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Institutional and policy process for climate-smart agriculture: evidence from Nagaland State, India

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ABSTRACT

A critical global policy question is how the environmental management interventions could be repurposed to meet the sustainable development goals and their target for food security, climate protection, and environmental sustainability. A common challenge facing food systems in developing countries is to improve agricultural productivity to ensure food security for all without increasing the emission of greenhouse gases (GHGs) from agriculture. Climate-smart agriculture (CSA) approaches help to reduce GHG emissions from agriculture and address the challenges of climate change (CC) and food insecurity. Yet, CSA lack understanding of the institutional arrangements and policy processes. This paper examines 38 aspects to assess the institutional and policy status for CC mitigation and adaptation and CSA in Nagaland, India. Furthermore, we use these aspects to develop a scale to measure the policy and institutional environment for mitigation and adaptation of CC and implementation of CSA. Nagaland is relatively in a better position in nine aspects, although it can improve. Methodologically, the scale developed in this paper and the identified factors can help study the institutional and policy status of a country, state, or region. We identify several implications for understanding CC and CSA institutions and policies for informing policy research and practice.

Key words: climate-smart agriculture, institutional and policy factors, institutional and policy process, policy stages, scale

HIGHLIGHTS

- This paper examines 38 different institutional and policy variables affecting the mitigation and adaptation of climate change (CC) strategies supporting the implementation of climate-smart agriculture (CSA).
- Evidence-based strategies are identified for scaling up the CSA interventions in the Indian context.
- The proposed scale is consistent to measure the institutional and policy status concerning CC mitigation and adaptation and implementation of CSA.

1. INTRODUCTION

A fundamental global policy question is how the environmental management interventions could be repurposed to meet the sustainable development goals (SDGs) and their target for food security, climate protection, and environmental sustainability. Addressing climate change (CC) is Sustainable Development Goal 13, which emphasizes the integration of CC mitigation and adaptation into national policies. Strengthening institutional and policy-making capacity on CC mitigation and adaptation is a priority, along with knowledge and awareness-raising and early warnings. The Economic and Social Council of the United Nations (UNs) urges that all governments integrate SDG 13 into their national plans and policies and create needed institutional arrangements (UN 2020). Furthermore, the issue of CC is globally institutionalized through the United Nations Framework Convention on CC (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC). Yet, while institutional arrangements and policy processes needed for poverty alleviation goals are well documented (Banerjee & Duflo 2011; IPCC 2014), similar arrangements of CC mitigation and adaptation policies and climate-smart agriculture (CSA) program interventions are currently missing in the developing world (Patra & Babu 2017). In the Indian context, for example,

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although the agriculture sector has undergone a massive transformation during the last six decades (Babu *et al.* 2019), its policy and institutional capacity remain inadequate to implement CSA (Babu & Pinto 2017; Patra & Babu 2017).

Agriculture is the solution to the various problems that threaten human existence (Rajak 2022). CC is the biggest threat to the agriculture and food system (Jabal *et al.* 2022). In the context of sustainable agricultural development, increasing the productivity of crops and livestock to ensure food security without increasing the emission of GHGs remains a challenging task. To address the trade-off between maximizing productivity and improving the resilience of agricultural systems, CSA approaches have emerged as potential solutions (FAO 2009, 2013; Everest 2020). The agriculture sector can apply CSA approaches to the dual challenges of CC and food insecurity (Lipper *et al.* 2014). The CSA interventions have enabled farmers to increase the productivity of crops (Vincent & Balasubramani 2021). Yet, policy and institutional constraints continue to thwart the implementation of CSA strategies in developing countries.

Literature on methods for studying policy and institutional mechanisms for addressing CC remains limited. Furthermore, an improved understanding of the specific factors affecting the policy process and institutional arrangements can help in setting priorities for strengthening them. The theoretical literature on policy processes has identified various models that attempt to explain how actors and players contribute to the development of a policy and its implementation (Resnick *et al.* 2018). For example, Kingdon's model of policy process explains how three strands of policy actors and institutions shape policy development: the political, public, and activist strands of opinions (Kingdon 1993). The institutional development model policy-making proposed by Elinor Ostrom addresses how institutional challenges and poor collective action constrain the development and implementation of programs and policies (Ostrom 2022). Sabatier (1998) developed a model of advocacy coalitions that join hands to push for the development and implementation of a policy. Advocacy Coalition Framework identifies the groups of individuals and institutions that work towards identifying interested groups that work towards a policy development process, although they may benefit from the outcomes that may not be related. Resnick *et al.* (2018) combines the theoretical foundations of the policy process literature and developed a set of 16 hypotheses to study the drivers of the policy process and apply it in a developing country setting.

Practical applications of these above theoretical frameworks in solving remain a challenge as these models were mostly limited to the developed country setting. Applications of these models to identify and prioritize the intervention areas have not been fully developed. Methodologically, limited progress has been made in translating to translate theoretical models into quantitative applications. Finally, the application of these models to CC interventions in developing country contexts is limited. This paper makes two important contributions to the literature. First, it applies the Kaleidoscope model of the policy process developed recently to develop a scoring method to identify factors that drive the policy and institutional process in addressing CC interventions. Second, it applies the method to the state of Nagaland, India, and profiles existing institutional and policy mechanisms that support the design and implementation of CSA. The paper is organized as follows. Section 2 presents a conceptual framework that is used as the basis for our assessment. Section 3 presents the methodology adopted in the study. Section 4 presents the results and discussion. The concluding remarks form the last section.

2. CONCEPTUAL FRAMEWORK

This section develops a conceptual framework to identify various variables influencing the integration of CC, CSA, and environmental concerns in the policy process. These variables are then used to develop the policy and institutional process profile of the North-eastern state of Nagaland, India, for designing and implementing CSA interventions. Appropriate institutional arrangement and policy processes are prerequisites for the sustainable implementation of CC mitigation and adaptation interventions. Institutions are the prime drivers of the success or failure of a society (Acemoglu & Robinson 2012). Institutions are decision making and regulatory instruments (North 1991; Fukuyama 2013). Institutional arrangements can enhance the efficacy of coordinated responses to CC mitigation (Adger *et al.* 2005; Dovers & Hezri 2010; Dupuis & Knoepfel 2013). Policy making, bureaucratic polity, and policy implementation are the three key components in institutional arrangement (Fischer *et al.* 2007). The policy is the institutional statement of a government's position to address a perceived problem (Rahman & Hickey 2019). Bureaucratic polity is the bridging agent between policy formulation and policy implementation. The policy implementation level is the politically, geographically, and socio-ecologically well-defined constituency where policies are implemented (Rahman & Hickey 2019). The public policy process is a step or course of action taken by the government to address the issue or problem. These steps include the identification of a problem, the formulation of a policy to solve the problem, the implementation of that policy, and the evaluation of whether the solution is working as

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expected (Babu *et al.* 2018). Analyzing these steps in the context of CSA implementation remains a neglected area of research.

An in-depth analysis of the institutional and policy process is gaining momentum in policy research to improve the effectiveness and efficiency of the implementation of policies (Sabatier 2007). In this paper, we accepted three levels of institutional dimensions, namely, policy making, bureaucratic polity, and policy implementation (Fischer *et al.* 2007) and adopted the following stages of the policy process (Resnick *et al.* 2015, 2018; Babu *et al.* 2018), namely, 'agenda setting', 'policy design', 'policy adoption', 'policy implementation', and 'evaluation and reform' and analyses the efforts taken to integrate issues of CC, CSA, and environmental concerns in the policy process (Figure 1). The adopted institutional stages (Fischer *et al.* 2007) are also included in the policy stages (Resnick *et al.* 2015, 2018; Babu *et al.* 2018) and policy stages are more inclusive. Accordingly, we adopted the following stages of the policy process along with various influencing factors at these stages for developing the profile of the policy process.

Agenda setting: The most popular question in policy research is why certain issues arrive on the policy agenda while others do not. Three key determinants to transfer a problem into a policy. The first determinant is some critical juncture, or punctuated equilibrium or 'focusing event' (Birkland 1997; Resnick *et al.* 2015). The 'focusing event' or critical juncture is a period when major reforms are possible in the policy scenario after a long period (Collier & Collier 1991; Thelen 2003; Pierson 2004). A 'focusing event' may be an international declaration, initiative, or meeting (Resnick *et al.* 2015). The second determinant is 'powerful advocacy coalitions'. Since a focusing event is not sufficient to place an issue in a government's policy agenda, powerful advocacy is required to push for action on the issue. The third determinant is the 'recognized, relevant problem'. The policy or development initiative needs to address a relevant or recognized problem of a state or country's population.

Policy Design: Agenda and design elements are interlinked together, and strong linkages are desirable to retain the agenda sustainably in the policy process. Successful implementation of the policy depends on the design of the policy. Three key determinants play a crucial role in policy design (Resnick *et al.* 2015). One of the determinants is 'pressing versus chosen problems'. Ideational considerations are also a determinant and central to the policy design process. 'Cost-benefit calculation' is the third determinant at the policy design stage.

Institutional levels, policy stages, and determinants of policy stages and status of implementation

Institutional levels	Policy process stages	The determinants of policy stages	Potential variables capturing current policy and institutional status
Policy development	**Agenda setting**	i) Critical juncture, or punctuated equilibrium or 'focusing event'	State intent; Inclusion of adaptation and mitigation strategies; inclusion in institutional and policy process; system for implementation; allocating sufficient budget; capacity strengthening of stakeholders;;business environment of the state; External investment for industry and business in the state; Political stability in the state; Law and order in the state; Control of corruption; Socio-economic status farmers; Social equality; Use of ICTs by farmers; Educational status of farmers; Adoption of innovations in the farming system; Status of adoption of Climate Smart Practices; Performance of existing extension system; Extension Worker /Farmers ratio; National Extension services to provide extension services to state farmers; State Extension services; Access of ICTs by farmers; State expenditure for agriculture sector; Expenditure for agricultural research; Research Expenditure to address the impacts of CC; Research Expenditure to reduce the emission of GHGs; Villages connected by all-weather road; During flood and drought events, farming communities can have access to resources (money, food, water) to maintain their livelihood; Implementation of employment guarantee program; Agriculture-related public works; State GHG accounting system; Access to grain stock reserves by the farming community; Access of market information system by farming community; Adaptive capacity; Disaster risk management coordination; Multi-sectoral (crops, livestock, forestry and fishery) coordination to address the impacts of CC, and : Multi-sectoral (crops, livestock, forestry and fishery) coordination to implement the CSA.
		ii) 'Powerful advocacy coalitions'	
		iii) 'Recognized, relevant problem'	
Administrative polity	**Policy design**	i) 'Pressing versus chosen problems'	
		ii) 'Ideological consideration'	
		iii) 'Cost-benefit calculation'	
	Policy adoption	i) 'Veto players'	
		ii) 'Opponents Versus proponents'	
Policy implementation	**Policy implementation**	i) 'Budgetary strength'	
		ii) 'Institutional capacity'	
		iii) 'Veto Player'	
		iv)'Commitment of Policy champion'	
	Policy evaluation and reform	i) 'Changing information and belief'	
		ii) 'Changing material condition'	
		iii) 'Institutional shift'	

Figure 1 | Conceptual framework for the analysis of climate change institutional and the policy process. *Source*: Adapted from Resnick *et al.* (2018).

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Policy Adoption: The right design of policy is the prerequisite for policy adoption. Some policies are designed in such a way that the adoption is obvious, and in some respect propensity to adopt are less. In the policy adoption scenario, various determinant factors are present. 'Veto players' such as the prime minister, president, chairperson of the high-level committee, or ministers of central and state government play a vital role in the adoption of the policy. Policy changes are much faster if there are few veto players (Tsebelis 2002). Another critical determinant of the adoption stage is opponents or proponents.

Policy Implementation: Implementation refers to the efforts at the government level for the implementation of the policy. This is the actual visible evidence of policy change (Resnick *et al.* 2015). In the policy implementation stage, four determinants are needed to be considered. Requisite 'budget' and availability of financial allocation are required for implementation. 'Institutional capacity' is the second determinant, followed by 'Implementing stage veto players' is the third, and 'Commitment of policy champions' is the fourth crucial determinant factor of policy implementation.

Evaluation and Reform: The evaluation and reform stage is the last stage in the policy process. Refinement and revitalizing the policy is essential to enhance its effectiveness and efficiency. 'Changing information and beliefs' and 'changing material condition' are the variables under the evaluation and reform stage.

Variables identified in the policy process stages help in the development of the institutional and policy profile for a specific region or country. However, applying the conceptual framework developed above will require focussing on specific variables and testing and validating their importance in developing the profile. Using a consultative process involving key informants and capacity development exercises involving professionals involved in the implementation of the CSA, we identify priority variables that help in the development of the institutional and policy profile of the North-eastern state of Nagaland in India. In the next section, we present a methodology for identifying key variables based on the conceptual framework presented above.

3. METHODOLOGY

Using the conceptual framework presented earlier, this study has been conducted in Nagaland state, India. Nagaland is approximately situated between 25°6′ and 27°4′ latitude; North of Equator, and between the longitudinal lines of 93°20′ and 95°15′E. The total geographical area of the state is 16,527 square km (Govt. of Nagaland 2012), India. Nagaland is also located in the Eastern Himalayan Region, India (Figure 2), and has several agro-ecological zones with six significant subtypes of climate.

Various information sources, including documents on the institutional arrangement, policy mechanism, and extension strategy, provide the basis for developing the data collection tools used in developing this profile. Technological innovations

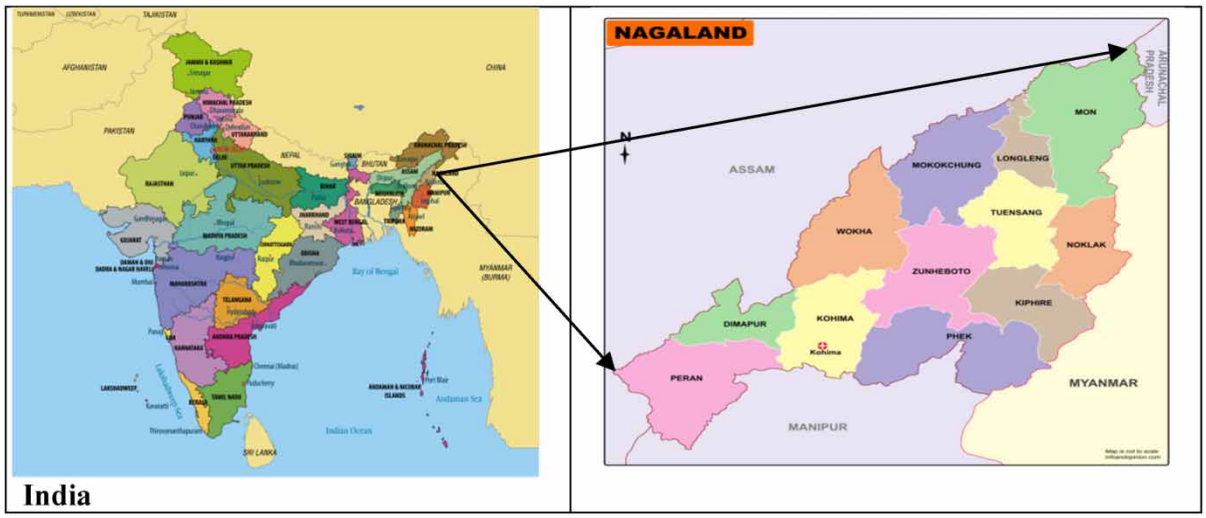

Figure 2 | Area of study (Nagaland, India).

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can be promoted by policies (Tidd 2006; World Bank 2008); many policies addressing adaptation and mitigation are already known (World Bank 2010). To implement the climate-smart development policy, institutional change and reform should be a priority (World Bank 2010). However, understanding the drivers of institutional and policy processes and their importance can help in designing and implementing interventions. In profiling existing institutional and policy mechanisms related to the mitigation and adaptation of CC, we develop an approach to identify and rank selected factors that require a priority attention.

Altogether, 38 variables [x_1: State intent to address the impacts of CC on agriculture; x_2: Govt. included adaptation and mitigation strategies in existing agricultural policy; x_3: Developing a system for implementation of adaptation and mitigation strategies in agriculture; x_4: Govt. is developing a system for implementation of CSA; x_5: Govt. is allocating sufficient budget to address the issues of CC; x_6: Govt. is emphasizing the capacity strengthening of stakeholders to combat on impacts of CC; x_7: Govt. is emphasizing the capacity strengthening of stakeholders to adopt CSA; x_8: Business environment of the state; x_9: External investment for industry and business in the state; x_{10}: Political stability in the state; x_{11}: Law and order in the state; x_{12}: Control of corruption; x_{13}: Socio-economic status of people/farmers; x_{14}: Social equality; x_{15}: Use of ICTs by farmers/people; x_{16}: Educational status of farmers/people; x_{17}: Status of adoption of innovations in the farming system; x_{18}: Status of adoption of Climate Smart Practices in the existing farming system; x_{19}: Performance of existing extension system in respect of timeliness of delivery of extension services; x_{20}: Existing ratio of Extension Worker: farmers; x_{21}: Existing National Extension services to provide extension services to state farmers; x_{22}: Existing State Extension services to provide extension services to state farmers; x_{23}: Access of ICTs by farmers for agricultural information; x_{24}: State expenditure for agriculture; x_{25}: Expenditure for agricultural research; x_{26}: Expenditure for research to address the impacts of CC; x_{27}: Expenditure for research to reduce the emission of GHGs; x_{28}: Villages of state are connected by all-weather road; x_{29}: During flood and drought events, farming communities can have access to resources (money, food, water) to maintain their livelihood; x_{30}: Implementation of MGNREGA for guarantee employment; x_{31}: Agriculture-related public works/activities (such as hillside terracing, soil and water conservation); x_{32}: State GHG accounting/inventory system; x_{33}: Access to grain stock reserves by the farming community; x_{34}: Access of market information system by farming community; x_{35}: Adaptive capacity (Availability of social resources to put adaptation into place to reduce exposure and sensitivity); x_{36}: Disaster risk management coordination; x_{37}: Multi-sectoral (crops, livestock, forestry, and fishery) coordination to address the impacts of CC; x_{38}: Multi-sectoral (crops, livestock, forestry, and fishery) coordination to implement the CSA (consult Table 1) have been included along with different aspects of institutional (policy, polity, and policy implementation) and policy (agenda setting, policy design, policy adoption, policy implementation, and policy evaluation and reform) process. They include for example, the willingness of state to implementation of CSA, business environment, and law and order, socio-economic and psychological status of farmers of the state, existing extension delivery mechanism, trend of the flow of funds to agriculture, agricultural research, CC and mitigation adaptation of GHGs, infrastructure, and disaster mitigation facilities, and GHGs accounting, grain stock, and MIS to understand the existing institutional and policy process of the state in respect of the implementation of CSA, and mitigation and adaptation of CC.

The variables (x_1–x_{38} in Table 1) were used in a formal questionnaire with 5 points scale (highly unsatisfactory, unsatisfactory, satisfactory, highly satisfactory, and extremely satisfactory with the weightage of 1, 2, 3, 4, and 5, respectively). The rating was done by 22 judges, who are familiar with the institutional and policy issues related to CSA interventions, to assess the degree of reliability of each variable. Variables that received more than the midpoint score were retained.

To validate the results of the rating by judges, a state-level workshop was conducted to strengthen the knowledge level of district-level functionaries involved in the district-level policy process. This workshop focused on strengthening the capacity of participants on CC, the impact of CC on agriculture and food security, CSA, and institutional and policy mechanism for implementation. End of the capacity strengthening programme, each of them was asked to assess the existing institutional arrangement and policy mechanism of the state by using and responding to the issues in the questionnaire in the presence of resource persons. In total, 31 functionaries from five departments [namely, Agriculture, Horticulture, Livestock and veterinary, Water conservation, and Farm Science Centre (KVK)] participated in the workshop on 'Climate-Smart Agriculture' for 2 days.

The 'Cronbach's alpha' analysis is used to assess the questionnaire's reliability and internal consistency. Discrimination measures and factor analysis (principal component analysis) with *varima*x rotation are also adopted to construct the scale for the measurement of institutional and policy processes in respect of the implementation of CSA. Using factor analysis,

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Table 1 | Rotated component/factor matrix and indicators of institutional and policy status for implementation of CSA

Factor (Indicator)	Items/Variables (mean scoring)	Factor loading	Eigen value	% of variance	Cumulative %	Cronbach alpha: Each Factor	Cronbach alpha: All variables	Communality
1 (Funding for research on CC, CSA, and agriculture)	x_{26}: Expenditure for research to address the impacts of CC (2.000)	0.924	7.235	10.23	10.23	0.857	0.857	0.928
	x_{25}: Expenditure for agricultural research (2.032)	0.814						0.924
	x_{27}: Expenditure for research to reduce the emission of GHGs (2.064)	0.669						0.919
	x_{12}: Control of corruption (1.741)	0.626						0.879
	*x_{24}: State expenditure for agriculture (2.322)	0.474						0.842
2 (Multi-sectoral coordination)	x_{38}: Multi-sectoral (crops, livestock, forestry, and fishery) coordination to implement the CSA (2.290)	0.901	4.063	9.55	19.78	0.865		0.957
	x_{37}: Multi-sectoral (crops, livestock, forestry, and fishery) coordination to address the impacts of CC (2.322)	0.837						0.916
	x_{34}: Access of market information system by farming community (1.903)	0.812						0.928
	x_{36}: Disaster risk management coordination (2.290)	0.511						0.800
3 (Readiness to implement CSA)	x_6: Govt. is emphasizing the capacity strengthening of stakeholders to combat on impacts of CC (2.483)	0.923	3.471	8.23	28.01	0.775		0.977
	x_3: Developing a system for the implementation of adaptation and mitigation strategies in agriculture (2.516)	0.841						0.916
	x_2: Govt. included adaptation and mitigation strategies in existing agricultural policy (2.451)	0.568						0.794
4 (Status of adoption of GHGs accounting and CSA)	x_{20}: Existing ratio of Extension Workers: Farmers (3.000)	0.807	3.119	7.05	35.07	0.661		0.838
	x_{18}: Status of adoption of Climate-Smart Practices in the existing farming system (1.967)	0.600						0.834
	x_{15}: Use of ICTs by farmers/people (2.451)	0.542						0.735
	x_{32}: State GHG accounting/ inventory system (1.709)	0.516						0.714
5 (Institutional and extension interventions)	x_4: Govt. is developing a system for the implementation of CSA (2.419)	0.823	2.933	7.02	42.09	0.598		0.858
	x_9: External investment for industry and business in the state (2.000)	0.674						0.745
	x_{22}: Existing State Extension services to provide extension services to state farmers (3.129)	0.652						0.762
6 (Willingness to mitigate CC and adoption of ICTs)	x_1: State intent to address the impacts of CC on agriculture (2.548)	0.921	2.325	6.92	49.01	0.683		0.944
	x_{23}: Access of ICTs by farmers for agricultural information (2.612)	− 0.668						0.871

(*Continued.*)

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Table 1 | Continued

Factor (Indicator)	Items/Variables (mean scoring)	Factor loading	Eigen value	% of variance	Cumulative %	Cronbach alpha: Each Factor	Cronbach alpha: All variables	Communality
7 (Good governance and education)	x_{11}: Law and order in the state (2.225)	0.864	2.103	6.86	55.87	0.685		0.927
	x_{10}: Political stability in the state (1.903)	0.641						0.824
	x_{21}: Existing National Extension services to provide extension services to state farmers (2.870)	0.615						0.779
	x_{16}: Educational status of farmers/ people (2.258)	0.569						0.812
8 (Infrastructural development for socio-economy)	x_{28}: Villages of state are connected by all-weather road (1.870)	0.849	1.999	6.46	62.33	0.682		0.857
	x_{13}: Socio-economic status of people/farmers (2.000)	0.781						0.865
	x_{33}: Access to grain stock reserves by the farming community (1.967)	0.502						0.918
9 (Social equality and capacity strengthening for CSA)	x_{14}: Social equality (2.387)	0.733	1.635	6.24	68.59	0.652		0.891
	x_7: Govt. is emphasizing the capacity strengthening of stakeholders to adopt CSA (2.451)	0.574						0.890
	*x_5: Govt. is allocating sufficient budget to address the issues of CC (2.129)	0.456						0.798
10 (Quality Extension services and status of adoption)	x_{19}: Performance of existing extension system in respect of timeliness of delivery of extension services (2.903)	0.838	1.442	6.14	74.73	0.785		0.838
	x_{17}: Status of adoption of innovations in the farming system (2.612)	0.752						0.852
11 (Infrastructure creation and employment generation)	x_{30}: Implementation of MGNREGA for guaranteed employment (2.161)	0.900	1.281	6.00	80.73	0.680		0.939
	x_{31}: Agriculture-related public works/activities (such as hillside terracing soil and water conservation) (2.258)	0.732						0.812
	*x_{29}: During flood and drought events, farming communities can have access to resources (money, food, water) to maintain their livelihood (1.838)	0.440						0.888
12 (Adaptive capacity and business environment)	x_{35}: Adaptive capacity (Availability of social resources to put adaptation into place to reduce exposure and sensitivity) (2.516)	0.807	1.125	5.42	86.15	0.400		0.886
	x_8: Business environment of the state (2.096)	− 0.638						0.864

Extraction method, principal component analysis; rotation method: *varimax* with Kaiser normalization.

*Variables excluded due to low factor loading.

Source: Author's Compilation.

large numbers of variables of similar backgrounds were clubbed into a small set of factors. Factors with an eigenvalue greater than 1 were retained. Variables with a loading of 0.5 and above and commonality above 0.7 were retained for further interpretation and used in the development of the profile reported in the next section.

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4. RESULTS AND DISCUSSION

Developing an outline of the policy and institutional process for implementing environmental management interventions requires a complete understanding of the broad building blocks. In the context of CSA, institutional arrangement, policy process, financial investment, and extension strategies are recognized as four pillars of the 'implementation stool' for implementing CC responses (World Bank 2016). 'A country's policies and the capacity of its institutions to implement and administer policies are vital determinants of whether an enabling environment is in place for making CSA a practical and operational reality' (World Bank 2016). CSA is an amalgamation of institutions, policies, technologies, and financing, and therefore, harmonious interactions and coordination among these factors are essential (Notenbaert *et al.* 2017). In developing the policy and institutional profile of the policy and institutional process in addressing CC-related interventions in agriculture, we assessed the reliability and internal consistency of the set of variables using Cronbach's alpha for 38 variables (0.857), implying that the scale items are highly consistent. The results of the analysis are given in Table 1. In what follows, we highlight specific factors that provide the present policy and institutional profile of Nagaland state from the perspective of designing and implementing CC and CSA interventions.

4.1. Policy environment

Indian agriculture is highly vulnerable to CC (IPCC 2014; Patra & Babu 2017). For instance, in India, a study with long-term data proves that climatic variables show an increasing trend (Debnath *et al.* 2021; Datta & Behera 2022) and productivity of rice is a decreasing trend (Debnath *et al.* 2021). The intention of the state government to address the impacts of CC on agriculture (x_1) is a basic indicator of the policy environment. The state of Nagaland is neither reluctant nor eager to initiate and implement any interventions to address the impacts of CC on agriculture.

The increased rate of emission of GHGs is worsening the climatic condition and hastening CC (Oo *et al.* 2020). CC has a huge impact on agriculture (Jayadas & Ambujam 2021; Mugambiwa & Makhubele 2021). The inclusion of the mitigation and adaptation strategies to CC in existing agricultural policies (x_2) of the state is another indicator of the seriousness of the policy process (IPCC 2014; Alfieri *et al.* 2019). Results of the analysis indicate that the inclusion of adaptation and mitigation strategies in existing agricultural policy is a low priority of the state-level policymakers. In addition, institutional architecture for developing a system for implementation of adaptation and mitigation strategies in agriculture (x_3) and developing a system for implementation for CSA (x_4) is lacking. However, there is an increasing call for improving such mechanisms, including community-based adaptation (CBA) strategy to achieve resilience towards CC-related impacts of agriculture (Ensor *et al.* 2018; Chaudhuri *et al.* 2021).

Sufficient financial allocation is a critical indicator of investment levels in addressing CC (x_5). The annual budget of the state is mainly based on Central Government funding. Therefore, budgetary allocation to address the issues of CC is inadequate and is dependent on Central allocation to the state. In 2019–20, about 5.00% of the government budget of India was allocated to the Ministry of Agriculture and Farmers Welfare. Around 6.00% of the allocated amount to the Ministry of Agriculture and Farmers Welfare has been spent on agricultural research and education. The expenditure of the Government of India for agriculture as well as for research is much less compared with developed countries and other emerging economies such as China (Tiwari 2020). Therefore, the existing flow of funds from the state government for agriculture, agricultural research, research on CC, and mitigation of GHG emissions is grossly inadequate for implementing any policy and program interventions.

The inclusion of a decentralized policy approach is immensely required in CC mitigation and adaptation scenario (Jain & Singh 2020). An inclusive and decentralized policy system involves multiple stakeholders for the successful formulation and implementation of policy (Khanal *et al.* 2019; Woodruff & Regan 2019). Stakeholders' quality is also the key to the formulation and implementation of the policy. According to Nicolletti *et al.* (2020), the social learning approach is an effective tool for CC adaptation and needs to adopt in the public policy cycle. Emphasis on inclusion and capacity strengthening of stakeholders to combat on impacts of CC (x_6) and design and implement CSA interventions by state government (x_7) is limited. In addition to involvement and capacity strengthening of stakeholders, mass awareness about CC, global warming, and the impact of CC on agriculture and the role of agriculture for CC is needed to address the issues of CC and for implementation of CSA (Patra & Babu 2017).

4.2. Business and governance environment

Agriculture is an important contributor to the Gross Domestic Product of the state and nation and should be considered an industry (Rajak 2022). Promotion of agriculture as a business and enhancing external investment in agriculture are essential

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for agricultural transformation (Babu *et al.* 2018). The business environment (x_8) and the external investment for industry and business in the state (x_9) are less than adequate, and due attention is needed to improve the business and industry environment. The state government should take the initiative to establish a better system to attract investment and businesses that support CSA adoption both from the private sector and civil society organizations.

Effective implementation of CC mitigation and CSA requires transparent and responsible governance mechanisms (IPCC 2014). A stable political environment (x_{10}), law and order in the state (x_{11}), good governance, and less corruption (x_{12}) are important considerations for climate adaptation (Dovers & Hezri 2010). All these variables require improvement in the state, which will have a positive effect on the development and implementation of the CC-related policies and CSA interventions.

4.3. Social and technology issues

Social issues are most important in CC mitigation and adaptation policy (Agarwal *et al.* 2012; Skoczkowski *et al.* 2018). The socio-economic condition of people (x_{13}), social equality (x_{14}), educational status of farmers (x_{15}), and the use of ICT for access to information (x_{16}) are also included as variables to assess the readiness of the state (Table 1). The socio-economic status of rural people and farmers, social equality, and the education status of the farmers influence their decision to adopt new technologies, including the use of information and communications technologies. The state government needs to address these issues for the successful adoption of CSA practices.

The understanding of the relationship between the productivity of crops and CC is relatively less explored (Madhukar *et al.* 2022). The adoption of new technologies or innovations in agriculture has a significant impact on agriculture (Rajak 2022). The status of the adoption of technologies is a crucial factor and a valid indicator for the future trend of the adoption of innovations. The status of the adoption of innovations in the farming system (x_{17}) in the state is relatively better than the status of the adoption of specific CSA practices (x_{18}). This is partly due to the lack of information on CSA technologies and their benefits among the farmers. Improvements CSA-focussed extension system can help in reducing the impact of CC on agriculture (Patra & Babu 2020).

4.4. Institutional support, infrastructure, and service provision

Supporting institutions, infrastructure, and service provision is necessary for the smooth implementation of CC adaptation, mitigation, and CSA (World Bank 2016). For example, India's extension system is one of the most extensive knowledge and technology dissemination institutions in the world (Babu *et al.* 2013). Despite the critical role of the extension system during the green revolution period and in achieving national food self-sufficiency, it was unable to reach more than 60% of farmers (Govt. of India NCF 2006). Early warning and micro-level adaption strategies are essential for climate action (Hernández *et al.* 2021). The performance of the existing extension system with respect to timeliness of delivery of extension services (x_{19}) and the existing ratio of extension workers to farmers (x_{20}) needs further improvement to reduce delays in delivery of extension services, improve access to inputs, and increase the efficiency and productivity of agricultural systems (Patra 2004). In this context, the national programs on extension need adaptation to the state (x_{21}) and the state-level extension services need to reach farmers (x_{22}) in remote areas for the CC and CSA-related interventions to make an impact on agricultural systems of the state. In addition, there is a high scope for expanding the role of ICT and digital technologies for agricultural information (x_{23}).

The entire North-Eastern Region (NER) of the country is under high priority for development programs and is getting special preference from the central government. This region is receiving 10% of the total national budget (MDoNER 2017). As a result, all the states, including Nagaland, are getting a special preference to receive both financial and other benefits from the central government.

Strong institutional support is needed to improve the dissemination of CSA information to farmers (FAO 2013). Sustainable institutional creation and coordination among relevant institutions are also needed for mitigation and adaptation (Tongwane *et al.* 2016). The higher degree of community and farmers' awareness of CC and CC response has a direct and positive influence on adaptation to CC impacts (Ado *et al.* 2019). The higher degree of community and farmers' awareness of CC and CC response has a direct and positive influence on adaptation to CC impacts (Ado *et al.* 2019; Datta & Behera 2022). Effective public and private extension systems in the state can accelerate technology transfer and information dissemination. ICTs have immense potential in the technology transfer domain (Vincent & Balasubramani 2021). Increasing the use of ICT could help in the adoption and implementation of CSA approaches.

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In 2019–20, about 5.00% of the government budget of India was allocated to the Ministry of Agriculture and Farmers Welfare. Around 6.00% of the allocated amount to the Ministry of Agriculture and Farmers Welfare has been spent on agricultural research and education. The expenditure of the Government of India for agriculture as well as for research is very less as compared with developed countries (Govt. of India 2019). Similarly, state expenditure for agriculture (x_{24}), expenditure for agricultural research (x_{25}), expenditure for research to address the impacts of CC (x_{26}), and expenditure for research to reduce the emission of GHGs (x_{27}) are considered. Therefore, the existing flow of funds from the state government for agriculture, agricultural research, research on CC, and mitigation of GHG emissions are inadequate.

The development of new technologies is crucial for the mitigation and adaptation of CC (Antle *et al.* 2019). Investment in agricultural and climate research has immense potential to develop new technologies (Rosegrant *et al.* 2016), which will enable farmers to achieve expected production and productivity as well as provide support to combat the issues of CC. Emphasis on the adaptation finance and resilience finance is also needed for proper research and development of financial allocation and utilization (Barrett 2017).

Agriculture-related public works (such as hillside terracing and soil and water conservation) can improve the sustainability of natural resources in increasing agricultural production, and better rural livelihoods (x_{31}). The implementation of MGNREGA (Mahatma Gandhi National Rural Employment Generation Act) for guarantee employment (x_{30}) by the Government of India introduced as a holistic anti-poverty scheme can become part of a multi-pronged strategy to reduce vulnerability to address CC in India (Adam 2015). But the implementation of the scheme has not met the expectations of the policymakers.

Rural infrastructural facilities have a direct influence on accelerating the adoption of innovation in the farming sector. According to the Rural Poverty Report (IFAD 2011), 'around 75% of the world's poor live in rural areas, and agriculture is their primary source of income'. Support from the public, private, and third sectors during the disaster and off-season of the year are also crucial to maintain the livelihood of the farming community. The rural road is the basic infrastructure. It has increased the mobility of men and materials and facilitated economic growth and social development (Govt. of India 2016). Villages of the state are not connected by all-weathered roads (x_{28}), indicating road connectivity in the state is very weak. Access to resources (money, food, and water) during the disaster (x_{29}) to maintain livelihoods are poor. CC increases the risk of flood and disaster (Ding *et al.* 2022), so, access to resources (money, food, and water) during the disaster (x_{29}) to maintain livelihoods should be adequate, but the condition is poor.

The state does not have a system to account for GHG emissions (x_{32}). Access to grain stock reserves by the farming community (x_{33}) and access to the market information system by the farming community (x_{34}) need improvement. The adaptive capacity of individuals and institutions (x_{35}) is important for CC and CSA interventions (Bhadwal *et al.* 2019). There is a need for harmonious coordination among the institutions and policies for the promotion and implementation of CSA. Critical requirements for an enabling policy environment to support and implement CSA are greater coherence, coordination, and integration among CC, agricultural development, and food security policy process (World Bank 2016). Disaster risk management coordination (x_{36}), multi-sectoral (crops, livestock, forestry, and fishery) coordination to address the impacts of CC (x_{37}), and multi-sectoral (crops, livestock, forestry, and fishery) coordination to implement the CSA (x_{38}), and address the issues of the state needs to improve. This result is not surprising as such coordination is also missing at the national level.

The overall mean score is 2.26, which is less than the midpoint of the score (2.5). Therefore, the existing institutional and policy mechanism of the state is inadequate to address the issues of CC and for the implementation of CSA. But in respect of nine variables (x_1, x_3, x_{17}, x_{19}, x_{20}, x_{21}, x_{22}, x_{23}, and x_{35}) out of 38 (Table 1), the mean score values are higher than the midpoint (2.5) and the State in these respects is relatively in a better position. From the study, it can be concluded that with the help of 38 relevant variables, one can identify the institutional and policy status of the state. Overall, the scores are inadequate concerning CC mitigation, adaptation, and implementation of CSA. The remaining part of this section is concerned with the conversion of these concepts and variables into a scale for future use by other researchers and evaluation workers.

Based on the factor analysis (Table 1), 12 factors were retained as an *eigenvalue* of greater than 1. Altogether, 35 items were retained based on the factor loading greater than 0.50, and the remaining three variables are excluded due to low factor loading. The cumulative percentage of variance is 86.15, with a Cronbach alpha value of 0.857. Based on the factor analysis and Cronbach alpha test, 35 variables emerged as consistent and appropriate to test institutional and policy processes for CSA. Furthermore, all the factors are represented with a suitable nomenclature, according to the variables present under each of the factors (Table 1).

Factor 1 accounted for 10.23% of the total data variability, with a Cronbach alpha value of 0.857. Four variables (x_{26}, x_{25}, x_{27}, and x_{12}) having high factor loading (Table 1) are retained, and nomenclature is given as 'Funding for research on CC,

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CSA, and agriculture'. Concerning research, it is evident that throughout the world, extensive research work is in progress on CC and its impact (Jabal *et al.* 2022). Factor 2 accounted for 9.55% of the total data variability with a Cronbach alpha value of 0.865. Four variables (x_{38}, x_{37}, x_{34}, and x_{36}) having high factor loading (Table 1) are retained, and nomenclature is given as 'Multi-sectoral coordination'.

CC is happening, but the adoption of adaptation and mitigation strategies in the farming sector by farmers is inadequate (Wongnaa & Babu 2020). Three related issues, (x_1, x_2, and x_3) with the intention of augmentation of adoption of the same have been included in the study. They are clubbed under Factor 3. Factor 3 accounted for 8.23% of the total data variability with a Cronbach alpha value of 0.755. Three variables (x_6, x_3, and x_2) having high factor loading (Table 1) are retained, and based on the retained variables, the nomenclature is given as 'Readiness to implement CSA'.

Factor 4 and Factor 5 accounted for 7.05% and 7.02% of the total data variability, with Cronbach alpha values of 0.661 and 0.598, respectively. The nomenclature has given as 'status of adoption of GHGs accounting and CSA' and 'Institutional and extension interventions', respectively.

Factor 6 and Factor 7 (Table 1) accounted for 6.92% and 6.86% of the total data variability, with Cronbach alpha values of 0.683 and 0.685, respectively. The terminology has been given as 'Willingness to mitigate CC and adoption of ICTs' and 'Good governance and education'.

Factor 8, Factor 9, Factor 10, Factor 11, and Factor 12 accounted for 6.46%, 6.24%, 6.14%, 6.00%, and 5.42% of the total data variability with a Cronbach alpha value of 0.682, 0.652, 0.785, 0.680 and 0.400, respectively. The nomenclatures are given as 'Infrastructural development for socio-economy', 'Social equality and capacity strengthening for CSA', 'Quality Extension services and status of adoption', and 'Adaptive capacity and business environment', respectively (Table 1). Concerning capacity strengthening and extension service about CC and CSA, Datta & Behera (2022) reported that a considerable portion of the farmers' perceptions is not aligned with the meteorological data, and dissemination of information through the extension system is urgently needed.

Analysis of the institutional and policy mechanism for mitigation and adaptation of CC and implementation of CSA of the Nagaland state, based on the policy stages and determinants of policies, provides some valuable lessons (Table 2).

4.5. Indicators of institutional and policy process

In this subsection, we look at the status of policy and institutional variables at various stages of the policy cycle: agenda setting, policy design, policy adoption, policy implementation, and evaluation and refinement. We begin with the agenda setting stage. Table 2 summarizes the results based on the conceptual framework presented in Section 2. Addressing the issues of CC and the adoption of CSA are well recognized in India, and several sporadic initiatives have started long back, and thus CC and CSA are on the policy agenda at the national level. Some recent focusing events that further places these issues on the policy agenda include the introduction of NEPED (2018) by different international agencies, namely, CIDA, GIZ, UNDP, and IFAD, with some resilient climate activities. Evidence of powerful advocates for CC and CSA is inadequate in the state of Nagaland. However, the National action plan on CC, the State action plan on CC, and Paris Agreement remain crucial advocacy tools for agenda setting. In the Nagaland state, similarly, land and forest degradation due to shifting cultivation, deforestation, and sinking of forest areas are often used as relevant and recognized references. Brahic *et al.* (2022) support this and show that public perceptions have strongly influenced the agenda setting of forest policy.

In the policy design stage, issues related to land and forest degradation due to shifting cultivation, deforestation, and sinking of forest areas are recognized as drivers for CC. Interventions from different national and international agencies, as well as persistent soil and climate degradation by shifting cultivation, traditional cultivation practices, and non-use of fertilizers and chemicals, are the driving factors for the policy design. Therefore, issues of CC and the adoption of CSA are in pressing versus the chosen domain of the policy process.

At the state level, no prominent role played by any player is identified in the policy adoption stage. A key exception at the national level is the set of initiatives from the Ministry of Environment, Forest, and CC, Govt. of India, which is accelerating the process of adoption of mitigation and adaptation measures. As mitigation and adaptation of CC and implementation of CSA have been internationally emphasized as interventions, they are a high priority for Nagaland state. Time is propitious to address the problems of CC and the implementation of CSA, but action by the state-level players will be critical.

The state government is mostly dependent on the donors, and the central government for CC and CSA-related interventions, and budgetary levels are inadequate at the implementation stage. Institutional capacity is insufficient, and mitigation and adaptation of CC and implementation of CSA are not adopted in state-level implementation plans. Finally, not much

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Table 2 | Policy stages, institutional and policy mechanisms, for implementation of CSA

Policy stages	The determinants of policy stages	Existing policy and institutional status
Agenda Setting	(i) Critical juncture, or punctuated equilibrium or 'focusing event' (ii) 'Powerful advocacy coalitions' (iii) 'Recognized, relevant problem'	• Introduction of NEPED • The different international agencies, namely, CIDA, GIZ UNDP, IFAD • National action plan on CC • State action plan on CC • Paris Agreement • Land and forest degradation due to shifting cultivation; deforestation; and sinking of forest area
Policy Design	(i) 'Pressing versus chosen problems'	• It is in 'pressing versus chosen' dualism • Interventions from different national and international agencies, as well as persistent soil and climate degradation by shifting cultivation, are forcing factors for policy design
	(ii) 'Ideological considerations' (iii) 'Cost-benefit calculation'	• Traditional cultivation practices, shifting cultivation, and non-use of fertilizers and chemical • Maximum vulnerable beneficiaries from low socio-economic status are included in the scheme
Policy Adoption	(i) 'Veto players'	• No prominent role was played by any player, rather initiatives from the Ministry of Environment, Forest and CC, Govt. of India are accelerating the process of adoption of mitigation and adaptation
	(ii) 'Opponents versus proponents'	• Propitious time is prevailing
Policy Implementation	(i) 'Budgetary strength'	• The state government is mostly dependent on the donor, and the central government and budgetary strength is wholly inadequate
	(ii) 'Institutional capacity'	• Inadequate and not adopted in the policy system or document
	(iii) 'Veto Player'	• Central Government is playing the role through NEP and action plan
	(iv)'Commitment of policy champion'	• Yet not evident
Policy Evaluation and Reform	(i) 'Changing information and belief'	• Inadequate in respect of CSA implementation
	(ii) 'Changing material condition'	• Inadequate
	(iii) 'Institutional shift'	• Inadequate

Source: Author's Compilation based on the Kaleidoscope model of the policy process (Resnick *et al.* 2018).

has been initiated to evaluate any specific CC, and CSA interventions as the implementation of several central level policies at the state level remains at the nascent stage.

The main objective of developing the above profile of the policy process is to identify the entry points for policy dialogues and consultations that will lead to identifying knowledge gaps, policy and institutional capacity, investment needs, governance, and accountability issue, and human capacity needs at various levels. Such profiles developed for developing countries can help move the policy system towards responding to the CC and CSA interventions by removing the bottlenecks for interventions.

Therefore, a broad conclusion of the foregoing profile is that the existing institutional and policy mechanism of the state is inadequate to address the issues of CC and the implementation of CSA. In line with this conclusion, Raihan & Hossain (2021) suggested that institutional and policy arrangements were required for CC mitigation and adaptation interventions in Sylhet, Bangladesh. Vincent & Balasubramani (2021) also demonstrate that a CSA policy framework, the convergence of allied institutions, and targeted stakeholders are needed in the process of implementation of CSA interventions in Andhra Pradesh, India.

5. SUMMARY AND CONCLUSIONS

Global goals related to CC mitigation and adaptation need action at the national and sub-national levels. Translating these goals into action and impact on the ground requires a complete understanding of the policy and institutional environment. It is well documented that the agriculture sector contributes to GHG emissions, CC, and global warming and is also greatly affected by CC (Patra & Babu 2017). Increasing productivity to ensure food security for all without increasing the emission of

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GHGs is a challenging task, and implementing CSA interventions could achieve both goals. Yet, institutional and policy processes needed to implement CSA interventions are not fully understood in developing countries. This paper intends to fill this research gap.

In this paper, using a conceptual framework, we develop the policy and institutional profile of the State of Nagaland in India. We identify key factors affecting the institutional and policy processes of designing and implementing CSA interventions. The state has inadequacy with respect to CC mitigation adaptation and implementation of CSA. Results of the study indicate factors such as GHG emission inventory, identification and promotion of smart technologies, creation of a favourable business environment in the state, external investment for industry and business in the state, law, and order in the state, control of corruption, expenditure in research and research infrastructure, creation of rural and transportation infrastructure, and market information facilities require immediate attention for effective adoption and implementation of CSA interventions.

It is concluded that 38 pertinent items pragmatically evaluated the institutional and policy status of the state through 12 sub-heads (12 factors). The approach developed in this paper for ranking and selection of key drivers of policy and institutional process seems adequate to assess the institutional and policy process in respect of CC mitigation and adaptation and implementation of CSA. The approach adopted for the study could be replicated for other parts of India and other countries. Future research could involve undertaking similar studies for other countries that can help identify the key driving factors that need to be strengthened to improve the policy and institutional process for addressing CC adaptation and mitigation and implementing CSA interventions.

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AUTHORS' CONTRIBUTIONS

N.K.P. designed the study and drafted the manuscript. S.C.B. guided the design of the research and draft of the manuscript. N.K.P. did the fieldwork and data analysis. Both authors edited and approved the final manuscript.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper.

CONFLICT OF INTEREST

The authors declare there is no conflict.

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