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AGRICULTURAL AND NATURAL RESOURCES ADAPTATIONS TO CLIMATE CHANGE

Agricultural and Natural Resources Adaptations to Climate Change: Governance Challenges in Asia

Ganesh P. Shivakoti[1], Marco A. Janssen[2] and Netra B. Chhetri[3]

[1] Asian Institute of Technology, Ostrom Center for Advanced Study in Naturale Governance (OCeAN), TH

[2] Arizona State University, Center for Behavior, Institutions and Environment (CBIE), US

[3] Arizona State University, School for the Future of Innovation in Society (SFIS), US

Corresponding author: Ganesh P. Shivakoti (ganeshpshivakoti@gmail.com)

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In most of the rapidly developing countries of the Asian region, the sustainability outcomes have been impacted by the increasing levels of resource use which is causing the depletion of ecosystems at an alarming rate (UN, 2017). The Green Revolution helped the Asian agricultural dependent economies to increase agricultural production, alleviate poverty and avert the fears of famine and starvation. However, it brought about second-generation problems including loss of soil fertility mainly due to monoculture, high input use leading to environmental pollution, degrading soil and water bodies, pest resistance, biodiversity loss and increased pressure on natural resource base (IWMI, 2009). The natural resource-dependent indigenous communities are striving to achieve sustainable livelihoods through satisfying sectoral policy concerns and priorities. There is a stronger need to fulfill personal, societal and institutional goals by making strategic interventions in an attempt to solve the emerging issues of common pool resource (CPR) management. In doing so, there should be sound knowledge available to understand the diversity and dynamism of the natural resource systems and the interface of human and natural systems. An understanding of the various methodological approaches used to gauge and/or assess the natural resource systems and its interactions of various components within the system is also required. Previous research has covered numerous issues and challenges of the natural resource governance in Asia including the rights, access and control over natural resources of the local communities, current practices in managing natural resources and the socio-ecological systems (SES), the new forms of natural resource governance, linking regional issues with those at local level, local-level land cover and land-use change, conservation and development related agroforestry policy outcomes at local level, alternative livelihood adaptation and management strategies in the context of climate change, community participation and collaborative governance of natural resources and application of various multi-methods and multi-level analysis and modeling techniques for building problem solving mechanisms (Febriyamansya et al. 2017, Shivakoti et al. 2017, Thanh et al. 2017, Thang et al. 2017). Though these research reporting provide rich literature and lessons for effective management of the natural resources in the region, the emerging issues and the resultant new forms of the natural resource governance are also crucial to be considered while managing natural resources. This special issue provides answers to the issues and challenges regarding management of the common pool resources in the wake of uncertainty in the Asian region highlighting pressing issues related to the coupled human and natural systems particularly in the face of global change and provide useful insights regarding the robustness, resilience and collective actions. The papers also explore the nexus of resource use, economic growth, and environmental conservation along with the agricultural production challenges largely due to mutually exclusive interests in resource use.

Using Ostrom and her colleagues' Institutional Analysis Design (IAD) framework, eight design principals, social-ecological systems (SES) frameworks, the papers in this special issue attempt to provide practical solutions to the issues particularly to promote polycentric governance of the natural resources, maintain social connectivity, advance system thinking, maintain inter and intragenerational equity and provide a

base for understanding the multi-methods and multi-level techniques used in assessing the dynamics of resource systems. New forms of CPR governance are required to meet emerging challenges. The complex interactions between multiple stressors present the most pressing threats to the management of CPRs that require management on large spatial and temporal scales and recognizing the importance of the broader context of decisions (Fischer, 2018). Ostrom's SES framework offers an interdisciplinary tool for studies of linked human-natural systems (Vogt et al. 2015). To solve the emerging challenges to the management of CPRs, the three themes of the present volume provides a representative collection of research studies on various aspects of the natural resource systems, their governance, and collaboration. There is a growing body of literature focusing on understanding factors enabling groups in solving social dilemmas and effectively governing shared resources (Anderies, 2016). Two related issues need to be addressed while solving the social dilemmas: i) the best outcome, in group of individuals facing choices, can only be achieved through coordinating individual decisions for maximizing total group payoff and ii) individuals have strong incentives to make a choice that is best for themselves (as there is no guarantee that others will coordinate decisions) but may have negative impacts on the group (Ostrom et al. 1994).

Elinor Ostrom in her seminal work proposed that neither the state nor the market is uniformly successful to enable individuals for sustaining long-term, productive use of natural resource systems. She also proposed that 'communities of individuals have relied on institutions resembling neither the state nor the market to govern some resource systems with reasonable degrees of success over long periods of time' (Ostrom, 1990). To solve problems associated with common pool resources, individuals have organized themselves and rules have been formed by the resource users which severely constrained the authorized actions available to them (Forsyth and Johnson, 2014). There are two distinct and important elements of a solution to CPR problems: restricting appropriators' access and creating incentives for resource users to contribute to the resource system instead of overexploiting it. Both the features and important as only restricting access to resource can fail if the appropriators compete for shares and depletion of the resources occurs unless some incentives are introduced to prevent overexploitation (Ostrom, 1999).

The property rights-based policy interventions while effective in specific occasions have often revealed that issue is in the practical implementation details. Specific circumstances and the local context either enabled or prevented the success of such policies (Von Weizsaecker et al. 2005; Acheson 2006; Clark 2006) hence focusing attention only on the governance without taking into account the system where it is embedded will be misleading. A systems approach is useful as it takes on a holistic view of the world and allows for interactions to be discovered (Roling and Jiggins, 1998). Therefore, good governance principles derived from a relatively context-free, general theory will be of little use in practice. Ostrom termed this mismatch as the problem of panacea thinking asked academics and practitioners to move beyond it (Ostrom et al. 2007; Ostrom 2010). The systems approach to resource management aims to explore the complex interactions within the hard system and soft system. Based on the social-ecological systems, known as coupled human and natural systems or human-environment systems, there are interconnections between nature and people. The inter-relationships coevolve constantly making nature and people analytically inseparable (Folke 2006, Liu et al. 2007). Though there is a dynamic complexity in the social-ecological systems, many of these systems are primarily shaped by a relatively small number of variables (Walker et al. 2006). The intractable complexity of the systems can be reduced by identifying and investigating the link between these crucial variables. This will allow useful scientific and policy insights. New ways of thinking, as suggested by the recent literature, are required (if not essential) in managing complex issues of sustaining and enhancing resource condition. Though the range of new methods and methodologies are vast, many of these new ways of thinking have emerged from or embrace the concepts inherent in Systems Thinking (Garavito-Bermúdez et al. 2016) which is a disciplined approach for examining problems more completely and accurately before acting.

A large number of studies have made several management prescriptions for managing agricultural and natural resources either from the national development point of view or from the local-level community perspectives. But only a few studies point towards the inter-relationship among various resources as mediated by institutional arrangements; which have implications for the management of such resources in an integrated manner vis-a-vis poverty reduction. However, there are still several issues such as the failure to comprehend and conceptualize social and ecological systems as coupled systems that adapt, self-organize and are co-evolutionary in the present context of infrastructure development market dependent economies. The coping mechanisms developed by local communities in managing their agricultural and natural resources in the face of labor shortage and global market competition are worth further exploration as a way of effective policy guidelines and feedback.

Specifically, the following issues are of interest:

a. How can the sustainability of efforts to improve the efficiency of community resource systems be assessed in the context of the current debate on the effects of climate change?
b. What are the effective polycentric policy approaches for governance and management of agricultural and natural resources including infrastructures that are environmentally sustainable and locally adaptive to cope with the climate change and global market competition?
c. Is there a prudent way of defining an agricultural and natural resources governance mechanism relating to Coupled Infrastructural Systems and SES in Asia, which can pave way for effective policy interventions for broader participation from multiple stakeholders?

The International Journal of Commons has mostly featured either developed country commons problems or the study conducted by developed country scholars from the developing countries. This special issue is the collection of papers written by the scholars in Asia who have produced good research outputs but have been constrained several factors; English editing being an important constraint. We provided English editing services through Center for the Study of Behavior, Institutions and the Environment (CBIE) at Arizona State University in order to make the manuscripts at par with the writing of native English speakers. This special issue has a collection of papers from the studies conducted by the national scholars of South and Southeast Asia from India, Indonesia, Nepal, Pakistan, and Thailand. We introduce the key themes of findings in each paper.

The first paper on adaptation to climate change in the rain-fed farming system in Punjab, Pakistan discuss the problems faced by farmers who are highly exposed to the adverse effects of climate change due to complete reliance on frequency, intensity, and timing of the rainfall (Bakhsh and Kamran, 2019). Adaptation in such condition according to the authors, becomes crucial to remain in farming in climate change regime and in such settings farm households mostly adapt to risks posed by climate change individually. However, the benefits of private adaptation can be private and public depending on the type of adaptation strategies. By investigating different adaptation strategies of farmers, the study examines the role of socioeconomic characteristics of farmers on adaptation to climate change. The paper concludes that education, farming experience, family size and tractor ownership are significantly related with adaptation to climate change and based on their research findings the study concludes that policymakers should consider the potential difference in private benefits and public benefits resulting from private adaptation to climate change in relation to human capital, family assets, and farm machinery when designing policy interventions for climate adaptations. Thus, the public goods related private adaptations should be encouraged through appropriate policy interventions.

The paper from India, on the other hand, addresses the policy problem related to groundwater commons (Bahinipati and Viswanathan, 2019).) In their paper, the authors point out the possibility of reducing the existing pressure on groundwater in general and dark-regions of Gujarat State in particular with wide-scale adoption of micro-irrigation technologies in Gujarat could reduce the existing pressure on groundwater as these regions have been experiencing unsustainable levels of water extractions. According to the authors, from a macro-perspective, the real water-saving potential of the new micro-irrigation technology paradigm depends on how best the farmers' get convinced about the looming water scarcity and try to adapt to the new technology. They make their argument by examining the impact of micro-irrigation adoption on groundwater utilization at the tube well level. Based on a large number of tube well-owning farmers adopting micro-irrigation systems, the authors conclude that micro-irrigation adoption per se is statistically insignificant to make any considerable reduction in the pressure on groundwater use, and technology adoption along with metered power connection leads to a reduction in groundwater extraction. Thus, in their policy suggestion they caution that the promotion of water-saving irrigation technology alone may not lead to sustainable groundwater conservation outcomes unless the farmers are made to behave responsibly especially under extreme water scarcity conditions. The study also recommends while supporting for adoption of micro-irrigation systems, the state also should effectively regulate the pilferages in farm power use by expediting the process of metering to achieve the desired goals of sustainable management of groundwater commons in the state.

Surahman (2019) makes an argument for development and optimization degraded peatlands for agricultural expansion as an option, although the area is one of the main sources of Green House Gas (GHG) emissions considering the limitations of the highly productive arable land for supporting food security in Indonesia. The paper puts forward specific management strategies to reduce the emission

and to serve the future generations by exploring the existing farming action on the climate change mitigation, and strategies of degraded peatlands management to mitigate climate change in term of reducing GHG emission. The paper has examined the existing condition of mitigation action by farmers in their farming systems and then using multiple research methods. The findings point out that the farmer's existing climate change mitigation actions pertain to land preparation, water management, and soil management in their farming system. The paper further suggests such additional measures as canal blocking system, introducing technology for water and soil management, revitalizing agricultural extension institution as well as establishing fire brigade and improving farmer experience and knowledge on climate change.

The research from another SE Asian country of Thailand has investigated and identified the influencing factors in the adoption of good agricultural practices (GAP) and the decision by small-scale asparagus and sweet corn farmers in producing for export (Laosutsan et al. (2019). The study has its significance for the common pool resource such as wise use of water to produce more with fewer drops of water. This becomes more important considering the comparative advantage of efficient use of water for the SE Asia region as the crops are produced for both domestic and regional consumption. The analysis of the household survey results revealed that the income variable is the most influential factor in the GAP adoption by participating vegetable farmers and that the location factor exerts the most influence over the growers' export decision. In addition, to effectively increase the GAP adoption rate among the Thai agriculturists, the exporters and relevant government agencies should make GAP certification compulsory which has big imprint of efficient use of water-saving technology.

While the first study from Pakistan discussed the issue of climate change adaptation problems faced by rain-fed farmers in plain areas of Punjab Pakistan, the second study has focused on land ownership and catastrophic risk management in agriculture from analysis of the Case of rugged areas in Khyber Pakhtunkhwa Province of Pakistan (Ullah et al. 2019). The paper identifies a number of threats in agriculture sector from the growing instability in production levels arising mainly due to adverse weather conditions and these climatic risks are usually beyond the control of farmers and are mostly uncertain. But managing these risks and uncertainties is crucial in the effort to safeguard food security and alleviate poverty for the farmers. The study points out the importance of land tenure agreements along with other socioeconomic factors which play an important role in a farmer's decision to adopt sophisticated risk coping tools. The results of the study also reveal that the adoption of traditional risk coping tools is relatively higher among landless tenants when compared with owner-cum-tenant farmers and owner farmers. However, for formal risk coping tools (agricultural credit) tenant farmers have significantly lower access when compared with owner farmers. Owner farmers, on the other hand, can access financial institutions to lessen their burden of risks. Therefore the study suggests the financial institutions facilitating tenant farmers' access to credit facilities by accepting animal/crops as collateral.

The final paper from Nepal discusses in detail on how local institutions cope with and adapt to combined environmental and socio-economic changes by using the case of 12 farmer-managed irrigation systems (FMIS) in Central and Western Nepal (Thapa and Scott, 2019). The findings from the paper re-emphasize the importance of local irrigation institutions which manage water stress using diverse and integrated approaches broadly categorized as structural and operational measures. Structural measures include water-source expansion and infrastructure rehabilitation works whereas water re-allocation and drought contingency rules are examples of operational measures. The paper further emphasizes the integration of structural and operational measures which is more prevalent in highly water-stressed irrigation systems than less stressed ones. Thus, the choice of adaptation strategies has direct implications for agricultural productivity, and, thus FMIS which implement structural measures have harvested more crops per year than those systems that adopted only operational strategies or no adaptation strategies. According to the authors, climate variability and change act as a threat multiplier because they compound the existing threats the FMIS face from social and economic changes. Thus, the key to effective integration of structural and operational measures that help FMIS to maintain their productivity during water stress is collective action and governance to overcome biophysical limitations which re-emphasizes the importance of polycentric and self-governance mechanism as forwarded by Ostrom.

Competing Interests

The authors have no competing interests to declare.

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