for the conservation of local biodiversity and community efforts to balance different ESs through SI echoes the debate regarding local community engagement in nature conservation. Such engagement can take different forms, e.g., ownership, governance, or management (Borrini-Feyerabend et al., 2013; Eagles, 2009). The main principles for good PA management were identified by Nguinguiri (2004) as the capacity of local stakeholders to partake in decision-making processes, transparency, and access to information. They also include subsidiarity and decentralisation, also described by Ostrom as the key principles for common-pool resource management (1990).

4. Conclusion

The creation of the first community-led micro-reserve in the Kyrgyz Republic became the result of collaborative efforts by diverse stakeholders at different levels. At the local level, it was initiated by the Ton District HFA with the support of the community-based pasture management body and facilitated by the municipalities concerned that mediated SIs around ES provision and use. Those efforts were strengthened by the coordination and technical assistance of CAMP Alatoo, a national-level NGO that - jointly with state agencies - contributed to the national-level legal transformation, as well as managed to mobilize funding.

The identification of ES bundles and trade-offs is key to the management of the Baiboosun Micro-Reserve and could also inform the process of scaling up this model across the country. To support the territory's multi-functionality, it is essential

to clearly understand which ESs are more favourable to bundled management, how stakeholders interact in ES management and governance, and how ES provision, in turn, influences SIs (Barnaud et al., 2018).

The authors propose the two main perspectives for future research. Firstly, further investigation is necessary to gain additional insights on how the target PA is integrated in the larger territory of Lake Issyk-Kul's southern shore, as well as on how conservation can support maintaining natural infrastructure, e.g., the PA's capacity to forge a network and support biodiversity connectivity, provide clean water, etc. International literature shows how PAs can provide intermediate regulation services (related to water and biodiversity) supporting farming in a larger area (Castro et al., 2015). Secondly, an assessment of the ESs provided by the Baiboosun Micro-Reserve could highlight the plural values created and shift the focus away from solely monetary valuation (Arias-Arévalo et al., 2018).

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MZh, IM, CAMP Alatoo PF and Baiboosun Jaratylysh Korugu PF conceived and supervised the study. MZh, CAMP Alatoo PF and Baiboosun Jaratylysh Korugu PF collected and organized the data. IM developed the conceptual framework, analysed data, wrote the paper and made manuscript revisions.