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Sustainable Land Management in Kyrgyzstan and Tajikistan: A Research Review

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The Mountain Societies Research Institute (MSRI) is dedicated to supporting and enhancing the resilience and quality of life of mountain societies through the generation and application of sound research. MSRI has five objectives:

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Preface

The Mountain Societies Research Institute (MSRI) actively works to transfer knowledge to policy and practice with the goal of improving the quality of life for people of the mountain areas in Central Asia. Launched in 2011, the MSRI Background Paper Series strategically identifies research priorities and pathways to application for each of MSRI's core thematic areas. Through structured and thorough analysis of various types of literature and stakeholder engagement, the papers assess the state of research in each thematic area as they relate to Central Asian mountain societies, identify and prioritise knowledge gaps, and identify opportunities for linking research to decision making for policy and practice. The papers also serve as a foundation for future MSRI primary research initiatives and aim to inspire other researchers and funding organisations. The first Background Paper was on Pastoralism and Farming in Central Asia's Mountains (<http://msri.ucentralasia.org/events.asp?Nid=215>), and papers on Mountain Tourism and Sustainability, Food Security and Farming Systems, and Spatial Information and Decision Support Systems are forthcoming.

This paper, the second in the series, focuses on Sustainable Land Management (SLM) in Kyrgyzstan and Tajikistan. Given that a large proportion of the population in both countries resides in rural mountain communities and is dependent on mixed market-subsistence farming or livestock, the issue of land management is critical to survival and quality of life. These communities face substantial challenges to sustainable livelihoods, ranging from poverty and deteriorating infrastructure to climate change and natural disasters. They also bring particular expertise in their land management priorities and ideally are the ultimate users of research recommendations. Strategically focused and applied research can therefore play a critical role in engaging mountain communities and better understanding and addressing the challenges they face.

Based on an extensive review of over 130 international and regional publications, this paper offers a comprehensive view of the existing state of research on SLM and the interface between research and action. By placing the literature within the Global Land Project analytic framework, the paper provides a clear view of the focus and gaps in existing research. A key finding of the review was a focus on the impact of changes in land use and management on ecosystems, with a corresponding gap on the implication of these changes on ecosystem services. An additional finding, related to the context in which research is conducted, is the disconnect between researchers and land users, both during the process of identifying actionable research topics and the critical process of implementing research recommendations. The paper examines differences between Soviet-era and contemporary approaches to research on land use, providing a useful framework to build on the considerable scientific achievements of the Soviet era while addressing the dynamic and global realities of Central Asian mountain communities today.

In addition to the literature review, a special stakeholders feedback session was held at the 2012 Central Asian Mountain Partnership Forum (CAMP 2012), which focused on SLM, to engage likely end-users of research. An earlier version of the paper was presented to more than 48 policymakers, practitioners, local village organisation representatives, local and international NGO representatives, donor representatives, and local and international researchers. Discussion focused on factors that hinder interactions among research, policy and practice and recommendations to overcome these factors. MSRI is grateful for the comments and recommendations of the participants, which were incorporated into the final version of the paper.

A research team including MSRI Research Fellow Jyldyz Shigaeva, MSRI Research Associate Bettina Wolfram and MSRI Senior Research Scientist Chad Dear worked collaboratively across disciplines, languages, and continents to produce this background paper.

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Table of contents

Executive Summary	7
1. A Changing Role for Research on Land Use and Management	8
2. Key Concepts and Frameworks	10
2.1 SLM and Rational Use of Land Resources (RULR)	10
2.2 Global Land Project Socio-ecological Analytical Framework	11
2.3 Concepts Used in Research for Sustainable Development.....	12
3. Methods	14
3.1 Identifying Literature.....	14
3.2 Data Entry and Literature Analysis.....	18
4. Results	19
4.1 Quantitative Description of the Selected Publications	19
4.2 The State of SLM Research on Kyrgyzstan and Tajikistan	23
4.3 Research Recommendations from the Publications	43
4.4 Recommendations for Policy and Practice from the Publications	48
4.5 Research, Policy and Practice Interaction	56
5. Conclusions, Discussion and Recommendations	64
5.1 Limitations of the Study	64
5.2 Assessing the State of SLM research in Kyrgyzstan and Tajikistan.....	66
5.3 Research-Action Interface	69
5.4 Recommendations for Strengthening SLM Research.....	71
REFERENCES:	
Literature Reviewed.....	74
Additional References	81
ANNEX:	
Survey form for SLM literature analysis	83

Figures

Figure 1. Overview map of Kyrgyzstan and Tajikistan	9
Figure 2. Modified Global Land Project (GLP) Framework.	12
Figure 3. Multi-level Stakeholder Approach to SLM	13
Figure 4. What country(s) do the selected publications focus on?	20
Figure 5. Country focus by publication type	20
Figure 6. Altitudinal focus by publication type	21
Figure 7. Stakeholder focus in publications by publication type.....	22
Figure 8. GLP framework	24
Figure 9. Number of publications assigned to different system components and links of the GLP framework	24
Figure 10. Sub-categories of System Components.....	25
Figure 11. Number of academic articles from Kyrgyzstan and Tajikistan assigned to different system components and links of the GLP framework	26
Figure 12. Number of international academic articles assigned to different system components and links of the GLP framework	26
Figure 13. Erosion risk map allowing analysis of the potential effect of soil conservation measures in Faizabad District, Tajikistan	40
Figure 14. Research recommendations by publication type	43
Figure 15. Recommendations for policy and practice by publication type	49
Figure 16. Share of contribution of each type of publication to system, target and transformation knowledge	59
Figure 17. Contribution of each type of publication to disciplinary, interdisciplinary and trans-disciplinary research	60
Figure 18. Organisational affiliation of authors of academic articles published in Kyrgyzstan and Tajikistan.....	61
Figure 19. Organisational affiliation of authors of international academic articles.....	62
Figure 20. Organisational affiliation of authors of grey literature	62
Figure 21. Collaboration between authors from different types of organisations	63
Figure 22. Collaboration between researchers from local and international organisations.....	64
Figure 23. Number of papers analysed for Kyrgyzstan and Tajikistan for this study and number of papers from the Perth conference).	68

Tables

Table 1. Selected journals published in Kyrgyzstan and Tajikistan	16
Table 2. Libraries searched in Kyrgyzstan and Tajikistan.....	17
Table 3. Number and percentage of publications addressed by the links.....	25
Table 4. Research recommendations by primary author's organisational affiliation	44
Table 5. Research recommendations for policy and practice by primary author's organisational affiliation	49

Executive Summary

This paper reviews and discusses the state of research on sustainable land management (SLM) in Kyrgyzstan and Tajikistan and analyses the interface between research and action. The authors methodically selected 131 publications for analysis. These publications included academic literature published in journals from Kyrgyzstan and Tajikistan, academic literature published in journals outside the region, and grey literature from the post-independence period (late 1991 to mid-2012). Soviet-era literature is both highly relevant and abundant and therefore warrants a separate analysis. Using the Global Land Project (GLP 2005) analytical framework, we analysed the distribution of the selected publications across the components and links in a socio-ecological system. Excerpts that exemplified the main contribution of each publication were extracted and further categorised based on emergent themes. These themes were used to organise a narrative synthesis of the publications. The publications are also analysed based on other variables such as publication types, geographic focus, altitudinal zone and stakeholder level. These analyses aimed to identify research gaps. A brief comparison with Björnson Gurung et al's (2012) state of the art assessment of research needs for sustainable development in the world's mountains was also made.

Analyses of the research-action interface involved attributing each publication to one type of knowledge based on the knowledge categorisation of system knowledge, target knowledge and transformation knowledge (ProClim 1997) and assessing the research type (disciplinary, multi-disciplinary, or transdisciplinary research). Further, the organisational affiliation of authors was analysed to understand the degree to which collaboration occurred between authors affiliated with local and international organisations as well as between authors from different types of organisations, including academic and non-academic organisations. The research-action interface was also analysed through a stakeholder feedback session held at the September 2012 Central Asian Mountain Partnership Forum in Dushanbe, Tajikistan, the theme of which was SLM (CAMP Forum 2012).

There is a strong emphasis in the literature on the impact of changes in land use and management on states, properties and functions of ecosystems, however, there is little research on the implications this in turn has on ecosystem services. This is the opposite finding of a similar analysis focused on publications at the global scale (Björnson Gurung et al 2012). Another key gap was the lack of research on Kyrgyzstan and Tajikistan regarding the influence of global factors on social and ecological systems, despite social, economic and political integration into global structures since the Soviet collapse and the increasing influence of climate change. Our analysis disaggregated the findings of academic literature published in the region and international academic literature and revealed stark differences. These differences are partly attributed to the legacy of the late Soviet-era principle of "rational use of land resources," which fit the centrally planned economy, but lacks approaches for market and decentralised resource governance. Finally, the emphasis of research on system knowledge, the lack of transdisciplinary research, and the critical feedback of stakeholders at a regional sustainable land management forum suggest that actionable SLM research on Kyrgyzstan and Tajikistan is rare. Recommendations are made for targeted, application-focused, multi-stakeholder research and knowledge sharing, including local and international researchers as well as practitioners, policymakers and land users.

1. A Changing Role for Research on Land Use and Management

Issues of land use and management are vital to mountain societies in Kyrgyzstan and Tajikistan. The majority of populations in these countries are in rural mountain areas and are directly dependent on livestock and small-scale mixed market-subsistence farming, with Kyrgyzstan relying more on livestock than Tajikistan. These production systems are characterised by high costs and comparatively low outputs. High levels of poverty, deteriorating infrastructure, limited access to energy supplies, and active migration processes in the region are resulting in changes to land use and management practices. Additionally, the mountain societies in Kyrgyzstan and Tajikistan are vulnerable to the effects of natural disasters due to remoteness as well as the limited capacities of local populations and responsible government structures (PALM 2011).

These contemporary challenges exist within a structural transition from a centrally planned, Soviet mode of land use and management to a more de jure and de facto decentralised, market-oriented system. Compared to the Soviet era, land use and management and associated land degradation are affected by a new set of drivers (Kerven et al 2012) and a greater degree of socio-economic, political and environmental uncertainty.

While new opportunities and challenges for sustainable land management (SLM) emerged through the transition, there has been a lack of relevant, up-to-date, empirical, rigorously investigated, and adequately documented scientific knowledge particular to Central Asian mountain societies. Research in the Kirgiz and Tajik Soviet Socialist Republics was planned and financed centrally from Moscow within strict ideological parameters of development. The main aim of agricultural research was to increase yields to meet centrally-planned production quotas and the rapidly increasing demand for food and fodder. The capacity of local research institutions, however, was undermined with the withdrawal of Soviet support (Abdurasulov 2007). Filling the void of locally-produced academic research has been the now abundant short-term research, assessments and evaluations associated with official development assistance programmes. Kerven et al. (2011), in a critical review of pastoralism and farming research in Central Asia's mountains, concluded that "many of the [project-based grey literature documents] reviewed were superficial, derivative and non-empirical" and acted to promulgate rather than critically investigate "environmental orthodoxies" in an effort to gain more donor funding (36).

Similar to Kerven et al. (2011), this paper analyses the state of research on the broader topic of SLM in Kyrgyzstan and Tajikistan. Further, this paper analyses the opportunities and challenges of research-informed



Boys grazing livestock on summer pastures, Naryn Oblast, Kyrgyzstan (Azamat Isakov, CAMP Alatoo)

implementation and policymaking. Finally, the paper outlines recommendations for the substance and process of future research, including means of producing targeted, application-focused, multi-stakeholder research and knowledge sharing, including local and international researchers as well as practitioners, policy-makers and land users.

2. Key Concepts and Frameworks

This section introduces the key concepts, definitions and frameworks guiding the paper. It starts with an overview and definition of the key concept referred to by this paper, SLM, and what is often called its equivalent from the Soviet era, Rational Use of Land Resources (RULR). For the purpose of analysing and structuring this literature review, we used a modified version of the Global Land Project analytical framework (GLP 2005). Additional concepts used in research for sustainable development (Wiesmann and Hurni, 2011) were also applied, such as transdisciplinarity (Pohl and Hirsch Hadorn 2007), different knowledge types (ProClim 1997) and the multi-level stakeholder approach (Hurni et al. 1998).

2.1 SLM and Rational Use of Land Resources (RULR)

The concept of SLM was an outgrowth of the global discussion on sustainable development initiated by the Brundtland Commission and carried forward by the 1992 United Nations (UN) Conference on Environment and Development (Earth Summit). A group working on behalf of the Food and Agricultural Organisation (FAO) in 1991 to develop “A framework for Sustainable Land Management” defined the principles of SLM as follows:

Sustainable land management combines technologies, policies and activities aimed at integrating socio-economic principles with environmental concerns so as to simultaneously: maintain or enhance production/services (Productivity), reduce the level of production risk (Security), protect the potential of natural resources and prevent degradation of soil and water quality (Protection), be economically viable (Viability), and socially acceptable (Acceptability). These five objectives of Productivity; Security; Protection; Viability and Acceptability are seen to be the basic ‘pillars’ on which the SLM edifice must be constructed and against which its findings must be tested and monitored (Smyth and Dumanski, 1993, Chapter 1).

SLM quickly gained popularity in Western scientific and official development assistance circles. Over the following years a multitude of definitions suggested by different organizations followed. As the SLM vision elaborated for the TerrAfrica project summarised, “SLM emphasized that people (the human resources) and the natural resources on which they depend directly or indirectly, are inextricably linked. Rather than treating each in isolation, all ecosystem elements are considered together, in order to obtain multiple ecological and socio-economic benefits” (FAO 2008: 21). Thus, land and ecosystem services are no longer restricted to their productive capacity but their provisioning, regulating, cultural and supporting services are considered (MA, 2005).

For the purposes of this paper, we maintain the definition of SLM developed at the UN Earth Summit (1992) as “the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions”.

SLM has been widely used in Central Asia as part of numerous projects, however, the meaning is often conflated with what many Central Asian researchers and decision-makers refer to as the late Soviet-era equivalent principle of the Rational Use of Land Resources (RULR). According to the Soviet technical standards known as GOST (a Russian acronym for gosudarstvennyy standart), GOST 26640-85 on “Land: Terms and Defini-

tions”, valid as of 1 January 1987, defines “rational use of land resources” as land use where “all land users, throughout the production process, ensure maximum achievement of the objectives of their land use while giving due consideration to protecting the land and maintaining optimal interaction with environmental factors.”

RULR was embedded within the Soviet planning system in which the centralised authority dictated production parameters leaving researchers to develop the technological capacity to achieve defined targets. State control over rehabilitation and rational use of agricultural land was considered a precondition for the development of the agro-industry and for increasing agricultural production. The approach to RULR research included the systematic assessment and monitoring of land resources within the framework of the “State Land Cadastre”. Qualitative assessments of land, including special large-scale soil and geo-botanical surveys, as well as land suitability and valuation appraisals were obligatory research programmes for maintaining the Land Cadastre. While the RURL principle includes land protection and “maintaining optimal interaction with environmental factors,” in practice, as Hurni et al. (2004) argued “critical research addressing negative side-effects of technologies and identifying knowledge gaps was almost totally suppressed” (216).

Unlike in SLM, social and political dimensions of land use and management were not part of the RULR principle. As such, throughout the Soviet Union, including the Kirgiz and Tajik Soviet Socialist Republics, there was a strong tradition of natural science schools of agrarian, soil and botanical research and a very limited number of research institutes focusing on social science in general and almost no social scientists focusing on land management specifically (Zaslavskaya 1990). Today the principle of RURL is still prominent. Almost all legislation in Kyrgyzstan and Tajikistan that regulates land use and management refers to RURL, including the Land Codex of the Kyrgyz Republic. While this review of literature focuses on SLM it also includes publications more aligned with contemporary applications of RULR and analyses the differences and tensions between these two concepts.



Soviet-era mosaic on a house depicting the importance of agricultural productivity, Dushanbe, Tajikistan (Bettina Wolfgramm 2011)

2.2 Global Land Project Socio-ecological Analytical Framework

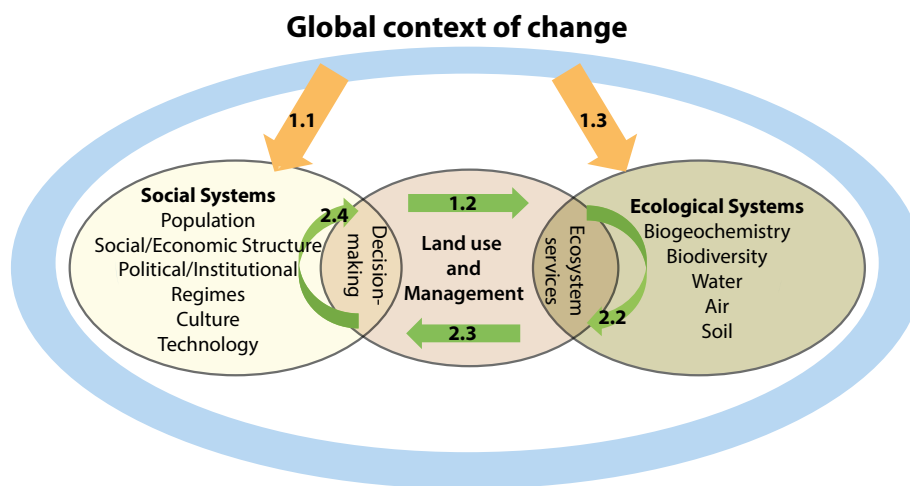
In addition to the many definitions of SLM, there are also numerous conceptual and analytical frameworks relevant to SLM. Some of these frameworks include:

- The Millennium Ecosystem Assessment (MEA) (MA 2005);
- The Drivers-Pressures-State-Impact-Responses (DPSIR) framework (Kristensen 2004);
- The hybrid conceptual framework of the DPSIR and the MEA frameworks (Smeets and Weterings 1999);
- A General Framework for Analyzing Sustainability of Social-Ecological Systems (Ostrom 2009);
- The conceptual framework of the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD 2009); and
- The analytical framework of the Global Land Project Science Plan (GLP 2005).

Of these, we selected the Global Land Project (GLP) framework as the most useful to systematically structure a review of SLM research in Kyrgyzstan and Tajikistan and to identify research gaps. The GLP framework helps to understand coupled human-environmental systems and changes in the interaction between social and ecological systems and land use and management. The framework aims to facilitate analysis of the transition undergone by land systems, recognising that resource use and management are shaped by ecosystem services, on one hand, and by social systems through decision-making processes, on other. The framework aims to be applicable to the study of system links at the local and regional scale, and to and from the global scale (GLP 2005).

Figure 2 is a modified version of the GLP framework that was used to guide the review of SLM literature. The modified framework includes three system components (or circles) representing the social system, the ecological system, and land use and management, which is located at the interface between social and ecological systems. Further, two themes describing the links (arrows) between the components were addressed: theme 1 on *Dynamics of Land Systems* and theme 2 on *Consequences of Land System Change* (GLP 2005).

Figure 2. Modified Global Land Project (GLP) Framework.



We chose the GLP framework to structure this research review for the following reasons. The GLP framework takes into account the impacts and consequence of globalisation on both social and ecological systems. The framework explicitly recognises the role of decision-making actions regarding land use and management, and its impact on ecosystem services. Thus, it addresses issues critical to formulating research policy and can provide information for decision makers. Finally, the GLP framework was developed to set out a research agenda for a large, decadal research project, based on credible, high quality science, which corresponds to the aim of this literature review.

The GLP framework has previously been used for assessing and synthesising research from large numbers of scientific results, namely in the conference on Global Change and the World's Mountains, which took place in Perth, Scotland, in 2010. For the Perth Conference, it was applied to analyse the state and progress of mountain research and its contribution to sustainable mountain development, as well as to reflect on required reorientations of research agendas (Bjørnsen Gurung et al. 2012).

2.3 Concepts Used in Research for Sustainable Development

Wiesmann and Hurni (2011) have argued that “quality and relevance of sustainability-oriented development research implies a transdisciplinary mode of knowledge production that bridges disciplines and paradigms and includes science-society interfaces, leading to the generation of system, target, and transformation knowledge” (63).

We applied these concepts to assess the generation and application of SLM research in Kyrgyzstan and Tajikistan. As described below, the knowledge typology of system, target and transformation knowledge (section 2.3.1) helps to categorise research results as they relate to development or progress. The multilevel stakeholder approach (section 2.3.2) defines the range of actors that play a role in SLM and helps to identify at which level or on which actors research focuses. Finally, disciplinary, multi-disciplinary, interdisciplinary, and transdisciplinary research (section 2.3.3) helps to categorise the way researchers define their field of study and set the system boundaries of their study.

2.3.1 Systems knowledge, target knowledge and transformation knowledge

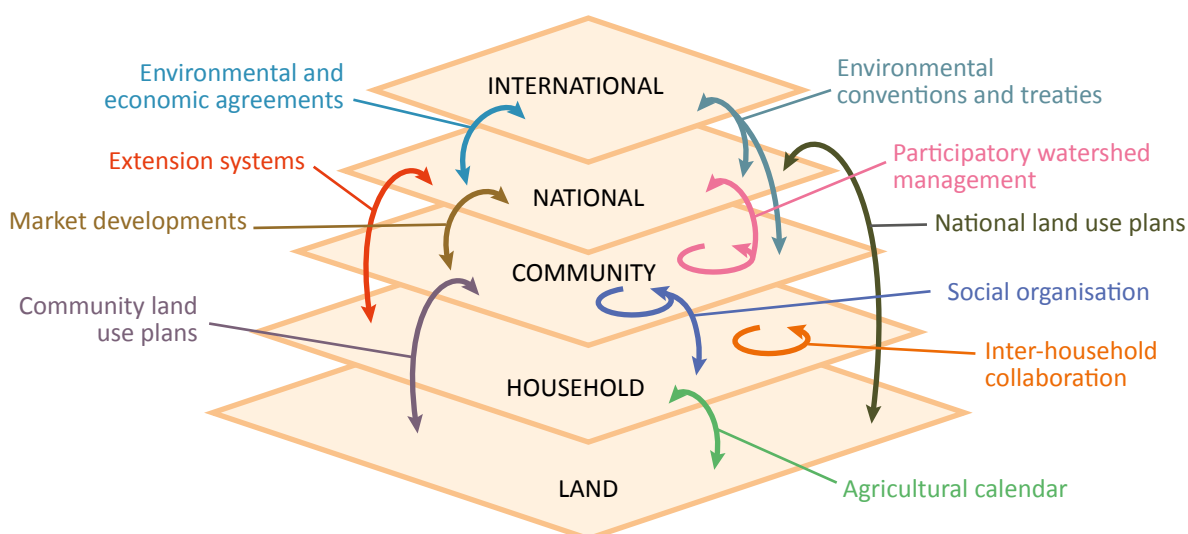
System knowledge, target knowledge, and transformation knowledge is a knowledge typology relevant to research on change that was first defined by the “Forum for Climate and Global Change” of the Swiss Academy of Science (ProClim 1997: 15). The concept has since been adapted, for example by the *Mountain Research and Development* (MRD) Journal and the National Centre of Competency in Research (NCCR) North-South program. MRD1 defines the three types of knowledge as follows:

Systems knowledge describes how current systems—i.e. society, the economy, the environment, etc.—work. In order to shape sustainable development, all actors concerned need to be involved in defining a vision and negotiating what are the “right” things to do, i.e. they need to develop target knowledge together. They do this on the basis of systems knowledge, which helps find missing links and enhance understanding of complex wholes. Transformation knowledge is needed to shape the transition from the current to the envisaged situation, to decide how to do the “right” things and put the vision of sustainable development into practice, and to define what corrective action is needed (Based on td-net and NCCR North-South definitions).

2.3.2 Multi-level stakeholder approach

Early SLM concepts, technologies, and approaches often focused solely on the land user. A multi-level stakeholder approach (Figure 3) emphasises instead that “not all stakeholders are farmers or villagers” and that the role of off-site actors such as administrators, local and international civil society organisations, and researchers should also be considered (Hurni 2000). Further, the approach recognises the interconnections of stakeholders acting at different levels of decision-making, and the necessity to understand their motives and impacts when aiming at understanding land use change.

Figure 3. Multi-level Stakeholder Approach to SLM



1 http://www.mrd-journal.org/About_edpol.asp

2.3.3 Disciplinary, multi-disciplinary, interdisciplinary and transdisciplinary research

Academic research is often organised around a specialisation or discipline. Increasingly over the past four decades, researchers' recognition of complexity and the development of advanced tools and methodologies to address complexity (e.g. computer powered modeling approaches); an increasing focus on problem-based applied research; and increased recognition of the importance of different ways of knowing (including technical, local and indigenous knowledge) have led to the use of multidisciplinary, interdisciplinary and transdisciplinary approaches to research.

Pohl and Hirsch Hadorn (2008) characterised multidisciplinary research as “approaching an issue from the perceptions of a range of disciplines...but each discipline works in a self-contained manner with little cross-fertilisation among disciplines, or synergy in the outcomes” (429). Interdisciplinary research is often described as incorporating multiple disciplines, but in more of an integrated manner that includes the cross-fertilisation and synergies absent in multi-disciplinary research. Transdisciplinary research goes a step further by defining its means as “participatory research and collaboration between disciplines”. Pohl and Hirsch Hadorn (2007) describe it as follows: “The starting point for transdisciplinary research is a socially relevant problem field. Within this field, transdisciplinary research identifies, structures, analyses and deals with specific problems in such a way that it can: a) grasp the complexity of problems, b) take into account the diversity of life-world and scientific perceptions of problems, c) link abstract and case-specific knowledge, and d) develop knowledge and practices that promote what is perceived to be the common good” (30).

3. Methods

This section describes the methods used for identifying literature, including selection criteria, types of literature included and processes for collecting literature. Methods for data entry and analysis are also described, as well as the process used to gather stakeholder input.

3.1 Identifying Literature

3.1.1 Substantive, geographic and temporal scope of the literature

The definition of SLM and the GLP framework presented in Section 2 guided decisions to select publications based on the substance of publications. Specifically, publications had to focus on at least one of the three elements of sustainability (environmental, economic and social) and had to address the use or management of land and water resources within one of the major land use types (such as cropland, forests and pastures). Publications that focused on purely disciplinary studies, such as research on single flora or fauna species or pure agronomy research, were excluded. Publications that focused on non-renewable resources, such as mining, and environmental issues not linked to agriculture or forestry, such as contamination from non-agricultural sources, were also excluded.

The geographic scope of this paper is Kyrgyzstan and Tajikistan. Publications that did not present findings based on research in Kyrgyzstan or Tajikistan or that only briefly mentioned these countries were excluded.

The paper focused on literature from the post-independence period, from late 1991 to mid-2012. Soviet-era literature is both highly relevant and abundant, and was deemed to warrant a separate analysis.

3.1.2 Types of literature included and processes for selecting publications

Three types of literature were included:

- international academic literature
- academic literature published in Tajikistan and Kyrgyzstan
- grey literature

Books, proceedings and graduate-level theses and dissertations were excluded. Books and proceedings were excluded for the practical reason that we lacked access to them in Kyrgyzstan and Tajikistan. Additionally, proceedings are often published without a strict peer-review process. We excluded PhD theses and candidate and doctoral dissertations under the assumption that findings from high quality theses and dissertations would be published and accessible in academic journals.

The methods for selecting publications in these three categories are described below.

3.1.2.1 International academic literature

This type of literature includes articles in journals that are published by a publishing company or organisation and have undergone peer-review. Our aim was to identify all international academic literature that met our substantive, geographic and temporal criteria. To accomplish this, we conducted “full-text” keyword searches on major academic archiving systems including Web of Knowledge, Scopus and Google Scholar. Keyword searches included:

- Generic phrases associated with SLM, such as “land management,” “land degradation,” “land resources,” “land cover,” and “land use”;
- Land use types as categorised in the Kyrgyzstan and Tajikistan land use code, such as “pasture,” “crop-land,” and “forest”; and
- Components within the definition of SLM, such as “soil,” “water,” “vegetation,” “wildlife,” and “live-stock.”

Each key phrase was searched for in combination with each of the following location keywords, also using the “full text” feature: “Central Asia,” “Kyrgyz Republic,” “Kyrgyzstan,” and “Tajikistan”. Results were reviewed to ensure their relevance and date range.

Next, we searched the bibliographies of identified articles for additional sources that may have been missed through keyword searches. This process was continued until no additional articles were found.

3.1.2.2 Academic literature published in Kyrgyzstan and Tajikistan

Hard copies of academic literature published in Kyrgyzstan and Tajikistan are kept in university libraries, public libraries and the libraries of the Academy of Sciences. There is no comprehensive electronic archiving system and therefore no means of thoroughly conducting keyword searches. The best way to identify literature was to manually review the hardcopy tables of contents of all available issues of relevant journals for the period 1991 to 2012.

There are many journals and other forms of academic literature published in Kyrgyzstan and Tajikistan. These vary in the degree to which objective quality control measures are applied to submitted articles. Our aim was to identify articles that were most likely to have undergone an objective peer review. We chose to focus on academic articles in multidisciplinary journals that are certified by the Higher Attestation

tion Committees (HAC) of the Kyrgyz Republic and for Tajikistan, the HAC of the Russian Federation.² These journals include what are generally considered to be the best articles from all-recognised disciplines, including ecology, economics and agriculture. We also included one specialty, disciplinary journal because of its focus on land management.

While the selection criteria inevitably excluded many potentially relevant and high quality articles in other HAC-certified specialty journals or in non-HAC certified journals, we determined this to be the most objective and efficient means of narrowing the scope of journals to a manageable number. We recommend future analyses of literature from the many other academic journals published in Kyrgyzstan and Tajikistan.

As with international academic literature, our aim was to identify and include all documents meeting our criteria as described above. All issues of all selected journals, however, were not available in the libraries searched. Table 1 lists the journals included in our analysis and Table 2 lists the libraries searched.

Table 1. Selected journals published in Kyrgyzstan and Tajikistan

Journal name	Country of publication	First publication date	Publication schedule	Estimated % of issues available in libraries
HAC-certified for candidate and doctoral dissertations of all specialties				
Journal of National Academy of Sciences (Izvetiya Akademii Nauk)	Kyrgyzstan	1966	Quarterly	~90
Journal of Universities (Izvestiya Vuzov)	Kyrgyzstan	2002	Quarterly	~60
Science and New Technology journal (Nauka i novye tehnologii). Previously named Science and Technique (Nauka i Tehnika)	Kyrgyzstan	1993	4-6 times per year	~60
HAC-certified for candidate and doctoral dissertations for agricultural specialty				
Journal of Kyrgyz Agrarian University (Vestnik Kyrgyzskgo Agramogo Universiteta)	Kyrgyzstan	2003	Quarterly	~90
Patent news of Tajikistan	Tajikistan	2000	Quarterly	~80
Tajikistan and the Contemporary World	Tajikistan	2009	Bi-monthly	~95
Bulletin of the Academy of Sciences of the Republic of Tajikistan	Tajikistan	1951-1990; 1994	Bi-monthly	~95
Journal of Academy of Sciences of the Republic of Tajikistan social sciences edition	Tajikistan	1952	Quarterly	~95
Journal of Academy of Sciences of the Republic of Tajikistan edition on biological and medical sciences.	Tajikistan	1952	Quarterly	~95
Journal of the Tajik National University	Tajikistan	1990	Quarterly	~95

² HAC is a national government agency in Russia and some other post-Soviet states that oversees the awarding of advanced academic degrees. HAC has compiled and certified a series of journals in which scientific and other articles are published. HAC of the Kyrgyz Republic is the state scientific expert body, subordinated to the Government of the Kyrgyz Republic, which develops and implements a unified state policy and attestation of scientific and scientific-pedagogical personnel, awarding degrees (kandidat nauk and doktor nauk) and assigning academic titles (docent, professor). HAC was never established in Tajikistan, even during the Soviet times, and HAC of the Russia Federation serves as the responsible entity for Tajikistan.

Table 2. Libraries searched in Kyrgyzstan and Tajikistan

Libraries in Tajikistan	Libraries in Kyrgyzstan
Library of Academy of Sciences	National Library of Kyrgyz Republic
Library Firdausi	Central Scientific Library of National Academy of Sciences of the Kyrgyz Republic
Central Library of Dushanbe	Republic Library named after K.Bayalinov for Children and Youth
Library of Tajik National University	Library of Kyrgyz Agrarian Academy
State Library for Technical Patenting	
Library of the Tajikistan Pedagogical University	

3.1.2.3 Grey literature

There was a large amount of grey literature published on issues relevant to SLM in Kyrgyzstan and Tajikistan from 1991 to 2012. Our aim was to clearly define what would and what would not be considered grey literature and then to limit our selection to those documents that were most relevant and of the highest quality. These parameters were necessary to maintain our focus on SLM, ensure quality and maintain a manageable number of publications.

We adopted the following definition of grey literature, with some modifications:

Grey literature stands for manifold document types produced at all levels of government, academics, business... (and) industry (on-governmental organisations, multilateral organisations and international financial institutions), in print and electronic formats that are protected by intellectual property rights, of sufficient quality to be collected and preserved by library holdings or institutional repositories, but not controlled by commercial publishers, i.e. where publishing is not the primary activity of the producing body (Schopfel 2010: 17).

Examples of grey literature relevant to this paper include: working papers; white papers; technical reports from government agencies, non-governmental organisations and research groups; external evaluation reports of development projects; and policy or development strategies. Examples of documents that were not considered grey literature and therefore not included were internal evaluations, project progress reports, promotional materials and other documents focused on the work of an organisation, produced by staff from that organisation.

The authors compiled a list of approximately 20 of the most prominent English-language grey literature documents on SLM in Kyrgyzstan and Tajikistan. Efforts were made to select publications addressing different thematic fields of land use and management and the different land use categories. For each thematic field, the most recent publications meeting our criteria were chosen. Additionally, publications that included primary or secondary research with clear methods were selected over publications that only reviewed literature or did not include a description of methodology. This list was distributed to SLM experts in the region for comment and was then finalised by the authors.

Unlike the methods used to identify articles published in international peer-reviewed journals and selected academic journals in Kyrgyzstan and Tajikistan, grey literature was purposefully selected and is not representative of all the literature on SLM defined as grey literature.

3.2 Data Entry and Literature Analysis

The authors extracted data from each identified document for quantitative and qualitative analysis based on the aims of the paper. Data were entered into a data entry form that was linked to a database. A copy of the data entry form is included in Annex 1. For data entry and analysis, a digital version of the form and specialised software were used. Analyses are briefly described below in relation to the main objectives of the paper.

3.2.1 Analysing the state of SLM research in Kyrgyzstan and Tajikistan

To assess the state of research, we first identified the main contribution of each of the identified documents. Portions of the text that best captured its main contribution were extracted and directly quoted or synthesised in the data entry form. This text was usually found in the abstract, executive summary or conclusion of documents. The text was then used for further qualitative analysis as described below.

Similar to the procedures used in Bjørnsen Gurung et al (2012), we then attributed the main contribution of each document to one or more of the components (circles) and one or more of the links (arrows) of the GLP framework (GLP 2005). After data entry forms were completed for all of the documents, the narrative data attributed to each component and link was further categorised based on themes that emerged from the data. These themes were used to organise a synthesis of the main contributions including comparisons between publications. This synthesis was the output of the qualitative analysis of the state of research.

For the quantitative analysis, we used descriptive statistics to analyse the distribution of knowledge across other variables not related to the GLP, such as publication types, geographic focus, altitudinal zone, stakeholder level and types of organisational affiliations of authors. These analyses revealed thematic gaps in the research as well as knowledge gaps based on these variables. A brief comparison with Bjørnsen Gurung et al's (2012) state of the art assessment of research needs for sustainable development in the world's mountains was also made.

3.2.2 Analysing recommendations for research, policy and practice

Similar to the analysis of the state of research, recommendations for research, policy and practice were identified, directly quoted or synthesised in the data entry form, and attributed to the ecological or social system component of the GLP and to one of the two themes of the GLP: dynamics of land system change or consequences of land system change. These narrative data were further categorised based on emergent themes. Descriptive quantitative analysis was completed based on types of publication and organisational affiliations of authors.

3.2.3 Analysing interactions among research and policy or practice

Analyses related to the interactions among research and policy or practice were based on the document analysis as well as a stakeholder feedback session held at the September 2012 Central Asian Mountain Partnership Forum (CAMP Forum 2012) in Dushanbe, Tajikistan, which focused on the theme of SLM.

Analysis of the publications involved attributing the main content of each document to one type of knowledge based on the ProClim knowledge categorisation of systems knowledge, target knowledge and transformation knowledge (ProClim 1997) and assessing the research type (disciplinary, multidisciplinary, interdisciplinary, or transdisciplinary). For the purpose of simplifying data entry and analysis, we operationalised "disciplinary research" as only addressing natural or social science, "multi-disciplinary research" and "interdisciplinary research" as involving social and natural science, and "transdisciplinary research" as involving social and natural science and participatory knowledge generation.

The organisational affiliation of authors was analysed to understand the degree to which collaboration occurred between authors affiliated with local and international organisations as well as between authors from different types of organisations (academic, government, NGO, etc.).

The CAMP Forum feedback session included 48 stakeholders including policymakers, practitioners, local village organisation representatives, local and international NGO representatives, donor representatives, and local and international researchers.

The feedback session focused on factors that hinder interactions among research, policy and practice and recommendations to improve such interactions. Feedback session participants worked in four groups. Each of the 48 participants were asked to provide one response to each of the following questions:

- What is the single biggest barrier preventing policymakers and practitioners from using research?
- What is the single biggest reason research is not guided more by the needs of policy-makers and practitioners?
- What is one recommendation to improve the interaction among research, policy and practice?

Responses were categorised based on emerging topics.

3.2.4 Elaboration of recommendations

Recommendations for future research and improved links to decision-making for policy or practice are based on the interpretation of key findings, lessons learned from the research process for this study, and the limitations of the research process. The recommendations are also informed by the key concepts and frameworks employed in the paper.

4. Results

Section 4 presents the results of the analyses conducted on the selected SLM publications. Section 4.1 includes descriptive analyses of the publications. Section 4.2 focuses on the state of SLM knowledge in Kyrgyzstan and Tajikistan and includes the results of quantitative and qualitative analysis of the main empirical contributions of the publications. Section 4.3 includes the results of an analysis of the research recommendations made by authors of the publications. Section 4.4 describes recommendations for policy and practice made by the authors. Section 4.5. includes an analysis of the interaction of research, policy and practice based on the substance and authors of the selected literature. The analyses and their presentation in Sections 4.2, 4.3, and 4.4 were guided by the GLP framework.

4.1 Quantitative Description of the Selected Publications

This section provides an overview of the set of publications that was compiled for the literature review.

There were 131 publications selected for analysis based on the criteria described in Section 3. This sample included three types of publications:

- academic articles published in Kyrgyzstan and Tajikistan – 52 (39.7 percent)
- international academic articles - 52 (39.7 percent)
- grey literature – 27 (20.6 percent)³

The publications were categorised based on the countries, altitudinal zone and stakeholder level on which they focused.

³ The sample of grey literature was purposefully selected and does not represent all grey literature.

4.1.1 What country(s) do the selected publications focus on?

Over half of the selected publications (58.8 percent) focused on Kyrgyzstan and one fourth (26.0 percent) focused on Tajikistan. Only a small percentage (4.6 percent) focused on both Kyrgyzstan and Tajikistan (Figure 4).

Figure 4. What country(s) do the selected publications focus on?

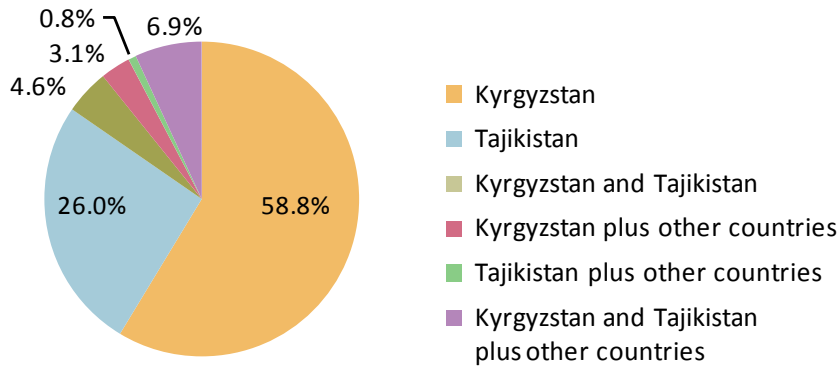
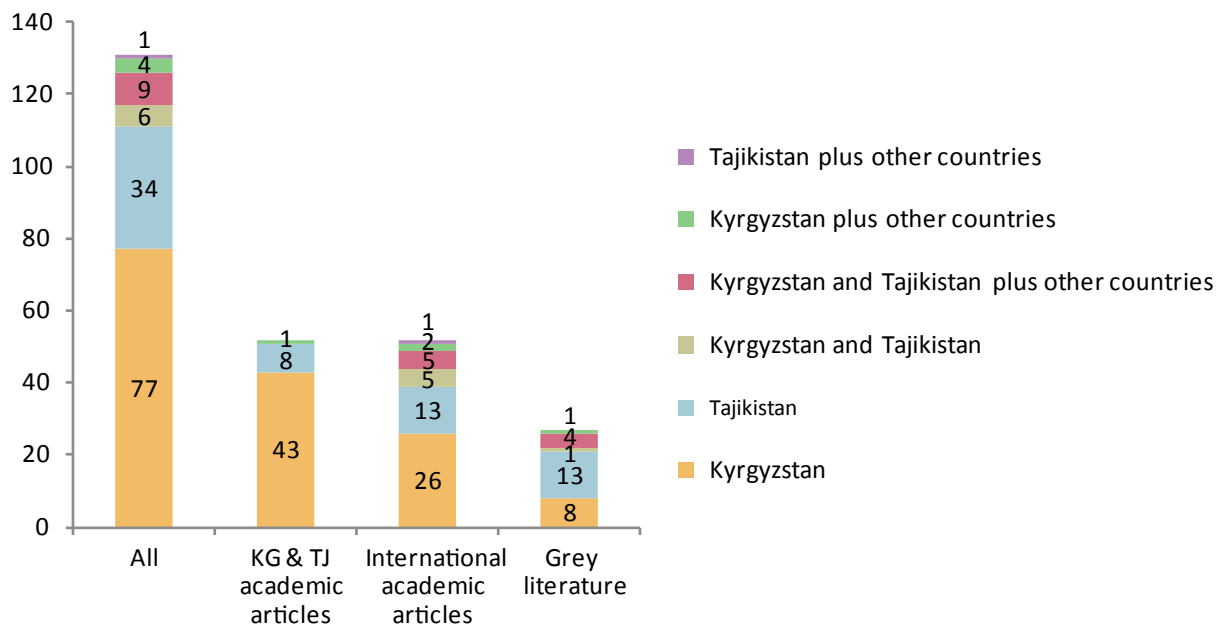


Figure 5. further disaggregates the data by type of publications. Only 1 (1.9 percent) of the 52 Kyrgyz and Tajik academic articles focused on more than one country, while 13 of 52 (25 percent) international academic articles focused on more than one country.

Figure 5. Country focus by publication type



4.1.2 What altitudinal zone do the selected publications focus on?

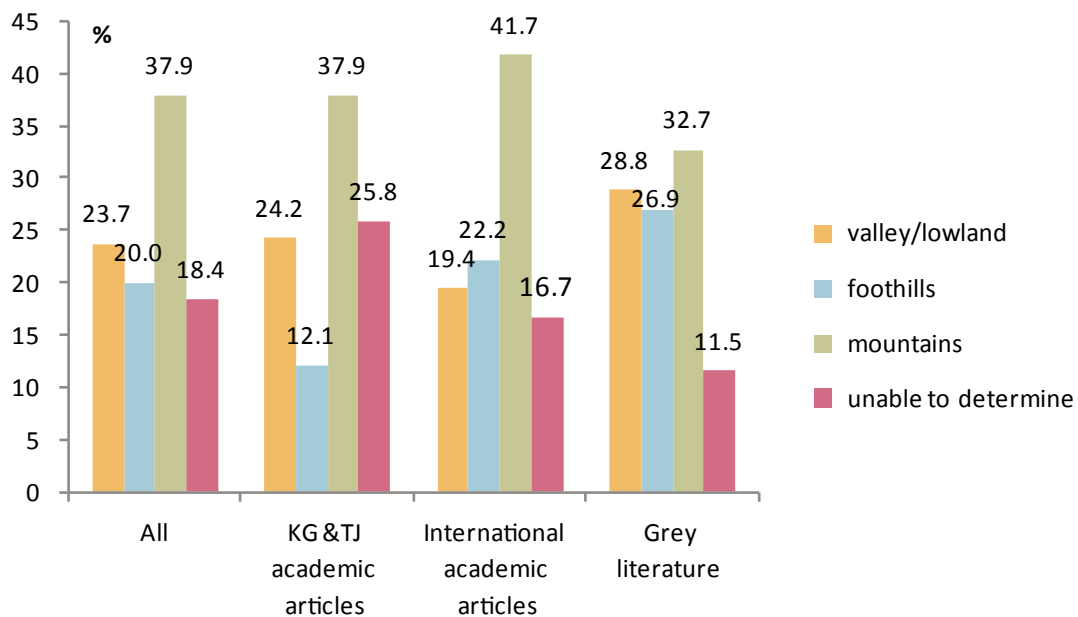
More than one-third (37.9 percent) of the publications focused partly or wholly on mountain areas. Figure 6 illustrates that mountains were the dominant altitudinal zone in all publication types. Approximately one-fourth (23.7 percent) focused partly or wholly on valleys, and slightly less (20 percent) focused on foothills. 18.4 percent of publications did not clearly identify which altitudinal zone they focused on.⁴

⁴ Sum of percentages may be more than 100 % because a single publication may fit to several categories.



Lowlands, foothills and mountains of the Sokuluk River basin, Chui Valley, Kyrgyzstan (Jyldyz Shigaeva)

Figure 6. Altitudinal focus by publication type



4.1.3 What stakeholder level do the selected publications focus on?

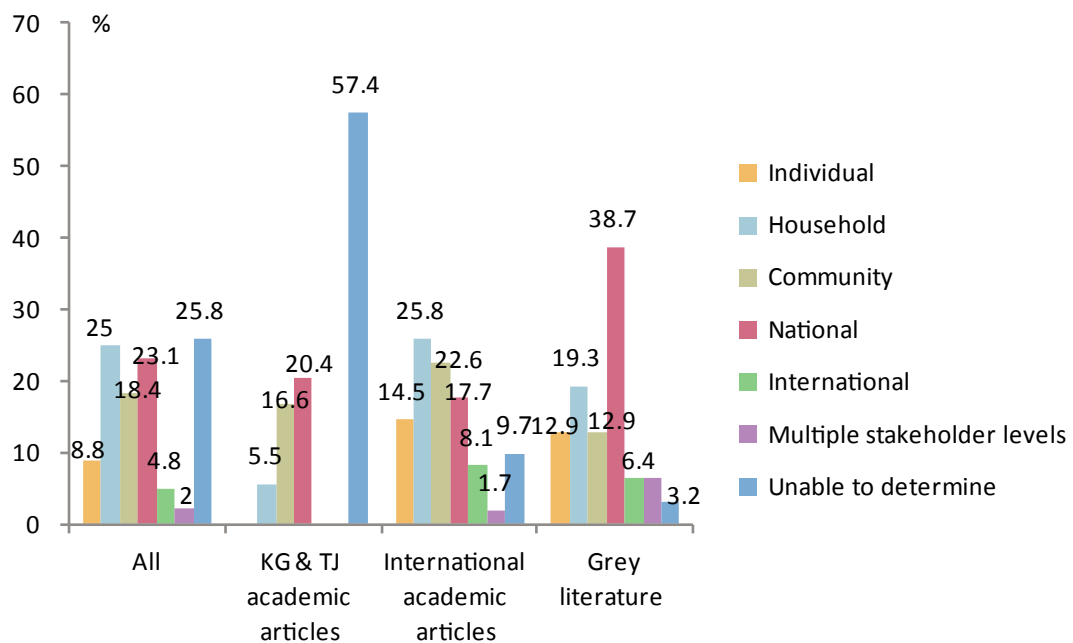
Of those articles published in Kyrgyzstan and Tajikistan with a clearly identifiable stakeholder, about one-fifth (20.4 percent) focused on the national level, less (16.6 percent) focused on the community, and even fewer (5.5 percent) focused on the household level. None focused on the individual or international level⁵ (Figure 7). Most (57.4 percent) of the articles published in Kyrgyzstan and Tajikistan did not focus on a clearly identifiable stakeholder because they dealt with ecological rather than social or political systems.

⁵ Sum of percentage may be more than 100 % because a single publication may fit to several categories



Kyrgyz family gathered for a celebration (CAMP Alatoo)

Figure 7. Stakeholder focus in publications by publication type



In contrast to Kyrgyz and Tajik academic articles, most international academic articles focused on either household (25.8 percent) or community stakeholders (22.6 percent).

The largest proportion of grey literature (38.7 percent) focused on the national level. The individual and community level, shared the same proportion (12.9 percent). The smallest proportion of grey literature focused on the international level and at multiple stakeholder levels at 6.4 percent each.

The majority of all publications focused on the household (25.0 percent) and national levels (23.8 percent). Only about 5 percent focused on the international stakeholder level. Publications looking at multiple stakeholder levels were limited.



Lowlands, foothills and mountains of the Hissar Valley, Tajikistan (Bettina Wolfgramm 2011)

4.2 The State of SLM Research on Kyrgyzstan and Tajikistan

This section includes the results of quantitative and qualitative analysis of the main empirical contributions of the selected publications in Kyrgyzstan and Tajikistan.

4.2.1 Quantitative analysis of publications using the GLP framework

This section addresses the state of research on sustainable land management (SLM) in Kyrgyzstan and Tajikistan. As described in Section 3, and similar to the procedures used in Björnsen Gurung et al (2012), we attributed the main content of each publication to one or more of the “system components” (circles) and to one or more of the “links” (arrows) between system components in the GLP framework. Each link represents one of two “themes” in the GLP framework: “Dynamics of Land Systems” or “Consequences of Land System Change” (GLP 2005).

Figure 8 is a modified version of the GLP framework that was used for the analysis. The modified framework includes three system components (or circles) representing:

- the social system,
- the ecological system
- land use and management, located at the interface between the social and the ecological system

The modified framework also includes six links (or arrows), three in each of the two themes, that address the following questions:

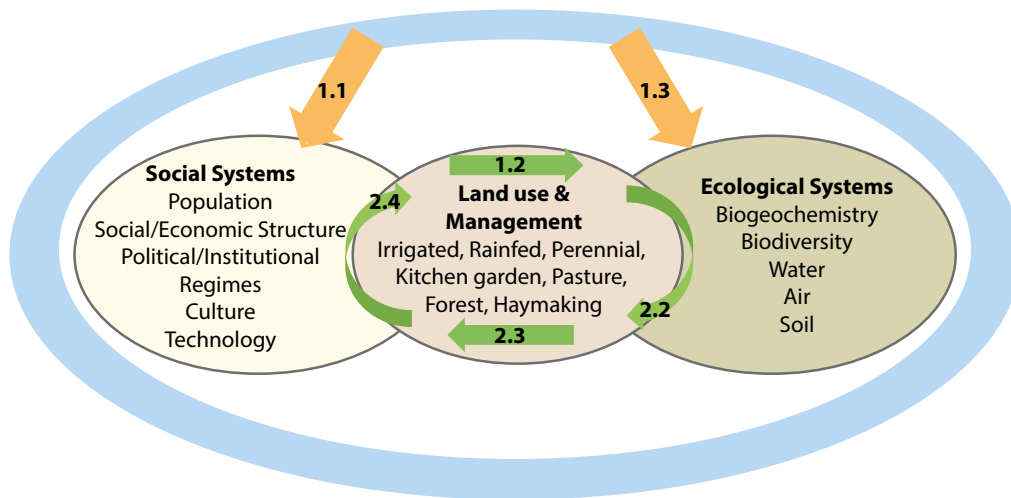
Theme 1: Dynamics of Land Systems

- 1.1: How do globalisation and population change affect regional and local land use decisions and practices?
- 1.2: How do changes in land management decisions and practices affect biogeochemistry, biodiversity, biophysical properties and disturbance regimes of terrestrial and freshwater ecosystems?
- 1.3: How do the atmospheric, biogeochemical and biophysical dimensions of global change affect ecosystem structure and function?

Theme 2: Consequences of Land System Change

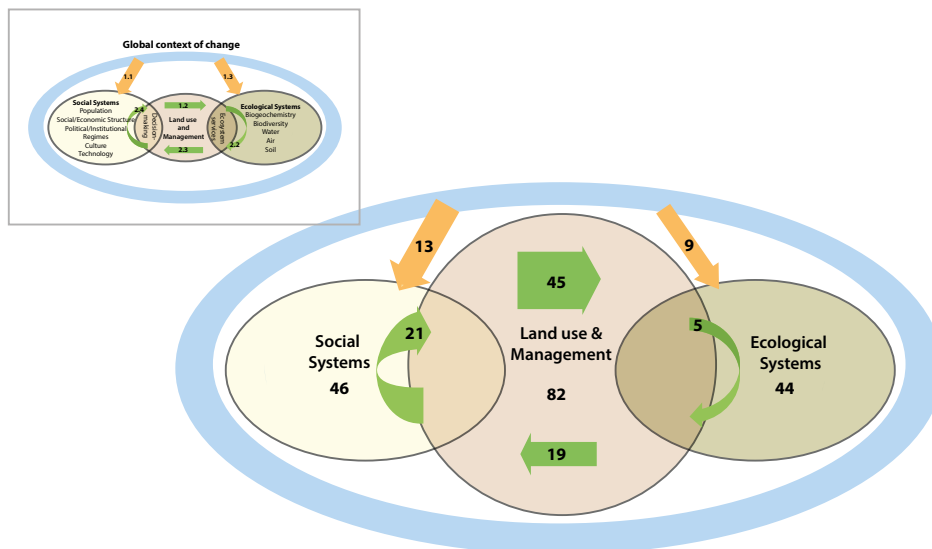
- 2.2: How do changes in ecosystem structure and functioning affect the delivery of ecosystem services?
- 2.3: How are ecosystem services linked to human well-being?
- 2.4: How do people respond at various scales and in different contexts to changes in ecosystem service provision?

Figure 8. GLP framework⁶



The categorisation of all publications is shown in Figure 9.

Figure 9. Number of publications assigned to different system components and links of the GLP framework



With regard to system components, the largest number of publications, 82 (47.7 percent), fell under the Land Use and Management system component; 46 (26.7 percent) were assigned to Social Systems, and 44 (25.6 percent) to Ecological Systems.

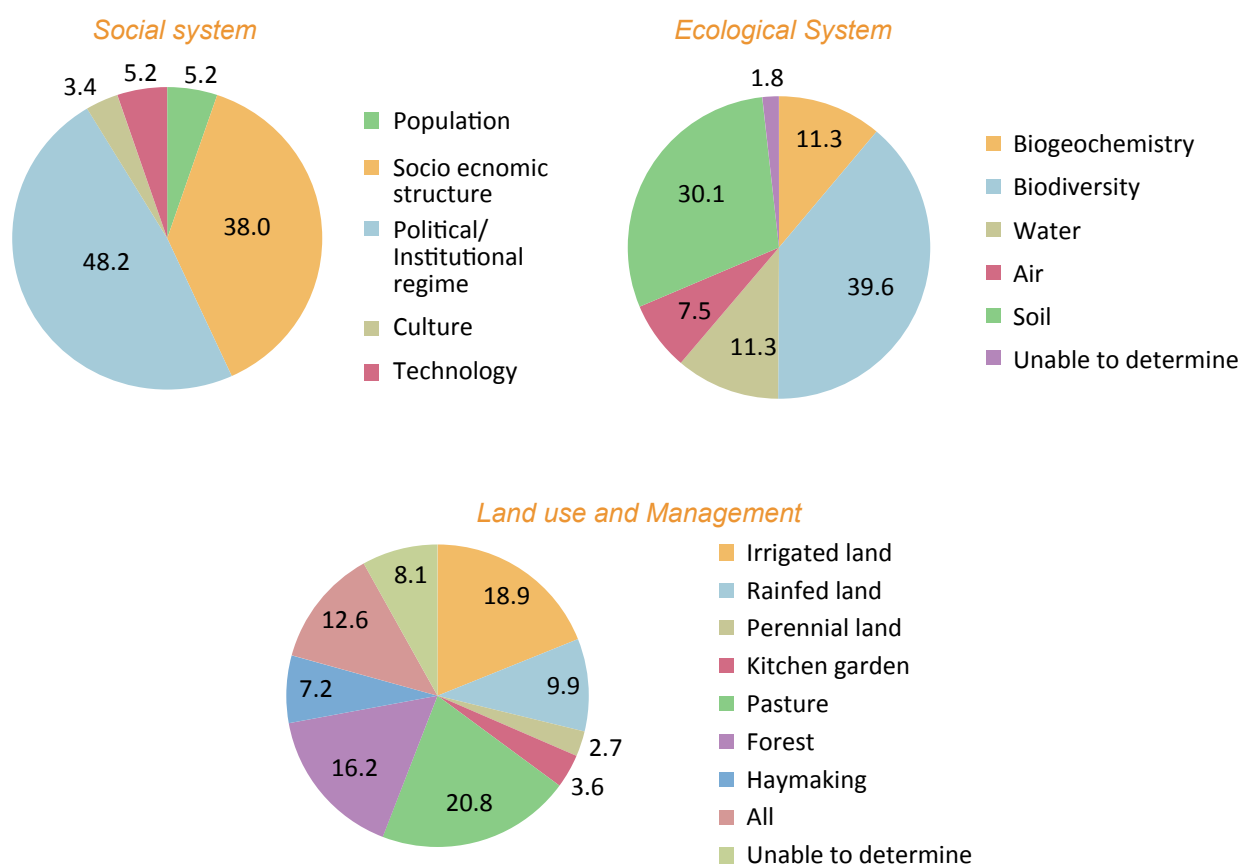
Figure 10 illustrates the categorisation of publications by the subcategories of each system component. Among publications primarily addressing Social Systems, the largest percentage addressed political/institutional regimes (48.3 percent) and socio-economic structures (37.9 percent). The remaining percentage was split almost equally between population (5.2 percent), technology (5.2 percent) and culture (3.4 percent).

⁶ Links 2.1., 3.1, 3.2., 3.3. were not included in this modified version of the GLP framework. Land Use categories were added to “Land Use & Management”

Results

Among publications primarily addressing Ecological Systems, biodiversity (39.6 percent) and soil (30.1 percent) were the most popular topics. Publications primarily addressing Land Use and Management were further categorised by land use. Among these, pasture (20.8 percent), irrigated land (18.9 percent) and forest (16.2 percent) were the most popular.

Figure 10. Sub-categories of System Components



With regard to the links between system components (arrows), the publications were assigned as follows:

Table 3. Number and percentage of publications addressed by the links

Theme Questions	Number of publications	% of publications
Dynamic of Land Systems		
1.1: How do globalisation and population change affect regional and local land use decisions and practices?	13	9.9
1.2: How do changes in land management decisions and practices affect biogeochemistry, biodiversity, biophysical properties and disturbance regimes of terrestrial and freshwater ecosystems?	45	34.3
1.3: How do the atmospheric, biogeochemical and biophysical dimensions of global change affect ecosystem structure and function?	9	6.9
Consequences of Land System Change		
2.2: How do changes in ecosystem structure and functioning affect the delivery of ecosystem services?	5	4.6
2.3: How are ecosystem services linked to human well-being?	19	14.5
2.4: How do people respond at various scales and in different contexts to changes in ecosystem service provision?	21	16

Figures 11 and 12 present a comparative analysis of academic articles from Kyrgyzstan and Tajikistan with international academic articles.

Figure 11. Number of academic articles from Kyrgyzstan and Tajikistan assigned to different system components and links of the GLP framework

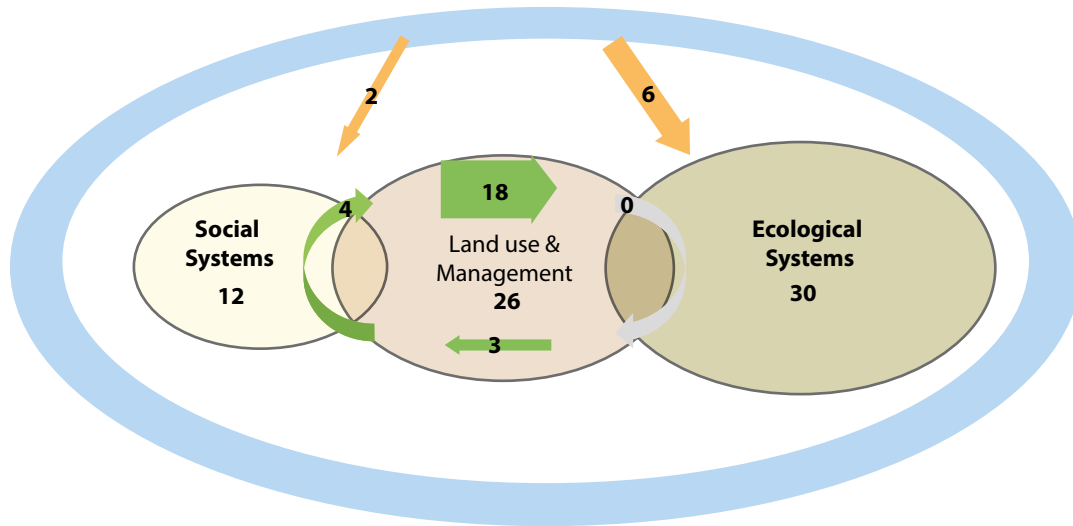
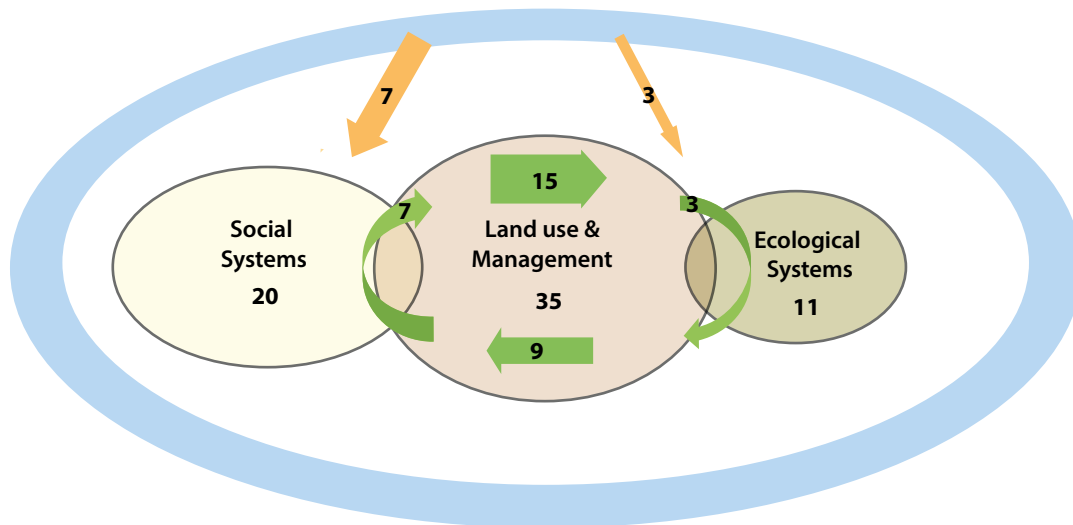


Figure 12. Number of international academic articles assigned to different system components and links of the GLP framework



The figures indicate a strong difference between academic articles published in Kyrgyzstan and Tajikistan and international academic articles with regard to system components. Academic articles from Kyrgyzstan and Tajikistan focused largely on ecological systems (30 or 57.7 percent) and land use and management (26 or 50 percent) while international academic articles focused on land use and management (35 or 67.3 percent) and social systems (20 or 38.5 percent).

The majority of all the articles focused on the impact of changes in land management decisions and practices on ecosystems properties and regimes (link 1.2). However, international academic articles focused more on social global drivers (such as globalisation) and Kyrgyz and Tajik articles focused more on environmental drivers (such as climate change). Only a few international articles, and no Kyrgyz or Tajik articles, focused on interactions within ecological systems.

4.2.2 Qualitative analysis of links between systems

This section provides a qualitative analysis of the links (or arrows) between the system components in the GLP framework. After attributing the main contribution of each publication to one or more of the links, we identified and further categorised the most prominent topics addressed. The description of each of these topics exemplifies prominent contributions to the state of research.

4.2.2.1 Dynamics of Land Systems

How do globalisation and population change affect regional and local land use decisions and practices? (Link 1.1—13 publications)

Two main topics were prominent in the publications categorised in this link: political and economic transitions and market integration, and migration and population growth.

Political and Economic Transitions and Market Integration

These publications focused on global social, political and economic factors that have impacted SLM in Kyrgyzstan and Tajikistan since the collapse of the Soviet Union, and were largely critical. Some publications analysed the activities and impact of donor and other international organisations to integrate Kyrgyzstan and Tajikistan into global markets. For example, Ivanov (2009:231), analyzing the impact of USAID projects on agriculture in Kyrgyzstan, concludes that agricultural reform was implemented due to external political factors and has had negative consequences, including a “food crisis.” More generally, Schmidt (2005) argues that the threat of unregulated exploitation of walnut forests in Kyrgyzstan is due to multiple factors, including an insecure economic situation, transformation and globalisation processes, and the appearance of new actors. Gintzburger et al suggest that new market-based demands and the lack of regulations may have led to over exploitation of land resources and changing crop patterns in Tajikistan. The author states that “the urgent need to produce more irrigated and rainfed wheat induced the strong decline of barley cropping and increased rangeland utilisation by livestock and fuel wood collection” (Gintzburger et al 2006:169). Muminjanov (2008) and Giuliani et al (2011) argue that market integration facilitated by foreign aid agencies in Tajikistan during the past two decades has led to the introduction of improved varieties in major crops like wheat, rice, cotton, vegetables and fruit, that has resulted in a huge loss in agricultural biodiversity.



Livestock bazaar in Sokuluk, Chui Region, Kyrgyzstan (Alma Karsymbek, Mountain Partnership)



Cropland on steep slopes categorised as pasture land, Faizabad, Tajikistan (Erik Bühlmann 2005)

Peyrouse argues more positively about the role of international actors, stating, “the objective of food security calls for international support for grain and vegetable production as well as storage and distribution infrastructure, which have always been a weak link in Soviet and post-Soviet economies” (Peyrouse 2009:12). Rowe (2010) concluded that the means by which the Tajik government expanded food production further contributed to agricultural problems that were apparent at the time of independence. The author argues that after the fall of the Soviet Union, the Tajik government had to meet the dual target of expanding food production while maintaining as much land as possible in cotton production, their economic mainstay. The continuation of top-down agrarian decisions to reach these two targets created new problems for farm labourers.

Today, as shown in research by de la Martinière (2012), every household in Kyrgyzstan is embedded in the market economy, some in a more favourable position than others. The author argues that in the context of increasing urban demand for animal products, the position of each farming system in dairy and beef marketing reveals its ability to seize economic opportunities in the agricultural sector and in competition with off-farm activities.

Finally, Bourne (2011) describes factors that influence the ability of Kyrgyzstan to compete globally with regard to trade in walnut products. This includes an analysis of Kyrgyzstan’s policies in relation to the World Trade Organization (WTO) and free trade agreements, as well as the experience of Kyrgyzstan applying organic/bio-standards.

Migration and Population Growth

Since 1991, demographic issues, such as migration and population growth have been a major topic of publications addressing the impact of globalisation. Describing rural out-migration in Central Asia in the early 1990’s, Patnaik states that “under the condition in Central Asia, which was not a market economy and also was a more traditional region compared with other regions of the USSR, labour mobility could not be brought about simply on the basis of economic forces” (Patnaik 1995:166).

Migration has social, economic and ecological consequences for land use decisions and practices. However, there is still little research that addresses the relationship between migration and land use and management. Schoch et al (2010) partially fill this gap for Kyrgyzstan. The authors argue that migration and livestock husbandry are strategies that complement each other, and discuss the pros and cons of migration for livestock and livelihoods. They point out that remittances from migration enable the acquisition of new livestock. However, in the long term, they caution there will be remittance dependency and decreased qualified labour to maintain livestock and cultivate land.



Livestock grazing on near-village pastures in the lower Varzob Valley, Tajikistan (Hanspeter Liniger 2010)

De la Martinière argues that “rural depopulation in Kyrgyzstan cannot be explained by the low profitability of the agricultural sector compared to trade and services, but by various individual strategies of income diversification in an environment of uncertainty” (De la Martinière 2012:342).

While internal and external labour migration is an important issue for Kyrgyzstan and Tajikistan that impacts SLM, a case study from Kyrgyzstan illustrated a less widespread migration phenomenon. Mambetaliev (2007) found that both urban areas and protected areas are potential migrant destinations. The author describes the case of Arkyt village located in the Sary-Chelek Biosphere Reserve, which was resettled to an area outside the reserve in 1970 in accordance with Kyrgyz legislation. Residents returned to the reserve because the lack of government enforcement enabled them to engage in illegal economic activities without paying fees, including grazing livestock, collecting fruits, berries and timber, and engaging in haymaking and bee-keeping. Outside the reserve, these activities are legal but users are charged a fee. The author concludes that the resettlement initiative was a failure because the consistent population growth since residents returned to the reserve has led to overexploitation of natural resources.



Old wooden bridge across the Ak-Sai River, Naryn Oblast, Kyrgyzstan (CAMP Alatoo)

How do changes in land management decisions and practices affect biogeochemistry, biodiversity, biophysical properties and disturbance regimes of terrestrial and freshwater ecosystems? (Link 1.2—45 publications)

Human impact on ecosystem properties, structure and regimes are inseparably connected with development. In countries undergoing transitions such as Kyrgyzstan and Tajikistan, negative ecological consequences are also due to poverty, unstable socio-economic situations, mismanagement and non-transparent government decisions.

Driving forces and effects of pasture use

Overgrazing was identified in many publications as the primary anthropogenic factor impacting ecosystems in Kyrgyzstan and Tajikistan. The link between overgrazing and its impacts on pasture diversity is noted in all publications on pastures in Kyrgyzstan and Tajikistan. Purely ecological research from Kyrgyzstan and Tajikistan (Lebedeva and Ionov 1994; Navruzshoev 1995) as well as international authors (Borchardt et al 2011) emphasise changes in species composition, structural variables of plant communities, and phenological growth and productivity under grazing. Inter- and transdisciplinary research (Shigaeva et al 2007; Vanselow et al 2012; Dorre and Borchardt 2012; Crewett 2012) identified driving factors behind pasture degradation or recovery and the ecological implications for pasture status. Shigaeva et al describes the simultaneous intensification of pasture areas near villages and underutilization of high/distant/inaccessible pastures in the Sokuluk watershed. This is because rural inhabitants now have fewer animals and assess high expenses that preclude making a profit from the use of high pastures. Access to high pastures is also limited by dilapidated infrastructure. Pasture status assessments indicate that the “forage productivity of remote high mountain pastures has increased from 5 to 22 percent since 1978” (Shigaeva et al 2007:389). A World Bank report on field examinations in Talas, Issyk-Kul and Chui oblasts of Kyrgyzstan found that summer pastures had increased herbage production, some by more than 20 percent, because “only large flocks/herds are now taken to distant pastures for summer grazing, and most small livestock owners do not take part” (World Bank 2007:57).

Contrary to these findings, a case study by Vanselow et al (2012:335) in the Eastern Pamirs of Tajikistan shows that “winter pastures both near and distant are extremely overgrazed” and “some distant and hardly accessible summer pastures show high livestock numbers in summer, contradicting former opinions about their underuse” (Vanselow et al 2012:324). The authors found “the main causes for intensive pasture use in the Eastern Pamirs include mesoclimatic conditions that control abundance of forage and water. This goes far beyond a simple center–periphery phenomenon based on the owner’s economies of scale, which has been repeatedly argued by other scholars.”



Previous cropland, abandoned when fertility declined, used as common pasture land, Faizabad District, Tajikistan (Bettina Wolgramm 2010)

There is disagreement regarding the impact of pasture reform in Kyrgyzstan. While international policy advisors (World Bank 2007) suggest that the abandonment of seasonal migration was due to administrative issues, Crewett argues that “administrative hurdles were not a major cause of the abandonment of seasonal migration in Kyrgyzstan” (Crewett 2012:267). There is also no common view on what kind of management decisions are needed to attain sustainable pasture management. Bussler (2010:50) concludes that “the Kyrgyz law on pastures, which came into force in 2009 provides the necessary legal basis to implement community based pasture management and could be a guideline for prospective draft bills concerning pastures on other Central Asian countries.” Research findings of Crewett (2012:267) cast doubt on the success of the legislation: the “second reform approach, which began in 2009 and replaced the previous administrative arrangement with community-based pasture management would not necessarily improve the sustainable use of pastures and boost livestock mobility.”

Two publications explained the historical forces behind pasture management in Kyrgyzstan. Zhaparov (1998:58), who investigated historical pasture use by Kyrgyz herders in the pre-Soviet period explains that “experienced herders tried not to graze livestock near the winter pastures, leaving these places specifically for heavy unfavorable days (severe storms, blizzards, etc.)”. A World Bank report highlights differences in pasture management objectives in the pre-Soviet, Soviet and post-Soviet periods. In pre-Soviet times, it was “essential to secure a balanced, efficient and sustainable exploitation of the available pasture resources by local herders.” The dominant objective in the Soviet period was “maximizing livestock production.” In post-Soviet times “pasture management practices represent in some ways a return to the pre-collectivization era, but without the positive elements of relatively small numbers of livestock, and at the same time retain many vestiges of Soviet-era regulations that are largely ignored” (World Bank 2007:55-57).

Impact of human activities on soil conditions

Publications addressing the human impact on soil conditions raise various factors, including the impact of fertilizers, intensified agricultural activity, reservoirs and irrigation, and land cover/land use change. Mamytov (1997) and Karabaev et al (2012) describe the impact of different anthropogenic activities on soil condition in Kyrgyzstan. Research by Rubcova et al (2007) and Orozakunova et al (2009) assess decreasing soil humus and nitrogen after intensified agricultural use without the necessary application of fertilizers. Rubcova et al (2007), demonstrate that from 1972 to 2000, loss of the humus in the plowing horizon of arable land in Isskyk-Kul oblast, Kyrgyzstan ranged from 19 to 57 percent, depending on the degree of erosion, and that nitrogen loss ranged from 25 to 53 percent. Yzakanov and Saipov (2006) describe the impact of artificial reservoirs, such as the Andijan reservoir in Kyrgyzstan, on the chemical properties of soil. Aidarov et al (2007) discuss the impact of irrigation on water properties of soil.



Soil assessment to determine water infiltration and soil organic carbon content of pasture areas, Nurobod, Tajikistan (Gulniso Nekushoeva 2010)



Active gully erosion triggered by runoff from cropland, Muminabad, Tajikistan (Bettina Wolfgramm 2011)

Other publications categorised under this link (Glaser et al 2000; Turrión et al 2000; Kosmynin et al 2009) generally discuss how changes in ecosystem structure and functioning affect the delivery of ecosystem services, with a focus on changes in biochemical and biophysical properties of soil. Glaser et al (2000:407) state that “pasture installation in the Alay Range, Kyrgyzstan, led to a loss of about 30 percent total organic carbon (TOC) compared with the native *Juniperus turkestanica* forests. The pasture soils accumulated about 20 percent nitrogen due to inputs via animal excrement.” Spatial assessment by Wolfgramm et al (2007) in the loess hills of Western Tajikistan showed distinctly lower levels of soil organic carbon content in large parts of the test areas where annual crop cultivation was dominant in the 1990s.

Conservation practices on arable lands

Azykova et al (1997) developed maps of all the oblasts of Kyrgyzstan illustrating different land resource use such as grazing, collecting medicinal plants and roads, and the extent of landscapes transformations

Water loss and inappropriate irrigation is one of the main problems on irrigated lands. One report by UNEP (2006:112) on water management in Tajikistan states that “consumption of water for irrigation exceeds consump-



Crop irrigation water canal in foothill zone of the Sokuluk River basin, Kyrgyzstan (Natalia Ershova)

tion limits for certain plants by twofold. The worn-out condition of irrigation and drainage systems increases excessive water consumption.” The same situation is described by Askaraliev (2005) in the Sokuluk river basin in Kyrgyzstan, where according to his estimation, the average loss of irrigation water can be as high as 87 percent due to the poor condition of irrigation canals, mismanagement and inappropriate water distribution.

Many authors suggest that assessing appropriate soil and water conservation methods is an important task. Abdullaev et al (2007) describe laser land leveling to improve water use, productivity and crop yields on small private plots in northern Tajikistan as one method for improving water conservation. A review by Pender and Mirzabaev (2008) describes the costs and benefits of alternative land management options, such as alternative planting and tillage methods; strip cropping with legumes, alfalfa and/or fallow; mulching and manure; micro-furrow; and drip irrigation within land use systems in Central Asia countries. Finally, Kienzler et al (2012) describe the impact of conservation agriculture on soil characteristics, reduced water demand, and crop productivity in Central Asian countries.

Human impact on forests

Deforestation is a major ecological problem in Kyrgyzstan and Tajikistan. Kirchoff and Fabian (2010) identify four main causes of deforestation in Tajikistan: illegal cutting, conversion of forest to agricultural land, fuel wood harvesting, and overgrazing. Various authors suggest that difficult socio-economic conditions force populations to survive through the destructive use of forests. Research by Hoeck (2007) in the Western Pamirs and Wiedemann et al (2012) in the Eastern Pamirs in Tajikistan revealed links between local energy-related resource use and land degradation. Hoeck points to a paradoxical situation in the semi-arid mountainous areas, characterized by harsh temperature and precipitation regimes, which severely constrain vegetation growth: “the scarcer the local energy resource base, the higher the overall energy consumption at household level appears to be” (Hoeck 2007:48). Muminjanov (2008) confirms that the clearance rate of Tajik forests far exceeds processes of self-restoration of those forests.

In Kyrgyzstan, walnut-fruit forests have attracted recent attention of local and international researchers due to their economic and ecological value and continuing degradation. Some ecological research (Gottshling et al 2007; Borchardt et al 2010, Turgunbaev et al 2007) is directed at understanding changes in species composition and structural parameters, vegetation patterns, and soil conditions under various human activities such as grazing, cutting and hay making. Feilhauer and Schmidlein (2009:429) argue that “a total removal of human activities would be counterproductive in terms of diversity conservation.” The link between human impact and forest status was also investigated for other forest species including Juniper forests in Kyrgyzstan (Rysaliev



Planting walnut saplings, Urumbash Forest, Jalal-Abad, Kyrgyzstan (Alma Karsymbek, Mountain Partnership)



Traces of illegal wood cutting, Muminabad District, Tajikistan (Bettina Wolfgramm 2011)

and Sabirova 2009). Historical research by Schmidt (2005) demonstrates how different political and economic regimes influenced the perception and utilisation, and consequently the condition, of forests.

Finally, Yakovleva (2001), Chyngozhoev (2005) and Yakovleva and Chyngozhoev (2007) investigate changes in forest status in different altitudinal zones after human interventions such as planting or improvement cutting.

Wildlife loss

Empirical research on wildlife status and dynamics is limited in Kyrgyzstan and Tajikistan. Michel (2010) states that the protection of Red Book species, such as Tajik markhor (*Capra falconeri heptneri*), Bukhara urial (*Ovis vignei bochariensis*) and ibex (*Capra sibirica*), is neglected. These species have been the focus of international trophy hunting without any conservation management. The author also highlights the lack of reliable demographic data for certain endangered species. Haslinger et al (2007) identifies increased pressure on endangered wildlife by hunting as one of three major threats to the sustainable use of natural resources and the preservation of nature. The other two are the intensified use of biomass as a fuel resource and inappropriate pasture management. With regard to aquatic ecosystems, (Alamanov and Heimo 2011) describe how the biodiversity of fish in Lake Issyk-Kul (Kyrgyzstan) changed after the introduction of new alien species, and the root causes of overfishing.

Impacts of land management on aquatic ecosystems

With regard to the impact of land management on aquatic ecosystems, one article assessed river pollution in upland areas due to livestock grazing and the application of pesticides (Jumamudinov and Shukurov 1997).

Research by Gracheva et al (2009) shows the effects on ground water recharge from changes in water release patterns from the Toktogul reservoir after hydropower generation in winter in Kyrgyzstan was prioritized over water release patterns for irrigation.

How do the atmospheric, biogeochemical and biophysical dimensions of global change affect ecosystem structure and function? (Link 1.3—9 publications)

Research on the impact of atmospheric, biogeochemical and biophysical dimensions of global change on ecosystem structure and function is very important for mountainous countries such as Kyrgyzstan and Ta-



Meteorological station supporting long-term datasets in Murghab, Tajikistan (Bettina Wolfgramm 2008)

Tajikistan. There is, however, little literature on these topics in those countries. All the literature identified for this review focused on climate change.

Climate change and land use/cover

According to modeling applied in the Second National Communication of the Kyrgyz Republic to the UN Framework Convention on Climate Change (UN 2009:136), the “redistribution of various landscape-climatic zones as well as reduction of average humidified areas are predicted” as consequences of global warming. The report predicts that “the share of areas with humidity lower than 0.30 (arid zone of deserts and semi-arid zone of semi-deserts) can approximately increase from 15.0 percent in 2000 to 23.3-49.7 percent in 2100. The areas and efficiency of high-mountainous outrun pastures of internal Tien-Shan, Ak-Say and Alay valleys might essentially decrease” (UN 2009:136). Wolfgramm et al (2011) highlight different aspects of land use sensitivity to climate change, including sensitivity relevant to all land use types; sensitivity exacerbated by land degradation; and sensitivities of specific land use types; and concluded that SLM provides options for decreasing these sensitivities and increasing the resilience of the land.



Summer pasture on the arid high plateau, Eastern Pamirs, Tajikistan (Bettina Wolfgramm 2008)

Climate change and water resources

Some publications (Mamatkanov et al 1997, Azykova et al 1997, Ershova 2007) focused on the impact of climatic change on water ecosystems and river runoff. Mamatkanov et al (1997) revealed that global warming has led to a shift of the spring seasonal flood from May to April and melting of about 4 km³ or 8.3 percent of all glacier volume in the Issyk-Kul region from 1972 to 1994.

The Second National Communication of the Kyrgyz Republic to the UN Framework Convention on Climate Change (2009) used climate change modeling to indicate what changes could occur with water resources including: a shift in the maximum summer runoff to earlier in the year; a further reduction of glaciation area from 64 percent in 2000 to up to 95 percent in 2100, depending on the accepted variant of climatic scenario; and a significant decrease in the level of Lake Issyk-Kul lake from 5.1 to 27.5 metres in relation to 2000, and the formation of sulphurous zone in the area of maximum depth.

Climate change and biodiversity

There is very little research on the impact of climate change on biodiversity. Research conducted in the Issyk-Kul region of Kyrgyzstan showed regional particularities of global warming reflected in changes in some phenological parameters of vegetation, species composition and vegetation cover in the direction of xerophytisation (Abylmeizova 2000; Turgunbaev et al 2007; Elemanov and Abylmeizova 2011). Research by Winter et al (2009) focused on the determination of the effects of climatic conditions on radial growth and annual nut production of Persian walnut (*Juglans regia*) in Southern Kyrgyzstan.

4.2.2.2 Consequences of land system change

How do changes in ecosystem structure and functioning affect the delivery of ecosystem services? (Link 2.2—5 publications)

Olimova and Olimov (2012) illustrate that inadequate irrigation, lack of new resources for land cultivation, and lack of modern machinery have decreased agricultural efficiency in areas affected by degradation in Tajikistan. The World Bank (2008) estimated the economic cost of environmental damage in Tajikistan at 9.5 percent of Tajikistan's GDP in 2006. The highest damage is from land degradation, including soil erosion and salinity, which accounts for 3.7 percent of the GDP, followed by natural disasters (1.6 percent of GDP) and finally, inadequate water supply, sanitation and hygiene (1.5 percent of GDP).

Glaser et al (2000) and Turrión et al (2000) generally address the impact of changes in ecosystem structure and functioning on the delivery of ecosystem services. Glaser et al (2000) show that deforestation of dense *Juniper turkestanica* stands and pasture establishment at 2900 metres above sea level led to carbon losses of at least 30 percent in the surface soil (0–10cm). This carbon release after a change in land use increases greenhouse gases in the earth atmosphere. Turrión et al (2000) in their study of the Alay Range of Kyrgyzstan concluded that intensive pasture use affects soil phosphorus pools, and thus soil fertility.

How are ecosystem services linked to human well-being? (Link 2.3—19 publications)

The diverse ecosystems of Kyrgyzstan and Tajikistan's mountain vertical zones provide various goods and services that can improve the well-being of both rural and urban populations. Numerous publications focused on the unequal distribution of the costs and benefits of ecosystem services between different stakeholders during the post-Soviet transition period. The role of local knowledge, historical change in land use and management and vulnerability to climate change were also prominent topics.

Distribution of costs and benefits of ecosystem services between different stakeholders

Most publications categorised under this topic focus on the link between forest ecosystem services and human well-being. Some authors (Kirchhoff and Fabian 2010; Turgunbaev et al 2007; Asylkulov 2007) also stress the important economic, social and environmental role of non-timber forest products such as different fruit, berries, perennial plants for rural livelihoods and well-being.

While ecosystem services may be used by all stakeholders, in reality, access and distribution of costs and benefits among various stakeholders differs. Fisher stated “income from forest products can, in some cases, make a positive contribution to income generation and poverty reduction, but only if the institutional arrangements governing access to the products are seriously reformed” (2004:10). Numerous authors explain that a key challenge is the inadequacy of the legislative framework of both the Soviet institutional and legal legacy and post-independence laws. Borchardt and Schmidt (2010) state, “The right to cut grass on specific plots, granted during the Soviet period, still prevails [in Kyrgyzstan], whereas rights to harvest nuts are given to local households on a yearly basis only. Disputes and irregularities are common when usufruct rights for nut collection are allocated. Especially in places with many inhabitants and limited forest resources, people quarrel about the available walnut trees.”

Undeland (2011) investigated the impact of a community-based forestry management (CBFM) model developed with substantial donor support and introduced in the southern region of Kyrgyzstan. The author argues that the model encouraged ultimately divided rural communities because it excluded poor and female-headed households and gave preference to wealthier households who have resources to maintain and protect the forest. Another division which was created was between those households who had already been allocated forest plots and those who did not receive plots.

Forester et al used household interviews in the Pamir-Alai region of Kyrgyzstan and Tajikistan to ascertain the energy consumption patterns of poor and wealthier families. The authors emphasise that a “reappraisal of energy as a central focus within mountain ecosystems and their services to the population is necessary for both ecosystem preservation and poverty reduction” (Forester et al 2011: 305). Bourne (2011), in his report on Kyrgyz walnut forests, considered links between walnut ecosystem services and well-being, with a focus on market chains. He concludes that the poorest leaseholders are pressured to sell their walnut harvest immediately at lower prices rather than store walnuts to sell later at higher prices. Shapakov et al (2011) demonstrate the value chain of selected mountain products (wool, berries/herbs) for income generation in the Pamir-Alai



Forest ecosystem services are very important for mountain communities in Kyrgyzstan (Alma Karsymbek, Mountain Partnership)

region, concluding that the income earned by poor households from berries could be significantly increased if the value chain was better established.

Households assets and the livelihood strategies were investigated by Shigaeva et al (2006) in Sokuluk watershed of Kyrgyzstan. They found that middle and rich households invest in more livestock to improve their wellbeing. In Tajikistan, Sedik found that the "...desire of livestock farmers to increase their production by adding animals creates greater demand for limited feed, leading to a further deterioration in the feed per animal ratio and a further fall in animal yields. Because of the risk of a persistent decline in yields and rural incomes, the transition from an intensive to an extensive livestock production system in Tajikistan carries a significant danger of pervasive and continuing rural poverty" (Sedik 2009:1).

Increasing the number of livestock without appropriate management, especially in forest areas, has led to conflicts between forestry and animal husbandry. Asylkulov (2007) emphasizes that despite conflicts, livestock husbandry and walnut forest production are complementary livelihoods.

Olimova and Olimov address the connections between poverty, conflict and environmental migration in Tajikistan. They observe that: "environmental degradation aggravates the already vulnerable stance of communities, deprives them of the opportunities to survive, thus driving them out of the affected areas" (Olimova and Olimov 2012:8).

Historical change in use and management of kitchen gardens

While many scientists have investigated the significance of forest or pasture ecosystem services for human well-being, Rowe (2009) is the only researcher identified who investigates the role of "kitchen gardens." The author describes the historic geography, layout and crops of kitchen gardens in Tajikistan, and provides quantitative data on the economic importance of these gardens. Their production levels grew dramatically in the late Soviet era, enabling sales of surplus and creating a food safety net during shocks.

Local knowledge about ecosystem services and benefits for human well-being

A study by Giuliani et al investigates the role that local fruit varieties can play in achieving the dual objectives of food sovereignty and income generation in the Tajik Pamir Mountains. The authors distinguish different household strategies for local and introduced fruit varieties; "many local varieties are maintained for a variety of reasons related to household consumption, whereas the main reason for cultivating introduced varieties is income generation. Great care must therefore be taken in planning market strategies: a pure market focus will almost certainly endanger household security, whereas a strategy linking income generation through the commercialization of crop varieties to the promotion of qualities central to household needs will improve diversity and public health" (Giuliana et al, 2011: 16). Kassam et al (2010) discuss how indigenous peoples of the Pamirs have maintained knowledge of multiple medicinal plants through periods of socio-cultural and ecological change. Jalilova (2012), however, highlights the lack of local knowledge regarding the role of wildlife in maintaining biodiversity and argues that increasing awareness of this is essential for maintaining biodiversity and establishing a sound conservation strategy and income generating activities in Kyrgyzstan.

Vulnerability of rural populations to climate change

Numerous authors focused on land users' vulnerability to and perceptions of climate change. Stucker et al (2012) investigated perceptions of climate change by local stakeholders in the Khojabakirgansai Basin, Kyrgyzstan, and the ecological impacts of climate change. Olimova and Olimov concluded that local populations recognise that their vulnerability to climate change is increased by environmental degradation: "the population of Tajikistan considers droughts, the shortage of potable and irrigation water, the per capita shortage of agricultural lands, land degradation (including crop lands and pastures) climate change, and particularly the abnormal fluctuations in precipitation and temperature increases as their major problems" (Olimova and Olimov 2012: 8). An investigation by OXFAM also highlights farmers' fears related to climate change in Tajikistan: "climatic

patterns are becoming more unpredictable and...this is making planting decisions a riskier undertaking than ever before” (OXFAM 2011:4)

How do people respond at various scales and in different contexts to changes in ecosystem service provision? (Link 2.4—21 publications)

Publications addressing responses to changes in ecosystem service provision can be divided into four categories: 1) sustainable land management practices and planning; 2) establishment of institutions and organisations; 3) creation of policy or government regulations; and 4) livelihoods and land use strategies of local population

Sustainable land management practices and planning

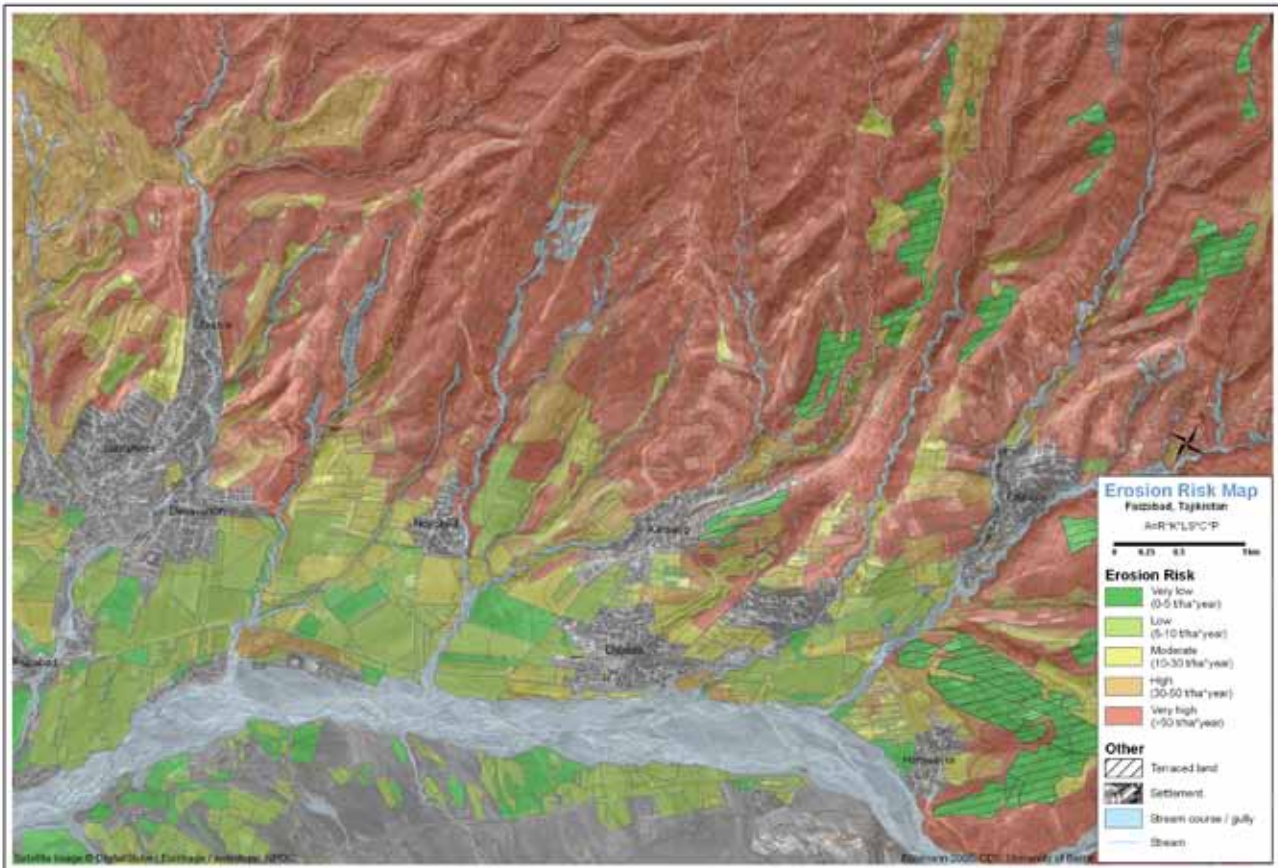
The majority of academic articles from Kyrgyzstan and Tajikistan addressing SLM practices and planning described different technologies for the rehabilitation of degraded soils or pastures. Tajik scientists Kodirov and Ibragimov (2008) discussed how pasture degradation can be arrested and productivity can be increased by growing strips of haloxylon species in the Eastern Pamirs. Kyrgyz researchers Abduldaev and Kuznezov (2008) identified different methods, such as overseeding of forage grass, irrigation and fertilising, to increase the productivity of degraded pastures. Based on a multi-year experiment, Tajik researchers Ikromov and Gulamdjanova (1998) suggested a new technology of droplet–furrow irrigation for gardens which distributes moisture equally and increases fruit yields by 25 to 40 percent by eliminating irrigation erosion and water loss. Kyrgyz researchers Gossu et al (2004) presented the results of melioration of salinised soils on two experimental plots over a seven year period, concluding that the use of sprinkling irrigation changed the degree of soil desalinisation from “very strong” to “weak.”

Bühlmann et al (2010) evaluate the potential of local conservation measures on cropland using a spatial modeling approach to provide decision-making support to plan sustainable land use. A sampling design to support comparative analysis between well-conserved units and other field units was established in order to estimate factors that determine water erosion, according to the Revised Universal Soil Loss Equation (RUSLE). A review of different levels of tolerable erosion rates showed that more cost-intensive and technologically advanced measures would lead to greater reduction of soil loss. A study by Jalilova et al (2012) discussed the involvement of local stakeholders in the decision making process and how their participation in forest management could be stimulated by the development of criteria and indicators for walnut forest management in Kyrgyzstan.



Drip irrigation and other water saving technologies are used by farmers in southern Kyrgyzstan (Alma Karsymbek, Mountain Partnership)

Figure 13. Erosion risk map allowing analysis of the potential effect of soil conservation measures in Faizabad District, Tajikistan (Erik Bühlmann 2006)



Establishment of institutions and organisations

In the last two decades, the governments of Kyrgyzstan and Tajikistan and international agencies have established several new institutions. Publications dealing with this issue focused on the role and effectiveness of these institutions.

Some organisations were created by governments in response to new challenges, such as biodiversity loss. The Republican National Genetic Resource Center (RNGRC) in Tajikistan was created as a government response to the lack of institutions addressing the conservation of genetic resources (Muminjanov 2008).

Other new institutions were created at the community level to address new realities in which Soviet institutions no longer functioned. For example, Water User Associations (WUAs) were created in response to deteriorated Soviet irrigation systems and the consequent decline in crop productivity. Another set of community-based institutions relevant to SLM that were recently established in Kyrgyzstan are pasture committees, which are an outcome of 2009 legislation on pasture management.

A comparative analysis of Kyrgyzstan, Uzbekistan and Tajikistan (Gunchinmaa and Yakubov 2010) demonstrates that WUAs improved the effectiveness of water consumption and distribution and helped increase crop productivity. In 2005, in WUAs in Kyrgyzstan, average yields for all major crops were consistently higher than national averages. Similarly, WUAs in Tajikistan showed slight increases in yields of cotton and wheat over the four years since WUAs were established.

Some of the publications are critical of these reforms. Sehring (2007) states that donor-driven reforms, such as WUAs, have not met their objectives, due to two main obstacles. First, the institutional environment in agri-

culture and local governance lacks the necessary incentives and conditions for reform to be effective and new formal rules are perceived as illegitimate and are undermined by informal ones; and second, WUAs as new organisations are in a process of “institutional bricolage,”⁷ dependent on existing and entrenched institutions. With regard to pasture committees, Jacquesson argues that promoting “recently introduced ‘grazing committees’ as the main actors in the management and control of pastures perpetuate the myths of self-government and tradition among nomads” Jacquesson further concludes that “...instead of acknowledging mobility as a central institution and taking into account the economic and political dynamics particular to mobile herd breeding, they [Kyrgyz and foreign policy-makers] tend to replace them by untested assumptions about clan and custom or self-government and tradition” (Jacquesson 2010:116).

Private community-based initiatives also exist. In Tajikistan, a local NGO supported by international organisations was formed by former poachers to create the first community-based conservancy organisation focused on the protection and sustainable use of ibex. Other private community-based initiatives are evolving for management of animals such as the urial and markhor (Michel, 2010).

Government policy and legislation

Global drivers and dynamic regional, national and local challenges have pushed governments to develop a variety of policy documents and strategies. Often, these documents are comprehensive, and based on the engagement of a range of stakeholders, such as local and international experts and civil society. The Second National Communication of the Kyrgyz Republic to the UN Framework Convention on Climate Change (2009) suggests possible measures for agricultural adaptation to climate change, including technological enhancement, economic mechanisms and government support. Similarly, the transboundary Pamir-Alai strategy included priority directions, objectives and an action plan for rehabilitating and maintaining ecosystems of the Pamir and Pamir-Alai and developing rural communities (PALM 2011).

A UNEP report explains that “measures developed within the State Ecological Programme and approved by the Government of Tajikistan—including the National Action Plan on Environment Hygiene and Protection and National strategies and action plans on land erosion and degradation, environmental pollution and biodiversity conservation and other issues—all have detailed implementation plans with identifying terms and responsible executors.” The authors argue, however, that the “absence of real resources for implementing the programs and plans does not allow for the realization of measures to prevent environment degradation and the realization of nature protection strategies, which are necessary for the irreversibility of development as a whole. One of the weak features of the aforementioned plans and programs is their lack of integrated analysis of complex socio-economic and ecological problems” (UNEP 2006:112)

Olimova and Olimov (2012) describe activities of the Government of Tajikistan to address natural disasters, including legislation on migration caused by natural calamities, institutions to manage migration, resettlement of households from hazardous zones, and providing assistance and support for resettlement. The authors also highlight the growth of self-managed migration, induced by ecological causes, particularly gradual environmental degradation.

Some publications identify different priorities between governments and international organisations. For example, a World Bank report points out differences between World Bank priorities and the priorities of the Ministry of Agriculture of the Kyrgyz Republic. While the government continues to prioritise the genetic improvement of both crops and livestock as the basis for increased productivity, the World Bank emphasises market-based incentives as the basis for production decisions by farmers. The report highlights the World Bank perspective that “genetic improvement does have an important role to play, but its impact is slower to manifest and it can be developed and introduced through private sector activity” (World Bank 2004).

7 Levi-Strauss used the term “bricolage” to describe “an intellectual activity in which pre-existing materials which are ready-to-hand are appropriated.” The French verb *bricoler* is used to emphasize a non-predetermined direction albeit the choice is limited by the elements available (Levi-Strauss 1968 as cited in Sehring (2007:280)



Gathering wood, Jormasak, Tajikistan (Bettina Wolfgramm 2011)

Other publications demonstrate that even when there is agreement on policy priorities, new legislation does not necessarily achieve the agreed-upon goal. For example, Bourne (2011:10) explains that the “Decree of the President of the Kyrgyz Republic #331 imposed a moratorium on cutting of wild walnut trees, even diseased limbs, with the aim of curbing rapid deforestation. Offenders would be subject to serious fines or imprisonment if caught. The result is that walnut trees do not receive proper care and maintenance to trim broken or diseased limbs which are left to rot. This policy may inadvertently cause a decrease in the stock of walnut trees as older trees become diseased and die off quicker than anticipated” (Bourne 2011:10).

In his historical analysis of the use and management of forest ecosystems from the times of Russian colonialism and Soviet socialism to the present day, Schmidt and Doerre show that “historical concepts for forest protection did not arise from the understanding of an intrinsic value of nature as often assumed, but instead were formed by powerful actors through pragmatic arguments to create control systems over this natural resource” (Schmidt and Doerre 2011: 288).



Watering rice plots, Batken Oblast, Kyrgyzstan (Natalia Ershova)

Livelihoods and land use strategies of local populations

While much SLM research points to inappropriate land management after the collapse of the Soviet Union, some publications emphasise that mismanagement and land degradation was already taking place during Soviet times. Bucknall et al observe that “irrigation and drainage systems were in poor condition even before the Central Asian countries became independent in 1991” (Bucknall et al 2003: ii). They authors describe a continuous process of degradation; “salinization and waterlogging have occurred because drainage systems have deteriorated. Salinization forces farmers to apply ever-greater quantities of water in an attempt to flush the salt out of the soil. This raises water tables further, and increases waterlogging, which further reduces yields.”

Howell (1996) focused on the diverse ways in which poor households are responding to the transition, highlighting the differences between urban and rural (both cultivated and pastoral) areas, as well as between households.

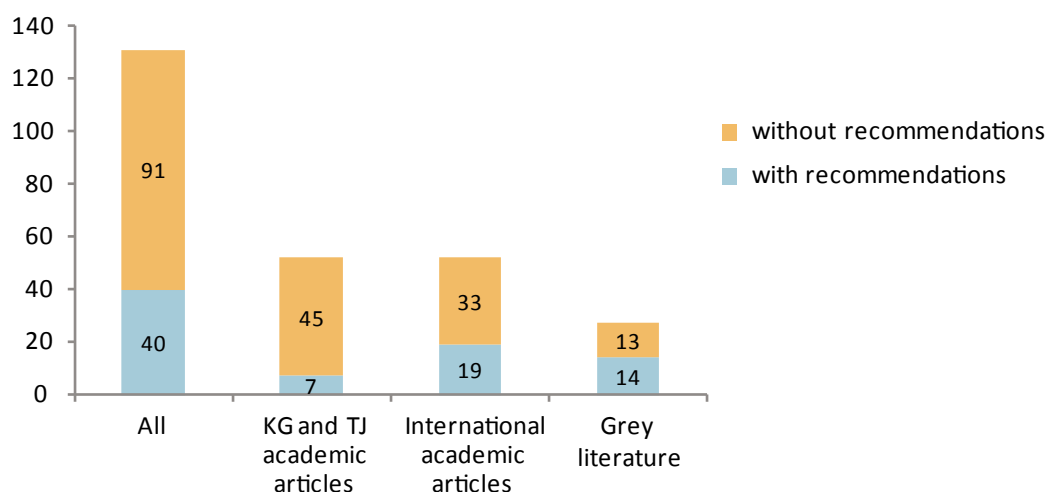
4.3 Research Recommendations from the Publications

This section describes the research recommendations suggested in the publications. Quantitative analysis presents recommendations by publication and organisation type. The qualitative analysis categorises and synthesises the research recommendations.

4.3.1 Quantitative description of research recommendations

Forty (30.5 percent) of the 131 selected publications included recommendations for future research. Recommendations by type of publication is shown in Figure.14.

Figure 14. Research recommendations by publication type



Research recommendations were included in more international academic articles and grey literature (36.5 percent and 51.8 percent respectively) than in academic articles from Kyrgyzstan and Tajikistan (13.5 percent).

Research recommendations were also categorised according to the organisational affiliation of primary authors (Table 4).

Table 4. Research recommendations by primary author's organisational affiliation

Type of Organisation	Number
University or research institution In Kyrgyzstan or Tajikistan (3) Outside Kyrgyzstan and Tajikistan (18)	21
United Nations Agency	4
Government research or scientific institution in Kyrgyzstan or Tajikistan	3
International Financial Institution	2
Non-governmental Organisation	2
Private consulting and other companies	2
Government (but not a research institution)	1
Other	1
Unable to determine	4
Total	40

Over half the research recommendations (21 or 52 percent) were made by primary authors affiliated with university and research institutions, most of which (18 or 85.7 percent) were based outside Kyrgyzstan and Tajikistan. Recommendations made in publications by authors affiliated with other types of organisations were evenly distributed and comprised only small numbers.

4.3.2 Qualitative description of research recommendations

The research recommendations were categorised based on the GLP system components (circles); Ecological Systems, Social Systems, and the links (arrows) between system components; Dynamics of Land Systems and Consequences of Land System Change.

4.3.2.1 Research recommendations for the study of ecological systems

Recommendations for future research on ecological systems focused mainly on the need for baseline inventories, data collection, monitoring and mapping. Specific topics are listed under each heading.

Inventories:

- vegetation in Kyrgyzstan (Wilson 1997)
- species composition and biodiversity abundance, with the aim of assessing natural resources in Kyrgyzstan and Tajikistan (PALM, 2011)
- fish resources in Lake Issyk-Kul, Kyrgyzstan (Alamanov and Mikkola 2011)

Large-scale data collection and analyses:

- wildlife population dynamics and habitat requirements, especially mammals in Kyrgyzstan (Jalilova et al 2012)
- productivity of different types of pastures and determining their carrying capacity in Kyrgyzstan and Tajikistan (PALM, 2011)
- fish biology and ecology of the ecosystem of Lake Issyk-Kul in Kyrgyzstan (Alamanov and Mikkola et al 2011)
- spatially contiguous quantifications of species numbers, shares and turnover rates in forest of Tajikistan (Feilhauer et al 2009)

Mapping (and monitoring in the third case):

- Soil in each district of Kyrgyzstan and Tajikistan to assess agrochemical and agrophysical soil properties (PALM 2011);
- Grazing capacity and redistribution of pasturelands to assess pasture capacities (PALM 2011); and
- Salinization and waterlogging in irrigated land in the northern-eastern part of the Fergana valley (Yzykanov and Saipov 2006).



Production of dried fruit in Muminabad District, Tajikistan (Christian Hergarten 2012)

Other research topics:

- Studies of biochemical and nutritional composition of different varieties of fruit in the Tajik Pamirs (Giuliani et al 2011); and
- The collection, study, multiplication and preservation of the germplasm of local varieties of agricultural crops in Tajikistan (Muminjanov 2008).

4.3.2.2 Research recommendations for the study of social systems

Recommendations for research on social systems focused primarily on studies of markets, forms of cooperation, and technology. Specific topics are listed under each heading.

Markets:

- Demand for agricultural and horticultural products on near and distant foreign, as well as domestic, markets for Kyrgyzstan and Tajikistan (PALM, 2011);
- Detailed survey of market volumes and conditions for understanding dynamics of the flow of goods for both walnuts and kernels in Kyrgyzstan (Bourne 2011); and
- Current and potential products made from coarse wool and traditional use of coarse felt for wall and floor insulation material in Kyrgyzstan (Shapakov et al 2011).

Forms of cooperation:

- Empirical analysis on the character of various groups and systems of cooperation in Kyrgyzstan and Tajikistan (Wheeler et al 2000; Lerman and Sedik 2008);
- The impact of economic setting, the viability of agriculture and the size of farm land on the performance of WUAs in Kyrgyzstan and Tajikistan (Sehring 2007);
- Informal rules, arrangements and traditions in water use and management in Kyrgyzstan and Tajikistan (Sehring 2007); and
- Evaluation of planning and distribution of water resources within WUA in Kyrgyzstan (Kazbekov et al 2009).

Technology:

- A cheap hand held tool that can speed up the process of walnut cracking in Kyrgyzstan (Bourne 2011);
- Ways of improving the success and adaptability of potato seeds in different parts of Tajikistan (Salimov 2007).

4.3.2.3 Research recommendations on the dynamics of land systems

Recommendations for research on the dynamics of land systems included a range of types of studies and topics:

- Interdisciplinary and transdisciplinary research investigating the status and dynamics of natural resources, their spatial distribution, and their use by various actors in Tajikistan (Breu et al 2003);
- Monitoring changes that result from grazing in Kyrgyzstan (Wilson 1997);
- Adaptive research to optimise the performance of innovative practices in conservation agriculture, accounting for biophysical conditions, farmer circumstances, machine availability, and other factors of production in Central Asia (Kienzler et al 2012);
- Generalising data on the impact of planting black saxaul (*Haloxylon aphyllum Iljin*) on the water regime of soil in Tajikistan to a larger area (Kodirov 2008) and
- Study the depth and direction of anthropogenic impact on vegetation in Kyrgyzstan (Lebedeva and Ionov 1994).

4.3.2.4 Research recommendations on consequences of land system change

Recommendations for research on land system change and its consequences focused on forest and pasture policy and reforms; stakeholder analysis; energy, poverty and land degradation; climate change adaptation; biodiversity conservation; natural disasters; mitigation of natural disasters; water management; and other issues. Specific topics are listed under each heading.

Forest and pasture policy and reforms:

- Forest policy and implications for poverty reduction in Kyrgyzstan (Fisher et al 2004);
- Organisational and functional structure of forest management in Kyrgyzstan (Nasbekova 2010); and
- Case studies and quantitative studies to develop a hypothesis on the effectiveness of existing community-based pasture governance reform (Crewett 2012).

Stakeholder analysis:

- Comprehensive stakeholder analysis to elaborate links between livestock, water issues, soil degradation, watershed management and forestry (Kirchhoff and Fabian 2010); and
- Analysis of relationships between key rural assets, such as land and access to irrigation, and household poverty (Bucknall et al 2003).

Energy, poverty and land degradation:

- Knowledge gaps on links between energy issues, land degradation and poverty (Förster et al 2011; Wiedemann et al 2012);
- Cultural and traditional practices and attitudes concerning land management and energy use (Förster et al 2011); and



Willows provide protection from riverbed erosion and spring fodder and firewood (Bettina Wolfgramm 2010)



Climate change assessment workshop, Dargh Village, Zerafshan, Tajikistan (Bettina Wolfgramm 2011)

- Potential demand, and market incentives, for use of thermal insulation by poorer households (Wiedemann et al 2012).

Climate change adaptation:

- Climate change adaptation in Tajikistan highlighting the involvement of all stakeholders and local perceptions of climate change (Wolfgramm et al 2011; Stucker et al 2012); and
- Identification of highly productive fodder plants that are resistant to climate change in Central Asia (PALM, 2011).

Biodiversity conservation:

- Identify and promote optimal human induced impact on vegetation considering natural resources and biodiversity in Kyrgyzstan (Lebedeva and Ionov 1994); and
- Scientific justification for the organisation of biosphere reserves and assessment of areas to include in an ecological network in Tajikistan (Karimov et al 2005) and Kyrgyzstan (Shukurov and Balbakova, 2000 2000).

Natural disasters:



Flash flood destroys infrastructure and cropland, Muminabad Region, Tajikistan (Sa'dy Odinochev 2012)



Small greenhouse plots, Jalal-Abad Oblast, Kyrgyzstan (Natalia Ershova)

- Mitigation of impacts of natural disasters including:
 - Selection of priority sites and areas for preventive measures to increase the safety of people and land (PALM, 2011); and
 - Practical recommendations for protecting people and land resources and the elaboration of large-scale maps of potential resettlement areas in Kyrgyzstan (Azykova et al 1997).

Water management:

- Less complex hydrological and water quality modeling to understand the interaction between variables that affect water availability and use in Central Asia (Bucknall et al 2003);
- Longer-term simulations to determine optimal pumping strategies, which depend on a trade-off between irrigation pumping costs and volume, against the pattern, volume and quality of drainage into the Syr Darya River (Gracheva et al 2009); and
- Economic, institutional and operational aspects of implementing a pumping strategy in Central Asia (Gracheva et al 2009).

Other:

- Further in-depth spatial and multivariate analyses regarding food access and consumption at the district level of rural Tajikistan (WFP 2005);
- Further investigation of indigenous knowledge of medicinal opium use in Tajikistan (Kassam et al 2010);
- How donors and policy makers can identify strong local implementing institutions or those that, with appropriate support, could be strengthened in Central Asia (Bucknall et al 2003); and
- How farmers respond to changing conditions in production, such as prices and availability of water in Central Asia (Bucknall et al 2003).

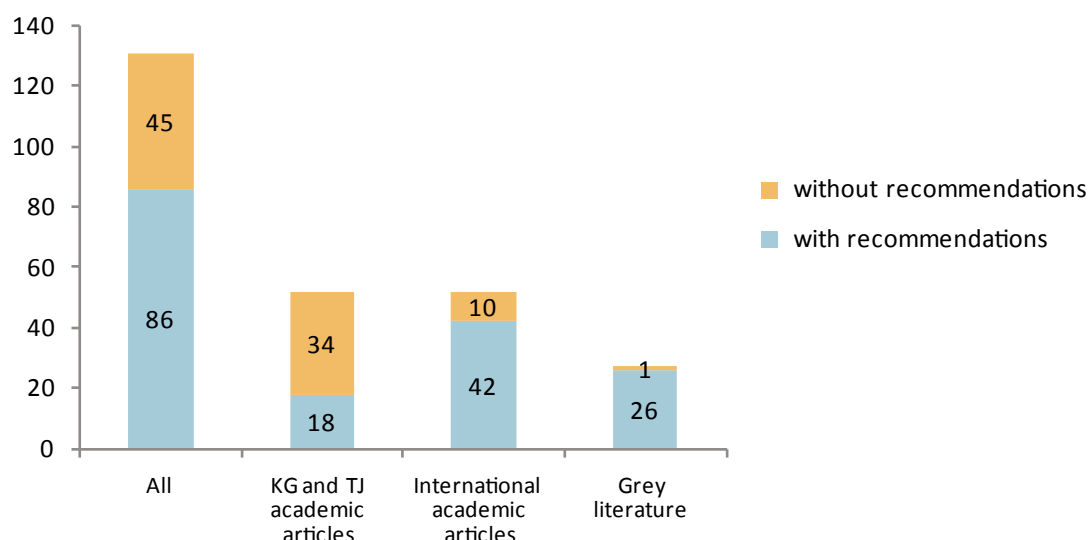
4.4 Recommendations for Policy and Practice from the Publications

This section categorises and synthesises the recommendations for policy and practice that were put forward in the publications.

4.4.1 Quantitative description of recommendations for policy and practice

Eighty six or 65.6 percent of the 131 publications included recommendations for policy or practice.⁸ Recommendations by each type of publication are shown in Figure 15.

Figure 15. Recommendations for policy and practice by publication type



The most (96.4 percent) recommendations for policy and practice were made in grey literature. This was followed by international academic articles (80.8 percent) and finally by academic articles from Kyrgyzstan and Tajikistan (34.6 percent). Table 5 illustrates the share of recommendations based on the organisational affiliation of primary authors.

Table 5. Research recommendations for policy and practice by primary author’s organisational affiliation

Type of organisations	Number
University or research institution	43
In Kyrgyzstan or Tajikistan (9)	
Outside Kyrgyzstan and Tajikistan (34)	
Government research or scientific institution in Kyrgyzstan or Tajikistan	7
Non-governmental Organisation	6
International Financial Institution	5
United Nations Agency	5
Government (but not a research institution)	2
Other	5
Private consulting companies and other companies	2
Unable to determine	11
Total	86

Half the research recommendations (43 or 50 percent) come from publications with a primary author who is affiliated with a university and research institution, with the majority (34 or 79 percent) affiliated with institutions outside Kyrgyzstan and Tajikistan and only 9 (or 21 percent) affiliated with universities in the two countries. Publications with primary authors affiliated with Government research institutions contributed 7 (or 8.1 percent) of the research recommendations. Research recommendations came from

⁸ Research recommendations from one publication were counted as one. However, each publication may contain several recommendations.

6 publications with primary authors affiliated with NGOs (6.9 percent) and 5 publications with authors affiliated with international financial institutions and United Nations agencies (5.8 percent). Recommendations for policy and practice were included in only two publications with primary authors affiliated with private consulting companies and other organisations.

4.4.2 Qualitative description of research recommendations

Most recommendations for policy and practice addressed just one of the GLP system components (circles), Social Systems.⁹ They were categorised accordingly, and also based on both themes related to the links (arrows) between system components: Dynamics of Land Systems and Consequences of Land System Change.

4.4.2.1 Recommendations regarding social systems

Changes in policy, legislation and institutional regimes

Changing legal frameworks is the most common recommendations in all of the reviewed publications. General recommendations were made to revise legal frameworks to improve: the investment climate (Ludi 2003; Bourne 2011); forest legislation in Kyrgyzstan (Fisher et al 2004; Nasbekova 2010, Undeland, 2011); fisheries sector legislation (Thorpe and van Anrooy, 2009; Alamanov and Mikkola, 2011); and protected area legislation in Kyrgyzstan (Shukurov and Balbakova, 2000; Koichumanov and Mambetaliev, 2004; Gottshling et al 2007). One publication recommended introducing a pasture law in Tajikistan (Robinson et al 2010).

More specifically, Nasbekova (2010) recommends harmonising forestry laws and regulations and other changes in the sector including the delineation of responsibilities and power between central and local governance bodies. Due to conflicts between the pasture and forest sectors in Kyrgyzstan, Undeland (2011) recommends the integration of areas that belong to the forest sector but are suitable for grazing.

There were a number of recommendations for institutional reform at the national level. Karimov et al propose the “establishment of the State Committee on Environment Protection and Forestry on the basis of the Ministry of Nature Protection and Forestry Agency “Tajikles” will allow the creation of a single system of managing protected areas and their development” (Karimov et al 2005:12). Sehring (2007) asserted that institutional reform in irrigation management in Kyrgyzstan should include long-term efforts to change perception patterns and normative attitudes because newly established formal rules in WUA are not perceived as legitimate and are undermined by informal ones. Thorpe and van Anrooy (2009) suggest institutional strengthening of the Department of Fisheries in Kyrgyzstan. Alamanov and Mikkola (2011) recommend new and revised laws and policy on institutional cooperation within the fisheries sector, suggesting that fisheries co-management is one way to encourage shared stewardship and empower user groups of Lake Issyk-Kul.

Changes in laws on protected areas

Numerous publications included detailed recommendations regarding legislation on protected areas in Kyrgyzstan. Details are outlined below.

- Include sections on ecotourism development in protected areas in legislation in Kyrgyzstan (Koichumanov and Mambetaliev, 2004);
- Include the management of ecological corridors, temporary reserves, and micro-reserves in the law on the status of transboundary protected areas in Kyrgyzstan (Koichumanov and Mambetaliev, 2004; Shukurov and Balbakova, 2000);
- Harmonise categories of protected areas in Kyrgyzstan according to the International Union for Conservation of Nature and Natural Resources system (Koichumanov and Mambetaliev, 2004);

⁹ Only a few focused on ecological systems and land use and management.

- Grant protected area status to valuable parts of the walnut forest (Koichumanov and Mambetaliev, 2004) and to some riparian woodlands and wetlands in Kyrgyzstan (Shukurov and Balbakova, 2000);
- Restrict the allocation of new land for the construction of homes on the territory of the Sary-Chelek Reserve in Kyrgyzstan (Mambetaliev, 2007); and
- Adopt regulatory measures for the rational use of shallow surface watersheds, terraces and ancient landslides for arable land, pastures and hayfields (Azykova et al 1997).

There were also recommendations to include territories of Kyrgyzstan and Tajikistan in protected areas. The creation of a single integrated protected area including Sary-Chelek biosphere reserve and some territories in the Fergan range was recommended in Kyrgyzstan (Gottshling et al 2007). In Tajikistan, the creation of special conservation areas was recommended to protect centres of endemism in the Gissar-Darvasian region, Mogol-tausian, Zeravshanian B, South Tadjikistanian B and C (Nowak et al 2011).¹⁰

Pasture law in Tajikistan

To guarantee access to pastures and avoid fragmentation in Tajikistan, Robinson et al (2010) recommend a system of permanent and common property rights for pastures, based on boundaries defined by the Land Committee and historical precedents that account for ecological variability and seasonal pasture requirements. The authors emphasise that laws should explicitly recognise common use, remove negative incentives to livestock mobility, and allow flexibility in grazing patterns. Finally, they recommend that policy makers in Tajikistan observe the implementation of pasture-related legislation in Kyrgyzstan.

Reform and empowerment of local institutions

Undeland (2011) recommends strengthening the role of local governance in the control over leshoz¹¹ in financial reporting. Rysaliev and Sabirova (2009) recommended to granting responsibility for forest conservation to leaders of oblast and rayon administrations in Kyrgyzstan, and consider assigning additional staff of foresters in regions with large areas of Juniper forest.

Busler (2010) recommends empowering community institutions to manage pastures and their infrastructure in Kyrgyzstan, and to consider possibilities for financing such institutions. Crewett cautions however, that a “mere shift of administrative responsibility to the municipal level, without the establishment of effective independent enforcement bodies, might be insufficient to increase flock mobility” (Crewett 2012:273) and suggests that rule enforcement might better be backed by a body external to the village, such as an umbrella organisation of Pasture User Unions at the district or regional level.

Equal access

Numerous authors recommend actions to ensure more equal access to land resources across sectors, from the individual to transboundary levels. Giovarelli (2004) recommends legal changes to ensure that women receive an equal portion of property upon divorce or abandonment. Förster et al (2011) recommend improved access to thermal energy and a subsidized supply for poor households living in higher altitudes, along with thermal insulation projects to improve livelihood conditions and to prevent desertification in the Pamir-Alai mountains. Busler (2010) recommends equal access to all pastures to implement the new pasture law in Kyrgyzstan. Finally, Lim (2012) suggests facilitating access to pastures and markets across the Tajik-Kyrgyz boundary.

Support the creation of groups and collective action

Some publications support the creation of water user groups or permanent basin-wide institutions to increase the effectiveness and equity of irrigation services delivery, fee collection and to expand cooperation during extreme events and to regenerate the environment (Kazbekov et al 2009; Gunchinmaa and Yakubov, 2010;

¹⁰ Nowak et al (2011) used these areas according to geobotanical classification by Goncharov (1937).

¹¹ Leshkhoz is the forest management unit responsible for practical implementation of forestry activities

Strucker et al 2012). Other support the creation of farmers' associations or cooperatives for producing, buying and selling agricultural products (Padulosi and Hoeschle-Zeledon, 2004; Wheeler, 2004; Ryazanov, 2007; WB, 2012). Kazbekov et al (2009) suggest facilitating infrastructure improvements through collective action, locally known as "hashar."

Support local communities with investments and credits

There were recommendations to support local communities through the provision of investment and credit opportunities.

General recommendations include:

- Improve the availability of micro-credit facilities to local communities to help them procure agricultural inputs and increase their production (WFP, 2005; Tabyshova and Dalbaev, 2010); and
- Direct funding and resources towards local programmes to engage returning migrants (Schoch 2010).

Specific recommendations include:

- The creation of a comprehensive investment afforestation programme in Tajikistan including community-based reforestation and forest management, rehabilitation of threatened watersheds, agro-forestry, conservation of biodiversity and entire ecosystems, and multipurpose forest and wildlife management (Kirchhoff, 2010);
- Promotion of external investments and credits for the rehabilitation of existing mini hydropower facilities and the construction of additional decentralized facilities to reduce the need for fuelwood (Hoeck et al 2007);
- Facilitate soft loans and other credit to enable farmers to access and utilise laser land leveling technology on a wider scale in Tajikistan (Abdullaev et al 2007); and
- Promote the concept of micro-credits as practiced by the Aga Khan Foundation in Central Asian countries (Peyrouse 2009).

Changes in fees

Several publications include specific recommendations to optimise the management and use of fees related to natural resources including pastures, wildlife and aquatic resources:

- Robinson et al (2010) suggest that Tajikistan follow Kyrgyzstan's lead and shift from a pasture use tax charged by hectare to one based on head of livestock;
- Borchardt et al (2011) suggest more transparency in the use of local budgets (which include income from pasture rent), to facilitate better maintenance of high passes to the pastures;
- Crewett (2012) recommends investments in infrastructure as critical to increasing flock mobility under the 2009 pasture reform legislation in Kyrgyzstan;
- Robinson et al (2010) recommend the cessation of tax on remote, long-term pastures in Tajikistan to facilitate pasture use;
- Michel (2010) suggests lowered fees for subsistence hunting by local residents and, in some cases, for hunting for sport/tourism;
- Gunchinmaa and Yakubov (2010) suggest lowering water fees in WUAs; and
- Alamanov and Mikkola (2011:488) recommend a fee regime and the creation of a management fund for commercial fishing in Lake Issyk-Kul Lake; "money received from the fees would be divided between the participating organisations/agencies as follows: the State Agency for Environmental Protection and Forestry - 30 percent, Fisheries Department 30 percent, Academy of Science 20 percent, local administration budget 10 percent, and state administration budget 10 percent".

Regional cooperation and access to markets

In recent years, integration processes and cooperation among Central Asia countries have been strengthened. Several publications include recommendations for policy and practice at the regional and bilateral

level. Peyrouse (2009) suggests developing grain cooperation between Central Asia states in the cultivation and trading of grain, by inviting Kazakhstan a leader in the regional cereal market. Peyrouse also suggests “boycotts against cotton from Tajikistan and Turkmenistan, where children are exploited” (Peyrouse 2009:11). Bourne (2011) suggests a review of potential and opportunities to market walnuts directly to other countries, particularly in Europe and Asia (including organic certification) and recommends the reconsideration of export policies between Uzbekistan and Kyrgyzstan.

A number of publications recommend improving access to markets as an important policy initiative towards improving livelihoods and the sustainable use of resources (Spoor 1995; Schoch et al 2010; Shapakov et al 2011; Jalilova et al 2012; de la Martinière 2012). Jalilova et al (2012) assert that access to markets will reduce human pressure on walnut forest biodiversity in Kyrgyzstan. Schoch et al (2010) emphasise the importance of reinforcing rural markets to reduce labour migration in Kyrgyzstan. Spoor (1995) recommended increasing the role of the public sector in improving market access. De la Martinière (2012) points to the need for development policies in Kyrgyzstan which provide information and incentives that support efforts to involve rural households in market possibilities. A World Food Program report (2005) recommended involving agricultural extension programmes in the provision of improved information on commodity markets.

One recommendation for policy or practice focused primarily on ecological systems, and even this recommendation had a strong social and institutional orientation. Lebedeva and Lonov (1994) recommended the creation of a vegetation monitoring service and the development of nature conservation measures for Kyrgyzstan.

4.4.2.2 Recommendations regarding land system dynamics

Improving agricultural practices and sustainability

Several publications included recommendations to enhance agricultural practices and sustainability:

- Optimise the production of cereals, meat and milk to be in balance with available natural resources in Central Asia (Gintzburger et al 2006);
- Promote appropriate crop diversification and production practices in place of monocropping practices (WB 2008);
- Improve land and cropping system management techniques with appropriate irrigation infrastructure rehabilitation (WB 2008);



Fodder stacks feed livestock throughout winter in the mountainous valley of Yagnob, Tajikistan (Bettina Wolfgramm 2010)

- Grow more labour intensive crops in farmers' groups with limited production resources, such as vegetables and potatoes instead of crops that require substantial areas of land, such as cereals and cotton Ryazanov (2007:32);
- Use seeded hay until the fourth year of life, followed by plowing and re-grassing of an area (Abduldaev and Kuznecov 2008);
- Recommendations for each soil-reclamation sub district depending on the condition of salinity and the level of water table to optimise resources. For sub districts with weak to medium saline soils, the following recommendations are given: planning, deep autumn tillage, leaching irrigation, fertilization etc. (Mamytova et al 1999); and
- Foster private and community-based firewood plantations and the production of efficient heating resources such as fuel briquettes (Hoeck et al 2007).

Regulation of grazing

Several publications included recommendations on regulating the number of grazing livestock through rotational schemes in pastures and forests in both Kyrgyzstan and Tajikistan (Navruzshoev 1995; Kosmynin et al 2009; Vanselow and , Kraudzun 2012). Wilson (1997) recommended harnessing the knowledge and expertise of scientists and administrators to learn rotational grazing, fodder conservation, and grazing limits on the numbers of stock and the time of use.

4.4.2.3 Recommendations regarding consequences of land system change

Stakeholder involvement

Many publications include recommendations to involve local stakeholders in decision-making processes and actions regarding forest and protected area management in Kyrgyzstan and Tajikistan (Undeland 2011; Fisher et al 2004; Jalilova et al 2012; Vacik, 2012; Schmidt and Doerre 2011; Koichumanov and Mambetaliev, 2004). Haslinger et al (2007) recommend launching an open, multi-level, multi-stakeholder discussion and negotiation platform to build trust and change negative attitudes about national parks. Liechti (2012) suggests engaging local users, researchers, and policy makers in social learning processes to deepened understanding of different perspectives and engage in joint knowledge production on pasture management.



Farmer field school (UNDP Shartuz 2011)

Awareness raising and training

Recommendations about information awareness and training for stakeholders such as farmers, women, managers, researchers are widespread in the reviewed publications. Several recommendations focus on biodiversity conservation in Kyrgyzstan and Tajikistan and included increasing public awareness about the importance of biodiversity (Jalilova et al 2012); conservation and efficient utilisation of plant genetic resources (Muminjanov, 2008), and the value of local fruits in Tajikistan (Giuliani et al, 2011). Other publications recommended increasing knowledge and training of farmers on the cultivation of wild fruit species in Kyrgyzstan (Turgunbaev et al 2007; Koichumanov and Sharshev 2011).

Other recommendations addressed the need to increase information dissemination, awareness, and learning among farmers and policy makers about the benefits of conservation agriculture (Kienzler et al 2012) and farmland restructuring (WB, DFID, 2012). These publications stressed the importance of strengthening farmer-to-farmer learning about agriculture and access to resources and markets as well as links between farmers, markets and service organisations

Wiedemann (2012) recommended increasing awareness among households on efficient heating, use of fuel, and ventilation in addition to technical measures regarding energy efficiency in the Eastern Pamirs of Tajikistan. The author emphasised that dissemination should be initiated in regional centres due to their higher potential demand and lower transaction costs.

Alamanov and Mikkola (2011) suggest mechanisms that permit academics, practitioners, entrepreneurs and extension staff to be aware of and access (at training workshops both in and outside the country) new technologies and techniques in the fisheries sector.

Farmers and women are among the groups identified with training needs in publication recommendations. Shapakov et al (2011) advocate the use of natural local materials for the production of traditional garments and decorative items. To achieve this, the authors recommend: training farmers in proper shearing techniques and basic grading and storing; and training farmers and women artisans in processing techniques for production of simple goods for their own consumption and the market. Giovarelli (2004) suggests training for women: related to leading enterprises such as accounting and social service provision and training in agronomy and livestock raising. Kazbekov et al (2009) recommend training farmers and managers to build their capacity to share water and ensure equity among users, particularly during water shortages.



Weaving on the summer pastures around Peshart, Murghab District, Tajikistan (Klaus Wolfram 2008)

Diversification of livelihood activities

Agricultural policies and practices which facilitate the diversification of livelihood activities, to include activities such as eco-tourism, processing of forest products, and bee-keeping for local populations were recommended by Ludi (2003), Gottshling et al (2007) Borchardt et al (2011) and OXFAM (2011).

Climate change adaptation

The Second National Communication of the Kyrgyz Republic to the UN Framework

Convention on Climate Change (2009) recommends numerous adaptation measures to climate change ranging from technological to policy changes. Recommendations in other publications focus on the development of early warning systems to save lives and reduce suffering from climate-related events (Suleimenov and Oram 2000; OXFAM 2011).

Wolfgramm et al (2011) recommend the following to enhance resilience to climate change: diversify land use practices and farm incomes; expand highly productive sustainable land use practices; protect land and livelihoods against extreme weather events; and the sustainable intensification of use of natural resources.

4.5 Research, Policy and Practice Interaction

This section includes three subsections: 1) a presentation of the results of a stakeholder feedback session that focused on hindering factors and recommendations to improve interactions between research, policy and practice; 2) an assessment of the contribution of the publications to research, policy and practice; and, 3) an analysis of types of authors and collaboration between types of authors.

4.5.1 Stakeholder feedback regarding interactions between research, policy and practice

A stakeholder feedback session was held to complement the analysis of literature regarding the interaction between research, policy and practice. The session engaged the 48 participants at the CAMP Forum in Dushanbe in October 2012, who were each asked to provide one response to each of the following questions:

1. What is the single biggest barrier preventing policymakers and practitioners from using research?
2. What is the single biggest reason research is not guided more by the needs of policy-makers and practitioners?
3. What is one recommendation to improve the interaction between research, policy and practice?

Responses were categorised based on emerging topics and are presented below. The summaries of responses are drawn, as much as possible, directly from participants' written responses. Each response represents one workshop participant.

Barriers preventing policymakers and practitioners from using research

The responses to this question can be categorised into four types of barriers: 1) barriers generated by policymakers and practitioners; 2) barriers generated by researchers; 3) barriers at the interface between research and policy and/or practice; and 4) barriers related to limited finances. All 48 participants responded to this question.

Barriers generated by policymakers and practitioners were identified by 9 of the 48 participants, and included:

- No interest and motivation of policymakers to apply research results;
- Incompetence of policymakers or lack of necessary knowledge to apply research;
- Corruption and the financial interests of policymakers;



Feedback session, CAMP Forum 2012, Dushanbe, Tajikistan (Alma Uzbekova 2012)

- Unwillingness to change a system that has existed for decades; and
- Irresponsibility of policy-makers.

Barriers generated by researchers were identified by 7 of the 48 participants and included:

- There is not enough good research;
- Practitioners and/or policymakers disagree with the recommendations from research;
- Research is too theoretical and not aimed at practical results;
- Research is conducted for other researchers;
- Research tends to go into too much detail while losing sight of the broader context; and
- Lack of trust and perceived credibility of research and researchers.

Barriers at the interface between research and policy or practice were identified by 18 of the 48 participants, who raised the following:

- Lack of coordination and communication; research findings are not disseminated to politicians or practitioners;
- Different interests of policymakers, practitioners and researchers. Some politicians or other officials think of science as parallel to but not connected to real life; and
- Lack of information.

The final group of responses (14 of 48) identified limited finances as a barrier to the implementation of research results and to disseminating and raising awareness of research results.

Reasons why research is not guided by the needs of policymakers and practitioners

The responses to this question were assigned to four categories including reasons related to 1) research and researchers; 2) policymakers and practitioners; 3) coordination; and 4) political instability. Thirty six participants responded to this question.

Reasons related to research and researchers were identified by 12 of the 36 respondents and included:

- Researchers do not account for the expenditures required to introduce research results into practice;
- Researchers do not reach out enough to other stakeholders to formulate their research questions;
- The pressure to publish prevents researchers from focusing on applying their research;
- Researchers conduct research only to attain scientific degrees;
- Research is conducted for the sake of research;
- Absence of motivation among researchers to focus on application; and
- Researchers have no knowledge of the real situation.

Reasons related to policymakers and practitioners were identified by 7 of the 36 respondents and included:

- Policymakers and practitioners are only interested in topics connected with economic benefits, for example economic functions of forests. Other topics including social and ecological research are neglected.
- And finally, the influence of politicians' ambitions, which do not conform to the interests of researchers.

Reasons related to coordination were highlighted by 16 of the 36 respondents and included:

- Research is not linked to national development plans;
- The absence of a joint agreed strategy between researchers, practitioners and policy-makers; no interaction, coordination, or initial agreement;
- Research is funded by donors for their own interests; and
- Lack of communication on actual research needs by policy makers.

One participant referred generally to the unstable situation in Kyrgyzstan in which the frequent changes of politicians and practitioners does not facilitate the development of research and the introduction of results into policy and/or practice.

Recommendations to improve the interaction between research, policy and practice

The responses to this question fall into three categories and include 1) recommendations directed at government; 2) recommendations directed at researchers, and 3) more general recommendations. Forty three participants responded to this question.

Recommendations directed at government were proposed by 17 of the 43 respondents and included:

- Targeted financing of research;
- Creation of research coordination council;
- Develop a joint single strategy between researchers, practitioners and policy-makers;
- Provide incentives for research with clear applications;
- Link research to national priorities;
- Change the education system; and
- Fight corruption.

One broad recommendation was for researchers: Link research to practical applications. The reverse recommendation was made for policy-makers and practitioners: Apply scientific results to policy and practice.

General recommendations were made by 24 of the 43 respondents, including:

- Recognise the importance of each other (researchers, practitioners and policy-makers);
- Take into account the interests of the nation and to be interested in improving the situation;



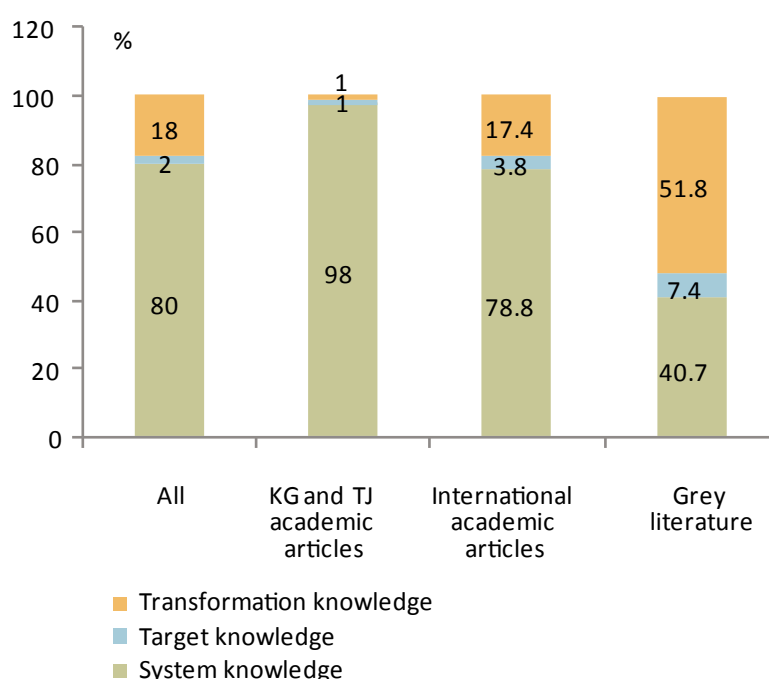
Regional multi-level stakeholder meeting on the Pamir- Alai SLM strategy, Jirgital, Tajikistan (PALM 2011)

- Create platforms for better exchange between politicians and researchers; and
- Organize joint trainings and events including researchers, policymakers and practitioners and conduct joint multi-level planning.

4.5.2 Contribution of the publications to different types of knowledge

To assess the link between research and action, we attributed the main content of each publication to one type of knowledge based on the ProClim knowledge categorisation of systems knowledge, target knowledge, and transformation knowledge (ProClim 1997).¹² Figure 16 shows the categorisation of the documents by the three types of publications.

Figure 16. Share of contribution of each type of publication to system, target and transformation knowledge



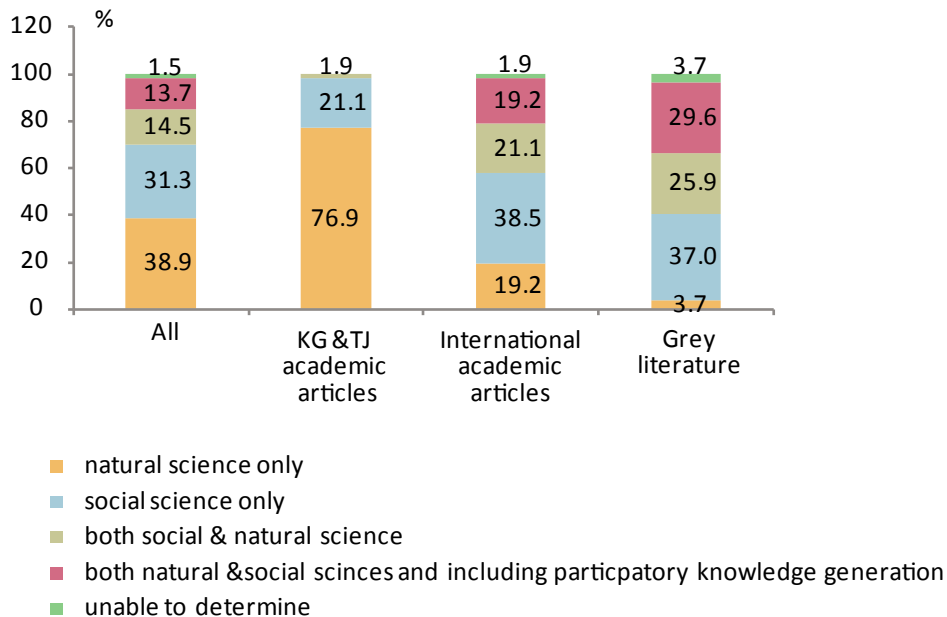
The majority (80 percent) of all types of publications contributed to system knowledge; 18 percent of publications contributed to transformation knowledge; and only 2 percent contributed to target knowledge. Nearly all Kyrgyz and Tajik academic articles (98 percent) contributed to system knowledge and a very small percentage of this type of publication contributed to target and transformation knowledge (1 percent each). International academic articles also contributed largely to system knowledge (78.8 percent), but had a larger contribution to transformation knowledge (17.4 percent) and target knowledge (3.8 percent). Unlike other types of publications, the selected grey literature was more evenly divided between its primary contribution to transformation knowledge (51.8 percent) and its secondary contribution to system knowledge (40.7 percent). Only 7.4 percent of selected grey literature contributed to target knowledge.

¹² In our survey form we used definitions from (MRD, http://www.mrd-journal.org/About_edpol.asp): **System knowledge**: describes how current systems (society, the economy, the environment) work. **Target knowledge**: in order to shape sustainable development, all actors concerned need to be involved in defining a vision and negotiating what are the “right” things to do; they need to develop target knowledge together. They do this on the basis of systems knowledge, which helps find missing links and enhance understanding of complex wholes. **Transformation knowledge** is needed to shape the transition from the current to the envisaged situation, to decide how to do the “right” things, put the vision of sustainable development into practice, and define what corrective action is needed.

4.5.3 Contribution of the publications to disciplinary, interdisciplinary and trans-disciplinary research

All publications were categorised according to their contribution to disciplinary (natural science only or social science only), interdisciplinary (both social and natural science)¹³ and trans-disciplinary research (both natural and social science and including participatory knowledge generation) (Figure 17).

Figure 17. Contribution of each type of publication to disciplinary, interdisciplinary and trans-disciplinary research



The largest percentage of all publications contributes only to the natural sciences (38.9 percent) with a slightly smaller percentage contributing only to the social sciences (31.3 percent). This means that contributions to disciplinary research totaled 70.2 percent. The remaining percentage was nearly evenly divided between interdisciplinary research (14.5 percent) and trans-disciplinary research (13.7 percent).

Almost 80 percent of Kyrgyz and Tajik academic articles contributed to natural science while only 21.1 percent contributed to social science. Together, over 98 percent contributed to disciplinary research, while less than 2 percent contributed to interdisciplinary research and no Kyrgyz or Tajik academic articles contributed to trans-disciplinary research.

International academic articles focused more on social sciences (38.5 percent) than on natural science (19.2 percent). The contribution to interdisciplinary research (21.1 percent) and trans-disciplinary research (19.2 percent) totaled just over 40 percent.

The selected grey literature contributed the smallest percentage (3.7 percent) to natural science among the publication types, but was the largest contributor to trans-disciplinary research (29.6 percent).

¹³ For the purposes of this paper, social science and natural science were considered disciplines. The authors recognise that research can also be interdisciplinary within the natural sciences or within the social sciences.

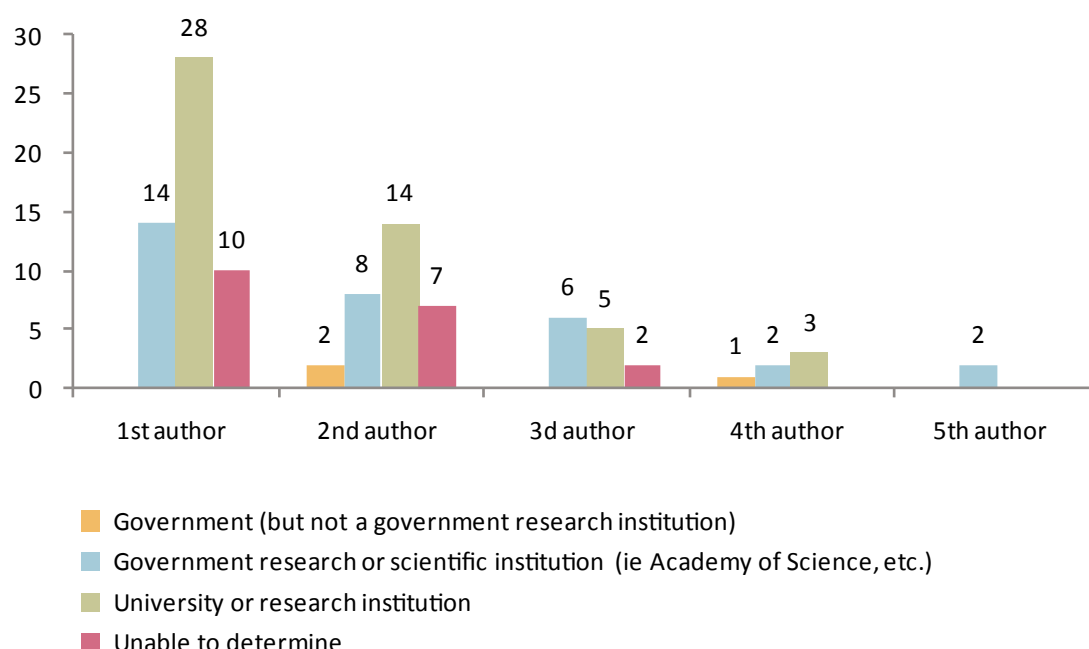
4.5.4 Analysis of contributing authors

This section describes the types of organisations authors are affiliated with, and how they collaborate with each other across institutions to facilitate links between research and implementation at the regional and international levels.

Authors of academic articles published in Kyrgyzstan and Tajikistan

There were a total of 104 authors of the 52 academic articles published in Kyrgyzstan and Tajikistan included in this analysis (Figure 18). This is an average of two authors per article. These authors largely came from two types of organisations: universities or research institutions (48.1 percent) and government research or scientific institutions such as the Academies of Science (30.8 percent). Less than 3 percent of authors came from non-research government institutions. The organizational affiliation of the remaining 18.3 percent of authors was not indicated in the article.

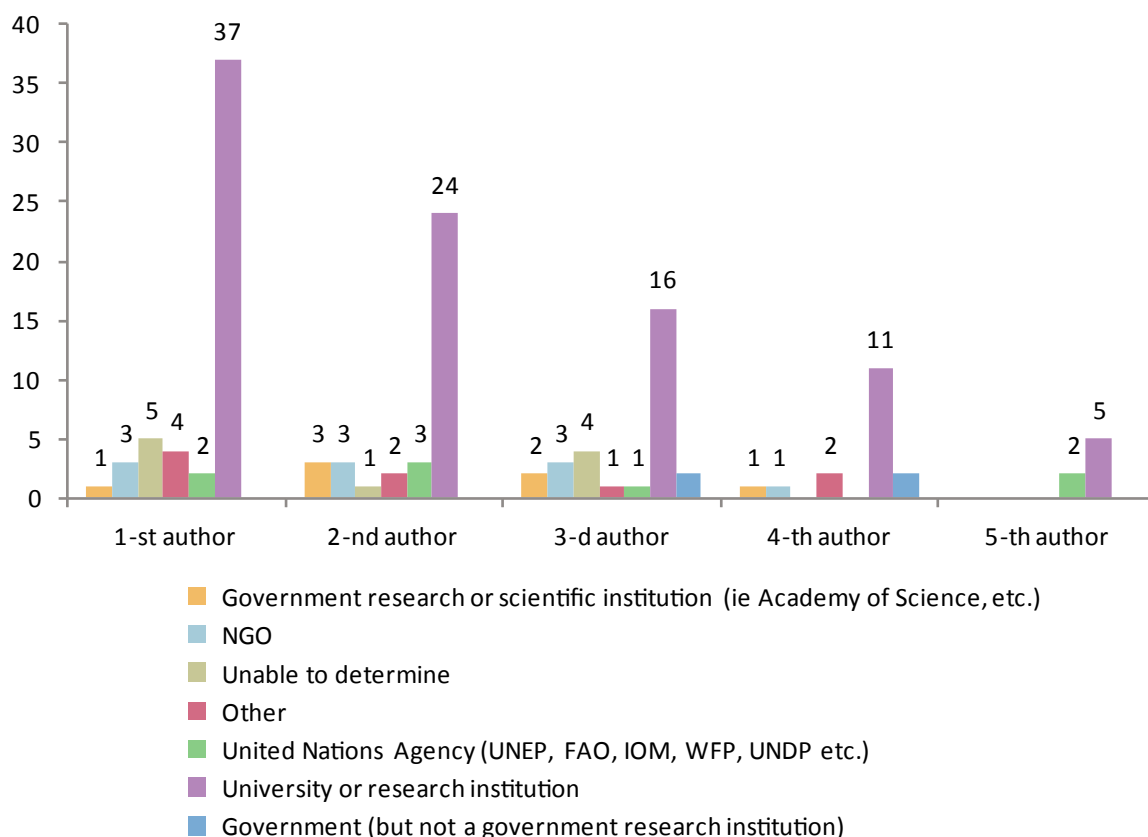
Figure 18. Organisational affiliation of authors of academic articles published in Kyrgyzstan and Tajikistan



Authors of international academic articles

There was a total of 140 authors of the 52 international academic articles included in this analysis (Figure 19). This is an average of 2.7 authors per article. Authors of international academic articles primarily came from universities or research institutions (66 percent). The remaining percentages were divided among NGOs (7.1 percent), UN agencies such as UNEP, FAO, IOM, WFP and UNDP (5.7 percent), government research or scientific institutions (5 percent), and non-research government institutions (2.8 percent).

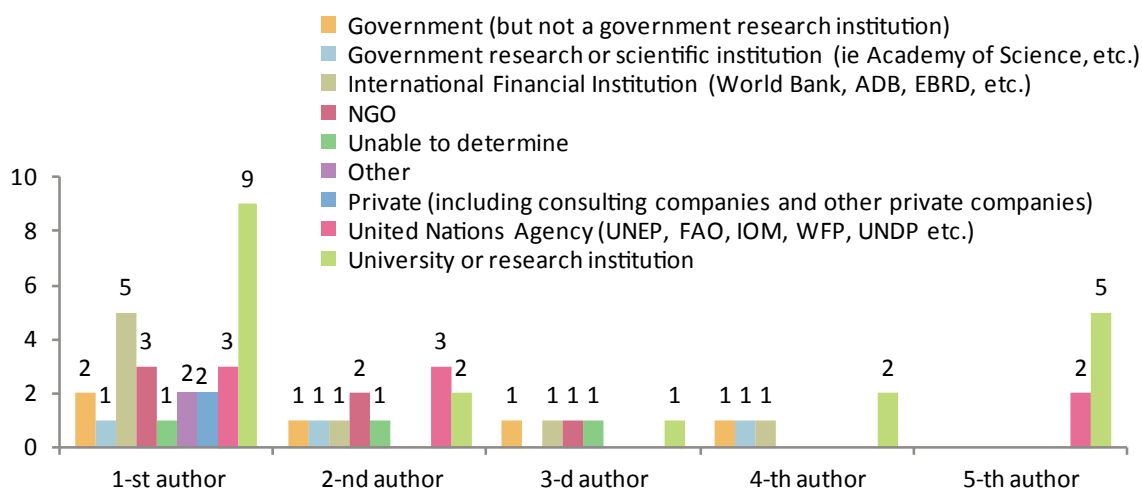
Figure 19. Organisational affiliation of authors of international academic articles



Authors of grey literature

There was a total of 54 authors of the 27 grey literature documents selected (Figure 20), with an average of two authors per publication. Authors of grey literature were more evenly divided than among the other two publication types. University or research institutions had the largest percentage (33.9 percent) of authors of grey literature. Authors affiliated with international financial institutions and UN agencies both made up 14.3 percent. Authors from NGOs and non-research government institutions contributed more to grey literature than to academic articles (10.7 percent and 8.9 percent respectively).

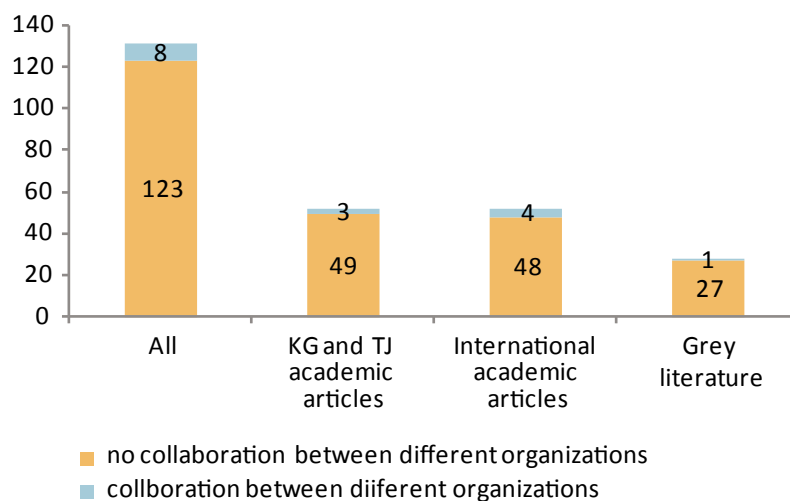
Figure 20. Organisational affiliation of authors of grey literature



Author collaboration

We analysed the incidence of collaboration between authors from different organisation types (Figure 21), as well as collaboration between authors affiliated with organisations from Kyrgyzstan and Tajikistan and those affiliated with organisations outside the countries (Figure 22).¹⁴

Figure 21. Collaboration between authors from different types of organisations



The large majority of publications (80.2 percent) did not involve collaboration between authors from different types of organisations.

There are very few incidents of authors collaborating across different types of organizations (only 2 out of 52). Most articles in Kyrgyz or Tajik publications are written by co-authors from the same type of organisation or by single authors. Of these, one is the outcome of a collaboration between researchers from a university and the government research institution, the Academy of Science. The other is a joint effort between authors affiliated with two different kinds of government institutions: government research institutes and the Secretariat of the President’s Board on Sustainable Development.

Collaboration across different types of organisations in international academic articles is more common than in Kyrgyz and Tajik academic articles; 19 (36.5 percent) of 52 international academic involved author collaborations of authors from different types of organizations.

In the grey literature, only five (17.8 percent) of the 27 publications involved collaborations by authors from different types of organisations, including a collaboration between authors from a university, UN agencies and NGOs.¹⁵

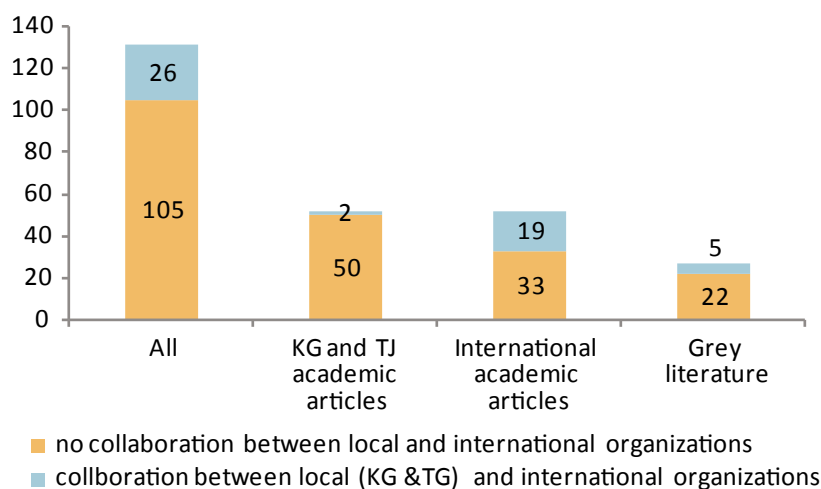
Figure 22 shows the limited extent of collaboration between researchers from local (Kyrgyz or Tajik) organisations and international organisations, with only eight of 131 involving cross-border collaboration.¹⁶

¹⁴ Publications categorised “without collaboration” included those with only one author because single authorship does not involve collaboration.

¹⁵ We acknowledge that the selected grey literature was limited.

¹⁶ International organizations include those from both ‘near-abroad’ (CIS states) and ‘far-abroad.’ Publications categorised as “without collaboration” include those with only one author.

Figure 22. Collaboration between researchers from local and international organisations



Of the 52 Kyrgyz and Tajik academic articles, there were only 3 examples of collaboration involving authors from both local and international organisations, just 5.8 percent. Of these, one involved a regional collaboration between authors affiliated with organizations in Kyrgyzstan and Kazakhstan, and two involved collaborations between authors affiliated with organizations in Kyrgyzstan and Tajikistan and authors affiliated with organizations from outside the region.

Only four (7.7 percent) of 52 international articles involved collaboration between authors affiliated with local (Kyrgyz and/or Tajik) organisations and authors affiliated with international organizations. Only one publication from the grey literature involved collaboration between an author from a local (Tajik) organisation and an author affiliated with an international organisation.

5. Conclusions, Discussion and Recommendations

This section begins with a brief discussion of the limitations of the study. It then synthesises and interprets the major findings of the analysis presented in Section 4. This includes the GLP-based analysis of literature, a comparison of findings with a similar analysis conducted at the global scale, and a discussion of findings related to the research-action interface. A discussion on the findings of this review related to the differences between RULR and SLM is also included. Recommendations are made for promoting targeted, application-focused, multi-stakeholder research and knowledge sharing, including local and international researchers as well as practitioners, policymakers and land users.

5.1 Limitations of the Study

There is a large amount and variety of literature available on land management in Kyrgyzstan and Tajikistan and any review will have limitations.

This review aimed to include as much of the literature as possible while still conducting a thorough analysis within time constraints. We applied strict criteria to select the 131 publications included (see methods discussion in Section 3) and made difficult decisions to exclude some types of literature, including annually published journals by local universities, candidate and doctoral theses, conference proceedings and many grey literature



Mural depicting newly terraced areas in the hills around Dushanbe, main bus station, Dushanbe, Tajikistan (Yvo Weidmann 2011)

documents. Notably, the review excluded Soviet-era literature covering land use and management, which we believe warrants further and separate analysis. We are aware of the tremendous contribution of Soviet literature (especially the ecological studies, including geobotanical, soil, and agricultural surveys and assessments) and the value of it as a basis for temporal comparisons. Understanding Soviet-era challenges and best practices for land management approaches and technologies could help inform contemporary SLM strategies.

The GLP, like any framework, has some limitations. By attributing publications to particular components (circles) and links (arrows), information from interdisciplinary, holistic and systems-focused publications was divided and distributed and the system perspective was sometimes lost in the presentation of our findings. Additionally, extracting portions of publications that best captured the main contribution (generally from the abstract, executive summary or conclusion of documents) and categorising it for further qualitative analysis (as presented in Section 4), excluded large parts of publications and the more nuanced information underlying the publications' main contributions. The qualitative analysis of publications illustrates major themes, subthemes and relationships among themes in the literature and invites future researchers to explore the nuances of these publications.

Little was revealed about the interactions within ecological systems (link 2.2). One reason for this may be that knowledge on this link requires long term monitoring, the capacity for which was greatly reduced after the collapse of the Soviet Union. Another may be a limitation of the methods used for this paper; SLM-oriented publications do not focus on pure ecological research and therefore this type of research may have been excluded due to our bias in selecting publications.

5.2 Assessing the State of SLM research in Kyrgyzstan and Tajikistan

5.2.1 Aggregate distribution of research across the GLP: Identifying gaps

By categorising SLM publications according to the GLP framework we were able to assess the distribution of SLM research on Kyrgyzstan and Tajikistan across a socio-ecological system and identify thematic gaps. When assessed in the aggregate (including all types of publications) the findings suggest that there is an emphasis in the literature on the land use and management component (circle) and there are no major distortions in the distribution of research between social and ecological systems. While it could easily be argued that there is not enough known about any of the components of the GLP, the findings suggest that overall there are no major distortions in the distribution of research across the social, the land management and the ecological systems.

Differences are apparent, however, in the distribution of research across the links (arrows) connecting GLP components. The majority of the publications focused on the impact of changes in land management decisions and practices on ecosystems properties and regimes (link 1.2). While this aggregate analysis of literature appears to show consistency between international and local literature, differences become evident when the publication types are disaggregated. This is discussed in the subsection below.

There is comparatively little research available on the influence of global factors on social systems (link 1.1) and in particular on regional and local land use decisions. This is despite the fact that after the collapse of the Soviet Union, Kyrgyzstan and Tajikistan became dramatically more integrated into global structures and processes and affected by globalisation. There is a similarly small amount of research on global factors affecting ecological systems (link 1.3). Publications attributed to this link focused mainly on climate change and did not consider other drivers (i.e. biochemical, biophysical). Even the impact of climate change on ecosystem structure and properties has been investigated insufficiently, despite the fact that Central Asia is “particularly vulnerable to climate change” (Lioubimtseva and Henebry 2009: 963).

While little was revealed about interactions within ecological systems (link 2.2), there was a comparatively large number of publications focused on the link between ecosystem services and human well-being (link 2.3). However, there was very little research on theoretical and methodological foundations for ecosystem services valuation. There were also few publications focused on how people respond to changes in ecosystem service provision (link 2.4). Specifically, there was little published on how people at various decision-making scales responded to changes in water discharge, an issue that is commonly associated with socio-political conflict.

Notably, topics that are currently prominent in Kyrgyzstan and Tajikistan were hardly represented in the literature. Specifically, there were few publications on the relationship between migration and SLM (especially gendered aspects); water conflicts and governance; energy, energy efficiency and SLM; disaster risk management and SLM; payments for ecosystem services; household strategies for food security and SLM; soil and water conservation measures and their benefits from the local to the watershed scale over the long-term; traditional land use management; and the relationship between protected areas and populations living in and around them. Further, even though specific topics such as forest management are more intensively studied, publications concentrate on specific forest types. For example a lot of attention has been paid to the walnut forests in Kyrgyzstan but none to the degradation of riverine (tugai) forests in Kyrgyzstan and Tajikistan.

5.2.2 From RULR to SLM

The concepts of RULR and SLM introduced in Section 2 are often viewed by local researchers and international and local development practitioners as equivalents. However, the results of this study illuminate the differences between RULR and SLM, both in terms of the state of research (section 5.2) and the action-research interface (section 5.3). While the conceptual and methodological understanding of SLM has developed since its introduction in 1992, RULR still represents the research approach to land management as defined by Soviet research in the 1980s.

In the Soviet planned economy there was a clearly defined interface where research and implementation met. Central planning meant that research objectives were linked to production goals and required the application of standardised methods. In contrast, today's decentralised decision-making requires continuous interaction between scientists and other stakeholders in land management. Depending on the location, time and needs, the interface where different actors meet has to be identified, goals have to be jointly defined and appropriate methods have to be elaborated.

The systemic research approaches inherent in the SLM framework capture the dynamics and complex interactions of environmental and societal factors at different spatial levels, and make collaboration between different disciplines inevitable. Conversely, when the concept of RULR was developed, technocratic approaches were used to analyse the cause-and-effect relationships of a system which had to serve set production targets, minimising the need to work across sectors.

Most importantly, RULR represents a time when set doctrines left little room for discussions on norms and values of society. Conversely, “at the core of research for sustainable development [and SLM] is the overarching understanding of sustainable development as a normative concept” (Wiesmann and Hurni 2011; 43); a concept of norms to be negotiated by society, and research communities as an integrative part of society.

5.2.3 Comparing International and Kyrgyz and Tajik academic literature

Prominent differences in the state of SLM research occur when types of publications are disaggregated. For example, local academic articles focus heavily on ecological systems while international articles focus more on social systems. More specifically, local academic articles largely focused on technical aspects of reseed-ing, weed control, fencing and fertilisation whereas international academic articles focused on institutional aspects of SLM.

The different emphasis of local versus international academic literature is consistent with the differences between RULR and SLM, suggesting that the structural and conceptual legacy of RURL continues to dominate local academic literature. This is consistent with Childress' (2004) finding that agricultural research systems in Kyrgyzstan “still largely reflect Soviet structures and research priorities” (9).

Local research that does address social-economic issues (e.g. microfinance and other investments in agriculture) often do not include any connection to land use and management. The argument for social scientific analysis is exemplified by a World Bank report (2006) arguing that technical aspects of land management “may be locally relevant once the basic [institutional] constraint is resolved” (52). The disproportionately large number of publications within international academic literature on social and institutional aspects is reflective of an emphasis on promoting institutional change.

Another important difference between local and international academic articles is the stakeholder level at which articles focused. During the Soviet era, household level research was practically non-existent. Notably, only 5.5 percent of contemporary local academic literature focused research at this level. This may explain why small-scale farmers in these countries (and the organisations that work with farmers) often claim that research by local institutions is irrelevant for them. This issue is further elaborated below (section 5.3).

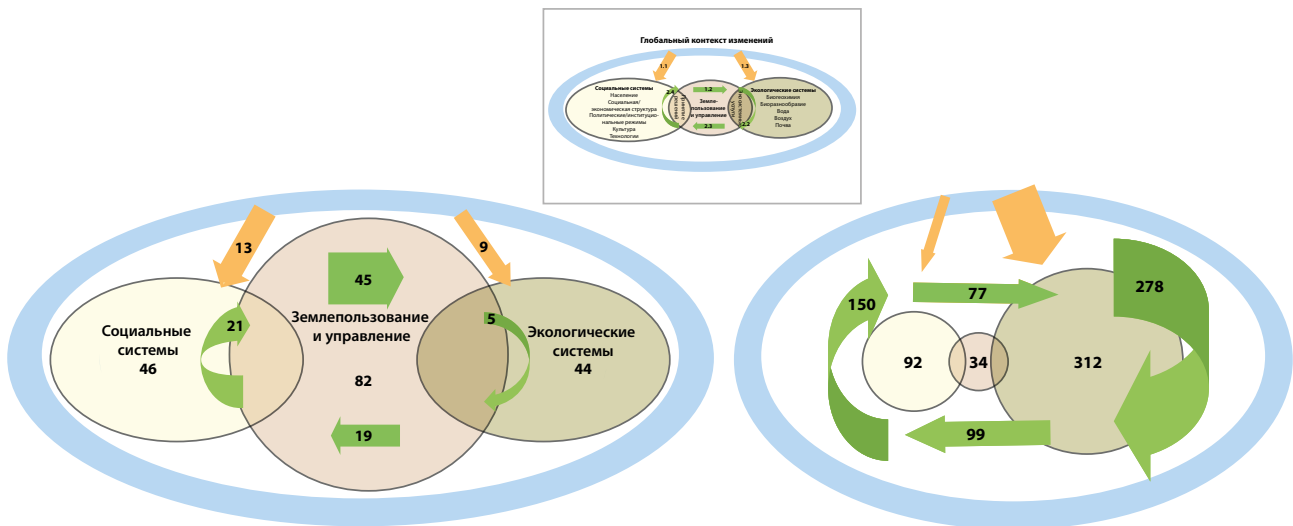
The differing focus of local and international research could potentially complement one another through collaboration. A complementary and collaborative relationship, however, is not reflected in the literature. The analysis reveals few examples (only 6 percent of all publications) of collaboration (as defined by the proxy measure co-authorship) including researchers from local organisations and researchers from international organisations. There are numerous practical reasons why such collaboration is rare, such as language barriers, access to literature, and capacity constraints. However, the differences, tensions and confusion surrounding the terminology and concepts of SLM and RULR may also be a contributing factor.

5.2.4 Comparison with global analysis

The results of the GLP analysis conducted using abstracts from the Global Change and the World’s Mountains conference in Perth, Scotland, in 2010 and presented by Bjørnsen Gurung et al. (2012) allow for a comparison between the state of research worldwide and the specific case of Kyrgyzstan and Tajikistan.¹⁷ When comparing the distribution of publications on social versus ecological systems, the social sciences are generally under-represented both at the global level (right side of Figure 23) and within local academic literature (Figure 11). However, international academic literature focused on Kyrgyzstan and Tajikistan included a much higher share of publications on social systems (twice as many as on ecological systems) (Figure 12). This existing research base on social systems provides an opportunity for international and local researchers to deepen their understanding on specific topics, by integrating local and international researchers’ perspectives and historical knowledge, and comparing different developments in Kyrgyzstan and Tajikistan. Such research is likely to be of interest to the mountain development research community worldwide.

The comparison of the number of publications attributed to the links (arrows) shows that publications (international, local, and grey) that focused on Kyrgyzstan and Tajikistan concentrate on the effect of land management on the state (and degradation) of the land resources (left side of figure 23), while the discussion in publications focusing at the global level has progressed to determine the impact this degradation has on ecosystem services (right side of Figure 23). This demonstrates how research (especially agricultural research) focusing on Kyrgyzstan and Tajikistan continues to apply simple cause-effect approaches, while current research at the global level integrates feedback loops and applies systems approaches.

Figure 23. Left: Number of papers analysed for Kyrgyzstan and Tajikistan for this study, and Right: from the Perth conference (2010) assigned to the different components of the modified GLP analytical structure as presented by Bjørnsen Gurung et al. (2012).



17 The focus of the Perth conference was not explicitly on SLM in mountain areas, but on “Global Change and the World’s Mountains” and the related concept of sustainable mountain development. Nonetheless, the similarity of the thematic focus and the methods used in Bjørnsen Gurung et al. (2012) and in this paper allow for a meaningful comparison.

5.3 Research-Action Interface

5.3.1 Lack of applied research

Stakeholders with different levels of decision making, including land users, SLM technical staff, policy-makers, and researchers themselves, have different demands from research,. However, different stakeholders are disconnected (Breu et al. 2005); research results are not influencing policy and practice, and policy and practice needs are not influencing research. The critical feedback from CAMP Forum participants and the findings of the literature review suggest that Breu's observation is supported and that actionable SLM research on Kyrgyzstan and Tajikistan is rare. For example, there was a broadly shared perception among CAMP Forum participants that research on Kyrgyzstan and Tajikistan lacks clear utility. This was supported by a key finding of our literature analysis: only 20 percent of all publications (and 2 percent of local academic literature) contributed to target and transformation knowledge, with the remaining contributing to system knowledge. These "system knowledge" publications deepened understanding of current conditions but did not identify a desired condition or a means to change current conditions.

As explained in Section 3, publications on purely agronomic studies were not included. It may appear that local academic literature focused on agricultural technology, particularly those pieces with recommendations for improved land use practices, would help identify or achieve a desired future condition (target and transformation knowledge). However, these publications create mainly system knowledge because the desired condition and the means to achieve it were developed in isolation of those it was meant to impact. Many of the recommendations were developed on experimental plots at research stations and cannot be transferred easily to the farmers' fields.

The recommendations in scientific publications (see section 4.4.2.3) indicate serious gaps between scientific knowledge and the transfer of knowledge and skills to practitioners. Land users have neither the knowledge nor the skills to use new technologies and there are insufficient training opportunities for farmers to learn them. Additionally, some technologies are not affordable. Even when research findings are well developed and appropriate, they are not disseminated to land users, practitioners and decision-makers (Jalilova et al 2012; Muminjanov 2008; Giuliani et al, 2011; Turgunbaev and Kaparova 2007; Koichumanov and Sharsheev 2011; Wiedemann 2012; Alamanov and Mikkola 2011; Shapakov et al 2011; Giovarelli 2004; Kazbekov et al 2009). Recommendations developed on research stations are therefore neither applied nor scaled up for implementation. There is a need for researchers and land users to work together on elaborating, adapting and disseminating appropriate SLM technologies. Research stations at the Academies of Science, built during Soviet times, provide some infrastructure for developing research and training centers where new concepts such as Participatory Technology Development (PTD) could be shared with land users and practitioners.

Extension services are critical institutions for disseminating and scaling up SLM practices (Gabathuler et al. 2011). More than a decade ago, Schmidt (2001) stated that "current agricultural research in Kyrgyzstan is by and large of little use to smallholders, and therefore extension and research ignore each other" (112). Extension services established in Kyrgyzstan, at the beginning of 2000's, have not yet succeeded in linking research and researchers with land users. In Tajikistan, Mandler (2010) explains that "Although the various ways of knowledge exchange do exist in rural Tajikistan, agricultural extension is far away from...inducing innovations...Instead, local governance interferes in both farmers' communicative interventions and their exposure to innovation. These two points appear as main drawbacks to advisory services in Tajikistan at the moment" (28).

Other approaches, tested by NGOs and international organisations working at local levels have yielded successful results, demonstrating how to work with scientific support. An example of collaborative work including communities, NGOs and researchers is described by Busler (2010). However, in many successful cases, implementation remains within a small, contained area.

Government strategies are also not yielding the expected effects at the local level and are only partially implemented. In many cases, such strategies are perceived as ineffectual because strategic decisions are not followed up in a practical way which is evident and understandable to land users (UNEP 2006). This is also true for legal

frameworks that have been revised, modernised and adapted, since implementation lags behind. An example of this is the legal and institutional analysis conducted within the PALM project (PALM 2010).

5.3.2 Lack of participatory research

Another indication of the lack of applied research was the finding that less than 14 percent of all publications and none of the local academic articles included participatory knowledge generation associated with transdisciplinary research. CAMP Forum participants highlighted the need to create incentives and mechanisms for communication and collaboration between researchers and potential users of research. The lack of stakeholder engagement in local academic research is likely due to the fact that there is no clear applied focus of research and no tradition of transdisciplinary or other participatory research in the region. The lack of stakeholder engagement in international academic research may also be due to no clear applied focus to research, as well as to short timeframes and language barriers. The result, once again, is that potential end users are not engaged in research processes and are subsequently less likely to make use of research outputs, even those that include practical recommendations.

Notably, the majority of all publications (80.2 percent) did not involve collaboration (measured by the proxy of incidence of co-authorship between individuals affiliated with different types of organisations, including academic and non-academic organisations). This is further evidence of the lack of collaboration between researchers and potential end users of research.

5.3.3 The role of research in highly dynamic conditions

While there is a disconnect between research and application, our analysis also found a number of examples where institutional reforms recommended in the literature have taken place in Kyrgyzstan and in Tajikistan. In Tajikistan, recommendations from the UNEP report (2005) to establish a Committee on Environmental Protection were implemented shortly after they were released. Recommended legal reforms are also being implemented. In Tajikistan, until 2007, the government exerted pressure on land users to plant cotton (Rowe 2010). A “Freedom to Farm” provision was included in the Action Plan on Reforming Agriculture of the 2009 Government Resolution 406 (DFID-WB-USAID 2012) and farmers now have more freedom to select their crops. In Kyrgyzstan, a large number of research publications recommended changes in legislation on protected areas were integrated into Kyrgyzstan’s new law on protected areas.



Farmers move their animals to lowlands after winter fodder stocks are depleted, , Varzob, Tajikistan (Bettina Wolfgramm 2012)

It is unclear whether these recommendations inspired and informed subsequent action or if the recommendations were simply reflective of the momentum of reform at the time. However, these examples indicate that the recommendations were at least relevant.

One recommendation of this paper is the improvement of systems to generate information and make it accessible to inform decision-making. However, the reforms described above indicate that two decades after independence, Kyrgyzstan and Tajikistan are still undergoing substantial change, particularly within social systems. In these contexts, stakeholders often have to make decisions quickly, without sufficient and reliable information. The reality is that many decisions will continue to be made under dynamic and uncertain conditions. Learning how to make decisions under such conditions is just as important as generating information to reduce uncertainty. Applied research in such cases can aim at assisting decision-makers to understand complex system dynamics without necessarily illuminating cause-and-effect relationships.

5.4 Recommendations for Strengthening SLM Research

The SLM framework has a holistic approach that can best be informed by systemic, and inter- and trans-disciplinary research. There is a need for targeted, application-focused, multi-stakeholder research and knowledge sharing, including local and international researchers as well as practitioners, policymakers and land users. The recommendations below are directed towards achieving this for SLM research, but are also applicable to other fields of research, in Kyrgyzstan and Tajikistan.

5.4.1 Focus research on application-focused multi-stakeholder research processes

The collaborative development of research agendas and strategies by stakeholders is critical for the type of research recommended. However, implementing collaborative approaches is challenging. A critical influence on research agendas is funding. In feedback forums, international experts comment that priority research directions in Kyrgyzstan and Tajikistan are often donor-driven, rather than locally rooted.

When efforts are made to engage local end users in identifying knowledge needs and developing research strategies, the result is often a wish list rather than the strategic identification of knowledge gaps and a clear pathway to applying research results. Internationally, there is a large amount of literature relevant to this topic, however, some challenges are specific to the Central Asian context. Analysis of efforts in the region (Pamir Strategy Project (2002); the NCCR North-South (2002); the preparatory phase of the GEF PALM (2004); the CAMMoN initiative (2009); the GEF PALM project (2009-10); and the SLM session conducted at the CAMP Forum 2012) are a first step in identifying and addressing the specific challenges.

1. Remove structural constraints through academic institutional reform and promote national research strategies

There are numerous structural constraints inhibiting systemic, inter- and trans-disciplinary research in Kyrgyzstan and Tajikistan. This type of research will only be effective and sustainable if the Kyrgyz and Tajik governments, and their respective Higher Attestation Committees, demonstrate openness and leadership in this area. The Academies' strict disciplinary policies that do not recognise inter- and trans-disciplinary research should be reformed. There is also a need, in each country, for a national research strategy to be elaborated and implemented that includes institutional capacity building; inclusive processes for identifying priority research directions; governmental support for prioritised research; support for mechanisms facilitating collaboration among researchers, practitioners, decision-makers and land users; and mechanisms to attract and support young researchers trained abroad.

2. Promote modern participatory monitoring that builds on Soviet-era achievements

During the Soviet era, monitoring and conducting inventories of natural resources for planning purposes were obligatory activities for most government departments responsible for natural resources. Capacity for these activities declined dramatically after independence. However, there is a need for thorough cataloguing of biophysical monitoring data and the strategic rehabilitation of high value stations from the Soviet and post-Soviet eras. Furthermore, systems are needed to integrate modern tools and approaches, including Geo-information Systems (GIS), (online) database systems, PDAs (personal digital assistants), current laboratory methods (such as soil spectroscopy), appropriate survey designs and statistical approaches, to help to make surveying and monitoring of ecosystems more efficient and effective. Decision makers at various levels and land users should be involved in identifying questions and problems that can be informed by biophysical and social monitoring. Participatory monitoring systems focused on informing land use decision-making can be designed, using Soviet-era inventories and rehabilitated and upgraded stations as a foundation.

3. Improve access to and management of research findings

There is a need to improve access to and management of research findings in Central Asia. There are numerous barriers preventing local and international researchers from reading each other's publications, let alone collaborating. The following are recommendations for improving access to publications and therefore information sharing and understanding between these groups.

- **Online options:** International researchers publishing on Central Asia can publish in open access journals. Local researchers should place publications online and provide abstracts in English. This will help not only to connect local researchers with international scientific world, but will also provide an incentive to improve the quality of publications. There is a precedent for this in the region; the Higher Attestation Committee (HAC) of the Kyrgyz Republic uploaded extended abstracts of all candidate and doctoral dissertations on their official website (<http://www.nakkr.kg/referat/>). This could be replicated in Tajikistan.
- **Mapping and accessing knowledge:** The uncertainty under which land planning and management currently takes place could be reduced if existing information was more accessible. Existing knowledge management tools and lessons from other regions should be explored. One example of an effective tool is an article mapper developed in the *Agrobiodiversity Initiative (TABI)* in Laos <http://www.tabi.la/articlemapper/?Itemid=38>, which tracks articles by study location.



Soil spectral measurements facilitate monitoring of soil conditions, Tajik Soil Institute, Tajikistan (Johanna Zwahlen 2012)

- **Encouraging peer-review publishing:** While some international universities in Kyrgyzstan and Tajikistan, and some individual scholars who study abroad are actively contributing to the international literature, state support to encourage these initiatives is required. The peer-review process ensures an international standard and provides an international audience for researchers. There is a need to institutionalise incentives for local researchers to publish peer-review articles, such as salary increases and promotions. Additionally, training should be provided to PhD candidates (aspirants) in scientific writing and publishing according to international standards.

4. Strengthen collaboration between researchers, practitioners and policy-makers

Strengthening collaboration between researchers, practitioners and policy-makers is an important, and long-term objective that requires efforts from all sides. Recommendations from the CAMP Forum feedback session include having each stakeholder group work “to create platforms for better exchange between politicians, researchers and practitioners” and “to organise joint multi-level planning, trainings, events including researchers, policymakers and practitioners”. These initiatives should not simply lead to declarative outputs, but should have specific objectives and lead to action.

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ANNEX 1: Survey form for SLM literature analysis

I. CODING INFORMATION

1. Document code: *¹⁸

Please enter your answer here:

2. Document reviewer: *

Please choose only one of the following:

- Jyldyz Shigaeva
- Bettina Wolfgramm
- Chad Dear
- Other. If other, provide name

II. AUTHOR AND DOCUMENT INFORMATION (ENTER UP TO 5 AUTHORS)

3. What is the last name and first initial of the author?

If author is an organisation, list the name of the organisation.

Please enter your answer(s) here:

4. What is the organisational affiliation of the author?

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If author is an organisation, repeat the name of organisation. Abbreviations and acronyms are ok.

5. To what type of organisation is the author affiliated?

Please choose only one of the following:

- Government (but not a government research institution)
- NGO
- Government research or scientific institution (i.e. Academy of Science, etc.)
- University or research institution
- United Nations Agency (UNEP, FAO, IOM, WFP, UNDP etc.)
- International Financial Institution (World Bank, ADB, EBRD, etc.)
- Private (including consulting companies and other private companies)
- Not able to determine
- Other. If other, explain. _____

¹⁸ Response required

6. Is the author's affiliated organisation from Kyrgyzstan or Tajikistan?

Please choose only one of the following:

- Yes, a Kyrgyz or Tajik organisation
- No, an organisation from outside these two countries
- Not able to determine

7. What is the documentation type? *

Please choose only one of the following:

- English-language peer-reviewed publication
- English language book
- Russian language peer-reviewed publication
- English or Russian language grey literature
- Soviet-era document
- Other. If other, explain _____

8. What year was the document published. *

Please enter your answer here:

III. CATEGORISING LITERATURE BASED ON THE GLP FRAMEWORK

9. Which component(s) of the GLP does the document primarily address? *

Please choose all that apply:

- Social systems
- Ecological systems
- Land use and management
- Not able to determine

If social systems, then choose one or more of the following:

- Population
- Social/economic structure
- Political/institutional regimes
- Culture
- Technology
- Not able to determine

Conclusions, Discussion and Recommendations

If ecological systems, then choose one or more of the following:

- Biogeochemistry
- Biodiversity
- Water
- Air
- Soil
- Not able to determine

If land use and management, then choose one or more of the following:

- Irrigated agricultural land
- Rainfed agricultural land
- Perennial agricultural land
- Kitchen garden
- Pasture land
- Forest
- Haymaking
- All
- Not able to determine

10. Which interactions in the GLP framework does the document address? *

You can choose up to three answers

- T1.1 – How do globalisation and population change affect regional and local land use decisions and practices?
- T1.2 – How do changes in land management decisions and practices affect biogeochemistry, biodiversity, biophysical properties and disturbance regimes of terrestrial and freshwater ecosystems?
- T1.3 – How do the atmospheric, biogeochemical and biophysical dimensions of global change affect ecosystem structure and function?
- T2.2 – How do changes in ecosystem structure and functioning affect the delivery of ecosystem services?
- T2.3 – How are ecosystem services linked to human well-being?
- T2.4 – How do people respond at various scales and in different contexts to changes in ecosystem service provision?
- Document content does not address any of the GLP linkages.

11. Describe the contribution of the document to the attributed linkage.

Please enter your answer here: (No more than 300 words)

Describe the contribution of the document to the attributed linkage.

Please enter your answer here: (No more than 300 words)

Describe the contribution of the document to the attributed linkage.

Please enter your answer here: (No more than 300 words)

IV. ASSESSMENT OF LINK BETWEEN RESEARCH AND PRACTICE

12. To which of the following knowledge types does the document make its primary contribution? *

Please choose only one of the following:

- Systems knowledge
- Target knowledge
- Transformation knowledge
- Not able to determine

13. To which of the following does the document make its primary contribution? *

Please choose only one of the following:

- Natural science only
- Social science only
- Both natural science and social science
- Both natural science and social science and including participatory knowledge generation
- Not able to determine
- Other. If other, explain _____

14. To which of the following does the document make its primary contribution? *

Please choose only one of the following:

- Theory
- Concepts / Approaches
- Methodology
- Data / Research Results
- Case Study
- Not able to determine
- Other. If other, explain _____

15. Does the document make an explicit recommendation for policy or practice? *

Please choose only one of the following:

- No.
- Yes.

If yes, describe the recommendation: _____

V. TARGET GROUPS

16. At which scale does the document focus? *

Please choose all that apply:

- Individual
- Household
- Community
- National
- International
- All scales
- Not able to determine

17. About which of the following does the document focus? *

Please choose all that apply:

- Business (including small and large-scale and formal or informal)
- Public organisations (including local and international NGO's)
- Kyrgyzstan or Tajikistan Government
- Content of the document does not focus on any particular type of organisation
- Not able to determine
- Other. If other, explain: _____

VI. IDENTIFICATION OF EMERGING RESEARCH THEMES

18. Does the document explicitly present themes or questions for future research? *

- Yes
- No

19. If yes, copy or paraphrase these stated themes or questions in the space provided.

Please enter your answer here: (No more than 300 words.)

VII. SPATIAL AND TEMPORAL FOCUS OF LITERATURE

20. At what spatial scale is the document primarily focused? *

Please choose only one of the following:

- Regional (meaning multiple countries in the greater Central Asia region)
- National
- Oblast or Rayon level
- Local sub-district (Jamoat or Ayil Okmotu)
- No scale is indicated
- Not able to determine
- Other. If other, explain _____

21. On what country(s) does the document focus? *

Please choose only one of the following:

- Kyrgyzstan
- Tajikistan
- Kyrgyzstan and Tajikistan
- Kyrgyzstan plus other countries
- Tajikistan plus other countries
- Kyrgyzstan and Tajikistan plus other countries

22. In which zone does the document focus? *

Please choose all that apply:

- Valley/lowlands
- Foothills
- Mountains
- Not able to determine

23. How are temporal aspects addressed by the documentation? *

Please choose only one of the following:

- One point in time
- Two points in time
- Analysis of a continuous development over time
- Not able to determine
- Other. If other, explain _____



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