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MIX-METHOD ANALYSIS FOR ASSESSING THE ADEQUACY OF THE STATE OF GOVERNANCE FOR CLIMATE COMPATIBLE DEVELOPMENT IN AGRICULTURE SECTOR

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Abstract

The vulnerability index of Pakistan, business as usual case of agriculture and development agenda entail adaptation, resilience and mitigation strategies for low carbon future; thus an integrated climate compatible development (CCD) approach of 'triple-win strategies' with adequate and inclusive governance mechanism becomes important for environmental security. The existing climate governance arrangements in Pakistan are complex and lack ownership at federal and provincial level. In this backdrop, governance index produced for assessing the adequacy of the overall state of governance for CCD in agriculture sector, by developing and applying a novel mix-method analysis model. Considering multi-sectors and multi-actors for CCD, this model combined rules-based and rights-based governance approaches. Six basic governance components and MCDA method with SMART's Ratio Scale were employed. Six novel principles of climate governance and good governance with 281 Indicators of 09 CCD Criteria were used on cross section data collected through 340 KIIs and 17 FGDs. Statistically validated empirical results provide baseline and decipher that climate response level in agriculture sector is in readiness phase and quite similar to global trends in developing countries. This model proved well and its extended use would certainly provide guidance to improve governance for CCD not only in Pakistan but also worldwide.

Keywords: *climate compatible development, governance index, climate governance principles, CCD Criteria, indicators, novel analysis model, MCDA*

Introduction

Climate change is a stark reality (Khan, 2019; Iqbal, 2019; Iqbal and Khan, 2018; Werz and Reed, 2014; Wissenbach, 2010) and a non-traditional defining challenge to the humankind today (Stern, 2016; Srikanth, 2014). Shifting climate is a serious matter (USEPA, 2016) and it is the most serious externality of 21st century (Yang, 2020; Nordhaus, 2019) that has high vulnerability risks towards 'sustainability of ecological resources' (Landis *et al.*, 2013; Hunsaker *et al.*, 1990) including agriculture, worldwide (Anwar *et al.*, 2013; Ladányi and Horváth 2010; Aydinalp and Cresser, 2008). Developing countries' agricultural economies are on big stakes (Mendelsohn, 2008; Mirza, 2003; Mendelsohn and Dinar, 1999) due to higher vulnerability risks and weak governance mechanisms (Kiers *et al.*, 2008). The cascading effects require robust coping strategies (Rehman and Salman, 2013) through adequate governance mechanisms at national, subnational and local levels (Wright *et al.*, 2014; Juhola, 2010; Adger, 2001), particularly for agriculture.

The synergies between SDG-13 (UN, 2015) and the Paris Agreement (UNFCCC, 2015) need alignment for agriculture adaptation, food security and poverty (Campbell *et al.*, 2018). Concerns about food security are very critical (Porter *et al.*, 2014) due to extreme events, spatio-temporal variations (Zeng *et al.*, 2020; Reyes and Elias, 2019; Toros, 2012) and impacts of climate change on production systems (Mahato, 2014; Vermeulen *et al.*, 2012; Vien, 2011; Thornton *et al.*, 2014). A drastic decline in crop yields is forecasted for 2030 (Challinor *et al.*, 2014; Iqbal and Khan, 2012).

SDGs Report 2020 highlights that the climatic extreme events would likely to continue with similar trends, with an anticipated rise of 3.2 °C in global temperature by the year 2100. The annual global emissions reduction target is lagging behind about 7.6% in limiting warming effect to 1.5° (UN, 2020). A level of 0.99 ± 0.13 °C more than the defined baseline of pre-industrial era (i.e. 1850 to 1900) was observed for the global average temperature in 2018 with a relatively skinny La Niña effect (WMO, 2019). IPCC (2018) highlighted an anomaly in the global mean temperature. The NOAA's continental ranking marked the year 2018 among top ten (10) warmest periods for the Oceania, South America, Europe, Africa and Asia except for N-America, in a record of 109 past years (Blunden and Arndt, 2019).

Pakistan, a least contributor to GHG emission i.e. 0.8% of global total, is among the most affected and acutely vulnerable (DARA, 2012) countries worldwide; with a reported 0.53% loss to its GDP with an economic toll of USD 3,792.52 million due to 152 highly extreme climatic events between 1999 and 2018. It would likely to increase further between 2021 and 2030 (Eckstein *et al.*, 2019; Iqbal, 2016). Pakistan's agriculture sector has 174.56 MT CO_2-equivalent per annum (43%) contribution towards country's overall GHG emissions, likely increase to about 457 MT CO_2-equivalent per annum by 2030. It is the 2nd highest after the leading contribution by the energy sector. Pakistan's INDC statement 2016 provides a commitment of reducing its 2030 projected emissions up to 20% and estimated the abatement cost of approximately 40 billion US$, including the agriculture sector. Whereas, adaptation cost estimated to approximately 7 to 14 billion US$ per annum (UNFCCC, 2016).

Pakistan's agriculture contributes 19.3% towards national GDP and is still a leading sector for the livelihood of majority of the population (PES, 2020). It has very complex interdependence with water and energy sectors and interplay with marine and freshwater fisheries vis-à-vis food security. Pakistan's vulnerability index, BAU case of agriculture governance, water patterns in Indus basin system and development agenda entail adaptation, resilience and mitigation strategies for low carbon future; thus an integrated climate compatible development (CCD) approach of "triple-win strategies" (Mitchell and Maxwell, 2010) with adequate governance mechanism becomes an important one. Pakistan conceptualized national level programme for CCD in year 2012 (CDKN, 2012), while 18th amendment in *National Constitution* (GoP, 2010) was a parallel development due to which the federal and provincial climate response mechanisms may be assumed to have more complications now.

Pakistan's agriculture governance has cross-sectoral implications to govern CCD agenda despite Pakistan Climate Change Act (GoP, 2017), and the 'National Climate Change Policy 2012' (GoP, 2012) and its implementation framework (GoP, 2014a) are now in place. These instruments have implications at federal and provincial level and the situation would likely to aggravate further in the context of fully functional local bodies, primarily due to a decades old ownership problem. Since most of the climatic problems are multi-scale in causes and consequences for agriculture, the multi-in-one "Climate Smart Agriculture" (CSA) solutions have the potential to ensure food and environmental security and contribute towards CCD (Chandra, 2017) but requires a system of governance (Dovers, 2005).

An analysis of existing state of current agriculture governance system in Pakistan may provide a basis for choosing options or making strategies for CCD agenda. Agriculture governance is generally concerned with the country's increase in growth (Dasgupta and Roy, 2011; Sidibe *et al.*, 2018). The term 'Governance' was used properly first by *Harlan Cleveland* in mid 1970s. However, the literature links the origin of 'Governance' concept with Greek word *'Kybernan' and* the Roman Empire also used a similar Latin term '*gubernare'* means to 'direct, rule or guide' (Ysa *et. al.*, 2014). Thus, alternate arguments exist about the novelty of the term 'governance', i.e. being *"as old as human civilization"*. During 1980s, the concept of governance got significance, but overall its concepts and approaches are still ambiguous (Anderson *et. al.*, 2014).

Over period of times and from informal to formal governance concepts, two main 'rules-based' (legal and regulatory centric) and 'right-based' approaches evolved. The informal governance concept is based on practices and processes without observing formal rules and procedures and

doesn't provide voting rights to the weak actors (Kleine, 2014; Stone, 2011; Follesdal *et al.*, 2004). The 'formal governance' concept normally revolves around rules. The various shortcomings of 'rules-based approach' are linked with the application of 'top-down' and 'command-and-control' practices, which raised concerns pertaining to its legitimacy and effectiveness (Pierre and Peters, 2000). 'Right-based approach' revolves around the rights, participation and active engagement of all kinds of relevant actors and the political economy by having constructive relationships, system arrangements for shaping interactions, a negotiation structure and mechanisms for the accountability towards concerned matters (Saunders & Reeve, 2010; Visseren-Hamakers and Glasbergen, 2007). Since climate compatible development involves multi-sectors, multi-actors and participatory nature, thus adopting a single conceptual framework or governance approach is unjustified and unsatisfactory that would likely limit its actual scope in agriculture sector of Pakistan.

Various methodological frameworks for governance analysis regarding social, environmental, economic and development sectors were proposed in the past (Ha *et al*., 2018; Oliveira and Hersperger, 2018; Douxchamps *et al.*, 2017; Ramasamy, 2017; Virtudes, 2016; Borrini *et. al.*, 2013; Kartodihardjo *et. al.*, 2013; Reusser *et al.*, 2013; Greiber and Schiele, 2011; UNFCCC, 2013). But the fact is that there are question marks on their effectiveness. However, integration of scientific applications may facilitate policymakers (Okpara *et al.*, 2018). The matter of governance is propagated well in literature with abundant and diverse dimensions (Thornton *et al*., 2018; Sanchez and Roberts, 2014), principles (Aven and Renn, 2018; Dasgupta and Roy, 2011; Lockwood *et al*., 2010; Chuku, 2009; Bosselmann *et al.*, 2008; Graham *et al.*, 2003;), criteria (Wood *et al*., 2017; Wise *et al*., 2016), indicators (Dongab and Hauschilda, 2017; Ijeoma *et al.*, 2015), and perspectives (Nakono *et al.*, 2016) about its analysis and effectiveness of methodological framework (Ruhanen *et al.*, 2010). So far, there is no widely accepted standard analysis framework for empirical assessment of governance from local to subnational, local to national and subnational to national levels (Pyone *et al.*, 2017).

In this backdrop, this paper has produced governance index for CCD in agriculture sector of Pakistan, by developing and applying a novel mix-method analysis framework model. This model proved well and its extended use would certainly provide guidance to improve governance for CCD not only in Pakistan but also worldwide.

Aim, objectives and scope

This paper stems out of a broad PhD research study by the lead author. The overarching aim of this empirical study was to assess the adequacy of the overall state of governance for CCD in agriculture sector of Pakistan. The overall scope revolves around three key objectives that include: (i) development of principles, criteria and indicators (PCIs) for CCD in agriculture sector; (ii) analysis of existing framework of governance for CCD in agriculture sector at federal, provincial and district level and (iii) provision of research-based recommendations to bring improvements in governance arrangements for CCD. Technically, agriculture sector covers all four elements of climate compatible development i.e. adaptation, mitigation, resilience and low carbon development. The geographical limitations of this study were set in the context of Pakistan.

Research question

This research study has tested the research question that a proactive and inclusive system covering all aspects of governance at federal, provincial and local levels is in place for climate compatible development in agriculture sector of Pakistan. In order to analyze and assess the state of governance, this study investigated the overall governance mechanism for climate compatible development in Pakistan by narrowing down the key questions for policy, legal and institutional aspects of the basic governance mechanism; actor's capacity and practice and performance system.

Methodology

Study approach and development of governance analysis model

This empirical study followed two steps; first development of a measuring tool and second step was the use of that tool for determination of governance index. In the absence of a widely accepted empirical governance analysis framework (Pyone *et al.*, 2017), opinion of the experts was taken through a focus group discussion session and a Problem Tree / Situational Analysis (Hovland, 2005) was carried out regarding the adoption of the right approach for the governance analysis and assessment for CCD in Pakistan. Guidance was taken from the existing approaches, analysis frameworks and models as discussed in the introduction section of this paper, based on their content analysis. Therefore, 'rules-based' and 'rights-based' governance approaches, governance components and MCDA methods (Amer and Diam 2011; Diam *et al.*, 2009) were combined for the development of a novel analysis framework model. It integrates six (06) principles of climate and good governance, nine (09) criteria and two hundred eighty one (281) indicators for CCD in agriculture. Figure 1 illustrates the methodological steps followed for the study while Table 2 shows the analysis model. This model is a generic and advanced form of the participatory assessment of REDD+ governance in Indonesia (Kartodihardjo *et. al.*, 2013). It primarily focuses on specific issues of CCD in agriculture sector, and is equally applicable to other segments of the sectoral economy, by using modified set of indicators viz-a-viz the sectoral economy involved.

Key Variables

Overall governance system for the study includes basic response mechanism i.e. policy, legal and institutional arrangements; role and capacities of state and non-state actors i.e. line departments of the government at federal, provincial and district levels; CSOs & academia, CBOs; Corporate / private sector stakeholders; practice and performance system i.e. implementation and compliance monitoring (Kartodihardjo *et. al.*, 2013). It was classified into six governance components (GCs) i.e. GC-1 to GC-6 and a set of six (06) novel climate response principles (CPs) of governance (as shown in Figure 1) for CCD process and response strategies were formulated for these components. Following is the list of newly developed six climate principles.

(1) Respect climate policies, processes, strategies, law and the institution (CP1)
(2) Ensure climate competence, capacity and active role of the line government departments (CP2)
(3) Promote vibrant and influential role of the civil society stakeholders with climate competence and capacity (CP3)
(4) Maintain active engagement of the community based stakeholders towards climate endeavors (CP4)
(5) Dynamic role of the private sector stakeholders for best climate solutions (CP5)
(6) Achieve and maintain participatory sustainable climate compatible performance (CP6)

The climate response principles were set into the analysis model along-with World Bank's six principles of good governance i.e. Transparency (GP1), Fairness (GP2), Participation (GP3), Capacity (GP4), Accountability (GP5) and Effectiveness (GP6); with their two hundred eighty one (281) composite indicators against nine (09) CCD criteria (Table 1). These variables for CCD process and response strategies were determined by employing Problem Tree / Situational Analysis in a way to ensure their applicability to all sectors of economy. The applicability of these variables on different CCD's conceptual segments i.e. adaptation, mitigation, resilience and low carbon development was screened and evaluated with the help of Network Diagram Analysis by using flip charts, for their direct and indirect as well as cross-sector linkages. These situational analysis tools are very widely and centrally practiced by the development sector organizations and agencies for many policy governance and planning segments, and can be efficiently conducted through a focus group discussion (FGD) exercise (Hovland, 2005). Table 1 gives detail regarding the screened and evaluated variables for their respective applicable CCD segments. Simple multi-attribute rating technique (SMART) was used (Edward, 1977) for a ratio scale (i.e. 0 = Not applicable or no response yet, 0.01 to 1.99 = Very Poor, 2.00 to 3.99 = Poor, 4.00 to 4.99

= Considerable, 5.00 to 5.99 = Fair, 6.00 to 7.49 = Good, 7.50 to 8.99 = Very Good, 9.00 to 10.0 = Excellent) of scoring and weighting the criteria against the indicators. A multi-variables coding system was developed and used to distinguish different sets of variables viz-a-viz governance components, principles, criteria and indicators. A pre-test exercise was carried out at Islamabad for weighting, normalization and validation of indicators.

Tools for primary data collection

Based on summary of nine criteria and respective contents of the indicators, a simple guide was developed to moderate the participants of the focus group discussion for achieving a level of comfort about the subject matter concerned so that they could score / rate the indicators, on questionnaire cum matrix, with clear understanding. The sets of governance indicators were utilized in the form of questionnaire / matrix for the application of scoring scale by adding columns on the right side. Template for field based utilization of sets of indicators with scoring scale is given in Table 3.

Table 1. *Screened & evaluated CCD components (with direct & indirect linkage)*

Components of CCD Processes and Response Mechanism: Issues/principles-based Criteria at federal, provincial and district levels	**Screening of CCD Components**			
	Adaptation	**Mitigation**	**Low Carbon Development**	**Resilience**
Disaster Risk Reduction (DRR), Vulnerability & Spatial Mapping (C-1)	√			√
Regulation of Rights (C-2)	√	√	√	√
Climate Smart Practices (C-3)	√	√	√	√
Technological Innovation (C-4)	√	√	√	√
Climate Organization (C-5)	√	√	√	√
Institutional Effectiveness (C-6)	√	√	√	√
Climate Infrastructure (C-7)	√	√	√	√
Sectoral Nexus (C-8)	√	√	√	√
Sustainability (C-9)	√	√	√	√

Table 2. *Analytical Model for Governance of overall CCD Response in Pakistan*

	Components of the Basic Governance (GCs)			
Components of CCD Response Strategies: Issues/Principles based Criteria (attributing adaptation, mitigation, resilience & low carbon development) at federal, provincial and district levels	**Basic Response Mechanism:** Policy, Legal and Institutional Framework	**Role and Capacities of State and Non-State Actors:** Line Departments, CSOs, CBOs, and Economic Operators / Private Sector	**Practice and Performance System:** Implementation, compliance monitoring and performance (i.e. Practice)	**Component of Generic Principles of Good Governance (GGP)**
	CP1	CP2, CP3, CP4, CP5	CP6	
DRR, Vulnerability and Spatial Mapping	**Indicators:** The composite indicators reflect the principles of overall Governance vis-à-vis CCD process and response strategies at federal, provincial and district levels in Pakistan			
Regulation of Rights				
Climate Smart Practices				Transparency
Technological Innovation				Fairness
Climate Organization				Participation
Institutional Effectiveness				Capacity
Climate Infrastructure				Accountability
Sectoral Nexuses				Effectiveness
Sustainability				

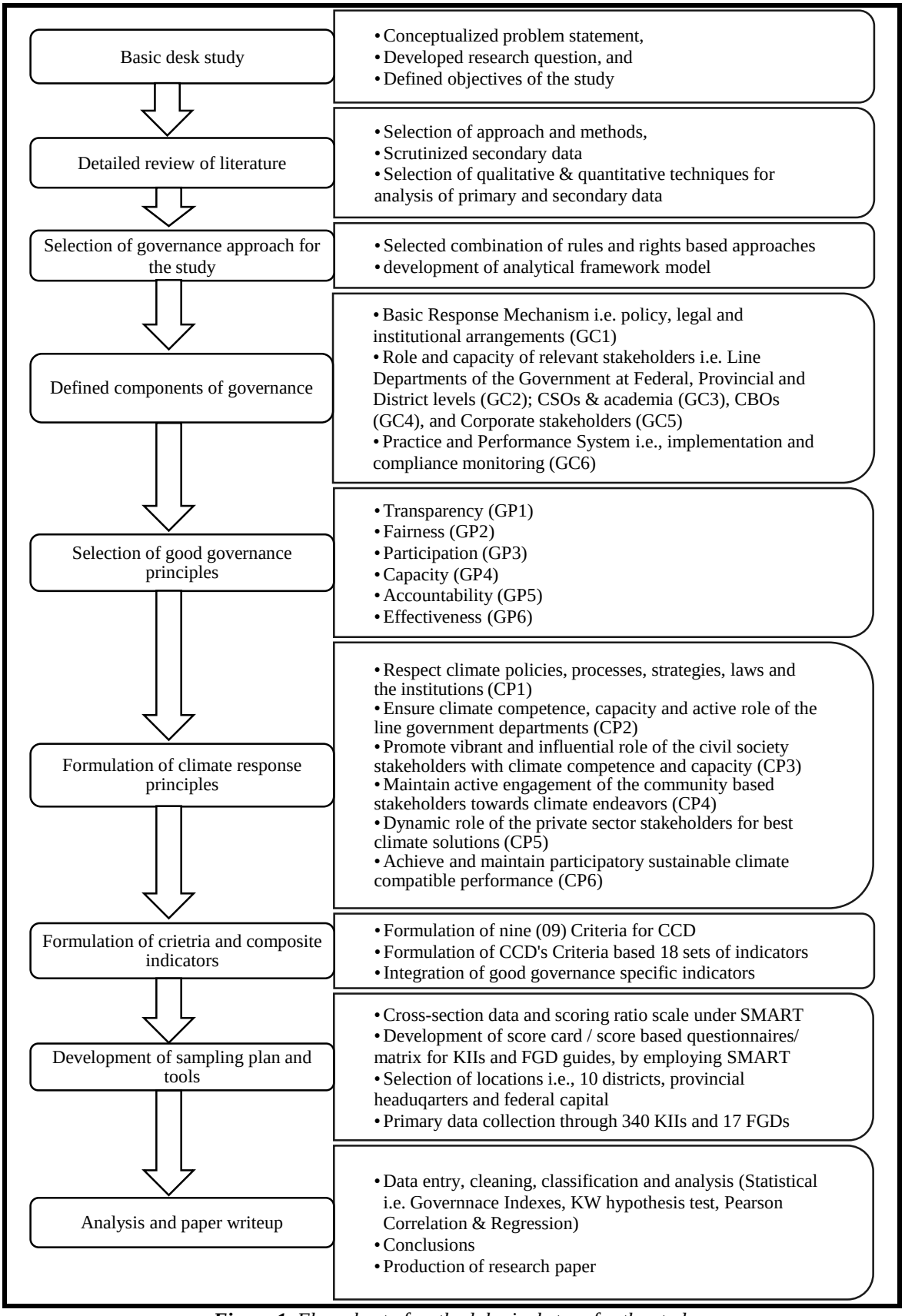

Figure 1. *Flow chart of methodological steps for the study*

Table 3. *Template for utilizing indicator sets as questionnaire/scoring matrix*

Code	Criteria and Indicators	**Respondent's Name:** _____ **Gender:** Male Female **Constituency:**							
		Indicator Score / Rating (Ratio Scale)							
		Not applicable or no response yet (Score 0)	Very Poor (0.01 to 1.99)	Poor (2.00 to 3.99)	Considerable (4.00 to 4.99)	Fair (5.00 to 5.99)	Good (6.00 to 7.49)	Very Good (7.50 to 8.99)	Excellent (9.00 to 10.0)
		Corresponding Score in Percentage							
		0	1-19	20-39	40-49	50-59	60-74	75-89	90-100

Sampling plan, locations and sample size

The sampling plan consisted of two important segments i.e. (1) geographical boundaries and (2) the size of the sample against which key informant interviews (KIIs) and focus group discussion sessions were conducted. Sampling was done at federal, provincial and district levels. Seven (07) capital cities including one (1) federal, four (4) provincial and two (2) other cities along-with 10 districts (Bahawalpur, Rajanpur, Sanghar, Badin, Swat, Mansehra, Jhal Magsi, Khuzdar, Muzaffarabad and Ghizer) were selected for taking the responses from relevant stakeholder's representatives. The selection of districts was carefully done by taking into account the existing climate related projects and programmes by the government and other stakeholder organizations. A total stock of 357 observations each for agriculture sector was taken at federal, provincial and district levels, for which one Focus Group Discussion (FGD) and 20 Key Informant Interviews (KIIs) per location were conducted.

Data entry, cleaning, classification and analysis

'Microsoft Excel 2013' was used for the entry, cleaning and classification of basic data, along-with data analysis for development of constituency, component and criteria wise governance indices and their graphs. 'IBM SPSS Statistics 25' was used for advanced statistical analysis, for which classified data sets in Excel 2013 were imported for the application of different results validation tests with descriptive and graphical outputs.

Statistical validation of results

Three statistical models were tested for the validation of results. Nonparametric Kruskal-Wallis (KW) hypothesis test or H test was applied by using 'IBM SPSS Statistics 25' with descriptive outputs for asymptotic significances against the significance level of *'0.05'*, in order to examine the distribution of the sample groups variables constituency and gender wise prior to indicate whether the samples are dominating one way or the other way stochastically. It helped to cross-check perception differences in overall population, responses at different levels of the governance arrangements (i.e. federal, provincial and district levels), significant results, where null hypothesis is rejected, authenticated the originality of the sample data with the existence of different perception and trends at different levels of the governance mechanism for climate compatible development in Pakistan. Earlier, Atif *et al.,* (2018) studied the socio-economic determinants of urban vegetation by employing KW test.

1-tailed Pearson correlation analysis against the significance level of 0.01 level was carried out by using "IBM SPSS Statistics 25" with descriptive outputs in order to examine the relationship between different governance components for overall sectoral governance index. It helped in

understanding the impact and interlocking of different variables on each other thus depicted a clear picture of complex interdependence for CCD agenda in Pakistan.

Multivariate Linear Regression technique was employed by using 'IBM SPSS Statistics 25' with descriptive outputs including model summary, ANOVA summary, Coefficients summary along-with Collinearity statistics and Residual statistics as well as graphical outputs including Normal P-P Plot of Regression Standardized Residual and Scatter Plot of Regression Standardized Residual. It was intended to statistically examine the mathematical relationships or association between the two variables i.e. the dependent and the independent ones, and to validate the results of different parts of the study. It was carried out governance component wise for which GC6 component was the dependent variable among six (06) components of the governance.

Results

Table 4 shows overall governance index for CCD response in agriculture sector of Pakistan. Figure 2 provides a graphical overview of governance index vis-à-vis its components. Figure 3 shows component wise Governance Index on a clustered bar chart, Figure 4 forms a radar for the distances against governance index and Figure 5 shows overall index for CCD Response at federal and provincial levels. Figure 6 shows overall index at district level.

Overall results depict GC1 index scores 7.52, 4.60 and 3.93 with an average score 5.35; GC2 index scores 7.02, 4.23 and 3.17 with an average score 4.80; GC3 index scores 5.57, 3.18 and 2.31 with an average score 3.69; GC4 index scores 2.82, 2.34 and 1.71 with an average score 2.29; GC5 index scores 3.0, 1.64 and 0.96 with an average score 1.86; GC6 index scores 5.77, 3.44 and 2.10 with an average score 3.77; and constituency wise average scores 5.28, 3.24 and 2.36 at federal, provinces and districts levels respectively. The overall average governance index score is 3.63 for agriculture sector in Pakistan.

Table 4. *Overall Governance Index for CCD Response in Agriculture Sector*

Governance Component	Constituency wise Index Score			
	Federal	**Provinces**	**Districts**	**Average**
Policy, Legal and Institutional Arrangements (GC-1)	7.52	4.60	3.93	5.35
Capacity of Line Departments (GC-2)	7.02	4.23	3.17	4.80
Capacity of Civil Society Stakeholders (GC-3)	5.57	3.18	2.31	3.69
Capacity of Community Based Stakeholders (GC-4)	2.82	2.34	1.71	2.29
Capacity of Corporate Actors (GC-5)	3.00	1.64	0.96	1.86
Practice and Performance (GC-6)	5.77	3.44	2.10	3.77
Overall Average	**5.28**	**3.24**	**2.36**	**3.63**

[**Scale:** 0 = Not applicable or no response yet, 0.01 to 1.99 = Very Poor, 2.00 to 3.99 = Poor, 4.00 to 4.99 = Considerable, 5.00 to 5.99 = Fair, 6.00 to 7.49 = Good, 7.50 to 8.99 = Very Good, 9.00 to 10.0 = Excellent]

Regarding statistical validation, Tables 5 and 6 provide summaries of constituency and gender based KW Hypothesis tests respectively for overall sample in agriculture sector, for which asymptotic significances are displayed with their respective significance level of 0.05 (against N = 357) where null hypothesis is rejected for all the cases. It authenticates the observations and depicts different responses from all respondents at federal, provincial and district levels.

Pearson correlations with significance at the 0.01 level (1-tailed) are shown in Table 7 and Figure 7 that indicate a strong correlation among various components of the governance though GC4 is on a lower side value of 0.621 with GC5.

Whereas; descriptive statistics of multivariate Regression analysis for overall sample of agriculture sector are shown in Tables 8 to 11 while Figure 8 shows normal P-P Plot and Figure 9 shows scatter plot of Regression standardized residual for overall sample in agriculture sector. GC6 was used as dependent variable.

The values of R and R Square are 0.941 and 0.885 respectively. Coefficients of T-test show significant relationship of GC6 with GC2, GC3 and GC4. However, 0.033 tolerance (i.e. below 0.10) and 30.176 VIF (i.e. above 10) values are not supporting the significant relationship between GC6 and GC2. T-test coefficients of GC1 and GC5 have values below ±2 though collinearity is in a good zone for GC5 but it is not supporting to GC1; despite all components have shown very good zero-order correlations with GC6.

The normal P-P plot shows reasonably higher deviations with upward and downward fluctuations and the scatter plot also shows different groups but overall it is showing good results within the ±3 boundaries.

Although all components of the governance are impacting each-other, as a whole the null hypothesis of the basic research question can't be rejected. So, it indicates so far the absence of a proactive and inclusive response mechanism to govern climate compatible development in agriculture sector at Federal, Provincial and Districts levels in Pakistan for its environmental security.

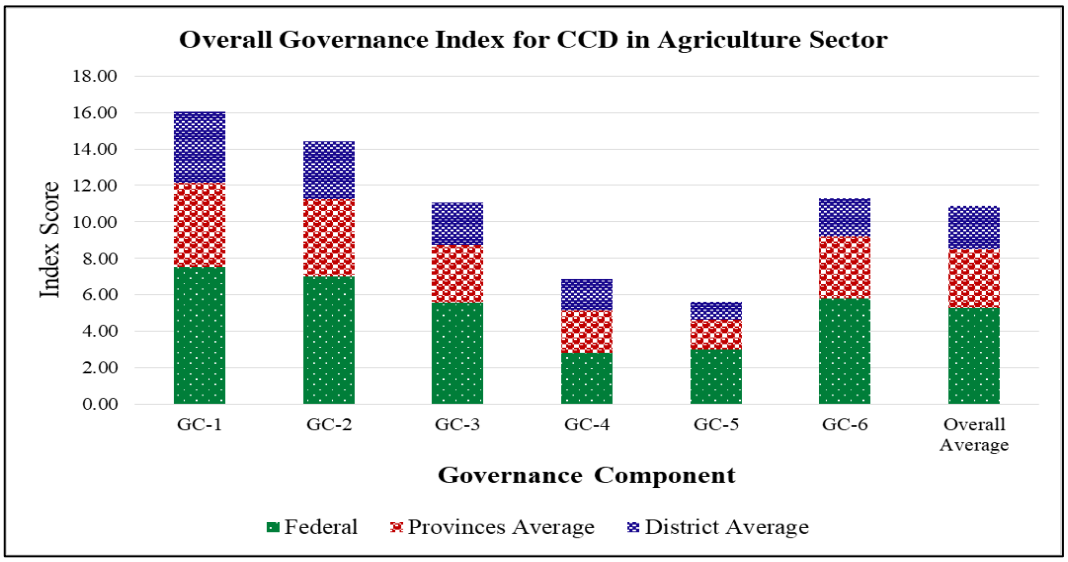

Figure 2. *Overall Governance Index for CCD Response in Agriculture Sector*

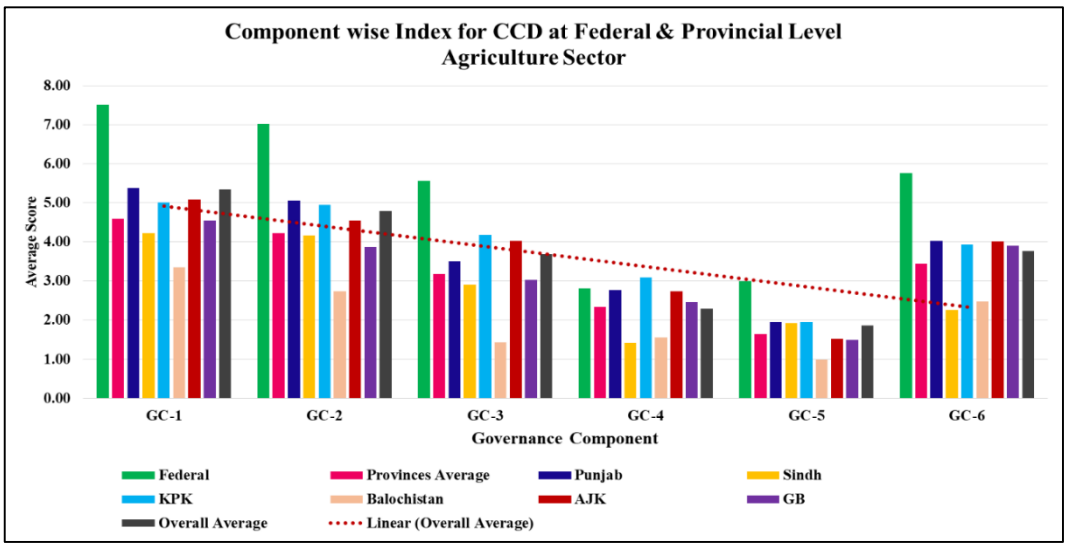

Figure 3. *Component wise Governance Index for CCD Response at Federal & Province Level*

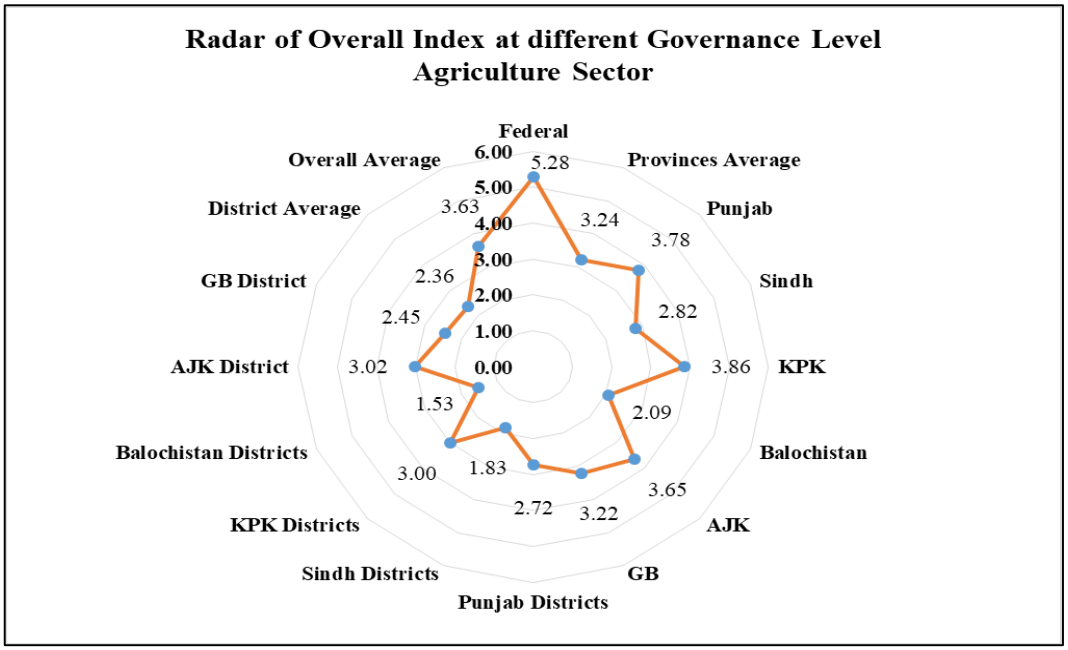

Figure 4. *Radar of overall Index for CCD Response at different Governance Levels*

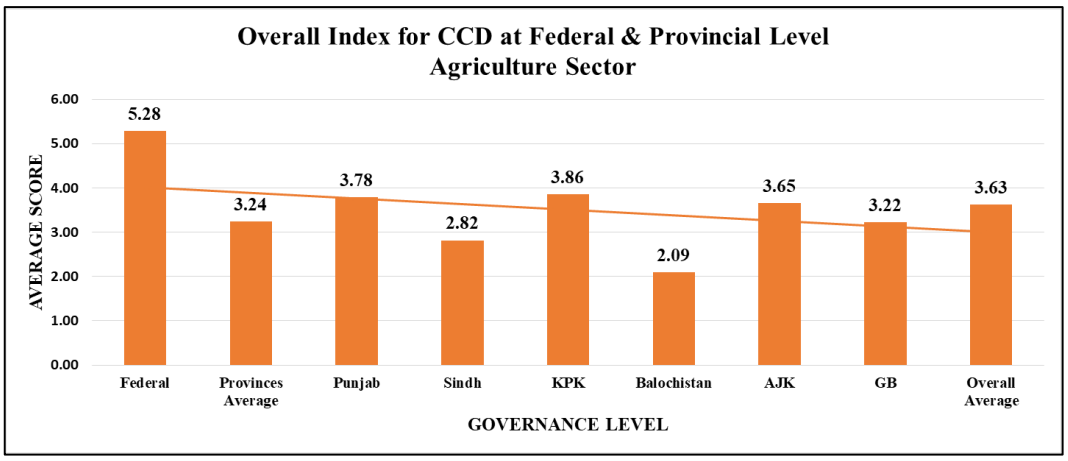

Figure 5. *Overall Governance Index for CCD Response at Federal & Provincial Levels*

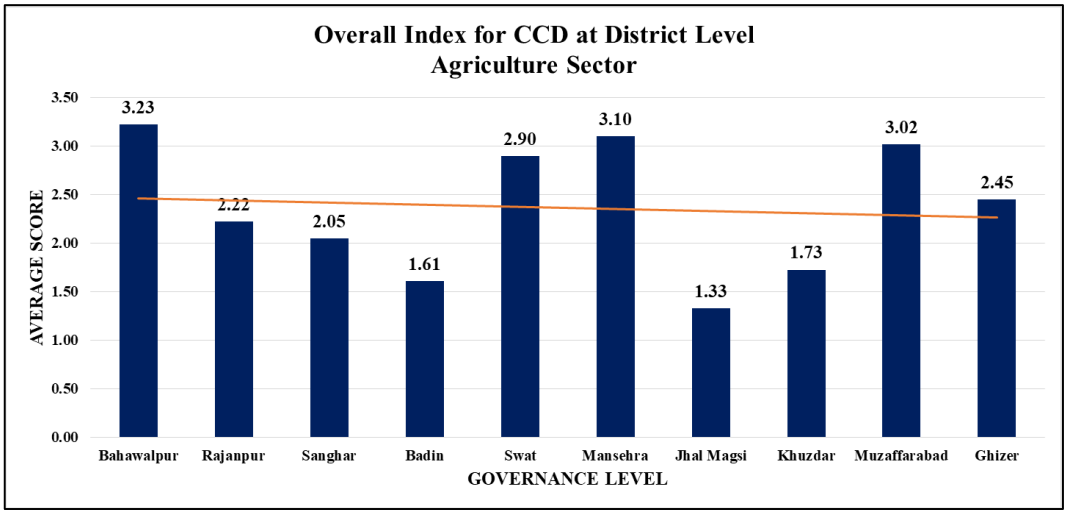

Figure 6. *Overall Governance Index for CCD Response at District Level*

Table 5. *Summary of Constituency based KW Test for overall sample in Agriculture*

Hypothesis Test Summary				
	Null Hypothesis	**Test**	**Sig.**	**Decision**
1	The distribution of Policy, Legal and Institutional Arrangements is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
2	The distribution of Capacity of Line Departments is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
3	The distribution of Capacity of Civil Society Stakeholders is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
4	The distribution of Capacity of Community Based Stakeholders is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
5	The distribution of Capacity of Corporate Actors is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
6	The distribution of Practice and Performance is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
Asymptotic significances are displayed. The significance level is .05. N = 357				

Table 6. *Summary of Gender based KW Test for overall sample in Agriculture Sector*

Hypothesis Test Summary				
	Null Hypothesis	**Test**	**Sig.**	**Decision**
1	The distribution of Policy, Legal and Institutional Arrangements is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
2	The distribution of Capacity of Line Departments is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
3	The distribution of Capacity of Civil Society Stakeholders is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.002	Reject the null hypothesis.
4	The distribution of Capacity of Community Based Stakeholders is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.001	Reject the null hypothesis.
5	The distribution of Capacity of Corporate Actors is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.008	Reject the null hypothesis.
6	The distribution of Practice and Performance is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.005	Reject the null hypothesis.
Asymptotic significances are displayed. The significance level is .05. N = 357				

Table 7. *Governance's Component wise Correlations for CCD in Agriculture Sector*

Correlations							
		GC1	**GC2**	**GC3**	**GC4**	**GC5**	**GC6**
GC1	Pearson Correlation	1					
	Sig. (1-tailed)						
GC2	Pearson Correlation	.961**	1				
	Sig. (1-tailed)	.000					
GC3	Pearson Correlation	.896**	.912**	1			
	Sig. (1-tailed)	.000	.000				
GC4	Pearson Correlation	.769**	.810**	.872**	1		
	Sig. (1-tailed)	.000	.000	.000			
GC5	Pearson Correlation	.883**	.916**	.771**	.621**	1	
	Sig. (1-tailed)	.000	.000	.000	.000		
GC6	Pearson Correlation	.876**	.916**	.830**	.841**	.823**	1
	Sig. (1-tailed)	.000	.000	.000	.000	.000	
***. Correlation is significant at the 0.01 level (1-tailed).*							

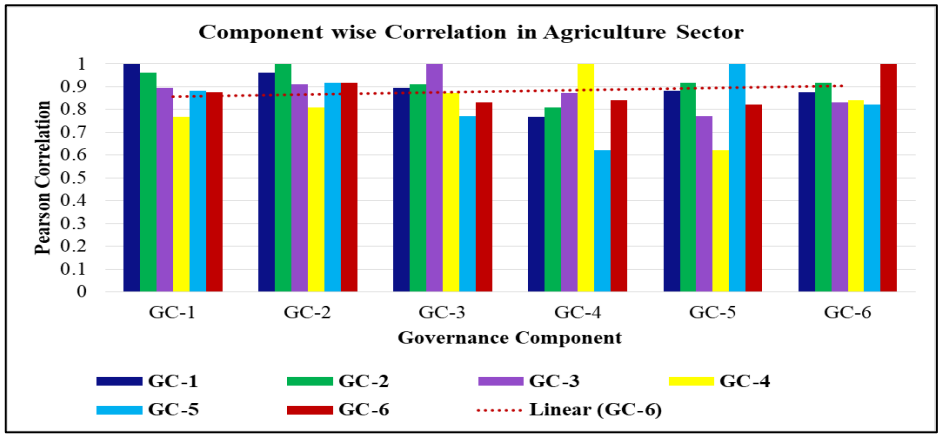

Figure 7. Component wise Pearson Correlations for CCD in Agriculture Sector

Table 8. *Regression Model Summary for overall sample of Agriculture Sector*

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.941[a]	.885	.883	.41042

a. Predictors: (Constant), Capacity of Corporate Actors, Capacity of Community Based Stakeholders, Capacity of Civil Society Stakeholders, Policy, Legal and Institutional Arrangements, Capacity of Line Departments
b. Dependent Variable: Practice and Performance

Table 9. *ANOVA Summary for overall sample of Agriculture Sector*

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	454.527	5	90.905	539.668	.000[b]
	Residual	59.125	351	.168		
	Total	513.651	356			

a. Dependent Variable: Practice and Performance
b. Predictors: (Constant), Capacity of Corporate Actors, Capacity of Community Based Stakeholders, Capacity of Civil Society Stakeholders, Policy, Legal and Institutional Arrangements, Capacity of Line Departments

Table 10. *Summary of Regression Coefficients for overall sample of Agriculture Sector*

Coefficients[a]									
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations Zero-order	Collinearity Statistics	
		B	Std. Error	Beta				Tolerance	VIF
1	(Constant)	-1.11	0.134		-8.267	0			
	GC1	0.113	0.074	0.105	1.536	0.125	0.876	0.071	14.121
	GC2	0.682	0.099	0.685	6.884	0	0.916	0.033	30.176
	GC3	-0.352	0.052	-0.377	-6.789	0	0.83	0.107	9.385
	GC4	0.781	0.068	0.471	11.559	0	0.841	0.197	5.07
	GC5	0.199	0.105	0.101	1.893	0.059	0.823	0.116	8.622

a. Dependent Variable: GC6

Table 11. *Regression's Residual Statistics for overall sample of Agriculture Sector*

Residuals Statistics[a]					
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.7866	5.5835	2.7892	1.12994	357
Residual	-.63758	.89599	.00000	.40753	357
Std. Predicted Value	-1.772	2.473	.000	1.000	357
Std. Residual	-1.553	2.183	.000	.993	357

a. Dependent Variable: Practice and Performance

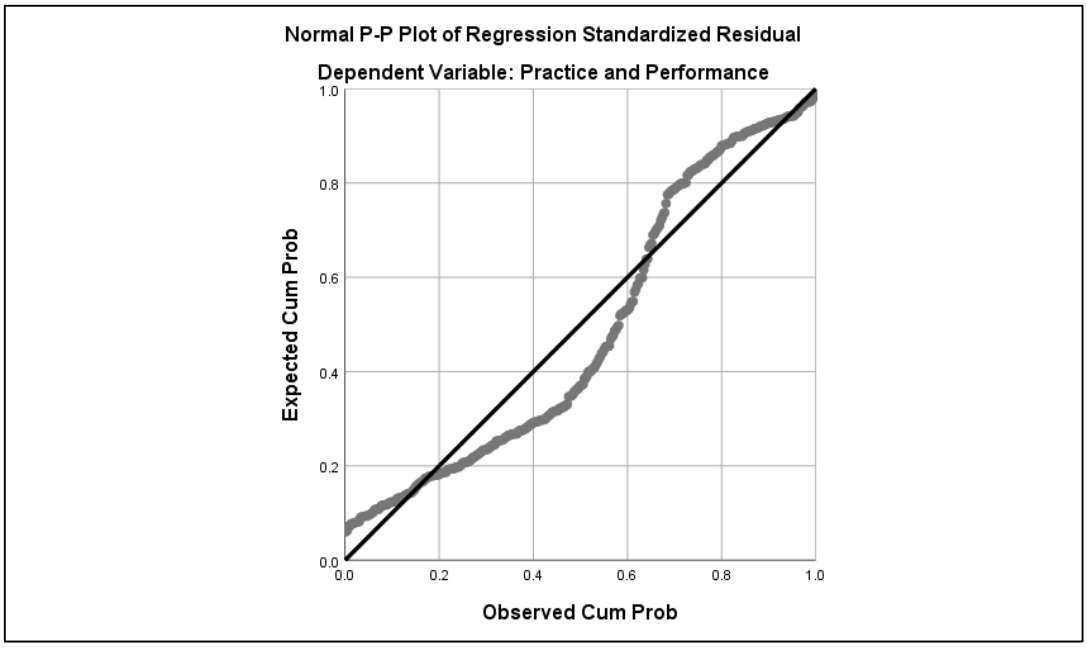

Figure 8. Normal P-P Plot of Regression Standardized Residual for Overall sample

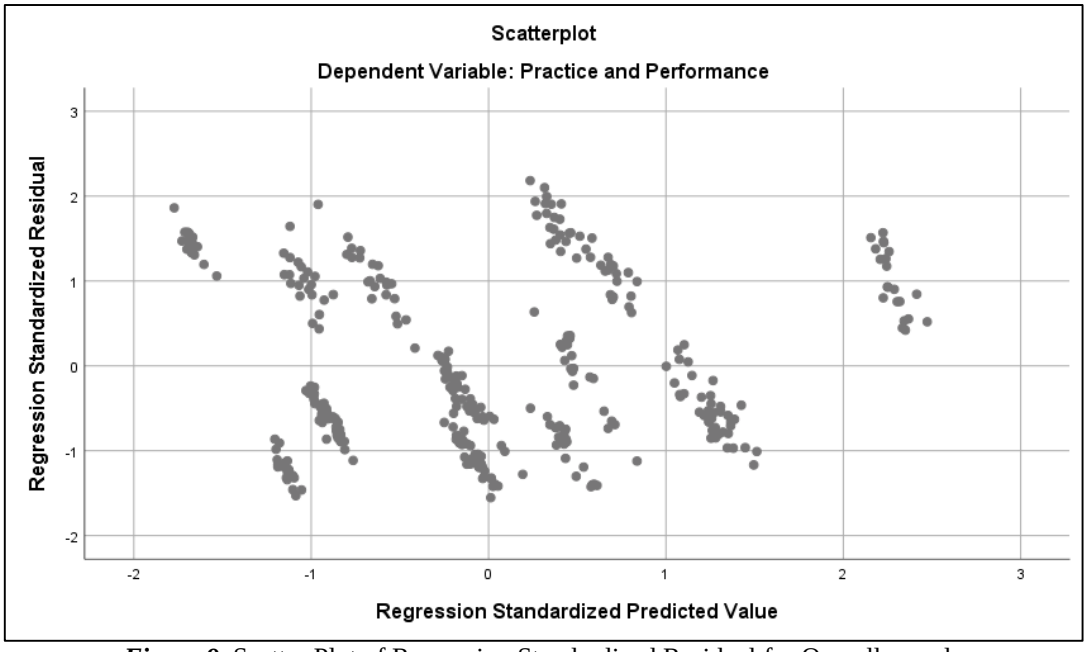

Figure 9. Scatter Plot of Regression Standardized Residual for Overall sample

Discussion

The national economies have important role of agriculture sector and the case of Pakistan is very significant considering the leading role of agriculture towards national GDP, livelihood of local communities on a large scale and food security. On one hand, it is the backbone of the country's economy while on the other it is the largest consumer of freshwater resources i.e. surface and the subsoil water which is a matter of grave concern; and also the 2nd largest GHGs emitter after the energy sector in Pakistan. The case of Pakistani agriculture is highly vulnerable to climatic impacts for which adoption of resilience centric approach can be instrumental to contribute significantly towards climate mitigation, adaptation and low carbon strategies as outlined in 'Framework for Implementation of Climate Change Policy of Pakistan' (FICCP). The federal

context and the success of FICCP (GoP, 2014a) have strong linkages with the adequate governance arrangements at provincial and district levels as the agriculture is a provincial subject. It has cross-sectoral linkages and overlaps for policies, strategies, legal and institutional mechanism governing on vulnerability assessment, spatial mapping and Local Adaptation Plans of Actions (LAPAs), reducing GHG emissions, early warning system, technological innovation, climate smart practices, climate organization, restricting agricultural rights to protect dry river belt / mountainous slope areas, and the cascading effect of climate change on food security vis-à-vis marine fisheries and agriculture at global, regional, sub-regional and national scales. The climatic impacts on marine fisheries (Ding *et al.*, 2017; Blasiak *et al.*, 2017) and agriculture have an interplay due to a very strong and complex interdependence between the two and various segments of the land based and marine economy. This interplay is particularly important in the context of agriculture, water and energy sectors; particularly in responding climatic extreme events for disaster risk reduction and ensuring overall sustainability by employing the climate compatible development philosophy. CCD agenda for agriculture, water and energy sectors has very strong linkages due to complex interdependence among them, in the case of Pakistan.

In this context, the results of this study reveal major governance gaps at federal, provincial and districts levels in response strategies for climate compatible development in agriculture sector of Pakistan; as the basic research question is validated through a statistical procedure. Observations gathered through FGDs are also supporting the overall quantitative governance index. So far, the overall climate response level in agriculture sector of Pakistan is still in readiness phase i.e. within the boundaries of initial governance arrangements and its trends are more or less same to the global trends for the status of climate governance in developing countries, as reflected on page 51 of the 'SDGs Report 2020'.

The federal level developments for CCD response under GC1 are very good. While, provinces have shown a considerable response but results for the local context are not encouraging at districts level across Pakistan. The relevant federal policies and strategies have all the requisite material for CCD in agriculture. The contents of the National Food Security Policy (NFSP) 2018 are very much focused and harmonized to address all components of climate compatible development by meeting the agenda under FICCP 2014 (MNFSR, 2018; GoP, 2014a). A fair commitment is found towards building a climate resilient system for agriculture sector of Pakistan. But, most of the provinces including KPK, Balochistan, AJK and GB need to revamp the existing ones or bring new policies (GoKP, 2014; Government of Balochistan, 2014; GoAJK, 2014). However, the Punjab Agriculture Policy 2018 is an up-to-date and comprehensive document that desires concrete short and medium term actions for its vision i.e. "diversified, sustainable, modern and market-driven sector" (Government of Punjab, 2018). It is coherent with FICCP. It has provided a commitment to offer facilitation in achieving the 2030 SDGs targets vis-à-vis strong interlocking agriculture sector on SDG1, SDG2, SDG5, SDG6, SDG8, SDG13, SDG16 and SDG17. The contents of the document cover all segments of climate compatible development vis-à-vis geography for regional distribution of various crops, climate zones and type of agriculture measures. It has a clear recommendation for the adoption of climate smart agriculture by classifying and focusing on four strategies i.e. (1) adaptation and resilience, (2) reducing GHG emissions, (3) enabling set of institutional arrangements, and (4) capacity of the relevant actors with adequate financial flows. However, the regulation of rights is quite tricky matter and it needs to be protected through proper legal instruments in the form of an Act of provincial assemblies and compliance monitoring mechanism. Like the province Punjab, Sindh Agriculture Policy 2018-2030 has also been developed on the latest state of knowledge (Government of Sindh, 2018). Here, CSA came under limelight to put together multi-in-one solutions; in the changing scenarios and high rate of unforeseen fluctuations due to climatic variations so far witnessed and are quite alarming as well as challenging. CSA solutions have the potential to ensure food security through more efficient and sustainable productions, enhanced resilient agri-ecological systems, and also minimizing the level of GHG emissions (Chandra, 2017). CSA and Sustainable intensification in agriculture are closely interconnected climate response approaches, as adaptation and mitigation are integral and crucial part for both of them.

Sustainable intensification can increase food production from limited farmland in a way that reduces environmental and climatic impact, and does not undermine the capacity of food production in the future (Campbell *et al*., 2014). It may be the right approach for the case of Pakistan's agriculture productivity considering the anticipated manifold increased demand due to steady rise in population pressure over the years to come.

It is most likely that a number of countries would be facing multiple jeopardies in the context of their agriculture and marine fisheries sectors due to climatic impacts and response options would be "context-dependent" in order to have trade-offs for interlocking agenda of SDGs. There is also a likelihood for the change in dietary habits and life-style due to an unforeseen shift in consumption patterns particularly in coastal cities and communities, which is also a matter of concern with its strong relevance to SDG12 i.e. "responsible consumption and practice". For SDG13, strategy 1.6 under section 10.3 of FICCP addresses the requirement and actions for healthy and sustainable fisheries thus also corresponds to SDG14 regarding "Conserve and sustainably use the oceans, seas and marine resources for sustainable development". Strategy 1.3 under section 10.3 of FICCP requires actions regarding development of appropriate crop varieties for the agriculture in coastal belt areas. Whereas, climate change has strong linkages for all the SDGs, thus poverty alleviation, food security, sustainable consumption, life below water and livelihood entails the need to strategize and plan a set of actions for a sustainable relationship between the agriculture and marine fisheries.

The results also support the initial problem diagnosis that was based on the analytical review of literature for this study according to which the policies, strategies and institutional arrangements are on advance stage at federal level. But the majority of provincial cases are lagging far behind towards it. However, the stock-taking survey and analytical review of federal level documentation, legal instruments and climate response strategies depict a number of parallel developments and contents' overlap in among documents causing distortion, confusion and conflict. For example, the contents of 'Work Programme for Climate Change Adaptations and Mitigation in Pakistan: Priority Actions 2014' (GoP, 2014b) and FICCP documents by the Government of Pakistan have massive overlap regarding strategies and defined actions; thus, caused duplication of efforts by different stakeholders and utilization of available resources can be considered irrational. Disaster risk reductions related developments also remained quite complex and depict duplications in an uncoordinated way. Whereas, sectoral ownership also remained a decades old major challenge in the governance system of Pakistan, for which capacity of the line departments is an obvious and integral part of overall governance mechanism.

The results of the study depict that the capacity of the line departments (GC2) is good at federal level while it is considerable at provinces but has more or less same position at districts level. The capacity of the civil society stakeholders (GC3) is fair at federal level while there is a need to do a lot at provinces and districts levels across Pakistan. There are missing links found regarding the capacities of the line departments on two important segments i.e. Local Adaptation Plans of Actions (LAPAs) and early warning system.

Capacities of the actors under GC4 and GC5 have shown a big disconnect from mainstream governance line as the index scores correspond poor to very poor situation from federal to district context. Overall situation for the case of Balochistan is quite discouraging. There is a major disconnect found between the federal level institutions and the community based stakeholders which is a very critical and limiting factor for CCD response strategies and needs to be dealt carefully so as to actively engage all relevant stakeholders. Since agriculture is provincial segment and agriculture extension department has the relevant mandate, so it is the core responsibility of this unit to mainstream the local actors. The provincial governments need to strengthen this important component of local governance and to enhance coordination between the federal, provincial and district levels institutional arrangements. Capacity mapping exercises may be done by the federal and provincial governments so as to better plan against climate response requirements for future. For the purpose, governance indicators from this study may be used for

need assessment on various aspects of CCD. This would be instrumental in enhancing the performance through better practices under GC6.

Results under GC6 depict the major issues of sustainability and regulation of rights at the level of all constituencies across Pakistan. There is a strong disconnect found between the planning and execution at all levels. A number of good documents exists at federal and provincial levels that can support the overall climate agenda in particular and CCD in general, but their implementation has major issue. On one hand there is an issue of fiscal resources while on the other hand lack of political will and desired levels of capacities act as limiting factors. There was consensus among the experts of FGDs at all levels that this situation was further aggravated soon after the promulgation of the 18th amendment in the national constitution of Pakistan after which coordination issues between the federal and provincial institutions rendered major challenges thus institutional effectiveness remained poor as depicted by the governance index and also validated during all the FGDs.

It was opined, discussed, debated and concluded during FGDs that strong political commitment, capacity enhancement and allocation of sufficient amount of fiscal resources can produce good performance at all levels. This would be instrumental in enhancing the performance through better practices under GC6 which is, at the moment, fair to good for all criteria in governance index in federal context while poor in provincial and districts contexts. This major grey area under practice and performance component (GC6) particularly at provincial and districts levels entails the need to develop and implement provincial actionable climate response strategies with clearly defined roles and responsibilities for agriculture sector in Pakistan.

Above all, the allocation of sufficient financial resources is very much needed but a missing link at the moment particularly for the adaptation segment for which federal and provincial governments need to address this issue in their budget planning and management cycle. This would be instrumental in ensuring the sustainability of all CCD criteria with a strong adherence to the novel climate principles which were developed as part of this study, under all components of the governance system.

Conclusion

The finding of the study deciphers that the overall climate response level in agriculture sector of Pakistan is still in readiness phase i.e. within the boundaries of initial governance arrangements and its trends are more or less same to the global trends for the status of climate governance in developing countries, as reflected on page 51 of the "SDGs Report 2020". The overall analysis and assessments have found several challenging governance gaps that exist at federal, provincial and districts levels in response strategies for climate compatible development in agriculture sector of Pakistan. There is a strong disconnect found between the planning and execution which has rendered major grey areas under practice and performance component at all levels. The sectoral ownership remained a decades old major challenge in the governance system of Pakistan, for which capacity of the line departments is an obvious and integral part of overall governance mechanism. There are missing links found regarding the capacities of the line departments on two important segments i.e. Local Adaptation Plans of Actions (LAPAs) and early warning system. It has generated a major challenge for the sustainability of overall mechanism and regulation of rights at the level of all constituencies across Pakistan, and the overall situation for the case of Balochistan is quite discouraging. The cascading effect of climate change on food security vis-à-vis marine fisheries and agriculture has also missing links which is critically important for "context-dependent" response options in order to have trade-offs for interlocking agenda of SDGs; due to a very strong and complex interdependence between the land based and maritime economy. There is a number of good documents that exists at federal and provincial levels that can support the overall climate agenda in particular and CCD in general, but their implementation is a major issue and a number of parallel developments and contents' overlap in among documents causing distortion, confusion and conflict. The success of FICCP has a very strong linkage with the governance arrangements at provincial and district levels. On one hand there is an issue of

fiscal resources while on the other hand lack of political will and desired level of actors' capacities act as limiting factors. This situation was aggravated soon after the promulgation of the 18th amendment in the national constitution of Pakistan after which coordination issues between the federal and provincial institutions rendered major challenges thus institutional effectiveness remained poor as depicted by the governance index and also validated during all the FGDs. Statistically, these findings are also validated through the outcome of Regression analysis that has indicated so far the absence of a proactive and inclusive response mechanism to govern climate compatible development in agriculture sector at federal, provincial and districts levels in Pakistan for its environmental security. Although all components of the governance are impacting each-other, as a whole the null hypothesis of the basic research question can't be rejected. The application of this novel analytical model framework proved well and its extended use would certainly provide guidance for strengthening the futuristic governance for climate compatible development not only in Pakistan but also in other countries.

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