

Problems and prospects of grassland development: policy issues

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ABSTRACT

There are a range of government and non-government policies that affect grassland development around the world. The objective of this paper is to provide examples of successful policies which have been instrumental in the preservation and maintenance of grasslands and to highlight policies which have resulted in negative consequences. This paper will not attempt to provide a complete overview of policies, but instead will provide examples from representative countries. Policies which affect grasslands can be classified into two broad categories: government policies that cover comprehensive landscape issues like the Grassland Household Contract System (GHCS) in China or the Federal Land Policy Management Act (FLPMA) in the USA and narrow in scope policies which often provide subsidies to accomplish specific production or environmental objectives. Comprehensive policies are often developed to address major country wide grassland issues, but over time can result in unintended negative outcomes. Narrow subsidy-based policies accomplish specific goals, but come at a monetary expense to society. In conclusion, any policy which affects grasslands should be carefully monitored over time and governments should discontinue or dramatically change policies that have become ineffective and continue and enhance policies which are providing useful production, environmental and societal benefits.

Keywords: Culture, environment, forage, grassland management, grassland policies, producers, rangeland management, society.

Introduction

Grasslands and rangelands occupy approximately 70% of the world's agricultural area (FAOSTAT 2013) with 68% of them are located in developing countries (Boval and Dixon, 2012). People rely heavily upon grasslands for food and forage production. Around 20 percent of the world's native grasslands have been converted to cultivated crops (Ramankutty *et al.*, 2008) and significant portions of world milk, meat, and wool production occur on grasslands managed solely for those purposes. The livestock industry - largely based on grasslands - provides livelihoods for about 1 billion of the world's poorest people and produces one-third of the global protein intake (Steinfeld *et al.*, 2006; FAOSTAT 2013). In developed countries, the native grasslands are often converted into

pastureland or cropland for high yielding and high quality forage production for animal use. For example, the tall-grass prairie in the US was reduced because of conversion to intensive agriculture, with less than one percent of the original prairie remaining to the north and east of the Missouri River and with remnant prairies reduced to 0.1% of their original cover in Wisconsin (Cochrane & Iltis, 2000). In developing countries like East Africa, there is extensive utilization of native grasslands and their use is expected to increase (Reid *et al.*, 2005). In countries around the world government policies have been developed and implemented to improve the management and utilization of grasslands and rangelands.

The objective of this paper is to provide examples of successful policies which have been instrumental in the preservation and

maintenance of grasslands and to highlight policies which have resulted in unintended negative consequences. This paper will not attempt to provide a complete overview of policies, but instead will provide examples from representative countries. In developing this paper and the IGC keynote presentation the following questions were sent to representative countries.

- 1) What are the current policies that influence grassland and rangeland management in your country?
- 2) How are these policies beneficial or detrimental to primary producers?
- 3) How are these policies beneficial or detrimental to the environment?
- 4) How are these policies beneficial or detrimental to society?

China

The economic and property rights reforms in the early 1980s dramatically modified grazing management in the pastoral areas in China. Livestock were privatized, but most of the grazing lands were communally used by all herding households. This led to the classic problem of resource degradation on common land (Hardin 1968). Uncontrolled grazing on communal pastures prevailed even until the late 1990s and there were public concerns over ecosystem degradation and desertification in most pastoral areas (Zhang, 2013). A series of grassland management policies, also collectively referred to as The Grassland Law, were implemented that have brought about large-scale changes for pastoral societies and grassland/rangeland ecosystems (Wang *et al.*, 2010). These include: Grassland Household Contract System (GHCS), ecological construction projects (ECPs), and the Herder Settlement Policy (HSP). Li *et al.* (2014) summarizes the impacts of these policies on ecosystems, animal husbandry, livelihoods,

and pastoral society, as well as on the causes of policy failures. Based on their findings, they suggest that any negative outputs of these policies may ultimately stem from an incomplete understanding of pastoralism among policy makers.

The GHCS was developed to clarify the property rights of individual households by controlling livestock numbers based on the perceived carrying capacity of grasslands and rangelands. The perception was that this approach would restore grasslands and prevent further degradation. By 2011, the total contracted area was 79% of China's usable grassland/rangeland (MOA, 2001). The policy has generated many positive impacts, but as it has developed over time there have been negative impacts on ecosystems, animal husbandry, herder livelihood and pastoral society. Giving property rights to households has increased individual responsibility over land management, but there is an emerging consensus that GHCS has caused rangeland fragmentation. Therefore, Li's review (2014) recommended a re-aggregation of grassland/rangeland resources as a strategy for further development of the GHCS. Interesting, there has been some disagreement within governmental and academic circles as to whether problems created by the GHCS policy have been caused by improper implementation or by flaws within flaws in the policy itself. Regardless though, adjustments are recommended to make GHCS more effective in the future.

Most of the ECP projects were implemented in the 1990's as a result of a series of disasters including sandstorms and flooding. The State Council Report of 2002 stated that 90% of China's grassland/rangeland was degraded to some extent. The ECP policy developed regulations that range from a grazing ban for one year, grazing rest for a season, or where grassland degradation

is less serious, rotational grazing and stocking rate controls. By 2011, ECP projects had excluded 40.33 million ha of grassland/rangeland. Both government sources and researchers have concluded that these policies have provided positive impacts on ecosystems, but both recognized that the ECP's had negative impacts on herder livelihoods, social connections and pastoral culture. Government subsidies which encouraged intensive animal production have helped to alleviate reduced income from the loss of traditional pastoral practices, but most researchers argue that subsidies have only partially addressed the negative impact of ECP projects. In summary, even though the policy improved ecosystem conditions, it had negative consequences for herder livelihoods, increased social conflicts and marginalized traditional culture (Li *et al.*, 2014).

The primary objectives of HSP policy is to provide herders with improved living conditions (housing, medical, and educational), reduce the number of nomadic herders, improve livestock production with improved forage seed cultivars, livestock housing, and supplemental feed, while

reducing grazing pressure on grassland/rangeland ecosystems. Both government sources and researchers agree that the policy achieved effective improvements in herder livelihoods and animal husbandry. The ecological impacts of the policy are still being debated, but the negative impacts of HSP on pastoral society have been rather obvious. Therefore, even though HSP improved the livelihoods of individual herders, it has induced social divisions and led to the marginalization of traditional culture on a larger scale. Like the GHCS policy, there is disagreement as to whether negative impacts were created by the HSP policy itself or improper implementation of policy (Li *et al.*, 2014).

After nearly 30 years of rangeland management policy reforms, the development and implementation of GHCS, ECP and HSP policies constitute a major grassland/rangeland management paradigm shift that have brought great reforms and changes to pastoralism and management systems. Comprehensive reviews like that of Li *et al.* (2014) provide the opportunity to build on the positive impacts of GHCS, ECP, and HSP, while addressing shortcomings of these policies for the future and providing guidance for future grassland/rangeland management policies and research.

Norway

In contrast to China, the cultivated land in Norway is only 3% of the total land area, yet agriculture is still regarded as vital for keeping activity and settlement in rural areas. Government policies are designed to maintain agricultural production in all parts of the country, with a goal of keeping food self-sufficiency at the present level (Knutson, 2007). Currently, Norwegians import 55% of their food and export about 95% of the fish caught or produced. Farmers get yearly support per ha for management of grassland and pastures. The support is highest in the northern region, and in the mountain region. In Western Norway the support is USD 492-615 per ha. Half of the support is called "area support", the other half is called "landscape support". Farmers also receive payments for grazing animals, both grazing on cultivated land and on natural grassland. Norway is not a member state of the European Union (EU), but is closely associated with the Union through its membership in the European Economic Area (EEA) as European Free Trade Association (EFTA) member. The EEA agreement grants Norway access to the EU's internal market and it has adopted most EU legislation related to that market. This essentially means that Norway is a practical part of EU when it comes

to free movement of goods, capital, services and people, but food and beverage is excluded (because those are subsidized by the EU). Therefore, Norway is free to set agricultural policies.

Current agricultural policies encourage farmers in Southeastern Norway to produce mainly cereals. Farmers in Western and Northern Norway are encouraged to produce grass, milk and meat. There are laws for "minimum area" for spreading of animal manure. "The Agricultural Agreement" refers to the policy where annual negotiations occur between the government and farmer unions on prices and support, including support for drainage of agricultural land. The government also supports agricultural research and advisory services, There are target prices for many products, but not all. A target price is in principle the maximum prices farmers can obtain. Import tariffs make it possible to have domestic prices above international prices.

In Norway, several policies have been enacted since the late 1980s that have targeted soil erosion, transfer of soil particles and phosphorus (P) losses. The subsidies as part of these policies led to a fourfold decrease in the area plowed from 1991 to 2001 and reduced P fertilizer consumption by 60%, especially in areas with high livestock density. Moreover, in the late 1980s agricultural point sources of P from storage facilities of manure and fodder were reduced. Bechmann *et al.* (2005) evaluated the effect of these policy-induced measures and changed agricultural practices on suspended sediment (SS) and total P (TP) concentrations in three agricultural catchments. The results from this research suggested that subsidies and mitigation measures can reduce concentrations of TP and SS in stream-water in highly polluted catchments.

The policy change in the 1990s from price support to acreage support and support per

animal was thought to reduce farming intensity and thus be beneficial for the environment (Brunstad, 2005). Grazing is regarded as positive for biodiversity. Current policies resulted in more open landscape which has been appreciated by Norwegians and tourists to the country. They also enhance food security if difficult political or environmental situations occur in the future (Knutsen, 2007).

Overall, agricultural policies in Norway are positive for farmers. A primary negative to farmers are the required minimum areas for spreading of animal manure and limitations on livestock stocking rates. For society, the fairly high compensation that farmers receive to abide by these policies is significant both in tax dollars required for hectare and per animal and in resulting higher food prices. Society benefits by having strong food security, clean water, and scenic farmland. Norwegian's investment in the future of agriculture is an important indication of their support of these policies with the highest total public expenditures on agricultural research at 6% of agricultural GDP (FAOSTAT, 2013).

Sweden

As part of the European Union (EU) Sweden forage and grassland policies are EU policies that have been adapted locally by the Swedish Board of Agriculture (2015). These policies and the subsidies that accompany them have recently been updated, so the positive or negative results of these policies are not yet apparent. There are two general types of grassland in Sweden: short-term fields harvested for hay, silage, and pasture and that provide almost all the forage in the country, and semi-natural grassland that in the past played the major role for both forage and grazing – today they are mainly used for extensive grazing. There is no true rangeland in Sweden (with the possible exception of land used for grazing reindeers in the north).

The subsidies given to farmers in the past have focused on keeping as much semi-natural grassland in use as possible since they are the most biodiverse ecosystems in Sweden. These grasslands may not be fertilized and must be grazed annually for a farmer to receive USD 116 per ha. The amount can be increased for more specific management, mimicking those that were used in the past. There are currently also subsidies for all kinds of cattle > 1 years of age. Short-term forage fields were also eligible for a fixed subsidy in the past. Today there is a scheme with the aim to increase the 'greenness' of a farm, and it is complicated to calculate how much will be given to a specific farm, but short-term forage fields will be taken into consideration, especially those that include clovers (Swedish Board Ag., 2015).

Japan

Japan, similar to Norway and other European countries, has a number of agricultural policies with priorities that include food security and self-sufficiency, agriculture trade, value-added agricultural production, innovation in agricultural research and technology, agricultural production with a priority on environmental conservation, cooperation between urban and rural areas, and the promotion of urban agriculture (MAFF, 2014). There are four main agricultural policies which affect grassland agricultural production in Japan and each has positive and negative implications for farmers, the environment, and society as a whole.

Policy 1: Increase in Forage Production and Decrease in Animal Management Costs. The first part of this policy aims at enhancing forage production (both quantity and quality) by encouraging renovation or improvement of grasslands using techniques such as introduction of high performance forage species and/or cultivars, and control of noxious weeds. The second part of the policy

encourages increased stocking of dairy and beef cows on pastures vs. indoor feeding. These policies are beneficial to primary producers by increasing forage and animal production and decreasing animal management costs (MAFF, 2015).

The first part of the policy is concerned mainly with renovation of existing grasslands because of the high cost involved in developing new grasslands (e.g. conversion of forests into grasslands). Therefore, this part of the policy should have a minimal detrimental effect on the environment. However, the policy to encourage increased pasturing of livestock, may have an adverse effect on soil conservation (risk of erosion) and water quality (i.e. - manure and urine) depending on stocking density. This policy is acceptable to society though, because it encourages production and utilization of domestic resources and improved maintenance of "green space" (MAFF, 2015).

Policy 2: Measures for the Meso-mountainous Region and Abandoned Farmlands. The meso-mountainous region (i.e. intermediary area between plains and mountains) accounts for 73% of land area of Japan. The most critical issue in this region is the abandonment of farmlands due to aging of primary producers and labor shortages. This policy encourages the use of land resources in the meso-mountainous region for forage and livestock production through various management techniques depending on the natural and social conditions of the land (e.g. conversion of abandoned farmlands to grazing land). It is considered beneficial to primary producers by restoring abandoned farmland for agricultural production. The policy is also considered to be beneficial to the environment, because a decrease in the area of abandoned farmlands will reduce the spread of weeds, pests and wildlife which damage agricultural crops and the environment. This policy is beneficial to society because it is expected to lead to the

conservation of national land and the revitalization of the region (MAFF, 2015).

Policy 3: Measures for Preventing Damage by Non-Native Species. Most forage species used in Japan are non-native, introduced species and the policy demands that these species should be maintained in a cultivated system and managed so as not to cause damage to the ecosystem. This policy affects primary producers negatively by increasing production cost and management requirements, but provides a positive benefit to the environment and society (MOE, 2015).

Policy 4: Intensification of the Prevention, Monitoring and Control of Animal Diseases. This policy is definitely beneficial to primary producers because it decreases the risk of animal loss due to diseases. On the other hand, it may increase the costs for producers utilizing public pastures because these are also used by urban people for recreational purposes. The decreased opportunity for urban people to have contact with farm animals may be unfavorable to society (MAFF, 2015).

United States

In the United States there are many government policies which affect grasslands and rangelands. There are less policies that directly influence livestock production on grasslands in comparison to some developed countries, but there are several environmental policies that have had unintended negative consequences for grassland farmers. Before these are discussed, the “policy” that has had the most positive impact is the “generally” free market for beef in the USA and the high percentage of privately held land. Although not a policy per se, Brantley (USDA-NRCS National Grazing lands Specialist) summarized the societal benefits that he has found from working with US producers in multiple states over the last 25 years. When land is held by deed and inherited by

successive generations, long term improvements and land conservation is encouraged in contrast to land that is leased or occupied by producers who are tenants. Privately held land encourages a focus on long term profits more than or equal to short term profits because land stability encourages a longer planning horizons. Landscape level planning can be successfully coordinated because neighbors are also stable and valued. Similarly, the increased efficiencies of shared labor and shared equipment are more likely when producers and neighbors own farms/ranches by deed and stability reigns. During periods of low profit margins producers do not have much to lose by trading short term profit for conservation. A negative impact of this “policy” is that free market fluctuations can create short term gain opportunities that cause conservation to be abated or reversed for profit (e.g. – the cultivation of grasslands for crop production when grain prices are high).

Shewmaker and Rimbey (pers. comm.) provided insightful perspectives on several national policies that were initiated 40-50 years ago to address current issues at the time. These policies are FLPMA (Federal Land Policy Management Act), NEPA (National Environmental Policy Act), and ESA (Endangered Species Act). In recent years, anti-agriculture activists have used these policies to obstruct planning and rangeland improvements that will reduce livestock impacts on the grasslands/rangelands they claim they are trying to “protect.”

FLPMA was enacted by congress in 1976 to recognize the value of the public lands, declaring that these lands would remain in public ownership (FLPMA, 2015). The National Forest Service, National Park Service, and now, the Bureau of Land Management (BLM), are commissioned in FLPMA to allow a variety of uses on their land. FLPMA

addresses topics such as land use planning, land acquisition, fees and payments, administration of federal land, range management, and right-of-ways on federal land.

NEPA is a United States environmental law that established a U.S. national policy promoting the enhancement of the environment (NEPA, 2015). Additionally, it established the President's Council on Environmental Quality (CEQ). NEPA is one of the most emulated statutes in the world and it is often referred to as the modern-day "environmental Magna Carta" (Eccleston, 2008). NEPA's most significant accomplishment was setting up procedural requirements for all federal government agencies to prepare environmental assessments (EAs) and environmental impact statements (EISs). EAs and EISs contain statements about the environmental effects of proposed federal agency actions. The law has since been applied to any major project—federal, state, or local—that involves federal funding, work performed by the federal government, or permits issued by a federal agency. Court decisions throughout the law's history have expanded the requirement for NEPA-related environmental studies to include actions where permits issued by a federal agency are required regardless of whether federal funds are spent to implement the action.

ESA is an act designed for the conservation of endangered and threatened species of fish, wildlife, and plants, and for other purposes (ESA, 2015). The ESA's primary goal is to prevent the extinction of imperiled plant and animal life, and secondly, to recover and maintain those populations by removing or lessening threats to their survival. The U.S. Supreme Court found that "the plain intent of Congress in enacting" the ESA "was to halt and reverse the trend toward species

extinction, whatever the cost." The Act is administered by two federal agencies, the United States Fish and Wildlife Service (FWS) and the National Oceanic and Atmospheric Administration (NOAA).

Each of these policies (FLPMA, NEPA, and ESA) was designed with good intentions, but activist groups have used the U.S legal system and often misinterpretations of these policies to severely restrict grassland/rangeland utilization across the country. It even seems that some activist groups use opposition to certain programs as fund raising opportunities to maintain their organization. For example, one of the issues affecting sage grouse protection is the reclamation of juniper-encroached rangelands—a result of fire suppression of about 100 years. Some conservation groups such as The Nature Conservancy, Audubon Society, etc. have been proactive and have been engaged in the planning process to control phase I juniper encroachment, and support efforts to improve sage grouse habitat. Conversely, the Western Watersheds Project group was not willing to be involved in the NEPA process until right before a successful agreement was signed and they staged a public protest and asked for a court-order injunction.

Each of these policies can be both beneficial and detrimental to the environment. When public agencies restrict grazing, fine fuels build up to the point of catastrophic fires such as the Murphy Wildland Fire Complex in Idaho and Nevada, July 2007 (Launchbaugh *et al.*, 2007). Although it is recognized that grazing will not stop all fires, it will reduce the fine fuels and enhance the ability of fire fighters to control a wildfire. In the Murphy case, the fire consumed 240,000 ha of sagebrush that the sage grouse rely on for habitat. The policy to not allow grazing on burned pastures for at least 2 years jeopardized the rangeland with renewed fuel buildup and

some of the same area was burned again. These policies can become inflexible and take the decision-making out of local control. Much of the fire issue can be traced back to the BLM discontinuing Temporary Non-Renewable (TNR) permits. TNR's were used to harvest excess forage (such as cheat grass) in off-season periods. This was primarily done in the fall, winter and early spring months. In the case of the Murphy Complex, many of those grazing permits were never adjudicated after seeding and water development and BLM thought it most prudent to deal with increased grazing capacity by using TNRs. When activists threatened lawsuits against this practice, BLM pulled TNRs off the table in Idaho. Many of the large Idaho fires have taken place after the end of TNR.

In conclusion, generally policies like FLPMA, NEPA, and ESA are beneficial to society. The policies benefit the public by allowing them to be involved in the planning and decision making on public lands, but they have negative implications when activist groups use them as a legal obstacle or even the threat of legal action. It is essential that governments regularly monitor policies and practices which affect grasslands and discontinue policies which are no longer needed or formulate modifications to make these policies more effective. One example of this approach in the USA is The Conservation Effects Assessment Project (CEAP). CEAP is a multiagency effort by the Natural Resources Conservation Service (NRCS), National Institute of Food and Agriculture (NIFA), Agricultural Research Service (ARS), and National Resources Inventory (NRI) to quantify environmental effects of conservation practices used by landowners participating in selected USDA programs. The goal of CEAP is to inform the USDA-NRCS, scientific and outreach communities, and especially policy advisors of the current status of various policies and

programs. A major outcome of CEAP was the development of a literature review synthesis which is a landmark contribution on the effects of conservation practices on environmental goods and services derived from US grasslands (Nelson, 2012). The strong scientific basis of the CEAP review will facilitate the development of comprehensive erosion control, nutrient management, and conservation planning technologies, which will in turn reduce environmental impacts from pastureland and provide a foundation for future work (Sanderson, 2011).

Kenya

Two policies were developed in the 2000's in Kenya that focused on the revitalization of the Arid and Semi-arid Lands (ASALs) of Kenya (ASAL, 2004; NLP, 2009). ASALs constitute about 80% of the country's land mass, host about 10 million people and approximately 70% of the national livestock herd. Previous policies aimed at revitalizing ASALs were drafted with a degree of bias against pastoralism as a viable and sustainable way of life. Emphasis was put on sedentarization of nomadic pastoralists with a strong focus toward crop farming. Because such policies were mainly top-down, discriminative and un-consultative, they often failed. The failure of the past policies made it appear that ASALs were generally unproductive, yet in reality they have enormous economic potential in livestock production, mining, tourism and biodiversity. The new policy framework (ASAL, 2004) outlines priorities and measures necessary to bring about sustainable development in the ASALs that have in the past only been associated with poverty and need. It underscores the importance of the ASALs to the rest of Kenya's economy and identifies areas where the ASALs contribute significantly to the country's development.

The National Land Policy was a shift in the classification of land bringing about the recognition of community land ownership (NLP, 2009). Before this in the ASAL areas land ownership was always problematic leading to over utilization and therefore degradation of grasslands (Harden, 1968), but with the new classification a clan or community can take care of their portion of land. As an example the Mogeno community ranch in the Taita Taveta area now controls grazing and charcoal burning on their 10,000 acre range, something they could not do before. Since they have land ownership documents they have been able to borrow from commercial banks to improve the infrastructure on the land. As this area is a major wildlife corridor between the world famous Tsavo East and West Parks the Mogeno ranch also benefits from tourism dollars, therefore they recognize the value of wildlife conservation and now allow migration through their ranch. Additionally, some of the Maasai communal ranches in Kajiado have developed their own community based grazing management systems and are even reseeded some of their degraded pastures. This would not have been possible without land ownership issues being addressed. The negative result from the National Land Policy is that many of the communities have sold off their land and much has disappeared into real estate which blocks wildlife migration and reduced pasture availability. A number of these community ranches have developed into wildlife conservancies which keep livestock integrated with wildlife and therefore benefit from tourism.

The ASAL policy has several pillars including (ASAL, 2004):

- i) Recognizing movement of livestock as a central piece in reducing degradation of the grasslands and nomadic pastoralism as the most appropriate production system in the arid areas. This allows

government structures (National Drought Management Authority) to be involved in defusing tension and conflict based on competition for resources (pasture and water) and an early warning system is being developed which apart from identifying potential conflict areas also allows the government agencies to provide support (NDMA, 2012).

- ii) Provision of services to pastoralists – including:
 - a. Weather proof roads – due to poor roads the cost of transporting animals to Nairobi which is a major market will cost between USD 723 – 800 to transport about 18 heads of cattle which is approximately a third of the value of the animals.
 - b. Market structures – including livestock markets. The development of these infrastructures has resulted in better distribution of food and other goods and improved the marketing of livestock.
 - c. Improve access to water – construction of dams, water pans and boreholes. Unfortunately in some areas this seem to be a problem especially in areas where permanent boreholes have been provided it has led to degradation around the borehole as the pastoralists tend to remain in the area much longer

Conclusion

Policies which affect grasslands can be classified into two broad categories: government policies that cover comprehensive landscape issues like the Grassland Household Contract System (GHCS) in China or the Federal Land Policy Management Act (FLPMA) in the USA and narrow in scope policies which often provide subsidies to

accomplish specific production or environmental objectives. Comprehensive policies are often developed to address major country wide grassland issues, but over time can result in unintended negative outcomes. Narrow subsidy-based policies accomplish specific goals, but come at a monetary expense to society. In conclusion, any policy which affects grasslands should be carefully monitored over time and governments should discontinue or dramatically change policies that have become ineffective and continue and enhance policies which are providing useful production, environmental and societal benefits.

Acknowledgements

Valuable inputs received from Dr. Ying-Jun Zhang and Dr. Liu Xiangzhou - China, Dr. Olav Martin Synnes and Dr. Agnar Hegrenes - Norway, Dr. Bodil Frankow-Lindberg - Sweden, Japanese Society of Grassland Science - Japan, Dr. Glenn Shewmaker, Dr. Neil Rimbey, Mr. Sid Brantley, Dr. Chuck West, Dr. Matt Sanderson - USA, Dr. David M Mwangi - Kenya, Dr. Devendra R Malaviya - India, Dr. Wal Whalley - Australia, Dr. Joung-Kyong Lee - South Korea is thankfully acknowledgement.

References

ASAL. 2004. Draft National Policy for the Sustainable Development of Arid and Semi Arid Lands of Kenya. Republic of Kenya. Ministry of Lands. <http://theredddesk.org/countries/policies/draft-national-policy-sustainable-development-arid-and-semi-arid-lands-kenya>.

Bechmann, M. and P. Stålnacke. 2005. Effect of policy-induced measures on suspended sediments and total phosphorus concentrations from three Norwegian agricultural catchments. *Science of the Total Environment* 344(1-3): 129-142. <http://www.sciencedirect.com/science/article/pii/>

S0048969705001038.

Boval M and R.M. Dixon. 2012. The importance of grasslands for animal production and other functions: a review on management and methodological progress in the tropics. *Animal* 5: 748-762.

Brunstad, R.J., I. Gaasland and E. Vårdal. 2005. Multifunctionality of agriculture: an inquiry into the complementarity between landscape preservation and food security. *Eur. Rev. Agric. Econ.* 32(4): 469-488. doi:10.1093/erae/jbi028.

Cochrane, TS and HH Iltis. 2000. Atlas of the Wisconsin prairie and savanna flora. Department of Natural resources and University of Wisconsin-Madison Herbarium, Madison, Wisconsin. <http://www.botany.wisc.edu/herbarium/info/psatlas.asp>

Eccleston, CH. 2008. NEPA and Environmental Planning: Tools, Techniques, and Approaches for Practitioners. CRC Press. ISBN 9780849375590

ESA. 2015. Endangered Species Act of 1973. US Forest and Wildlife Service. <http://www.fws.gov/endangered/laws-policies>.

FAOSTAT. 2013. FAO Statistical Yearbook. <http://www.fao.org/docrep/018/i3107e/i3107e.PDF>

FLPMA. 2015. Federal Land Policy Management Act of 1976. US Bureau of Land Management. www.blm.gov/flpma/FLPMA.pdf

Han, J.G., Y.J. Zhang, C.J. Wang, W.M. Bai, Y.R. Wang, G.D. Han and L.H. Li. 2008. Rangeland degradation and restoration management in China. *The Rangeland Journal* 30: 233-239.

Hardin G. 1968. The Tragedy of the Commons. *Science* 162: 1243-1248.

Knutsen, H. 2007. Norwegian Agriculture - Status and Trends 2007. Norwegian Agric. Economics Research Institute. http://nilf.no/publikasjoner/Publikasjoner_som_NILF_utgir-Innhold.

Launchbaugh, K., B. Brammer, M.L. Brooks, S. Bunting, P. Clark, J. Davison, M. Fleming, R. Kay, M. Pellant, D.A. Pyke, and B. Wylie. 2007. Interactions Among Livestock Grazing,

- Vegetation Type, and Fire Behavior in the Murphy Wildland Fire Complex in Idaho and Nevada, July 2007. Open-File Report 2008-1214. <http://pubs.usgs.gov/of/2008/1214/>.
- Li, Y.B., Gongbuzeren and W.J. Li. 2014. A review of China's rangeland management policies. IIED Country Report. IIED, London. <http://pubs.iied.org/10079IIED>.
- MAFF. 2014. 2013 Annual Report on Food, Agriculture and Rural Areas in Japan, Summary. Ministry of Agriculture, Forestry and Fisheries, Japan. http://www.maff.go.jp/e/japan_food/repodata/pdf/2013_summary.pdf.
- MAFF. 2015. Ministry of Agriculture, Forestry and Fisheries, Japan. <http://www.maff.go.jp/e/index.html>.
- MOA. 2011. Retire livestock to restore grassland project attained obvious success in Western China. http://www.gov.cn/gzdt/2011-08/04/content_1919844.htm.
- MOE. 2015. Ministry of the Environment, Japan. <http://www.env.go.jp/en/index.html>.
- NDMA. 2012. Programming Framework to End Drought Emergencies in the Horn of Africa. Republic of Kenya. Ministry of Lands. resilience.igad.int/attachments/article/243/CPP%20Kenya.pdf
- Nelson, CJ 2012. Conservation outcomes from pastureland and hayland practices: Assessment, recommendations, and knowledge gaps. Allen Press, Lawrence, Kansas. www.nrcs.usda.gov/wps/portal/nrcs/detail/ia/technical/cp/?cid=stelprdb1080581
- NEPA. 2015. National Environmental Policy Act of 1969. www.nepa.gov.
- NLP, 2009. Sessional Paper No. 3 of 2009 on National Land Policy. Republic of Kenya. Ministry of Lands. <http://landwise.landesa.org/record/1393>.
- Ramankutty, N., A.T. Evan, C. Monfreda, and J. A. Foley. 2008. Farming the planet: 1. Geographic distribution of global agricultural lands in the year 2000, *Global Biogeochemical Cycles*, 22,GB1003, doi:10.1029/2007GB002952.
- Ried, R.S., S. Serneels, M. Nyabenge and J. Hanson. 2005. The changing face of pastoral systems in grass dominated ecosystems of eastern Africa. In: *Grasslands of the World*. (JM Suttie, SG Reynolds and C Batello, eds.) Rome, Italy: FAO.
- Sanderson, M.A., A.J. Franzluebbbers, S. Goslee, J. Kiniry, L. Owens, K. Spaeth, J. Steiner, and T. Veith. 2011. Pastureland Conservation Effects Assessment Project: Status and expected outcomes. *Journal of Soil and Water Conservation*. 66(5): 104A-145A.
- State Council. 2002. Some opinions of state council on enhancing grassland conservation and construction. In Editorial Committee of Chinese Animal Husbandry Year Book. Beijing: Chinese Agricultural Publishing.
- Steinfeld H., P. Gerber, T. Wassenaar, V. Castel, M. Rosales and C. de Haan. 2006. Livestock's long shadow: environmental issues and options. Rome, Italy: FAO.
- Swedish Board of Agriculture. 2015. www.jordbruksverket.se.
- Wang JG. 2010. Non-equilibrium, common and indigenous: new perspectives for rangeland management. China Social Science Academic Press.
- Zhang, Y.J., L.Z. Zhang, M.L. Wang, X.L. Li, Q.C. Yang, J. Hanson and M.A. Jorge. 2013. Drivers of change for grassland and forage systems: A case study of China. Proc. of the 22nd International Grassland Congress. Sydney, Australia. 15-19 Sept. 2013. <http://www.internationalgrasslands.org/files/igc/publications/2013/proceedings-22nd-igc.pdf>.