

Research on land use functions in Central Asia: A bibliometric analysis

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1. Introduction

- Agriculture remains an important sector for the Central Asia's economy providing economic and social stability (Bobojonov and Aw-Hassan, 2014)
- Change of climate in the region however, have caused significant impacts on agricultural production, ecosystems and human health (Fischer et al., 2002; Lioubimtseva et al., 2005)
- Transboundary water management issues (energy nexus irrigation) have further resulted in a decline of agricultural production in the region (Rakhmatullaev et al., 2010)
- Advancing desertification and soil degradation in the Aral Sea area further impedes the region's sustainable land use practices (Indoitu et al., 2012)
- The increase of dust storms in the Aral Sea areas is an additional challenge that impacts on human health (Groll et al., 2013).
 - High rates of asthma, cancers, respiratory illness, and the increase of infant mortality are the most commonly reported health problems in the region (*ibid.*)

1. Introduction

Objective:

- Analyse current international research on agricultural land use in Central Asia (CA) through applying the Land Use Functions (LUFs) framework

Research questions:

- What are the type and relative shares of environmental, economic, and social aspects of agricultural land use in CA addressed by the international research community?
- Where are the existing knowledge gaps for potential future studies to achieve sustainable land use?

2. Land Use Functions framework

- Land use functions (LUFs) are defined as “the goods and services provided by the different land uses that summarise the most relevant environmental, economic, and societal issues of a region” (see Perez-Soba et al., 2008)
- It takes into account all three sustainability dimensions (environmental, economic, and social) in to land use decisions
- A large number of indicators are grouped into 9 LUF categories that are classified by three pillars of sustainability:
 - Environmental: Abiotic, biotic and ecosystem processes
 - Economic: Production, market and transport/infrastructure
 - Social: Employment, health and culture

2. The land use functions

Land use functions (LUF)	Definition
Environmental dimension	
LUF 1: Provision of abiotic resources	The role of land in regulating the supply and quality of air, water, minerals and soils.
LUF 2: Support and provision of biotic resources	Factors affecting the capacity of the land to support biodiversity, in the form of the genetic diversity of organisms and the diversity of habitats.
LUF 3: Maintenance of ecosystem processes	The role of land in the regulation of ecosystem processes related to the production of food and fibre, the regulation of ecosystem processes related to the hydrological cycle and nutrient cycling, cultural services, and ecological supporting functions such as soil formation.
Economic dimension	
LUF 4: Land-based production	Provision of land for production activities that do not result in irreversible change, e.g. agriculture, forestry, renewable energy, and land-based industries such as mining.
LUF 5: Residential and land independent production	Provision of space where residential, social, and productive human activity takes place in a concentrated mode. The utilization of the space is largely irreversible due to the nature of the activities.
LUF 6: Transport / Infrastructure	Provision of space used for roads, railways, and public transport services, involving development that is largely irreversible.
Social dimension	
LUF 7: Provision of work	Employment provision for all activities based on natural resources, quality of jobs, job security, and location of jobs (constraints, e.g. daily commuting).
LUF 8: Human health and recreation (spiritual & physical)	Access to health and recreational services, and factors that influence service quality.
LUF 9: Cultural (landscape identity, scenery & cultural heritage)	Landscape aesthetics and quality, and values associated with local culture.

Source: Modified from Perez-Soba et al. (2008: 382-383)

3. Methodology: Study area

- In this study, CA comprises the five republics of former Soviet Union: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan
- It covers about 400 million hectare (Mha) area and has a total population of 65 million
 - Total agricultural land is approximately 280 Mha, out of which only 7% is arable land
- Its climatic conditions:
 - Highly continental with hot and dry summers and short and extremely cold winters
 - Mean annual evaporation rate in the region may get as high as 1600 mm, greatly exceeding the mean annual rainfall as low as 100 mm in parts of Uzbekistan and Turkmenistan
- Most regions of CA require large-scale irrigation to cultivate crops



3. Methodology: Database search

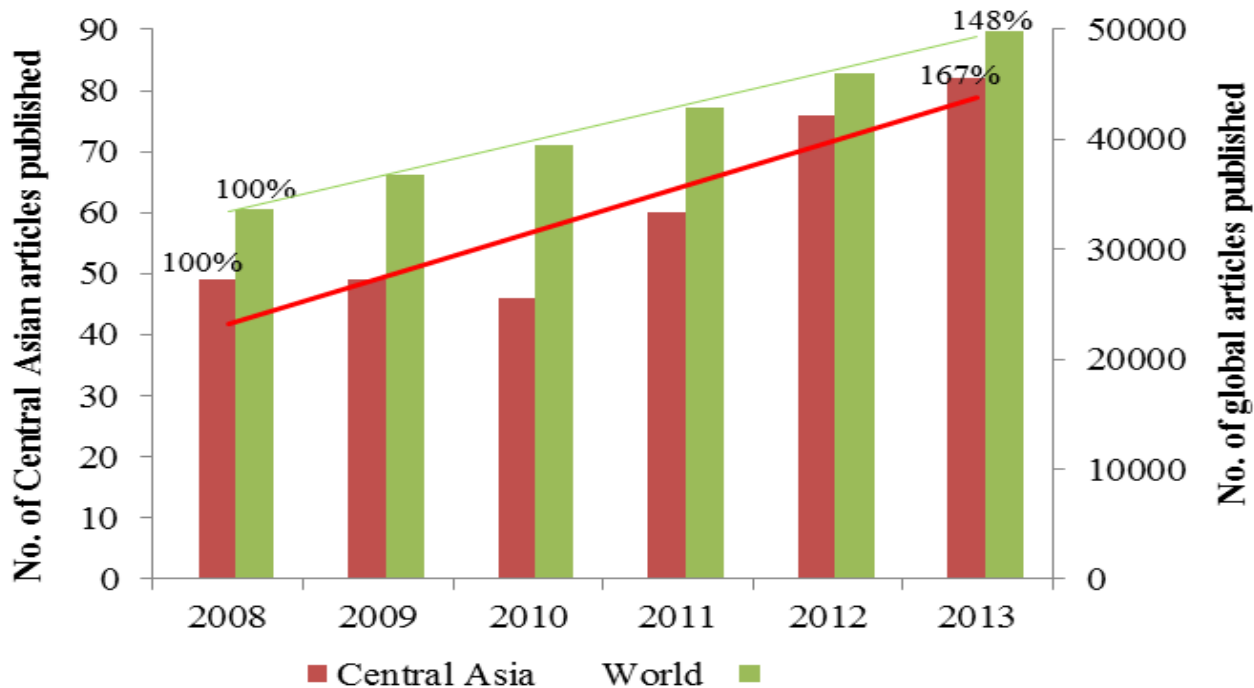
- A systematic database search of peer-reviewed articles was conducted using the electronic Web of Science – a comprehensive citation search database
- We selected the English-language articles that were published between 2008 and 2013 reflecting the release of LUF framework by Perez-Soba et al. (2008)
- Search terms used:
 - Thematic search: Agriculture, Farm, Land use, Land, Water management, Irrigation
 - Regional search: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Central Asia
- Documents were considered relevant if they matched at least one of the regional search terms and one of the topical search terms in **title, abstract or keywords**
- Based on title, abstract and keywords, each article was assigned to one or several of nine LUF categories
 - In case of uncertainties, we scrutinised the entire paper and assigned to LUFs

3. Methodology: LUFs in relation to CA context

Sustainability dimension	Land use functions (LUFs)	Taxonomy of activities
Environmental	LUF 1	Water balance, soil salinity, water quality, and air, water and soil pollutants
	LUF 2	Habitats for fauna and flora, and organisms
	LUF 3	Ecosystem services, land degradation, soil fertility, pasture and arable lands
Economic	LUF 4	Crop yields, value chains, biomass production
	LUF 5	Market mechanisms, financial services, rural banks, and property rights on land
	LUF 6	Irrigation infrastructure, transboundary water conveyances, large-scale water projects
Social	LUF 7	Provision of job opportunities, income, and livelihood security
	LUF 8	Human health, nutrition and food security
	LUF 9	Cultural heritage and diversity, gender, and landscape

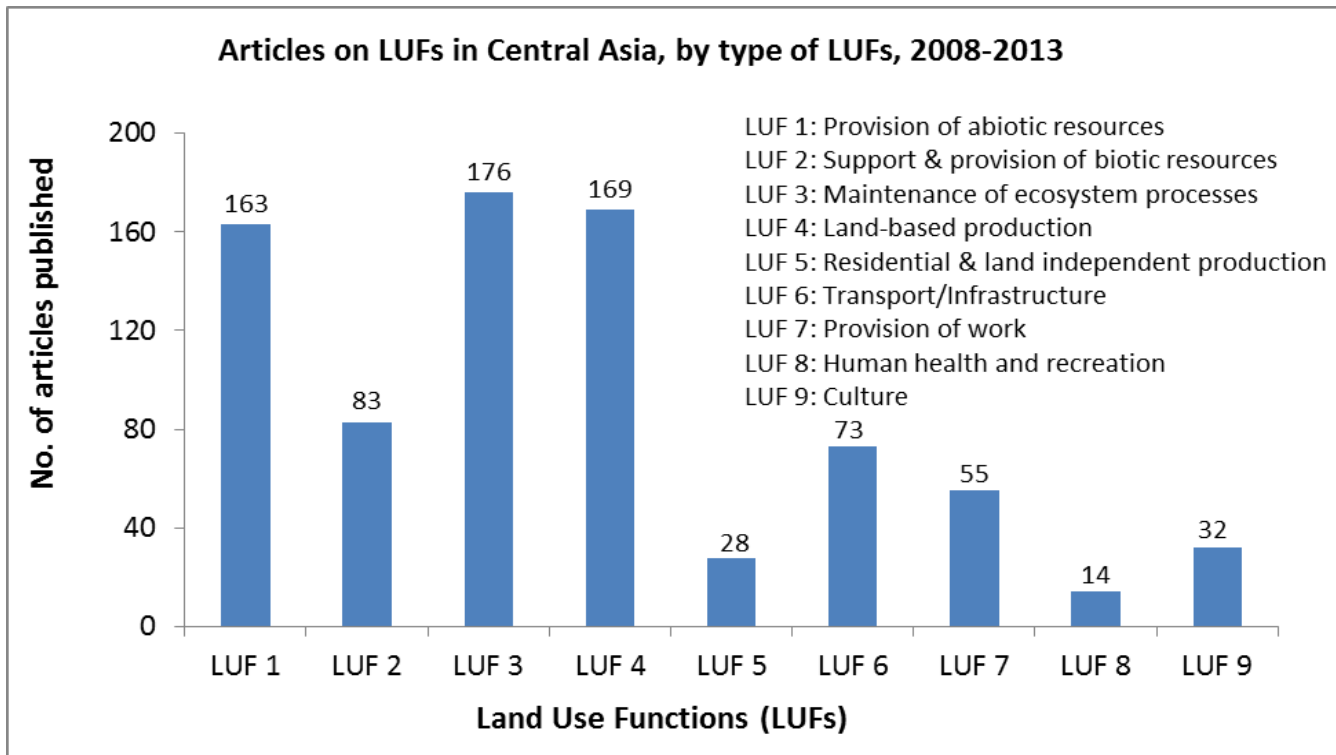
4. Results and discussion

- We found 362 articles relevant to agricultural land use in CA
 - Initially, we identified 697 papers from the automated database search
- Not surprisingly, the number of LUF-related articles are generally increasing overtime
 - Due primarily to the engagement of international research groups in the region



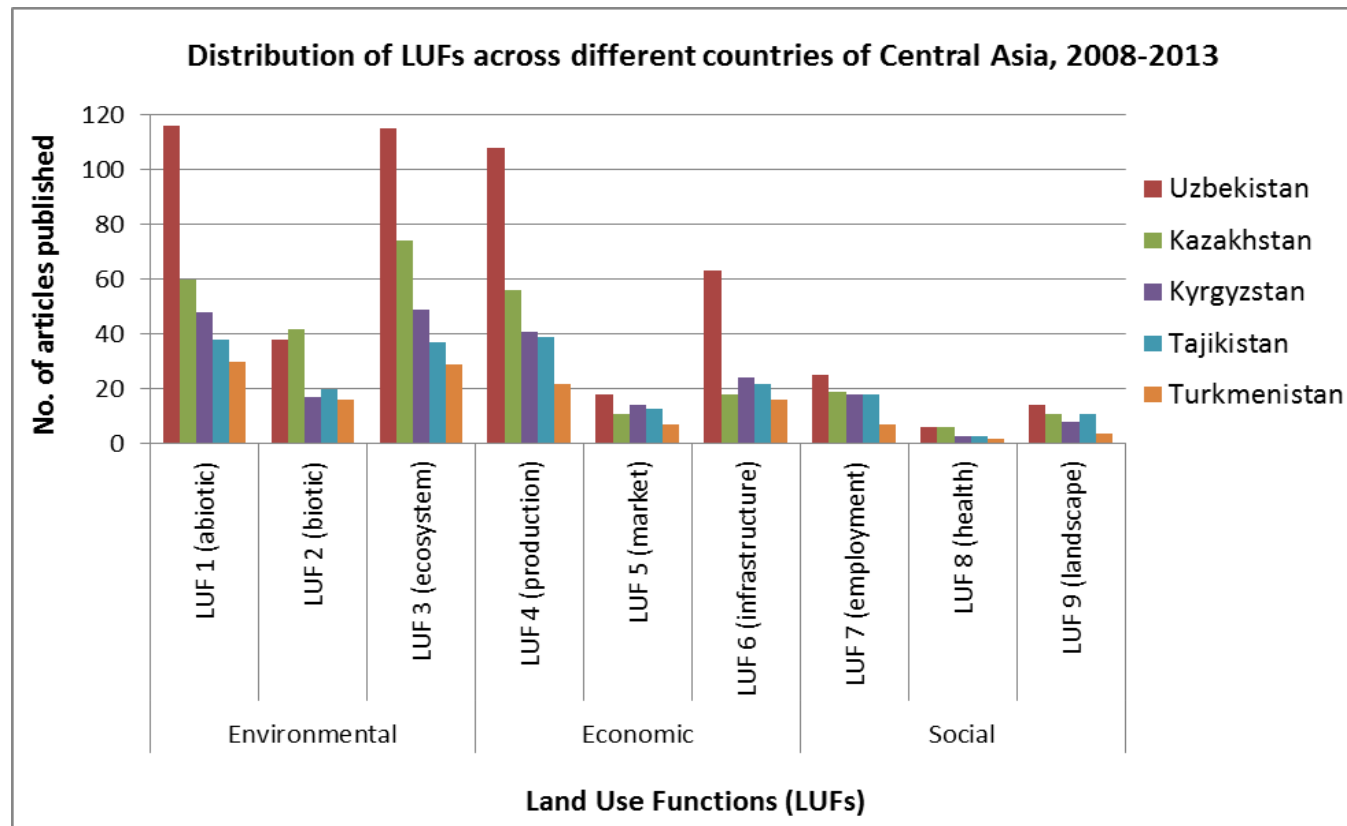
4. Results and discussion

- Provision of abiotic resources (LUF 1), maintenance of ecosystem processes (LUF 3) and land-based production (LUF 4) dominate the portfolio
 - Provision of biotic resources (LUF 2) remains underexplored
- Health (LUF 9) is the least concern of land use scientists despite widespread impacts of land degradation on human health around the Aral Sea areas



4. Results and discussion

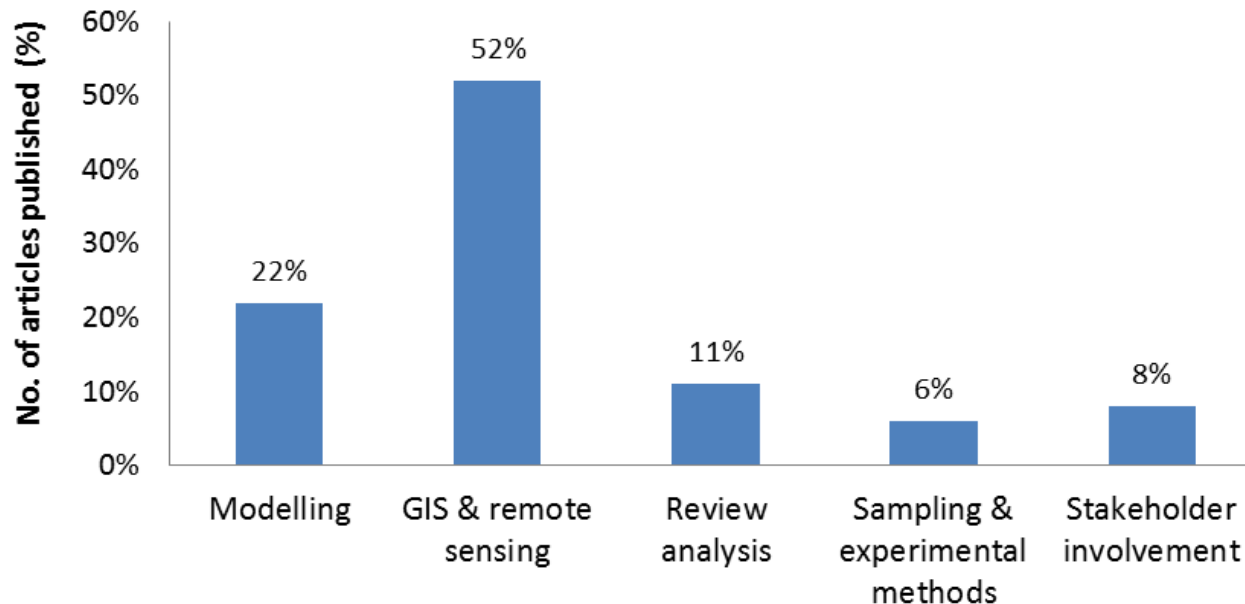
- Despite having a large agricultural land, Kazakhstan ranked 2nd in terms of No. of publications covering different types and relative shares of LUFs
- Review indicated that ZEF (Bonn) and IWMI (Central Asia) were active in Uzbekistan and thus, the country tops the publication list



4. Results and discussion

- More than half of the papers employ GIS and remote sensing to analyse land-related issues
- Sampling & experimental methods as well as stakeholder involvement have been less focused scientific methods in the papers
- Ground research by means of collecting qualitative data is rather marginal

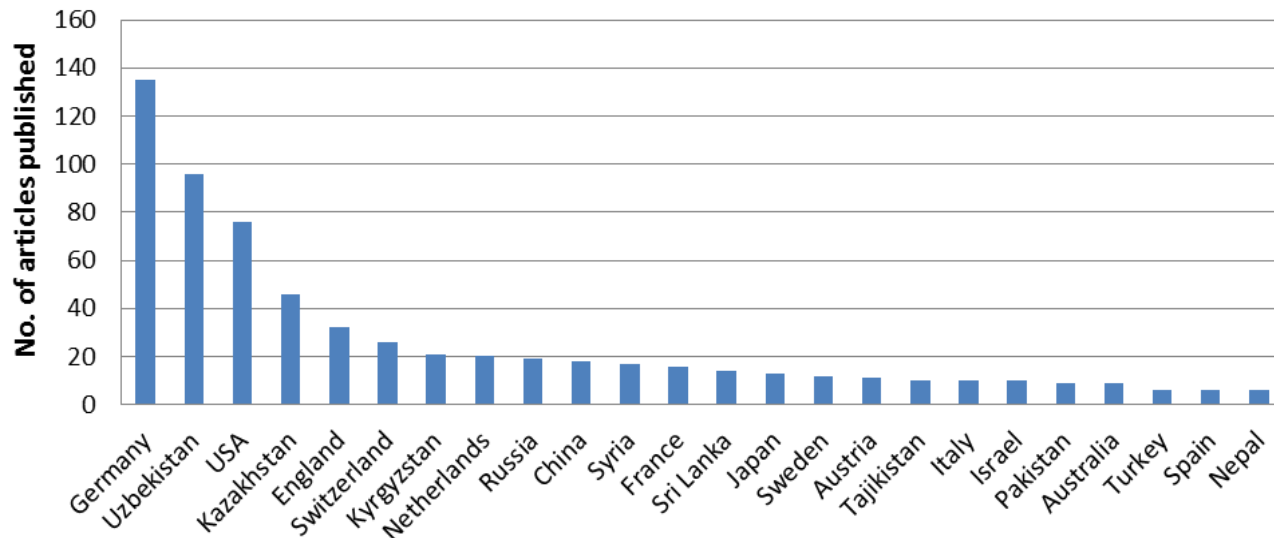
Articles published on LUFs in Central Asia, by type of scientific methods, 2008-2013



4. Results and discussion

- The German university scientists have been very active in CA doing research on agricultural land use
- Analysis show almost one-third of total papers (i.e. 135) are either single or co-authored with author's affiliation belonging to a German academic institution
- A close look at the papers that are authored or co-authored confirm our assumption: major chunk of articles coming from ZEF Bonn (53% of the 135 papers)

Articles on LUFs in Central Asia, by country of author's affiliation, 2008-2013



5. Conclusion

- Through applying the LUF framework, the study identified research focus and gaps in CA that future scientists can contribute
- The analysis indicate that most publications focus on the importance of environmental and economic dimensions of land use:
 - Environmental: LUF 1 and LUF 3 are the highest and surprisingly, less on LUF 2
 - Economic: LUF 4 and LUF 6 receive more attention than LUF 5
- Societal aspects of sustainability have been far less important for international scholars despite the increase of health issues
- Due to large-scale international projects, Uzbekistan benefited from intensive support for research among CA nations
- German institutions lead the ranking of authorship (lead author and co-author)
- Quantitative-oriented research were focus of the majority papers

5. Conclusion

Going forward:

- It would be interesting to identify local key stakeholders and policy makers in the area of agricultural land use in CA and undertake participatory workshop to get their perspectives with regards to relative relevance to LUFs
- Through comparing different perspectives we may identify a mismatch between the research interests and the needs of key actors, which could further open up a new research interests
- Finally, review of non-English and local CA articles shall be further explored for the evaluation of status quo on research and for a further harmonization of research needs to close existing knowledge gaps

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Thank you for your attention

Questions and Comments