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Measuring the Resilience of Smallholder Farmers to Climate Change Impacts and Water Scarcity in the Pishin Lora Basin, Balochistan: A Composite Resilience Index Approach

Muhammad Yousuf[1], Dr. Abdul Rahim Changezi[2], Muhammad Sulaman[3]
[1] Lecturer, Department of Social Work, University of Balochistan, Quetta.
Email: yousaf.socialwork@um.uob.edu.pk ; usuf.barech@gmail.com
[2] Assistant Professor, Department of Social Work, University of Balochistan, Quetta.
Email: rahimji@yahoo.com
[3] Lecturer, Department of Social Work, University of Balochistan, Quetta.
Email: salmankhan44488@gmail.com

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Corresponding author:
Muhammad Yousuf
Email:
usuf.barech@gmail.com

ABSTRACT

Climate change and water scarcity are the most critical phenomena of disasters across the world to increase the vulnerability of populous dependent on water related occupations. Small-scale farmers in the Pishin Lora Basin, Balochistan are significantly affected by hydro-climatic hazards during the last two decades. Enhancing community resilience is a widely used practice around the world to cope with climatic shocks. This research study aims to measure resilience of small-scale farmers to the impacts of climate change in the Pishin Lora Basin. By applying the disproportionate stratified sampling method, 264 smallholder farmers were interviewed through a structured questionnaire in two selected districts Pishin & Mastung of Pishin Lora Basin-river. Quantitative data was analyzed by computing correlation coefficients, regression models and a resilience index. The community resilience was measured through 5 components and 58 indicators of resilience. The results show low level resilience (with composite resilience index score = 0.34) of small-scale farming communities. The institutional resilience with a CRI score of 0.18 is the lowest of all components followed by economic (0.32), physical (0.38), social (0.40), and human resilience (0.43). The resilience of small-scale farming communities in Mastung district (0.31) is lower as compared to that in Pishin (0.37). Resilience is highly dependent upon social capital, diversified income sources, capacity building programs, memberships and women's participation. The study recommends community-driven policy recommendations to improve the socio-economic, physical and institutional resilience through consolidated mechanism for disaster risk management.

Introduction

Community resilience is considered a significant concept to characterize and measure the capabilities of people to forecast, absorb, recover, or accommodate the impacts of hazards or disastrous events in an efficient and timely manner (Patel et al., 2017; Deeming et al., 2014; Almedom, 2013; Berkes & Ross, 2013; Walker & Westley, 2011). Understanding of resilience goes beyond merely "social-ecological systems", for example, (Armitage et al., 2012) by integrating social subjective aspects such as perceptions and beliefs along with the governance and institutional settings that outline the capabilities of people to enhance resilience (Ensor & Harvey, 2015; Paton, 2005; Tobin, 1999).

Smallholder or small-scale farmers who operate farming on two or less hectares (World Bank, 2008) are highly vulnerable to water scarcity, climate variability, and climate change (Speranza, 2010) because mostly they cultivate marginal areas, rely on rain-fed farming and lack of access to financial and technical support to assist them to invest in climate resilient agriculture (Donatti et al., 2018; Holland et al., 2017; Morton, 2007). The Food and Agriculture Organization of the United Nations (FAO) defines several indicators to define small-scale farmers/food producers in order to monitor SDGs 2015-2030 target No. 2.3. Working paper suggests indicators including land size, land quality, water access, education, health and low income (Khalil et al., 2017) but it is summarized that "farm size" is the most common and easy source to define small-scale farmers which defines small farms as "*those with 2 or less than 2 hectares of cropland*" (Thapa, 2009; World Bank, 2008). Grain (2014) also claims that farm size is the most widespread criterion to determine small-scale farms. Climate change and water scarcity pose a critical risk to small-scale farmers and impend to weaken global steps for food security, poverty reduction, and sustainable development (Lipper et al., 2014; Vermeulen et al., 2012). In 2016, it was estimated that there were 475 million small-scale farmers who farm 2 or less hectares of land (Lowder et al., 2016). Most of the small-scale farmers are poor, face food insecurity and dwell in very precarious situations (Cohn et al., 2017; Morton, 2007). Small-scale farmers with very little resources and knowledge about climate change in the least developed countries will suffer from the severe effects of climatic shocks. This is due to the fact that these farmers can do little in regard to mitigation. Thus they need to adapt to climate change impacts locally (Kassam et al., 2011).

The Pishin Lora Basin (18,700 sq. km) is one of the major basins but is severely exhausted and water-stressed in the province. Due to high variability in climate, increasing water requirements for agriculture, irrational water pumping, and intense drought spells for the last thirty years, water-table in Pishin Lora Basin is depleting at the rate of over 3 meters per year (Qureshi, 2020; IDP, 2007). It is the worst affected basin in the province in terms of water scarcity and extreme weather events during the last three decades (Halcrow, 2007). The basin has almost exhausted (Ashraf et al, 2016). Since there is no surface perennial irrigation system in the geographical area of Pishin Lora Basin, therefore, all sectors including agriculture, domestic, commercial, ecosystem, and mining, etc. are solely dependent on either groundwater or flood water irrigation system. Climate change, variability, extreme weather events, water scarcity, and increasing temperatures have made life very miserable for people in general and the farming community in particular. Except for district Quetta which is an urban city and capital of the province, in the other districts of the basin, a good majority of the rural population (31- 49%) get their livelihood from farming (Halcrow Pakistan and Cameos, 2008).

To the deteriorating crisis situation of water scarcity and climate variability impacts, the local farmers deal with and adopt coping mechanism in different ways. They either engage in seeking non-agricultural sources of livelihood and selling out their agricultural assets; establish new farms in other parts of the region or keep farming continue in the same area by pumping water from even deeper depth under different patterns of farming (Steenbergen et al, 2014). It has been established that water scarcity and climate change will worsen the situation in the future and cause more threats to the livelihood of people who are still dependent on farming. The most important factor that can help farmers handle and live with this hazardous situation is their strong resilience and adaptive capacity. Their resilience needs to be strong enough in terms of social, economic, physical, human, and institutional capacity to cope with the water scarcity and climate change impacts. The resilience of farming communities is directly linked with their vulnerability to hazards; the weaker resilience of a community is the higher vulnerability will be.

This paper is focused on resilience to the impacts of climate change among smallholder farming communities in the Pishin Lora Basin in Balochistan, Pakistan. The general objective of the research study is to assess the resilience of small-scale farmers and their households to water scarcity and climate change impacts in Pishin Lora Basin, Balochistan, Pakistan. The specific objective of the research is;

- To assess small-scale farmers' resilience to water scarcity and climate change impacts through outlining their absorptive, adaptive, and transformative capacities.

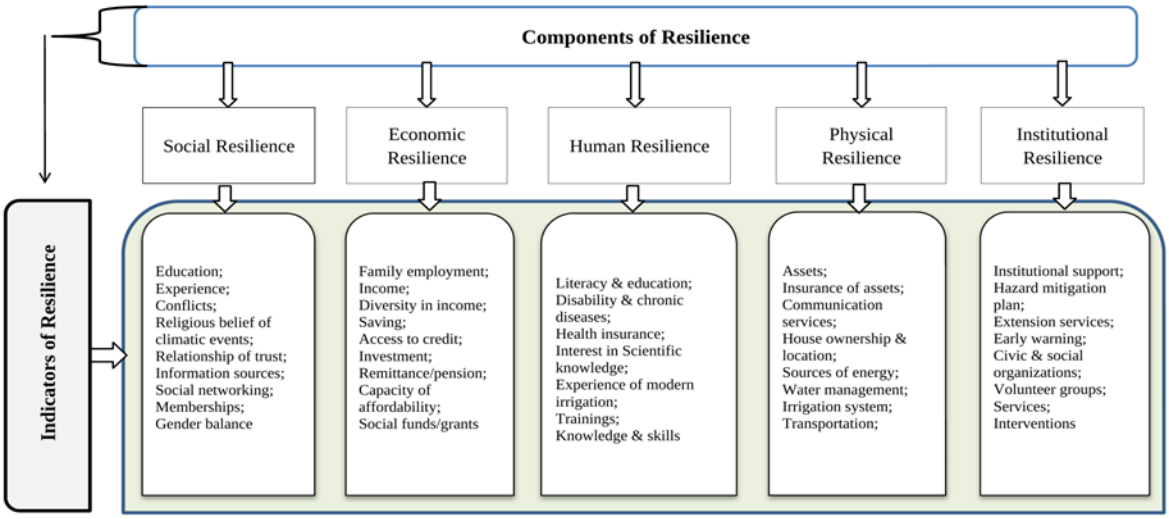
Conceptual Framework

Resilience has emerged as a unifying concept in a number of disciplines associated with the sustainable development sciences (Curtin & Parker, 2014). The focus on resilience goes beyond ecological studies and natural resource management in areas like health, disaster management, community planning, food security, and international development (Xu et al., 2015). Efforts to apply resilience in various domains have spurred interest in assessing and measuring resilience that has extended into many approaches including quantitative and qualitative methods, statistical analyses, participatory investigations, and development of models and metrics. *"Resilience is not a single number or a result"* states Walter & Salt (2012) rather; this is an emerging property that is related in a variety of ways and across different domains to the overall system (Quinlan et al., 2016).

Another highly cited category of resilience models focuses on assessing the social, economic, environmental, human, physical, and institutional, components of the resilience through the development of composite resilience indices. Each component of resilience is measured through latent indicators. For example, Qasim et al., (2016); Nasrullah et al., (2015); Ainuddin & Routray, (2012a); Cutter et al., (2010); Mayunga (2009); Buckle, (2006); Tierney (2006); and Adger (2000) primarily focused on social, economic, physical and institutional dimensions to measure community resilience. Ostadtaghizadeh et al., (2015) also emphasize that there are at least five defined and measurable domains of community resilience to disasters including, economic, social, physical, natural, and institutional (Ostadtaghizadeh et al. 2015).

The conceptual framework for this research study is adapted from resilience models developed in the field of disaster risk management by different researchers (Qasim et al, 2016; Nasrullah et al, 2015; Ainuddin & Routray, 2012a; Cutter, 2010; Mayunga, 2010). Primarily, these models are based on reducing vulnerability factors which consequently, enhances the resilience of the community to disaster risks. The models measure community resilience on the basis of several dimensions of resilience: social, economic, human, physical, and institutional, except for Mayunga (2010) who emphasizes the capital-based approach. Cutter et al. (2010) model was developed to assess socio-ecological resilience, and Ainuddin & Routray, (2012a) model was developed to measure community resilience to earthquakes. Nasrullah et al. (2015) disaster resilience was developed to measure community resilience to multiple disasters i.e. flood, drought, and earthquake while the resilience framework conceptualized by Qasim et al. (2016) measured the resilience of the community to floods in the Khyber Pakhtunkhwa province of Pakistan. To measure the resilience of smallholder farmers to climate change impacts in this study, the five component indicators of resilience from the above models have been chosen including social, economic, human, physical, and institutional.

Figure 1 Conceptual Framework for Assessing Farmers' Resilience to Climate Change and Water Scarcity



Note: Conceptual framework for assessing farmers' resilience to CC impacts is adopted from (Cutter, 2010; Mayunga, 2010; Ainuddin & Routray, 2012a; Nasrullah, 2015, Qasim et al., 2016)

All components of community resilience are inter-related. Each component has short-term results (outcomes) which will eventually lead to long-term results (impacts) on community resilience. For instance, the social dimension of resilience leads to improved understanding, support, coordination, and integration & cohesion. Economic resilience enhances the absorptive and adaptive capacity to climatic shocks while the human component of resilience results in enhanced human skills, knowledge & capacity to understand climatic risks; and increased transformative capacity. Physical resilience can improve absorption & adaptation; facilitate communication and access; and decrease heavy loss risks. The institutional component of community resilience will result in better DRM support mechanism; effective pre & post-disaster management; and integration of services. The long-term impact of the overall resilience model will be a resilient society with social integration, a vivacious economy, skilled human resources, developed physical infrastructure, and effective institutional support for vulnerable farming communities (Nawaz, I., & Lyu, R. (2026).

Materials and Methods

Study Area and Sampling

The universe of this research study was the catchment area of the Pishin-Lora Basin – located in the uplands of Balochistan. Geographically, Balochistan province is the largest province of Pakistan but the poorest and least populated one. A very high majority of the population depends on agriculture and livestock for their livelihood. Pishin-Lora Basin is known as one of the major basin rivers and severely drought affected since 1997 (Ashraf et al., 2016; Halcrow, 2007). It is spread over five districts including Pishin, Quetta (the capital and most populous district of the province), Mastung, and some parts of Killa Abdullah and Kalat. Primary data was collected in two districts (Pishin and Mastung) as they are completely watered by Pishin-Lora Basin and agriculture is commonly adopted by a large population as a source of income.

Small-scale farming has a dominant stake in agricultural production in the two selected districts. The selected districts have been suffering from water scarcity and the impacts of hydro-climatic shocks for more than two decades. Frequent climate-related extreme events such as drought spells, flash floods, temperature raise, hails, and wind storms have made the life of farming communities very challenging.

Primarily, two districts (Pishin and Mastung) among the five catchment districts of the Pishin-Lora Basin were selected on the basis of previous records of climate change impacts and extreme weather events (EWEs). There are 4 Tehsils and 52 Union Councils (UCs) in Pishin and 3 Tehsils and 20 UCs in Mastung. 12 UCs from each District were purposively selected for the field survey by implying cluster sampling technique. Each selected UC has been considered as a separate cluster in the study. Later, for the field survey, 11 households of small-scale farmers from each UC were selected using the UNICEF pencil-spin selection method (Haque et al. 2022; Ogbu & Guha-Sapir, 2021). All selected UCs were from rural areas of both districts as the selected UCs have small-scale farming as a dominant source of income and extensive record of extreme weather events, water scarcity, and hydro-climatic hazards based on reconnaissance survey and secondary records (Ashraf et al., 2016).

According to Agriculture Census Report, 2011, the number of small-scale farmers in Pishin and Mastung is 23806 & 1989 respectively (GoP, 2012). Small-scale farmers have characteristics of homogenous nature; therefore; a very large sample size is not required.

To determine the sample size for the field survey, the Arkin & Colton (1963) formula was used. Based on a total number of small-scale farmers (N=25795), the total sample size (n=264) was selected for both districts. Due to huge variation in the total number of small-scale farmers between selected strata—the districts, disproportionate/non-proportional stratified sampling technique was implied to ensure balanced allocation & fractional sampling. Therefore; an equal number of elements i.e. 132 households from each district were selected. The disproportionate allocation of sample size helped for a more balanced comparative analysis across the districts (Khan et al., 2020; Nayeem & Huma, 2017; Statistics Canada, 2017; Etikan et al., 2016; Daniel, 2011**)**

Data Collection and Analysis

Quantitative data was mustered from a field survey through a structured questionnaire. Already selected components, variables, and indicators were inserted into the questionnaire to gauge the resilience of farming households. A field survey was carried out during May-July 2021, which is a peak time for farmers to be present in the fields. Qualitative data was collected to get an in-depth perception, understanding, and opinion of relevant stakeholders. For this purpose, four Focus Group Discussions (FGDs) – two in each district, and eight Key Informant Interviews (KII) were conducted. FGDs were carried out with the small-scale farmers severely affected by hydro-climatic hazards, social activists, representatives of farmers' local NGOs, associations/unions, local tribal leaders, and fruit/vegetable commission agents. KIIs were conducted with officials from line departments, public representatives, officials of the Regional Meteorological Department, and Provincial/District Disaster Management Authorities (PDMA and DDMA). The findings of FGDs and KIIs assisted with the finalization of the survey questionnaire, study components, variables, and indicators. It also provided guidelines for setting weightage to component variables of resilience. The opinions of participants of FGDs and KIIs were well recorded and are included in the results. Researcher observation was used as a supplementary tool to validate primary data obtained through questionnaire, FGDs, and KIIs.

Data analysis and graphical illustration of data were carried out using Statistical Package for Social Science (SPSS) version 21, and MS Excel respectively.

Development of Computation of Resilience Indices

The resilience of small-scale farmers was assessed on the basis of five major components of resilience—social, economic, human, physical, and institutional. Each component of resilience has a number of variables and each component variable has its specific indicator/s **(listed in Table 2-6)**. To produce resilience indices, variables and indicators within each component were assigned percentages. It is evident from the literature that weights can be assigned to the variables and indicators in subjective or empirical methods. For the purpose of this study, the subjective approach of assigning weightage to variables or indicators was used as used by (Haque et al., 2022; Shah et al., 2018; Cutter et al., 2010). Assignment of weightage values to each variable/indicator was guided by previous researches on community disaster resilience assessment mostly carried out in South-Asian countries (Haque et al. 2022; Raheem, et al. 2018; Qasim et al, 2016; Nasrullah et al, 2015; Ainuddin & Routray, 2012a) and discussions during FGDs and KIIs. Additionally, to validate the weightage of each variable/indicator (as listed in Table 2) guidance was acquired from experts of resilience and researchers in the field of disaster risk management. The weightage of variables was acquired in the form of percent. Later, the percent value of each variable was converted into a score that ranged from 0—1.

To obtain variable resilience index (VRI) for each single variable, the percent value of a variable of the sample households was divided by the optimum weightage value **(as in Eq. 1).** As shown in Table 2, each variable has either positive or negative impact on the resilience of small-scale farmers. In case the variable has a positive impact on resilience, the more the score of VRI is near 1, the higher the resilience will be while the more the score of VRI is near 0, the lower the resilience of the variable will be. However, in case of a negative impact on resilience, the VRI should be dealt with in the reverse manner by flipping the scale of measurement from 1—0. For example, religious belief in climate change has a negative impact on the resilience of small-scale farmers, as farmers who think that climate change, water scarcity, and EWEs are merely the results of human sins, such farmers are less likely to accept scientific reasoning of climatic hazards and, consequently, are less prepared for adaptations. In this case, the resilience score is measured from 1—0, where VRI nearer to 1 is less resilient as compared to VRI nearer to 0. Eq. 1 represents the formula to calculate Variable Resilience Index (Haque et al, 2022; Qasim et al, 2016; Nasrullah et al. 2019; Ainuddin & Routray, 2012a).

Eq. 1

Mathematical Expression for Calculating Variable Resilience Index

$i = o/w$

Where:

i = variable resilience index (VRI)

o = obtained percent of value from field survey

w = Weightage of optimum value

The scores of the resilience index of various variables and components are further analyzed by assigning resilience levels to resilience scores (Table 1). A total of five levels of resilience have been developed on the basis of equal distribution of scores (Haque et al., 2022).

Eq. 2

Mathematical Expression for Calculating Resilience Index of each Component (SRI, ERI, HRI, PRI & IRI)

$$\text{Component Resilience Index (CRI)} = \sum_{i=1}^{n} \text{CRI}/n$$

where n is the number of indicators of that component.

Eq. 3

Mathematical Expression for Calculating Composite Resilience Index for Both Districts and Overall Study Area

$$\text{Composite/Aggregate Resilience Index (CRI) for districts/PLB} = \sum_{i=1}^{5} \text{CRI}/N$$

where N is the total number of components of resilience.

Table 1

Levels of Resilience (r) on the basis of Resilience Index Scores

r score	r level
≤ 0.20	Very low level of resilience
0.21—0.40	Low resilience
0.41—0.60	Medium level of resilience
0.61—0.80	Good resilience
0.81—1.0	Very good level of resilience

Results

As elaborated in the methodology section, the resilience of smallholder farmers to climate change impacts was assessed through a resilience index. The indices consisted of five major components; (i) Social, (ii) Economic, (iii) Human, (iv) Physical, and (v) Institutional. Each component has a number of variables—selected through rigorous literature reviews and field discussions with experts and key informants. To measure variables of resilience components, each variable was assigned different indicators. Resilience assessment was carried out on the basis of variable resilience index (VRI), components resilience index [social resilience index (SRI); economic resilience index (ERI); human resilience index (HRI); physical resilience index (PRI) & institutional resilience index (IRI)] and composite variable index (CRI). The variable, components, and composite resilience for both districts and the overall study area have been calculated and presented in Table 2. Beside variable scores, the table also elaborates on percent values (% value) and optimum weightage of each variable in the form of % value and resilience index (RI).

Social Resilience

Social resilience is concerned with understanding, access, and participation in education, social capital, formal and informal institutions, the relationship of trust, social networking, governance issues, and gender equity (DFID, 1999). It indicates the social abilities and strengths of the community to deal with climatic stressors (Haque et al., 2022). Table 2 is the analysis of the social component of resilience among smallholder farming communities in both selected districts of PLB.

Table 2

Variable Resilience Index (VRI) of Social Resilience Indices

No.	Component / Indicator	Overall (%)	Optimum (%)	Impact	VRI Pishin	VRI Mastung	VRI Overall
1	**Social Resilience (SRI)**				**0.41**	**0.40**	**0.40**
1.1	Formal education	44.0	90	+	0.61	0.36	0.49
1.2	Secondary education OR above	11	85	+	0.15	0.11	0.13
1.3	Experience in agriculture (=/< 10 years)	9.85	55	−	0.11	0.25	0.18
1.4	Population with <16 years of age	31.5	75	−	0.47	0.37	0.42

1.5	Population with >65 years of age	12	85	–	0.16	0.12	0.14
1.6	Access to basic health services (< 1 km radius of residence)	53.05	95	+	0.57	0.55	0.56
1.7	Conflicts	18.55	25	–	0.48	1.00	0.74
1.8	Religious belief of CC	36.75	85	–	0.48	0.38	0.43
1.9	Relationship of trust and cooperation	47.7	65	+	0.68	0.79	0.73
1.10	Multiple sources of information for updates of climate change and hazards	53.9	85	+	0.63	0.64	0.63
1.11	Effectiveness of information sources	39.4	75	+	0.45	0.60	0.53
1.12	Social networking	14.35	65	+	0.29	0.15	0.22
1.13	Membership with CSOs	7.5	65	+	0.16	0.07	0.12
1.14	Women participation in decision making	22.75	75	+	0.43	0.17	0.30

Source: Field Survey, 2022. VRI = variable resilience index; % = percent value from the field survey; Optimum = weightage of optimum value; Impact: + positive, – negative effect on resilience (for negative-impact variables the scale is read in reverse).

The results of the field survey (Table 2) reveal that the overall social resilience (SRI) of PLB is low (0.40) (reference: table 1). The SRI score of Pishin and Mastung is 0.41 and 0.40 respectively. Similarly, a study carried out in the Noshki district of Balochistan reveals lower resilience and higher vulnerability of the community to climatic hazards (Nasrullah & Ainuddin, 2014).

The variable *social capital* shows a very good VRI score (0.73) where the Mastung district contributes a dominant stake of resilience (0.79) in the study area in the score of social capital. Social capital, a relationship of trust, and cooperation among the farming communities ensure coordination and support during and in the aftermath of climate shocks. It facilitates coordination and cooperation during emergencies and facilitates access to community resources (Ainuddin & Routray, 2012a)

The lowest resilience score is for *formal membership* of farmers with Civil Society Organizations (0.12) and *social networking/informal linkages* with civil society organizations (0.22). Only 14.35% of farmers have linkages with civil society organizations in the study area. Social networking and linkages with civil society organizations promote coordination and cooperation. It helps share and learn experiences of the farming community and improves understanding of climatic hazards, especially in disaster-prone areas to deal with water scarcity (Nasrullah & Ainuddin, 2019). Membership in CBO improves social networks and access to information during contact with outside stakeholders, sharing ideas on risk measures and collective management of communal resources (Owusu et al., 2016).

Economic Resilience

Economic resilience is related to the abilities of a community to adopt various strategies for livelihood. It can be in the form of income, sources of income, saving, investments, social funds, remittances/pensions, etc. (DFID, 1999) that enhance a community's capacity to recover from disasters (Haque et al., 2022). Table 2 elaborates on the economic resilience of small-scale farming communities in both selected districts of PLB.

Table 3

Variable Resilience Index (VRI) of Economic Resilience Indices

No.	Component / Indicator	Overall (%)	Optimum (%)	Impact	VRI Pishin	VRI Mastung	VRI Overall
2	**Economic Resilience (ERI)**				**0.39**	**0.26**	**0.32**
2.1	Percent of economically active members in family	22.6	40	+	0.66	0.47	0.57
2.2	HH income above poverty line (Middle Income Class Poverty Line @ 3.20 USD)	31.8	80	+	0.45	0.35	0.40
2.3	Multiple or diverse sources of income	40.55	65	+	0.72	0.52	0.62
2.4	Saving scheme of family	14.75	80	+	0.25	0.12	0.18
2.5	Access to credit/loan facility	17.55	80	+	0.25	0.19	0.22
2.6	Investment other than agriculture	22.75	70	+	0.41	0.24	0.33
2.7	Remittances/pension	6.05	40	+	0.23	0.08	0.15
2.8	Capacity of affordability	18.05	90	+	0.22	0.18	0.20
2.9	Social funds/grants	17.05	75	+	0.28	0.17	0.23

Source: Field Survey, 2022. VRI = variable resilience index; % = percent value from the field survey; Optimum = weightage of optimum value; Impact: + positive, – negative effect on resilience (for negative-impact variables the scale is read in reverse).

Table 2 elaborates the economic resilience scores of both selected districts and the overall study area. The economic resilience index score of Pishin and Mastung is 0.39 and 0.26 respectively. While the overall economic resilience index score of the study area is 0.32. This denotes that the level of economic resilience of the small-scale farmers in PLB is low. Similar findings indicating a low level of resilience of the community to drought were reported in another study in Balochistan (Nasrullah et al., 2015).

Saving schemes and *remittances/pension* for households of small-scale farmers are both very low with VRI scores of 0.18 and 0.15 respectively. Access to saving and credit facilities for farming households increases their capability to deal with socio-economic problems during disasters (UNDP-CoBRA, 2017) particularly when livelihood sources are tight. The saved amount helps households recover quickly from the impacts of extreme weather events. Remittances and pension are effective sources of livelihood for poor families. Improved sources of income have a positive association with recovery from natural disasters in developing countries. (Nasrullah & Ainuddin, 2019; Sato et al., 2022).

The findings of ERI show that the economic resilience of small-scale farmers is not satisfactory. Only 23 percent of farmers have access to *social funds/grants*. The resilience variable score in Mastung (0.17) is lower than the Pishin (0.28) indicating low resilience of small-scale farmers in both districts.

Human Resilience

Human resilience refers to skills, knowledge, good health, and training of people that enhance their abilities to pursue a variety of strategies for livelihood and make income (DFID, 1999). Table 2 is the analysis of human resilience of smallholder farming communities in both selected districts of PLB.

Table 4

Variable Resilience Index (VRI) of Human Resilience Indices

No.	Component / Indicator	Overall (%)	Optimum (%)	Impact	VRI Pishin	VRI Mastung	VRI Overall
3	**Human Resilience (HRI)**				**0.46**	**0.40**	**0.43**
3.1	Literacy rate in community	46.32	90	+	0.59	0.44	0.51
3.2	HH members with secondary education or higher	10.25	75	+	0.17	0.10	0.14
3.3	HH members with formal education	30.8	85	+	0.40	0.32	0.36
3.4	Disability and chronic diseases	22.35	55	–	0.39	0.43	0.41
3.5	Health insurance	0	45	+	0.00	0.00	0.00
3.6	Interest in Scientific knowledge of climate change	56.45	85	+	0.78	0.54	0.66
3.7	Skills to enhance resilience to climate change	31.95	85	+	0.40	0.36	0.38
3.8	Experience of modern irrigation systems	16.25	65	+	0.29	0.21	0.25
3.9	Training of climatic threats and adaptations	11.75	80	+	0.23	0.07	0.15
3.10	Farmers' satisfaction from their knowledge bank and skills of climatic shocks	77.25	80	+	0.99	0.94	0.97
3.11	Effectiveness of indigenous knowledge and local experience	70.05	95	+	0.73	0.75	0.74
3.12	Effectiveness of scientific knowledge to cope with climatic hazards	38.25	85	+	0.42	0.48	0.45
3.13	Availability and affordability of agriculture labour	48.1	90	+	0.56	0.51	0.53

Source: Field Survey, 2022. VRI = variable resilience index; % = percent value from the field survey; Optimum = weightage of optimum value; Impact: + positive, – negative effect on resilience (for negative-impact variables the scale is read in reverse).

As reflected in table 2, the human resilience index (HRI) of smallholder farmers in PLB falls in medium level of resilience, where the overall HRI score is 0.43. The VRI score for the Pishin district (0.46) is higher than that of the Mastung district (0.40).

The overall human resilience of smallholder farmers in PLB is not satisfactory in regard to the ongoing alarming risks and threats associated with climate change and water scarcity in the region. Major factors include lack of farmers' interest and the poor role of institutions to develop the skills of the farming community to deal with climate hazards at the grass-root level (Nasrullah & Ainuddin, 2014).

Physical Resilience

Physical resilience is concerned with basic infrastructure (roads, bridges, water supply, communication services, etc.) in a community that is used by the community to have productive functioning (DFID, 1999). Table 2 represents the analysis of physical resilience of smallholder farming communities in both selected districts of PLB.

Table 5

Variable Resilience Index (VRI) of Physical Resilience Indices

No.	Component / Indicator	Overall (%)	Optimum (%)	Impact	VRI Pishin	VRI Mastung	VRI Overall
4	**Physical Resilience (PRI)**				**0.42**	**0.35**	**0.38**
4.1	Multiple HH assets	34.77	90	+	0.41	0.36	0.39
4.2	HHs with insurance of assets	0	45	+	0.00	0.00	0.00
4.3	Access to multiple communication services	43.86	65	+	0.70	0.65	0.67
4.4	Effectiveness of information sources	26.85	90	+	0.33	0.27	0.30
4.5	House ownership	53.05	90	+	0.66	0.52	0.59
4.6	Vulnerability of household location	49.65	95	–	0.48	0.57	0.52
4.7	Effective/multiple sources of energy to manage water	32.2	80	+	0.48	0.32	0.40
4.8	Paved water channels for irrigation	26.5	95	+	0.30	0.25	0.28
4.9	Easy access to public transportation	35.4	95	+	0.38	0.36	0.37
4.10	Possession of personal vehicle	16.3	75	+	0.28	0.15	0.22
4.11	Capacity to afford public transportation	53.8	95	+	0.65	0.48	0.57
4.12	Infrastructure for transportation	28.4	90	+	0.37	0.26	0.32
4.13	Access to safe drinking water	43.9	98	+	0.49	0.41	0.45

4.14	Water and fodder for livestock	25	85	+	0.37	0.22	0.29

Source: Field Survey, 2022. VRI = variable resilience index; % = percent value from the field survey; Optimum = weightage of optimum value; Impact: + positive, – negative effect on resilience (for negative-impact variables the scale is read in reverse).

The physical resilience index for Pishin and Mastung are 0.42 and 0.35 while the overall physical variable index (PRI) is 0.38 (Table. 7.12). This explains a low level of physical resilience of smallholder farmers to climatic stressors and water scarcity. Similarly, Nasrullah et al., (2014) conducted a study in the Noshki district of Balochistan also reported low resilience of the community to drought.

As presented in Table 2, a few variables of physical components of resilience show a medium level of resilience such as access to multiple communication services; house ownership; capacity to afford public transportation, and access to safe drinking water. However, most of the variables of physical the component show low resilience of small-scale farmers which included insurance of physical assets; effectiveness of information sources; paved water channels for irrigation; easy access to public transport; possession of personal vehicle; infrastructure for transportation; and water & fodder for livestock.

Since the overall PRI (0.38) falls in the category of low level of resilience, therefore, farmers in the Pishin-Lora basin have been suffering from the impacts of climate change and water scarcity. Their ability to recover from EWEs is not satisfactory.

Institutional Resilience

Institutional resilience is related to the framework that enables people to prepare for and mitigate risks and impacts of disaster (Haque et al., 2022; Shah et al., 2018, Qasim, et al., 2016). Table 2 illustrates the analysis of institutional resilience of smallholder farming communities in both selected districts of PLB.

Table 6

Variable Resilience Index (VRI) of Physical Resilience Indices

No.	Component / Indicator	Overall (%)	Optimum (%)	Impact	VRI Pishin	VRI Mastung	VRI Overall
5	**Institutional Resilience (IRI)**				**0.19**	**0.17**	**0.18**
5.1	Institutional support for DRM	13.25	80	+	0.15	0.18	0.17
5.2	Hazard mitigation plan.	13.25	80	+	0.15	0.18	0.17
5.3	Access to extension services	26.1	90	+	0.37	0.21	0.29
5.4	Early warning system	11.35	95	+	0.14	0.10	0.12
5.5	Existence of civic and social organizations	12.96	95	+	0.14	0.14	0.14
5.6	Volunteer groups	14.05	85	+	0.15	0.18	0.17
5.7	Effectiveness and efficiency services	24.5	85	+	0.29	0.28	0.29
5.8	Frequency of activities regarding climate hazards	0.625	5	+	0.14	0.11	0.13

CRI – Composite Resilience Index	**0.37**	**0.31**	**0.34**

Source: Field Survey, 2022. VRI = variable resilience index; % = percent value from the field survey; Optimum = weightage of optimum value; Impact: + positive, – negative effect on resilience (for negative-impact variables the scale is read in reverse).

Field data (Table 2) reveals that the Institutional Resilience Index (IRI) is very low in both selected districts of the Pishin-Lora basin. Other researchers also report that the role of institutions is not satisfactory to deal with climate change impacts in Pakistan (Javed, 2016; Qureshi, 2005). The component resilience score of Pishin is 0.19 and Mastung is 0.17. The overall component resilience index for both districts is 0.18 which shows very poor level of resilience. All variables of institutional component show a very low level of resilience, except (i) access to extension services and effectiveness & (ii) efficiency of services by organizations show a low level of resilience.

The VRI score for *institutional support* for disaster risk management (DRM) is 0.17. Same is for the variable *hazard mitigation plan* (0.17). Provision of emergency relief services to climate-affected households by the district, NGOs, family, and friends is pivotal for quick recovery and hence improved resilience (Owusu et al., 2016). Covering the maximum population for a hazard mitigation plan increases community safety and facilitates to develop and implement disaster risk reduction strategy at community level. It also reduces high probability of losses from disasters (Ainuddin & Routray, 2012a & 2012b).

Farmers are not satisfied with the role of government organizations in terms of prevention, mitigation, and preparedness for climatic hazards and extreme weather events. In some communities, platforms for organizational support do exist such as farmers' associations, community/volunteer groups, community-based organizations, tribal organizations i.e. *Jirga/Merh* and religious organization, however, the role of these organizations is very poor in assisting communities with climatic stressors. Farmers in the PLB area, claim that activities such as awareness raising, capacity building, technical support, and research are very much lacking in communities. However, physical infrastructure and emergency response exist in some communities to some extent.

Composite Resilience Index (CRI)

Composite Resilience Index (CRI) is the average of all five Component Resilience Indices i.e. SRI, ERI, HRI, PRI, and IRI. It represents the aggregate resilience index of overall variables and components used in this study. CRI has been calculated both for Pishin & Mastung district, and the overall study area.

As shown in table 2, the CRI score of the overall study area is 0.34 that falls under the low resilience level (reference: table 1). Institutional resilience (0.18) is the lowest followed by economic (0.32), physical (0.38), social (0.40), and human resilience (0.43). HRI (human resilience) is the only resilience index that fall in the category of medium level of resilience. The CRI of Pishin (0.37) is better than Mastung (0.31) as shown in Figures 2 & 3.

Figure 2

Comparative Analysis of Component Resilience Index Small Scale Farmers in Pishin and Mastung

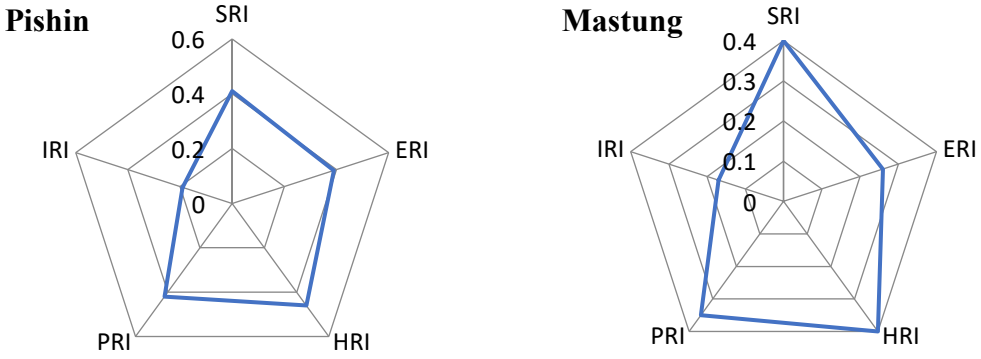
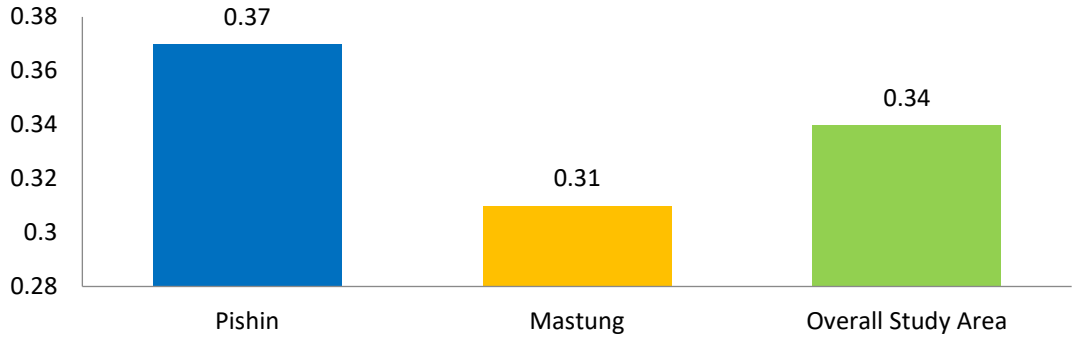


Figure 3

Composite Resilience Index Scores of Pishin, Mastung and over all Study Area



Discussion and Conclusion

Analysis of resilience indices reveals a low level of the composite resilience of small-scale farmers to the impacts of climate change in the Pishin Lora Basin. Institutional resilience (0.18) is the lowest followed by economic; physical; social; and human resilience (0.32; 0.38; 0.40; and 0.43 respectively). The aggregate resilience of smallholder farmers in Pishin District (0.37) is somehow better than in Mastung (0.31). As per resilience levels, none of the components of the resilience index reaches a good level of resilience. The Human Resilience Index with a score of 0.43 is the only resilience component that falls in the lower range of medium level of resilience.

1. The aggregate resilience of the small-scale farming community to climate change impacts is poor in Pishin Lora Basin with a marginal difference between the selected districts. Small-scale farmers in Pishin District have somehow improved resilience as compared to Mastung. Based upon the five selected components of resilience, institutional resilience was the lowest of all components followed by economic, physical, social, and human resilience. Human resilience was the only component that indicated the bottom range of medium level of resilience.

2. The variables of resilience components were associated with each other and influenced community resilience to a varying degree. For instance, education strongly influenced community understanding, perceptions & concerns about climate change; their readiness for adaptations; and skills in forecasting climatic events. Similarly, social capital, memberships with CSOs, gender participation, diversified income sources, training, and capacity-building programs played a vital role in strengthening community resilience. However, religious beliefs of climatic events, low community literacy, poor human skills, poverty, lack of credit facilities, and stereotype investments increased vulnerability, decreased the adaptations, and resulted in poor resilience among the farming community. Physical assets and infrastructure in the community such as transportation, irrigation facilities, access to water, and housing had a notable stake in strengthening resilience. The poor institutional support for DRM, ineffective hazard mitigation plans, faulty early warning system, and rare existence of civic & social organizations played a major role in lowering the resilience of the farming community

Policy Recommendations

This research study identifies that community resilience to climate change impacts and water scarcity cannot be addressed separately, but integrated with all other development agendas of social development. The study has strongly emphasized urgent measures by policymakers to take pragmatic steps for water scarcity in the Pishin Lora Basin by utilizing maximum resources and energy. The thesis also emphasizes assisting and motivating small-scale farmers for effective sustainable adaptations to decrease further extensive climatic impacts on society as a whole. It is, indeed, a lack of attention and focused actions by policymakers to address the resilience of farmers to climate change impacts in the province that has resulted in increasing concern regarding the preparedness of institutions for the rapidly intensifying challenges of climatic shocks.

Social resilience can be enhanced more specifically by a holistic policy-making process by engaging the literacy and education sector; access to effective health services; linking religious segments of the society to modern climate science; community access to effective sources of information for updates on climate change and shocks; developing mutual trust and cooperation in the community; and improving social networking and membership with civil society organizations. This research also identified poor participation of

women in various forms at the community level. It is pivotal to improve gender balance, women's leadership roles, social networking of women, and engage women in decision- making processes to support community resilience in times and places of extreme weather events.

To improve the economic resilience of small farm holder communities, the policy-makers and practitioners need to have a bottom-up approach aiming to increase diverse opportunities for a livelihood that would eventually assist with the reduction of poverty. Programs to assist households in income saving and small-scale credit facilities, especially for farmers of marginal farming would prove to offer effective choices of adaptations and enhanced resilience. Communities need to be assisted with social fund initiatives by organizations of social sectors. This study identified that merely depending on agriculture production has weakened resilience; it is, therefore, needed for policymakers to facilitate smallholder farmers to invest and engage in sources of income other than agriculture.

Though the human resilience of the target population is better, even pragmatic policy steps need to be taken because human resilience would supplement and complement other dimensions of resilience. Literacy and education programs need to be revisited and enhanced in line with the needs of climate change science and grass-root level needs of farming communities making it easy for remote rural communities to get the benefits. As already highlighted, farmers' trust and interest need to be developed in scientific knowledge of climate change through a comprehensive program by giving a major stake to the community. Knowledge and experience sharing of climate resilient successful cases would prove a handy support for strengthening community resilience. This can be done through a series of training workshops and community sessions supported by professional workers and experts.

Policy-makers and practitioners are required to address the physical aspects of resilience by facilitating community-based programs of access to effective communication services, especially for vulnerable small producers. This is equally important for enhanced resilience to make sure small-scale farming households have access to towns and markets, especially in remote rural. House location in disaster vulnerable location in case of drought and floods need to be specifically addressed through awareness programs and financial assistance to avoid heavy physical, economic, and human losses. Community-based clean, climate-resilient, and sustainable water projects need to be facilitated by engaging local organizations to support quick recovery in the aftermath of climatic shocks.

Based on the findings of this research study, institutional resilience was the poorest of all dimensions of resilience, therefore, more attention needs to be paid to this segment. Both public and civil organizations need to be facilitated and sensitized to have a special focus on the emerging issue of disaster risk management by developing all-inclusive hazard mitigation plans by engaging the community. This can be done more effectively by facilitating volunteer groups, religious organizations, farmers' associations, and local tribal platforms such as *Jirga/Merh* to engage in climate change-related matters at the grass-root level. Extension services are already provided to some communities, however, they need to be accessible and more effective for small-scale farming households for improved adaptations to climate-resilient methods.

Besides prompt policy measures, further academic research is also critical to further improve and facilitate the strengthening of small-scale farmers' resilience to climate change impacts. Large-scale data need to be mustered through field surveys by taking a larger sample size to get in-depth information and statistic on farming communities in all districts of PLB. Additionally, similar studies to measure climate resilience by applying various models may also be carried out in other river basins of the province and country to assist policy-makers guide and frame national-level policy with a special focus on enhancing the resilience of smallholder farming communities.

References

1. Adger, W.N. (2000). Social and Ecological Resilience: Are They Related? Progress in Human Geography 24(3), 347-63. http://dx.doi.org/10.1191/030913200701540465

2. Ainuddin, S., Routray, J.K. (2012a). Community resilience framework for an earthquake prone area in Baluchistan. International Journal of Disaster Risk Reduction. 2. 25–36. 10.1016/j.ijdrr.2012.07.003.

3. Almedom, A. M. (2013). Resilience: Outcome, Process, Emergence, Narrative (OPEN) theory, On the Horizon, 21, 15–23, https://doi.org/10.1108/10748121311297030.

4. Arkin, H., Colton, R.R. (1963). Tables for statisticians, New York: Barnes and Noble Books, 2nd Edition, contributed by National Library of Australia.

5. Armitage, D., Béné, C., Charles, A. T., Johnson, D., and Allison, E. H.(2012) The Interplay of Well-being and Resilience in Applying a Social-Ecological Perspective, Ecol. Soc., 17, https://doi.org/10.5751/ES-04940-170415
6. Ashraf, M., Majeed, A., Saeed, M. (2016) Impact evualtion of a karez irrigation scheme in Balochistan-Pakistan: Issues and options, Pakistan Journal of Agriculture Science. Vol. 53(3), 661-671
7. Berkes, F. and Ross, H. (2013) Community Resilience: Toward an Integrated Approach, Soc. Natur. Resour., 26, 5–20, https://doi.org/10.1080/08941920.2012.736605
8. Buckle, P. (2006). Assessing social resilience. Disaster resilience: An integrated approach, 88(06), 88-103.
9. Cohn, A. S., Newton, P., Gil, J. D., Kuhl, L., Samberg, L., Ricciardi, V., ... & Northrop, S. (2017). Smallholder agriculture and climate change. Annual Review of Environment and Resources, 42, 347-375. Retrieved from: https://doi.org/10.1146/annurev-environ-102016-060946
10. Curtin, C. G., & Parker, J. P. (2014). Foundations of resilience thinking. Conservation biology, 28(4), 912-923.
11. Cutter, S. L., Burton, C. G., & Emrich, C. T. (2010). Disaster resilience indicators for benchmarking baseline conditions. Journal of Homeland Security and Emergency Management, 7(1).
12. Daniel, J., (2011). Sampling Essentials: Practical Guidelines for Making Sampling Choices. SAGE Publications, Inc. Pp 134-136
13. Deeming, H., Fordham, M., Swartling, Å. G. (2014) Resilience and Adaptation to Hydrometeorological Hazards, in: Hydrometeorological hazards: Interfacing science and policy, edited by: Quevauviller, P., Wiley Blackwell, Chichester, West Sussex, United Kingdom, 291–316.
14. DFID (1999). Sustainable Livelihoods Guidance Sheets. London: DFID.
15. Donatti, C.I., Harvey, C.A., Martinez-Rodriguez, M.R., Vignola, R., Rodriguez, C.M., (2018). Vulnerability of smallholder farmers to climate change in Central America and Mexico: current knowledge and research gaps. Clim Dev. https://doi.org/10.1080/17565529.2018.14427 96
16. Ensor, J. and Harvey, B. (2015) Social learning and climate change adaptation: Evidence for international development practice, WIREs Clim. Change, 6, 509–522, https://doi.org/10.1002/wcc.348
17. Etikan I, Alkasim R, Abubakar S. (2016). Snowball Sampling and Sequential sampling technique comparison. Int J Biom Biosta. 3(1):00055.
18. GOP (2012). National Climate Change Policy. Government of Pakistan, Ministry of Climate Change. Islamabad.
19. Grain (2014). Hungry for land: Small farmers feed the world with less than a quarter of all farmland.
20. Halcrow (2007). Supporting Public Resource Management in Balochistan. Basin-wide Water Resources Availability and Use. Asian Development Bank: Supporting Public Resource Management in Balochistan.
21. Halcrow Pakistan and Cameos (2008). Pishin Lora Basin Management Plan. Asian Development Bank: Supporting Public Resource Management in Balochistan.
22. Haque, M.M., Islam, S., Sikder, M.B., Islam, M.S., (2022). Community flood resilience assessment in Jamuna floodplain: A case study in Jamalpur District Bangladesh. International Journal of Disaster Risk Reduction, 72, 102861
23. Holland M.B., Shamer S.Z., Imbach, P., Zamora, J.C., Medellín, C., Leguía, E., Donatti, C.I., Martínez-Rodríguez, M.R., Harvey, C.A., (2017). Mapping agriculture and adaptive capacity: applying expert knowledge at the landscape scale. Clim Change. https://doi.org/10.1007/s1058 4-016-1810-2
24. Javed, S. (2016). A study on Pakistan's vulnerability to climate change, current policies and institutional set up for dealing with it. Master thesis: Department of International Environment and Development Studies, Faculty of Social Sciences, Norwegian University of Life Sciences.

25. Kassam, K.-A. S., Baumflek, M., Ruelle, M., & Wilson, N. (2011). Human Ecology of Vulnerability, Resilience and Adaptation: Case Studies of Climate Change from High Latitudes and Altitudes. In J. Blanco, & H. Kheradmand (Eds.), Climate Change - Socioeconomic Effects. InTech.

26. Khalil, C.A., Conforti, P., Ergin, I., Gennari, P. (2017). Defining small-scale food producer to monitor target 2.3 of the 2030 agenda for sustainable development. Working Paper Series ESS/17-12 Food and Agriculture Organization of United Nations, Rome.

27. Khan, N., Naushad, M., Akbar, A., Faisal, S., & Fahad, S. (2020). Critical Review of COVID-2019 in Pakistan and Its Impact on Pakistan Economy. Institute of Development Studies; Agriculture University; Peshawar. Available at SSRN 3629718.

28. Lipper L, Thornton P, Campbell BM, Baedeker T, Braimoh A, Bwalya M, Caron P, Cattaneo A, Garrity D, Henry K, Hottle R. (2014) Climate-smart agriculture for food security. Nat Clim Change. https ://doi.org/10.1038/nclim ate24 37

29. Lowder, S.K., Skoet, J, Raney, T. (2016). The number, size, and distribution of farms, smallholder farms, and family farms worldwide. World Dev. https://doi.org/10.1016/j.worlddev.2015.10.041

30. Mayunga, J.S. (2009). Measuring the Measure: A Multi-dimensional Scale Model to Measure Community Disaster Resilience in the U.S. Gulf Coast Region. Doctoral dissertation, Texas A&M University. Available electronically from http : / /hdl .handle .net /1969 .1 /ETD -TAMU -2009 -05 -769

31. Morton, J.F. (2007). The impact of climate change on smallholder and subsistence agriculture. Proceedings of the National Academy of Sciences (PNAS) of the United States of America. Vol. 104. No. 50. 19680-19685. doi: 10.1073/pnas.0701855104 . Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2148357/ Accessed on 29th May 2021

32. Nasrullah & Ainudddin (2014). Role of local governance institutions in promoting social resilience in drought prone district of Nushki, Baloshictan. Central Asia Journal. No. 75. 155-170

33. Nasrullah, Ainuddin, S. (2019) Role of Local Governance institutions in promoting disaster resilience in natural disasters in Balochistan. Doctoral Thesis, Department of Disaster Management and Development Studies, University of Balochistan, Quetta, Pakistan

34. Nasrullah, Ainuddin, S., Kakar, K.M. (2015). Status of Community Resilience in Disaster Prone Districts of Baluchistan, Pakistan. Open Journal of Earthquake Research, 4, 126-135. http://dx.doi.org/10.4236/ojer.2015.44012

35. Nayeem, S., Huma, P., (2017). Non-probability and probability sampling chapter. Aligarh Muslim University.

36. Ogbu, T. J., & Guha-Sapir, D. (2021). Strengthening data quality and reporting from small-scale surveys in humanitarian settings: a case study from Yemen, 2011–2019. Conflict and Health, 15(1), 1-8.

37. Ostadtaghizadeh, A. Ardalan, D. Paton, H. Jabbari, H. R. Khankeh. (2015) Community Disaster Resilience: A Systematic Review on Assessment Models and Tools, PLOS Current Disasters,7.

38. Owusu, A.B., Jakpa, J.T., Awere, K, G., (2016). Smallholder farmers' vulnerability to floods in the Tolon District, Ghana, Interdisciplinary Environmental Review, Vol. 17, Nos. 3/4, 286-311

39. Patel, S. S., Rogers, M. B., Amlôt, R., Rubin, G. J. (2017) What Do We Mean by 'Community Resilience'? A Systematic Literature Review of How It Is Defined in the Literature, PLOS Currents Disasters, http://currents.plos.org/disasters/article/what-do-we-mean-by-community-resilience-a-systematic-literature-review-of-

40. Paton, D. F. (2005) Community Resilience: Integrating Hazard Management and Community Engagement, in: Proceedings of the International Conference on Engaging Communities, edited by: United Nations & Queensland State Government, International Conference on Engaging Communities, Brisbane, Queensland, Australia, 14–17 August 2005.

41. Qasim, S., Qasim, M., Shrestha, R. P., Khan, A. N., Tun, K., & Ashraf, M. (2016). Community resilience to flood hazards in Khyber Pukhthunkhwa province of Pakistan. International Journal of Disaster Risk Reduction, 18, 100-106.

42. Quinlan, A. E., Berbés-Blázquez, M., Haider, L. J., & Peterson, G. D. (2016). Measuring and assessing resilience: broadening understanding through multiple disciplinary perspectives. Journal of Applied Ecology, 53(3), 677-687.

43. Qureshi, A. S. (2005). Climate change and water resources management in Pakistan. Climate change and water resources in South Asia, 197-230

44. Qureshi, A. S. (2020). Groundwater governance in Pakistan: From colossal development to neglected management. Water, 12(11), 3017.

45. Raheem, A., Murtaza, G., & Ainuddin, S. (2018). Revealing Households' Vulnerability to Earthquake in District Ziarat, Balochistan. Journal of Education & Humanities Research, Vol.6.NO 2. 174-200

46. Sato, T., Tachibana, T., Sakurai, T., & Rayamajhi, S. (2022). Do remittances make poor households more resistant to 'natural disasters'? Evidence from the 2015 earthquake in Nepal. International Journal of Disaster Risk Reduction, 73, 102858.

47. Shah, A. A., Ye, J., Abid, M., Khan, J., & Amir, S. M. (2018). Flood hazards: household vulnerability and resilience in disaster-prone districts of Khyber Pakhtunkhwa province, Pakistan. Natural hazards, 93(1), 147-165.

48. Speranza, C.I. (2010). Resilient adaptation to climate change in African agriculture, Bonn, Germany : DIE. (Studies / Deutsches Institut für Entwicklungspolitik; 54) ISBN 978-3-88985-489-6

49. Statistics Canada (2017). Sampling methods date modified. 10-23.

50. Steenbergen F.V., Kaisarani, A.B., Khan, N.U., Gohar, M.S., (2015). A case of ground water depletion in Balochistan, Pakistan: Enter into the void. Journal of Hydrology: Regional Studies 4, 36-47 http://dx.doi.org/10.1016/j.ejrh.2014.11.003

51. Thapa, G. (2009). Smallholder Farming in Transforming Economies of Asia and the Pacific: Challenges and Opportunities. Discussion Paper prepared for the side event organized during the Thirty-third session of IFAD's Governing Council, 18th February 2009.

52. Tierney, K. (2009). Disaster Response: Research Findings and Their Implications for Resilience Measures. CARRI Research Report 6. Oak Ridge: Community and Regional Resilience Institute. http://www.resilientus.org/library/Final_Tierney2_dpsbjs_1238179110.pdf

53. Tobin, G. (1999). Sustainability and community resilience: The holy grail of hazards planning?, Global Environ. Chang., Part B: Environmental Hazards, 1, 13–25, https://doi.org/10.1016/S1464-2867(99)00002-9 , 1999

54. UNDP-CoBRA (2017). Community Based Resilience Assessment (CoBRA) Conceptual Framework and Methodology. United Nations Development Programme (Version-2). Retrieved from: https://www.undp.org/publications/cobra-conceptual-framework . Access date: March 22, 2022

55. Vermeulen S.J., Aggarwal P.K., Ainslie A., Angelone C., Campbell B.M., Challinor A.J., Hansen J.W., Ingram J.S.I., Jarvis A., Kristjanson P., Lau C. (2012) Options for support to agriculture and food security under climate change. Environ Sci Policy. https://doi.org/10.1016/j.envsc i.2011.09.003

56. Walker, B. Westley, F. (2011) Perspectives on resilience to disasters across sectors and cultures, Ecol. Soc., 16, https://doi.org/10.5751/ES-04070-160204

57. World Bank (2008). World Development Report 2008: agriculture for development, Washington, DC; online: http://siteresources.worldbank.org/INTWDR2008/Resources/WDR_00_book.pdf

58. Xu, L., Marinova, D.V., & Guo, X. (2014). Resilience thinking: a renewed system approach for sustainability science. Sustainability Science, 10, 123-138.

59. Nawaz, I., & Lyu, R. (2026). Agricultural Exports and Economic Growth: An Econometric Modeling Framework. *Dialogue Social Science Review (DSSR)*, *4*(4), 125-133.

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