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Capacity Assessment Of Community Based Organizations For Climate Smart Agriculture Extension To Promote Climate Compatible Development: A Governance Index Approach

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Abstract

Climate change impacts vary across various agro-ecological zones and thus require context specific climate smart interventions. The global institutions like World Bank and Food and Agriculture Organization are persuading countries for transition to modern agriculture practices aiming at promoting climate smart agriculture (CSA) and strengthening the adaptive capacities at grass-root levels. Paris Agreement of 2015 also emphasizes on the role of community based organizations (CBOs) for preparing local communities in collaboration with local institutions for coping with climate related disasters effectively. CBOs act as mediators, bridging the gap between local communities and institutions by consistently engaging with administration to effectively implement CSA practices. CBOs can play an effective role towards triple-win strategies of climate compatible development (CCD), provided if these organizations have adequate capacity. In recent years, many CBOs are involved in modern agriculture practices. Still, there is a big capacity gap in utilizing their role to an optimum level. Present study tries to find out whether CBOs including farmers' groups in Pakistan have adequate capacity to adopt modern climate smart agricultural practices to achieve the country's targets set for SDG-2 and SDG-13. It employed a principle-criteria-indicator (PCI) based governance analysis model to develop an index for assessing CBOs' capacity with a cross-sectional data of 340 KIIs and 17 FGDs at federal, provincial and districts levels in Pakistan. The analysis model combined different governance approaches with mix-method multi-criteria methods including MCDA's SMART and statistical tests for validation purposes. Based on empirical results, it is deciphered that CBOs' capacity is not well matched with CCD agenda in Pakistan.

Keywords: governance analysis; modelling; actors' capacity index; modern agriculture; crop emissions; climate compatible development; MCDA

Introduction

Climate change, a daunting phenomenon (B. A. Iqbal & Ghauri, 2011; K. M. J. Iqbal et al., 2020; K. M. J. Iqbal & Khan, 2018) is posing serious challenges for agriculture and food security (Abbas & Zulfiqar, 2021; Altieri et al., 2017) and in achieving sustainable development goals (SDGs). Climate variability causes shifts in seasons, rainfall patterns, soil moisture content and water availability, which consequently impact crop productivity. Various agro-ecological zones are facing varied intensities of climate change impacts (Ullah, 2017), thus require context specific climate smart interventions. To cope with this challenge, countries are working on studying the impacts in their specific context and developing adaptation strategies accordingly. The SDG-13 calls for joint action against climate change by developing resilience and adaptive capacity to cope with climate related disasters and ensuring food security (SDG-2). For this purpose, the global institutions like World Bank and Food and Agriculture Organization (FAO) are persuading countries for transition to modern agriculture practices aiming at promoting climate smart agriculture (CSA) and strengthening the adaptive capacities at grass-root levels (Lipper et al., 2014; Taylor, 2018; Totin et al., 2018). The Paris Agreement of 2015 also highlights the role of community based organization (CBOs) in preparing local communities for coping with climate related disasters effectively in collaboration with government institutions (Mumtaz, 2021). CBOs act as mediators, bridging the gap between local communities and institutions by working in close connection with administration to effectively implement climate smart agriculture (CSA) practices.

Developing countries with dwindling resource base and weak institutional capacities are facing serious challenges in coping with climate disasters and developing institutional adaptive capacities. The situation requires that social actors (people, households, businesses, private sector) should be well prepared to cope with emerging risks and harness climate related opportunities (Berkhout, 2012). Mainstreaming stakeholders is an important part of the guidance documents on climate adaptation worldwide, with special emphasis on local stakeholders from affected communities (Wright et al., 2014). CBOs being more interactive and cooperative among other actors, can play an effective role to help in reducing government expenditure on extension work, provided these organizations have adequate capacity and training. In recent years, many community organizations have been involved in activities that promote modern agriculture practices (Khanal et al., 2019). Farmers are practicing different adaptation strategies to adjust with climatic changes and increase their livelihood. Most reported adaptation strategies focus on modern and climate smart practices including high yielding and climate resistant crop varieties, on-farm water management, soil conservation, adjusting crop cycles with changing climatic patterns, agro-forestry and greenhouse gases (Khanal et al., 2019). Studies also reveal that in agricultural areas, farmers unite in the form of small community groups to identify and implement CSA practices that better suit their local conditions. Such initiatives are often referred to as community based adaptation (CBA), where local people identify objectives and means to implement modern CSA practices better suited to their local context.

These CBOs facilitate the process of participation, access to credits, joint actions, access and dissemination of information and sharing of experiences through their localized networks help in reaching the most vulnerable groups of the society and thus empower them to get involved in decision making process (Aboniyo & Mourad, 2017). This is the reason that modern agriculture practices are increasingly being proposed for climate compatible agriculture. However, the degree to which modern agriculture practices will be adopted will depend on multiple factors including actor's capacity and effective planning. Developing countries like Pakistan, where human, technological and financial resources to cope with climate related disasters and adaptation measures are limited (Amir et al., 2020; Muhammad et al., 2012), are more vulnerable to climate change. In these countries, farmers with small holdings are at greater risk to extreme weather events (Amir, Saqib, Khan, Ali, et al., 2020). Pakistan being a predominantly agrarian economy, badly hit by rising temperature, erratic rainfall patterns and floods. Studies predict a decrease in crop yield in future posing risk for the farming community. Communities most affected by climate change are farmers with small land holdings that constitute more than 80% of the total farming community. The situation demands an active role of social actors in disseminating knowledge and facilitating access to resources for farmers for enhancing their adaptive capacity. This will only be possible if the social actors like CBOs and farmer groups are equipped with adequate resources to perform their responsibilities effectively. Experts have opined that the role of CBOs in aligning agriculture practices with CSA is in its infancy stage but growing at a reasonable pace (Mumtaz, 2021).

In this context, the present study tries to find out whether CBOs and farmer groups in Pakistan have adequate capacity to extend and adopt modern CSA practices to achieve targets set for achieving SDG-2 and SDG-13 by the government. The study implied a principal-criteria-indicator (PCI) based governance framework model to develop an index for assessing the capacity of CBOs at federal, provincial and district levels in Pakistan.

Methodology

Research design

This article is based on the fourth climate principle i.e. *'maintain active engagement of the community based stakeholders towards climate endeavors (CP4)'*, which has been constructed as part of the Doctorate study of the first author (Table-1). Focus of present study was limited to finding out whether CBOs in Pakistan have capacity to adopt modern CSA practices to achieve the country's targets set for

SDG-2 and SDG-13. The study employed mix-method modeling by combining quantitative and qualitative approaches, tools and methods. In this specific case, Figure 1 delineates the research design for the overall study, while figure 2 portrays the framework employed. The research employs a mix of 'Rules-based' and 'Rights-based' approaches to governance of the MCDA technique focusing on the six major components of governance (Amer & Daim, 2011; Costa et al., 2017; Daim et al., 2009; Ishtiaque et al., 2019; McIntosh & Becker, 2020). Before the governance analysis model system for CCD, three expert consultation meetings on the topic (Borgatti et al., 2009; Ingie Hovland, 2005; Wellman, 1983) were carried out to provide a situational analysis. The model is generic for the sectoral indicators, and an advance form of the framework employed by participatory assessment of REDD+ governance in Indonesia (Kartodihardjo et al., 2013). The model developed in the study is flexible to be applied as whole or in parts for any of the six climatic principles or the governance components as it has a simple and well integrated design. Researchers and decision makers can utilize this model by following simple steps, but with dedicated efforts for the collection of cross-sectional primary data. For this study, only the first CP4 and GC4 were chosen (Table 1) to develop governance index considering the competence of CBOs for climate compatible development in the agriculture sector. Figure 2 depicts the logical sequence used for the subset of novel multivariate model. The two step analysis process involved in the making of tools for measuring, and the second step involved the practical use to determine governance index for a basic response mechanism under an agriculture sector-centric case study.

Determination of key variables and primary data collection

To address the newly developed governance model, the study required variables by involving principles, criteria and indicators (PCIs). Six climate response principles formulated by the first author against six components of the basic governance mechanism are illustrated in Table 1. A delicate process of narrowing down followed by determining the set of 36 composite indicators against nine CCD criteria, governance component 4 (GC4) i.e. role and capacities of CBOs, CP4 and six (06) principles under the World Bank's good governance measures (Kartodihardjo et al., 2013) , as depicted in Figure 2. A commonly used scenario based learning and situational analysis technique (Dey, 2012; I. Hovland, 2005; Norris et al., 2012; Serrat, 2017) was used for the study using flip charts in three in-house consultative meetings which were conducted in Islamabad. This study has additional advantage and added value to the state of knowledge by producing and testing an advanced version of the governance analysis model with nine criteria and six principles and 36 indicators for CCD, and a unique arrangement of multi-variables.

Table 1. 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

A commonly used (SMART) MCDA's Simple Multi-attribute Rating Technique (Edwards, 1977; Gärtner et al., 2008; Heinrich Blechinger & Shah, 2011; Leskinen & Kangas, 2005) was employed along with ration scale to score and weigh the criteria against indicators. The ratio scale comprises of 0 = no response or not applicable 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. Weighing, normalizing and validating exercises of indicators were conducted before the formal testing. SMART ratio scale was used to structure a questionnaire cum scoring matrix by incorporating the applicable set of 36 composite indicators for agriculture governance in GC4. Two essential elements were key in the sampling plan i.e. (1) the geographical limits (2) the sample size against which interviews of informants and focus group sessions were directed. Sampling covered various sectors i.e. federal, provincial and district. Seven federal and provincial capitals and ten districts (Swat, Mansehra, Bahawalpur, Rajanpur, Sanghar, Badin, Jhal Magsi, Khuzdar, Muzaffarabad and Ghizer) were identified locations for response recording from selected stakeholders. The selection of sampling sites was made considering the existing climate related developments and projects by various stakeholders' including civil society organizations (CSOs), academia, and private sector institutions. 357 purposive samples were gathered; encompassing one Focus Group Discussion (FGD) and 20 Key Informant Interviews (KIIs) per location.

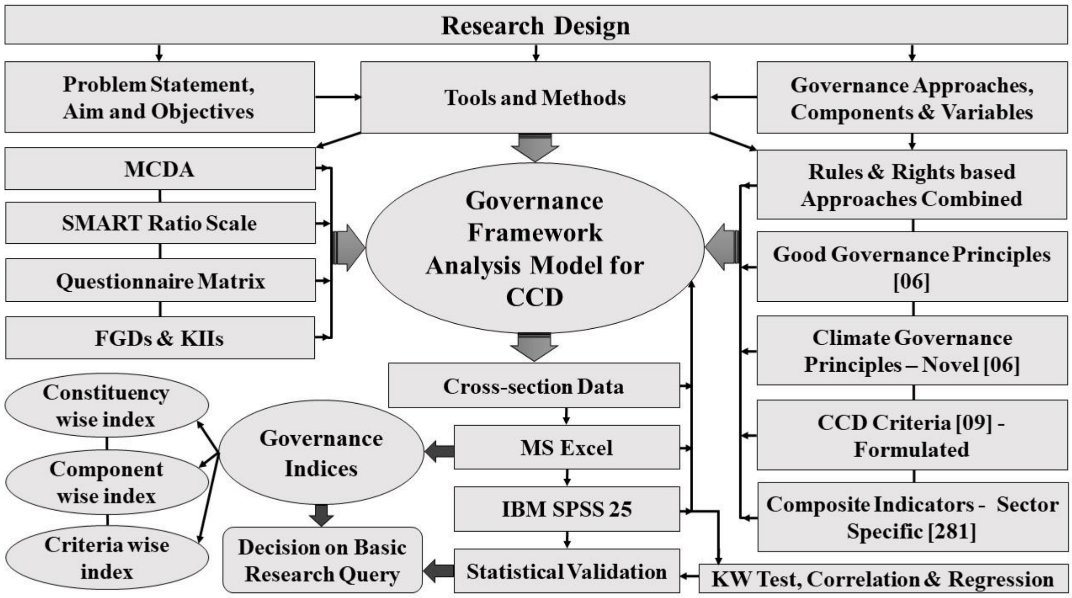

Figure 1. Study design and methodological steps' process flow (Source: PhD dissertation of first author)

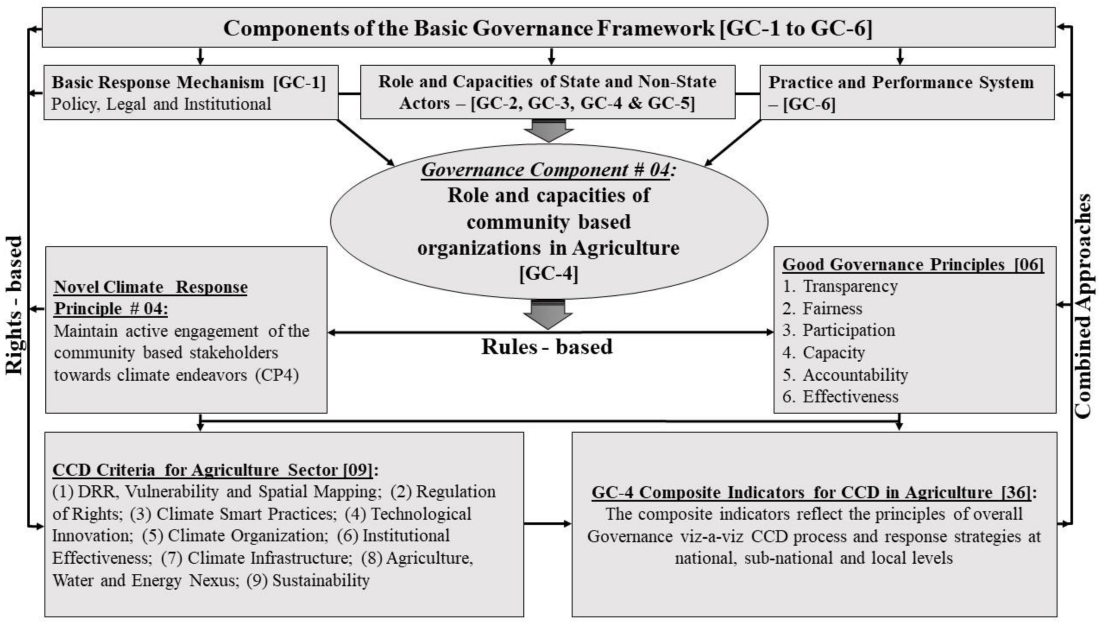

Figure 2: Multivariate Model of GC4 for CCD in Agriculture Governance (Source: PhD dissertation of first author)

Primary data management and analysis

For the purpose of compiling, clearing and processing the raw data, along with developing governance index and its presentation for GC4 in Pakistan's agriculture sector, 'MS Excel 2016' was used. Validation of results was done using three statistical tests including non-parametric Kruskal-Wallis (KW) hypothesis or H-test, Pearson Correlation and Regression by 'IBM SPSS Statistics 25'. The understanding and characterization of sample groups was done using KW test, along with testing constituency of variables and gender-wise before indicating the domination of samples at various levels of governance i.e. federal, provincial and regional. Authenticity of sample data was checked through it with the presence of diverse trends on the ratio scale. 1-tailed Pearson correlation analysis aided in developing understanding about the association, impact and interlocking of various governance variables on each other to gain clarity about diverse interdependence of variables related to the CCD agenda in agriculture sector. Finally, Multivariate Linear Regression analysis aided in assessing the mathematical relationships among various interconnected variables to draw conclusion on the research question.

Results

Table 2 shows criteria wise GC4 index for CCD response in the agriculture sector of Pakistan. Figures (3-6) provides graphical overview of governance index viz-a-viz nine criteria of CCD, criteria wise GC4 index scores on a clustered bar chart, radar for the distances against governance index and overall GC4 index for CCD response at federal and provincial levels respectively. District levels index score are portrayed in Figure 7. Overall results depict AC-1.4 index scores 3.38, 2.58 and 1.83 with an average score 2.60; AC-2.4 index scores 1.99, 2.11 and 1.76 with an average score 1.95; AC-3.4 index scores 3.13, 2.46 and 1.84 with an average score 2.48; AC-4.4 index scores 2.99, 2.53 and 1.79 with an average score 2.44; AC-5.4 index scores 2.70, 2.55 and 1.85 with an average score 2.37; AC-6.4 index scores 3.81, 2.59 and 1.84 with an average score 2.75; AC-7.4 index scores 3.00, 2.55 and 1.84 with an average score 2.47; AC-8.4 index scores 2.51, 2.30 and 1.81 with an average score 2.21; AC-9.4 index scores 1.86, 1.36 and 0.84 with an average score 1.35; and constituency wise average scores 2.82, 2.34 and 1.71 at federal, provinces and districts levels respectively. The overall GC4 index score is 2.29.

Regarding statistical validation, Table 3 and 4 provide summaries of constituency and gender based KW Hypothesis Tests respectively for overall sample of GC4 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 5 and figure 8 that indicate a very strong correlation among all CCD criteria of the governance under GC4 except AC-9.4 that has shown a very weak bond with all others. Whereas; descriptive statistics of multivariate regression analysis for overall sample of agriculture sector are shown in Tables 6 to 9 while Figure 9 shows normal P-P Plot and Figure 10 shows scatter plot of Regression standardized residual for overall sample in agriculture sector. AC-9.4 i.e. sustainability of GC4 was used as a dependent variable.

The values of R and R Square are 0.573 and 0.328 respectively which are on lower sides. Coefficients of T-test show significant relationship of AC-9.4 with only three other criteria i.e. AC-1.4, AC-4.4 and AC-6.4 (with values above ± 2); except all other majority of the criteria. The collinearity diagnostics is also very good for the established significant relationships of AC-9.4 with three other criteria thus supporting their significance. On the other hand, results of zero-order correlations are also not very good under GC4.

The normal P-P plot shows very good result with a low level of deviations to upward and downward fluctuations and the scatter plot shows a bonded group with few outliers on Y-axis, but overall it is showing very good results within the ± 3 boundaries. Although a number of the criteria under GC4 index of the governance are impacting each-other, as a whole the null hypothesis of the basic research question can't be rejected for the case of GC4. So, GC4 results also indicate 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 climate compatible development.

Table 2: GC-4 Index for CCD Response in Agriculture Sector

CCD Criteria	Criteria wise Index Score			
	Federal	**Provinces**	**Districts**	**Average**
Disaster Risk Reduction, Vulnerability and Spatial Mapping (AC-1.4)	3.38	2.58	1.83	2.60
Regulation of Rights (AC-2.4)	1.99	2.11	1.76	1.95
Climate Smart Practices (AC-3.4)	3.13	2.46	1.84	2.48
Technological Innovation (AC-4.4)	2.99	2.53	1.79	2.44
Climate Organization (AC-5.4)	2.70	2.55	1.85	2.37
Institutional Effectiveness (AC-6.4)	3.81	2.59	1.84	2.75
Climate Infrastructure (AC-7.4)	3.00	2.55	1.84	2.47
Agriculture, Water and Energy Nexus (AC-8.4)	2.51	2.30	1.81	2.21
Sustainability (AC-9.4)	1.86	1.36	0.84	1.35
Overall Average	**2.82**	**2.34**	**1.71**	**2.29**

[**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]

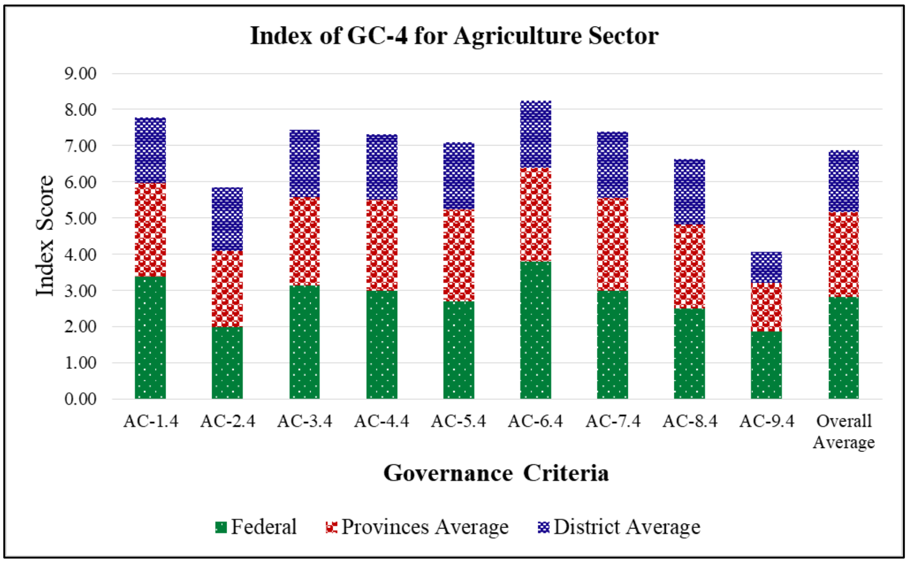

Figure 3: Criteria wise GC-4 Index for CCD Response in Agriculture Sector

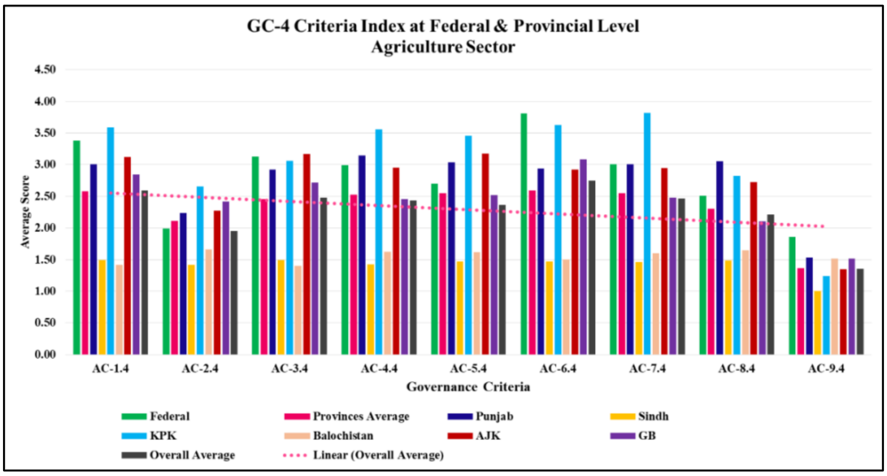

Figure 4: Criteria wise GC-4 Index for CCD Response at Federal & Province Level

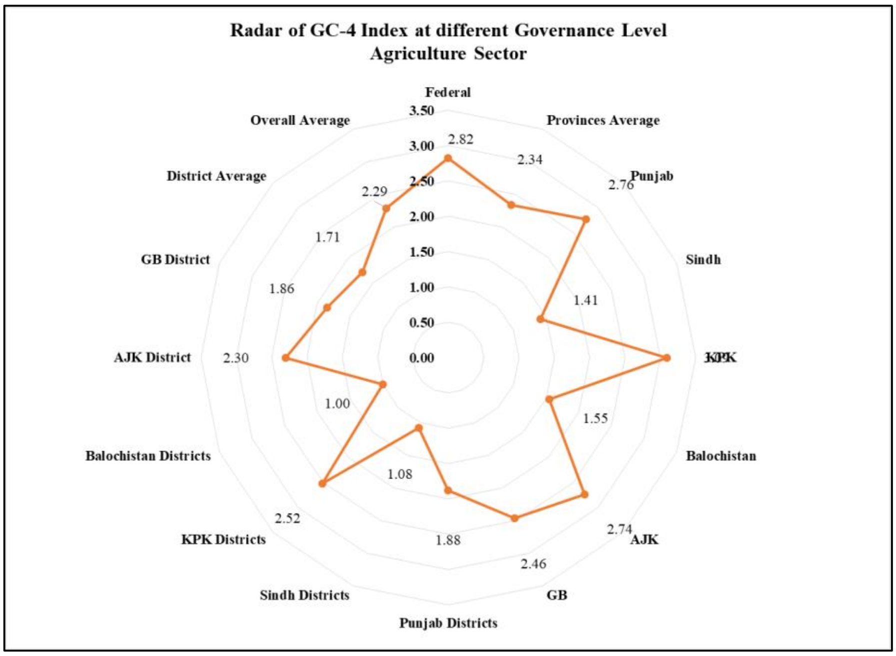

Figure 5: GC-4 Index Radar for CCD Response at different Governance Level in Agriculture

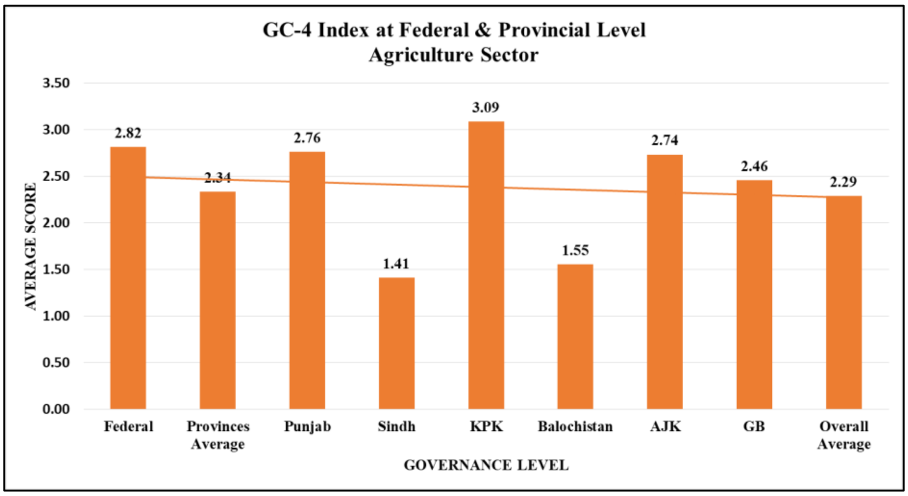

Figure 6: GC-4 Index for CCD Response at Federal & Provincial Level in Agriculture Sector

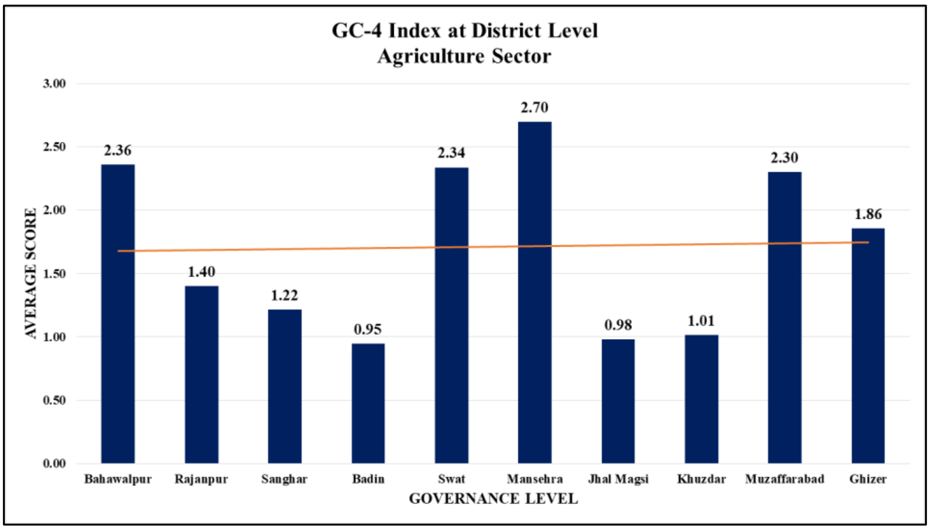

Figure 7: GC-4 Index for CCD Response at District Level in Agriculture Sector

Table 3: Summary of Constituency based KW Test for GC-4 sample in Agriculture Sector

Hypothesis Test Summary				
	Null Hypothesis	**Test**	**Sig.**	**Decision**
1	The distribution of DRR, Vulnerability and Spatial Mapping is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
2	The distribution of Regulation of Rights is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
3	The distribution of Climate Smart Practices is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
4	The distribution of Technological Innovation is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
5	The distribution of Climate Organization is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
6	The distribution of Institutional Effectiveness is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
7	The distribution of Climate Infrastructure is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
8	The distribution of Agriculture, Water and Energy Nexus is the same across categories of Constituency.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
9	The distribution of Sustainability 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 4: Summary of Gender based KW Test for GC-4 sample in Agriculture Sector

Hypothesis Test Summary				
	Null Hypothesis	**Test**	**Sig.**	**Decision**
1	The distribution of DRR, Vulnerability and Spatial Mapping is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.002	Reject the null hypothesis.
2	The distribution of Regulation of Rights is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.069	Retain the null hypothesis.
3	The distribution of Climate Smart Practices is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
4	The distribution of Technological Innovation is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.004	Reject the null hypothesis.
5	The distribution of Climate Organization is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.011	Reject the null hypothesis.
6	The distribution of Institutional Effectiveness is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.007	Reject the null hypothesis.
7	The distribution of Climate Infrastructure is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
8	The distribution of Agriculture, Water and Energy Nexus is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.005	Reject the null hypothesis.
9	The distribution of Sustainability is the same across categories of Gender.	Independent-Samples Kruskal-Wallis Test	.087	Retain the null hypothesis.
Asymptotic significances are displayed. The significance level is .05. *N = 357*				

Table 5: Summary of Correlations between CCD Criteria for GC-4 in Agriculture

Pearson Correlations									
CCD Criteria	**AC1.4**	**AC2.4**	**AC3.4**	**AC4.4**	**AC5.4**	**AC6.4**	**AC7.4**	**AC8.4**	**AC9.4**
AC1.4	1								
AC2.4	.761**	1							
AC3.4	.852**	.747**	1						
AC4.4	.822**	.702**	.767**	1					
AC5.4	.849**	.768**	.797**	.757**	1				
AC6.4	.894**	.755**	.840**	.824**	.830**	1			
AC7.4	.854**	.730**	.808**	.809**	.788**	.846**	1		
AC8.4	.830**	.775**	.832**	.792**	.833**	.816**	.812**	1	
AC9.4	.543**	.381**	.475**	.498**	.463**	.537**	.444**	.443**	1
***. Correlation is significant at the 0.01 level (1-tailed), N = 357*									

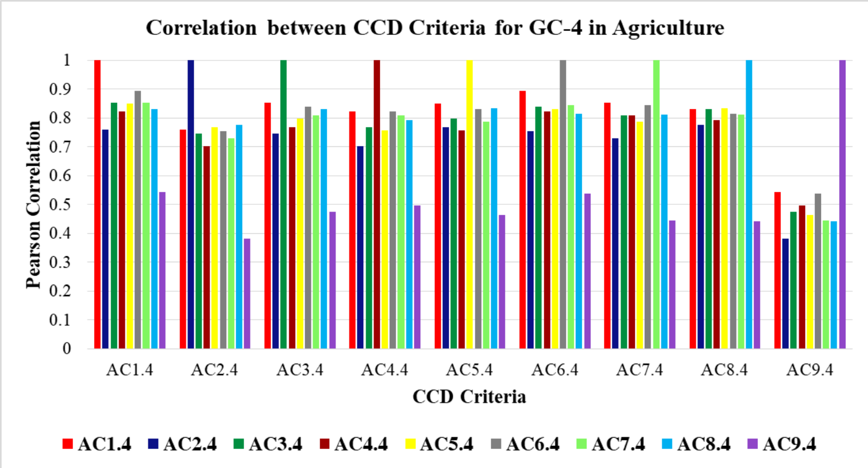

Figure 8: CCD Criteria wise Pearson Correlations for GC-4 in Agriculture Sector

Table 6: Regression Model Summary for GC-4 sample of Agriculture Sector

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.573[a]	.328	.313	.36750

a. Predictors: (Constant), Agriculture, Water and Energy Nexus, Regulation of Rights, Technological Innovation, Climate Smart Practices, Climate Organization, Climate Infrastructure, Institutional Effectiveness, DRR, Vulnerability and Spatial Mapping
b. Dependent Variable: Sustainability

Table 7: ANOVA Summary for GC-4 sample of Agriculture Sector

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22.967	8	2.871	21.257	.000[b]
	Residual	46.999	348	.135		
	Total	69.966	356			

a. Dependent Variable: Sustainability
b. Predictors: (Constant), Agriculture, Water and Energy Nexus, Regulation of Rights, Technological Innovation, Climate Smart Practices, Climate Organization, Climate Infrastructure, Institutional Effectiveness, DRR, Vulnerability and Spatial Mapping

Table 8: Summary of Regression Coefficients for GC-4 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)	0.557	0.063		8.86	0			
	DRR, Vulnerability and Spatial Mapping	0.195	0.06	0.392	3.253	0.001	0.543	0.133	7.539
	Regulation of Rights	-0.079	0.053	-0.115	-1.496	0.136	0.381	0.328	3.05
	Climate Smart Practices	0.019	0.049	0.038	0.392	0.695	0.475	0.206	4.854
	Technological Innovation	0.084	0.041	0.18	2.058	0.04	0.498	0.252	3.967
	Climate Organization	0.001	0.049	0.001	0.015	0.988	0.463	0.209	4.792
	Institutional Effectiveness	0.136	0.051	0.303	2.665	0.008	0.537	0.149	6.692
	Climate Infrastructure	-0.093	0.047	-0.193	-1.987	0.048	0.444	0.205	4.881
	Agriculture, Water and Energy Nexus	-0.036	0.06	-0.06	-0.596	0.552	0.443	0.192	5.196

a. Dependent Variable: Sustainability

Table 9: Regression's Residual Statistics for GC-4 in Agriculture Sector

Residuals Statistics[a]					
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.5732	1.6891	1.0826	.25399	357
Residual	-.84182	1.72332	.00000	.36335	357
Std. Predicted Value	-2.005	2.388	.000	1.000	357
Std. Residual	-2.291	4.689	.000	.989	357

a. Dependent Variable: Sustainability

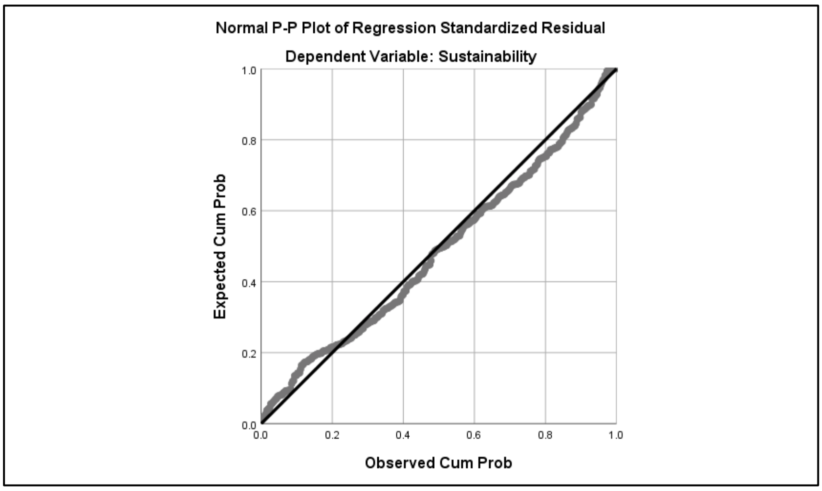

Figure 9: Normal P-P Plot of Regression Standardized Residual for GC-4 in Agriculture Sector

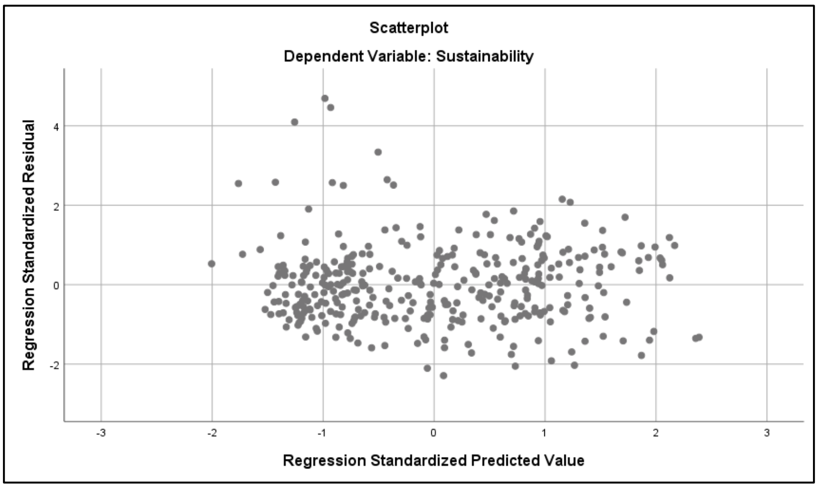

Figure 10: Scatter Plot of Regression Standardized Residual for GC-4 in Agriculture Sector

Discussion

Pakistan is a sub-tropical country, highly susceptible to change in temperature and rainfall patterns which increase the vulnerability of the agriculture sector (Ullah, 2017). Developing capacity to adapt to climate change and related impacts is the primary strategic response of Pakistan (Mumtaz, 2018, 2021). During discussion with the farmers' group, it was revealed that farmers were aware of the impacts of climate change and perceived that shortening of growing periods, water availability, loss of soil moisture and changing soil characteristics, and increase in frequency of pest infestation are due to climate change. In the current situation, SDG-2 that deals with food security is becoming a challenge due to widespread impacts of climate change on the agriculture sector. Community based organizations, farmer groups or social networks operate at grass-root level and play an important role in enhancing adaptive capacity of the farmers (Abid et al., 2017). Studies reveal a positive correlation between participation of farmers in CBOs and enhancement in adaptive capacity (Amir et al 2020; Ashraf et al., 2018; Trinh et al., 2017).

Results based on a low index score (ranging from 1.35 to 2.75) with total average score of 2.29 against all criteria (1-9) under GC4 (Table 2) exposed a very challenging situation about the capacity of community based stakeholders in the agriculture sector of Pakistan. The situation makes the efforts of line departments for meeting demands of vulnerable groups at grass-root level questionable (Ayers et al., 2014; Mumtaz, 2021). Role of CBOs is crucial and particularly important at grass root level for developing a climate resilient system with proper adaptation arrangement (Aboniyo & Mourad, 2017).

Experts have emphasized that CBOs need an enabling environment to work effectively, which is only possible through mainstreaming the CBOs in the planning process (Wright et al., 2014). Criteria 6 deals with institutional effectiveness, which was assessed in terms of creating opportunities for CBOs to participate in planning and capacity building processes by line departments. The overall average score (2.75) against criteria 6 particularly at district levels (1.84) exposed institutional barriers to mainstreaming the relevant stakeholders in the planning process and lack of institutional coordination (Chaudhury et al., 2016).

It was highlighted in all FGDs as well that the capacity of local actors is very much important but the situation is very critical, and the situation is even worse in the case of Balochistan. There is a strong disconnect between all actors and so far districts lack their Local Plan of Actions (LAPAs) through which the local people can be engaged actively (Chaudhury et al., 2016; Khanal et al., 2019). There are also issues of regulation of rights particularly in the dry river belt, the mountainous and low delta areas which are more vulnerable to extreme climatic events in Pakistan. Similarly, the local communities in the coastal and low-delta areas are found in total disconnect. A lot more work at provinces and districts levels across Pakistan is needed.

Criteria 9 dealt with sustainability of actions in terms of the existence of vibrant CBOs for environmental, social and economic security of farmers. The core for the sustainability of capacity under GC4 is very poor at all levels of federal, provincial and district constituencies across Pakistan.

The need for development infrastructure to combat climate is also realized considering the index scores. This infrastructure can support the existing and future initiatives of the civil society through an enabling environment for their active participation and inclusion so as to meet requirements of principles of good governance. The effectiveness of institutions is relatively fair at federal level, while the other constituencies are so far standing very behind the desired comfortable level of very good to excellent scales of the governance index.

The major challenges faced by CBOs as are evident from low index score at criteria 1-9 and also reported by stakeholders during KII and FGDs are lack of financial resources, dissemination of information, lack of training and capacity building opportunities, weak linkages with government and international institutions (Mumtaz, 2021).

During FGDs, it was revealed that there is a major disconnect between the government and local actors and the situation is very much discouraging at all governance levels across the country. There is a need to enhance capacities of the local actors and ensure an active engagement at federal, provincial and district levels in Pakistan. The role of the agriculture extension department is pivotal in order to ensure sustainability of the overall endeavor which is quite alarming at the moment; as depicted by the governance index.

Conclusion

Climate change is a reality which has increasingly become evident from its widespread impacts on the agriculture sector. Adaptations to climate change by employing modern practices can help farmers to sustain their livelihood and ensure food security at national level. Social actors like farmers' groups and community based organizations play an important role particularly in developing countries as observed in this study, where institutional access at grass-root levels is limited. However, the study also indicates weak capacities of CBOs to extend climate smart agriculture practices. Lack of funds, opportunities for training and capacity building, institutional collaboration and existence and efficiency of CBOs also is a hindrance. The PCI based model helped in assessing performance of the CBOs against a standardized replicable index, while at the same time indicators based approach helped in identifying areas of weak capacities of CBOs and possible causes. The study stresses upon the strengthening of the role of CBOs for creating an enabling environment for farmers to practice climate smart initiatives for climate compatible and sustainable agriculture.

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