Policy Brief

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Sustainable Agriculture: Opportunities under Agro-ecological Zones

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KEY OUTCOMES

- *Erratic rainfall and temperatures due to climate change intensify floods, soil erosion, and degradation, significantly reducing crop productivity through increased salinity, waterlogging, and nutrient loss. Consequently, rural communities face heightened vulnerability to food insecurity and extreme poverty due to increased drought and flood risks.*
- *Land degradation due to floods couple with excessive application of fertilisers and pesticides, increases desertification, which further affects land ecology by reducing soil organic matter, leading to loss of biodiversity.*
- *Agro-ecological zoning provide a mechanism for sustainable agriculture practices with suitable cropping patterns to tackle climate change and to sustain food security.*
- *Therefore, the objective of the policy brief is to suggest crop specific to agro-ecological conditions to sustain agriculture in response to serious threat of climate change.*
- *The Sustainable Agriculture Index (SAI), formulated in this study is based on the technique employed by the United Nations to help evaluate the sustainability in crop production in various agro-ecological zones.*
- *Data of production of five main crops; wheat, rice, cotton, sugarcane, and jawar have been taken for five years' time periods (1999-00, 2004-05, 2009-10, 2014-15, and 2018-19) to compute the SAI for 24 districts across the four provinces. The districts are distributed across 10 agro-ecological zones that was designed by Pakistan Agriculture Research Council (PARC).*
- *Findings shows that crops should be produced based on the characteristics of agro-ecological conditions. The zones designed earlier by PARC in 1980 also need modification as much has changed since then.*
- *Results also confirm the need of adopting climate resilient strategy for exmaple flood and drought resistant seeds can be planted in the highly effected zones.*
- *The extension department can play vital role for this purpose and can inform about crop that is best suited for the region given the weather, rainfall, and temperature conditions.*
- *The findings are limited given the absence of comprehensive centralised data or data bank to integrate all factors related to economic, social, and environment.*

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1. Introduction

Agriculture is a cornerstone of Pakistan's economy, providing food and livelihoods for a large portion of the population. It contributes about 24% to GDP, employs roughly 34.7% of the workforce, and accounts for a substantial share of foreign exchange reserves (Azam & Shafique, 2017; Economic Survey of Pakistan, 2024). Yet the sector remains hampered by inefficiencies that prevent resources from yielding optimal outputs.

Irrigation and water management present critical challenges. About 47% of Pakistan's land is under irrigated agriculture, with canal-supplied land constituting roughly 70–80% of this area; the remainder relies on groundwater and rainfall (FAO, n.d.; Siyal et al., 2023). The canal system loses approximately 60% of its water through aging infrastructure, poor maintenance, and mismanagement (Nasreen & Ashraf, 2021a; Sattar, 2012). Additional economic constraints include variable seed quality and low varietal diversity, inefficient fertilizer use, traditional irrigation that exacerbates water scarcity, excessive groundwater extraction leading to salinity and water stress, poor land management, high input costs, limited access to modern technology and markets, insufficient investment, and often overuse of fertilizers and pesticides. These practices also fail to account for social and environmental dimensions. Over application of agrochemicals degrades soil quality, fosters pest outbreaks, and poses health risks to rural communities, contributing to both acute and chronic diseases (Fatima et al., 2024; Hassan et al., 2020; Sattar, 2012; Shafiq et al., 2021).

Climate change compounds these challenges. Wheat yields, in particular, are highly vulnerable to changes in precipitation and temperature; projections suggest significant yield losses by mid- and late-century (Azam & Shafique, 2017; Dogar, 2023; Rehman et al., 2019; Sattar, 2012; Zaman & Jehanzeb Khan, 2022). The climate-vegetation nexus has already affected more than 20 million people and damaged a substantial portion of agricultural land. The locust outbreak of 2020–2021 further devastated the crop sector (Khan et al., 2021). Climate change–driven degradation for the region is estimated to account for about 6% of GDP overall, with Sindh experiencing well over 15% of GDP in losses. Soil erosion, declining soil fertility, deteriorating air quality, rising pest pressure, longer harvest periods, and water pollution are commonly observed consequences. In the northern regions, yields of wheat declined by about 6%, and basmati rice by 15–18% in certain estimates.

Many farmers remain unaware of climate-smart agriculture practices that could build resilience, such as selecting water- and drought-tolerant crops, adopting drought-resistant seeds, practicing mixed cropping and crop rotation, using cover crops and crop diversification, improving fertilizer management, implementing soil and water conservation measures, adjusting sowing times, tree planting, and embracing sustainable land-management approaches (Fatima et al., 2024; Sattar, 2012).

Regional evidence underscores the scale of the challenge. In Khyber Pakhtunkhwa (KPK), land degradation has reduced cultivated land and crop yields, with yield declines around 42–44% in some districts like Mardan. Tillage farming has exacerbated soil erosion by about 24%, and overall soil erosion affected millions of hectares in Punjab in 2016. Salinization and poor canal water quality further threaten land productivity. Flood-driven irrigation, combined with saline inputs, worsens salinity and soil health, threatening both food security and potable water supplies (Israr et al., 2020; Mazhar & Shirazi, 2020).

Beyond erosion and salinity, desertification and excessive chemical use degrade soil organic matter and nutrient content. Overgrazing causes soil compaction, reduces infiltration, and lowers water availability, while biodiversity losses and pest dynamics worsen agricultural outcomes. In the Pothwar region, some farmers have adopted organic farming and biofertilizers to restore soil health and diversify production, yet they often overlook conservation tillage methods (Saeed et al., 2023).

Despite these pressures, there is limited assessment of climate change impacts on crops within Pakistan's agroecological zones. This policy brief aims to evaluate how cropping patterns may shift over the next two decades in response to climate change across agroecological zones, with a view to sustainability. It also considers how climate change affects rural social structures, food and water security, and land ecology. The objective is to recommend plausible policy directions and to propose a reconfiguration of agroecological zones to support sustainable, climate-resilient agriculture.

2. Background

The Pakistan Agricultural Research Council (PARC) distributed the agriculture land into 10 agro-ecological zones in the 1980s, based on climate suitability, geography, and water availability as represented in Table 1.

The First Zone, Indus Delta is suitable for producing rice, sugarcane, banana, and pulses. The districts included in this zone are; Thatta and Hyderabad. The Southern Zone is second, which is suitable for wheat, rice, and gram on the right bank, and wheat, cotton, and sugarcane on the left bank. This zone has districts; Sukkur, Shikarpur, Sanghar, Nawabshah, Dadu, Khairpur, Tharparkar, Larkana, Jacobabad, Sibi, and Rahimyar Khan.

The third zone, Sandy Desert, is favorable for castor, wheat, guar, and millet. This zone comprises districts Sanghar, Nawabshah, Tharparkar, Rahimyar Khan, Bahawalnagar, Muzaffargarh, Mianwali, and Sargodha.

The fourth zone, Northern Irrigated Plain, is beneficial for producing wheat, rice, cotton, sugarcane, maize, citrus, oilseeds, millets, tobacco, berseem, sugar beet, orchards, and mangoes. The zone comprises districts: Bahawalnagar, Rahimyar Khan, Multan, Vehari, Sahiwal, Lahore, Faisalabad, Jhang, Chiniot, Gujranwala, Sargodha, Gujrat, Peshawar, and Mardan.

The fifth zone, Barani (rainfed) Lands, is favorable for millets, pulses, wheat, oilseeds, maize, sorghum, gram, and lentils. The zone comprises districts Bannu, Mianwali, Dera Ismail Khan (D.I. Khan), Abbottabad, Attock, Talagang, Sialkot, Gujrat, Jhelum, Rawalpindi, and Chakwal.

The sixth zone, comprising the district Hazara, Rawalpindi, and nearby areas, often referred to as the Wet Mountains (High Mountains) regions, supports rice, maize, and wheat production.

The seventh zone, Northern Dry Mountain Zone, is suitable for barley, grains, maize, and grazing. The zone comprises the districts of Chitral, Swat, Mohmand Agency, Dir, Khyber, Kalakand, and the Tribal areas.

Table 1: Agroecological Zones

Zones	Zone Name	Climate	Rainfall	Temperature	Soil
I	Indus Delta	Tropical Arid	Average 75mm per month in Summer and less than 5mm in winter	Summer temperatures range from 34 to 40^0C, while winter temperatures are 19 and 20^0C.	Clayey and silty
II	Southern Irrigated Plain or the Lower Indus Plain.	dry and subtropical	In summer, it rains 18 millimeters to the north and 45-55millimeters to the south per month.	---	The upper floodplain is calcareous loamy and clayey, whereas the lower portions are silty and sandy loam.
IIIa	Sandy Desert (a)	---	300 millimetres	---	Sandy and Loamy fine
IIIb	Sandy Desert (b) Zone of sand ridges and dunes.	---	300-350 mm	---	Sandy and loamy fine
IVa	Northern Irrigated Plain (a) or Flood Plains and Bar Uplands	Semiarid to Arid	300-500 millimeters per year in the east, and 200-300 millimeters in the southwest per year.	---	Sandy, loam-clay, and loam.
IVb	Northern Irrigated Plain (b) in the alluvial valleys of Peshawar and Mardan	Semi-dry	20-30 mm monthly	---	Silty clays and clay loams
V	Barani (rainfed) Lands	The southern portion is semi-dry and hot	85-200millimetres in summer and 30-45 millimetres in winter.	---	The Salt Range and the Potwar Plateau
VI	Wet Mountains or High Mountains	---	235 millimeters summer, 116 millimeters winter, covered by forest, covered by rainfed agriculture	---	Silt loams to silty clays
VII	Northern Dry Mountains	---	25-75 millimetres each month winter, 10-20 millimetres summer each month	---	Deep and Clayey
VIII	Western Dry Mountains;	Barren Hills and Sloping Terrain	95 millimetre per month summer and 63-95 millimetres per month winter	---	deep and loamy
IX	Dry Western Plateau or mountainous territory	---	37 mm per month during summer; the coastal belt in this zone receives sea breezes.	---	
X	Sulaiman Piedmont or Sulaiman Range	Arid and Hot Climate	Lower than 15 millimeters per month; irrigation is reliant on hill torrent flooding.	---`	

Note: (1) Summer Temperatures range from 34 to 40°C, while winter temperatures are 19 and 20°C.

The eighth zone, Western Dry Mountains, is suitable for maize, wheat, and fruits. The zone comprises the districts of South and North Waziristan, Kalat, Zhob, Lorelai, Sibi, Kohat, Quetta, Bannu, and Karachi.

The ninth zone, Dry Western Plateau Zone, supports maize, wheat, millet, sorghum, melons, vegetables, and fruit crops. The zone comprises districts: Lasbella, Mekran, Chagai, Dadu, Kharan, and Karachi.

The tenth zone, consisting of Karachi, Dera Ghazi Khan (D.G. Khan), and D.I. Khan regions, often called the Sulaiman Piedmont Zone, is suitable for gram, millet, and wheat production.

3. Current Situation

The Pakistan Agriculture Research Council (PARC) in 2019 updated the "Agroecological zones of Pakistan" based on hydrology, soils, topography, irrigation network, and climate. The United Nations (UN) Food and Agriculture Organisation (FAO) has further defined 14 agroecological zones of Punjab in its report, "Agroecological Zones of Punjab, Pakistan". According to the FAO, Wheat is suitable in every zone and moderately suitable in zones XI and XIII, which include the Thal Zone 2 and the Rice Zone. It is also low to moderately suitable in Ground Medium rainfall zones and High rainfall zones, specifically zones XIII and XIV. The districts that are most and moderately suitable for this crop are Lodhran, Sahiwal, Toba Tek Singh, Okara, Bahawalpur, Hafizabad, Faisalabad, Multan, Kasur, Jhang, Mandi Bahuddin, Chiniot, Gujranwala, and Sargodha. The districts of Gujrat and Chakwal are not suitable for this crop. Similarly, the districts suitable for the Rice crop production are Bahawalnagar, Okara, Pakpattan, Gujranwala, Hafizabad, Kasur, Nankana Sahib, Jhang, Sheikhupura, Mandi Bahauddin, Sialkot, and Narowal, suitable in VII, VIII, X, and XII zones. The Cotton crop is suitable for production in Rajanpur, Rahimyar Khan, Bahawalpur, Vehari, Bahawalngar, Lodhran, Khanewal, Multan, D.G.Khan, Sahiwal, Muzaffargarh, and Mianwali districts. The zones that are identified as suitable for this crop are I to VII. The Sugarcane is suitable for cropping in the districts of Rahimyar Khan, Muzaffargarh, Toba Tek Singh, Jhang, Faisalabad, Chiniot and Sargodha districts, lies in the zones XII, VI, VIII, and X. Zones XI, XIV have less suitability for this crop. Further, the Maize crop is suitable to produce in Pakpattan, Okara, Kasur, Sahiwal, Chiniot, Faisalabad, Vehari, Lodhran, Toba Tek Singh, Sargodha, Rawalpindi districts. The zones that are suitable for the production of this crop are in zones V, VII, VIII, and is less suitable in sugarcane areas of XI, and XIV. The moong is suitable for production in districts Layyah, Bhakkar, and Mianwali - falls in zones VI, IX, and X. The gram crop is suitable in district Layyah, Bhakkar, and Khushab districts and the most suitable zones are IX and XI.

4. Methodology

a) Data Description

The panel data of economic or revenue per hectare of five crops namely, Wheat, Rice, Cotton, Sugarcane, and Jawar, considering10 agroecological zones and 24 districts belonging to the four provinces with a five years timelag (2000, 2005 2010, 2015, and 2019) is used for the assessment purpose. The data is obtained from secondary data sources of Pakistan, shown in Table 1. The districts from each province is selected based on agroecological zones as

defined by the Pakistan Agriculture Research Council (PARC) in 1980, the aim is to assess the changes if needed in the zones.

b) Sustainable Agriculture Index (SAI)

The methodology of the Sustainable Agriculture Index (SAI) is based on the normalisation technique adopted by the United Nations (UN) to derive the Human Development Index (HDI). The techniques as adopted by (Guha et al., 2018; S. Singh & Nayak, 2020a; Sundar Pani & Mishra, 2022; UNDP, 2006) is applied to the revenue per hectare of each crop or the yield of each crop to obtain the SAI. Specifically,

$$SAI_{ijt} = \frac{X_{ijt} - MIN_{ij}X_{ijt}}{MAX_{ij}X_{it} - MIN_{ij}X_{it}} \qquad (1)$$

This ratio, SAI, aims to measure the Sustainability in Agricultural production as an Index. Here, i denotes crops (i=1, 2,3, ….., 10) in the jth district of each province of Pakistan (i=1, 2,3, ….., 24); t refers five periods of time (t=2000, 2005, 2010, 2015, 2018); and X_{ijt} refers the revenue per hectare of each crop for the jth district; $MIN_{ij}X_{ijt}$ is lowest value of X_{it}in the district j; and $MAX_{ij}X_{it}$ is highest value of X_{ijt} in the district j. The index value ranges in 0 to 1; if the index falls in 0.9 to 1 or nearest, the jth district will be called highly suitable for the ith crop. If this index falls in the range of 0.5 to 0.8 or nearest, the jth district will be called suitable for ith crop. Furthermore, if the index falls in 0.1 to 0.5 or nearest; the jth district will be called less suitable for ith crop; and if this index falls nearest or close to zero, the jth district will be called unsuitable for ith crop.

5. Analysis

The SAI index developed for crops is shown in Table 2. The wheat crop is highly suitable to moderately suitable in districts Loralai, Kalat, and Lasbella in the province of Balochistan. Although Loralai and Kalat districts were less suitable during 2004-05 and 2009-10 due to water scarcity and also due to the 2009-10 flood. In Punjab, it is highly suitable to produce in Rahimyar Khan, Sahiwal, Bahawalpur, and Layyah districts, whereas it is less sustainable to produce in Gujrat and Sialkot districts. The 2014-15 flood inundated the wheat crop yield in the Sahiwal district. This crop is better suited for districts in Abbottabad, Mardan, Swat, and Dera Ismail Khan (D.I. Khan) of Khyber Pakhtunkhwa (KPK) province, as well as Nawabshah and Sanghar districts of Sindh province. Our Analysis matches somewhat, but in contrast for districts Sibi, Zhob, Layyah, Dadu, Tharparkar, Shikarpur, with the PARC 1980 report and FAO 2019 report for some districts, but in contrast for most of the districts.

Similarly, the rice crop is highly to moderately suitable in the districts Rahimyar Khan of Punjab province, Swat and D.I. Khan of KPK province, and Dadu of Sindh province. The flood 2009-10 mostly destroyed crops in these districts accept in Swat. In addition, our Analysis matches somewhat, but in contrast for districts Sahiwal, Gujrat, Sialkot, Thatta, Tharparkar, Shikarpur, Sanghar, Nawabshah with the PARC 1980 report and FAO 2019 report. Further, the SAI index for cotton crop is only suitable in district Rahimyar Khan because of poor management of land and water scarcity. This crop is not suitable for production in Balochistan overall due to water scarcity, poor management and land

conditions for cotton crop. The crop is also less suitable to produce in districts of Sahiwal, Gujrat, Sialkot, Bahawalpur, Layyah, Abbottabad, Mardan, Swat, D.I.Khan, Karak, Lakki Marwat, Thatta, Nawabshah, Sanghar, Tharparkar, Shikarpur, and Dadu and in contrast with the PARC (1980) and FAO (2019).

Further, the cotton crop is highly to moderately suitable for production in the districts of Rahimyar Khan, and Bahawalpur of Punjab; Sanghar district of Sindh. Layyah and Sanghar districts were less suitable for producing this crop in 1999-00. Districts Layyah, Thatta, Nawabshah, and Sanghar were also affected by the 2014-15 flood, which destroyed the sugarcane crop. All districts in Balochistan are unsuitable for producing this crop. Our Analysis matches somewhat with the PARC 1980 report and the FAO 2019 report, but our results are in contrast with these reports for the districts of Bahawalpur, Layyah, Sibi, Sahiwal, Gujrat, Sialkot, Tharparkar, Shikarpur, and Dadu.

The sugarcane crop is mostly suitable to moderately suitable for production in the districts of Rahimyar Khan, Bahawalpur, and Layyah of Punjab province; Mardan and D.I. Khan of KPK province; and Thatta, Nawabshah, and Sanghar of Sindh Province. Layyah and Sanghar districts were less suitable for producing this crop in 1999-00. Districts Layyah, Thatta, Nawabshah, and Sanghar were also affected by the 2014-15 flood, destroying the sugarcane crop. All the Baluchistan districts are unsuitable for producing this crop. Our Analysis matches somewhat with the PARC 1980 report and the FAO 2019 report, but in contrast with these reports for the districts of Bahawalpur, Layyah, Sibi, Sahiwal, Gujrat, Sialkot, Tharparkar, Shikarpur, and Dadu.

The crops comparison by zones has been showed in Table 3. According to the table results, there has been changed in cropping pattern after frequent floods in their respective zones that need to put pressure on to adapt climate change and use water-resistant and pesticide-resistant seeds. Cotton can only be produced in three Zones. Rice cannot be produced in Indus Delta because Indus Delta water is shrinking and does not irrigate all crops.

Table 2: SAI Index for Crops

	2018-19					2014-15					2009-10					2004-05					1999-00				
Districts	**Wheat**	**Rice**	**Cotton**	**Sugar**	**Jawar**	**Wheat**	**Rice**	**Cotton**	**Sugar**	**Jawar**	**Wheat**	**Rice**	**Cotton**	**Sugar**	**Jawar**	**Wheat**	**Rice**	**Cotton**	**Sugar**	**Jawar**	**Wheat**	**Rice**	**Cotton**	**Sugar**	**Jawar**
Loralai	1.00				0.50	1.00	1.00				1.00				0.58	0.45				0.00	0.86				
Sibi	0.00				0.43	0.73	0.73				0.97				1.00	0.08				1.00	0.27				
Kalat	0.85					0.68	0.68				0.25					0.53					1.00				
Lasbella	0.79				1.00	0.63	0.63				0.97				0.00	1.00				1.00	0.86				
Musa Khail	0.45				0.00	0.12	0.12				0.47				0.27	0.00					0.00				
Zhob	0.47				0.02	0.00	0.00				0.00				1.00	0.18					0.31				
Rahimyar Khan	0.95	1.00	1.00	1.00	0.36	1.00	1.00		1.00		0.83	0.41	1.00	1.00	0.61	0.81	1.00	1.00	1.00	1.00	0.60	0.57	0.50	0.53	0.94
Sahiwal	1.00	0.43	0.29	0.47	1.00	0.00	0.00	0.80	0.63		1.00	0.58	0.10	0.14	1.00	1.00	0.43	0.00	0.16	0.74	1.00	0.32	0.55	0.00	1.00
Gujrat	0.00	0.00		0.00	0.03	0.44	0.44		0.56		0.00	0.41		0.34	0.22	0.00	0.99		0.51	0.72	0.00	0.00		0.85	0.51
Sialkot	0.54	0.22		0.22	0.00	0.38	0.38		0.48		0.46	1.00		0.00	0.00	0.64	0.00		0.00	0.00	0.51	0.15		1.00	0.00
Bahawalpur	0.86	0.16		0.65	0.18	0.93	0.93	1.00	0.84		0.88	0.00	0.54	0.60	0.16	0.77	0.97	0.85	0.56	0.68	0.66	0.37	1.00	0.71	0.90
Layyah	0.63	0.14	0.00	0.96	0.04	0.60	0.60	0.00	0.00		0.70	0.43	0.00	0.54	0.02	0.90	0.62	0.14	0.81	0.74	0.15	1.00	0.00	0.43	1.00
Abbottabad	0.67					0.82	0.82				0.77					0.65					0.61	0.00			0.93
Mardan	0.92	0.00		0.20	0.97	1.00	1.00	0.00	0.85	1.00	1.00	0.88		1.00	1.00	1.00	0.00		1.00	1.00	1.00	0.41	0,00	1.00	1.00
Swat	1.00	0.77				0.88	0.88				0.77	1.00				0.80	0.65				0.46	0.77		0.00	
Dera Ismail Khan	0.74	1.00		1.00	1.00	1.00	1.00	1.00	1.00	0.57	0.87	0.00		0.00	0.04	0.91	1.00		0.00	0.76	0.59	1.00	1.00	0.84	0.92
Karak	0.00				0.00	0.00	0.00			0.00	0.00				0.00	0.00				0.00	0.00	.			0.00
Lakki Marwat	0.60	0.20		0.00	0.88	0.61	0.61		0.00	0.79	0.17			0.84		0.39					0.16	0.35		0.69	
Thatta	0.00	0.00	0.11	1.00	0.35	0.03	0.03	0.15	0.02	0.45	0.10	0.00	0.92	1.00	0.71	0.23	0.00	0.03	0.52	0.50	0.00	0.12		0.82	0.00
Nawabshah	1.00		1.00	0.92	0.68	1.00	1.00	0.03	0.01	0.76	1.00	0.27	0.39	0.25	1.00	0.99	0.21	0.07	1.00	1.00	1.00	0.40	1.00	1.00	1.00
Sanghar	0.66		0.94	0.68	0.00	0.40	0.40	1.00	0.02	0.00	0.76	0.03	1.00	0.80	0.36	1.00	0.42	0.08	0.70	0.75	0.66	0.00		0.00	0.66
Tharparkar	0.16		0.00	0.00		0.00	0.00	0.00	0.00	---	0.00		0.36	0.00		0.00		0.00	0.00						
Shikarpur	0.44	0.34	0.22	0.90	1.00	0.06	0.06		0.00	---	0.05	0.50		0.34	0.00	0.36	1.00		0.10	0.00	0.16	1.00	0.00	0.52	0.28
Dadu	0.61	1.00	0.83	0.47	0.92	0.29	0.29	0.65	1.00	1.00	0.11	1.00	0.00	0.04	0.01	0.63	0.80	1.00	0.49	0.51	0.26	0.91	0.70	0.71	0.45

Source: Our estimation.

Table 3: Crops Comparison by Zones

Zones	Zone Name	Crops Recommended in 1980	Crops Recommended by SAI
I	Indus Delta[1]	Rice, Cotton, Sugarcane	Wheat, Sugarcane
II	Southern Irrigated Plain or the Lower Indus Plain.	Wheat, Rice, Cotton sugarcane	Wheat, Rice, Cotton, Sugarcane, Jawar
III	Sandy Desert	Wheat	Wheat, Cotton, Sugarcane, Jawar
IV	Northern Irrigated Plain	Wheat, Rice, Cotton, Sugarcane	Wheat, Rice, Cotton, Sugarcane, Jawar
V	Barani (rainfed) Lands	Wheat	Wheat, Sugarcane, Jawar
VI	Wet Mountains or High Mountains	Wheat and Rice	Wheat, Rice, sugarcane, Jawar
VII	Northern Dry Mountains	---	Wheat, Rice
VIII	Western Dry Mountains	Wheat	Wheat
IX	Dry Western Plateau or mountainous territory	Wheat	Wheat, Rice
X	Sulaiman Piedmont or Sulaiman Range	Wheat	Wheat, sugarcane, Jawar

6. Policy Recommendation

Sustainable Agriculture has become the key to ensuring food security and income of the rural society, given the condition of soil, land, water, and ecological management in agroecological zones. This means suitable cropping depends on the soil characteristics (soil erosion and degradation), impact of climate, surface and ground water quality and quantity, topography, and agricultural land use pattern. The recent flood of 2025 and a pre-monsoon spell from June 2025 have further affected agroecological zones. If not periodically assessed, the flood will further devastate Pakistani crops and decline land and agricultural productivity, which leads to a decline in household income and will increase rural poverty, posing a food security threat.

For this purpose, the policy brief recommends the following options:

- Devise the new agroecological zones based on changing cropping patterns and reserve water-intensive crops (rice and sugarcane) in the region which have more fertile land and receives excessive rainfall or has a canal system.
- Agroecological zones should be mapped frequently (preferably after 2 years) due to frequent climate change.
- Develop and grow crops specific to defined zones.
- Policymakers should make a data bank of each indicator related to the rural economy, such as the cost of production, inputs used, data related to soil conditions, land evaluation, water requirements, farm-to-market information to assess crop demand and supply, especially the data regarding the use of fertilisers, pesticides. These databases will be helpful in designing comprehensive agroecological zones for crop production.
- Farmers should adapt a climate change strategy and use drought, flood, heat-resistant, and water-intensive seeds which are suitable for each agroecological zone.

- To adapt to climate change, monoculture farming should be avoided, and intercropping, mixed cropping, cover crops, conservation tillage and tree plantation should be adopted to increase soil health and reduce soil erosion and degradation.

- Water conservation techniques should be adopted and implemented, and a system should be made to channel runoff into the canal to reduce salinity and waterlogging problems.

- Canal systems infrastructure should be repaired to reduce leakages and increase water conveyance management efficiency.

- The agriculture extension department should be active to provide awareness to farmers about the suitability of crop specific to the zone.

- Information related to rainfall, temperature, humidity and wind speed and the early warning system should be made effective to inform farmers prior to any disaster. The extension department further builds resilience strategies at each union council or village level to support farmers.

- Rural communities should build ponds and dams and adapt rain harvesting techniques to ensure water at the farm level and to save rain and floodwater from being lost.