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Integrated Climate Action in the Context of the Water-Land Nexus: Centrifugal Force vs. Centripetal Force

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Abstract

This paper aims to promote integrated climate action in the context of the water-land nexus by highlighting the interrelations between mitigation and adaptation interventions as well as the interlinkage of water and land sectors. Due to growing concerns on water security associated with climate change, more innovative tools to address water security are needed.
The water-land nexus is useful to promote the efficient resources management, effective risks management, and sustainable development as well as to address water security. Key centrifugal force and centripetal force for integrated climate action in the water-land nexus are identified, which are reflected in the following policy recommendations:

1) a holistic assessment of climate action;
2) a precautionary approach;
3) integrated development planning processes in the context of the water-land nexus; and
4) balanced approach to empower key actors in both water and land sectors.

Keywords

Integrated climate action, water-land nexus, centrifugal force, centripetal force, water security

01
Introduction

One of the most significant UN initiatives is the 2030 Agenda for Sustainable Development, which are specified within the internationally agreed 17 Sustainable Development Goals (SDGs) and 169 targets. Based on the lessons learned from the 'Water for Life' decade,[1] a comprehensive water goal (SDG 6) was developed, aiming to 'ensure availability and sustainable management of water and sanitation for all'. According to UN-Water, the water goal is highly linked with other SDGs, so it is central in achieving the SDGs (refer to Figure 7-1).[2] Due to the key role of water in economic, social, and environmental aspects of the SDGs framework, there are growing interests in ensuring water security.

Water security is very complicated, so it is often considered beyond the traditional water sector. By applying a nexus approach, cross-sectoral issues can be more efficiently addressed and some interlinked sectors can make collective efforts to explore co-beneficial solutions. The water-land nexus has been primarily promoted by the agricultural sector and food security, coupled with water security, becomes the core issue in this nexus. Although food security is still an urgent issue particularly in the developing countries, the water-land nexus should also focus on other important issues such as competing goals and unsustainable uses of the limited water and land resources in support of rapid urbanization and industrialization. Since climate change is considered as one of the common challenges to water security and food security, climate change should be addressed in the water-land nexus.

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The Paris Agreement, the new global climate deal, finally entered into force on 4 November 2016, which requires more robust climate action towards a climate neutral world. In the climate negotiations, the collective mitigation goal (*e.g.* 2°C or 1.5°C temperature limit) had been always highlighted, so the political agenda and investment focused on national or sectoral emissions reduction targets and mitigation interventions that reduce the sources or enhance the sinks of greenhouse gases (GHG). As climate-related risks had been noticeably increased, however, the significant need for adaptation was recognized by international and national decision makers as well as local communities and governments. In the Paris Agreement, countries agreed to further promote adaptation interventions to reduce vulnerability and build resilience to the impacts of climate change and also apply a balanced approach to climate finance and international support for between mitigation and adaptation.[3]

Although the UN Framework Convention on Climate Change (UNFCCC) is the primary forum for global negotiations on climate change, SDG 13 also provides a basic framework to promote and track climate action by focusing on the importance of 'urgent action to combat climate change and its impacts'. Integration is particularly highlighted in SDG 13 targets and indicators, which do not include only mitigation and adaption, but also disaster risks reduction/ impact reduction/early warning, technology transfer and development action in the context of policy/strategy/plan or education.[4]

While the importance of integrated climate action has been widely recognized in the international frameworks for climate change, climate action has been rarely integrated in the national context of climate policy or development plan as well as in the context of the water-land nexus. This paper aims to promote integrated climate action in the context of the water-land nexus. Through literature review, it explains what integrated climate action means in the context of the water-land nexus and why this nexus context is proposed to combat climate change. And then, it explores how to nurture climate action by identifying centrifugal force or centripetal force for its integration.

Figure 7-1 *SDG 6 infographic on the linkages between the water targets and other SDGs (Source UN Water. http://www.unwater.org/app/uploads/2017/05/SDG6-Interlinkages-1and2.pdf/)*

02

Literature Review: Interlinkages between Mitigation and Adaptation

Mitigation and adaptation measures have been separately implemented until recently. Mitigation interventions can proactively reduce climate risks, but it is impossible to completely avoid climate risks, which requires reactive adaptation interventions to deal with negative and often irreversible effects caused by unavoidable climate risks. It is recognized that mitigation and adaptation are complimentary to deal with climate change and that the climate neutral world can be achieved by incorporating both mitigation and adaptation measures into the development pathway towards low GHG emissions and climate-resilience.

Climate expert groups such as the Intergovernmental Panel on Climate Change (IPCC) identified co-benefits and synergies as well as common enabling factors and constraints for mitigation and adaptation e (IPCC, 2014c). In order to ensure the effectiveness of the integration, it is fundamental to understand the differences, commonalities, and interlinkages between mitigation and adaptation measures.

2.1. Differences between Mitigation and Adaptation

a) **Objective**: Mitigation is to limit anthropogenic GHG emissions in the atmosphere by reducing the causes of climate change, while adaptation is to deal with the impacts of climate change by enhancing resilience to climate risks and impacts.

b) **Key parameters**: Mitigation focuses on emission factors or total emissions, while adaptation focuses on vulnerability and resilience.

c) **Priority**: The priority groups (locations or sectors) for mitigation have the high levels of GHG emissions, sufficient financial resources, or cost-effective mitigation measures, while adaptation prioritizes the most vulnerable groups to climate risks.

d) **Approach**: The primary approach for mitigation is command-and-control, market-based, or technical, while adaptation often relies on a process-based or community-based approach. By establishing standards for GHG emissions or energy efficiency, many countries apply a command-and-control approach. The typical policy instruments of a market-based approach are carbon taxes, GHG emissions trading system (ETS), and the Clean Development Mechanism (CDM).[5] A one-off adaptation intervention cannot cope with the long-lasting and irregular impacts of climate change over time, so adaptation requires a process-based approach for socio-institutional learning and iterative climate action.[6] Due to the importance of inclusive and participatory climate action, community-based approach (CBA) to climate change adaptation has been promoted by many organizations such as CARE, United Nations Development Programme (UNDP), and International Institute for Environment and Development (IIED).[7]

e) **Spatial and time scale of impacts (Tol, 2005)**: Benefits from mitigation interventions are not directly associated with those who bear the mitigation costs but distributed to global communities and future generations. Adaptation interventions generally benefit local communities immediately or in a relatively short period.

f) **Driver of climate action**: Mitigation has been historically driven by international agreements, while adaptation has been often driven by the needs of local communities or governments. Climate actions can be taken at all different governance levels.

g) **Boundary of projects**: Mitigation requires a relatively specific and smaller boundary (*e.g.* one plant) for projects, while adaptation requires a broader project boundary by considering community-based situation or natural and human systems.

h) **Uncertainty level (IPCC, 2014b)**: Climate change is complex so it is important to understand the uncertainty level. Uncertainties associated with climate interventions may vary widely across different measures, sectors or operational conditions. Many factors (such as economic development, natural system, policies, financial capital, technological innovation, social characteristics and cultural norms/values) unevenly influence the effectiveness of mitigation or adaptation, so it is not easy to determine the level of uncertainty ex ante. Compared with adaptation, however, mitigation seems to face a lower level of uncertainty because measurement, reporting, and verification (MRV) technique for mitigation interventions is advanced, accumulated experience and knowledge (data/information) of mitigation activities are well recorded, and global attention and obligations are quite intensive.

2.2. Commonalities between Mitigation and Adaptation

a) **Complementary risk management**: Proactive mitigation interventions that reduce climate risks and reactive adaptation interventions that cope with unavoidable climate risks are complementary rather than substitutive. To effectively manage climate risks, therefore, a portfolio of diverse mitigation and adaptation interventions is required for climate policy. It is noted that many of current

adaptation interventions can be more proactively (*e.g.* before the real impacts are observed) employed due to the ongoing development of technologies in modeling, analysis and evaluation on climate sensitivity and adaptive capacity, (IPCC, 2014a).

b) **Sustainable development**: Mitigation and adaptation both have implications for sustainable development since they share common goals such as efficient resource management and equal access to resources. Climate action in the developing countries can be more effectively implemented by addressing development challenges such as poverty, food security, water security, and education. Therefore, the conceptual framework of sustainable development is required for the effective integration between mitigation and adaptation (Harry and Morad, 2013). Many development agencies such as UNDP, Green Climate Fund (GCF), and World Bank have already prioritized development projects relevant to both mitigation and adaptation.

c) **Implications for other policies**: Mitigation and adaptation also have implications for environmental policy because climate action results in ancillary benefits[8] such as reduced air pollution or reinforced biodiversity. According to the IPCC (IPCC, 2014a), environmentally sound technologies can be beneficial to combat climate change in terms of both mitigation and adaptation. So, technological development paths are often determined for both climate action and environmental sustainability.

2.3. Examples of the Interlinkage between Mitigation and Adaptation

a) The IPCC report (IPCC, 2007) provides various examples and implications for the interrelationships between mitigation and adaptation:

- Four types of interrelationships between adaptation and mitigation are identified. The first type is adaptation actions that have consequences for mitigation. The second type is mitigation actions that have consequences for adaptation. The third type is decisions that include trade-offs or synergies between adaptation and mitigation. And the last type is processes that have consequences for both adaptation and mitigation.
- There will be significant benefits from integrated (mitigation & adaptation) interventions, especially for high climate sensitivities and in sectors/regions that are already showing signs of being vulnerable. National vulnerability index analysis (with and without mitigation) implies that mitigation can reduce vulnerability in terms of exposure and sensitivity to climate change.
- The impacts of adaptation on mitigation can be both positive and negative and vice versa. On the operational scale of most projects, however, the impacts of adaptation interventions are unlikely to be significant to mitigation.
- Short-term mitigation interventions (*e.g.* hybrid forest plantations) may pose a threat to adaptation (*e.g.* low biodiversity and ecosystem resilience).

b) The latest IPCC report (IPCC, 2014a) highlights the positive interrelationship between mitigation and adaptation:

- Mitigation will reduce the rate and magnitude of future climate change, which can minimize the likelihood of exceeding critical threshold of adaptation. However, it should be noted that the impacts of mitigation interventions on adaptation will appear in the future so the current interlinkage between mitigation and adaption is less noticeable and that the threshold of adaptation is relative and site specific. That is, the possible impacts of climate action will vary over space and time.
- Knowledge about adaptation can be used to determine the level and timing of mitigation. However, much knowledge about adaptation is dominated by community-based case studies, which may limit general applications of the knowledge.

c) Dang *et al.* (2003) illustrate how to incorporate adaptation benefits in a mitigation project by conducting a case study of Vietnam:

- By linking both adaptation benefits and sustainable development criteria in the analysis of potential Clean Development Mechanism (CDM) projects, they identify mitigation projects can have ancillary benefits of adaptation.
- They insist that an integration framework for adaptation and mitigation should be established and incorporated in a development policy by demonstrating potential interlinkage between adaptation and mitigation.

d) Based on review of 112 adaptation and 123 mitigation projects in different portfolios that include CDM and Community and Biodiversity Standard (CCB) projects, the Center for International Forestry Research (CIFOR) study[9] shows that mitigation projects have higher potential for adaptation:

- 78% of the adaptation projects had the potential co-benefits of mitigation.
- 100% of the mitigation projects had the co-benefits of adaptation, which doesn't mean that mitigation projects will automatically generate adaptation benefits. The study implies that the potential of mitigation projects for adaptation will be promoted through coordinated project design for the effective integration.

e) The CDM has been designed and implemented to connect mitigation interventions with adaptation potential as well as sustainable development:

- The Adaptation Fund is financed with a share of proceeds (2% of CERs) from issued CDM project activities. Adaptation can be further promoted by this Fund when the scalability of the CDM is facilitated.

- The UNFCCC secretariat develops the 'Sustainable Development co-Benefits Tool' that enables project participants to voluntarily report the sustainable development co-benefits of their CDM projects. So far, not many CDM project participants use the SD tool, but the published reports demonstrate that their projects contribute to sustainable development.[10]

Although there are various practical research and assessments to confirm the interrelationships between mitigation and adaptation, many national climate action plans do not seem to take their interrelationships and synergies into account. According to a synthesis report[11] from the UN secretariat that supports global climate change negotiations under the United Nations Framework Convention on Climate Change (UNFCCC), most countries announced their mitigation and adaptation commitments but only several countries specified sectors and some example measures that could generate synergies between mitigation and adaptation and a few countries (*e.g.* Burkina Faso and Chile) reported that they would apply an integrated approach. This synthesis report confirmed that most countries identified key sectors and sector-specific work programmes and policies separately for mitigation or adaptation, while some countries highlighted a cross-sectoral approach or the nexus of key sectors such as energy and of interest here, water and land (focusing on agriculture and forestry).

"Climate neutral world can be achieved by incorporating both mitigation and adaptation measures into the development pathway towards low GHG emissions and climate-resilience."

03

Key Sectors and Sectoral Approach to Combat Climate Change

In the context of climate change, mitigation or adaptation interventions have been implemented primarily by key sectors. The key sectors for mitigation include energy, building, transport, industry, waste, and land use sectors that have high emissions or high potential for emissions reduction, while the key sectors for adaptation include water, agriculture, human settlement, health, and ecosystem sectors that are most vulnerable to the impacts of climate change (IPCC, 2007). The IPCC and other international expert groups identify the key sectors for mitigation and also those for adaptation, but the key sectors are varied depending on country-specific situations in terms of the economic, social and environmental aspects.

Since mitigation interventions will generate global benefits for later generations rather than direct benefits for those who implement mitigation interventions or bear mitigation costs, it is necessary to establish regulatory or incentive frameworks to promote mitigation interventions in the key sectors. Mitigation measures such as energy-efficient technologies or efficient resources management can somehow compensate the increased investment costs, but costs of most mitigation measures overweigh direct benefits for the implementers. So, regulatory or incentive frameworks are developed to remove market barriers, increase market opportunities, promote technology development, and provide financial supports. Some key sectors, particularly the industry sector, apply a global sector-based approach and promote international collaborations to reduce GHG emissions through voluntary Agreements and actions (*e.g.* cement sustainability initiative).[12]

Through sectoral vulnerability assessments, countries can identify and manage future threats and implement sector-specific adaptation measures, which can produce local benefits directly for the target groups. As climate-related stresses and risks are increasing, incentives of the vulnerable sectors become stronger to implement adaptation interventions. However, vulnerable sectors and groups often do not have sufficient resources and knowledge for the implementation, so sectoral adaptation measures can be implemented more cost-effectively by integrating into relevant socio-economic and environmental policies and projects. Since traditional knowledge and practices of local communities, specific landscape scopes of local ecosystems, and broad participation are important in successful adaptation interventions, community-based approaches are highly recommended.

Water sector and land use sector are very important in the context of climate change because both are the key vulnerable sectors and also their contributions to climate

mitigation can be significant. Adaptation interventions to cope with climate-related risks in the water sector and measures to ensure water security are often similar or produce co-benefits. For example, the water sector has expanded and improved water systems ranging from water sources to end users and adopted innovative technologies for rainwater harvesting, groundwater recharging, desalination, water recycling/reuse, and water conservation, resulting in contributions to both climate change and water security. Adaptation interventions such as coastal protection infrastructure and stabilization of river can also help ensuring water security. By utilizing the advanced information & communication technology (ICT) and monitoring techniques, flood control and water systems can be more effectively managed.

Nicol & Kaur (2009) identify that most of adaptation plans found in the National Adaptation Programmes of Actions (NAPAs)[13] are supply-side interventions. Since the NAPAs are prepared by Least Developing Countries (LDCs) and most LDCs are suffering from water scarcity, their priority needs are to explore and secure water resources. In many other countries, supply-side interventions are still dominant. In South Korea, for example, the 'Four Major Rivers Restoration Project (4MRRP)' was proposed as one of the key adaptation interventions and performed multiple tasks such as water security, flood control, and community development, but it was highly associated with supply-side interventions. However, remaining or emerging challenges and problems in the water sector cannot be fully addressed by supply-side interventions, and they may be rather intensified due to competing objectives and inconsistent strategies of water security and climate action.

The water sector is one of the largest energy consumers, so the sectoral emissions can be reduced through energy efficiency (*e.g.* efficient pumping), fuel switch (*e.g.* from coal to LNG), water saving (*e.g.* water-loss control) and system monitoring including metering of water consumption. The water sector makes a significant contribution to GHG emissions reduction directly by developing renewable energy plants using hydropower. Wastewater treatment plants can be climate neutral by establishing systems for heat recovery, biogas electricity generation from anaerobic treatment, and sludge recycling/incineration.[14] Table 7-1 summarizes key adaptation and mitigation interventions in the water sector and also includes some interventions for both adaptation and mitigation.

Climate change intensifies water scarcity and flooding, so the causal relationship between climate change and water becomes more noticeable and the impacts of climate change on water resources have attracted more attention than their reciprocal relationship. Therefore, the mitigation potential is not fully considered in the water sector and some counter-productive outcomes of adaptation measures on GHG emissions associated with the land sector are sometimes overlooked.

Land is the key resource that has been used for various purposes such as human settlement, agriculture, forestry, and water. In the context of climate change, 'Land Use, Land-Use Change and Forestry' (LULUCF) sector had been developed, which was replaced by 'Agriculture, Forestry and

Adaptation interventions	Mitigation interventions
Augmentation & Improvement of water supply system	Hydropower
Groundwater recharge	Energy efficient pumping
Rainwater harvesting	Fuel switch (to low carbon intensity)
Water recycling and reuse	Heat recovery
Desalination	Biogas electricity generation
Coastal protection infrastructure	Sludge recycling/incineration
Stabilization of river/ Flood control	CH_4 recovery/reduction
Water conservation and saving	
System monitoring	
Integrated Water Resource Management (IWRM)/ Water governance	
Public awareness and Education	

Table 7-1 Adaptation and mitigation interventions in the water sector

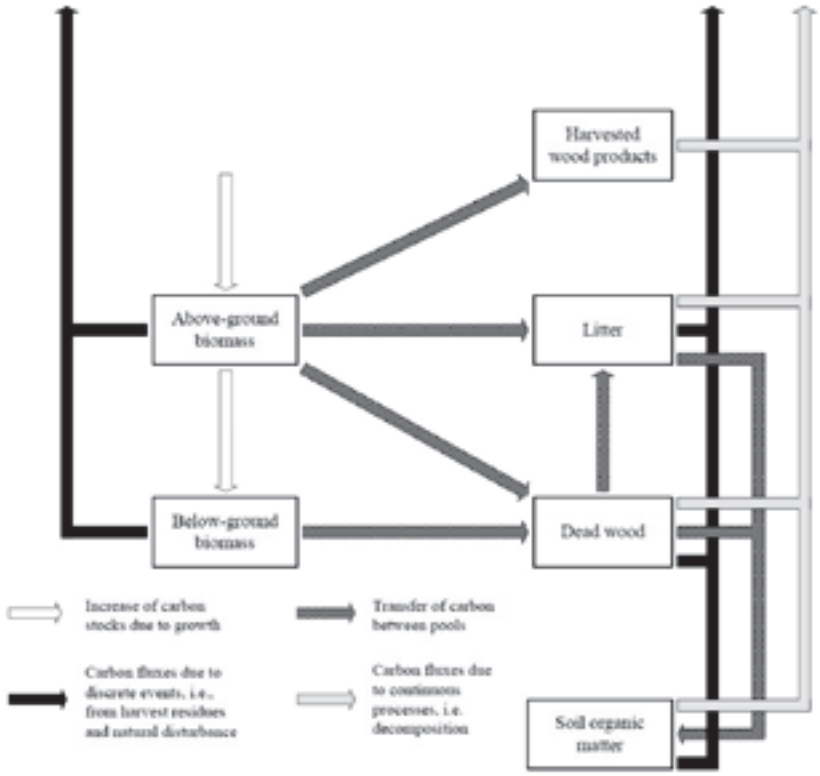

Figure 7-2 Generalized carbon cycle of terrestrial AFOLU ecosystems (Source 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Vol 4, Chap 2.)

Other Land Use' (AFOLU) sector.[15] However, instead of AFOLU, the term of LULUCF is widely used because the LULUCF sector still remains in the GHG inventories. In accordance with the Good Practice Guidance for LULUCF developed by the IPCC, the changes in carbon stocks and GHG emissions caused by land-use change can be estimated and monitored, so mitigation interventions in the land sector focuses on land-use change in order to understand the reciprocal relationship between climate change and land change. Figure 7-2 shows carbon cycle of ecosystem in the LULUCF sector.

According to United Nations Convention to Combat Desertification (UNCCD), one fourth of total global emissions come from the land-use sector.[16]
The land development, mainly the land conversion to agricultural land, is responsible for deforestation and the loss of carbon storage. The land sector has contributed to enhance the sinks of GHG by implementing afforestation and reforestation (A/R)[17] and by avoiding deforestation. The land sector has also contributed to reduce the sources of GHG emissions by generating bioenergy or applying effective wetland restoration (*e.g.* peatland rewetting).

Land is also vulnerable to climate change, so various adaptation measures are implemented to increase the resilience and improve the adaptive capacity, which includes adjustment of planting practices, crop variety, crop relocation, erosion control, soil conservation and disturbance control. The land sector generally serves both mitigation and adaptation functions, but the integration between mitigation and adaptation are not based on synergy but on co-benefits (Duguma *et al.*, 2014).[18]
That is, when climate action either for mitigation or adaptation is implemented in the land sector, the co-benefits are intentionally considered or unintentionally delivered, but synergy is not systematically considered to generate more beneficial outcomes. Table 7-2 summarizes key adaptation and mitigation interventions in the land sector, which shows that many interventions in the land sector can be implemented for both adaptation and mitigation.

Adaptation interventions	Mitigation interventions
Sustainable crop and soil management	Low emissions agriculture
Erosion control	Agro-forestry
Disturbance control	Bioenergy generation
Ecosystem conservation and restoration	
Afforestation and reforestation (A/R)	
Water & Energy efficient irrigation techniques	
Integrated land use planning	
Public awareness and Education	

Table 7-2 Adaptation and mitigation interventions in the land sector

04

Climate Action in The Context of the Water-Land Nexus

The water-land nexus is driven by pollution, scarcity and economics (Nkonya *et al.*, 2011).[19] Since water and land can be a pollution source for each other, integrated water-land management is called for to promote the co-benefit of reducing pollution loads in water and soil. Particularly, non-point source (NPS) pollution that is widely distributed through rainfall or snowmelt can be effectively controlled only in the context of the water-land nexus. Due to the overuse/exploitation of water resources and drought, water scarcity becomes a major constraint for land development. Water development (*e.g.* dam development) requires land-use changes, which often reinforce social conflicts and competing interests over limited land resources. For sustainable development, access to and productivity of water and land should be further improved as well as coordinated conservation strategies and integrated development planning processes of water and land should be promoted.

Due to the interdependencies and interactions of water and land resources, each sector recognizes the need for cooperation in order to manage negative consequences or restricted conditions caused by the other sector. Based on cooperation experience and successful achievements in risks reduction and resource use efficiency, the water-land nexus has been widely applied. The water-land nexus has been further enhanced through integrated planning processes that intensify development opportunities and potentials. That is, the water-land nexus is useful to promote the efficient resources management, the effective risks management, and sustainable development. A nexus approach focuses on synergies, trade-offs, and cross-sectoral governance and management, which can promote sustainable development (Hoff, 2011).

Climate change is one of the core challenges in both water and land sectors. Since water security and food security are significantly influenced by climate change, climate change is considered as a risk factor and strong efforts are put on adaptation in the context of the water-land nexus. Climate action (for mitigation and/or adaptation) may result in synergies between the water and land sectors or may result in counter-productive outcomes across the sectors. By applying the integrated assessment of climate action and using empirical evidences in the IPCC's technical paper (IPCC, 2008),[20] three types of integration are identified in the water-land nexus.

The first type of integration in the water-land nexus is adaptation measures in one sector that have consequences for adaptation and/or mitigation in the other sector. For example, irrigation efficiency, one of the main adaptation measures in the land sector, will contribute to water-saving and energy-saving and consequentially deliver co-benefits for adaptation and mitigation in the water sector. Rainwater harvesting is one of the adaptation measures in the water sector, which reduces the needs of water development and the likelihood of land-use changes that may cause deforestation. Dam and reservoirs, adaptation measures in the water sector, require land-use changes, so such adaptation measures can have negative impacts on mitigation in the land sector.

The second type of integration in the water-land nexus is mitigation measures in one sector that have consequences for adaptation and/or mitigation in the other sector. For example, wetland restoration is implemented to reduce the sources of GHG emissions in the land sector by rewetting drained peatlands, which can contribute to improve the adaptive capacity in the water sector through enhanced flooding control. In order to replace petroleum fuels, it is often promoted to generate bioenergy, which may increase competition for limited land and water resources (Hoff, 2011). Hydropower considered as one of the effective mitigation measures in the water sector will change land-use and land-cover types and intensify competitions over water resources, which may have negative impacts on mitigation in the land sector as well as adaptation in the water sector.

The third type of integration in the water-land nexus is climate action that have both mitigation and adaptation functions across sectors. Afforestation and reforestation (A/R) will enhance the carbon sinks and adaptive capacity of ecosystems, so this intervention has integral mitigation and adaptation functions. However, A/R projects demand more water, so A/R can reduce water resources, resulting in negative impacts on adaptation in the water sector. When fast-growing alien species are selected to improve the efficiency of A/R, biodiversity can be reduced, which results in negative impacts on adaptation in the land sector. If no trade-offs are considered between mitigation and adaptation in the water-land nexus, the negative impacts can be significant (IPCC, 2007).

Figure 7-3 demonstrates an approach to understand integrated climate action in the water-land nexus, which includes key drivers (*e.g.* sustainable development and cross-sectoral governance/management) and challenges (*e.g.* competing objectives, limited resources, and growing risks).

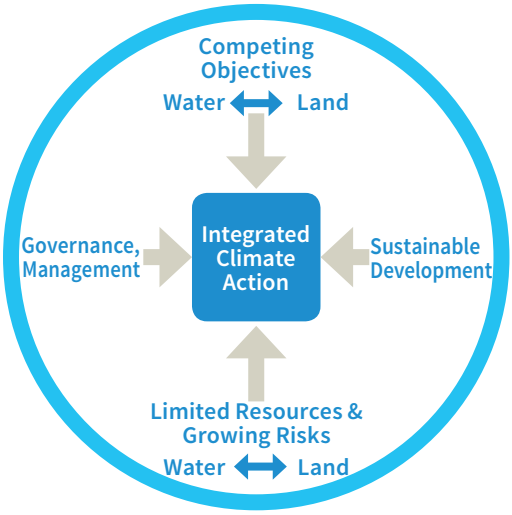

Figure 7-3 *Approach on integrated climate action in the water-land nexus*

05

Centrifugal vs. Centripetal Force of the Effective Integration

Four sections (*e.g.* adaptation in water, mitigation in water, adaptation in land, and mitigation in land) are introduced for the integration between mitigation and adaptation within the water-land nexus as specified in Figure 7-4. Each section has its distinct scope and specific objective, and its independence can be further enhanced by the following centrifugal forces:

- Complexity and Uncertainty: A high level of uncertainty persistently remains in this complex nexus area of climate change, so current knowledge of the integration between mitigation and adaptation is limited. Due to the lack of empirical data, robust evidences derived from quantitative assessments of their relationships are insufficient.
  The knowledge gap in assessing the opportunities and risks associated with the four sections is the key cause for the lack of awareness and actions on their effective integration. Diverse socio-economical and political settings reinforce complexity and uncertainty in addressing climate change in the water-land nexus.
- Sectoral approach: As described above, a sectoral approach is widely applied to combat climate change. That is, most mitigation and adaptation interventions have been implemented by each sector, which can result in unintended negative consequences to other sectors, particularly when they are not coordinated. Cross-cutting issues are mainly associated with risks and problems, which can be effectively addressed by coordinated governance and management. However, a sectoral approach makes it difficult to sustain coordination across sectors, which often fails to identify and ensure potential synergies.
  The lack of knowledge communication across sectors and expert-dominant governance reinforce the sector approach. Kim *et al.* (2017) identify that knowledge flows across water and agriculture sectors in Korea are very limited and problematic at the community, local, provincial, and ministerial levels. Recently the nexus approach has been applied, but knowledge-sharing and collaboration among sectoral experts rarely go beyond the sectoral scope.
- Institutional fragmentation: Since climate change becomes the top priority of political agenda in many countries, most governing bodies (including centralized and polycentric) are involved in addressing climate change.
  However, the institutional arrangements are rather diverse and fragmented. Also, coordinated governance is a token effort (tokenism) or difficult, particularly at the planning stage. Due to the broad scopes of water and land, the participations of multiple stakeholders and decision-makers are required. Governing bodies organized along hierarchical lines are often unfamiliar with horizontal communications across segmented water and land authorities, so it is difficult to apply a coherent approach to climate change and take conflicting interests and goals of participants into account.
- Trade-offs without synergies: Due to the limited resources, trade-offs between competitive mitigation and adaptation measures are often needed. If mutually aligned, mitigation and adaptation can deliver synergies. Through simple checklists, positive lists, or negative lists, synergies can be enhanced and/or negative consequences can be minimized. In fact, the integration can be effective when trade-offs and synergies are assessed coherently and comprehensively. However, there are few reliable assessment tools available to quantify both synergies and trade-offs.
  Therefore, synergies are rarely considered and trade-offs are made primarily based on political priorities and dynamics. In the nexus context, there are more opportunities for synergies and less needs for trade-offs, which should be further explored.

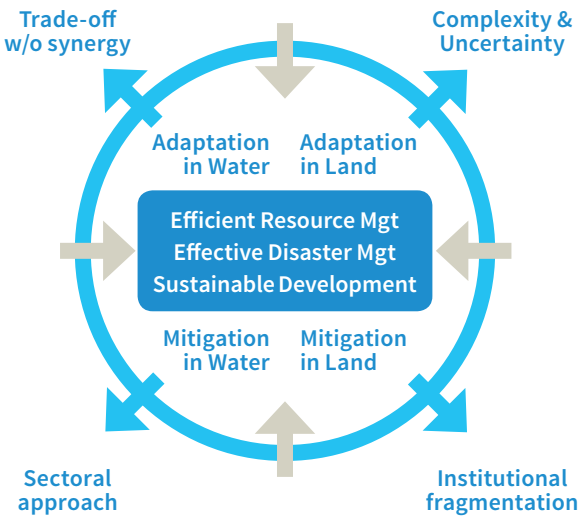

Figure 7-4 *Centrifugal vs. centripetal forces of the integration*

While the centrifugal forces can enhance the independence of each segment, the centripetal forces can promote their integrations. It should be noted that each segment cannot be completely independent and they are inherently overlapped or linked. The core functions of all the four segments are highly associated with resources management, disaster management, and sustainable development. Therefore, the four segments can be effectively integrated in achieving the common goals of resource efficiency, disaster risks reduction, and sustainable development, which can deliver joint mitigation and adaptation outcomes in the water-land nexus. Coordinated governance and enhanced capacities are needed to ensure the centripetal forces working for the integration. Above all, sustainable development is critical to promote the integration.

06

Conclusion: Policy Recommendations

Although water security is a more comprehensive and inclusive issue compared to water scarcity, water scarcity is the most prominent and common threat, which has been addressed mainly by the top-down, supply-oriented approach. Physical and socio-economic water scarcity is not yet fully addressed. Increasing transparency issues and conflicts associated with water scarcity exacerbate water security, so the importance of water governance[21] has been widely recognized. Water governance consists of complex systems for dynamic decision-making related to water resources and public-private cooperation, and political element is particularly important (Batchelor, 2007). Due to the interdependences between water and other sectors, water governance also calls for cross-sectoral collaboration, and communicative governance should be further enhanced. In order to address climate change challenges in the context of the water-land nexus, good water governance is essential.

To promote the effective integration between mitigation and adaptation in the context of the water-land nexus, policy options can be considered to weaken the centrifugal forces or strengthen the centripetal forces, which include efforts to fill the knowledge gaps, systematic data collection and assessment, institutional reform, enhanced coordination, and cross-sectoral collaboration. Here, some feasible recommendations are proposed.

> *"Efforts to fill the knowledge gaps, systematic data collection and assessment, institutional reform, enhanced coordination, and cross-sectoral collaboration are needed for integrated climate action."*

- **A holistic assessment of climate action** should be enhanced at the preparation, planning and evaluation stages. For example, environmental impact assessment (EIA) can be improved by incorporating both adaptation and mitigation components into the assessment requirements of programmes and projects. The assessment should be quantitative and integrated, based on systematic monitoring schemes and data collection. It is also important to identify and evaluate context-specific conditions, driving factors and enabling environments for synergies and negative outcomes.
- **A precautionary approach** should be applied to reduce counter-productive consequences of climate action. A comprehensive checklist can be useful to identify risks of negative outcomes of climate actions. If robust evidences are accumulated at the local and project level, a negative list (associated with counter-productive consequences) or a positive list (associated with synergies and co-benefits) of mitigation interventions and adaptation interventions can be developed within specific application conditions.
- **Integrated development plans** should be developed in the water-land nexus and climate action should be mainstreamed. In many countries, national development plans generally incorporate long-term perspectives of multiple sectors but rarely consider cross-cutting strategies, effects or impacts. Since water and land are key sectors in national development plans, the water-land nexus approach can be applied to develop national development plans or water resources development plan and land development plan can be combined in a coherent manner. Given that spatial and time scale of impacts from mitigation or adaptation interventions are different, a long-term comprehensive plan should be developed to maximize cost-effectiveness, increase co-benefits, minimize counter-productive consequences, avoid inefficient duplications, and reduce inconsistencies.
- **Balanced approach** to empower key actors in both water and land sectors is needed. Particularly, the participation and capacity of local institutions should be enhanced. Expert-produced knowledge is important but not enough to fully understand the complicated local contexts, so local knowledge should be further identified and accumulated.

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Notes

1. In 2003, the resolution on the 'Water for Life' decade was adopted and promoted by the United Nations General Assembly in order to achieve the environmental sustainability goal (Millennium Development Goal 7) focusing on safe drinking water and basic sanitation (A/RES/58/217). In 2015, the 'Water for Life' decade was closed with some remaining challenges and problems.
2. http://www.unwater.org/publications/sdg-6-infographics/.
3. Authentic texts of the Paris Agreement are available in six languages (Arabic, Chinese, English, French, Russian and Spanish) at http://unfccc.int/paris_agreement/items/9485.php.
4. The UN develops the 'Sustainable Development Knowledge Platform', where all SDGs' progress and relevant information have been communicated. Specific progress of SDG 13 in 2016 and 2017 is available at https://sustainabledevelopment.un.org/sdg13.
5. At the national level, carbon taxes can be set for GHG-intensive goods such as coals. ETS can be established for countries or companies at the regional or national level by setting an emission target for each participant and allowing them to buy and sell emission allowances or reductions credits. CDM established under the Kyoto protocol is a project-based market mechanism. Project participants can earn certified emission reductions (CERs) when their projects implement mitigation measures and reduce GHG emissions below the baselines of their emissions. More information is available at https://unfccc.int/index.php/topics/market-and-non-market-mechanisms/the-big-picture/what-are-market-and-non-market-mechanisms.
6. http://www.sdgfund.org/sites/default/files/ENV_CASE%20STUDY_Philipines_community%20based%20adaptation%20in%20agriculture.pdf.
7. In 2010, the Global Initiative on Community-Based Adaptation (GICBA) was launched by IIED.
8. Bollen *et al.* (2009) provide a variety of evidences on the co-benefits of mitigation interventions, particularly focusing on the reduction of local pollutants
9. https://www.forest-trends.org/ecosystem_marketplace/forest-ag-projects-can-combine-adaptation-and-mitigation-cifor-study/
10. http://cdmcobenefits.unfccc.int/Pages/SD-Reports.aspx
11. 'UNFCCC synthesis report on the aggregate effect of the Intended Nationally Determined Contributions (INDCs)' summarized the 189 INDCs submitted as of 4 April 2016, which is available at http://unfccc.int/focus/indc_portal/items/9240.php.
12. https://www.wbcsd.org/Sector-Projects/Cement-Sustainability-Initiative.
13. In 2001, the NAPAs, a Least Developed Countries Fund (LDCF), and an LDC Expert Group (LEG) were established to support LDCs in addressing their vulnerability. More information is available at https://unfccc.int/topics/resilience/workstreams/national-adaptation-programmes-of-action/introduction.
14. Germany federal agency (BMZ) introduces several effective mitigation measures in the water sector, and provides calculated potential CO_2 reductions of each measure. More information is available at https://wocatpedia.net/images/9/9e/00_GIZ_Climate_Change_Mitigation_in_the_Water_Sector.pdf.
15. In 2003, the IPCC developed the Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG-LULUCF) in order to provide guidance for the calculation of carbon stock changes and GHG emissions in the LULUCF sector.
The 2006 IPCC Guidelines for National Greenhouse Gas Inventories improved the GPG-LULUCF, which included the introduction of AFOLU. available at https://wocatpedia.net/images/9/9e/00_GIZ_Climate_Change_Mitigation_in_the_Water_Sector.pdf.
16. https://www.unccd.int/issues/land-and-climate-change.
17. Afforestation and Reforestation (AR) is highlighted as one of the key sectors for mitigation projects, particularly under the Clean Development Mechanism (CDM). Reducing emissions from deforestation and forest degradation (REDD) is another initiative offering financial incentives to increase carbon stocks through forest conservation.
18. Duguma, L. A. and his colleagues explored complementarity (co-benefits) and synergy between mitigation and adaptation in the land sector, based on Tanzania's ecosystem.
19. FAO's report on sustainable land and water management addressed the key issues in the land-water nexus, which is available at http://www.fao.org/fileadmin/templates/solaw/files/thematic_reports/TR_16_web.pdf.
20. In chapter 6, IPCC's technical paper VI (2008) provided several empirical evidences on the interrelationship between climate change mitigation measures and water, which is available at https://www.ipcc.ch/site/assets/uploads/2018/03/climate-change-water-en.pdf.
21. There are many reports and organizations that connect water crisis with governance crisis.
For example, "Water: A Crisis of Governance Says Second UN World Water Development Report", which is available at http://portal.unesco.org/en/ev.php-URL_ID=32057&URL_DO=DO_TOPIC&URL_SECTION=201.html.