Assessing Agricultural Policy Coherence for Climate Resilience in South Asia: Insights from Multi-Criteria Decision-Making

Executive Summary

The Multi-Criteria Decision-Making (MCDM) analysis evaluated agricultural sustainability and policy coherence across India, Bangladesh, Pakistan, and Sri Lanka to identify priority areas for climate-resilient agricultural transformation with a specific focus on coastal systems. This analytical exercise integrated expert judgments informed by field realities of coastal agriculture, contextualising national policy evaluation and generating decision-oriented insights on resilience priorities. The assessment integrated 21 sustainability indicators grouped under environmental, economic, and institutional dimensions, examining the strength, scope and implementation depth of national agricultural frameworks. Composite coverage scores reflected how effectively existing policies addressed adaptive capacity, livelihood security, and ecosystem stability in regions exposed to saline intrusion, cyclonic hazards, and coastal resource degradation.

India demonstrated the most comprehensive institutional coverage, achieving a portfolio strength of 71.6 per cent. Flagship programmes such as the Gramin Krishi Mausam Sewa, National Innovations on Climate Resilient Agriculture, and Pradhan Mantri Krishi Sinchayee Yojana contributed to strong performance in climate information systems, irrigation efficiency, and adaptive technology dissemination. These functions remain vital in coastal districts of Odisha, Andhra Pradesh, Tamil Nadu, and Gujarat, where saline water intrusion, erratic monsoon patterns, and declining groundwater tables continue to affect productivity. Persistent weaknesses in risk management, credit access, and soil health underscored the need for integrated mechanisms that link productivity enhancement with resilience financing and coastal infrastructure strengthening.

Bangladesh, with a portfolio coverage achievement of 66.8%, exhibited an inclusive policy structure with substantial emphasis on community participation, gender inclusion, and food security, supported by initiatives such as the Delta Plan 2100 and the National Agricultural Policy. High performance in water efficiency and adaptation planning reflected institutional maturity shaped by decades of delta management experience. However, challenges in soil degradation control, input management, and long-term financial protection constrained resilience outcomes, especially across the coastal belt where saline intrusion, tidal flooding, and groundwater contamination have eroded farm viability. Sustained institutional attention to soil-water interface management and adaptive livelihood diversification remains critical for climate-resilient coastal agriculture.

Pakistan presented the most uneven policy performance, achieving 65.3 per cent overall coverage. Strengths were concentrated in knowledge transfer and market access, while critical weaknesses persisted in soil health, credit and finance, and risk management. Despite multi-policy attention, implementation remained hindered by coordination and funding gaps. The country's extensive coastal and deltaic systems along the Indus Basin face compound risks from salinity, drought, and water scarcity, yet operational integration between irrigation management and coastal agricultural planning remained limited. Findings indicated that institutional capacity, rather than policy absence, was the principal constraint to resilience delivery.

Sri Lanka achieved 66.3 per cent portfolio coverage, characterised by strong emphasis on climate resilience and knowledge transfer, but marked by gaps in soil health, financial inclusion, and market integration. Post-crisis recovery frameworks such as the Climate Smart Agriculture Investment Plan and the Coastal Zone and Climate Resilience Management Plan introduced valuable innovations but required consistent funding and institutional reinforcement. Coastal farming systems continued to face salinity stress, cyclone exposure, and declining soil fertility, highlighting the need for joint interventions across water, finance, and livelihood domains.

Across all four countries, the comparative analysis confirmed that while policy architectures were comprehensive, implementation remained fragmented. Three cross-cutting priorities emerged as regionally

critical for coastal agricultural sustainability: rehabilitation of soil and water resources to stabilise productivity in saline-affected and erosion-prone areas; institutionalised risk management and financial inclusion mechanisms to protect smallholders from climate and market shocks; strengthened extension and community-based adaptation systems to translate policy intent into field-level practice.

The study concluded that future resilience efforts must move beyond policy design toward coordinated, adequately financed, and locally adaptive systems capable of addressing the compound risks that define South Asian coastal agriculture- salinity intrusion, tidal inundation, cyclonic impact, and livelihood insecurity, while advancing inclusive, climate-resilient growth across the region.

1 Introduction

South Asia is among the most climate sensitive regions of the world, where agriculture remains central to food security, employment, and rural welfare (IPCC, 2022; World Bank, 2021). The livelihoods of hundreds of millions depend on farming systems shaped by monsoon behaviour and finite land and water resources (FAO, 2018; ADB, 2017). In recent decades the region has experienced a rise in the frequency and severity of extreme weather, including prolonged droughts, destructive floods, heat waves, and saline intrusion along low lying coasts (UNESCAP, 2020; Cruz et al., 2007). These pressures have intensified degradation of soils and aquifers, disrupted cropping calendars, and revealed structural weaknesses in agrarian economies (OECD, 2022). Governments have launched a wide range of policy responses, yet the scale and complexity of climate risk demand a coherent regional understanding of how existing instruments actually contribute to resilience on the ground (UNDP, 2019; SACEP, 2021).

The selection of India, Bangladesh, Pakistan, and Sri Lanka together represent the major deltaic and coastal systems of the subcontinent, stretching from the Indus Basin to the deltas of the Ganges, Brahmaputra, and Meghna, and across the maritime landscapes of the Bay of Bengal and the Arabian Sea (IPCC, 2022; SACEP, 2021). These zones are increasingly affected by sea level rise, tidal surges, salinity, and changing rainfall regimes that threaten soil productivity, freshwater supply, and the security of coastal livelihoods (World Bank, 2021; OECD, 2022). The concentration of smallholder farming, aquaculture, and paddy cultivation along these coasts makes them central to regional food production and employment (FAO, 2018). Examining these countries jointly therefore provides a comprehensive understanding of how policy structures respond to the shared challenge of sustaining agriculture in climate exposed coastal environments (ADB, 2017; UNDP, 2019).

Indian agriculture spans a vast gradient from arid interiors to humid coastal belts and from temperate hills to alluvial plains. The sector continues to employ a major share of the labour force while providing essential contributions to the national economy (FAO, 2018). Climate variability has heightened production risk through erratic rainfall, heat stress, and declining groundwater (IPCC, 2022). In response, India has introduced an expansive policy portfolio that includes the National Action Plan on Climate Change with mission-based programmes, the National Adaptation Fund for Climate Change, the Pradhan Mantri Krishi Sinchai Yojana for irrigation efficiency, and the National Initiative on Climate Resilient Agriculture focused on research and field validation (Government of India, 2020). These instruments aim to align water management, soil health, risk reduction, and market linkages with sustainable intensification. Progress has been uneven across states, and coordination among schemes and institutions remains a continuing task for durable impact at village level (OECD, 2022).

Bangladesh faces a distinct set of challenges rooted in deltaic geomorphology and coastal exposure. Salinity ingress, tidal surges, and irregular monsoon rainfall have reduced soil fertility, increased irrigation demand

for freshwater, and shifted pest and disease dynamics (World Bank, 2021; IPCC, 2022). Agricultural livelihoods in coastal districts remain highly sensitive to these hazards. The government has advanced multiple national frameworks, including a long-term adaptation pathway under the Bangladesh Delta Plan, policies for agriculture, food and nutrition security, and water management, and an investment plan for climate smart agriculture (Bangladesh Planning Commission, 2018). Together they seek to embed resilience through climate informed extension, adaptive research, and improved infrastructure (ADB, 2017; UNDP, 2019). However, overlaps in mandates, gaps in financing, and variable capacity at local level continue to limit consistent outcomes for farmers (OECD, 2022).

Agriculture in Pakistan operates under chronic water stress combined with recurrent heat extremes. Much of the territory is arid or semi-arid, and production depends heavily on the Indus Basin Irrigation System. Persistent groundwater depletion, soil salinisation, and waterlogging constrain productivity and increase vulnerability to drought and flood cycles (IPCC, 2022; World Bank, 2021). While the sector provides livelihoods for a large rural population and uses the vast majority of available freshwater, sustainability remains at risk. National and provincial policies have been established for climate change, food security, water, and agroforestry, with the aim of improving resource efficiency and adaptive capacity (Ministry of Climate Change, Government of Pakistan, 2021). Implementation is hampered by fragmented governance, limited monitoring, and uneven data integration, which together restrict learning and course correction at system scale (OECD, 2022; UNDP, 2019).

Sri Lankan agriculture reveals another face of regional vulnerability shaped by topographic diversity and recent economic strain. Rural livelihoods rely on monsoon rainfall and a mix of plantation and food crops that are exposed to drought in the Dry Zone, intense rainfall variability elsewhere, and coastal saline intrusion (IPCC, 2022; SACEP, 2021). Severe soil erosion on hill slopes has long undermined productivity, and input shortages during the recent crisis intensified pressure on farm incomes (FAO, 2018). Policy attention has therefore turned to soil conservation, water efficiency, diversification, and ecosystem protection across the dry, wet, and intermediate zones (Government of India, 2020; UNDP, 2019). Despite clear strategic intent, institutional fragmentation and capacity constraints slow translation from plans to measurable resilience outcomes, especially in hill and coastal districts (OECD, 2022).

This report addressed the regional need for a systematic and comparable appraisal of current policy support for climate resilient agriculture. It applied a structured Multi Criteria Decision Making approach to evaluate national policy portfolios against a set of 21 sustainability indicators that represent ecological, economic, and social dimensions of resilience (ADB, 2017; OECD, 2022). By using the same analytical lens across India, Bangladesh, Pakistan, and Sri Lanka, the report identified areas of strength, overlap, and under coverage, highlighted single policy dependencies that posed risk, and opportunities for convergence, financing, and monitoring that could enhance field level outcomes (SACEP, 2021; UNDP, 2019)

2.Methodology

2.1 Selection and ranking of indicators

21 sustainability indicators were identified through review of peer-reviewed literature and national assessment reports on climate-resilient agriculture frameworks, South Asian agricultural vulnerability, and policy effectiveness. The indicator framework spanned ecological, economic, and social sustainability pillars. A panel of six domain experts then ranked the twenty-one indicators from one to twenty-one according to their relative importance for resilience.

2.2 Weight derivation for the indicators using the Rank Sum method

The ranked indicators were transformed into numerical weights that together equalled 1.0 (or 100 %) for application in the quantitative analysis. To achieve this, the Rank Sum weighting method was employed, providing a clear and transparent basis for assigning greater importance to indicators with higher ranks (SK, 2025). This method ensures that the relative influence of each indicator reflects its assigned priority within the ranking system.

The Rank Sum weight for an individual indicator was determined using the following equation:

$$w_j = \frac{\{(n - r_j + 1)\}}{\left\{\sum_{\{k=1\}}^{\{n\}k} K\right\}}$$

where $n = 21$ represents the total number of indicators, rj denotes the rank assigned to indicator j, and the denominator represents the sum of all rank values from 1 to 21. The denominator is therefore calculated as 1 + 2 + 3 + … + 21 = 231, which can also be expressed through the general formula for the sum of consecutive integers: $n(n + 1)/2 = 21 \times 22 / 2 = 462 / 2 = 231$.

2.3 Mapping of indicators to national policies

Each indicator was mapped to relevant national schemes and programmes addressing climate resilience in agriculture. Mapping was carried out through review of official policy documents, implementation guidelines, and evaluations, and was validated by the six experts. The process established which schemes explicitly covered each indicator and the depth of their linkage.

2.4 Scoring framework

Each policy was assessed against the mapped indicators on three dimensions by the experts: provision level, implementation level, and implementation quality. Scores were assigned by the experts on a scale of 0 to 1. The final indicator score for each policy represents the mean of the three components.

Provision level	Extent and clarity of policy provisions for the indicator	0.0–0.3 = minimal; 0.3–0.6 = partial; 0.6–0.8 = substantial; 0.8–1.0 = comprehensive
Implementation level	Share of intended coverage actually reached	0.0–0.3 = below 30 %; 0.3–0.6 = 30–60 %; 0.6–0.8 = 60–80 %; 0.8–1.0 = above 80 %
Implementation quality	Effectiveness within covered areas and groups	0.0–0.3 = poor; 0.3–0.6 = moderate; 0.6–0.8 = good; 0.8–1.0 = excellent

2.5 Aggregation using Simple Additive Weighting

Individual policy-indicator scores were combined to determine the overall portfolio coverage through the Simple Additive Weighting (SAW) approach (Aryafar & Roshanravan, 2021; Ciardiello & Genovese, 2023; Van Dua, 2024; Grybaitė & Burinskienė, 2024). For each indicator j, the mean score across all policies addressing that indicator was calculated and then multiplied by the corresponding indicator weight. This yielded the indicator's weighted contribution to the overall portfolio coverage, as represented by the equation:

$SAW_j = \text{Average Score}_j \times w_j$

The sum of all SAW values for the 21 indicators provided the total portfolio coverage percentage. This measure identified which sustainability dimensions were adequately addressed by existing policy instruments and highlighted those where major deficiencies or vulnerabilities persist.

2.5 Gap Analysis

The indicator gap analysis was conducted to determine, for each indicator, whether sufficient policy support exists and how effectively that support is implemented. For every indicator *j*, the average score across all relevant policies was first obtained, and the corresponding gap was then calculated using the formula:

$\text{Indicator Gap}_j = (1.0 - \text{Average Score}_j) \times \text{Weight}_j$.

The resulting value quantified the unaddressed or residual policy need for that indicator. Higher gap values indicated inadequate policy coverage or weak implementation performance, signalling potential vulnerabilities within the overall portfolio. Indicators dependent on a single policy or with low mean scores were interpreted as areas requiring targeted strategic intervention.

The total portfolio gap was determined by summing the gap values for all 21 indicators. Portfolio Coverage Achievement was then computed as:

Portfolio Coverage Achievement = 1.0 - Total Portfolio Gap

3 Results and Discussion

3.1 India

Table 3.1.1: Indicator Ranking and Sustainability Weights

Rank	Indicator	Rank Sum Weight	Percentage
1	Water-use Efficiency & Conservation Measures	0.0909	9.09%
2	Climate Resilience & Adaptation Provisions	0.0866	8.66%
3	Food Security & Nutrition Provisions	0.0823	8.23%
4	Soil Health & Nutrient Management Provisions	0.0779	7.79%
5	Risk Management & Insurance Coverage	0.0736	7.36%
6	Credit & Financial Inclusion Mechanisms	0.0693	6.93%
7	Community Participation Mechanisms	0.0649	6.49%
8	Knowledge Transfer & Extension Services	0.0606	6.06%
9	Technology Adoption & Modernization Support	0.0563	5.63%
10	Market Access & Value Chain Development	0.0519	5.19%
11	Gender Inclusion & Women's Empowerment	0.0476	4.76%
12	Biodiversity Conservation Mechanisms	0.0433	4.33%
13	Farm Profitability & Income Enhancement Provisions	0.0390	3.90%
14	Youth Engagement & Capacity Building	0.0346	3.46%
15	Land Degradation Prevention Provisions	0.0303	3.03%
16	Ecosystem Services Protection Frameworks	0.0260	2.60%
17	Input Cost Management Strategies	0.0216	2.16%
18	Social Safety Net Integration	0.0173	1.73%
19	Pollution Control & Environmental Safety Standards	0.0130	1.30%
20	Cultural Preservation & Indigenous Knowledge Systems	0.0087	0.87%
21	Export Enhancement	0.0043	0.43%
TOTAL		**1.0000**	**100.00%**

Water efficiency and conservation, followed by climate adaptation, food security, soil health, and risk management, together captured the principal climate pressures of India where rainfall variability, groundwater stress, and soil fatigue interact to shape livelihood risk. Moderate emphasis on credit, participation, extension, and technology reflected long investment in institutional delivery and advisory

systems. Lower weights for cultural preservation and export enhancement indicated a portfolio that prioritises domestic resilience over external competitiveness. Overall, the hierarchy reflected how smallholders were more exposed to risks than large farmers, and aligned with a policy stance that prioritises foundational adaptive capacity and production stability ahead of market expansion.

Table 3.1.2: Indicator-Policy Mapping Matrix

Indicator	Policies Providing Coverage
Water-use Efficiency & Conservation	Pradhan Mustri Krishi Sinchayee Yojana (PMKSY); National Initiative on Climate Resilient Agriculture (NICRA); National Action Plan on Climate Change (NAPCC); Gramin Krishi Mausam Seva (GKMS)
Climate Resilience & Adaptation	NICRA; NAPCC; Agricultural Technology Management Agency (ATMA) Scheme; GKMS
Food Security & Nutrition	National Food Security Mission (NFSM); Soil Health Card Scheme (SHC); NICRA
Soil Health & Nutrient Management	SHC
Risk Management & Insurance	Pradhan Mustri Fasal Bima Yojana (PMFBY); GKMS
Credit & Financial Inclusion	NFSM; PMKSY
Community Participation	NICRA; ATMA; GKMS
Knowledge Transfer & Extension Services	ATMA; NICRA; GKMS
Technology Adoption & Modernization Support	ATMA; PMKSY; GKMS; NICRA
Market Access & Value Chain Development	NFSM; PMKSY
Gender Inclusion & Women's Empowerment	NFSM; NICRA; GKMS
Biodiversity Conservation	NICRA; NAPCC; GKMS
Farm Profitability & Income Enhancement	PMKSY; NFSM; GKMS
Youth Engagement & Capacity Building	ATMA; NICRA; GKMS
Land Degradation Prevention	SHC
Ecosystem Services Protection	NAPCC; GKMS
Input Cost Management	SHC; GKMS
Social Safety Net Integration	PMFBY; NFSM
Pollution Control & Environmental Safety	SHC; GKMS
Cultural Preservation & Indigenous Knowledge Systems	NICRA; NAPCC; GKMS
Export Enhancement	NFSM; PMKSY

The mapping matrix showed that agricultural resilience in India was driven by a wide range of programmes that target interrelated thematic areas. Most indicators were supported by several policies, reflecting deliberate diversification intended to minimise reliance on individual schemes. In areas related to resource management, particularly soil health and land degradation control, the Soil Health Card Scheme served as the most significant operational framework, representing a focused governmental effort toward maintaining soil fertility and promoting balanced nutrient management. Water efficiency and climate adaptation were backed by multiple complementary programmes that added institutional strength but also created the need for close coordination to avoid duplication. Overall, the mapping confirmed that policy intent was

extensive. However, the real measure of success would rely on how well these concurrent mechanisms worked together at ground level through effective integration, implementation, and monitoring.

Table 3.1.3: Policy-Indicator Assessment Matrix

Indicator	NICRA	NAPCC	ATMA	SHC	PMKSY	NFSM	PMFBY	GKMS
Water-use Efficiency & Conservation	0.68	0.68	-	-	0.78	-	-	0.68
Climate Resilience & Adaptation	0.84	0.73	-	-	0.56	-	-	0.76
Food Security & Nutrition	0.73	-	-	0.58	-	0.81	-	-
Soil Health & Nutrient Management	-	-	-	0.75	-	-	-	-
Risk Management & Insurance	-	-	-	-	-	-	0.74	0.65
Credit & Financial Inclusion	-	-	-	-	0.70	0.68	-	-
Community Participation	0.82	-	0.79	-	-	-	-	0.74
Knowledge Transfer & Extension	0.84	-	0.87	-	-	-	-	0.81
Technology Adoption & Modernization	0.58	-	0.79	-	0.70	-	-	0.73
Market Access & Value Chain	-	-	-	-	0.62	0.70	-	-
Gender Inclusion & Women's Empowerment	0.76	-	-	-	-	0.74	-	0.60
Biodiversity Conservation	0.73	0.70	-	-	-	-	-	0.65
Farm Profitability & Income Enhancement	-	-	-	-	0.73	0.72	-	0.72
Youth Engagement & Capacity Building	0.67	-	0.69	-	-	-	-	0.68
Land Degradation Prevention	-	-	-	0.74	-	-	-	-
Ecosystem Services Protection	-	0.70	-	-	-	-	-	0.64
Input Cost Management	-	-	-	0.70	-	-	-	0.70
Social Safety Net Integration	-	-	-	-	-	0.73	0.73	-
Pollution Control & Environmental Safety	-	-	-	0.67	-	-	-	0.62
Cultural Preservation & Indigenous Knowledge	0.62	0.59	-	-	-	-	-	0.60
Export Enhancement	-	-	-	-	0.50	0.50	-	-

Note: - indicates that the policy did not address the indicator. All scores were on a 0-1 scale, calculated as the average of Provision Level, Implementation Level, and Implementation Quality dimensions.

The assessment matrix highlighted noticeable differences in how various sustainability indicators were addressed within national policies. Indicators associated with knowledge dissemination, averaging around 0.84, and community participation, between 0.79 and 0.82, performed the strongest, showing that systems for farmer training and participatory extension were well established and functioning more or less

effectively. Climate resilience, with scores ranging from 0.73 to 0.84, and biodiversity conservation, between 0.65 and 0.73, also demonstrated solid progress, suggesting that adaptive and ecosystem-based strategies were becoming integral to policy design. In contrast, lower scores for market access, pollution control, and export promotion indicated that farmers still faced significant structural and logistical barriers to entering value chains and adopting sustainable production practices. Risk management, credit, and financial inclusion fell within moderate ranges, reflecting the ongoing difficulty of expanding insurance coverage and formal financial access in rural economies. In conclusion, the indicator analysis showed that while adaptive and informational capacities had improved substantially, economic and environmental dimensions remained less mature, requiring integrated approaches to link productivity gains with broader sustainability outcomes. The comparatively high scores in some areas arose from the strength and scope of policy frameworks, yet uneven implementation and variation in on-ground quality continued to limit the overall impact.

Table 3.1.4: Indicator-Level Coverage Assessment

Indicator	Weight	Policies Addressing	Avg Score	Indicator Coverage %	SAW Contribution	Gap	Status
Water Efficiency	0.0909	4	0.70	70.5%	0.0641	0.0268	Moderate
Climate Resilience	0.0866	4	0.72	72.2%	0.0626	0.0240	Moderate
Food Security	0.0823	3	0.71	70.7%	0.0582	0.0241	Moderate
Soil Health	0.0779	1	0.75	75.0%	0.0584	0.0195	**Vulnerable**
Risk Management	0.0736	2	0.70	69.5%	0.0512	0.0224	Moderate
Credit & Finance	0.0693	2	0.69	69.0%	0.0478	0.0215	Moderate
Community Participation	0.0649	3	0.78	78.3%	0.0508	0.0141	Adequate
Knowledge Transfer	0.0606	3	0.84	84.0%	0.0509	0.0097	**Strong**
Technology Adoption	0.0563	4	0.70	70.0%	0.0394	0.0169	Moderate
Market Access	0.0519	2	0.66	66.0%	0.0343	0.0176	Weak
Gender Inclusion	0.0476	3	0.70	70.0%	0.0333	0.0143	Moderate
Biodiversity	0.0433	3	0.69	69.3%	0.0300	0.0133	Moderate
Farm Profitability	0.0390	3	0.72	72.3%	0.0282	0.0108	Moderate
Youth Engagement	0.0346	3	0.68	68.0%	0.0235	0.0111	Moderate
Land Degradation	0.0303	1	0.74	74.0%	0.0224	0.0079	**Vulnerable**
Ecosystem Services	0.0260	2	0.67	67.0%	0.0174	0.0086	Weak
Input Cost	0.0216	2	0.70	70.0%	0.0151	0.0065	Moderate
Social Safety Net	0.0173	2	0.73	73.0%	0.0126	0.0047	Moderate
Pollution Control	0.0130	2	0.64	64.5%	0.0084	0.0046	Weak
Cultural Preservation	0.0087	3	0.60	60.3%	0.0052	0.0035	Weak
Export Enhancement	0.0043	2	0.50	50.0%	0.0022	0.0022	Very Weak
TOTAL PORTFOLIO	**1.0000**				**0.7159**	**0.2841**	

Portfolio Coverage Achievement: 71.6%
Portfolio Gap: 28.41%

The overall portfolio coverage of 71.6 % reflected strong alignment between national agricultural policies and resilience priorities, even though implementation gaps remained evident. High achievement in knowledge dissemination demonstrated the comparative strength of Indian extension and advisory systems, while moderate results in ecological and financial dimensions revealed uneven progress in execution and adoption across regions. Although Soil health and land degradation received considerable policy attention through initiatives such as the Soil Health Card Scheme, the continued signs of deterioration in the field suggested that challenges lay more in implementation quality than in the absence of supportive policies. Lower outcomes in market connectivity, ecosystem restoration, and preservation of traditional knowledge indicated that resilience efforts were still concentrated within the production sphere rather than fully extending to social and ecological dimensions. Taken together, the results portrayed a policy landscape that was strategically well directed but still hindered by institutional capacity and coordination gaps that limited consistent local impact.

Table 3.1.5: Policy Function Scope Analysis

Policy	Indicators Addressed	Coverage Scope %	Scope Type	Primary Functions
Gramin Krishi Mausam Seva (GKMS)	14	66.7%	Broad	Weather advisory, climate adaptation, technology extension, farmer risk communication
National Initiative on Climate Resilient Agriculture (NICRA)	10	47.6%	Broad	Climate adaptation research, technology demonstration, community engagement
Pradhan Mustri Krishi Sinchayee Yojana (PMKSY)	7	33.3%	Moderate	Water management, irrigation infrastructure, farm income
National Food Security Mission (NFSM)	7	33.3%	Moderate	Food productivity, input subsidies, market linkages
National Action Plan on Climate Change (NAPCC)	5	23.8%	Moderate	Policy coordination, biodiversity framework, ecosystem services
Soil Health Card Scheme (SHC)	5	23.8%	Moderate	Soil testing, nutrient management, land protection
Agricultural Technology Management Agency (ATMA)	4	19.0%	Narrow	Extension delivery, community platforms, technology transfer
Pradhan Mustri Fasal Bima Yojana (PMFBY)	2	9.5%	Narrow	Crop insurance, risk mitigation

The analysis highlighted the distinct yet interconnected functions of the principal Indian agricultural programmes in strengthening climate resilience. Broad platforms such as GKMS and NICRA acted as the structural foundation for adaptive capacity, combining climate forecasting, technological outreach, early warning services, and community participation. Mid-range schemes like PMKSY and NFSM concentrated on irrigation efficiency, productivity improvement, and market connectivity, representing essential but largely input-oriented dimensions of resilience. Policies such as NAPCC and the Soil Health Card Scheme complemented these by embedding ecological priorities, linking soil health and environmental protection with economic performance. At the targeted end, initiatives including ATMA and PMFBY delivered focused support through extension services and risk transfer, bridging the information and protection gaps at farm level. This layered configuration reflected the complexity of field conditions, where farmers depended on multiple overlapping instruments rather than a single all-encompassing system. Collectively, the structure represented a logically coherent resilience framework in which broad policies established

national direction and specific interventions ensured local relevance. Enhancing inter-policy coordination and operational coherence remained vital to convert this functional diversity into tangible, place-based results.

Table 3.1.6: Indicator-Specific Gap Analysis and Portfolio Vulnerability

Indicator	Policies Addressing	Best Policy Score	Avg Score	Gap Severity	Vulnerability Assessment
Water Efficiency	4	0.78 (PMKSY)	0.70	High	Good diversification but average implementation quality limits coverage
Climate Resilience	4	0.84 (NICRA)	0.72	High	Multiple pathways but limited farmer adoption of recommendations
Food Security	3	0.81 (NFSM)	0.71	High	Production-focused without nutritional diversity integration
Soil Health	**1**	**0.75 (SHC)**	**0.75**	**Moderate**	**Critical: SHC dependency-if policy fails, entire function lost**
Risk Management	2	0.74 (PMFBY)	0.70	High	Limited integration with early-warning systems or adaptation strategies
Credit & Finance	2	0.70 (PMKSY)	0.69	Moderate	Insufficient agricultural credit availability and insurance penetration
Community Participation	3	0.82 (NICRA)	0.78	Low	Well-covered through diversified approaches
Knowledge Transfer	3	0.87 (ATMA)	0.84	**Low**	**Strong: Well-covered with good quality extension infrastructure**
Technology Adoption	4	0.79 (ATMA)	0.70	Moderate	Wide coverage but farmer uptake limited by affordability and demonstration effectiveness
Market Access	2	0.70 (NFSM)	0.66	Moderate	Limited value chain integration and farmer group strengthening
Gender Inclusion	3	0.76 (NICRA)	0.70	Moderate	Present in multiple policies but not systematically mainstreamed
Biodiversity	3	0.73 (NICRA)	0.69	Moderate	Addressed through climate adaptation frameworks without focused conservation policy
Farm Profitability	3	0.73 (PMKSY)	0.72	Low	Reasonably covered across three policies
Youth Engagement	3	0.69 (ATMA)	0.68	Moderate	Emerging focus but not mainstreamed in traditional extension
Land Degradation	**1**	**0.74 (SHC)**	**0.74**	**Low**	**Critical: SHC dependency-no significant standalone land protection policy**
Ecosystem Services	2	0.70 (NAPCC)	0.67	Low	Weakly addressed through adaptive management and conservation principles
Input Cost	2	0.70 (SHC)	0.70	Low	Input cost optimization addressed through soil management and weather advisory
Social Safety Net	2	0.73 (PMFBY)	0.73	Low	Reasonably covered through insurance and food security schemes
Pollution Control	2	0.67 (SHC)	0.64	Low	Weakly addressed; no comprehensive agricultural pollution management policy

Indicator	Policies Addressing	Best Policy Score	Avg Score	Gap Severity	Vulnerability Assessment
Cultural Preservation	3	0.62 (NICRA)	0.60	Low	Marginally addressed; indigenous knowledge not systematically documented
Export Enhancement	2	0.50 (NFSM, PMKSY)	0.50	Very Low	Minimal policy focus; export competitiveness not primary objective

The gap assessment indicated that although most indicators were reasonably well covered, structural weaknesses prevailed in areas that required greater integration and sustained implementation. Water efficiency and climate adaptation possessed strong institutional frameworks but encountered field-level barriers arising from limited technology uptake and behavioural resistance. Soil health and land management received significant policy support, yet consistent monitoring and farmer involvement were essential to convert these efforts into measurable improvement. Moderate deficiencies in risk management and access to credit continued to stem from restricted insurance penetration and unequal distribution of rural financial services. In contrast, knowledge dissemination and community participation performed strongly because of the maturity of institutional and extension systems. Taken together, the policy environment for resilience in India appeared comprehensive in structure, though its lasting effectiveness would depend on coordination across sectors, participatory engagement, and locally responsive implementation.

3.2 Bangladesh

Table 3.2.1: Indicator Ranking and Sustainability Weights

Rank	Indicator	Rank Sum Weight	Percentage
1	Water-use Efficiency & Conservation Measures	0.0909	9.09%
2	Climate Resilience & Adaptation Provisions	0.0866	8.66%
3	Risk Management & Insurance Coverage	0.0823	8.23%
4	Food Security & Nutrition Provisions	0.0779	7.79%
5	Soil Health & Nutrient Management Provisions	0.0736	7.36%
6	Credit & Financial Inclusion Mechanisms	0.0693	6.93%
7	Community Participation Mechanisms	0.0649	6.49%
8	Knowledge Transfer & Extension Services	0.0606	6.06%
9	Technology Adoption & Modernization Support	0.0563	5.63%
10	Market Access & Value Chain Development	0.0519	5.19%
11	Gender Inclusion & Women's Empowerment	0.0476	4.76%
12	Biodiversity Conservation Mechanisms	0.0433	4.33%
13	Farm Profitability & Income Enhancement Provisions	0.0390	3.90%
14	Youth Engagement & Capacity Building	0.0346	3.46%
15	Land Degradation Prevention Provisions	0.0303	3.03%
16	Ecosystem Services Protection Frameworks	0.0260	2.60%
17	Input Cost Management Strategies	0.0216	2.16%
18	Social Safety Net Integration	0.0173	1.73%
19	Pollution Control & Environmental Safety Standards	0.0130	1.30%
20	Cultural Preservation & Indigenous Knowledge Systems	0.0087	0.87%
21	Export Enhancement	0.0043	0.43%
TOTAL		1.0000	100.00%

The ranking reflected the concrete climate and coastal pressures shaping agriculture in Bangladesh. Water efficiency held the highest weight, signifying the serious effects of salinity intrusion caused by sea-level rise, higher tidal amplitudes, and freshwater scarcity that together impact more than half of the country's cultivated land. Climate resilience, with a weight of 8.66 %, ranked next, demonstrating the existential risks from cyclones, tidal surges, and unpredictable monsoons that defined the deltaic farming environment. Risk

management followed at 8.23 %, emphasising the urgent need for insurance and preparedness systems in regions where cyclones occured every three to four years, often resulting in near-total crop destruction and prolonged recovery periods. Food security (7.79 %) and soil health (7.36 %) came next, reflecting sustained pressure on productivity due to salinity-driven degradation and nutritional vulnerability in coastal settlements. Credit access (6.93 %) and community participation (6.49 %) followed, pointing to institutional gaps in adaptive capacity and participatory planning. The lowest-weighted indicator, export enhancement (0.43 %), appropriately illustrated that current policy efforts prioritised domestic food and livelihood security over global market competitiveness in climate-sensitive coastal regions.

Table 3.2.2: Indicator-Policy Mapping Matrix

Indicator	Policies Providing Coverage
Water-use Efficiency & Conservation Measures	National Adaptation Plan Bangladesh (NAPB); Bangladesh Delta Plan 2100 (BDP); National Agriculture Policy 2018 (NAP); Climate-Smart Agriculture Investment Plan (CSAIP); National Water Management Plan (NWMP)
Climate Resilience & Adaptation Provisions	NAPB; BDP; NAP; CSAIP; NAEP; Coastal Zone Policy (CZP)
Risk Management & Insurance Coverage	NAPB; BDP; CSAIP
Food Security & Nutrition Provisions	NAPB; BDP; NAP; National Food and Nutrition Security Policy (NFNSP); CSAIP; CZP
Soil Health & Nutrient Management Provisions	BDP; NAP; NFNSP; CSAIP; NWMP; CZP; NAPB
Credit & Financial Inclusion Mechanisms	NAP; NFNSP
Community Participation Mechanisms	NAPB; BDP; CSAIP; NAEP; NWMP; CZP
Knowledge Transfer & Extension Services	NAPB; NFNSP; CSAIP; NAEP
Technology Adoption & Modernization Support	NAPB; BDP; NAP; CSAIP; NAEP
Market Access & Value Chain Development	BDP; NAP; NFNSP; NAEP
Gender Inclusion & Women's Empowerment	NAPB; NAP; NFNSP; NAEP; CZP
Biodiversity Conservation Mechanisms	NAPB; BDP; CSAIP; CZP
Farm Profitability & Income Enhancement Provisions	BDP; NAP; NFNSP
Youth Engagement & Capacity Building	NAPB; CSAIP; NAEP
Land Degradation Prevention Provisions	NAPB; BDP; NAP; CZP
Ecosystem Services Protection Frameworks	NAPB; BDP; CSAIP; NWMP; CZP
Input Cost Management Strategies	NAPB; BDP; NAP
Social Safety Net Integration	BDP; NFNSP
Pollution Control & Environmental Safety Standards	NAPB; BDP; NAP; CZP
Cultural Preservation & Indigenous Knowledge Systems	NAPB; CSAIP; NAEP
Export Enhancement	NAP

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The mapping matrix showed that agricultural resilience in Bangladesh was guided by eight principal programmes that collectively addressed interconnected thematic areas. Most indicators were supported by multiple policies, reflecting deliberate diversification intended to minimise dependence on individual schemes. The National Adaptation Plan and the Bangladesh Delta Plan acted as overarching coordination frameworks, each encompassing fifteen indicators and serving as the central integrative mechanisms. More focused instruments such as the National Agricultural Extension Policy and the National Water Management Plan contributed specialised roles, particularly in technology dissemination and resource management. However, some weaknesses were evident: export enhancement relied on a single policy under the National Adaptation Plan, while credit and social safety nets were supported by only two policies, exposing structural shortfalls in financial inclusion and social protection. Risk management, which held the third rank in importance, was addressed by just three instruments—the National Adaptation Plan of Bangladesh, the Bangladesh Delta Plan, and the Climate Smart Agriculture Investment Plan—indicating a potential area of vulnerability despite its strategic significance.

Table 3.2.3: Policy-Indicator Assessment Matrix

Indicator	NAPB	BDP	NAP	NFNSP	CSAIP	NAEP	NWMP	CZP
Water-use Efficiency	0.67	0.74	0.67	-	0.74	-	0.68	-
Climate Resilience	0.72	0.79	0.62	-	0.74	0.70	-	0.64
Risk Management	0.57	0.68	-	-	0.67	-	-	-
Food Security	0.68	0.70	0.66	0.76	0.73	-	-	0.59
Soil Health	0.62	0.71	0.64	0.69	0.70	-	0.62	0.59
Credit & Finance	-	-	0.59	0.64	-	-	-	-
Community Participation	0.68	0.72	-	-	0.71	0.76	0.64	0.63
Knowledge Transfer	0.64	-	-	0.66	0.72	0.82	-	-
Technology Adoption	0.66	0.68	0.61	-	0.73	0.76	-	-
Market Access	-	0.71	0.64	0.66	-	0.73	-	-
Gender Inclusion	0.69	-	0.64	0.68	-	0.73	-	0.56
Biodiversity	0.66	0.66	-	-	0.66	-	-	0.62
Farm Profitability	-	0.68	0.63	0.68	-	-	-	-
Youth Engagement	0.63	-	-	-	0.63	0.69	-	-
Land Degradation	0.63	0.68	0.63	-	-	-	-	0.59
Ecosystem Services	0.65	0.68	-	-	0.66	-	0.59	0.63
Input Cost	0.67	0.66	0.61	-	-	-	-	-
Social Safety Net	-	0.65	-	0.63	-	-	-	-
Pollution Control	0.64	0.63	0.64	-	-	-	-	0.53
Cultural Preservation	0.62	-	-	-	0.62	0.66	-	-
Export Enhancement	-	-	0.50	-	-	-	-	-

Note: - indicates that the policy did not address the indicator. All scores were on a 0-1 scale, calculated as the average of Provision Level, Implementation Level, and Implementation Quality dimensions.

The assessment matrix indicated clear variation in how different sustainability indicators in Bangladesh were addressed across policies. Indicators linked to knowledge transfer, averaging 0.82, and community participation, at 0.76, achieved the highest performance, suggesting that systems for farmer training and participatory engagement were relatively well established. Climate resilience, ranging from 0.70 to 0.79, and biodiversity conservation, from 0.62 to 0.66, also demonstrated reasonable coverage, indicating growing integration of adaptive approaches into national frameworks. In contrast, export enhancement (0.50), credit and finance (0.59 to 0.64), and risk management (0.57 to 0.68) recorded lower scores, revealing persistent structural and implementation barriers. Risk management, now ranked third due to the high frequency and severity of cyclones, showed only moderate performance, with an average score of 0.64 across three policies, indicating a significant vulnerability that required targeted policy attention. Moderate results for soil health

and financial inclusion reflected continuing gaps in field-level implementation and limited access to rural finance.

Table 3.2.4: Indicator-Level Coverage Assessment

Indicator	Weight	Policies Addressing	Avg Score	Indicator Coverage %	SAW Contribution	Gap	Status
Water Efficiency	0.0909	5	0.700	70.0%	0.0636	0.0273	Adequate
Climate Resilience	0.0866	6	0.702	70.2%	0.0608	0.0258	Adequate
Risk Management	0.0823	3	0.640	64.0%	0.0527	0.0296	Weak
Food Security	0.0779	6	0.687	68.7%	0.0535	0.0244	Moderate
Soil Health	0.0736	7	0.653	65.3%	0.0481	0.0255	Moderate
Credit & Finance	0.0693	2	0.615	61.5%	0.0426	0.0267	Weak
Community Participation	0.0649	6	0.690	69.0%	0.0448	0.0201	Moderate
Knowledge Transfer	0.0606	4	0.710	71.0%	0.0430	0.0176	Adequate
Technology Adoption	0.0563	5	0.688	68.8%	0.0387	0.0176	Moderate
Market Access	0.0519	4	0.685	68.5%	0.0356	0.0163	Moderate
Gender Inclusion	0.0476	5	0.660	66.0%	0.0314	0.0162	Moderate
Biodiversity	0.0433	4	0.650	65.0%	0.0281	0.0152	Moderate
Farm Profitability	0.0390	3	0.663	66.3%	0.0259	0.0131	Moderate
Youth Engagement	0.0346	3	0.650	65.0%	0.0225	0.0121	Moderate
Land Degradation	0.0303	4	0.632	63.2%	0.0192	0.0111	Weak
Ecosystem Services	0.0260	5	0.642	64.2%	0.0167	0.0093	Weak
Input Cost	0.0216	3	0.647	64.7%	0.0140	0.0076	Weak
Social Safety Net	0.0173	2	0.640	64.0%	0.0111	0.0062	Weak
Pollution Control	0.0130	4	0.610	61.0%	0.0079	0.0051	Weak
Cultural Preservation	0.0087	3	0.633	63.3%	0.0055	0.0032	Weak
Export Enhancement	0.0043	1	0.500	50.0%	0.0022	0.0022	Vulnerable
TOTAL PORTFOLIO	1.0000				0.6677	0.3323	

Portfolio Coverage Achievement: 66.8%

Portfolio Gap: 33.2%

The agricultural policy framework of Bangladesh achieved an overall portfolio coverage of 66.8 % across the evaluated climate-resilience indicators. High performance in knowledge transfer, with 71.0 % coverage, demonstrated the strength of the country extension and advisory systems, supported by the National Agricultural Extension Policy through farmer field schools and participatory demonstrations. Water efficiency and climate resilience, at 70.0 and 70.2 % respectively, reflected effective alignment with national salinity management and cyclone preparedness objectives, though gaps persisted in the local adoption of coastal technologies. Risk management, despite being a top-ranked priority, remained weak at 64.0 %

coverage, as only three policies addressed cyclone risk and agricultural insurance, with insurance access in coastal farming areas remaining below 2 %. Food security and soil health achieved moderate coverage but required stronger on-ground monitoring to tackle salinity-related degradation and nutrition challenges. Credit and financial inclusion were notably underperforming, with only 61.5 % coverage and minimal formal credit access for smallholders. Overall, while the coastal agriculture policy framework of Bangladesh was well aligned with resilience goals, its effectiveness was constrained by implementation capacity, coordination challenges, and limited translation of policy intent into field-level outcomes.

Table 3.2.5: Policy Function Scope Analysis

Policy	Indicators Addressed	Coverage Scope %	Scope Type	Primary Functions
National Adaptation Plan Bangladesh (NAPB)	15	71.4%	**Broad**	Adaptation planning, ecosystem-based solutions, resilience pathways, capacity building, livelihood protection
Bangladesh Delta Plan 2100 (BDP)	15	71.4%	**Broad**	Water and land security, integrated delta management, infrastructure resilience, livelihood development, ecosystem health
National Agriculture Policy 2018 (NAP)	13	61.9%	**Broad**	Agricultural production, input supply, technology transfer, market linkages, climate-smart practices, gender inclusion
Climate-Smart Agriculture Investment Plan (CSAIP)	12	57.1%	**Broad**	Climate-smart technology investment, productivity and resilience coupling, adaptation financing, technology demonstration
Coastal Zone Policy (CZP)	9	42.9%	**Moderate**	Coastal zone integrated management, mangrove conservation, livelihood diversification, ecosystem protection, community engagement
National Food & Nutrition Security Policy (NFNSP)	8	38.1%	**Moderate**	Food security assurance, nutritional status, fortification, vulnerable group support, value chain strengthening
National Agricultural Extension Policy (NAEP)	8	38.1%	**Moderate**	Extension delivery, farmer platforms, technology transfer, advisory services, community-based learning
National Water Management Plan (NWMP)	5	23.8%	**Narrow**	Water resource allocation, irrigation infrastructure, drainage management, polder sluice operation, water efficiency

The scope analysis highlighted the distinct yet interconnected roles of major agricultural programmes in Bangladesh that collectively supported climate resilience. Broad-based initiatives such as the National Adaptation Plan of Bangladesh and the Bangladesh Delta Plan provided integrated functions combining climate information, adaptation research, and community participation, forming the backbone of national adaptive capacity. Mid-range programmes including the National Adaptation Plan, Climate Smart Agriculture Investment Plan, Coastal Zone Policy, National Food and Nutrition Security Policy, and National Agricultural Extension Policy concentrated on sector-specific themes such as agriculture, food systems, and coastal management, offering targeted but essential coverage. Narrow-scope schemes like the National Water Management Plan addressed specialised areas of resource management. This layered arrangement reflected field realities in which farmers depended on multiple complementary interventions rather than a single framework. Sustained success required stronger convergence mechanisms to convert this functional diversity into cohesive, locally relevant coastal resilience outcomes, with particular emphasis on reinforcing risk management across policy domains in line with its elevated third-rank priority.

Table 3.2.6: Indicator-Specific Gap Analysis and Portfolio Vulnerability

Indicator	Policies Addressing	Best Policy Score	Avg Score	Gap Severity	Vulnerability Assessment
Water Efficiency	5	0.74 (CSAIP, BDP)	0.70	Moderate	Reasonably diversified; coastal salinity complexity adds implementation bottleneck
Climate Resilience	6	0.79 (BDP)	0.70	Moderate	Multiple pathways but farmer adoption of climate advisories remains moderate
Risk Management	**3**	**0.68 (BDP)**	**0.64**	**HIGH**	**Critical: Only 3 policies address Rank 3 priority; cyclone insurance penetration <2%; weak preparedness despite elevated ranking**
Food Security	6	0.76 (NFNSP)	0.69	Moderate	Comprehensive coverage but production-focused without full nutritional integration
Soil Health	7	0.71 (BDP)	0.65	Moderate	Multiple policies but field-level salinity degradation persists; monitoring weak
Credit & Finance	2	0.64 (NFNSP)	0.62	HIGH	Critically limited: Agricultural credit remains inaccessible to smallholders
Community Participation	6	0.76 (NAEP)	0.69	Moderate	Well-covered; implementation variable across coastal districts
Knowledge Transfer	4	0.82 (NAEP)	0.71	LOW	Strong: Well-established extension infrastructure
Technology Adoption	5	0.76 (NAEP, CSAIP)	0.69	Low	Reasonably diversified; adoption constrained by capital access
Market Access	4	0.73 (NAEP)	0.69	Low	Moderate coverage; coastal value chain development nascent
Gender Inclusion	5	0.73 (NAEP)	0.66	Low	Multiple pathways but limited transformative impact on women's livelihoods
Biodiversity	4	0.66 (NAPB, BDP, CSAIP)	0.65	Low	Multiple pathways but conservation focus limited in coastal zones
Farm Profitability	3	0.68 (BDP)	0.66	Low	Addressed through price support and input subsidies
Youth Engagement	3	0.69 (NAEP)	0.65	Low	Limited policy focus; emerging through extension programmes
Land Degradation	4	0.68 (BDP)	0.63	Low	Multiple pathways but salinity-induced degradation weakly addressed
Ecosystem Services	5	0.68 (BDP, CSAIP)	0.64	Low	Well-mapped in policy but operational mechanisms underfunded
Input Cost	3	0.67 (NAPB)	0.65	Low	Addressed through subsidy mechanisms; sustainability concerns
Social Safety Net	2	0.65 (BDP)	0.64	Low	Limited integration with agricultural productivity pathways
Pollution Control	4	0.64 (NAP)	0.61	Low	Weakly addressed; coastal agricultural pollution lacks specific regulations
Cultural Preservation	3	0.66 (NAEP)	0.63	Low	Marginally addressed; indigenous coastal knowledge undocumented
Export Enhancement	1	0.50 (NAP)	0.50	HIGH	Critical: NAP-only dependency; if policy fails, function completely lost

The gap analysis showed that although most indicators were moderately well addressed, critical weaknesses persisted in areas that required stronger integration and sustained implementation. Risk management represented the most significant gap, ranked third with a weight of 8.23 %, yet achieving only 64.0 %

coverage through three policies with limited delivery strength. Insurance coverage for cyclones remained below 2 % in coastal regions despite the high level of exposure to catastrophic losses, while early warning systems were insufficiently linked to agricultural planning and post-disaster recovery mechanisms lacked adequate financial support. This formed the most prominent mismatch between policy intent and implementation. Water efficiency and climate adaptation had strong institutional support but continued to face challenges in technology adoption and location-specific application. Credit and finance displayed the second-highest gap severity, with restricted access to rural credit constraining the ability of farmers to invest in adaptive technologies and risk protection tools. Export enhancement showed extreme vulnerability due to single-policy dependence under the National Adaptation Plan, performing at only 0.50, although this weakness had limited influence because of its low weight of 0.43 %. In contrast, knowledge dissemination and community participation achieved solid performance, benefiting from well-developed extension networks and participatory mechanisms. Overall, the coastal resilience policy environment of Bangladesh was comprehensive in conception, but its long-term success depended on strengthening risk management systems in line with their high priority and ensuring coordinated, inclusive, and context-responsive implementation.

3.3 Pakistan

Table 3.3.1: Indicator Ranking and Sustainability Weights

Rank	Indicator	Rank Sum Weight	Percentage
1	Water-use Efficiency & Conservation Measures	0.0909	9.09%
2	Climate Resilience & Adaptation Provisions	0.0866	8.66%
3	Food Security & Nutrition Provisions	0.0823	8.23%
4	Soil Health & Nutrient Management Provisions	0.0779	7.79%
5	Risk Management & Insurance Coverage	0.0736	7.36%
6	Credit & Financial Inclusion Mechanisms	0.0693	6.93%
7	Community Participation Mechanisms	0.0649	6.49%
8	Knowledge Transfer & Extension Services	0.0606	6.06%
9	Technology Adoption & Modernization Support	0.0563	5.63%
10	Market Access & Value Chain Development	0.0519	5.19%
11	Gender Inclusion & Women's Empowerment	0.0476	4.76%
12	Biodiversity Conservation Mechanisms	0.0433	4.33%
13	Farm Profitability & Income Enhancement Provisions	0.0390	3.90%
14	Youth Engagement & Capacity Building	0.0346	3.46%
15	Land Degradation Prevention Provisions	0.0303	3.03%
16	Ecosystem Services Protection Frameworks	0.0260	2.60%
17	Input Cost Management Strategies	0.0216	2.16%
18	Social Safety Net Integration	0.0173	1.73%
19	Pollution Control & Environmental Safety Standards	0.0130	1.30%
20	Cultural Preservation & Indigenous Knowledge Systems	0.0087	0.87%
21	Export Enhancement	0.0043	0.43%
TOTAL		**1.0000**	**100.00%**

The ranking captured the major climatic and agricultural pressures confronting Pakistan. Water efficiency held the highest weight, reflecting the country's severe scarcity, with per capita availability of only 908 cubic metres, which was well below the international water stress threshold of 1,000 cubic metres and placed Pakistan among the most water-limited nations globally. The Indus Basin Irrigation System, which supported nearly 90 % of agricultural production, suffered from declining storage capacity, rapid groundwater depletion, and an expected 32 % water shortfall by 2025 that threatened about 70 million tons

of food output. Climate resilience, weighted at 8.66 %, ranked second, emphasising Pakistan's high position on the global climate risk index and the projected 5.3°C temperature increase that would intensify heat-induced yield losses of 30 % in cotton and 15 % in maize. Food security, with a weight of 8.23 %, ranked third, underscoring population growth expected to increase tenfold by 2100 and the heavy reliance of 42.3 % of the labour force on agriculture. Soil health (7.79 %) and risk management (7.36 %) followed, encompassing waterlogging, salinisation, and the alternating cycles of drought and flood that continued to affect wheat production, the main staple crop. Indicators with lower weights, such as export enhancement (0.43 %), accurately represented the national emphasis on domestic food security rather than international market competitiveness within a water-scarce, climate-stressed environment.

Table 3.3.2: Indicator-Policy Mapping Matrix

Indicator	Policies Providing Coverage
Water-use Efficiency & Conservation Measures	National Climate Change Policy (NCCP); National Food Security Policy (NFSP); National Adaptation Plan (NAP); National Water Policy (NWP); Sindh Agriculture Policy (SAP)
Climate Resilience & Adaptation Provisions	NCCP; NFSP; NAP; NWP; Ten Billion Tree Tsunami Programme (TBTTP); SAP; PM Clean & Green Pakistan Initiative (PCGPI)
Food Security & Nutrition Provisions	NCCP; NFSP; NAP; SAP; Ehsaas Social Safety Net Programme (EHSAAS)
Soil Health & Nutrient Management Provisions	NCCP; NFSP; NAP; NWP; TBTTP; SAP; PCGPI
Risk Management & Insurance Coverage	NCCP; NAP
Credit & Financial Inclusion Mechanisms	NFSP; SAP; EHSAAS
Community Participation Mechanisms	NCCP; NFSP; NAP; NWP; TBTTP; PCGPI
Knowledge Transfer & Extension Services	NFSP; NAP; TBTTP; SAP
Technology Adoption & Modernization Support	NCCP; NFSP; NAP; TBTTP; SAP
Market Access & Value Chain Development	NFSP; SAP
Gender Inclusion & Women's Empowerment	NCCP; NFSP; NAP; SAP; EHSAAS
Biodiversity Conservation Mechanisms	NCCP; NAP; TBTTP; PCGPI
Farm Profitability & Income Enhancement Provisions	NFSP; SAP
Youth Engagement & Capacity Building	NFSP; NAP; PCGPI
Land Degradation Prevention Provisions	NCCP; NAP; TBTTP; PCGPI
Ecosystem Services Protection Frameworks	NCCP; NAP; NWP; TBTTP; PCGPI
Input Cost Management Strategies	NFSP; NAP; SAP
Social Safety Net Integration	NFSP; EHSAAS
Pollution Control & Environmental Safety Standards	NCCP; NAP; TBTTP; PCGPI
Cultural Preservation & Indigenous Knowledge Systems	NAP
Export Enhancement	NFSP; SAP

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The mapping matrix indicated that agricultural resilience in Pakistan was supported by eight principal programmes that addressed multiple, overlapping thematic areas. Most indicators were linked to several policies, although the average of 3.86 policies per indicator was lower than the corresponding averages for Bangladesh and India, suggesting a more concentrated policy framework. The National Adaptation Plan and the National Food Security Policy acted as comprehensive coordination mechanisms, covering sixteen and fifteen indicators respectively, or about three-quarters of the total scope. The National Climate Change Policy 2012 and the Sindh Agriculture Policy 2018–2030 each covered twelve indicators, providing broad sectoral alignment. Targeted schemes such as the Ten Billion Tree Tsunami Programme and the Prime Minister Clean and Green Pakistan Initiative contributed specialised environmental and climate functions. However, gaps were evident in policy diversification. Risk management was addressed by only two policies- the National Climate Change Policy and the National Adaptation Plan- with an average score of 0.585, creating a weakness despite its high ranking. Market access also depended on two policies, while cultural preservation was covered by a single policy under the National Adaptation Plan with a performance level of 0.55. Credit and financial inclusion, although linked to three policies, displayed limited effectiveness with an average score of 0.567, reflecting structural barriers in financial access. The Sindh Agriculture Policy added meaningful value across twelve indicators, confirming the importance of including provincial-level frameworks within the national governance structure.

Table 3.3.3: Policy-Indicator Assessment Matrix

Indicator	NCCP	NFSP	NAP	NWP	TBTTP	SAP	EHSAAS	PCGPI
Water-use Efficiency	0.65	0.68	0.70	0.72	-	0.66	-	-
Climate Resilience	0.75	0.68	0.78	0.62	0.65	0.64	-	0.60
Food Security	0.70	0.80	0.72	-	-	0.68	0.58	-
Soil Health	0.63	0.65	0.66	0.60	0.62	0.64	-	0.58
Risk Management	0.55	-	0.62	-	-	-	-	-
Credit & Finance	-	0.60	-	-	-	0.58	0.52	-
Community Participation	0.68	0.70	0.72	0.65	0.66	-	-	0.62
Knowledge Transfer	-	0.75	0.68	-	0.70	0.72	-	-
Technology Adoption	0.62	0.68	0.70	-	0.65	0.66	-	-
Market Access	-	0.72	-	-	-	0.68	-	-
Gender Inclusion	0.58	0.65	0.68	-	-	0.62	0.55	-
Biodiversity	0.68	-	0.70	-	0.72	-	-	0.65
Farm Profitability	-	0.65	-	-	-	0.62	-	-
Youth Engagement	-	0.60	0.62	-	-	-	-	0.58
Land Degradation	0.62	-	0.66	-	0.64	-	-	0.60
Ecosystem Services	0.65	-	0.68	0.58	0.70	-	-	0.62
Input Cost	-	0.58	0.60	-	-	0.56	-	-
Social Safety Net	-	0.62	-	-	-	-	0.68	-
Pollution Control	0.58	-	0.62	-	0.60	-	-	0.65
Cultural Preservation	-	-	0.55	-	-	-	-	-
Export Enhancement	-	0.52	-	-	-	0.50	-	-

Note: - indicates that the policy did not address the indicator. All scores were on a 0-1 scale, calculated as the average of Provision Level, Implementation Level, and Implementation Quality dimensions.

The assessment matrix indicated substantial variation in how Pakistan addressed sustainability indicators across policies. Knowledge transfer, with an average score of 0.71, and market access, with 0.70, recorded the strongest results, although market access remained vulnerable due to dependence on only two policies. The National Food Security Policy 2018 performed consistently well across fifteen indicators with scores between 0.68 and 0.80, suggesting comprehensive design and moderate implementation depth, while the

National Adaptation Plan achieved similar strength with scores ranging from 0.62 to 0.78 across sixteen indicators, reflecting firm prioritisation of climate adaptation. Several domains, however, continued to perform weakly despite broad coverage. Risk management averaged only 0.585, with scores of 0.55 under the National Climate Change Policy and 0.62 under the National Adaptation Plan, highlighting continuing challenges in agricultural insurance and drought preparedness. Credit and finance displayed critically low performance at 0.567 despite coverage under three policies, confirming that barriers to rural finance access persisted. Soil health, covered by seven policies, achieved an average of 0.626, showing that issues such as salinisation, waterlogging, and degradation remained unresolved. Export enhancement registered the lowest results, between 0.50 and 0.52, while cultural preservation depended on a single policy at 0.55, and input cost management remained weak at 0.56 to 0.60 despite fertiliser subsidy programmes. Overall, the findings suggested that informational and institutional capacities had advanced moderately, whereas economic and environmental dimensions of sustainability required more intensive and coordinated intervention.

Table 3.3.4: Indicator-Level Coverage Assessment

Indicator	Weight	Policies Addressing	Avg Score	Indicator Coverage %	SAW Contribution	Gap	Status
Water Efficiency	0.0909	5	0.682	68.2%	0.0620	0.0289	Moderate
Climate Resilience	0.0866	7	0.674	67.4%	0.0584	0.0282	Moderate
Food Security	0.0823	5	0.696	69.6%	0.0573	0.0250	Moderate
Soil Health	0.0779	7	0.626	62.6%	0.0487	0.0292	Weak
Risk Management	0.0736	2	0.585	58.5%	0.0431	0.0305	Weak
Credit & Finance	0.0693	3	0.567	56.7%	0.0393	0.0300	Weak
Community Participation	0.0649	6	0.672	67.2%	0.0436	0.0213	Moderate
Knowledge Transfer	0.0606	4	0.712	71.2%	0.0432	0.0174	**Adequate**
Technology Adoption	0.0563	5	0.662	66.2%	0.0373	0.0190	Moderate
Market Access	0.0519	2	0.700	70.0%	0.0363	0.0156	Adequate
Gender Inclusion	0.0476	5	0.616	61.6%	0.0293	0.0183	Weak
Biodiversity	0.0433	4	0.687	68.7%	0.0298	0.0135	Moderate
Farm Profitability	0.0390	2	0.635	63.5%	0.0248	0.0142	Weak
Youth Engagement	0.0346	3	0.600	60.0%	0.0208	0.0138	Weak
Land Degradation	0.0303	4	0.630	63.0%	0.0191	0.0112	Weak
Ecosystem Services	0.0260	5	0.646	64.6%	0.0168	0.0092	Weak
Input Cost	0.0216	3	0.580	58.0%	0.0125	0.0091	Weak
Social Safety Net	0.0173	2	0.650	65.0%	0.0112	0.0061	Moderate
Pollution Control	0.0130	4	0.612	61.2%	0.0080	0.0050	Weak
Cultural Preservation	0.0087	1	0.550	55.0%	0.0048	0.0039	**Vulnerable**
Export Enhancement	0.0043	2	0.510	51.0%	0.0022	0.0021	Weak
TOTAL PORTFOLIO	**1.0000**				**0.6483**	**0.3517**	

South Asian Forum for Environment (SAFE)

Portfolio Coverage Achievement: 64.8%

Portfolio Gap: 35.2%

The agricultural policy framework of Pakistan achieved an overall coverage of 64.8 per cent across targeted climate-resilience indicators, which was 6.8 percentage points lower than the India baseline and 2.1 points below the Bangladesh analysis. This performance gap reflected severe implementation constraints, weak federal-provincial coordination following the Eighteenth Constitutional Amendment, and the scale of Pakistan's water crisis exceeding the institutional response capacity. Knowledge transfer showed the strongest performance at 71.2 per cent coverage, supported by the National Food Security Policy, the National Adaptation Plan, the Ten Billion Trees Tsunami Programme, and the Sindh Agriculture Policy through farmer training and demonstration programmes. Market access achieved 70.0 per cent coverage, yet remained structurally vulnerable due to dependence on only two policies. Water efficiency and food security, at 68.2 and 69.6 per cent respectively, demonstrated moderate results but faced persistent on-ground difficulties from irrigation inefficiencies, groundwater depletion, and population-driven food pressures. Major weaknesses appeared in risk management, which achieved only 58.5 per cent coverage under the National Climate Change Policy and the National Adaptation Plan, and in credit and finance, which reached 56.7 per cent coverage across three policies, constrained by limited rural banking infrastructure and high collateral requirements. Soil health attained 62.6 per cent despite attention from seven policies, indicating continuing salinisation, waterlogging, and nutrient depletion. Overall, the policy architecture was well designed but remained hindered by inadequate capacity, coordination failures, and limited translation of policy intent into practical outcomes, particularly for water management, risk protection, and rural finance functions essential for resilience.

Table 3.3.5: Policy Function Scope Analysis

Policy	Indicators Addressed	Coverage Scope %	Scope Type	Primary Functions
National Adaptation Plan (NAP)	16	76.2%	**Broad**	Climate risk integration, adaptation planning, ecosystem-based solutions, capacity building, resilience pathways
National Food Security Policy (NFSP)	15	71.4%	**Broad**	Food production, nutrition security, value chain development, market access, farmer income enhancement
National Climate Change Policy (NCCP)	12	57.1%	**Broad**	Climate mitigation and adaptation, biodiversity conservation, disaster risk reduction, environmental governance
Sindh Agriculture Policy (SAP)	12	57.1%	**Broad**	Provincial agricultural development, water management, technology adoption, market linkages, credit access
Ten Billion Trees Tsunami Programme (TBTTP)	9	42.9%	**Moderate**	Tree-crop integration, soil conservation, biodiversity enhancement, ecosystem services, community forestry
PM Clean & Green Pakistan Initiative (PCIIP)	8	38.1%	**Moderate**	Environmental protection, pollution control, green infrastructure, climate mitigation, youth engagement
National Water Policy (NWP)	5	23.8%	**Narrow**	Water resource allocation, irrigation efficiency, groundwater management, water conservation
Ehsaas Social Safety Net (EHSAAS)	4	19.0%	**Narrow**	Poverty reduction, social protection, targeted cash transfers, gender empowerment, food security for vulnerable

The scope analysis emphasised the distinct yet connected roles of major agricultural programmes in Pakistan that supported climate resilience under conditions of severe water scarcity and rising heat stress. Broad-based initiatives such as the National Adaptation Plan and the National Food Security Policy provided integrated functions covering climate information, water planning, agricultural extension, and social protection, forming the foundation of national adaptive capacity. The National Climate Change Policy 2012 and the Sindh Agriculture Policy 2018–2030, both with moderate coverage, reinforced the linkages between climate and agriculture and highlighted the importance of provincial engagement in agricultural governance after the Eighteenth Constitutional Amendment. Mid-range programmes such as the Ten Billion Trees Tsunami Programme and the Prime Minister Clean and Green Pakistan Initiative focused on environmental priorities including tree–crop integration, ecosystem restoration, and pollution control, offering specialised but essential support. Narrower schemes such as the National Water Policy and the Ehsaas Social Safety Net Programme addressed resource and welfare dimensions but remained limited in scope, showing weak integration between water management, agriculture, and climate adaptation. This tiered policy framework reflected the complexity of the institutional landscape in Pakistan, where farmers interacted with multiple overlapping federal and provincial initiatives. However, limited policy diversification, gaps in high-priority areas such as risk management and finance, and continuing separation between water and agricultural planning constrained coherence. Future progress depended on stronger coordination mechanisms to integrate these policies into unified, locally relevant resilience outcomes.

Table 3.3.6: Indicator-Specific Gap Analysis and Portfolio Vulnerability

Indicator	Policies Addressing	Best Policy Score	Avg Score	Gap Severity	Vulnerability Assessment
Water Efficiency	5	0.72 (NWP)	0.68	Moderate	Reasonably diversified but faces severe groundwater depletion; implementation constrained
Climate Resilience	7	0.78 (NAP)	0.67	Moderate	Multiple pathways but heat stress and flood impacts exceed policy response capacity
Food Security	5	0.80 (NFSP)	0.70	Moderate	Comprehensive coverage but population pressure threatens production adequacy
Soil Health	7	0.66 (NAP)	0.63	High	**CRITICAL: Despite 7 policies, waterlogging (4.2M ha) and salinization (6.8M ha) persist; highest absolute gap 0.0292**
Risk Management	**2**	0.62 (NAP)	0.59	High	**CRITICAL: Only 2 policies; insurance penetration <5%; drought preparedness inadequate despite Rank 5 priority**
Credit & Finance	3	0.60 (NFSP)	0.57	High	**CRITICAL: Lowest coverage 56.7%; collateral barriers block smallholder access; structural finance gap**
Community Participation	6	0.72 (NAP)	0.67	Moderate	Well-covered; implementation variable across provinces
Knowledge Transfer	4	0.75 (NFSP)	0.71	Low	**STRONG: Adequate extension infrastructure; farmer field schools effective**
Technology Adoption	5	0.70 (NAP)	0.66	Low	Reasonably diversified; adoption constrained by credit access

Market Access	**2**	0.72 (NFSP)	0.70	Moderate	Adequate performance but 2-policy dependency creates vulnerability
Gender Inclusion	5	0.68 (NAP)	0.62	Moderate	Multiple pathways but limited transformative impact on women farmers
Biodiversity	4	0.72 (TBTTP)	0.69	Low	Moderate coverage; agroforestry programs show promise
Farm Profitability	**2**	0.65 (NFSP)	0.64	Low	Limited policy focus; 2-policy dependency
Youth Engagement	3	0.62 (NAP)	0.60	Low	Weak performance; limited youth-specific agricultural programs
Land Degradation	4	0.66 (NAP)	0.63	Low	Multiple pathways but deforestation and erosion continue
Ecosystem Services	5	0.70 (TBTTP)	0.65	Low	Well-mapped but operational mechanisms underfunded
Input Cost	3	0.60 (NAP)	0.58	Moderate	Weak performance; fertilizer subsidies inefficient and fiscally unsustainable
Social Safety Net	2	0.68 (EHSAAS)	0.65	Low	Limited agricultural productivity integration; EHSAAS performs well
Pollution Control	4	0.65 (PCIIP)	0.61	Low	Weakly addressed; agricultural pollution lacks specific regulations
Cultural Preservation	**1**	0.55 (NAP)	0.55	Moderate	**VULNERABLE: Single-policy dependency; indigenous knowledge undocumented**
Export Enhancement	2	0.52 (NFSP)	0.51	Low	Weak performance; appropriately low priority given domestic needs

The gap analysis indicated that although most indicators achieved moderate coverage through multiple policy pathways, serious weaknesses persisted in the domains that defined Pakistan's core agricultural constraints. Soil health represented the most significant operational shortcoming, with seven policies providing coverage yet attaining only 62.6 per cent and recording the largest overall gap. Problems such as waterlogging, salinisation, and nutrient depletion continued to affect millions of hectares across the Indus Basin despite numerous provisions for water management, agricultural development, and environmental protection. Weak soil testing infrastructure, poor awareness of salinity management, and underfunded drainage rehabilitation collectively prevented effective implementation. Risk management showed the second-highest gap severity, achieving only 58.5 per cent coverage across two policies, while insurance penetration remained below 5 per cent and drought early warning systems failed to connect with extension services. Recovery mechanisms after floods or droughts relied on ad hoc arrangements rather than formal structures, leaving farmers without reliable safety nets. Credit and financial inclusion, with 56.7 per cent coverage under three policies, faced structural barriers arising from collateral requirements, limited rural banking access, and high microfinance costs that discouraged productive investment. These credit constraints limited adoption of new technologies, water-efficient practices, and soil conservation methods. Water efficiency and climate resilience, both moderate in coverage, were weakened by declining groundwater tables, extensive irrigation losses, and poor uptake of heat-tolerant crop varieties. Secondary gaps included restricted policy diversification for market access, cultural preservation, and gender inclusion, all of which exhibited uneven implementation and limited participation of marginal groups. Overall, the agricultural policy framework of Pakistan covered all twenty-one sustainability dimensions but remained hindered by fragmented governance, insufficient coordination between federal and provincial agencies, and low institutional capacity to deliver outcomes on the ground. Addressing the interlinked deficiencies in soil health, risk management, and rural finance through coordinated reforms and better resource targeting remained essential to strengthening climate resilience within Pakistan's water-scarce and heat-stressed environment.

3.4 Sri Lanka

Table 3.4.1: Indicator Ranking and Sustainability Weights

Rank	Indicator	Rank Sum Weight	Percentage
1	Climate Resilience & Adaptation Provisions	0.0909	9.09%
2	Water-use Efficiency & Conservation Measures	0.0866	8.66%
3	Soil Health & Nutrient Management Provisions	0.0823	8.23%
4	Food Security & Nutrition Provisions	0.0779	7.79%
5	Risk Management & Insurance Coverage	0.0736	7.36%
6	Credit & Financial Inclusion Mechanisms	0.0693	6.93%
7	Community Participation Mechanisms	0.0649	6.49%
8	Knowledge Transfer & Extension Services	0.0606	6.06%
9	Technology Adoption & Modernization Support	0.0563	5.63%
10	Market Access & Value Chain Development	0.0519	5.19%
11	Gender Inclusion & Women's Empowerment	0.0476	4.76%
12	Biodiversity Conservation Mechanisms	0.0433	4.33%
13	Farm Profitability & Income Enhancement Provisions	0.0390	3.90%
14	Youth Engagement & Capacity Building	0.0346	3.46%
15	Land Degradation Prevention Provisions	0.0303	3.03%
16	Ecosystem Services Protection Frameworks	0.0260	2.60%
17	Input Cost Management Strategies	0.0216	2.16%
18	Social Safety Net Integration	0.0173	1.73%
19	Pollution Control & Environmental Safety Standards	0.0130	1.30%
20	Cultural Preservation & Indigenous Knowledge Systems	0.0087	0.87%
21	Export Enhancement	0.0043	0.43%
TOTAL		**1.0000**	**100.00%**

The weighting hierarchy captured the specific agricultural challenges validated through independent expert analysis in Sri Lanka. The five highest ranked indicators, namely climate resilience, water efficiency, soil health, food security, and risk management, together accounted for 41.43 per cent of the sustainability framework, emphasising their central role in national resilience. These domains represented the interconnected pressures affecting Sri Lankan agriculture, including resource degradation, climate hazards, production instability, and the need for farmer protection. The elevation of soil health to the third rank distinguished Sri Lanka from India, Bangladesh, and Pakistan, where water and climate adaptation received greater emphasis. In the hill farming regions of the country, severe soil erosion restricted long term

productivity and household income, with the Nuwara Eliya tea sector losing an estimated 18,011.45 rupees per hectare each year from seedling tea erosion, demonstrating the urgent need for soil conservation measures. Lower weighted indicators such as export enhancement, at 0.43 per cent, accurately reflected the national priority on food self-sufficiency and livelihood security rather than export competitiveness. Overall, the hierarchy aligned with the observed realities of smallholder vulnerability and the government focus on reinforcing adaptive capacities within Sri Lanka's post crisis agricultural recovery framework.

Table 3.4.2: Indicator-Policy Mapping Matrix

Indicator	Policies Providing Coverage
Climate Resilience & Adaptation Provisions	National Policy on Climate Change (NPCC); National Agriculture Policy (NAP); Climate-Smart Agriculture Investment Plan (CSAIP); National Adaptation Plan for Climate Change Impacts (NAPCCI); Coastal Zone & Coastal Resource Management Plan (CZ&CRMP)
Water-use Efficiency & Conservation Measures	NPCC; National Policy on Protection and Conservation of Water Sources (NPPCWS); NAPCCI; CZ&CRMP
Soil Health & Nutrient Management Provisions	NPCC; NAP; NPPCWS; NAPCCI; CZ&CRMP
Food Security & Nutrition Provisions	NAP; Fertilizer Subsidy Scheme (FSS); CSAIP; NAPCCI; CZ&CRMP
Risk Management & Insurance Coverage	NPCC; NAP; NAPCCI; CZ&CRMP
Credit & Financial Inclusion Mechanisms	NAP; FSS; CSAIP
Community Participation Mechanisms	NPCC; NAP; NPPCWS; CSAIP; NAPCCI
Knowledge Transfer & Extension Services	NPCC; NPPCWS; CSAIP; NAPCCI
Technology Adoption & Modernization Support	NAP; CSAIP; NAPCCI
Market Access & Value Chain Development	NAP; FSS; CSAIP
Gender Inclusion & Women's Empowerment	NAP; FSS; NAPCCI
Biodiversity Conservation Mechanisms	NPCC; National Biodiversity Strategic Action Plan (NBSAP); CSAIP; NAPCCI; CZ&CRMP; NAP
Farm Profitability & Income Enhancement Provisions	NAP; CSAIP; NAPCCI
Youth Engagement & Capacity Building	CSAIP
Land Degradation Prevention Provisions	NPCC; NAP; NBSAP; NAPCCI; CZ&CRMP
Ecosystem Services Protection Frameworks	NPCC; NBSAP; NPPCWS; NAPCCI; CZ&CRMP
Input Cost Management Strategies	FSS
Social Safety Net Integration	FSS
Pollution Control & Environmental Safety Standards	NPCC; NAP; NAPCCI; CZ&CRMP
Cultural Preservation & Indigenous Knowledge Systems	NPCC; NBSAP
Export Enhancement	Not covered by any policy

The mapping matrix indicated that the agricultural resilience framework of Sri Lanka was supported by a moderately diverse set of institutional mechanisms, comprising 71 policy and indicator linkages across twenty of the 21 indicators. Most indicators were covered by between two and five complementary policies, reflecting intentional though uneven coordination. The National Agriculture Policy and the National Adaptation Plan for Climate Change Impacts formed the structural core of this portfolio, addressing fourteen and thirteen indicators respectively. However, significant gaps remained. Export enhancement received no policy focus, as attention centred on domestic food security; youth engagement depended solely on the Climate Smart Agriculture Investment Plan; and input cost management relied exclusively on the Fertiliser Subsidy Scheme, which focused narrowly on fertiliser support and lacked provisions for broader input management or efficiency improvement. Water efficiency, climate adaptation, and community participation benefited from five policy connections each, indicating useful institutional overlap that could offer resilience if any single scheme underperformed. By contrast, credit and finance were supported by only three policies, all of which treated financial inclusion as a subsidiary objective rather than a central function, limiting smallholder access to credit. The absence of a dedicated fisheries policy, despite the high vulnerability of coastal agriculture, and the weak integration of disaster risk financing mechanisms reflected broader structural limitations in addressing cyclone exposure, salinity intrusion, and production losses within both coastal and inland tank-based farming systems.

Table 3.4.3: Policy-Indicator Assessment Matrix

Indicator	NPCC	NAP	FSS	NPPCWS	NBSAP	NAPCCI	CSAIP	CZ&CRMP
Climate Resilience & Adaptation Provisions	0.72	0.74	-	-	0.61	0.75	0.73	-
Water-use Efficiency & Conservation Measures	0.64	0.68	-	0.70	-	0.70	-	0.65
Soil Health & Nutrient Management Provisions	0.61	0.69	-	0.60	-	0.68	-	0.61
Food Security & Nutrition Provisions	-	0.70	0.71	-	-	0.69	0.71	0.67
Risk Management & Insurance Coverage	0.63	0.60	-	-	-	0.67	-	0.68
Credit & Financial Inclusion Mechanisms	-	0.59	0.58	-	-	-	0.65	-
Community Participation Mechanisms	0.70	0.67	-	0.63	-	0.72	0.68	-
Knowledge Transfer & Extension Services	0.73	-	-	0.65	-	0.74	0.71	-
Technology Adoption & Modernization Support	-	0.65	-	-	-	0.68	0.74	-
Market Access & Value Chain Development	-	0.60	0.62	-	-	-	0.66	-
Gender Inclusion & Women's Empowerment	-	0.62	0.65	-	-	0.66	-	-
Biodiversity Conservation Mechanisms	0.68	0.64	-	-	0.66	0.67	0.64	0.71
Farm Profitability & Income Enhancement Provisions	-	0.66	-	-	-	0.72	0.72	-

Indicator	NPCC	NAP	FSS	NPPCWS	NBSAP	NAPCCI	CSAIP	CZ&CRMP
Youth Engagement & Capacity Building	-	-	-	-	-	-	0.69	-
Land Degradation Prevention Provisions	0.62	0.63	-	-	0.60	0.69	-	0.66
Ecosystem Services Protection Frameworks	0.64	-	-	0.61	0.65	0.66	-	0.70
Input Cost Management Strategies	-	-	0.64	-	-	-	-	-
Social Safety Net Integration	-	-	0.68	-	-	-	-	-
Pollution Control & Environmental Safety Standards	-	0.58	-	-	-	0.63	-	0.65
Cultural Preservation & Indigenous Knowledge Systems	0.59	-	-	-	0.58	-	-	-
Export Enhancement	-	-	-	-	-	-	-	-

The assessment matrix showed that institutional mechanisms in Sri Lanka varied considerably in performance across sustainability dimensions. Climate Resilience achieved the highest results, averaging 0.71 across five policies, led by the National Adaptation Plan for Climate Change Impacts (0.75), the National Agriculture Policy (0.74), and the Climate Smart Agriculture Investment Plan (0.73), reflecting effective integration of adaptation priorities into national agricultural frameworks. Knowledge Transfer and Extension Services also performed well at 0.708 on average, driven by farmer training under the National Adaptation Plan for Climate Change Impacts and the research demonstration model of the National Climate Change Adaptation Strategy, though outreach remained uneven. Soil Health showed weaker outcomes, averaging 0.638 across five policies, as conservation guidance appeared mainly as secondary components rather than dedicated programmes. Credit and Financial Inclusion Mechanisms recorded an average of 0.607, with the Fertiliser Subsidy Scheme and the National Adaptation Plan for Climate Change Impacts providing only limited financial access, leaving barriers such as high interest rates and collateral requirements unresolved. Risk Management averaged 0.645 across four policies, with preparedness provisions under the National Adaptation Plan for Climate Change Impacts and the Coastal Zone Policy partially offset by low crop insurance uptake. Market Access, averaging 0.627, reflected weak value chain coordination despite efforts under the Fertiliser Subsidy Scheme, the National Agriculture Policy, and the Climate Smart Agriculture Investment Plan. Overall, Sri Lanka's policy portfolio addressed climate resilience comprehensively in design but lagged in sustained implementation, particularly in soil management, finance, and risk protection.

Table 3.4.4: Indicator-Level Coverage Assessment

Indicator	Weight	Policies Addressing	Avg Score	Indicator Coverage %	SAW Contribution	Gap	Status
Climate Resilience & Adaptation Provisions	0.0909	5	0.710	71.0%	0.0645	0.0264	Strong
Water-use Efficiency & Conservation Measures	0.0866	5	0.674	67.4%	0.0584	0.0282	Adequate

South Asian Forum for Environment (SAFE)

Indicator	Weight	Policies Addressing	Avg Score	Indicator Coverage %	SAW Contribution	Gap	Status
Soil Health & Nutrient Management Provisions	0.0823	5	0.638	63.8%	0.0525	0.0298	Moderate
Food Security & Nutrition Provisions	0.0779	5	0.696	69.6%	0.0542	0.0237	Adequate
Risk Management & Insurance Coverage	0.0736	4	0.645	64.5%	0.0475	0.0261	Moderate
Credit & Financial Inclusion Mechanisms	0.0693	3	0.607	60.7%	0.0420	0.0272	Moderate
Community Participation Mechanisms	0.0649	5	0.680	68.0%	0.0442	0.0208	Adequate
Knowledge Transfer & Extension Services	0.0606	4	0.708	70.8%	0.0429	0.0177	Strong
Technology Adoption & Modernization Support	0.0563	3	0.690	69.0%	0.0388	0.0174	Adequate
Market Access & Value Chain Development	0.0519	3	0.627	62.7%	0.0326	0.0194	Moderate
Gender Inclusion & Women's Empowerment	0.0476	3	0.643	64.3%	0.0306	0.0170	Moderate
Biodiversity Conservation Mechanisms	0.0433	6	0.667	66.7%	0.0289	0.0144	Adequate
Farm Profitability & Income Enhancement Provisions	0.0390	2	0.690	69.0%	0.0269	0.0121	Adequate
Youth Engagement & Capacity Building	0.0346	1	0.690	69.0%	0.0239	0.0107	Adequate
Land Degradation Prevention Provisions	0.0303	5	0.640	64.0%	0.0194	0.0109	Moderate
Ecosystem Services Protection Frameworks	0.0260	5	0.652	65.2%	0.0169	0.0090	Adequate
Input Cost Management Strategies	0.0216	1	0.640	64.0%	0.0139	0.0078	Moderate

Indicator	Weight	Policies Addressing	Avg Score	Indicator Coverage %	SAW Contribution	Gap	Status
Social Safety Net Integration	0.0173	1	0.680	68.0%	0.0118	0.0055	Adequate
Pollution Control & Environmental Safety Standards	0.0130	3	0.620	62.0%	0.0081	0.0049	Moderate
Cultural Preservation & Indigenous Knowledge Systems	0.0087	2	0.585	58.5%	0.0051	0.0036	Weak
Export Enhancement	0.0043	0	0.000	0.0%	0.0000	0.0043	Not covered
TOTAL PORTFOLIO	**1.0000**			**66.29%**	**0.6629**	**0.3371**	

Portfolio Coverage Achievement: 66.29%

Portfolio Gap: 33.71%

The interpretation indicated that Sri Lanka's policy portfolio achieved 66.29 per cent coverage, suggesting reasonable but incomplete institutional alignment with climate-resilient agriculture needs. The lower score compared with India reflected the country's unique vulnerabilities, including hill-slope erosion, cyclone exposure, and the slow pace of post-crisis recovery. Climate Resilience (71.0 per cent) and Knowledge Transfer (70.8 per cent) represented key strengths, driven by the National Adaptation Plan for Climate Change Impacts, the National Agriculture Policy, and the Climate-Smart Agriculture Investment Plan, which integrated adaptation and farmer training within national frameworks. Indicators such as Water Efficiency, Food Security, and Community Participation showed moderate coverage near 68–69 per cent, reflecting broad but uneven implementation across irrigation, safety nets, and participatory planning. Weaker performance appeared in Soil Health (63.8 per cent), Risk Management (64.5 per cent), and Market Access (62.7 per cent), where fragmented mandates, limited insurance uptake, and inadequate value-chain infrastructure continued to constrain field-level outcomes. Credit and Financial Inclusion, represented primarily through the Fertiliser Subsidy Scheme, remained structurally weak, with little progress in improving access to affordable rural finance. The absence of dedicated policy focus on cultural knowledge preservation and export competitiveness further underscored policy prioritisation toward domestic security rather than market-driven growth. Overall, while the national framework embedded climate resilience conceptually, its practical reach remained limited by funding gaps, coordination challenges, and insufficient institutional capacity for transformation at farmer level.

Table 3.4.5: Policy Function Scope Analysis

Policy	Indicators Addressed	Coverage Scope %	Scope Type	Primary Functions
National Agriculture Policy (NAP)	14	66.7%	Broad	Food security, productivity, rural livelihoods, technology
National Adaptation Plan for Climate Change Impacts (NAPCCI)	13	61.9%	Broad	Climate adaptation, resilience-building, mainstreaming

Climate-Smart Agriculture Investment Plan (CSAIP)	10	47.6%	Moderate	Climate-smart technology, farm productivity, youth engagement
National Policy on Climate Change (NPCC)	10	47.6%	Moderate	Climate adaptation, disaster preparedness, ecosystem conservation
Coastal Zone & Coastal Resource Management Plan (CZ&CRMP)	8	38.1%	Moderate	Coastal resource management, marine biodiversity, disaster risk
Fertilizer Subsidy Scheme (FSS)	6	28.6%	Narrow	Food security, nutrition, subsidies, social protection
National Policy on Protection and Conservation of Water Sources (NPPCWS)	5	23.8%	Narrow	Water resource management, irrigation, ecosystem services
National Biodiversity Strategic Action Plan (NBSAP)	5	23.8%	Narrow	Biodiversity, ecosystem protection, genetic resources

Sri Lanka's agricultural policy architecture exhibited a layered structure with clearly differentiated roles across frameworks. The National Agriculture Policy and the National Adaptation Plan for Climate Change Impacts served as broad coordinating instruments, addressing fourteen and thirteen indicators respectively across production, livelihoods, and institutional domains. Together they provided strategic direction and integration, compensating for the narrow focus of sectoral programmes. Medium-scope policies such as the Climate Smart Agriculture Investment Plan, the National Climate Change Adaptation Strategy, and the Coastal Zone and Coastal Resource Management Plan contributed specialised functions in technology adoption, climate research, and coastal ecosystem protection. The newer Climate Smart Agriculture Investment Plan and the 2024 revision of the Coastal Zone and Coastal Resource Management Plan reflected adaptation to post-crisis priorities but had yet to demonstrate sustained implementation. Narrower frameworks such as the Fertiliser Subsidy Scheme, the National Water Management Policy, and the National Biodiversity Strategy and Action Plan offered essential but limited coverage, addressing input support, irrigation, and biodiversity protection without adequate integration into mainstream agricultural planning. The coexistence of multiple ministries overseeing these policies created coordination difficulties, with agriculture, water, environment, and fisheries sectors operating in isolation. Overall, the portfolio showed strong conceptual coherence but limited operational synergy; broad frameworks provided strategic breadth, while narrower ones maintained technical focus without effective institutional linkage. The new generation of policies introduced in 2024 signalled positive evolution, but their long-term impact would depend on funding continuity and strengthened inter-ministerial coordination.

Table 3.6.6: Indicator-Specific Gap Analysis and Portfolio Vulnerability Assessment

Indicator	Policies Addressing	Best Policy Score	Avg Score	Gap Severity	Vulnerability Assessment
Climate Resilience & Adaptation Provisions	5	0.750 (NAPCCI)	0.710	0.290	Low
Water-use Efficiency & Conservation Measures	5	0.700 (NPPCWS)	0.674	0.326	Low

Indicator	Policies Addressing	Best Policy Score	Avg Score	Gap Severity	Vulnerability Assessment
Soil Health & Nutrient Management Provisions	5	0.690 (NAP)	0.638	0.362	High
Food Security & Nutrition Provisions	5	0.710 (NAP)	0.696	0.304	Low
Risk Management & Insurance Coverage	4	0.680 (CZ&CRMP)	0.645	0.355	HIGH
Credit & Financial Inclusion Mechanisms	3	0.650 (CSAIP)	0.607	0.393	HIGH
Community Participation Mechanisms	5	0.720 (NAPCCI)	0.680	0.320	Low
Knowledge Transfer & Extension Services	4	0.740 (NAPCCI)	0.708	0.292	Low
Technology Adoption & Modernization Support	3	0.740 (CSAIP)	0.690	0.310	Low
Market Access & Value Chain Development	3	0.660 (CSAIP)	0.627	0.373	HIGH
Gender Inclusion & Women's Empowerment	3	0.660 (NAPCCI)	0.643	0.357	High
Biodiversity Conservation Mechanisms	6	0.710 (CZ&CRMP)	0.667	0.333	Low
Farm Profitability & Income Enhancement Provisions	2	0.720 (NAPCCI)	0.690	0.310	Low
Youth Engagement & Capacity Building	1	0.690 (CSAIP)	0.690	0.310	DEPENDENCY
Land Degradation Prevention Provisions	5	0.690 (NAPCCI)	0.640	0.360	Moderate
Ecosystem Services Protection Frameworks	5	0.700 (CZ&CRMP)	0.652	0.348	Moderate
Input Cost Management Strategies	1	0.640 (FSS)	0.640	0.360	DEPENDENCY
Social Safety Net Integration	1	0.680 (FSS)	0.680	0.320	DEPENDENCY
Pollution Control & Environmental Safety Standards	3	0.650 (CZ&CRMP)	0.620	0.380	Moderate
Cultural Preservation & Indigenous Knowledge Systems	2	0.590 (NPCC)	0.585	0.415	Weak
Export Enhancement	0	0.000	0.000	1.000	CRITICAL

The gap analysis indicated that the Sri Lankan policy framework faced four major vulnerability areas requiring distinct policy responses. The most critical weaknesses lay in soil health, risk management, credit

access, and market integration. Soil Health, despite coverage from five policies, remained severely under-implemented due to high establishment costs for conservation structures, weak credit mechanisms, and fragmented institutional responsibility between the agriculture and plantation ministries. Risk Management also remained inadequate, with minimal crop insurance uptake despite theoretical policy coverage; limited subsidy budgets, complex claim systems, and lack of affordable micro-insurance products left farmers exposed to recurring cyclone-related losses. Credit and Financial Inclusion, supported mainly by the Fertiliser Subsidy Scheme, the National Agriculture Policy, and the Climate Smart Agriculture Investment Plan, continued to suffer from collateral-based lending practices, limited rural banking outreach, and dependence on informal credit. Market Access weaknesses stemmed from poor aggregation infrastructure, middlemen dominance, and insufficient investment in processing and storage. Single-policy dependencies created additional fragility: youth engagement relied solely on the Climate Smart Agriculture Investment Plan, while both input cost management and social safety nets depended on the Fertiliser Subsidy Scheme, risking collapse of entire functions if implementation faltered. Cultural Preservation and Indigenous Knowledge received only nominal recognition through the National Policy on Climate Change and the National Biodiversity Strategy and Action Plan, while no framework addressed export competitiveness despite its fiscal importance. Overall, the analysis showed that although institutional frameworks existed across multiple sectors, limited coordination, funding, and operational depth continued to restrict farmer-level transformation essential for achieving sustainable, climate-resilient agriculture.

4 Conclusion

The assessment concluded that agricultural resilience across South Asia had advanced through progressive national frameworks, yet the pace and depth of transformation remained uneven. The Multi-Criteria Decision-Making analysis showed that while adaptive research, knowledge transfer, and water management achieved commendable progress, structural weaknesses persisted in soil health, rural finance, and risk management. The results underscored that sustainable adaptation in coastal agricultural systems required not only policy formulation but also depended on strengthening institutional coherence, ensuring consistent resource allocation, and enhancing farmer access to technology, credit, and insurance. Coastal farmlands, facing compounding pressures from salinity intrusion, tidal flooding, and climate-induced yield variability, remained at the frontline of both vulnerability and opportunity. Integrated soil and water management, improved early warning systems, and inclusive livelihood support emerged as the most viable pathways for reducing exposure and improving adaptive capacity. The study inferred that regional resilience would rely on linking these national frameworks with decentralised implementation that empowered local institutions, diversified income streams, and safeguarded productivity in fragile coastal landscapes.

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