File S1

Supplementary Material for

Multi-variable governance index modelling of government's policies, legal, institutional strategies and management for climate compatible and sustainable agriculture development

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A. BROAD STUDY DESIGN

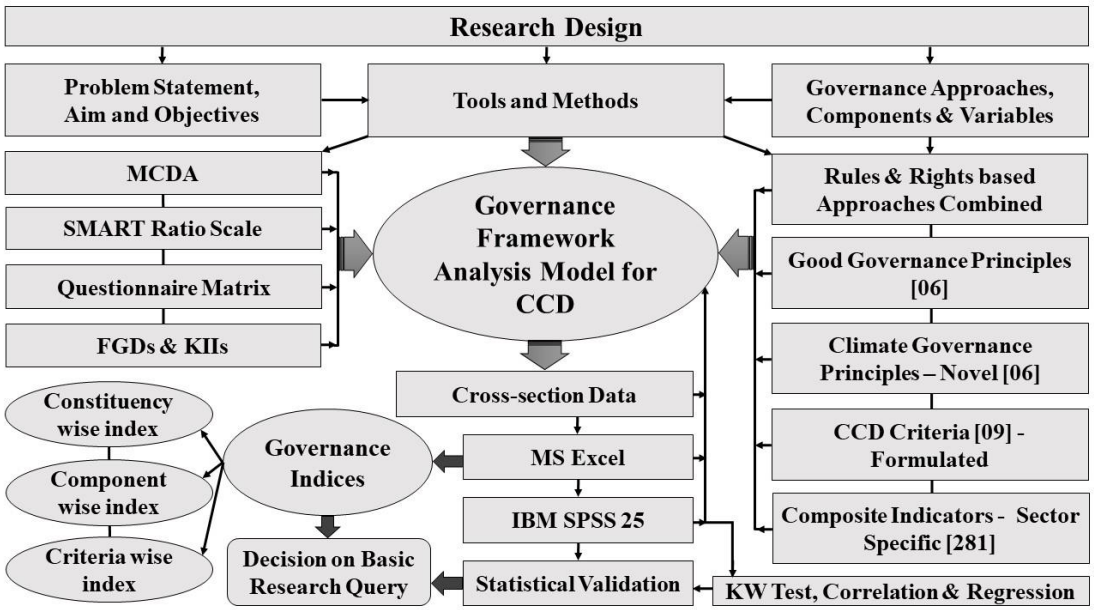


Figure S1. Broad study design and methodological steps' process flow (Source: PhD dissertation of first author)

B. CLIMATE PRINCIPLES AND GOVERNANCE COMPONENTS

Table S1. Climate Response Principles and components of basic governance mechanism

Code	Climate Response Principle	Corresponding Governance Component
CP1	**Respect climate policies, processes, strategies, law and the institution**	**Policy, legal and institutional arrangements (GC1)**
CP2	Ensure climate competence, capacity and active role of the line government departments	Role and capacities of the line government departments (GC2)
CP3	Promote vibrant and influential role of the civil society stakeholders with climate competence and capacity	Role and capacities of CSOs & academia (GC3)
CP4	Maintain active engagement of the community based stakeholders towards climate endeavors	Role and capacities of Community based organizations (GC4)
CP5	Dynamic role of the private sector stakeholders for best climate solutions	Role and capacities of Corporate / private sector stakeholders (GC5)
CP6	Achieve and maintain participatory sustainable climate compatible performance	Practice and performance system (GC6)

Source: PhD dissertation of first author

C. COMPOSITE INDICATORS OF GOVERNANCE FOR CCD IN AGRICULTURE SECTOR

1. Component 1 of the basic governance (GC-1) for agriculture sector: Basic response mechanism i.e. Policy, legal and institutional arrangements

Governance Principle for CCD # 1: Respect climate policies, processes, strategies, law and the institution

Table S2 provides detailed indicators for the Component 1 of the basic governance (GC-1) for climate compatible development in agriculture sector of Pakistan:

Table S2: Indicators matrix for CCD response mechanism in agriculture sector

Code	Agriculture sector specific CCD issues/principles based Criteria and Indicators at federal, provincial and districts level
AC-1.1	***Disaster Risk Reduction (including Vulnerability and Spatial Mapping)***
AC-1.1.1	Established and in-practice relevant policies, strategies, legal and transparent institutional mechanism governing on vulnerability assessment, spatial mapping and Local Adaptation Plans of Actions (LAPAs), early warning and responding climate extreme events for disaster risk reduction in Agriculture Sector
AC-1.1.2	Established and in-practice relevant policies, strategies, legal and or institutional mechanism ensuring active involvement of all relevant stakeholders in vulnerability assessment, spatial mapping and LAPAs for Agriculture Sector
AC-1.1.3	Established and in-practice relevant policies, legal and institutional mechanism addressing the capacity development of relevant government actors and farmers in vulnerability assessment, spatial mapping and LAPAs for disaster risk reduction and resilience in Agriculture Sector
AC-1.1.4	Established and in-practice relevant policies, legal and institutional mechanism having grievance handling and redressal mechanism in vulnerability assessment, spatial mapping and LAPAs for Agriculture Sector
AC-2.1	***Regulation of Rights (particularly in dry river belt areas)***
AC-2.1.1	Established and in-practice relevant policies, legal and **transparent** institutional mechanism governing on restricting agricultural rights and protection of dry river belt / mountainous slope areas
AC-2.1.2	Established and in-practice relevant policies, legal and institutional mechanism governing on restricting agricultural extensification and rights in dry river belt / mountainous slope areas
AC-2.1.3	Established and in-practice relevant policies, legal and institutional mechanism addressing the capacity development of all relevant actors on restricting agricultural rights and agriculture extensification in dry river belt / mountainous slope areas
AC-3.1	***Climate Smart Practices***
AC-3.1.1	Established and in-practice relevant policies, legal and **transparent** institutional mechanism governing on Climate Smart Agriculture practices w.r.t. CCD agenda
AC-3.1.2	Established and in-practice relevant policies, legal and institutional mechanism requiring a climate smart risk management and recovery system for crop failures
AC-3.1.3	Established and in-practice relevant policies, legal and institutional mechanism encouraging and incentivizing farmers to adopt best and climate smart agriculture practices
AC-3.1.4	Established and in-practice relevant policies, legal and institutional mechanism encouraging farmers to reduce GHG emissions by adopting best and climate smart agriculture and livestock practices
AC-3.1.5	Established and in-practice relevant policies, legal and institutional mechanism addressing the capacity development of farmers and other relevant actors for enhancing basic understanding about climate information regarding changing patterns
AC-4.1	***Technological Innovation***
AC-4.1.1	Established and in-practice relevant policies, legal and **transparent** institutional mechanism governing the Technological Innovation (e.g. seed development, contour farming, new conservations methods, biotechnological solutions, climate resilient breeds etc.) by promoting research and development on CCD in Agriculture sector
AC-4.1.2	Established and in-practice relevant policies, legal and institutional mechanism governing on best agricultural practices and on-farm management solutions through Technological Innovation

Code	Agriculture sector specific CCD issues/principles based Criteria and Indicators at federal, provincial and districts level
AC-4.1.3	Established and in-practice relevant policies, legal and institutional mechanism having a proper code of conduct for enhancing the crop productivity by using new and genetically modified climate / pest resistant varieties
AC-4.1.4	Established and in-practice relevant policies, legal and institutional mechanism addressing the capacity development of farmers and other relevant actors on agriculture drought management practices and reclamation of vulnerable agriculture land with innovative technological solutions
AC-5.1	***Climate Organization for Agriculture Sector***
AC-5.1.1	Established and in-practice relevant policies, legal and **transparent** institutional mechanism having accountability of the line departments responsible for the Agriculture Sector Management
AC-5.1.2	Established and in-practice relevant policies, legal and institutional mechanism with clarity on synchronization of institutional arrangement at all levels related to the Agriculture Sector
AC-5.1.3	Established and in-practice relevant policies, legal and institutional mechanism addressing the needs for legal enforcement and implementation of CCD agenda in Agriculture Sector
AC-5.1.4	Established and in-practice relevant policies, legal and institutional mechanism addressing the capacity and integrity of relevant senior level departmental posts dealing with the CCD agenda in Agriculture Sector
AC-5.1.5	Developed rules and mechanism for early warning system for disaster risk reduction
AC-6.1	***Institutional Effectiveness for Agriculture Sector***
AC-6.1.1	Established and in-practice relevant policies, legal, and **transparent and accountable** institutional mechanism including CC Authority/Ministry/Division governing the **institutional effectiveness** with proper control and focused enforcement of policies, strategies, rules and regulations for CCD agenda in Agriculture Sector
AC-6.1.2	Established and in-practice relevant policies, legal and institutional mechanism governing the planning and review mechanism in Agriculture Sector
AC-6.1.3	Established and in-practice relevant policies, legal and institutional mechanism addressing the needs for an effective coordination mechanism among Agriculture Sector line departments at Federal, Provincial and District levels
AC-6.1.4	Established and in-practice relevant policies, legal and institutional mechanism requiring a climate related bottom-up Robust Compliance Monitoring, Reporting and Evaluation mechanism for Agriculture Sector line departments at Federal, Provincial and District levels
AC-6.1.5	Established and in-practice relevant policies, legal and institutional mechanism addressing the needs for capacity building and strengthening of Agriculture Sector line departments and other actors at Federal, Provincial and District levels
AC-6.1.6	Established and in-practice relevant policies, legal and institutional mechanism ensuring inclusive decision-making process and mainstreaming climate compatible development in Agriculture Sector; at Federal, Provincial and District levels
AC-6.1.7	Established and in-practice relevant policies, legal and institutional mechanism having rules and procedure to respond / stop any fraudulent activity and corruption, and ensuring a proper complaint management system in Agriculture Sector
AC-6.1.8	In-practice relevant rules and mechanism for early warning system for disaster risk reduction
AC-7.1	***Climate Infrastructure for Agriculture Sector***
AC-7.1.1	Established and in-practice relevant policies, legal, and **transparent** institutional mechanism for development, formulation and periodic review of the agriculture sector policy, strategy, rules and regulations, and also meeting the needs of the institution for CCD agenda in Agriculture Sector
AC-7.1.2	Established and in-practice relevant policies, legal, and institutional mechanism addressing infrastructure needs for development of research based innovative technological solutions
AC-7.1.3	Established and in-practice relevant policies, legal, and institutional mechanism addressing infrastructure needs for water conservation and drought management in Agriculture Sector
AC-7.1.4	Established and in-practice relevant policies, legal, and institutional mechanism addressing infrastructure needs for storage and processing of agri-product at Federal, Provincial and District levels
AC-7.1.5	Established and in-practice relevant policies, legal, and institutional mechanism addressing the infrastructure and other needs for capacity development and awareness raising programme (including dissemination of meteorological & other information) in Agriculture Sector
AC-7.1.6	Established and in-practice relevant policies, legal, and institutional arrangements for Complaint handling and management system in Agriculture Sector
AC-8.1	***Agriculture, Water and Energy Nexus***

Code	Agriculture sector specific CCD issues/principles based Criteria and Indicators at federal, provincial and districts level
AC-8.1.1	Established and in-practice relevant policies, legal, and **transparent** institutional mechanism governing and requiring on departmental linkage and close coordination for CCD agenda in Agriculture Sector
AC-8.1.2	Established and in-practice relevant policies, legal, and transparent institutional mechanism governing and requiring on departmental linkage and close coordination for CCD agenda in the Agriculture and Water Sectors nexus at Federal, Provincial and District levels
AC-8.1.3	Established and in-practice relevant policies, legal, and transparent institutional mechanism governing and requiring on departmental linkage and close coordination for CCD agenda in the Agriculture, Water and Energy Sectors nexus at Federal, Provincial and District levels
AC-8.1.4	Established and in-practice relevant policies, legal, and transparent institutional mechanism **enforcing** on departmental linkage and close coordination for CCD agenda in the Agriculture, Water and Energy Sectors nexus at Federal, Provincial and District levels
AC-8.1.5	Established and in-practice relevant policies, legal, and institutional mechanism addressing the needs for capacity development of all relevant actors on departmental linkage and close coordination for CCD agenda in the Agriculture, Water and Energy Sectors nexus at Federal, Provincial and District levels
AC-9.1	***Sustainability for Agriculture Sector***
AC-9.1.1	Established and in-practice relevant policies, strategies, legal, and **transparent** institutional mechanism governing and requiring on environmental security and safeguards viz-a-viz water conservation / security, GHG reduction in overall value chain and organic farming etc., for CCD agenda in Agriculture Sector
AC-9.1.2	Established and in-practice relevant policies, strategies, legal, and **transparent** institutional mechanism governing and requiring on social safeguards and security viz-a-viz SDGs' on end hunger and food security, SDGs' on poverty alleviation, and safeguarding farmers livelihood etc., for CCD agenda in Agriculture Sector
AC-9.1.3	Established and in-practice relevant policies, strategies, legal, and **transparent** institutional mechanism governing and requiring on economic security / renaissance viz-a-viz impact on GDP, low cost technologies, conservation of input resources etc., for CCD agenda in Agriculture Sector

AC-X.Y.N Series = Governance indicators for CCD (where, AC denotes agriculture sector criteria; X = 1-9 denotes sequence number of issues based criteria; Y = 1-6 i.e. sequence number of GC; and N = 1,2,3… i.e. sequence number of criteria based indicator)